

Notices

of the American Mathematical Society

January 2006

Volume 53, Number 1

Pictures of Hyperbolic
Dynamical Systems
page 8

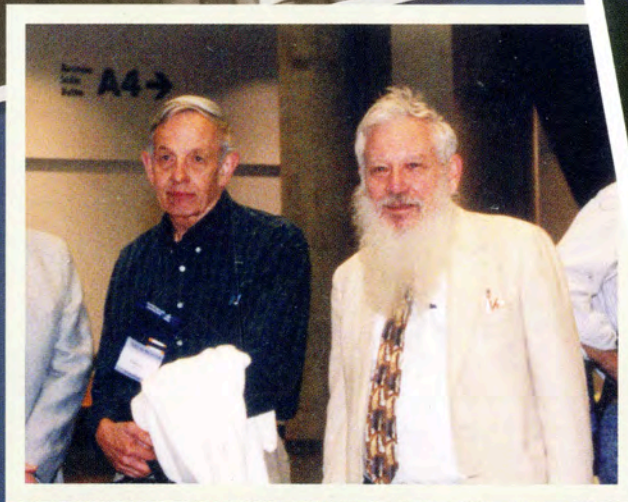
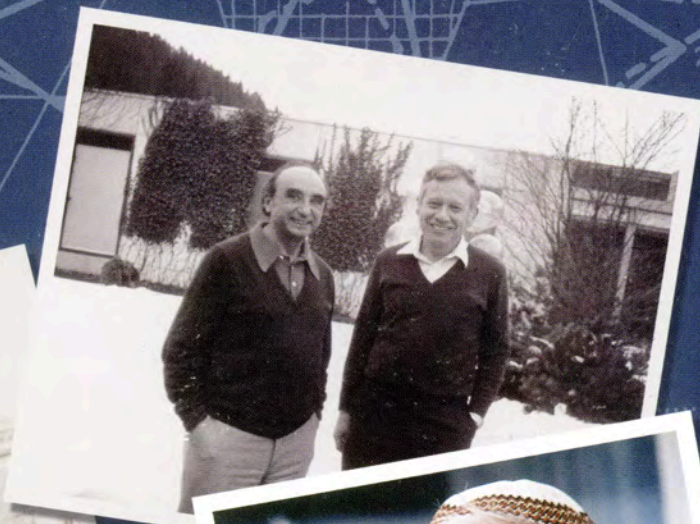
You Could Have Invented
Spectral Sequences
page 15

Mathematicians and Mathematics
Textbooks for Prospective
Elementary Teachers
page 20

Miami
Meeting
page 99

Notre Dame
Meeting
page 102

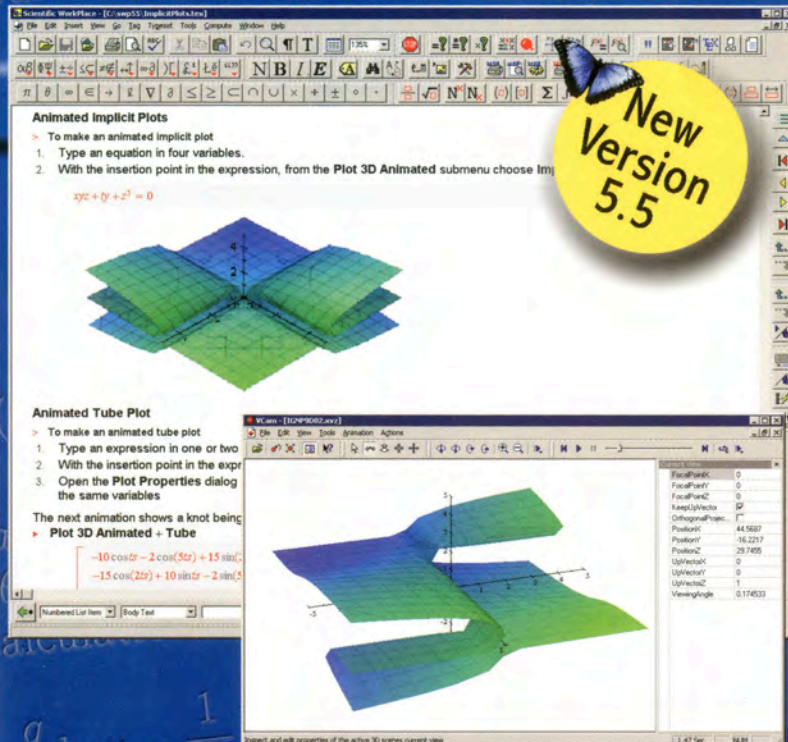
San Antonio
Program
page 111



*From knots to Nobel
(see page 65)*

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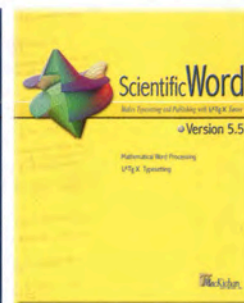
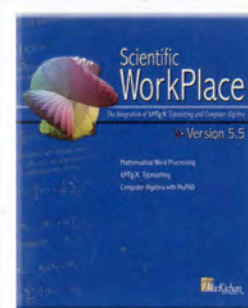
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- Graded Multiplicities in the Macdonald Kernel. Part I, *John R. Stembridge*
- Bost-Connes-Marcolli Systems for Shimura Varieties. Part I. Definitions and Formal Analytic Properties, *Eugene Ha and Frédéric Paugam*
- The δ -Approach to Approximate Inverse Scattering at Fixed Energy in Three Dimensions, *R. G. Novikov*
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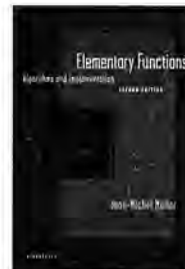
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January 2006

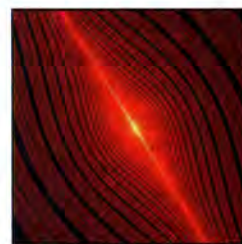
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Feature Articles

8 Pictures of Hyperbolic Dynamical Systems

Yves Coudene

The author describes, and provides computer-generated pictures of, simulations of some chaotic hyperbolic dynamical systems.



15 You Could Have Invented Spectral Sequences

Timothy Y. Chow

The author presents an accessible approach to understanding this important technical tool of homology.

20 Mathematicians and Mathematics Textbooks for Prospective Elementary Teachers

Raven McCrory

In response to recent interests and concerns about the mathematics preparation of elementary teachers, some mathematicians have written textbooks. The author takes a look at the distinctive features of some of these.



Communications

30 WHAT IS...a Quantum Group?

Shahn Majid

44 Aumann Awarded Nobel Prize

Abraham Neyman

49 MathSciNet Matters

Norman Richert

Commentary

5 Letter from the Editor: Deaths and Didactics

Andy Magid

6 Letters to the Editor

33 *Probability Theory: The Logic of Science*—A Book Review

Reviewed by William G. Faris

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Departments

Mathematics People	50
<i>Kleinberg Receives MacArthur Fellowship, NSF CAREER Awards Made, Viana Awarded ICTP/IMU Ramanujan Prize, Bhargava and Soundararajan Awarded SASTRA Ramanujan Prizes, Bhargava and Dencker Receive Clay Awards, Alfred W. Goldie (1920–2005).</i>	
Mathematics Opportunities	53
<i>Proposal Due Dates at the DMS, NDSEG Fellowships, AMS-AAAS Mass Media Summer Fellowships, CMI Liftoff Program for Summer 2006, NSF Computing Equipment and Instrumentation Programs, NSF Support for Interactions with Physical and Computer Sciences and Engineering, Departments Coordinate Job Offer Deadlines, Call for Contributions for ICMI Study.</i>	
For Your Information	56
<i>My Summer at National Public Radio, Correction.</i>	
Inside the AMS	58
<i>Current Events Session at Joint Meetings, AMS Releases New "Mathematical Moments", Trjitzinsky Memorial Awards Presented, Erdős Memorial Lectures, AMS Annual Report Issued, Deaths of AMS Members.</i>	
Reference and Book List	61
Mathematics Calendar	66
New Publications Offered by the AMS	71
Classified Advertisements	82
AMS Standard Cover Sheet	91
AAAS Conference in St. Louis, MO	95
General Information Regarding Meetings & Conferences of the AMS	96
Meetings & Conferences of the AMS	97
Presenters of Papers, San Antonio Meeting	111
Program of the Sessions, San Antonio Meeting	118
Meetings and Conferences Table of Contents	192

Deaths and Didactics

The May 1958 *Bulletin of the American Mathematical Society*, at that time the only “member publication” of the AMS, came in two parts: Part 1, bound in the standard green cover, contained the usual *Bulletin* material; Part 2, 129 pages bound separately in a distinctive blue cover, was a memorial tribute to John von Neumann. In the tribute, authors such as Kadison, Murray, Ulam, Kuhn, and Tucker discussed von Neumann’s mathematical contribution in expository articles that still make interesting reading nearly fifty years later. The *Bulletin* published a similar “Part 2” issue in January 1966, this time in a memorial tribute to Norbert Wiener. Also bound separately in blue covers, this tribute featured articles by, among others, Levinson, Doob, and S. Mandelbrojt. Although the *Bulletin* previously had, and subsequently did, publish memorial/obituary articles, I don’t know of any more of these separately bound tributes.

When the *Notices* moved to its current format in 1995, it became the venue for memorial articles. As this format has evolved, such articles have come to consist of a number of (sometimes as few as two, sometimes as many as four or five) short articles about the subject’s mathematical work and life by colleagues, students, etc. Examples include the elaborate one about A. Borel in the May 2004 *Notices*, a short one about W. Tutte in the March 2004 *Notices*, and a midsize one about D. Spencer in the January 2004 *Notices*. These articles are coordinated by a lead author who takes responsibility for recruiting the others and making sure that the various component pieces are nonoverlapping and cover the subject’s accomplishments adequately. Lead authors for memorial articles may volunteer or they may be solicited. Subjects of memorial articles are mathematicians whose work is generally recognized to be of wide consequence and lasting impact. Usually this is obvious; on occasion the *Notices* Editorial Board discusses potential subjects. Sometimes no article may appear, even for a worthy subject: it may not be possible to recruit a suitable lead author, or a lead author may not be able to complete the project. But we seem to average about two or three memorials per year. Let’s say there was an additional missed opportunity, so a total of four potential subjects per year. Let’s also say that it is clear by the time most potential subjects are thirty-five that their life work will merit a *Notices* memorial and that they live to be eighty-five (may it be one hundred twenty, of course). This means there are about 200 such mathematicians of all ages in any given year. If this represents one percent of the active and retired research mathematicians worldwide, there would be 20,000 total, and this number seems about right.

What about the other 99 percent of us? From time to time, the *Notices* receives unsolicited obituary articles

from colleagues and mathematical descendants of deceased mathematicians who would not be candidates for our standard memorial articles. In such cases, I invite the authors to instead contribute an expository article on a mathematical topic in an area of interest of the deceased. Such articles would undergo the standard *Notices* editorial process and, if accepted, would prominently note that they were written in memory of the deceased. Although so far no such articles have been received, I am happy to extend this invitation to all *Notices* readers.

Of course, for many years, the *Notices* has also carried a section of brief “Deaths of AMS Members” announcements. With this issue, the *Notices* inaugurates an additional way to memorialize: we will accept contributed brief (250 words or shorter) mathematical obituaries. The subject should be a research mathematician of some consequence, the contributions may be edited for style and content, and we will carry only one obituary for any subject. Lance Small’s obituary of Alfred Goldie in this issue (see “Mathematics People”) can be a model.

I want to shift from necrology to pedagogy. This issue of the *Notices* contains another article representing a new direction. In his feature “You Could Have Invented Spectral Sequences”, Timothy Chow gives a tutorial introduction to his topic. Sometimes I like to characterize the ideal *Notices* expository mathematical article as the ideal colloquium. Chow’s is more like the ideal graduate student seminar: he’s developing the subject, or rather a simplified model of it, in a self-contained situation. Unsolicited contributions of such articles are welcomed. *Notices* readers with novel ways to explain core mathematical topics are invited to submit articles or proposals for articles. Explanations of mathematical topics are nothing novel for the *Notices*. Our popular “WHAT IS...?” series of brief explanatory articles appears in almost every issue, including this one, where Shahn Majid tells us “WHAT IS... a Quantum Group?” Articles in this series are by invitation, but readers are welcome to suggest future topics.

—Andy Magid

The *Notices* welcomes unsolicited manuscripts. Information about writing for the *Notices* appears in the June/July 2005 issue, pages 660–661. Inquiries may be sent to notices@aftermath.math.ou.edu.

Letters to the Editor

Calculus Before College

Although the goal of finding common ground among mathematicians and mathematics educators is admirable, much of what appeared in the article "Reaching for common ground in K-12 mathematics education", October 2005, pp. 1055–1058, was of the motherhood-and-apple-pie variety. For instance, it's reassuring that all could agree that teachers should use a variety of instructional strategies or that calculators actually have an appropriate place in education.

But one item stood out as strange. The group apparently considered it "a fundamental premise" that by the time they leave high school, a majority of students should have studied calculus.

I'll ignore the ambiguity of the phrases "should have" or "studied calculus", and won't ask why the group thinks "a majority" should do this rather than some other percentage.

Rather, I wonder why this is here at all. This is the only area of mathematics beyond arithmetic that the group identifies specifically as a goal. By contrast, the word "statistics" does not appear anywhere in the article. Neither calculus nor statistics is part of the traditional K-12 mathematics education, but certainly the average citizen has far more need to understand basic ideas of statistics than basic ideas of calculus. A glance at our daily newspapers or a conversation with one's doctor makes clear that we all make important decisions based on understanding of statistical information and ideas.

Perhaps the group took for granted that a foundation in statistics should be part of the K-12 curriculum. If so, that is a positive step, and I wish they had said so. I would ask Richard Schaar to poll his group and ascertain which, if any, of them thinks calculus has a higher priority for a high school graduate than statistics and why, and what percentage of students they think should have studied statistics by the time they leave high school.

In fact, it's still a challenge today to get high school students to take three years of high school mathematics, so getting a majority of them to calculus is in the distant future, even if that were a priority. If the group meant the calculus goal as simply a dream, I wish they had made that clear.

On a different note, I would observe that while the group included at least one major critic of the K-12 mathematics curriculum projects that the National Science Foundation has funded over the past fifteen or so years, it included no one who has been part of the development of those projects. (Full disclosure: I am the codeveloper of one of those.) I suggest that any future dialogue of this sort show more balance.

—Dan Fendel
San Francisco State University
fendel@math.sfsu.edu

(Received October 9, 2005)

Resolution of Singularities

The October *Notices* contains a lovely interview with Heisuke Hironaka, which does a marvelous job of capturing his personality. Furthermore, the panel on p. 1010 correctly suggests that his resolution of singularities involves subtle, lengthy, and technical methods yielding a result of fundamental importance. However, the panel leaves the false impression that there has been, as yet, no progress made in simplifying and advancing his work. In fact, there has been a lot!

Progress was gradual at first, but picked up speed about ten years ago. Whereas Hironaka's proof is existential, now there are constructive proofs which have been implemented in the computer algebra systems Maple and Singular; see Villamayor's article "An introduction to constructive desingularization", arXiv:math.AG/0507537, 26 July 2005, and the other recent introductions by Cutkosky, by Hauser, and by Matsuki cited there. Furthermore, in his article "Resolution

of singularities—Seattle lecture", arXiv:math.AG/0508332, 17 Aug 2005, Kollár shows that it is now possible to prove Hironaka's full theorem in the last two weeks of a first course in algebraic geometry!

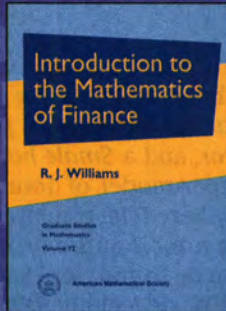
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(Received October 17, 2005)

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Topics at the very heart of financial mathematics

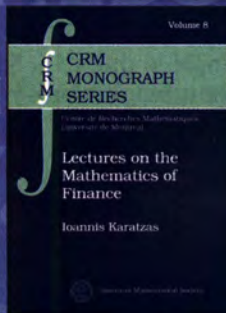


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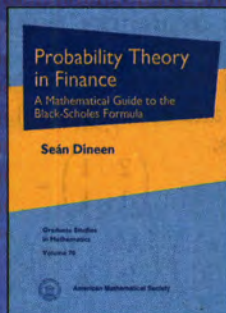
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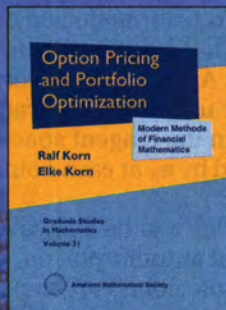
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Pictures of Hyperbolic Dynamical Systems

Yves Coudene

Introduction

Computer-generated pictures of fractals and attractors are quite common on the internet. The *Mandelbrot set*, the *Lorentz attractor*, and the *Henon attractor* are amongst the most represented dynamical systems on the web. Pictures and computer experiments have proven to be quite useful for their study. In some cases, computer-assisted proofs of their “chaotic” behavior are the only proofs available.

These systems all fall into the category of systems exhibiting non-uniformly hyperbolic behavior. Their study is modelled on the theory of uniformly hyperbolic dynamical systems and tries to recover some of the most prominent features of the hyperbolic theory: invariant SRB measures, bernoullicity of these measures, distribution results concerning the repartition of typical orbits, etc.

The modern theory of uniformly hyperbolic systems goes back to the middle of the twentieth century, with the work of D. V. Anosov [An67] and S. Smale [Sm67]. It is now a well-established theory and gives a pretty complete description of the dynamics of smooth systems whose differential is uniformly contracting and dilating on two invariant complementary sub-bundles of the tangent space. The theory provides numerous examples of non-trivial attractors and gives a nice description of the dynamic on these attractors by the use of a symbolic model.

As strange as it may seem, there are almost no pictures of these uniformly hyperbolic attractors. There may be several reasons for that; the theory was built during the 1960s and 1970s; at that time, computers were not powerful enough to handle the computations. Also computer experiments are usually focused on systems of physical origin. These systems are often of the non-uniformly hyperbolic type.

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We explain how to obtain pictures of three of the most famous hyperbolic surface diffeomorphisms, namely the *attractor derived from Anosov*, the *Plykin attractor*, and a *Smale horseshoe*, and how to build a paper-model of four entangled Wada lakes on the sphere. The transformations are built by perturbing a toral automorphism, following a recipe that can be found, for example, in the book of J. Palis and W. de Melo [PaDM82].

Attractors Derived from Anosov

The first example is due to S. Smale [Sm67]; it is obtained by perturbing an Anosov diffeomorphism. Hence it is called an *attractor derived from Anosov*. This attractor is defined on the two-dimensional torus T^2 . The torus may be seen as a product of two circles $S^1 \times S^1$, or as the quotient of the plane \mathbb{R}^2 by the subgroup \mathbb{Z}^2 of points with integer coordinates: $T^2 \simeq \mathbb{R}^2/\mathbb{Z}^2$.

Hyperbolic Automorphism of the Torus

We first need some properties of the matrix $A = \begin{pmatrix} 2 & 1 \\ 1 & 1 \end{pmatrix}$. Let us denote the golden mean by $\lambda = \frac{1+\sqrt{5}}{2} \simeq 1.618$. The matrix A admits two eigenvalues λ^2 and λ^{-2} ; the associated eigenvectors are $e_u = \frac{1}{\sqrt{1+\lambda^2}} \begin{pmatrix} \lambda \\ 1 \end{pmatrix}$ and $e_s = \frac{1}{\sqrt{1+\lambda^2}} \begin{pmatrix} -1 \\ \lambda \end{pmatrix}$, and the following relation holds:

$$\begin{pmatrix} 2 & 1 \\ 1 & 1 \end{pmatrix} = \frac{1}{\sqrt{1+\lambda^2}} \begin{pmatrix} \lambda & -1 \\ 1 & \lambda \end{pmatrix} \begin{pmatrix} \lambda^2 & 0 \\ 0 & \lambda^{-2} \end{pmatrix} \frac{1}{\sqrt{1+\lambda^2}} \begin{pmatrix} \lambda & 1 \\ -1 & \lambda \end{pmatrix}$$

The action of the matrix $\begin{pmatrix} 2 & 1 \\ 1 & 1 \end{pmatrix}$ on the plane gives an invertible transformation on the torus T^2 , called a *hyperbolic toral automorphism*. This transformation is an Anosov diffeomorphism: there are two invariant uniformly contracting and dilating sub-bundles in the tangent space. The contracting one is directed by e_u at each point, the dilating one by e_s .

The following can be shown about the dynamics of the toral automorphism:

- the periodic points are dense;

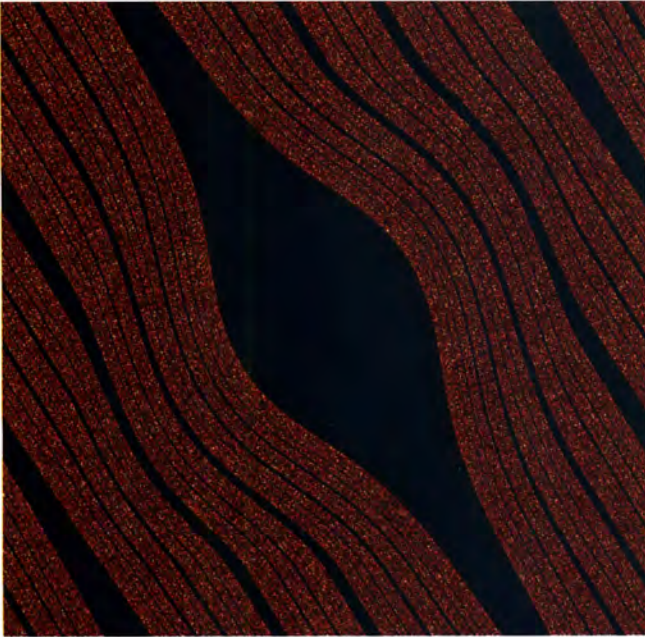


Figure 1.

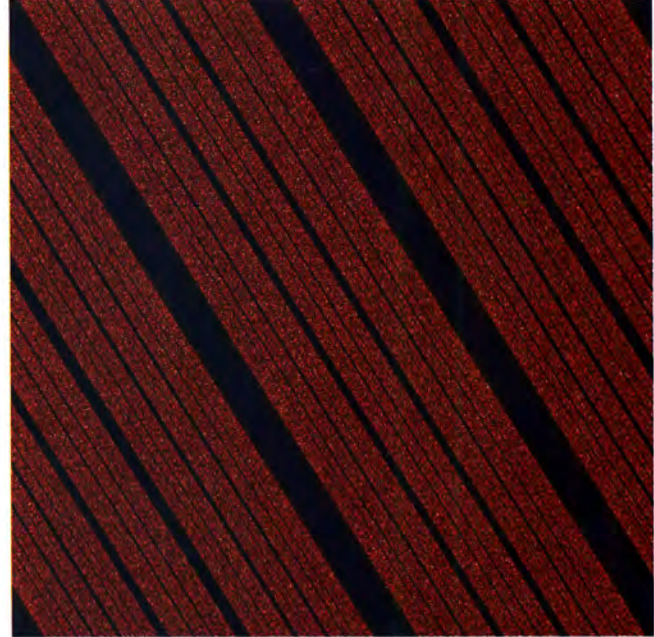


Figure 2.

Figure 2 (r.) is an enlargement of a small part of Figure 1 (l.), centered on the point $\begin{pmatrix} 0.5 \\ 0.5 \end{pmatrix}$. It reveals a structure of the type “Cantor times interval” in the complement of the basin of attraction.

- there exists a point whose orbit is dense;
- there are many ergodic invariant probability measures with full support.

These properties show that the dynamic of the transformation is indeed quite intricate. They can be obtained by the use of a symbolic model and are in fact shared by all transitive Anosov diffeomorphisms. The survey of J.C. Yoccoz [Yoc95] contains a nice presentation of these results.

The Perturbation

We now add a term to the diffeomorphism, so as to transform the fixed point $\begin{pmatrix} 0 \\ 0 \end{pmatrix}$ into an attracting fixed point.

$$f_1 : \begin{pmatrix} x \\ y \end{pmatrix} \mapsto \begin{pmatrix} 2 & 1 \\ 1 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} + \frac{p_1}{1 + \lambda^2} k(x/a)k(y/a) \begin{pmatrix} \lambda^2 & \lambda \\ \lambda & 1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix}$$

with $k(x) = (1 - x^2)^2 \mathbf{1}_{[-1,1]}(x)$ used as a C^1 “bump” function. The parameter a controls the extent of the perturbation, the parameter p_1 controls its amplitude. The additional term only modifies the dominant eigenvalue. The differential at the fixed point $\begin{pmatrix} 0 \\ 0 \end{pmatrix}$ is now conjugated to $\begin{pmatrix} \lambda^2 + p_1 & 0 \\ 0 & \lambda^{-2} \end{pmatrix}$.

Note that $\lambda_2 \approx 2.618$; so if we choose $p_1 = -2.2$, the point $\begin{pmatrix} 0 \\ 0 \end{pmatrix}$ becomes an attracting fixed point. If the parameter a is less than 0.5, say $a = 0.4$, the periodic point $\begin{pmatrix} 0.5 \\ 0.5 \end{pmatrix}$ of A is again a hyperbolic periodic point for f_1 . Hence not all points are attracted by $\begin{pmatrix} 0 \\ 0 \end{pmatrix}$. So, we may expect to see an open set of points attracted to the point $\begin{pmatrix} 0 \\ 0 \end{pmatrix}$, whereas there is still an invariant compact set on which the dynamics retains some of the features of the

hyperbolic toral automorphism. This is indeed what happens for the chosen set of parameters. The basin of attraction of the point $\begin{pmatrix} 0 \\ 0 \end{pmatrix}$ is depicted in Figure 1.

Let us explain how it was obtained. For each pixel on the picture, we calculate the number of iterations needed to reach a small neighborhood of the attracting fixed point $\begin{pmatrix} 0 \\ 0 \end{pmatrix}$, say the disk $\{(x, y) \mid x^2 + y^2 < 0.0001\}$. The pixel is colored according to that number of iterations: points that take less than ten iterations to reach the small disk are colored in black. The intensity of the color

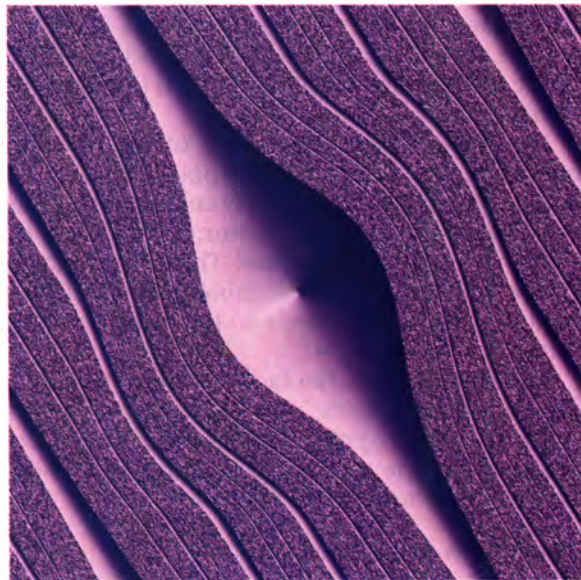


Figure 3.

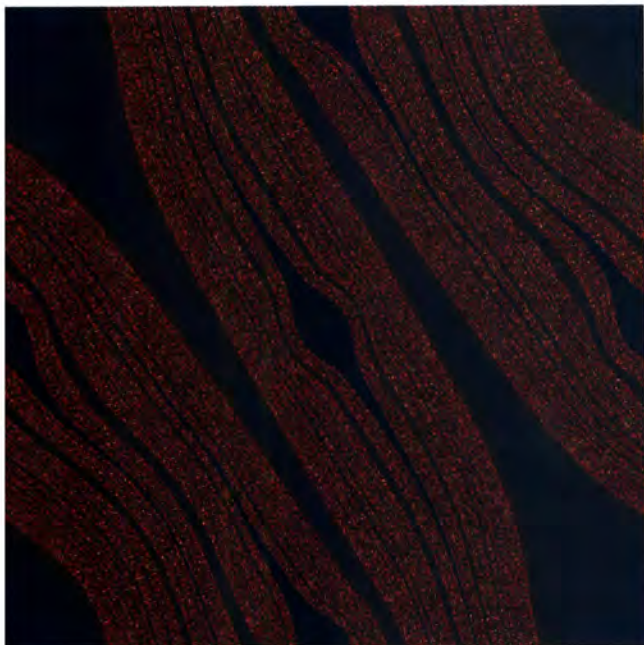


Figure 4.



Figure 5.

then increases until thirty iterations are needed, in which case the pixel appears in red. Pixels in yellow need around seventy iterations. Points needing more than two hundred iterations should appear in bright white, although they are hard to spot on the picture. Of course, points needing more than ten iterations to reach the small disk around the attracting fixed point are very close to the boundary of the basin of attraction; thus the colored area on Figure 1 almost coincides with the complement of the basin.

Other algorithms can be used to get a glimpse at that basin of attraction. In Figure 3, we first color the small disk $\{(x, y) \mid x^2 + y^2 < 0.0001\}$ radially. Points in the direction of $-\mathbf{e}_u$ are colored in white; the color smoothly fades until it reaches dark blue, which is attained for points in the direction of \mathbf{e}_u . Each pixel is then colored according to the color of the first iterate which falls into the small disk.

We now consider the inverse of the transformation f_1 , instead of f_1 . The point $\begin{pmatrix} 0 \\ 0 \end{pmatrix}$ is a repelling fixed point for f_1^{-1} . The complement of its basin of repulsion is an attractor; it is called an *attractor derived from Anosov*. The bright part in Figure 1 forms a small neighborhood of that attractor, and it corresponds to the “noisy” part in Figure 3.

The noise reflects the fact that the dynamic on the attractor is “chaotic”: the set of periodic points is dense, there are points with dense orbits; in fact it retains all the prominent features of the dynamics of the toral automorphism.

The Plykin Attractor

The attractor derived from Anosov lives on the torus. One can ask if there are uniformly hyperbolic

attractors on the sphere. The first example of such a system was given by Plykin [Ply74]; it can be obtained from the attractor derived from Anosov by realizing the sphere as a quotient of the torus.

Second Deformation

We first make another deformation to the map f_1 , in order to obtain other attracting basins. The orbit of the point $\begin{pmatrix} 0.5 \\ 0.5 \end{pmatrix}$ is periodic of period three under the transformation f . Indeed we have:

$$\begin{aligned} f_1 \begin{pmatrix} 0.5 \\ 0.5 \end{pmatrix} &= \begin{pmatrix} 0.5 \\ 0 \end{pmatrix}, \\ f_1 \begin{pmatrix} 0.5 \\ 0 \end{pmatrix} &= \begin{pmatrix} 0 \\ 0.5 \end{pmatrix}, \\ f_1 \begin{pmatrix} 0 \\ 0.5 \end{pmatrix} &= \begin{pmatrix} 0.5 \\ 0.5 \end{pmatrix}. \end{aligned}$$

Let us denote the integer part of some real number x by $E(x)$. The following change of variables:

$$\begin{cases} x_2 = x - 0.5 E(2x + 0.5) \\ y_2 = y - 0.5 E(2y + 0.5) \end{cases}$$

sends the three periodic points to the center $\begin{pmatrix} 0 \\ 0 \end{pmatrix}$. In order to transform these points into attracting periodic points, we add another term to the map f_1 and consider the map $f_2 : \mathbf{T}^2 \rightarrow \mathbf{T}^2$ sending $\begin{pmatrix} x \\ y \end{pmatrix}$ to:

$$\begin{aligned} \begin{pmatrix} 2 & 1 \\ 1 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} + \frac{p_1 k(\frac{x}{a})k(\frac{y}{a})}{1 + \lambda^2} \begin{pmatrix} \lambda^2 & \lambda \\ \lambda & 1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} \\ + \frac{p_2 k(\frac{x_2}{b})k(\frac{y_2}{b})}{1 + \lambda^2} \begin{pmatrix} \lambda^2 & \lambda \\ \lambda & 1 \end{pmatrix} \begin{pmatrix} x_2 \\ y_2 \end{pmatrix} \end{aligned}$$



Figure 6.

We take $a = 0.4$ and $b = 0.1$, so that the two perturbations do not interfere. The differential of f_2 at the three periodic points is conjugate to $\begin{pmatrix} \lambda^2 + p_2 & 0 \\ 0 & \lambda^{-2} \end{pmatrix}$. The periodic orbit of period three becomes attractive if, for example, $p_2 = -2.2$.

The result is depicted in Figure 4. That figure is centered on the periodic point $\begin{pmatrix} 0.5 \\ 0.5 \end{pmatrix}$. Its basin of attraction appears in black. The algorithm used for that picture is similar to the algorithm of Figure 1. The inverse of the third iterate of f_2 , f_2^{-3} admits four repelling fixed points; the complement of the basin of repulsion of these four points is an attractor, on which the dynamics enjoys properties similar to the hyperbolic automorphism of the torus. The four basins of repulsion are depicted in different colors in Figure 5.

From the Torus to the Sphere

We now consider the symmetry on the torus given by $(x, y) \mapsto (-x, -y)$. This symmetry has four fixed points, which are precisely the fixed point of f_2 and the three periodic points of period three. We may quotient the torus by this symmetry. The resulting space

is topologically a sphere; from the differential viewpoint, it is a sphere with four conical points. Such a space has a euclidean model, namely the tetrahedron. If we start from the hexagonal torus instead of the usual one, the resulting tetrahedron is regular.

The transformation f_2^{-1} commutes with the symmetry, so it defines a transformation of the tetrahedron, for which the four vertices are repelling fixed points. The *Plykin attractor* is obtained by smoothing the tetrahedron and the transformation f_2^{-1} in a neighborhood of the vertices. Note that if the smoothing is small enough, it takes place in the basins of repulsion of the repelling points and does not alter the attractor. So, for the purpose of representation, this smoothing is irrelevant. Figure 6 gives an explicit model for the tetrahedron, which can be cut and pasted to obtain a representation of the Plykin attractor.

Lakes of Wada

Finally, the sphere or the tetrahedron may be stereographically projected on the plane. The repelling

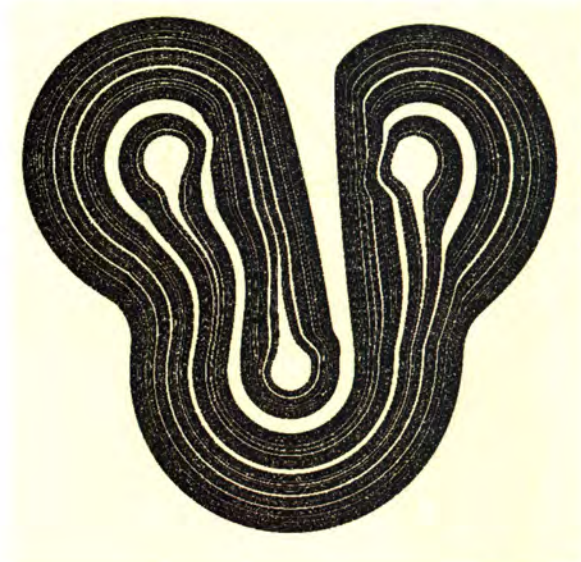


Figure 7.

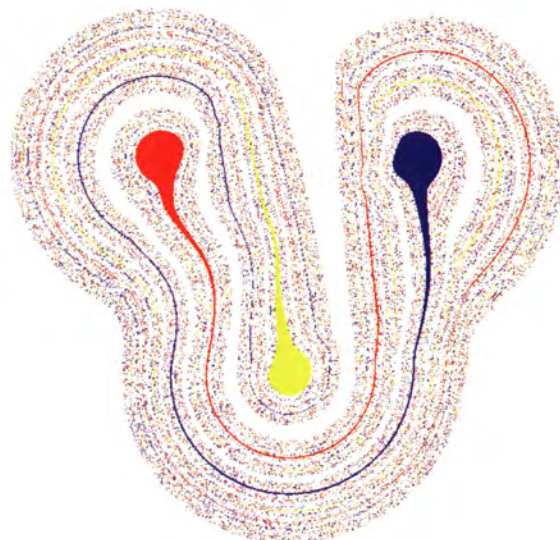


Figure 8.

fixed point $\begin{pmatrix} 0 \\ 0 \end{pmatrix}$ on the torus is sent to infinity by the projection. The map obtained from f_2^{-1} is a diffeomorphism of the plane, for which infinity is repelling; it admits moreover a period three repelling orbit, and the complement of the basins of repulsion is an attractor which is depicted in Figure 7.

Note that the basins of repulsion of the transformation form Lakes of Wada: each of the four basins is an immersed disk, and each of these disks has the same boundary, the attractor itself. In other words, any point on the attractor is accumulated by the four basins of repulsion. Such immersion of disks in the plane was first built by L. Brouwer, K. Yoneyama [Yon17]. The basins are depicted in different colors in Figure 8.

The Smale Horseshoe

Third deformation

We come back to the transformation f_1 on the torus. What happens if the periodic orbit of period three of f_1 is deformed into a repelling periodic orbit instead of an attracting periodic orbit? Such a deformation can be achieved by adding a third term to the automorphism of the torus:

$$f_3 \begin{pmatrix} x \\ y \end{pmatrix} = f_2 \begin{pmatrix} x \\ y \end{pmatrix} + \frac{p_3 k(\frac{x_2}{a})k(\frac{y_2}{a})}{1 + \lambda^2} \begin{pmatrix} x_2 \\ y_2 \end{pmatrix}$$

The parameter p_3 determines the amplitude of the perturbation. The eigenvalues of Df_3 at the periodic points of period three are equal to $\lambda^2 + p_2 + p_3$ and $\lambda^{-2} + p_3$. We take $p_2 = -2.2$, $p_3 = 0.7$.

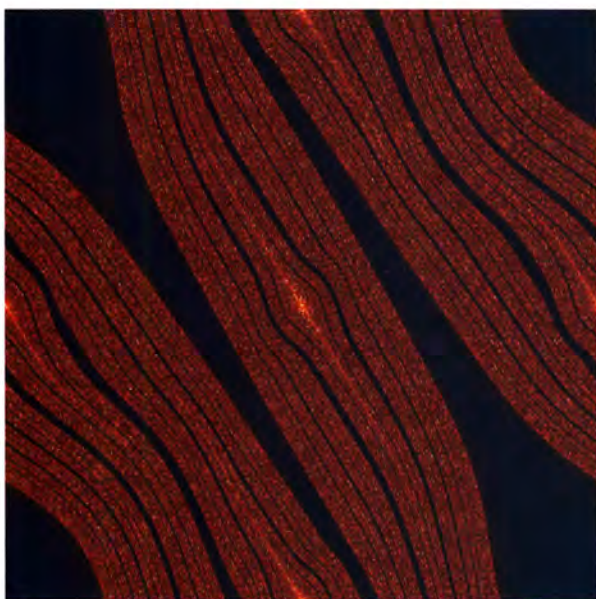


Figure 9.

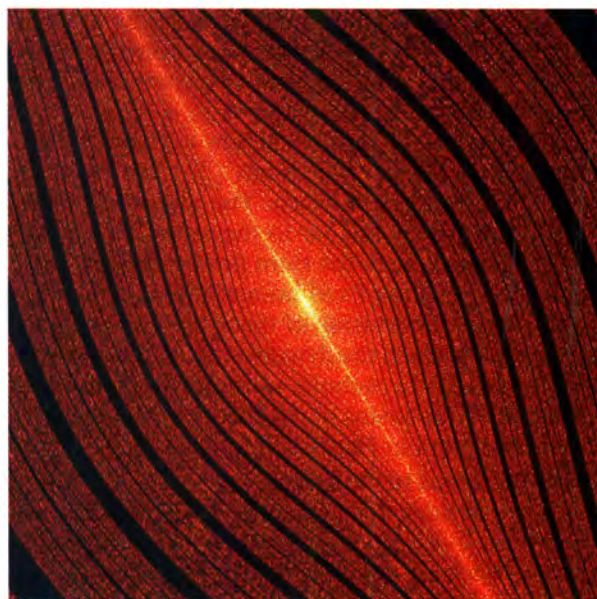


Figure 10.



Figure 11.

The result is shown in Figure 9; the algorithm used is the same as in Figures 1 and 2. The figure is centered on the point $\begin{pmatrix} 0.5 \\ 0.5 \end{pmatrix}$. Note that colors around this point seem to be brighter, compared to Figure 1. Figure 10 shows an enlargement around $\begin{pmatrix} 0.5 \\ 0.5 \end{pmatrix}$ and should be compared with Figure 2. We can see how the basin of attraction of the point $\begin{pmatrix} 0.5 \\ 0.5 \end{pmatrix}$ (in black on the picture) is repelled by the point $\begin{pmatrix} 0.5 \\ 0.5 \end{pmatrix}$.

Horseshoes

The transformation f_3 on the torus induces a mapping on the sphere, which exhibits a “Smale horseshoe”. It possesses a repelling orbit of period three, and infinity is an attracting fixed point.

The compact set K depicted in Figure 11 ($p_4 = 0$) consists of the points which are not attracted by infinity. This set may be split into three invariant

subsets: the repelling orbit of period three; a Cantor set consisting of the closure of the recurrent points of f_3 (different from the three repelling points); and the set of points which are attracted by this Cantor set. The closure of the recurrent points is the set usually called the *horseshoe*.

Figure 12 is a colored version of Figure 11, whereas Figure 13 is an enlargement of Figure 12 around one of the three repelling points. The brighter the points, the longer it takes to reach infinity; hence the colored part forms a neighborhood of the set of points which do not go to infinity.

Acknowledgment

All pictures were generated using the free software FRACTINT [Fr].

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Figure 12.



Figure 13.

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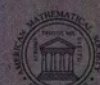
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You Could Have Invented Spectral Sequences

Timothy Y. Chow

Introduction

The subject of spectral sequences has a reputation for being difficult for the beginner. Even G. W. Whitehead (quoted in John McCleary [4]) once remarked, “The machinery of spectral sequences, stemming from the algebraic work of Lyndon and Koszul, seemed complicated and obscure to many topologists.”

Why is this? David Eisenbud [1] suggests an explanation: “The subject of spectral sequences is elementary, but the notion of the spectral sequence of a double complex involves so many objects and indices that it seems at first repulsive.” I have heard others make similar complaints about the proliferation of subscripts and superscripts.

My own explanation, however, is that spectral sequences are often not taught in a way that explains how one might have come up with the definition in the first place. For example, John McCleary’s excellent text [4] says, “The user, however, needs to get acquainted with the manipulation of these gadgets without the formidable issue of their origins.” Without an understanding of where spectral sequences come from, one naturally finds them mysterious. Conversely, if one *does* see where they come from, the notation should not be a stumbling block.

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Fools rush in where angels fear to tread, so my goal below is to make you, the reader, feel that you could have invented spectral sequences (on a very good day, to be sure!). I assume familiarity with homology groups, but little more. Everything here is known to the cognoscenti, but my hope is to make the ideas accessible to more than the lucky few who are able to have the right conversation with the right expert at the right time.

Readers who are interested in the history of spectral sequences and how they were in fact invented should read [3], which gives a definitive account.

Simplifying Assumptions

Throughout, we work over a field. All chain groups are finite-dimensional, and all filtrations (explained below) have only finitely many levels. In the “real world”, these assumptions may fail, but the essential ideas are easier to grasp in this simpler context.

Graded Complexes

Chain complexes that occur “in nature” often come with extra structure in addition to the boundary map. Certain kinds of extra structure are particularly common, so it makes sense to find a systematic method for exploiting such features. Then we do not have to reinvent the wheel each time we want to compute a homology group.

Here is a simple example. Suppose we have a chain complex

$$\cdots \xrightarrow{\partial} C_{d+1} \xrightarrow{\partial} C_d \xrightarrow{\partial} C_{d-1} \xrightarrow{\partial} \cdots$$

that is "graded", i.e., each C_d splits into a direct sum

$$C_d = \bigoplus_{p=1}^n C_{d,p}$$

and moreover the boundary map ∂ respects the grading in the sense that $\partial C_{d,p} \subseteq C_{d-1,p}$ for all d and p . Then the grading allows us to break up the computation of the homology into smaller pieces: simply compute the homology in each grade independently and then sum them all up to obtain the homology of the original complex.

Unfortunately, in practice we are not always so lucky as to have a grading on our complex. What we frequently have instead is a *filtered complex*, i.e., each C_d comes equipped with a nested sequence of submodules

$$0 = C_{d,0} \subseteq C_{d,1} \subseteq C_{d,2} \subseteq \cdots \subseteq C_{d,n} = C_d$$

and the boundary map respects the filtration in the sense that

$$(1) \quad \partial C_{d,p} \subseteq C_{d-1,p}$$

for all d and p . (Note: The index p is called the *filtration degree*. Here it has a natural meaning only if $0 \leq p \leq n$, but throughout this paper, we sometimes allow indices to "go out of bounds," with the understanding that the objects in question are zero in that case. For example, $C_{d,-1} = 0$.)

Although a filtered complex is not quite the same as a graded complex, it is similar enough that we might wonder if a similar "divide and conquer" strategy works here. For example, is there a natural way to break up the homology groups of a filtered complex into a direct sum? The answer turns out to be yes, but the situation is surprisingly complicated. As we shall now see, the analysis leads directly to the concept of a spectral sequence.

Let us begin by trying naively to "reduce" this problem to the previously solved problem of graded complexes. To do this we need to express each C_d as a direct sum. Now, C_d is certainly not a direct sum of the $C_{d,p}$; indeed, $C_{d,n}$ is already all of C_d . However, because C_d is a finite-dimensional vector space (recall the assumptions we made at the outset), we can obtain a space isomorphic to C_d by modding out by any subspace U and then direct summing with U ; that is to say, $C_d \simeq (C_d/U) \oplus U$. In particular, we can take $U = C_{d,n-1}$. Then we can iterate this process to break U itself down into a direct sum, and continue all the way down. More formally, define

$$(2) \quad E_{d,p}^0 \stackrel{\text{def}}{=} C_{d,p}/C_{d,p-1}$$

for all d and p . (*Warning:* There exist different indexing conventions for spectral sequences; most authors write $E_{p,q}^0$ where $q = d - p$ is called the *complementary degree*. The indexing convention I use here is the one that I feel is clearest pedagogically.) Then

$$(3) \quad C_d \simeq \bigoplus_{p=1}^n E_{d,p}^0.$$

The nice thing about this direct sum decomposition is that the boundary map ∂ naturally induces a map

$$\partial^0 : \bigoplus_{p=1}^n E_{d,p}^0 \rightarrow \bigoplus_{p=1}^n E_{d-1,p}^0$$

such that $\partial^0 E_{d,p}^0 \subseteq E_{d-1,p}^0$ for all d and p . The reason is that two elements of $C_{d,p}$ that differ by an element of $C_{d,p-1}$ get mapped to elements of $C_{d-1,p}$ that differ by an element of $\partial C_{d,p-1} \subseteq C_{d-1,p-1}$, by equation (1).

Therefore we obtain a graded complex that splits up into n pieces:

$$(4) \quad \begin{array}{cccccccc} \cdots & \xrightarrow{\partial^0} & E_{d+1,n}^0 & \xrightarrow{\partial^0} & E_{d,n}^0 & \xrightarrow{\partial^0} & E_{d-1,n}^0 & \xrightarrow{\partial^0} & \cdots \\ \cdots & \xrightarrow{\partial^0} & E_{d+1,n-1}^0 & \xrightarrow{\partial^0} & E_{d,n-1}^0 & \xrightarrow{\partial^0} & E_{d-1,n-1}^0 & \xrightarrow{\partial^0} & \cdots \\ & & \vdots & & \vdots & & \vdots & & \\ \cdots & \xrightarrow{\partial^0} & E_{d+1,1}^0 & \xrightarrow{\partial^0} & E_{d,1}^0 & \xrightarrow{\partial^0} & E_{d-1,1}^0 & \xrightarrow{\partial^0} & \cdots \end{array}$$

Now let us define $E_{d,p}^1$ to be the p th graded piece of the homology of this complex:

$$(5) \quad E_{d,p}^1 \stackrel{\text{def}}{=} H_d(E_{d,p}^0) = \frac{\ker \partial^0 : E_{d,p}^0 \rightarrow E_{d-1,p}^0}{\text{im } \partial^0 : E_{d+1,p}^0 \rightarrow E_{d,p}^0}$$

(For those comfortable with relative homology, note that $E_{d,p}^1$ is just the relative homology group $H_d(C_p, C_{p-1})$.) Still thinking naively, we might hope that

$$(6) \quad \bigoplus_{p=1}^n E_{d,p}^1$$

is the homology of our original complex. Unfortunately, this is too simple to be true. Although *each term* in the the complex $(\bigoplus_p E_{d,p}^0, \partial^0)$ —known as the *associated graded complex* of our original filtered complex (C_d, ∂) —is isomorphic to the corresponding term in our original complex, this does not guarantee that the two complexes will be isomorphic *as chain complexes*. So although $\bigoplus_p E_{d,p}^1$ does indeed give the homology of the associated graded complex, it may *not* give the homology of the original complex.

Analyzing the Discrepancy

This is a little disappointing, but let's not give up just yet. The associated graded complex is so closely related to the original complex that even if its homology isn't exactly what we want, it ought to be a reasonably good approximation. Let's carefully examine the discrepancy to see if we can fix the problem.

Moreover, to keep things as simple as possible, let us begin by considering the case $n = 2$. Then the array in diagram (4) has only two levels, which we shall call the "upstairs" ($p = 2$) and "downstairs" ($p = 1$) levels.

The homology group H_d that we really want is Z_d/B_d , where Z_d is the space of cycles in C_d and B_d is the space of boundaries in C_d . Since C_d is filtered, there is also a natural filtration on Z_d and B_d :

$$0 = Z_{d,0} \subseteq Z_{d,1} \subseteq Z_{d,2} = Z_d$$

and

$$0 = B_{d,0} \subseteq B_{d,1} \subseteq B_{d,2} = B_d.$$

Recall that we have been trying to find a natural way of decomposing H_d into a direct sum. Just as we observed before that C_d is not a direct sum of $C_{d,1}$ and $C_{d,2}$, we observe now that Z_d/B_d is not a direct sum of $Z_{d,1}/B_{d,1}$ and $Z_{d,2}/B_{d,2}$; indeed, $Z_{d,2}/B_{d,2}$ by itself is already the entire homology group. But again we can use the same trick of modding out by the "downstairs part" and then direct summing with the "downstairs part" itself:

$$\frac{Z_d}{B_d} \simeq \frac{Z_d + C_{d,1}}{B_d + C_{d,1}} \oplus \frac{Z_d \cap C_{d,1}}{B_d \cap C_{d,1}} = \frac{Z_{d,2} + C_{d,1}}{B_{d,2} + C_{d,1}} \oplus \frac{Z_{d,1}}{B_{d,1}}.$$

Now, the naïve hope would be that

$$(7) \quad E_{d,2}^1 \stackrel{?}{\simeq} \frac{Z_{d,2} + C_{d,1}}{B_{d,2} + C_{d,1}}$$

and

$$(8) \quad E_{d,1}^1 \stackrel{?}{\simeq} \frac{Z_{d,1}}{B_{d,1}},$$

and even that the numerators and denominators in equations (7) and (8) are precisely the "cycles" and "boundaries" in the definition (equation (5) above) of $E_{d,p}^1$. For then expression (6) would give us a direct sum decomposition of H_d . Unfortunately, in general, neither (7) nor (8) holds. Corrections are needed.

Let us first look "downstairs" at $E_{d,1}^1$. The "cycles" of $E_{d,1}^1$ are the cycles in $E_{d,1}^0$, and the "boundaries" are the image I of the map

$$\partial^0 : E_{d+1,1}^0 \rightarrow E_{d,1}^0.$$

The space of cycles in $E_{d,1}^0$ is $Z_{d,1}$, which is the numerator in equation (8). However, the image I is not $B_{d,1}$, for $B_{d,1}$ is the part of B_d that lies in $C_{d,1}$,

and while this contains I , it may also contain other things. Specifically, the map ∂ may carry some elements $x \in C_{d+1}$ down from "upstairs" to "downstairs," whereas I only captures boundaries of elements that were already downstairs to begin with. Therefore, $Z_{d,1}/B_{d,1}$ is a quotient of $E_{d,1}^1$.

Now let us look "upstairs" at $E_{d,2}^1$. In this case, the space of "boundaries" of $E_{d,2}^1$ is $B_{d,2} + C_{d,1}$, which is the denominator in equation (7). However, the space of "cycles" in this case is the kernel K of the map

$$\partial^0 : E_{d,2}^0 \rightarrow E_{d-1,2}^0,$$

which, by definition of E^0 , is the map

$$\partial^0 : \frac{C_{d,2}}{C_{d,1}} \rightarrow \frac{C_{d-1,2}}{C_{d-1,1}}.$$

Thus we see that K contains not only chains that ∂ sends to zero but also any chains that ∂ sends "downstairs" to $C_{d-1,1}$. In contrast, the elements of $Z_{d,2} + C_{d,1}$ are more special: their boundaries are boundaries of chains that come from $C_{d,1}$. Hence

$$\frac{Z_{d,2} + C_{d,1}}{B_{d,2} + C_{d,1}}$$

is a subspace of $E_{d,2}^1$, the subspace of elements whose boundaries are boundaries of $C_{d,1}$ -chains.

Intuitively, the problem is that the associated graded complex only "sees" activity that is confined to a single horizontal level; everything above and below that level is chopped off. But in the original complex, the boundary map ∂ may carry things down one or more levels (it cannot carry things up one or more levels because ∂ respects the filtration), and one must therefore correct for this inter-level activity.

The Emergence of Spectral Sequences

The beautiful fact that makes the machinery of spectral sequences work is that both of the above corrections to the homology groups $E_{d,p}^1$ can be regarded as "homology groups of homology groups"!

Notice that ∂ induces a natural map—let us call it ∂^1 —from $E_{d+1,2}^1$ to $E_{d,1}^1$, for all d , for the boundary of any element in $E_{d+1,2}^1$ is a cycle that lies in $C_{d,1}$, and thus it defines an element of $E_{d,1}^1$. The key claims (for $n = 2$) are the following.

- *Claim 1.* If we take $E_{d,1}^1$ and mod out by the image of ∂^1 , then we obtain $Z_{d,1}/B_{d,1}$. To see this, just check that the image of ∂^1 gives all the boundaries that lie in $C_{d,1}$.
- *Claim 2.* The kernel of ∂^1 is a subspace of $E_{d,2}^1$ isomorphic to

$$\frac{Z_{d+1,2} + C_{d+1,1}}{B_{d+1,2} + C_{d+1,1}}.$$

Again, simply check that the kernel consists just of those elements whose boundary equals a boundary of some element of $C_{d+1,1}$.

We can visualize these claims by drawing the following diagram.

$$\begin{array}{cccccc}
 0 & & 0 & & 0 & & 0 & & 0 & & 0 \\
 & \searrow^{\partial^1} & & \searrow^{\partial^1} & & \searrow^{\partial^1} & & \searrow^{\partial^1} & & \searrow^{\partial^1} & \\
 \cdots & & E_{d+1,2}^1 & & E_{d,2}^1 & & E_{d-1,2}^1 & & \cdots & & \\
 (9) & \searrow^{\partial^1} & & \searrow^{\partial^1} & & \searrow^{\partial^1} & & \searrow^{\partial^1} & & \searrow^{\partial^1} & \\
 \cdots & & E_{d+1,1}^1 & & E_{d,1}^1 & & E_{d-1,1}^1 & & \cdots & & \\
 & \searrow^{\partial^1} & & \searrow^{\partial^1} & & \searrow^{\partial^1} & & \searrow^{\partial^1} & & \searrow^{\partial^1} & \\
 0 & & 0 & & 0 & & 0 & & 0 & & 0
 \end{array}$$

Diagram (9) is a collection of chain complexes; it's just that the chain complexes do not run horizontally as in diagram (4), but slant downwards at a 45° angle, and each complex has just two nonzero terms. (*Reminder:* Our indexing convention is different from that of most authors, whose diagrams will therefore look "skewed" relative to diagram (9).) If we now define $E_{d,p}^2$ to be the homology, i.e.,

$$(10) \quad E_{d,p}^2 \stackrel{\text{def}}{=} H_d(E_{d,p}^1) = \frac{\ker \partial^1 : E_{d,p}^1 \rightarrow E_{d-1,p-1}^1}{\text{im } \partial^1 : E_{d+1,p+1}^1 \rightarrow E_{d,p}^1},$$

then the content of Claim 1 and Claim 2 is that $E_{d,1}^2 \oplus E_{d,2}^2$ is (finally!) the correct homology of our original filtered complex.

For the case $n = 2$, this completes the story. The sequence of terms E^0, E^1, E^2 is the spectral sequence of our filtered complex when $n = 2$. We may regard E^1 as giving a first-order approximation of the desired homology, and E^2 as giving a second-order approximation—which, when $n = 2$, is not just an approximation but the true answer.

What if $n > 2$? The definitions (2), (5), and (10) still make sense, but now E^2 will not in general give the true homology, because E^2 only takes into account interactions between *adjacent* levels in diagram (4), but ∂ can potentially carry things down two or more levels. Therefore we need to consider further terms E^3, E^4, \dots, E^n . For example, to define E^3 , we can check that ∂ induces a natural map—call it ∂^2 —from $E_{d+1,p+2}^2$ to $E_{d,p}^2$ for all d and p . One obtains a diagram similar to diagram (9), except with (E^2, ∂^2) instead of (E^1, ∂^1) , and with each arrow going down *two* levels instead of one. Then $E_{d,p}^3$ is $(\ker \partial^2)/(\text{im } \partial^2)$ at $E_{d,p}^2$. In general, the picture for E^r has arrows labeled ∂^r dropping down r levels

from $E_{d+1,p+r}^r$ to $E_{d,p}^r$, and E^{r+1} is defined to be the homology of (E^r, ∂^r) .

The verification that, for general n , $H_d \simeq \bigoplus_p E_{d,p}^n$ is a conceptually straightforward generalization of the ideas we have already seen, but it is tedious so we omit the details.

What Good Is All This?

In analysis, the value of having a series approximation converging to a quantity of interest is familiar to every mathematician. Such an approximation is particularly valuable when just the first couple of terms already capture most of the information.

Similar remarks apply to spectral sequences. One common phenomenon is for a large number of the $E_{d,p}^r$ and/or the boundary maps ∂^r to become zero for small values of r . This causes the spectral sequence to stabilize or *collapse* rapidly, allowing the homology to be computed relatively easily. We illustrate this by sketching the proof of Theorem 2 in a paper of Phil Hanlon [2]. This is far from a "mainstream" application of spectral sequences, but it has the great advantage of requiring very little background knowledge to follow. Readers who know enough topology may wish instead to proceed directly to the standard examples that may be found in any number of textbooks.

Let Q be a finite partially ordered set that is *ranked*—i.e., every maximal totally ordered subset has the same number of elements, so that every element can be assigned a rank (namely, a natural number indicating its position in any maximal totally ordered subset containing it)—and that is equipped with an order-reversing involution $x \mapsto x^*$. Let

$$(11) \quad \gamma = \{\alpha_1, \alpha_2, \dots, \alpha_r\} \quad \text{where} \\ \alpha_1 < \alpha_2 < \dots < \alpha_r$$

be a totally ordered subset of Q . We say that γ is *isotropic* if $\alpha_i \neq \alpha_j^*$ for all i and j .

Now adjoin a minimum element $\hat{0}$ and a maximum element $\hat{1}$ to Q , and consider the family of all totally ordered subsets of the resulting partially ordered set. These form an abstract simplicial complex Δ , and we can consider its simplicial homology groups H_d . We can also restrict attention to the isotropic totally ordered subsets; these form a subcomplex Δ^0 , which has its own homology groups H_d^0 .

Hanlon's Theorem 2 says that if Q is Cohen-Macaulay and its maximal totally ordered subsets have m elements, then $H_d^0 = 0$ if $0 \leq d < m/2$. The definition of *Cohen-Macaulay* need not concern us here; it suffices to know that Cohen-Macaulay partially ordered sets satisfy a certain homological property (given in Hanlon's paper). In particular,

knowing that Q is Cohen-Macaulay gives us information about H_d .

In order to deduce something about H_d^0 from the information we have about H_d , we seek a relationship between H_d and H_d^0 . Given γ as in equation (11), Hanlon's key idea is to let $\rho(\gamma)$ be the rank of α_i , where i is maximal subject to the condition that $\alpha_i^* = \alpha_j$ for some $j > i$. Then $\rho(\gamma) = 0$ if and only if γ is isotropic, but more importantly, applying the boundary map can clearly only decrease ρ , so ρ induces a filtration on Δ . Specifically, we obtain the p th level of the filtration by restricting to those γ such that $\rho(\gamma) \leq p$. Therefore we obtain a spectral sequence! This gives a relationship between $H_d^0 = E_{d,0}^1$ and the limit H_d of the spectral sequence.

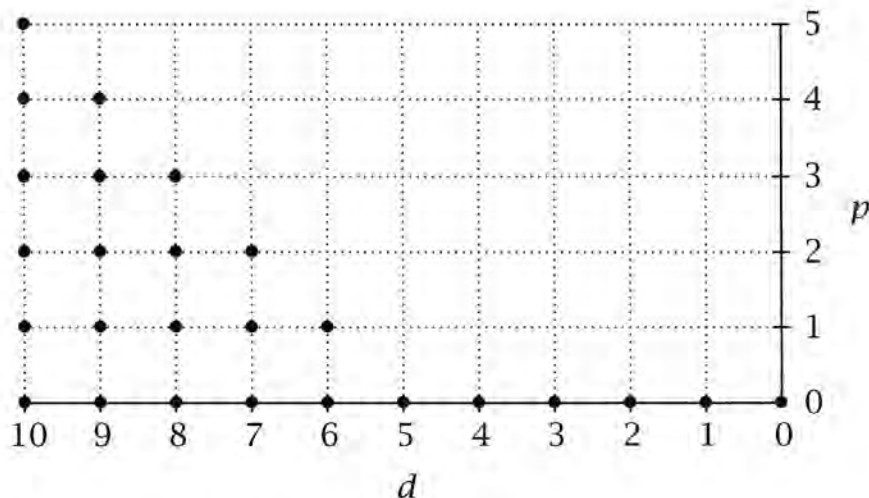
The heart of Hanlon's proof is to analyze E^1 . He shows that $E_{d,p}^1 = 0$ except possibly for certain pairs (d, p) . For instance, when $m = 10$, $E_{d,p}^1 = 0$ except possibly for the pairs (d, p) marked by dots in the diagram to the right.

If you imagine the 45° boundary maps, then you can see that some potentially complicated things may be happening for $d \geq 5 = m/2$, but for $m/2 > d$, $E_{d,p}^2$ will be isomorphic to $E_{d,p}^1$ for all p . In fact, $E_{d,p}^r \simeq E_{d,p}^1$ for all $r \geq 1$ when $m/2 > d$; the boundary maps slant more and more as r increases, but this makes no difference. Therefore just by computing E^1 , we have computed the full homology group for certain values of d . In particular, $H_d^0 \simeq H_d$ for $m/2 > d$. It turns out that the Cohen-Macaulay condition easily implies that $H_d = 0$ for $m/2 > d$, so this completes the proof.

A Glimpse Beyond

When our simplifying assumptions are dropped, a lot of complications can arise. Over an arbitrary commutative ring, equation (3) need not hold; not every short exact sequence splits, so there may be extension issues. When our finiteness conditions are relaxed, one may need to consider E^r for arbitrarily large r , and the spectral sequence may not converge. Even if it does converge, it may not converge to the desired homology. So in many applications, life is not as easy as it may have seemed from the above discussion; nevertheless, our simplified setting can still be thought of as the "ideal" situation, of which more realistic situations are perturbations.

We should also mention that spectral sequences turn out to be such natural gadgets that they arise not only from filtered complexes, but also from double complexes, exact couples, etc. We cannot even begin to explore all these ramifications here, but hope that our tutorial will help you tackle the textbook treatments with more confidence.



Why the Adjective "Spectral"?

A question that often comes up is where the term "spectral" comes from. The adjective is due to Leray, but he apparently never published an explanation of why he chose the word. John McCleary (personal communication) and others have speculated that since Leray was an analyst, he may have viewed the data in each term of a spectral sequence as playing a role that the eigenvalues, revealed one at a time, have for an operator. If any reader has better information, I would be glad to hear it.

Acknowledgments

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Mathematicians and Mathematics Textbooks for Prospective Elementary Teachers

Raven McCrory

Over the last decade, mathematicians and mathematics educators have turned their attention to teacher knowledge, responding to standards documents and state policies (Wilson, 2002) and to disappointing results of various national and international assessments of U.S. student performance in mathematics. It is the purpose of this article to explore the approach taken in four mathematics textbooks, written by research mathematicians for courses for prospective elementary teachers, to the problem of what teachers need to know and how they should learn it.

In 2001, the Conference Board of the Mathematical Sciences (CBMS, 2001) made recommendations about the mathematics K-12 teachers need to know. In the last decade, researchers in mathematics education have begun to specify and assess teacher knowledge in new ways (Ball, 2003; Hill et al., 2004; Ma, 1999) and research mathematicians have become increasingly involved in teacher education and the professional development of mathematics teachers. For example, Milgram (2004) gives a detailed account of a proposed series of courses that differ significantly from the CBMS guidelines, addressing what he thought were important shortcomings of the CBMS report. Four research mathematicians have recently written complete (Beckmann, 2003; Jensen, 2003; Parker and Baldrige, 2003) or

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partial (Wu, 2002) textbooks for mathematics courses for prospective elementary teachers.¹

While there is a general expectation that elementary teachers know enough mathematics to teach it, there are differences of opinion about what should be included in courses designed for elementary teachers, and how it should be taught (Askey, 1999; Ball, 2003; Ball and Bass, 2003; CBMS, 2001; Hill et al., 2004; Ma, 1999). One way to begin to analyze *what* is taught is to look at the mathematics textbooks written specifically for courses for prospective elementary teachers. In classes that use these textbooks, the books define a substantial element of what students have an *opportunity* to learn. Many states or certifying institutions require one, two, or more semesters of mathematics to qualify for an elementary teaching certificate. Some institutions require a minimum number of mathematics courses from the undergraduate curriculum, while others require classes specifically designed for elementary teachers. These latter are usually taught in mathematics departments. Certifying institutions may also require mathematics methods courses, usually taught in departments of education. It is textbooks for *mathematics* courses for elementary teachers to which our attention is turned.

Twenty textbooks, including the four recently written (or in preparation) by mathematicians, are being analyzed as part of a project aimed at investigating the mathematical education of prospective

¹ There are other textbooks in preparation to which I did not have access.

elementary teachers.² In the following sections, I first give a general overview of how the books can be characterized as textbooks and how the mathematicians' books differ from previous texts; then I look specifically at one topic—the definition of fractions—for a detailed view of some of the mathematical issues entailed in teaching elementary teachers. The focus will be on the four mathematicians' books, with some reference to other texts for particular contrast. Specifically, I explore the following questions:

1. How can these textbooks be characterized? In what ways are the mathematicians' textbooks different from the previous generation of books (written primarily by mathematics educators)?

2. What complexities of teaching mathematics and of teacher knowledge for such teaching are reflected in these four books?

Characterizing the Books

Analysis of the twenty books suggests that while there are many similarities in topics and overall content, they differ substantially in how they approach the mathematics elementary teachers need to learn. I have identified four aspects of the books that provide a framework for distinguishing among them: type of book, coherence, rigor, and claims.

Type of Book

In the overall analysis of the twenty textbooks, it is clear that the books differ in their purpose and design. Most of the books are encyclopedic, including every possible topic that might be covered in K–8 classrooms, and treating each topic as a separate entity (e.g., Billstein et al., 2003). These books are long, well indexed, and comprehensive. They typically have supplementary materials such as activity manuals, websites, and CD-ROMS. Other books are shorter and more concise, not aiming to cover all bases, but rather giving emphasis to some topics while mentioning others only briefly (e.g., Parker and Baldrige, 2004). These books tend to be more narrative in their approach to mathematics, in the sense of telling a nuanced story of

²For a complete list of books, go to <http://www.msu.edu/~mccrory/textbooks.htm>. Three books on the list have gone out of print since January 2005, and they are noted on the Web site. For more information on the larger project, go to <http://www.educ.msu.edu/Meet/>.

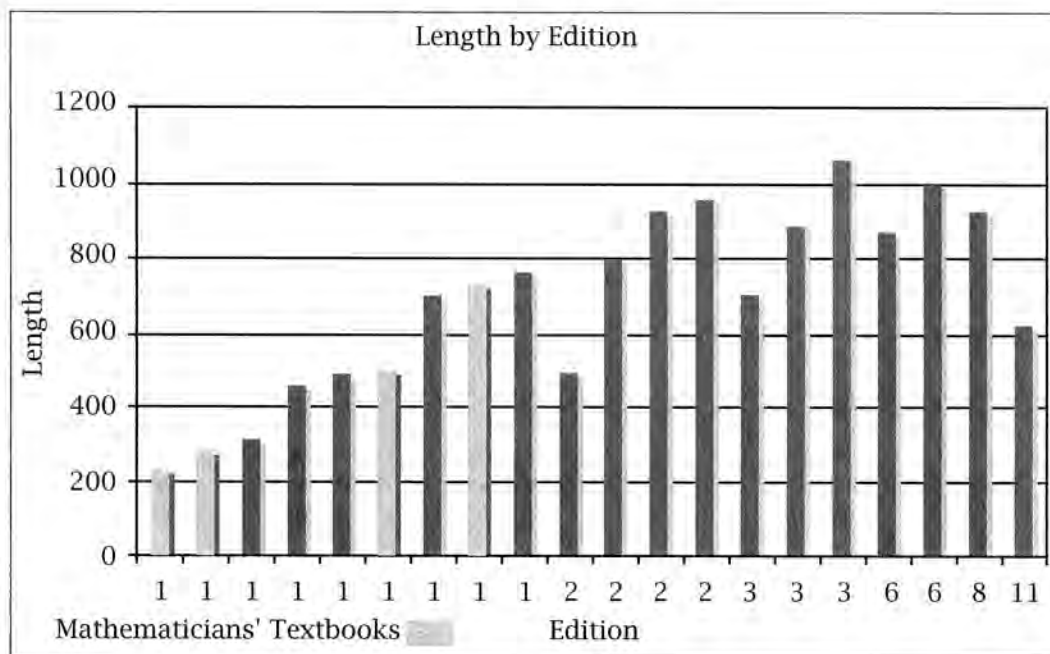


Figure 1. Textbook length by edition.

mathematics with big ideas in focus as the leading characters. In between are books that may “cover” all the topics but emphasize some more than others, or books that take a particular approach to the mathematics. For example, Masingila (2002) takes a problem-solving approach where the mathematics is introduced through problems. On this scale from encyclopedic and comprehensive to narrative and focused, the books by mathematicians are toward the narrative, focused end. This is not to say that they leave out important mathematics; rather, they provide a mathematical landscape where some topics and approaches are clearly more important than others.

On the comprehensive end of the scale, books serve as a resource for a class rather than a recipe for a course or a sequence of courses. Although it is at least conceivable that an instructor could completely “cover” an encyclopedic book in several semesters, he or she will likely need to pick and choose among topics, problems, and activities to teach a course from one of these books. On the other end of the scale, some of the books were written specifically to define a course (or sequence). I include here not only three of the books by mathematicians, but also books by other authors (e.g., Darken, 2003; Masingila 2002). Several authors (Darken, Masingila, Baldrige, Parker and Beckmann, personal communications) have suggested in conversations and interviews that they wrote the books to use in their own teaching *in response* to what they saw as a need for a different textbook.

One wonders if the books by mathematicians are shorter and more narrative because the authors are mathematicians or for other reasons. Other explanations are possible. For example, nearly all of the encyclopedic books are in multiple editions,

having been originally published many years ago. They are products of major publishing houses that may have influenced the content and layout of the books in ways that push them toward comprehensiveness and toward a particular editorial style. In fact, comparing book length to number of editions (Figure 1), suggests a regular pattern of increasing length with increasing editions, with a few exceptions. The mathematicians' texts are highlighted, all in first edition and all on the shorter side.

The difference pointed to here—between encyclopedic and narrative books—goes beyond length. In the introduction to her book, Beckmann writes:

The book focuses on explaining why. Prospective elementary school teachers will learn to explain why the standard procedures and formulas of elementary mathematics are valid, why nonstandard methods can also be valid, and why other seemingly plausible ways of reasoning are not correct.... [T]eachers will come to organize their knowledge around the *key concepts and principles* of mathematics, so that they will be able to help their students do likewise. (p. ix, my emphasis)

Her intention is to organize the book around key ideas, and her book proceeds with an exposition of arithmetic built around operations. Jensen takes a different approach, organizing his book “in the old-fashioned style of definition, theorem, proof used in Euclid’s *Elements*” (p. viii). Parker and Baldrige tie their textbook directly to a textbook series for elementary students (the Singapore series), focusing on helping prospective teachers learn one clear and logical development of elementary mathematics, rather than covering every possibility. Wu writes that his book “says only what needs to be said, so you will have to read every line and try to understand every line. This monograph tells a coherent story, but the outline of the plot (the procedures) is already familiar to you. It is the details in the unfolding of the story (the reasoning) that are the focus of attention here” (chapter 1, p. 2).

Coherence

The second characteristic of the new textbooks that distinguishes them as a group is their mathematical coherence. This is closely related to the type of book, yet distinctive enough to merit separate consideration. In each of these three complete books, and in Wu’s partial book, the authors take a perspective on the mathematics that yields a *sense of mathematics as a discipline*.

For example, Beckmann approaches elementary mathematics through operations: rather than build up each number system separately, including the operations within each system, she defines and

develops addition and subtraction as the headline topic and develops the number systems within addition and subtraction. Then she does the same with multiplication and finally with division, from whole numbers to rationals. This allows for a focus on operations and their definitions, bringing to the fore how they are the same no matter what kind of numbers are involved. Research on mathematics education has long recognized that students have misconceptions about operations, for example, seeing multiplication of fractions as something different from multiplication of integers (Harel et al., 1994). Beckmann’s approach addresses this problem mathematically by providing uniform definitions of operations that apply across number systems.

Wu, in his two chapters, emphasizes the importance of starting from definitions and building a coherent mathematical system from those definitions:

The way mathematics works is to start with one clearly stated meaning (i.e., a precise definition) of a given concept, and on the basis of this meaning we explain everything that is supposed to be true of this concept (including all other meanings and interpretations) using logical reasoning. (Wu, Chapter 2, p. 9)

He is explicit about mathematical processes and practices, pointing to definitions as basic building blocks and showing how alternate definitions, models, or conceptions flow from the primary definition.

Parker and Baldrige build the mathematics through “teaching sequences” that start with basic concepts accessible to young children and increase in complexity while retaining mathematical integrity. In a way, these two books—Wu on the one hand, and Parker and Baldrige on the other—start at opposite ends of the mathematical terrain. Wu presents concise, accurate and final definitions, working backwards from them to show how other conceptions and models fit. Parker and Baldrige build up from the simple to the complex, in a progression actually found in K-8 classrooms (using the Singapore materials.) Both are coherent, accurate conceptions of the mathematics that give a sense of mathematics as a discipline, and as something that, above all, makes sense.

At the other extreme, a textbook might present mathematics as a collection of topics, each approximately equal in value, that are related by virtue of being called mathematics (or dealing with numbers and symbols). Although none of the twenty textbooks give an *incoherent* picture of mathematics, in some books there is a “flatness” (Cuoco, 2001) that makes it difficult to tell what is

important and how the pieces all fit together to make sense.

Rigor

Dictionary definitions of the word “rigor” suggest strictness and severity. But in mathematics, rigor is a virtue: it is correctness, completeness, sparseness and elegance all rolled into one. While implicitly recognizing that the standard of rigor is different from that for peer-reviewed mathematics journals, the mathematicians have written textbooks that aim for and achieve rigorous mathematics. They pay attention to definitions, logical development of topics, making connections across topics, and mathematical reasoning. These are *mathematics* textbooks in ways that some of the other books, written by nonmathematicians, are not.

Jensen’s book is perhaps the paradigmatic version of the rigorous mathematics textbook. He takes a definition/theorem/proof approach to the entire subject. Every procedure and algorithm is proved, starting from basic definitions. The other mathematicians’ books include some proofs, and all of them emphasize the importance of clear, consistent, and correct justification. They are often (although not always) explicit in trying to teach the prospective teachers about the importance of rigor and clarity in mathematics, portraying mathematics as an endeavor in which care and accuracy are both important.

In all four books, the authors emphasize, explicitly and implicitly, the importance of definition; of building from definitions to other representations, models, or alternative definitions; and of mathematics as a subject that makes sense. By contrast, in one of the encyclopedic textbooks, the author presents several alternative conceptions of fractions without providing a starting definition, and without showing how the different conceptions relate to each other and, in fact, define the same mathematical object. In the books by mathematicians, such mathematical sloppiness does not occur.

Claims

Finally, with the exception of Beckmann, the mathematicians make definitive claims in their books about the right ways to teach mathematics. Implicitly, every book makes such claims by virtue of its contents and rhetoric, but in these books, the claims are explicit.³

Where do their claims come from? All of these mathematicians have many years of teaching experience, and of course, many years of experience as mathematicians. They have all worked with prospective elementary teachers (and some have provided professional development to practicing

³ Note that claims and recommendations about teaching are common in instructor’s manuals that accompany other textbooks. The distinction here is that, in these books, the claims are an integral part of the mathematics text itself.

teachers). Thus, they draw on their own experience—as teachers and as mathematicians. Milgram (2004) in his recommendations for courses uses a program developed in Russia in the 1930s and 1940s that made its way to Israel and later China. This program was adopted for use in the Singapore texts (Hong, 1999), which Parker and Baldrige use extensively. “[W]e pay a great deal of attention to the way in which the Russian program develops the core concepts in mathematics during the early years, and we also reference the Singapore program extensively to learn about how the three topics [Shulman’s types of mathematical knowledge for teaching] are treated in countries where instruction in mathematics is successful” (Milgram, p. 9). Parker and Baldrige’s book is used in conjunction with five of the Singapore booklets and includes homework assignments in these books as well as examples taken directly from them. The argument of these authors is reasonable enough: we can deduce from successful programs what it takes to be successful, and we can extend that from teaching elementary students to teaching elementary teachers. Milgram writes,

The emphasis on precision of language and definitions matters most for exactly the most vulnerable of our students. It is these students who must be given the most careful and precise foundations. The strongest students often seem able to fill in definitions for themselves with minimal guidance. On the other hand, foreign outcomes clearly show that with proper support along these lines, all students can get remarkably far in the subject. (p. 10)

The logic of this argument is compelling, but it is a logical argument, not an empirical one. Research in mathematics education has made substantial contributions to our understanding of how children learn, what misconceptions they are likely to have, and other individual or psychological aspects of mathematics learning. More elusive in empirical research is how to turn these findings about learning mathematics into successful teaching across a wide range of students and teachers.⁴

Whatever their basis, the mathematicians make claims in ways that are not found in other books. Again, this may not be because they are mathematicians: the books with the most claims about teaching and learning—the Wu chapters, the Parker

⁴ It would be particularly interesting to know whether teachers who learn mathematics in the ways suggested by the mathematicians’ textbooks are more successful as mathematics teachers. This is exactly the kind of research that is missing, in part because it is very difficult to accomplish.

and Baldrige textbook, and the Milgram report—are all books that have avoided the editorial processes of a major publisher. One can imagine that editors deliberately depersonalize textbooks, taking out all kinds of personal ideas and even the “voice” of the author, especially as books are revised and reissued over time. And one can imagine that textbook publishers want to avoid controversial statements and edit out anything that touches on opinion.⁵

What are some of these claims? The following are taken from the books’ introductions and sections on fractions.

The best way to (develop an understanding of elementary mathematics at the level needed for teaching) is to study actual elementary school textbooks and to do many, many actual elementary school mathematics problems. (Parker and Baldrige, p. viii)

Spoken statements such as ‘2 fifths + 2 fifths = 4 fifths’ and ‘2 sevenths + 3 sevenths = ___ [sic] sevenths’ are immediately clear to children. (Parker and Baldrige, p. 135)

$$\frac{k}{l} + \frac{m}{n} = \frac{kL+mN}{A} \text{ where } A = nN = lL \quad (11)$$

The worst possible abuse is the use of (11)—with A as the lcm of n and l —as the definition of the addition of the two fractions $\frac{k}{l}$ and $\frac{m}{n}$... it is enough to point out that formula (11) is a pedagogical disaster when used as the definition of adding fractions.... Therefore there is no contest: one should never teach fractions using (11) as the definition of addition. (Wu, Chapter 2 p. 53)

Fractions are best introduced to students using dollars and cents, since these are objects of intense interest. ... Students should next be introduced to the area model for fractions... (Milgram, p. 27–28)

For these students [preservice elementary teachers], the key to learning this material is getting all the facts, expressed at the right level, with all the details, and at a pace slow enough to allow proper absorption. (Jensen, p. viii)

⁵ On the other hand, Beckmann (personal communication) reports that her publisher did not intervene in the content of her book in any way, suggesting no changes in style or content.

While none of these statements is necessarily false, they are each a kind of claim rare in other textbooks. A collection of such statements, taken from the books written by these mathematicians, could well define a research agenda for mathematics education. The rhetoric in these texts sometimes suggests that we know such things as empirical facts, while these assertions are more likely the opinions of the authors, arrived at through a combination of logical mathematical analysis of the topics, personal experience, and in some cases research from mathematics education or other third-party evidence.

Whether the claims made are true or false, justified or not, the point here is that the other books—by non-mathematicians—are less likely to contain these kinds of claims. It is possible that this is a rhetorical style familiar to mathematicians and that their “claims” are meant to be taken the way one takes mathematical claims—as subject to further consideration in the face of different assumptions or new evidence, but always stated in their strongest, most cogent form, and logically justified.

Unfortunately, we do not have conclusive empirical evidence about the best ways to teach or about the best ways for all students to learn. In fact, empirical studies are fraught with problems that make the possibility of drawing unqualified conclusions about “the best” ways to teach and learn unlikely. Such conclusions depend on too many uncontrollable variables: the particular students in the class and their particular mathematical backgrounds, the resources available in the classroom, the number of students, the grade level, etc. The assumptions one would need to make, the definitions of key ideas, and the “axioms” on which such deductions could be based would be extremely restrictive.⁶ Even if one could specify an “ideal” class, there is still the question of how we could know that a particular approach to a topic is best. As we will discuss below, even mathematicians do not agree on some very basic aspects of teaching mathematics.

Complexities

One of the interesting aspects of the mathematicians’ books is that they sometimes disagree about important mathematical ideas. At these points of disagreement, we have insight into some of the complexities of teaching mathematics to

⁶ For example, to draw conclusions about “the best” way to teach a topic, one might need to specify class size, teacher qualifications, students’ prior knowledge and preparation, length of the class period, characteristics of the (ideal) textbook or curriculum materials, and more. For each of these, definitions and valid measurement would be required.

elementary teachers. It is possible that if all these authors were in the same room they could agree about how to approach this mathematics, and of course, there is no mandate that there must be agreement on all things mathematical. But as written, the mathematics is different from book to book in ways that might matter to prospective elementary teachers. Here are some of the points on which the books differ, posed here as questions (taken from sections on the definition of fractions in each book). Keep in mind that these are textbooks addressed to elementary *teachers*, not to children.

1. How are fractions best defined? How is that choice of (primary) definition justified mathematically and/or pedagogically?

2. Should a distinction be made between fractions and rational numbers? If so, exactly how should each be defined?

3. Should a distinction be made between the concepts of equal and equivalent fractions?

4. Should teachers know alternative definitions of fractions? Part/whole? Set theory? Number line? Division? How can equivalence among different definitions or models best be illustrated and taught?

5. Is it important to distinguish between a symbol and what it stands for? If so, how do we do that for fractions?

6. Is it important to have a single definition for a mathematical concept—like fraction—and use it exclusively throughout the text? To what extent, and in what ways, can a definition change within the text? What terms or concepts can be used in a definition—that is, what can be taken as given in a definition?

7. What do teachers need to learn explicitly about the role of definition in mathematics, and what can (or should) be left implicit?

8. Do these students need to do formal proofs of things like rules for fractions? What do they need to understand about proofs in general?

9. Is it better to teach prospective teachers a single approach to fractions, or teach them all the different approaches they might see in the curriculum materials they are confronted with as teachers? Is the latter the purview of a mathematics course, or of a methods course?

The mathematicians' books—as well as the other books—differ in important ways with respect to these questions. In the next section, I illustrate differences in the definition of fractions, and discuss why it might matter that mathematicians do not come to the same conclusions when they think hard—and apply their own extensive experience as teachers and mathematicians—about the best ways to teach elementary mathematics to elementary teachers.

An Example: Defining Fractions

Three of the mathematicians' textbooks and the Milgram book define a fraction as a point on the number line with particular characteristics. One includes both a part/whole definition and a number line definition. One uses only a part/whole definition. Among the other sixteen books, the most common definition is similar to that in Billstein, et al (2003):

[N]umbers of the form a/b are solutions to equations of the form $bx = a$. This set, denoted Q , is the set of rational numbers and is defined as follows:

$$Q = \{a/b \mid a \text{ and } b \text{ are integers and } b \neq 0\} \text{ (p. 266)}$$

Although this may be a legitimate definition (depending on what has been previously defined), it is problematic: it assumes a definition of “number” and “equation”; it assumes knowledge of multiplying a fraction by a whole number; and it is quite removed from any definition that a teacher would be likely to use with a child.

What do the mathematicians do? The definitions given below are what the authors explicitly call the definition of fractions—all of the authors use other models in their complete exposition of fractions, but build on a fundamental definition. They all agree on, and make explicit, the importance of providing precise and rigorous definitions, not only for fractions but throughout their texts. The differences in their definitions raise interesting questions about what prospective teachers need to know and how they can learn it, as well as what a textbook author can assume in stating definitions.

Consider, for example, Milgram's definition of fractions (Milgram, p. 222):

[Positive fractions] will be numbers of the form $\frac{a}{b}$ where a, b , are whole numbers and $b \neq 0$, and their definition is as follows. Divide the segment from 0 to 1 into b equal parts, which in this context means b non-overlapping congruent subsegments (here “congruent” simply means two sub-segments can be made to coincide completely by sliding one on top of the other). Do this for the segment between 1 and 2, between 2 and 3, and so forth. These divisions create a special collection of points, namely, the totality of the endpoints of these smaller segments. The leftmost of these division points is 0, and the rest of them form an equi-spaced collection to the right of 0 and they include whole numbers. We now give names to these division points: starting with 0, the first

one to the right of 0 will be $1/b$. The second $2/b$, the third $3/b$, etc. In general, if a is any nonzero whole number, $\frac{a}{b}$ is the a -th of these division points to the right of 0.... The number $\frac{a}{b}$ is called the fraction with numerator a and denominator b .

In the middle of this is a definition of congruence that uses the idea of "sliding". It gives a mathematically correct, clear image of what it means for two segments to be congruent. One might wonder, however, whether these undergraduate students would understand why it is acceptable to use Milgram's explanation of congruence: "congruent" simply means two sub-segments can be made to coincide completely by sliding one on top of the other." For these students, this definition may create the impression that anything goes in a definition. It is mathematically quite sophisticated to know when such an explanation is acceptable as part of a definition (cf., Lakatos, 1987). If that is okay, why is it wrong to define congruent triangles in a similar way, or to prove congruence by cutting out the objects and placing them on top of one another? How is this different from proof by example? In geometry and other high school mathematics courses, students learn that examples do not prove; yet this definition seems, at a naïve level, to be based on an example. What is taken as given? What is already defined? It is not that his definition of fraction is unclear, but rather that it raises the question of what is mathematically acceptable in a definition, and how students can learn what constitutes a mathematically acceptable definition.

Wu's definition creates similar issues (Wu, p. 4).⁷

Definition. Let k, l be whole numbers with $l > 0$. Divide each of the line segments $[0,1], [1,2], [2,3], [3,4], \dots$ into l segments of equal length. These division points together with the whole numbers now form an infinite sequence of equally spaced markers on the number line (in the sense that the lengths of the segments between consecutive markers are equal to each other). The first marker to the right of 0 is by definition $\frac{1}{l}$. The second marker to the right of 0 is by definition $\frac{2}{l}$, the third $\frac{3}{l}$, etc., and the k th is $\frac{k}{l}$. The collection of the $\frac{k}{l}$'s for all whole numbers k and l , with $l > 0$, is called the fractions. The

⁷ Wu also uses the idea of "sliding" to determine the length of a segment and to check for congruence (e.g., Chapter 2, pp. 7 & 11). An anonymous reviewer pointed out, and Wu confirmed, that their two definitions are not independent. They worked together on the committee that led to Milgram's book.

number k is called the *numerator* of the fraction $\frac{k}{l}$ and the number l its *denominator*.

What does it mean to say: "These division points together with the whole numbers now form an infinite sequence of equally spaced markers on the number line (in the sense that the lengths of the segments between consecutive markers are equal to each other)"? Where do these new terms—infinite sequence, equally spaced markers, length of segments—come from and how do we know what they mean? Can we assume that a prospective elementary teacher will understand not just the words, but why they can be used as part of a rigorous definition of fractions? This is not to say that the definition is incorrect or ambiguous (although it could be ambiguous or even meaningless to someone with little mathematical background), only that the words seem rather magical. The textbook author knows when he can use undefined terms or physical analogies and which words and ideas can be taken as given, but does the student?

Beckmann uses a part/whole definition and first defines a fractional *quantity* (Beckmann, p. 58):

If A and B are whole numbers, and B is not zero, then the fraction $\frac{A}{B}$ of an object, a collection, or a quantity is the amount formed by A parts (or A copies of parts) when the object, collection, or quantity is divided into B equal parts.

She emphasizes use of the word "of" to call attention to the importance of the unit:

Notice the crucial word *of* in the examples of fractions of objects, fractions of collections of objects, and fractions of quantities... Fractions are defined in relation to a whole, and this whole can be just one object, or it can be a collection of objects, such as the cars on the road, or 24 houses. ...Students from elementary school through college can correct many mistakes in their work with fractions if they can identify the whole associated with a fraction. That is, they need to understand what the fraction is 'of'. (p. 59, emphasis in original)

This is an essential part of her definition, which she uses throughout the chapter on fractions. Later in the book, to define fractions as numbers on the number line, Beckmann begins with the following:

We create the notion of the whole numbers by abstracting from our experiences with objects. For example,

2 apples, 7 balls, 25 people,...

is really like saying (somewhat awkwardly)

2 of apple, 7 of ball, 25 of person,...

which abstracts to the following notion of number: 2, 7, 25,... In the same way, we create the following notion of fractions as numbers by abstracting from fractions of objects: 2/3 of a pie... [abstracts to] 2/3... but even when fractions are viewed abstractly as numbers, they are still "of a whole". Just as 5 is "five ones," so, too, $\frac{3}{4}$ is "3/4 of 1". (p. 77)

Insisting on consistency and use of the definition of fractions in defining all aspects of fraction arithmetic, Beckmann generates these admittedly awkward constructions, "2 apples" means "2 of apple", to reach the conclusion that a fraction is a number on the number line, the same way that whole numbers are numbers on the number line.

Jensen's definitions (he uses two definitions to define fractions and their values) are as follows (Jensen, pp. 91 & 190):

Definition 2.104. The fraction $\frac{m}{n}$ of an object is the amount obtained by dividing the object into n equal parts and taking m of these parts.

Definition 5.1. The fraction $\frac{p}{q}$ represents the point on the number line arrived at by dividing the unit interval into q equal parts and then going p of these parts to the right from 0. This point is called the value of the fraction. A *rational number* is the value of some fraction.

Is the distinction between a point on a number line, the value of that point, and the fraction it defines something a teacher needs to understand? None of the other mathematicians' books make this distinction. Instead, when using the number line, they treat fractions as numbers or points on the number line, and equivalent fractions as different names for the same numbers or points. Which is correct? Does it matter for elementary teachers?

Parker and Baldrige take a different approach, defining a fraction as a point on a number line, but with a relatively intuitive definition, then building up to that definition through the numerous models and definitions that appear in elementary curricula (Parker and Baldrige, p. 131):

A fraction is a point on the number line. For example, to locate $\frac{7}{5}$, we start at

0, find the step size so that 5 equal steps gets us to 1, and then take 7 such steps, landing at the points called $\frac{1}{5}, \frac{2}{5}, \frac{3}{5}, \dots$ until we get to $\frac{7}{5}$.

[An illustration of the number line divided into fifths up to seven-fifths follows.]

Following this definition, they begin with a part/whole model of fractions and work through a "teaching sequence" that leads to the conception of fraction as number. They too use a physical metaphor—creating equal steps—to envision a fraction as a point on the number line. Although the above definition is the first sentence in their chapter on fractions, it is not labeled "definition", and they do not have a place where they specifically designate a definition for fraction.

These differences in how fractions are defined may seem insignificant to some, and it is possible, perhaps likely, that each of these mathematicians would judge the others' approaches as correct even if not ideal. Yet the details and how they are addressed represent sophisticated mathematical issues and point to a fundamental mathematical problem that is replayed across the curriculum: How do we create definitions and starting assumptions that are both mathematically correct and at the same time comprehensible and unambiguous to this population of students (prospective elementary teachers)? Definitions require terms, and terms require definitions. Where do we start with students who may be mathematically unsophisticated at best? This is not a new problem. Mathematics at every level demands attention to undefined terms and first principles. What is new here is balancing the desired rigor of mathematics with the background knowledge of prospective elementary teachers to create a coherent, rigorous, and comprehensible mathematics curriculum for their mathematical education. These authors address the fundamental problem that elementary teachers themselves face: as elementary school teachers must connect children's naïve conceptions of mathematics to mathematics that is correct and comprehensible, so instructors of elementary teachers must connect not only to their own students' conceptions (and misconceptions) of mathematics, but also to the mathematics they are likely to teach to their K-8 students. The mathematical question for textbooks authors, and course instructors, is dual: 1) What is a correct mathematical approach to fractions (or some other topic); and 2) what does an elementary teacher need to know that will allow her correctly and rigorously to build a bridge between that mathematics and what a child can understand?

From the perspective of these students—undergraduates, nineteen or twenty years old whose mathematics background consists of three or so years of high school mathematics—these issues and the differences across these texts can be extremely confusing. Students arrive at their undergraduate mathematics courses with ideas about fractions based on their own elementary and secondary education. They have all seen definitions of fractions and rational numbers, probably multiple definitions, before they take these courses. Whatever definition they are taught needs to somehow cohere with, or correct, their prior knowledge, and help them understand fractions in a way that can be used with children (Ma, 1999). The same issue arises in every aspect of elementary mathematics. We want these students to develop what Ma calls “profound understanding of fundamental mathematics”, and yet it is not clear that every approach (in this example, every definition of fractions) makes an equal contribution to such understanding.

Conclusions

These recent books by mathematicians provide important insights into the mathematical education of teachers. In each book, the rigor and coherence, the careful approach to mathematics, the emphasis on definition, the portrayal of mathematics as something that, above all, makes sense combine to provide a view of mathematics as a discipline that is missing from encyclopedic textbooks. Yet these very characteristics create problems that may be inherent in trying to teach a complex, sophisticated subject to naïve learners. The problems with definition of fractions illustrate the complexity of this endeavor, and suggest that we have a long way to go before we reach conclusive answers to the questions of what mathematics we should teach prospective elementary teachers and how it should be presented.

Along with many other mathematicians, some of these authors believe strongly that if mathematics is clearly and correctly explained, prospective teachers can and will learn it. To them, the key is clear, correct, and timely explanations. Although it is certainly true, as Wu points out, that “if students are not taught correct mathematics, they will not learn correct mathematics” (Chapter 2, p. 2), there is no single “correct” version of this mathematics, and we do not know what confusion is generated over time by the small but significant differences in what teachers are taught. If there is any place to quarrel with these books or their authors, it is with claims that there is a single correct way to approach these topics and that the reason teachers have not learned more mathematics in the past is a failure on the part of their teachers to approach mathematics correctly. The

lessons from the books by mathematicians are that the mathematics of elementary school has deep and complex roots; that there are different and sometimes conflicting approaches to explaining this mathematics; and that there may be no perfect *mathematical* solution to the problem of how to teach this subject.

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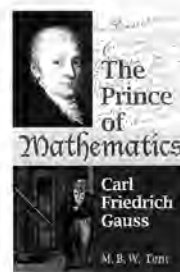
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a Quantum Group?

Shahn Majid

A quantum group is in the first place a remarkably nice object called a Hopf algebra, the axioms for which are so elegant that they were written down in the 1940s well before truly representative examples emerged from physics in the 1980s. So let us start with these elegant axioms, but with the caveat that it's the modern examples and their further structure that really make the subject what it is. A Hopf algebra H obeys the following axioms:

1. H is a unital algebra $(H, \cdot, 1)$ over a field k .
2. H is a counital coalgebra (H, Δ, ϵ) over k . Here the "coproduct" and "counit" maps $\Delta : H \rightarrow H \otimes H$ and $\epsilon : H \rightarrow k$ are required to obey $(\Delta \otimes \text{id})\Delta = (\text{id} \otimes \Delta)\Delta$ and $(\epsilon \otimes \text{id})\Delta = (\text{id} \otimes \epsilon)\Delta = \text{id}$.
3. Δ, ϵ are algebra homomorphisms.
4. There exists an "antipode" map $S : H \rightarrow H$ obeying $\cdot(\text{id} \otimes S)\Delta = \cdot(S \otimes \text{id})\Delta = 1\epsilon$.

There are three points of view leading independently to these axioms. Each of them defines what a quantum group is. For lack of space we will focus mainly on the first of these.

The first point of view starts with the observation that the functions $k(G)$ on a finite group or the coordinate algebra $k[G]$ of an algebraic group form Hopf algebras. For any finite set let $k(G)$ be the pointwise algebra of functions on G with values in k . We identify $k(G) \otimes k(G) = k(G \times G)$, i.e., functions in two variables. Then, when G is actually a group, we define for all $a \in k(G)$,

$$(\Delta a)(x, y) = a(xy), \quad (Sa)(x) = a(x^{-1}), \quad \epsilon(a) = a(e),$$

where e is the group unit element and $x, y \in G$ are arbitrary. We see that the group structure is encoded in the coalgebra Δ, ϵ and antipode S . Similarly, for every subset $G \subseteq k^n$ described by polynomial equations one has a "coordinate algebra" $k[G]$ defined as polynomial functions on k^n , modulo the ideal of functions that vanish on G . When k is algebraically closed we obtain in this way a precise (functorial) correspondence between such polynomial subsets and nilpotent-free commutative algebras with a finite set of generators. This is the basic setting of algebraic

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geometry. When the subset G forms a group and the group law is polynomial, the product map $G \times G \rightarrow G$ becomes under the correspondence an algebra homomorphism Δ going the other way. Likewise for the rest of the Hopf algebra structure. Two examples are as follows. The "affine line" is described by the coordinate algebra $k[x]$ (polynomials in one variable) with additive coproduct $\Delta x = x \otimes 1 + 1 \otimes x$ corresponding to addition in k . The reader can and should fill in the rest of the structure and verify that one has a Hopf algebra in fact for any field k . The "circle" is similarly described by the coordinate algebra $k[t, t^{-1}]$ (polynomials in t, t^{-1} with the implied relations $tt^{-1} = t^{-1}t = 1$) and multiplicative coproduct $\Delta t = t \otimes t$ corresponding to multiplication in k^* . Again, the reader should fill in and verify the rest of the Hopf algebra structure. Most familiar complex Lie groups are likewise defined by polynomial equations and have corresponding algebras $\mathbb{C}[G]$, as well as versions $k[G]$ defined over general fields with the same relations. Meanwhile, working over \mathbb{C} , a "real form" means the additional structure of a compatible complex-linear involution making the coordinate algebra into a $*$ -algebra. In this case one can denote the above two examples as $\mathbb{C}[\mathbb{R}]$ and $\mathbb{C}[S^1]$ when taken with $x^* = x$ and $t^* = t^{-1}$ respectively.

A general Hopf algebra H similarly has the structures Δ, ϵ, S but we do not assume that the algebra of H is commutative as it is in the above examples. This is the point of view of noncommutative geometry or "quantisation" in the mathematician's (but not physicist's) sense of a noncommutative deformation of a commutative coordinate or function algebra. Much of group theory and Lie group theory proceeds at this level; for example a translation-invariant integral $\int : H \rightarrow k$ (in a certain sense involving Δ), if it exists, is unique up to scale and does indeed exist in nice cases. Likewise the notion of a complex of differential forms $(\oplus_n \Omega^n, d)$ makes sense over any algebra H . At degree 1 the space Ω^1 of 1-forms is required to be an $H - H$ bimodule equipped with an operation $d : H \rightarrow \Omega^1$ obeying the Leibniz rule

$$d(ab) = (da)b + a(db), \quad \forall a, b \in H$$

and such that $\Omega^1 = HdH$. This is a bit weaker than in usual differential geometry even when H is

commutative because we do not demand that 1-forms commute with elements of H . When H is a Hopf algebra one can ask that Ω^1 is translation-invariant, again in a certain sense involving the coproduct Δ .

In this sense a “quantum group” is not merely a Hopf algebra but has additional structure analogous to that of a Lie group. The flavour of this deeper theory is visible already in the geometry of the line and the circle, even though these are commutative as algebras. For example, one may classify *all* simple translation-invariant differential structures (Ω^1, d) (those with no proper quotient). For $\mathbb{C}[x]$ they turn out to be labelled by $\lambda \in \mathbb{C}$ and of the form

$$da(x) = \frac{a(x + \lambda) - a(x)}{\lambda} dx, \quad dx a(x) = a(x + \lambda) dx$$

of a finite difference on any $a \in \mathbb{C}[x]$. Only the case where $\lambda = 0$ has dx commuting with functions, so only this case is seen in usual geometry. For $\mathbb{C}[t, t^{-1}]$ the translation-invariant (Ω^1, d) are classified by $q \in \mathbb{C}^*$ and have the form

$$da(t) = \frac{a(t) - a(qt)}{(1 - q)t} dt, \quad dt a(t) = a(qt) dt$$

of a “ q -derivative” on any $a \in \mathbb{C}[t, t^{-1}]$. These two examples indeed reflect the two main types of quantum group known today. The most famous example here is the “ q -deformation” quantum group $\mathbb{C}_q[SL_2]$ with generators a, b, c, d , and with relations and coproduct

$$\begin{aligned} ba &= qab, \quad bc = cb \\ ca &= qac, \quad dc = qcd, \quad db = qbd \\ da &= ad + (q - q^{-1})bc, \quad ad - q^{-1}bc = 1 \\ \Delta \begin{pmatrix} a & b \\ c & d \end{pmatrix} &= \begin{pmatrix} a & b \\ c & d \end{pmatrix} \otimes \begin{pmatrix} a & b \\ c & d \end{pmatrix} \end{aligned}$$

where matrix multiplication is understood (so $\Delta a = a \otimes a + b \otimes c$, etc.). One has similarly $\mathbb{C}_q[G]$ versions for all compact Lie groups G and their complexifications. For an easy example of the other “ λ -deformation” type try $\mathbb{C}_\lambda[\mathbb{R}^{1,3}]$ defined as the algebra with generators t, x_i where $i = 1, 2, 3$; relations $[x_i, t] = i\lambda x_i$; and an additive coproduct as for $\mathbb{C}[x]$ above. This is actually the enveloping algebra of a solvable Lie algebra (see below) but viewed as a noncommutative coordinate algebra. Measurements from NASA’s GLAST satellite in 2007 may be able to test if our own spacetime could be like this, with $\lambda \sim 10^{-44}$ seconds if the effect comes from quantum gravity. More nontrivial examples of this type are the “bicrossproduct” quantum groups to be mentioned later.

Our second point of view on what a quantum group is starts with the observation that the group algebra kG of any group and the enveloping algebra $U(\mathfrak{g})$ of any Lie algebra again form Hopf algebras, this time with a symmetric coproduct (their coalgebra is “co-commutative”). The group algebra over k of any group

G is simply the vector space with basis G and product that of G on basis elements, extended linearly. We also have

$$\Delta x = x \otimes x, \quad \epsilon x = 1, \quad Sx = x^{-1}$$

for all $x \in G$, extended linearly. Similarly, let $(\mathfrak{g}, [,])$ be a Lie algebra with $[,]$ the Lie bracket. An easy (but not very elegant) way to define $U(\mathfrak{g})$ is to choose a basis of \mathfrak{g} and let $U(\mathfrak{g})$ be the free associative algebra with the basis elements as generators and relations $vw - wv = [v, w]$ for all basis elements v, w . Everything is extended linearly so this equation also holds for all $v, w \in \mathfrak{g}$. The coproduct is the additive one $\Delta v = v \otimes 1 + 1 \otimes v$ on the generators. In these examples an action of the algebra kG or $U(\mathfrak{g})$ is equivalent to a linear action of the underlying group or Lie algebra, while Δ encodes the rule for how actions extend to tensor products. Likewise a general Hopf algebra H can be viewed as a “generalised symmetry” where an element $h \in H$ acts by Δh in the tensor product. This in turn is needed, for example, to specify what it means for another algebra to be covariant under H .

The most famous example here is $U_q(sl_2)$ with generators e, f, q^h, q^{-h} (the abuse of notation is conventional) and

$$\begin{aligned} q^h e q^{-h} &= q^2 e, \quad q^h f q^{-h} = q^{-2} f, \quad [e, f] = \frac{q^h - q^{-h}}{q - q^{-1}} \\ \Delta e &= e \otimes q^h + 1 \otimes e \\ \Delta f &= f \otimes 1 + q^{-h} \otimes f, \quad \Delta q^h = q^h \otimes q^h, \end{aligned}$$

We require $q^2 \neq 1$. One has similarly $U_q(\mathfrak{g})$ for all \mathfrak{g} defined by a symmetrisable Cartan matrix. These quantum groups have a rich algebraic structure leading to knot and 3-manifold invariants. Among the deepest theorems is the existence of the Lusztig-Kashiwara canonical basis inducing bases for highest weight modules, which is remarkable even in the classical case when $q \rightarrow 1$.

A third point of view is that Hopf algebras are the next simplest category after Abelian groups admitting Fourier transform. This point of view is responsible for the large class of “bicrossproduct” quantum groups of self-dual form. They are simultaneously “coordinate” and “symmetry” algebras, and truly connected with quantum mechanics. An example is $\mathbb{C}[\mathbb{R}^3 \rtimes \mathbb{R}]_\lambda \triangleleft U(so_{1,3})$ which is the Poincaré quantum group of the noncommutative spacetime algebra $\mathbb{C}_\lambda[\mathbb{R}^{1,3}]$ above. Here special relativity still applies but as a quantum group symmetry. At the same time this quantum group can be interpreted as the quantisation of a particle moving in a curved geometry with black-hole-like features.

Further reading

S. MAJID, *A Quantum Groups Primer*, L.M.S. Lect. Notes 292 (2002).

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Probability Theory: The Logic of Science

Reviewed by William G. Faris

Probability Theory: The Logic of Science

E. T. Jaynes

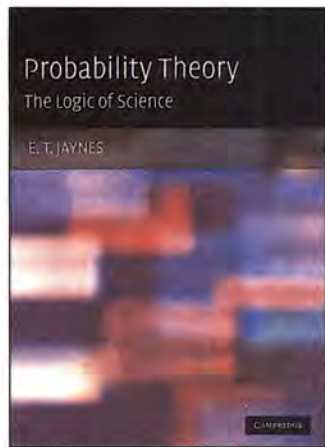
Edited by G. Larry Bretthorst

Cambridge University Press

Cambridge, 2004, \$70.00

xxix + 727 pages, ISBN 0-521-59271-2

Bayes's Theorem. Bayes's theorem is elementary probability; its application to the world involves a conceptual struggle of the first magnitude. Several hypotheses compete to explain the available experimental evidence. The data are accumulated; the evidence is at hand. Which hypothesis is indicated? The decision can be quite serious.



Here is an artificial but illuminating example. Two kinds of structural material are made. The good one is reasonably strong; the bad one fails considerably more often. A sample of material is delivered, but its composition is unknown. Thus there are two hypotheses: G that it is good, or B that it is bad. It is vital to know which hypothesis is true.

William G. Faris is professor of mathematics at the University of Arizona, Tucson. His email address is faris@math.arizona.edu.

The probability that the good material survives a crush test is known to be $P(S | G) = 5/6$. The probability that the bad material survives the same crush test is only $P(S | B) = 1/3$. The experimental fact is at hand: the sample passed the crush test. What can we say about the material?

To get some mathematics out of the way, here is Bayes's theorem in its most elementary form. (A more general version comes later in this review.) There are hypotheses θ with "prior" probabilities $P^H(\theta)$. For each hypothesis θ there is a conditional probability $P(x | \theta)$ for each data point x . The unconditional probabilities for the data points are then

$$(1) \quad P(x) = \sum_{\theta} P(x | \theta)P^H(\theta).$$

Bayes's theorem states that the "posterior" conditional probability of hypothesis θ given the observed data point x is

$$(2) \quad P^H(\theta | x) = \frac{P(x | \theta)P^H(\theta)}{P(x)}.$$

It is little more than the definition of conditional probability.

The theorem can also be written in terms of the normalized likelihood function $\hat{f}(x, \theta)$ defined by

$$(3) \quad P(x | \theta) = \hat{f}(x, \theta)P(x).$$

The Bayes result is then that

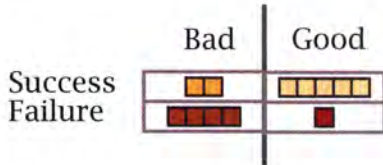
$$(4) \quad P^H(\theta | x) = \hat{f}(x, \theta)P^H(\theta).$$

Bayes's Theorem at a Glance

The Sample Distribution. A sample of material is Bad or Good; which one is not known. The result of a crush test is Success or Failure. The starting point is probabilities of Success or Failure given Bad or Good. In the example $P[S | B] = 2/6 = 1/3$ and $P[S | G] = 5/6$. The relative probabilities are indicated in the two graphs below:



The Joint Distribution. Suppose that the prior probabilities of the two hypotheses are equal, that is, $P^H[B] = 1/2$ and $P^H[G] = 1/2$. Then the combined graph gives equal weight to the two columns. This is shown below:



The Posterior Distribution. Bayes's theorem gives the probabilities for the hypotheses Bad and Good given Success or Failure. For example, $P^H[G | S] = 5/7$. The relative probabilities are indicated in the two graphs below:



Once the experiment has indicated Success or Failure, only one of these graphs is relevant.

—Bill Casselman and Bill Faris

The theorem says that the posterior probability of a hypothesis in light of the new evidence is obtained from the prior probability of the hypothesis by multiplication by the normalized likelihood function. This function incorporates the effect of the new evidence.

To apply this to the example, suppose that the two hypotheses good and bad have prior probabilities $P^H(G)$ and $P^H(B)$, which sum to one. The outcome was a success S . Does this indicate that the material is good? The theorem gives

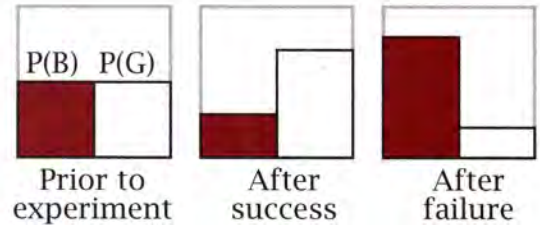


Figure 1. Crush test. The Bayes prior distribution with two possible Bayes posterior distributions. After the experiment only one of the two remains relevant.

$$(5) \quad P^H(G | S) = \frac{\frac{5}{6}}{\frac{5}{6}P^H(G) + \frac{1}{3}P^H(B)}P^H(G).$$

This is tempting. Can we argue, for instance by symmetry, that $P^H(G) = P^H(B) = \frac{1}{2}$? If so, then $P^H(G | S) = \frac{10}{7} \cdot \frac{1}{2} = \frac{5}{7}$. The new evidence that the sample passed the test made it much more likely that the material is good. This seems satisfying and exact. There is a nice picture, given in Figure 1.

The real problem in this analysis is of course with the assignment of the prior probabilities. Should they come from experiment, from general previous experience, or from subjective judgement? Can they be the result of pure reason, as suggested by the symmetry argument? Or should they be regarded as a mere technical device for directing a practical decision? This problem has a long history, and its status is still controversial.

Laplace's Law of Succession. In a passage in his *Théorie Analytique des Probabilités* (1812) Laplace calculated the probability that the sun will rise tomorrow, given that it has risen every day for the past 5,000 years. If one considers 5,000 years to be $n = 1,826,213$ days, then his probability is $(n + 1)/(n + 2) = 1,826,214/1,826,215$, enough to give considerable reassurance.

Here is one way to think of his calculation. Consider a Solar System. Each day it flips a biased coin with probability θ of heads to decide whether to have the sun rise. So given this Solar System, the probability that the sun will rise tomorrow is θ itself, quite independent of whatever has happened before.

Laplace asked: What if we know that we are in a Solar System where the sun has already risen n days in a row? A first thought might be that θ is the value that makes this most likely to happen. This would imply that $\theta = 1$. However, for Laplace this answer seemed to express almost too much confidence in what, after all, is a limited amount of data.

Here is one possible line of reasoning that Laplace could have used. A Solar System Construction Utility has created a huge (perhaps infinite) number of Solar Systems that have various values of θ . Furthermore, these values are evenly spread over the unit interval. Whether the sun rises

tomorrow depends on which Solar System is taken and on how the corresponding coin flip turns out. Without any further information we would say that this probability is $1/2$, because when we look at all Solar Systems and all corresponding coin flips, the fraction with heads is the same as the fraction with tails. But not every Solar System has experienced n days in a row where the sun rose. Knowing that we have such a Solar System gives us useful information. With this extra information the values of θ are not spread out uniformly any more; in fact, they are concentrated rather near (but not equal to) $\theta = 1$. What then is the probability of the sun rising tomorrow for this restricted class of Solar Systems? To find this, look at the fraction of these Solar Systems and corresponding coin flips for which the result is heads. Since in most of these Solar Systems the θ is very close to one, the fraction is itself very close to one. Laplace's calculation showed that it is $(n + 1)/(n + 2)$.

Laplace did not need to believe in multiple Solar Systems to make his argument. Another possible interpretation of the same mathematics is that there is only one Solar System. An initial state of ignorance is followed by increasing knowledge at each sunrise. In this view the probability calculation is an indication of the current state of knowledge.

Some have considered Laplace's argument absurd, but E. T. Jaynes, the author of the book under review, regards the technique as important and useful and defends Laplace against his critics. He admits that Laplace's choice of example is unfortunate, but he quotes Laplace himself stating that this particular calculation omits relevant information from celestial mechanics. As for the 5,000 years, Jaynes writes in a footnote (p. 564):

Some passages in the Bible led early theologians to conclude that the age of the world is about 5,000 years. It seems that Laplace at first accepted this figure, as did everyone else. But it was during Laplace's lifetime that dinosaur remains were found almost under his feet (under the streets of Montmartre in Paris), and interpreted correctly by the anatomist Cuvier. Had he written this near the end of his life, we think that Laplace would have used a figure vastly greater than 5,000 years.

A more mathematical derivation of the Laplace "law of succession" is as follows. Suppose the probability that the sun will rise each day is θ , and given this θ the events for different days are independent. Consider a sequence of n consecutive days. A day counts as a success if the sun rises that day. The probability of success on a certain specified subset of r days and failure on the remaining

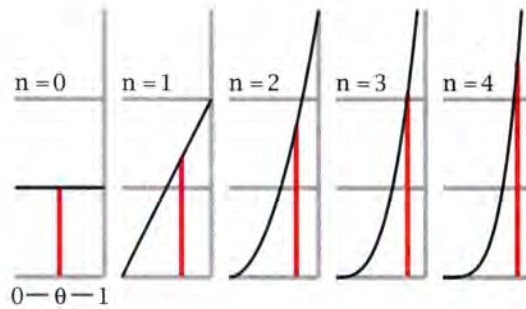


Figure 2. Sunrises. According to Laplace, each day the sun rises the distribution for the probability of another sunrise moves to the right and becomes more peaked near one.

$n - r$ days is $\theta^r(1 - \theta)^{n-r}$. Suppose (with Bayes and Laplace) that this θ is random and uniformly distributed on the unit interval. That is, the prior measure expressing the state of ignorance is $d\theta$. The joint probability for a particular pattern x and a particular probability near θ is the product $\theta^r(1 - \theta)^{n-r} d\theta$, where r is the total number of successes. Given the extra information of a particular pattern x with exactly r successes, the conditional probabilities for θ are calculated with

$$(6) \quad dP^H(\theta | x) = \frac{\theta^r(1 - \theta)^{n-r}}{\int_0^1 \theta^r(1 - \theta)^{n-r} d\theta} d\theta = \frac{1}{B(r + 1, n - r + 1)} \theta^r(1 - \theta)^{n-r} d\theta.$$

The constant $B(r + 1, n - r + 1)$ is the conventional notation for the value of the integral in the denominator; it ensures that $dP^H(\theta | x)$ defines a probability measure. So given the historical information, the probability of yet one more sunrise is

$$(7) \quad \int_0^1 \theta dP^H(\theta | x) = \frac{1}{B(r + 1, n - r + 1)} \times \int_0^1 \theta^{r+1}(1 - \theta)^{n-r} d\theta = \frac{r + 1}{n + 2}.$$

In the example of Laplace the sun rose each of the n days, so $r = n$. The picture for this case is given in Figure 2.

A main objection to Laplace's calculation was to his use of prior probability to express knowledge (or ignorance). If the probability of the sun rising tomorrow belonged to a sequence of numbers in the unit interval generated by a well-constructed random number generator (the Solar System Construction Utility), then there would be no problem. But here it seems to be a case of probability without a frequency interpretation.

Frequency Versus State of Knowledge. The mathematical theory of probability is consistent independent of any interpretation. However, many consumers of this theory regard *probability* as a mathematical construct that predicts *frequency*.

Frequency in this context means relative frequency or sample proportion, the number of successes divided by the total number of trials. The law of large numbers (which models the situation where the number of trials is large) shows that this interpretation has internal consistency.

Jaynes considers the frequency interpretation of probability as far too limiting. Instead, probability should be interpreted as an indication of a state of knowledge or strength of evidence or amount of information within the context of inductive reasoning. The foundation of his discussion is an axiomatic derivation (following R. T. Cox) of rules of inference for degrees of plausibility. At one point he suggests that instead of using a probability p in the interval $[0, 1]$, one could use an odds ratio $p/(1-p)$ in the interval $[0, +\infty]$, or even a measure of evidence $\log(p/(1-p))$ in the interval $[-\infty, +\infty]$. In the Laplace example, where the odds ratio is $n+1$ with n well above a million, the evidence $\log(n+1)$ (using base 10) would be above 6 bels (60 decibels). Such a number represents extremely strong evidence.

Furthermore, he argues that probability as empirical frequency hardly ever occurs in a pure form. Thus he writes (p. 337):

In most recent treatments of probability theory, the writer is concerned with situations where a strong connection between probability and frequency is taken for granted—indeed, this is usually considered essential to the very notion of probability. Nevertheless, the existence of such a strong connection is clearly only an ideal limiting case, unlikely to be realized in any real application. For this reason, the laws of large numbers and limit theorems of probability theory can be grossly misleading to a scientist or engineer who naively supposes them to be experimental facts, and tries to interpret them literally in his problems.

The goal of his presentation is to blur the distinction between probability theory (where one goes from the mathematical model to data) and statistical inference (where one goes from data to a mathematical model). Each probability value is to be a conditional probability of an event given other events. The emphasis is on discrete probabilities. The purpose of such a probability is to express a "judgement", not a physical fact (p. 86). All existing evidence must be taken into account, and when there is little existing evidence one must use prior probabilities for the hypotheses that express this ignorance. The fundamental tool in statistical inference is Bayes's theorem, which gives a method of passing from the conditional probability of data

given a hypothesis to the conditional probability of a hypothesis given the data. In his view, there are heroes (R. T. Cox, H. Jeffreys) and villains (R. A. Fisher and subsequent frequentists). The tone is polemical.

Jaynes is not the first writer to make such an argument; it is typical of many Bayesian statisticians. However, his background was not in statistics, but in physics. As a physicist he was prominent in a number of areas; in particular he is noted for promoting the method of maximum entropy, a technique for assigning prior probability distributions in order to reason about physical systems about which one has incomplete information. This led him to a more general interest in Bayesian inference and to the project of writing a book on the subject that would serve both as a reference and as a text book. At the time of his death in 1998 the book was partially finished, with some chapters still missing. The manuscript was edited by G. Larry Bretthorst, and now it appears as a published book of well over seven hundred pages. It should be mentioned that Bayesian statistics is not a new subject: it is treated in many other books (for instance [4] or the more advanced [1], [3]).

Maximum Likelihood Parameter Estimation.

Laplace's calculation may seem frivolous, but consider the following example. A disease has jumped from an animal host to humans. An international health conference is convened to recommend action. The participants need to know the survival rate (survival probability) to high accuracy in order to make further decisions. This rate is a number between 0 and 1; these numbers constitute a set of infinitely many hypotheses. The existing sample of infected humans is rather small, of size only $n = 16$. Of these a certain number r survived. This experimental number should be available in a few hours. What is the appropriate estimate, based on this evidence, of the survival rate from this disease in humans? There is no time to collect new evidence; only one day is left to evaluate the existing data.

The most obvious answer is the sample proportion r/n . It turns out, however, that this is not the only possible answer. This raises the question of how one justifies such a calculation.

The framework for a discussion of such issues is a situation where there are a number of possible *parameter* values or hypotheses. For each parameter value θ there is a probability measure $P(\cdot | \theta)$, representing the probabilities for various sets of *data* values. This is ordinarily called the *sample distribution*. The question is how to use the data to estimate the parameter. In the example each parameter value is a number θ between zero and one. This is the unknown survival rate. The data point x is the pattern of survival and loss; it has 2^n possible values, each 1 or 0. In what follows the only function of the data that matters is $r = \sum x$,

the number of survivors out of the n patients in the sample. Figure 3 shows the probabilities of the possible r/n values as determined by the sample distribution.

Here is one inference procedure that is simple, universal, and works reasonably well in many practical situations. For fixed θ consider the density of $P(\cdot | \theta)$ with respect to some reference measure Q on the data space, so

$$(8) \quad dP(x | \theta) = f(x, \theta) dQ(x).$$

For each parameter value θ this density $f(x, \theta)$ is a function of the data value x . Alternatively, for each data value x one may consider $f(x, \theta)$ as a function of the parameter value θ ; this is called the *likelihood function*. It is uniquely determined up to a factor that depends only on x . The procedure is to take the actual data, compute the parameter value that maximizes the likelihood function, and use this for the estimate of the true parameter value.

In the example the probability of survival for each patient is θ , and the probability of death is $1 - \theta$. The likelihood function defined with respect to counting measure on the 2^n possible outcomes is

$$(9) \quad f(x, \theta) = \theta^r (1 - \theta)^{n-r},$$

where $r = \sum x$ is the number of survivors. It is easy to see that the maximum likelihood value of θ is r/n , the sample proportion.

Bayes Theory. The new ingredient in Bayes theory is the *Bayes prior distribution*, a probability measure P^H on the parameter space. It is assumed given before the current experiment is performed. (This measure could also be called the *unconditional parameter distribution*.) With this marvelous object one can construct other useful quantities. There is a new probability measure P for the data, called the *Bayes unconditional data distribution*. This is obtained by averaging the sample distribution with respect to the Bayes prior distribution. In this context, the sample distribution $P(\cdot | \theta)$ could be called the *conditional data distribution*. There is a *normalized likelihood function* \hat{f} . This is a function of the data variable x and the parameter variable θ . It is defined by

$$(10) \quad dP(x | \theta) = \hat{f}(x, \theta) dP(x).$$

In the language of measure theory $\hat{f}(\cdot, \theta)$ is the density or Radon-Nikodym derivative of the conditional data distribution $P(\cdot | \theta)$ with respect to the unconditional data distribution P .

The most important object in Bayesian analysis is the *Bayes posterior distribution*. This could also be called the *conditional parameter distribution*. It is the distribution of the parameters given the data, and it represents the updated account of what is known after the experimental results are

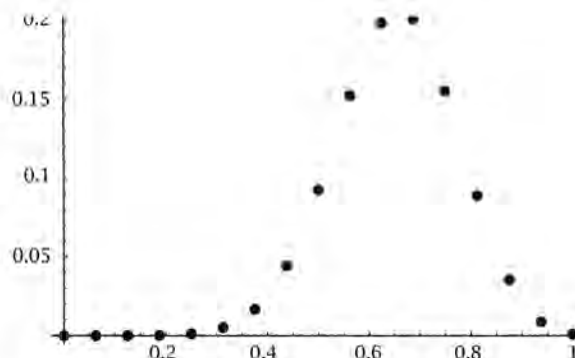


Figure 3. Distribution of the sample proportion. In this example the parameter value is $\theta = 0.65$, and the sample size is $n = 16$. The plot shows the probabilities associated with each value of r/n , for $r = 0, 1, 2, \dots, n$. These are computed from the binomial distribution. For each value of θ between 0 and 1 there is a corresponding such plot. The method of maximum likelihood says to choose the value of θ that makes the experimental result most probable.

in. Mathematically, it is a family of probability measures $P^H(\cdot | x)$ on the parameter space that give conditional probabilities for fixed data values x . *Bayes's theorem* says that the Bayes posterior distribution is given by multiplying the Bayes prior distribution by the normalized likelihood function. That is, the posterior probabilities given the data x are given by integrating

$$(11) \quad dP^H(\theta | x) = \hat{f}(x, \theta) dP^H(\theta).$$

Thus $\hat{f}(x, \cdot)$ is the density or Radon-Nikodym derivative of the conditional parameter distribution $P^H(\cdot | x)$ with respect to the unconditional parameter distribution P^H . This remarkable result is named after the Reverend Thomas Bayes, who presented a version of it in 1763.

One version of Bayesian statistical inference is the following. Acquire somehow on the basis of experience or intuition an appropriate Bayes prior distribution P^H . Perform the experiment and acquire the actual data x . The final (or updated) product is the Bayes posterior probability distribution $P^H(\cdot | x)$ corresponding to the data. This summarizes the revised state of knowledge and can be used however one wishes.

Bayes Decision Theory. Decision theory is another ingredient in statistical inference. The idea is to be explicit about actions and their consequences. There is a set of *actions*. In *estimation* this may consist of the values of certain parameter components, while in *hypothesis testing* it may be a set with as few as two points. There is also a *loss function* L that takes as inputs an action a and a state of nature θ and calculates a corresponding loss $L(a, \theta)$. This loss function may be measured crudely in dollars, or perhaps better in some sort

of utility units. Finally, a statistical inference procedure is a *decision function* δ from data values to possible actions. Thus decision theory moves from statistical inference as a way of gaining knowledge toward statistical inference as a guide to practical action, taking into account the economic consequences.

It is not difficult to combine Bayes theory and decision theory. Jaynes seems to be willing to do this, though with some reluctance. The procedure is simple. First look at the data x . Then consider the *Bayes posterior risk*

$$(12) \quad r_x(a) = \int L(a, \theta) dP^H(\theta | x)$$

of action a . The Bayes decision $\delta(x)$ is the a that minimizes this quantity. Its risk is then $r_x(\delta(x))$.

The Bayes posterior risk of action a given data x may be written explicitly as

$$(13) \quad r_x(a) = \int L(a, \theta) \tilde{f}(x, \theta) dP^H(\theta).$$

For the purposes of finding the Bayes decision $\delta(x)$ by minimization one can replace the normalized likelihood function $\tilde{f}(x, \theta)$ by any other likelihood function $f(x, \theta)$, in particular one that is defined independent of the Bayes prior distribution. Then the Bayes prior distribution P^H enters only in combination with the loss function $L(a, \theta)$ as the product $L(a, \theta) dP^H(\theta)$. As we shall see below, Jaynes has vigorous comments on this point.

Bayes Versus Frequentist. A frequentist might have no problem using a Bayes decision function δ . However, in this view the Bayes prior distribution P^H is merely a convenient way of selecting the δ . As an index of performance, the natural object is the *risk function* of the decision procedure δ given by

$$(14) \quad R_\delta(\theta) = \int L(\delta(x), \theta) dP(x | \theta).$$

This makes no reference either to the Bayes prior distribution or to actual experimental results.

A critic might ask: Why show me a risk function defined by a sum or integral over all data values, when you already have the actual data at hand? The frequentist answer is that the risk function shows how the procedure works in the long run, in all possible circumstances. One neither knows the actual circumstance, nor whether today's experiment gave an appropriate decision. A statistician can at best hope to do well most of the time, but on each individual experiment fate works its will.

The decision function δ maps data to actions. Suppose that there is also a reasonable estimation function δ' from data to parameters. (If the action space is the parameter space, then δ may serve as δ' .) Then the frequentist statistician can estimate the risk for the particular experimental data x at

hand by reporting the number $R_\delta(\delta'(x))$. This experimental number attempts to describe the risk of the decision; it may well differ from the Bayes posterior risk of the same decision.

One would think that natural selection would have eliminated one of the schools of statisticians by now. Why has this not happened? A mathematical identity may provide a clue. It says that the average of the Bayes posterior risk over all data values is the average of the frequentist risk over all parameter values. Thus

$$(15) \quad \int r_x(\delta(x)) dP(x) = \int R_\delta(\theta) dP^H(\theta).$$

Perhaps if the priors are not too crazy, then the two risk estimates are roughly compatible.

Bayes Parameter Estimation. Return to the example of the patients with the new disease. This example is so simple that it does not fairly represent Bayesian statistics or indeed statistical inference in general, but it illustrates some of the issues.

The unknown parameter is a number θ between zero and one. This is the survival rate for humans in general. The experimental sample consists of n patients. For each patient survival is indicated by 1 and death by 0, so the data vector x consists of a list of n values, each 1 or 0. The task is to use the data to estimate the parameter θ and to present this estimate to the health conference.

Decision theory needs a loss function. Economics experts assisting in the preparation of the conference have concluded that the problem at hand is an estimation problem with loss function $L(a, \theta) = (a - \theta)^2$. One might suspect that this choice may be more for mathematical convenience than the result of a deep analysis of the consequence of error. However it allows the analysis to proceed.

Suppose that there is prior information that the human survival rate for new diseases that jump from animal hosts is usually above 50 percent. In fact, a survival rate of about 75 percent might be reasonable, but this is not a firm figure. One simple device for arriving at a Bayes prior distribution that is mainly distributed above 50 percent is to consider that it would have about as much influence on the final result as if the sample size were increased by $m = 8$ and the number of successes were increased by $s = 6$. Of course there is no claim that there was ever an actual sample of size $m = 8$ with $s = 6$ successes. This is just a device for defining a Bayes prior distribution that is centered near 75 percent (since $s/m = 6/8 = 0.75$) but has considerable spread (since m is so small).

The mathematical representation of this distribution is

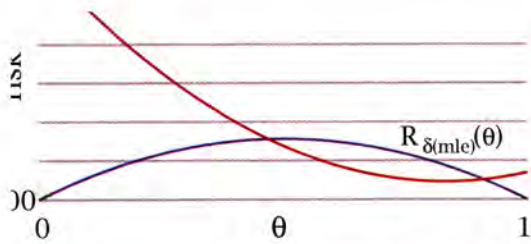


Figure 4. Procedures for estimating survival rates. Risk functions for the maximum likelihood estimator and for a Bayes estimator. One is less risky than the other?

$$dP^H(\theta) = \frac{1}{B(s, m-s)} \theta^{s-1} (1-\theta)^{m-s-1} d\theta.$$

where θ is where this comes from. Complete ignorance is expressed by a distribution proportional to $\theta^{-1}(1-\theta)^{-1}$. (Never mind that this starting point is not a probability distribution.) Each success adds one more power of θ , and each failure adds one more power of $(1-\theta)$. The normalization constant makes this a measure with total probability one, at least when s and $m-s$ are both greater than zero. This particular prior distribution is convenient mathematically, and it is indeed spread out over the required range of parameter values.

The effect of the experimental data is captured by the normalized likelihood function, which in this case is

$$\hat{f}(x, \theta) = \frac{B(s, m-s)}{B(r+s, n+m-s)} \theta^r (1-\theta)^{n-r},$$

where $r = \sum x$ is the number of successes. The Bayes posterior distribution is the product of the normalized likelihood function with the Bayes prior distribution, that is,

$$dP^H(\theta | x) = \frac{1}{B(r+s, n+m-s)} \theta^{r+s-1} (1-\theta)^{n+m-r-s-1} d\theta.$$

This posterior distribution incorporates more information and therefore is more concentrated than the prior distribution. The Bayes estimate of θ (under squared error loss) is the conditional mean of the Bayes posterior distribution, which is given

$$\delta(x) = \frac{r+s}{n+m} = \frac{n}{n+m} \frac{r}{n} + \frac{m}{n+m} \frac{s}{m},$$

where again r is the number of successes in the data x . Indeed, it says to act as if the sample size were increased by m and the number of survivals were increased by s . This gives a combination of the maximum likelihood estimate r/n and the non-experimental ratio s/m .

Even a frequentist may use such an estimator. From this point of view it is reasonable to look at the risk function R_δ , perhaps forgetting that the particular estimator δ has Bayesian origins. The advantage of considering the risk function is that it makes no reference to the Bayes prior distribution or to the experimental data values. With squared error loss this risk function is the sum of the variance with the square of the bias:

$$R_\delta(\theta) = \frac{n^2}{(n+m)^2} \frac{\theta(1-\theta)}{n} + \frac{m^2}{(n+m)^2} \left(\theta - \frac{s}{m}\right)^2. \quad (20)$$

The frequentist may consider various possible choices for the m and s (with fixed sample size n) that define the estimator. The problem is that one is not clearly better than the other. Less risk for one range of θ values is compensated by more risk at other θ values, and θ is unknown. However, if n is large enough, then perhaps at least one of the risk functions is acceptable to the frequentist. For sample size $n = 16$ the maximum likelihood risk function ($s = 0, m = 0$) is contrasted with the Bayes risk function ($s = 6, m = 8$) in Figure 4. The Bayes risk function has less risk in the range of θ values that the Bayesian considers most probable, but more risk elsewhere. These are not the only possibilities. A frequentist worried about the worst that could happen might prefer the estimator with $s/m = 1/2$ and $m = \sqrt{n}$, since it has constant risk.

In the example the sample size is $n = 16$, so the decision function that gives the Bayes estimate is $(r+s)/(n+m) = (r+6)/(16+8) = (r+6)/24$. This is a biased estimate, but that may be just what is needed. In fact, the Bayesian might argue that it is better to bias the result from the sample proportion toward the prior value of 0.75. After all, if the new findings deviate greatly from this, an experienced observer might well suspect a misleading run of bad luck in a relatively small sample. In short, it is foolish to ignore relevant evidence.

If the prior hypothesis of something like an average 75 percent survival rate is even roughly correct, then using it to bias the estimate toward this value is perhaps quite helpful. However, if the new disease, unlike its predecessors, is highly fatal (θ near zero), then the use of the prior hypothesis could lead to a nasty bias in the wrong direction. Has anyone thought of this possibility? What is the actual situation? Nobody knows for sure, and, in our scenario, the decisive meeting is just hours away. Suppose the decision is to use the particular Bayes estimate at hand, as the best way of updating what one hopes is the best available information.

The experimental result just came in. The data for the sixteen patients are

$$(21) \quad x = (1, 0, 0, 0, 1, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0).$$

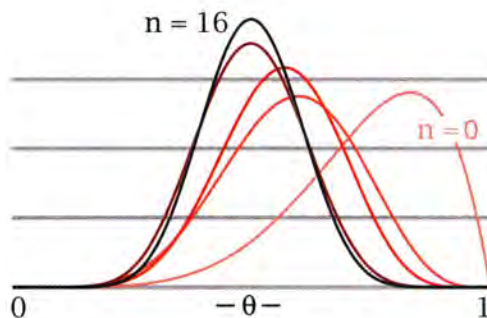


Figure 5. Disease survivors. As information on the seriousness of the disease accumulates, the Bayes distribution for the chance of survival becomes more peaked and moves to the left. Posterior distributions are shown for $n = 4, 8, 12, 16$.

There are only $r = 6$ survivors out of the 16 patients, so the Bayes estimate of the population survival probability is $12/24 = 0.5$. This is considerably above the maximum likelihood estimate $6/16 = 0.375$, but, given the assumptions, it is the best combination of prior knowledge and new evidence.

The prior distribution centered at 0.75 and posterior distributions that reflect accumulating evidence are shown in Figure 5. The final posterior distribution is centered at 0.5, well above the experimental proportion of 0.375, but reflecting its influence.

Ignorance Priors. Since the work of A. Wald relating Bayesian theory to decision theory there is not much dispute about whether Bayesian methods are reasonable; clearly in many cases they are [2]. The misgivings are about the interpretation of the prior probability measure P^H in circumstances when it has no natural frequency interpretation. There are really two problems: How to choose the prior? In what sense is the choice correct?

Jaynes reviews several proposals for how to choose the prior. In the case of complete ignorance one should look for *group invariance* to choose the prior. Thus, for instance, in the case of a location parameter θ_l this would be a multiple of $d\theta_l$, while in the case of a scale parameter $\theta_s > 0$ this would be a multiple of $d\theta_s/\theta_s$. The problem that these are not probability measures may be overcome by various devices.

In the case of the unit interval a natural prior for θ with $0 < \theta < 1$ is given by taking the evidence $\theta_l = \log(\theta/(1 - \theta))$ as a location parameter, so that a multiple of

$$(22) \quad d\theta_l = \frac{1}{\theta(1 - \theta)} d\theta$$

is the preferred choice.

This, by the way, is not the choice made by Laplace. He avoided the maximum likelihood esti-

mator r/n , perhaps on the ground that a run of $r = n$ sunrises should not suggest that the sun will certainly rise. Instead his estimator was $(r + 1)/(n + 2)$. Laplace was using the Bayes prior $d\theta$ for which there is a prior bias toward $1/2$ as strong as that which would come from a sample of size 2. That is, equation (6) corresponds to equations (16) and (18) with $s = 1$ and $m = 2$.

Say that there there is already a non-informative prior P^H , presumably a uniform distribution determined by group invariance. One wants to incorporate additional information to the effect that a certain quantity h has specified expectation equal to E . The statistician needs a new prior P_β^H such that

$$(23) \quad \int h(\theta) dP_\beta^H(\theta) = E.$$

Jaynes argues that the least informative such P_β^H is given by the *maximum entropy* principle. The result of using this principle is that

$$(24) \quad dP_\beta^H(\theta) = \frac{1}{Z_\beta} e^{-\beta h(\theta)} dP^H(\theta).$$

For each fixed β the constant Z_β is chosen so that P_β^H is a probability measure. The constant β is then to be chosen so that the expectation is equal to E . It is no accident that such formulas are fundamental in equilibrium statistical mechanics. In that context $h(\theta)$ is the energy of configuration θ , while β is inversely proportional to the temperature, and E is the expected energy corresponding to equilibrium at the given temperature.

The obvious objection is that there may be no group invariance available to determine the prior expressing total lack of information. Furthermore, whether or not there is group invariance, there is a general question of how to justify a method of choosing the Bayes prior distribution.

Jaynes discusses writers who are reluctant to introduce the notion of prior probability. He states (p. 419):

But these same writers do not hesitate to pull a completely arbitrary loss function out of thin air, and proceed with the calculation! Our equations show that if the final decision depends strongly on which prior probability assignment we choose, it is going to depend just as strongly on which particular loss function we use. If one worries about arbitrariness in the prior probabilities, then, in order to be consistent, one ought to worry just as much about arbitrariness in the loss functions. If one claims (as sampling theorists did for decades and as some still do) that uncertainty as to the proper choice of prior probabilities invalidates the Laplace-Bayes theory,

then, in order to be consistent, one must claim also that uncertainty as to the proper choice of loss functions invalidates Wald's theory.

Jaynes admits that there has been work on the problem of determining loss/utility functions. However he claims (p. 420):

Such constructions, if one can transfer them into a computer, will be better than nothing; but they are clearly desperation moves in lieu of a really satisfactory formal theory such as we have in the principles of maximum entropy and transformation groups for priors.

He even argues that "a change in prior information which affects the prior probabilities could very well induce a change in the loss function as well" (p.424). In a footnote he gives a literary illustration:

Quasimodo, condemned by an accident of Nature to be something intermediate between man and gargoyle, wished that he had been made a whole man. But, after learning about the behavior of men, he wished instead that he had been made a whole gargoyle: 'O, why was I not made of stone like these?'

Opinions. Jaynes has little patience with measure theory and scant interest in stochastic processes. For instance, he states that "those who persist in trying to calculate probabilities conditional on propositions of probability zero, have before them an unlimited field of opportunities for scholarly research and publication—without hope of any meaningful and useful results" (p. 485). This is consistent with the fact that he sees little use for the terms "sigma-algebra, Borel field, Radon-Nikodym derivative" (p. 676). As for stochastic processes, he asserts that "the most valuable applications of probability theory are concerned with incomplete information and have nothing to do with those so-called 'random phenomena' which are still undefined in theory and unidentified in Nature" (p. 709). Clearly his book is not the place to learn modern probability theory.

The central thesis of the book occurs in the following passage (p. xxii):

Our theme is simply: *probability theory as extended logic*. The 'new' perception amounts to the recognition that the mathematical rules of probability theory are not merely rules for calculating frequencies of 'random variables'; they are also the unique consistent rules for conducting inference (i.e. plausible

reasoning) of any kind, and we shall apply them in full generality to that end.

For the author, "maximum entropy is the appropriate (safest) tool when we have little knowledge beyond the raw data" (p. xxiv). Another passage summarizes his view of the role of uniform or maximum entropy priors (p. xxiv):

Bayesian and maximum entropy methods differ in another respect. Both procedures yield the optimal inferences from the information that went into them, but we may choose a model for Bayesian analysis; this amounts to expressing some prior knowledge—or some working hypothesis—about the phenomena being observed. Usually such hypotheses extend beyond what is directly observable in the data, and in that sense we might say that Bayesian methods are—or at least may be—speculative. If the extra hypotheses are true, then we may expect that Bayesian results will improve on maximum entropy; if they are false, the Bayesian inferences will likely be worse.

This prescription of Bayesian analysis as a universal recipe is too enthusiastic. A working hypothesis may be an incorrect hypothesis. Furthermore, the maximum entropy method is to be used in a situation of almost complete ignorance, where only a few moments are known. It depends ultimately on some uniform prior, typically defined by group invariance. From a frequentist point of view, the use of a uniform distribution as a prior seems to represent a definite knowledge claim. If this claim is far off the mark, then what is the virtue of making it? Perhaps a Bayes decision is a procedure to be evaluated in the same way as any other such procedure. If there is enough data the risk can be kept acceptably low.

A positive feature of the book is that the author thinks for himself (within this ideological framework) and writes in a lively way about all sorts of things. It is worth dipping into it if only for vivid expressions of opinion. The annotated References and Bibliography are particularly good for this. For instance, in the annotation to C. J. Preston's excellent book on *Gibbs States on Countable Sets* [5] Jaynes writes (p. 715):

Here we have the damnable practice of using the word *state* to denote a probability *distribution*. One cannot think of a more destructively false and misleading terminology.

There are many books on Bayesian statistics, but few with this much color. The term "state", by the

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way, has its origin in quantum theory, and its transfer to probability is quite natural. On the other hand, for Jaynes quantum theory presents problems (p. 328):

As Bohr stressed repeatedly in his writings and lectures, present quantum theory can only answer questions of the form: 'If this experiment is performed, what are the possible results and their probabilities?' It cannot, as a matter of principle, answer any question of the form: 'What is really happening when...?' Again, the mathematical formalism of present quantum theory, like Orwellian *newspeak*, does not even provide the vocabulary in which one could ask such a question.

This is an unusual perspective from a physicist, but others have been troubled by this issue [6]. Perhaps Jaynes has a point.

Acknowledgement. I thank my colleagues Rabi Bhattacharya, Hermann Flaschka, Don Myers, and Joe Watkins for comments on drafts of this review. I am particularly grateful to Bill Casselman for his magical multi-colored intervention at the editorial stage.

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Aumann Awarded Nobel Prize

Abraham Neyman



Robert J. Aumann

Robert J. Aumann, professor of mathematics at the Hebrew University and member of the Interdisciplinary Center for Rationality there, shares (with Thomas C. Schelling) the 2005 Nobel Prize in Economics [13].

Aumann was born in Frankfurt, Germany, in 1930, and moved to New York with his family in 1938. In 1955 he completed his Ph.D. in mathematics at MIT under the supervision of George Whitehead. His thesis, in knot theory, was published in the *Annals of*

Mathematics [1].

In 1955 Aumann joined the Princeton University group that worked on industrial and military applications, where he realized the importance and relevance of game theory, then in its infancy. In 1956 Aumann joined the Institute of Mathematics at the Hebrew University.

Over the past half-century, Aumann has played an essential and indispensable role in shaping game theory, and much of economic theory, to become the great success it is today. He promotes a unified view of the very wide domain of rational behavior, a domain that encompasses areas of many apparently disparate disciplines, like economics, political science, biology, psychology, mathematics, philosophy, computer science, law, and statistics. Aumann's research is characterized by an unusual combination of breadth and depth. His scientific contributions are path-breaking, innovative, comprehensive, and rigorous—from the discovery and formalization of the basic concepts and principles, through the development of the appropriate tools and methods for their study, to their

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application in the analysis of various specific issues. Some of his contributions require very deep and complex technical analysis; others are (as he says at times) “embarrassingly trivial” mathematically, but very profound conceptually [12, p. 1]. He has influenced and shaped the field through his pioneering work. There is hardly an area of game theory today where his footsteps are not readily apparent. Most of Aumann's research is intimately connected to central issues in economic theory: on the one hand, these issues provided the motivation and impetus for his work; on the other, his results produced novel insights and understandings in economics. In addition to his own pioneering work, Aumann's indirect impact is no less important—through his many students, collaborators, and colleagues. He inspired them, excited them with his vision, and led them to further important results [12, p. 2].

The limited space allotted to this article does not begin to allow a comprehensive account of Aumann's extensive contributions. Thus, the article must confine itself to brief commentary touching on only a small part of his work. It is important to note that the scope of each description is not indicative of the importance of the contribution. Further and more detailed accounts of Aumann's contributions may be found in [12].

We start with Aumann's study of long-term interactions, which had a most profound impact on the social sciences. The mathematical model enabling a formal analysis is a *supergame* G^* , consisting of an infinite repetition of a given one-stage game¹ G . A *pure strategy* in G^* assigns a pure strategy in G to each period/stage, as a function

¹A game G in strategic form consists of a set of players N , pure strategy sets A_i for each player i , and payoff functions g_i , which describe the payoff to player i as a function of the strategy profiles $a \in A := \times_{i \in N} A_i$.

of the history of play up to that stage. A profile of supergame strategies, one for each player, defines the play, or sequence of stage actions. The payoff associated with a play of the supergame is essentially an average of the stage payoffs.

In 1959 Aumann [2] defined the notion of a *strong equilibrium*—a strategy profile where no group of players can gain by unilaterally changing their strategies—and characterized the strong equilibrium outcomes of the supergame by showing that it coincides with the so-called β -core of G . When Aumann's 1959 methodology is applied to *Nash equilibrium*—a strategy profile where no single player can gain by unilaterally changing his strategy—the result is essentially the so-called *Folk Theorem* for supergames: the set of Nash equilibria of the supergame G^* coincides with the set of feasible and individual rational payoffs in the one-stage game. In 1976 Aumann and Shapley [11] (and Rubinstein² in independent work) proved that the equilibrium payoffs and the perfect equilibrium payoffs of the supergame G^* coincide.

Supergames are repeated games of complete information; it is assumed that all players know precisely the one-shot game that is being repeatedly played.

The theory of repeated games of complete information is concerned with the evolution of fundamental patterns of interaction between people (or for that matter, animals; the problems it attacks are similar to those of social biology). Its aim is to account for phenomena such as cooperation, altruism, revenge, threats (self-destructive or otherwise), etc.—phenomena which may at first seem irrational—in terms of the usual 'selfish' utility-maximizing paradigm of game theory and neoclassical economics [7, p. 11].

The model of repeated games with incomplete information, introduced in 1966 by Aumann and Maschler [9], analyzes long-term interactions in which some or all of the players do not know which stage game G is being played. The game $G = G^k$ depends on a parameter k ; at the start of the game a commonly known lottery $q(k)$ with outcomes in a product set $S = \times_i S_i$ is performed and player i is informed of the i -th coordinate of the outcome. The repetition enables players to infer and learn information about the other players from their behavior, and therefore there is

a subtle interplay of concealing and revealing information: concealing, to prevent the other players from using the

information to your disadvantage; revealing, to use the information yourself, and to permit the other players to use it to your advantage [8, pp. 46–47].

The stress here is on the strategic use of information—when and how to reveal and when and how to conceal, when to believe revealed information and when not, etc. [7, p. 23].

This problem of the optimal use of information is solved in an explicit and elegant way in [9].

Another substantial line of contributions of Aumann is the introduction and study of the continuum idea in game theory and economic theory. This includes modeling *perfectly competitive* economies as economies with a continuum of traders and proving the equivalence of the core and competitive equilibrium [3] as well as the equivalence of the core (and competitive equilibrium) and the value [5], proving the existence of the competitive equilibrium [4], and introducing and extensively developing the (Aumann-Shapley) value of coalitional games with a continuum of players [10]. These models with a continuum of agents enable precise analysis of economic and political systems where groups of participants have significant influence over the outcome, but each individual's influence is negligible.

Another fundamental contribution of Aumann is "Agreeing to Disagree" [6]: it formalizes the notion of *common knowledge* and shows (the somewhat unintuitive result) that if two agents start with the same prior beliefs, and if their posterior beliefs (about a specific event), which are based on different private information, are common knowledge, then these posterior beliefs coincide. This paper had a major impact; it led to the development of the area known as *interactive epistemology* and has found many applications in different disciplines like economics and computer science.

Other fundamental contributions include the introduction and study of *correlated equilibrium*, the study of *bounded rationality*, and many important contributions to cooperative game theory: extending the theory of *transferable utility* (TU) games to general *nontransferable utility* (NTU) games, formulating a simple set of axioms that characterize the NTU-value,³ and the "Game-theoretic analysis of a bankruptcy problem from the Talmud".⁴

Robert J. Aumann has been a member of the U.S. National Academy of Sciences since 1985, a

³Introduced in L. S. Shapley, Utility comparison and the theory of games, *La Décision* (Paris: Edition du C.N.R.S., 1969), pp. 251–263.

⁴With M. Maschler, *Journal of Economic Theory* 36 (1985), pp. 195–213.

²A. Rubinstein, *Equilibrium in Supergames*, RM-26, Hebrew University of Jerusalem, 1976.

member of the Israel Academy of Sciences and Humanities since 1989, a Foreign Honorary Member of the American Academy of Arts and Sciences since 1974, and a corresponding fellow of the British Academy since 1995. He received the Harvey Prize in Science and Technology in 1983, the Israel Prize in Economics in 1994, the Lanchester Prize in Operations Research in 1995, the Nemmers Prize in Economics in 1998, the EMET prize in Economics in 2002, the von Neumann prize in Operations Research and Management Science in 2005, and the Nobel Memorial Prize in Economic Sciences in 2005. He was awarded honorary doctorates by the Universität Bonn in 1988, by the Université Catholique de Louvain in 1989, and by the University of Chicago in 1992.

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How Many Mathematicians Have Won Nobels?

With the awarding of the 2005 Nobel in Economics to Robert J. Aumann have come remarks that he and John Nash were the only mathematicians to have received Nobel Prizes. But there have been others.

Bob Aumann was in the mathematics department at Hebrew University for many years. After writing a couple of papers in algebraic topology (his thesis area), he became one of the movers and shakers in game theory. (Remember after Aumann received his MIT Ph.D., he accepted a position at Princeton, which at that time was deeply involved in that new topic of game theory.) Indeed, I must wonder whether the award was given to Bob this year to make up for the serious mistake of not recognizing him at the same time as when Nash (also a Princeton mathematics Ph.D.) got his Nobel.

There are several other examples of mathematicians receiving the Nobel Prize. John Pople of Northwestern University (my former academic home), who was honored with the Chemistry Nobel in 1998, received his mathematics Ph.D. from Cambridge in partial differential

equations. All of his research involved finding different approximations for the Navier-Stokes equation and relating it to chemistry. Until his recent death, John always was very positive in his comments about the power and value of mathematics.

Another example is Herbert Hauptman, who received the 1985 Nobel in Chemistry. Hauptman earned his mathematics Ph.D. from Maryland with a dissertation “An N -dimensional Euclidean algorithm”.

Kenneth Arrow received the 1972 Nobel in Economics. He earned his M.A. in mathematics from Columbia, and much of his Ph.D. training was in statistics and economics. Read his work; Arrow was strongly influenced by mathematics and he uses it skillfully!

Another name is Gerard Debreu, who received the 1983 award in Economics. Debreu, who died in December 2004 and whose memory and research were recently recognized at a conference in Berkeley, received his doctorate in mathematics in France. Debreu always kept strong ties to mathematics. For instance, I was told that in the late 1970s, Debreu and Steve Smale played central roles in pulling

mathematics and economics into the same building at Berkeley. During Debreu's Ph.D. training, he was strongly influenced by the Bourbaki school in France. It is easy to believe this: not only did this school fashion Debreu's mathematical tastes, but Debreu's adoption of the Bourbaki formal writing style made many of his books and papers very difficult to read.

Earlier, Leonid Kantorovich received the 1975 award in Economics. He always was a mathematician; indeed, he was chair of the mathematics group in Novosibirsk in Siberia and later a mathematics group in Moscow. His name is familiar from conformal mappings, variational methods, functional analysis, etc.

While John Bardeen (the only double Nobel winner in Physics) did not earn his Ph.D. in mathematics, he did his graduate work at Princeton in mathematical physics. Much of his work involved mathematics. Moreover, John kept close ties to the mathematics department at Urbana; e.g., he was chair of the 1979 committee to find a new chair for that department.

If one wanted to count Nobel winners who used a significant amount of fairly sophisticated mathematics in their research, one probably would have close to half of all Economics winners and several more from Chemistry and Physics (including Einstein).

There is a persistent rumor that the reason there is no Nobel in mathematics or astronomy is that, had there been one, Mittag-Leffler would have won. But, the story goes, the political problem in awarding such a prize to him was that Mittag-Leffler was having an affair with Nobel's wife.

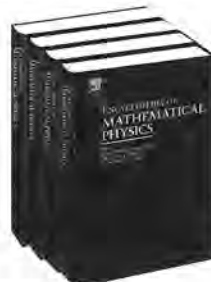
When I was at Northwestern, one of my colleagues, Alexandra Bellow (the well known ergodic theorist), was in Sweden with her husband at the time, Saul Bellow, when he received his Nobel Prize in literature. So she checked out the story about Mittag-Leffler. When she returned she told me that there was a minor flaw in this story—Nobel never was married!

—Donald Saari, University of California,
Irvine



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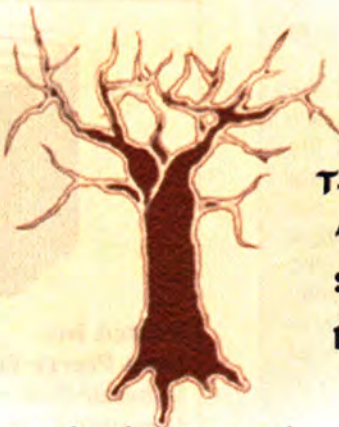
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See a demonstration of the website and submit information at the AMS booth during the Joint Mathematics Meetings.

Lindemann

MathSciNet Matters

The "MathSciNet Matters" column appears in the *Notices* several times a year. It includes information on new features of MathSciNet and on the underlying Mathematical Reviews Database, together with tips on how to use MathSciNet to make the most of its richness of structure and content.

The MR Citation Database. The September 2005 release of the new version of MathSciNet introduced several new features. The most significant is the MR Citation Database (<http://www.ams.org/mrcitations/search.html>). This new database is built upon the matched items in the reference lists that have been added to the MR Database for selected journals since 2001. An attempt is made to match each item in each reference list with an item in the MR Database, using a batch version of the reference matching tool MRef (the interactive version is at <http://www.ams.org/mref>). Matches are found on average for 85% of all references. Each day 1% of the unmatched items are examined again. The rate of successful matching varies by area. For example, many citations to applied mathematics papers are in journals that are not covered by MR.

Two ways to search the Citation Database are offered. The first is a search by author. Every MathSciNet author with at least one matched reference is included in the author portion of the Citation Database. Up to ten of the mostly frequently cited items are listed, together with the total number of citations for the author in the citation database. Another count given is the total number of distinct MR Database authors associated with items citing the given author. These numbers give a clear impression of the way mathematics disseminates through the community over time.

The second way to search is by journal among the matched references. The results are keyed to a specified year. For example, how many citations in 2004 reference list journals were made to papers in the given journal in the 5-year range 1999-2003? A bar chart presents all the citations to the given journal in 2004, in 5-year intervals, back to 1900. The bar charts show the "staying power" that mathematics has, a point that is frequently made in various policy discussions.

By September 2005 the number of journals with MathSciNet reference lists had grown to 195. By the time this is published the list will have grown to 325. The list of journals can be found at http://mrweb.mr.ams.org/mrcitations/journal_list.html.

Reference Citations in MathSciNet. The October 2005 column discussed the reference checking tool MRef, offered by the AMS at no charge. For matching of references in reference lists to the MR Database this tool is run "untouched by human hands" in order to make the matching of reference list items economically feasible. While the overwhelming majority of matches (and failures to match) are correct, errors are possible. MRef can fail to match based on the similarity of two or more items, for example, various editions of a book. MRef requires a unique match, so ambiguous cases return no match. It can in some cases return an incorrect match. A special case involves preprints and other unpublished material. Because many of these references will become published over time, special rules (involving fewer criteria) are used to allow matching with unpublished material. These matches are tagged with *cf.*, which serves as a little warning. The *cf.* matches are counted just like the unambiguous ones in the Citation Database. There are a number of caveats, in addition to these issues, that need to be understood before venturing any interpretation of the data returned from the MR Citation Database (see further http://www.ams.org/mrcitations/help/citation_database_understanding.html).

Reviewers Corner. A new interface to the submission of reviews on the Web is now available. The address is the same as always: <http://www.ams.org/mresubs>. However, you will now see a new *AMS Web Sign In* link at the upper left of the page. Clicking this link and entering your username/password will connect you to all your reviewer information, including paper and email addresses, current AMS Points total, reviewing classification list, and reviewing interests. We would like you to review your list of classifications and your interests periodically so that we can do the best possible job of sending you items that match your research and reviewing interests. The new page makes it easy to update those classifications and interests. If you proceed to submitting a review after signing in, you will find all your personal information fields already filled in. The Web submission of reviews has brought a measurable increase in efficiency. We hope that the new interface will be helpful to those reviewers already submitting on the Web and more enticing to those who have not yet done so. The majority of reviewers already have an AMS Web Account for logging in. If you don't have one, it is very simple to register and create a profile that includes your reviewer number.

—Norman Richert
Mathematical Reviews

Mathematics People

Kleinberg Receives MacArthur Fellowship

JON KLEINBERG of Cornell University has been awarded a MacArthur Foundation Fellowship for 2005. The prize citation calls Kleinberg “a computer scientist with a reputation for tackling important, practical problems and, in the process, deriving deep mathematical insights.”

Kleinberg’s research interests range from computer networking analysis and routing to data mining to comparative genomics and protein structure. He is best known for his contributions to two aspects of network theory: “small worlds” and searching the World Wide Web. The “small world” concept, originated by psychologist Stanley Milgram, states that any two people are linked by a relatively small number of connections among mutual acquaintances. Kleinberg extended this concept by introducing the notion of navigability—essentially, the information structure of the network necessary for individuals to make distant connections efficiently based solely on local information. He proved that, although certain architectures can be computationally efficient, no algorithm can find the shortest path in networks with short, random connections. In addition, Kleinberg has developed an algorithm for identifying the structure of website interactions; his algorithm distinguishes “authority” sites, which contain definitive information, from “hub” sites, which refer to authority sites using hyperlinks.

Jon Kleinberg received his A.B. (1993) from Cornell University and his Ph.D. (1996) from the Massachusetts Institute of Technology. He has held several research positions at IBM and has continued to be a member of the visiting faculty program at the IBM Almaden Research Center since 1998. He has been at Cornell University since 1996. The MacArthur Foundation Fellowship Program awards five-year, unrestricted fellowships of US\$500,000 to individuals across all ages and fields who show exceptional merit and promise of continued creative work.

—From a MacArthur Foundation news release

NSF CAREER Awards Made

The Division of Mathematical Sciences (DMS) of the National Science Foundation (NSF) has honored fourteen mathematicians in fiscal year 2005 with Faculty Early Career Development (CAREER) awards. The NSF established the awards to support promising scientists, mathematicians, and engineers who are committed to the integration of research and education. The grants run from four to five years and range from US\$200,000 to US\$500,000 each. The 2005 CAREER grant awardees and the titles of their grant projects follow.

MARK EMBREE, Rice University: Design and Analysis of Restarted Iterative Methods for Linear Systems, Eigenvalue Problems, and Model Reduction; EZRA MILLER, University of Minnesota, Twin Cities: Discrete Structures in Continuous Contexts; DAVID BEN-ZVI, University of Texas, Austin: Representation Theory on Curves; HELGE JENSEN, Pennsylvania State University: Large and Multidimensional Solutions of Conservation Laws; PETER KRAMER, Rensselaer Polytechnic Institute: Stochastic Dynamical Models in Microbiology; JONATHAN MATTINGLY, Duke University: Stochastic Analysis and Numerics in Partial Differential Equations and Extended Dynamical Systems; TIEFENG JIANG, University of Minnesota, Twin Cities: Random Matrices and Related Topics; ANNA VAINCHTEIN, University of Pittsburgh: Lattice Models of Martensitic Phase Transitions; THOMAS SCANLON, University of California, Berkeley: Geometric and Algebraic Model Theory; MATTIAS JONSSON, University of Michigan, Ann Arbor: A Unified Study of Singularities; SAMUEL KOU, Harvard University: Stochastic Modeling and Inference in Biophysics; JORDAN ELLENBERG, University of Wisconsin, Madison: Rational Points on Varieties and Nonabelian Galois Groups; WEI BIAO WU, University of Chicago: Asymptotics of Random Processes and Their Applications; and YUHONG YANG, University of Minnesota, Twin Cities: Adaptive Regression for Dependent Data by Combining Different Procedures.

—Elaine Kehoe

Viana Awarded ICTP/IMU Ramanujan Prize

MARCELO VIANA of the Instituto de Matemática Pura e Aplicada (IMPA), Brazil, has been awarded the first Srinivasa Ramanujan Prize for Young Mathematicians from Developing Countries by the Abdus Salam International Centre for Theoretical Physics (ICTP) and the International Mathematical Union (IMU). Viana was honored for his outstanding contributions to the field of dynamical systems. He has played a key role in the development of mathematics at IMPA and in Brazil.

The Ramanujan Prize is funded by the Niels Henrik Abel Memorial Fund and is designed to honor researchers under forty-five years of age who have conducted outstanding research in developing countries. The prize carries a cash award of US\$10,000 and a travel allowance to visit ICTP to deliver a prize lecture.

—From an ICTP announcement

Bhargava and Soundararajan Awarded SASTRA Ramanujan Prizes

MANJUL BHARGAVA of Princeton University and KANNAN SOUNDARARAJAN of the University of Michigan have been awarded the first annual SASTRA Ramanujan Prizes of the Shanmugha Arts, Science, Technology Research Academy (SASTRA) of South India.

The prize citations are as follows.

“Manjul Bhargava is awarded the 2005 SASTRA Ramanujan Prize for his phenomenal contributions to number theory, most notably for his discovery of higher order composition laws, for applying these laws to solve new cases of one of the fundamental questions of number theory, that of the asymptotic enumeration of number fields of a given degree d , and for making progress on the problem of finding the average size of ideal class groups of number fields and the related conjectures of Cohen and Lenstra. All this stems from his Ph.D. thesis written under the direction of Andrew Wiles of Princeton University and published as a series of papers in the *Annals of Mathematics*. Bhargava’s research has created a whole new area of research in a classical topic that has seen very little activity since the time of Gauss.”

“Kannan Soundararajan is awarded the 2005 SASTRA Ramanujan Prize for his brilliant contributions to several areas in analytic number theory that include combinatorial and multiplicative number theory, the Riemann zeta function, Dirichlet L -functions, the analytic theory of automorphic forms, and the Katz-Sarnak theory of symmetric groups associated with families of L -functions. Among other things, the prize recognizes his resolution of a conjecture of Ron Graham in combinatorial number theory in collaboration with R. Balasubramaniam, his fundamental results on the distribution of zeros of the Riemann zeta function, both

of these being his undergraduate research at the University of Michigan, as well his Ph.D. thesis written under the direction of Peter Sarnak of Princeton University, in which Soundararajan proved the spectacular result that more than $7/8$ -ths of quadratic Dirichlet L -functions have no zeros at the critical point $s = 1/2$. The prize also recognizes Soundararajan’s joint work with Brian Conrey that a positive proportion of Dirichlet L -functions have no zeros on the real axis within the critical strip, his joint work with Ken Ono providing a conditional proof of a conjecture of Ramanujan on the values of a certain quadratic form, and his recent work with Hugh Montgomery on the distribution of primes in short intervals.”

The prize was awarded at the International Conference on Number Theory and Mathematical Physics, held December 19–22, 2005, at SASTRA. Both recipients gave invited talks on their work.

The SASTRA Ramanujan Prize carries a cash award of US\$10,000 and is given for outstanding contributions by individuals under the age of thirty-two (the age Ramanujan was when he died) in areas of mathematics that were broadly influenced by Ramanujan’s work.

The prize committee consisted of Krishnaswami Alladi (chair), University of Florida; Manindra Agrawal, Indian Institute of Technology; George Andrews, Pennsylvania State University; Jean-Marc Deshouillers, University of Bordeaux; Tom Koornwinder, University of Amsterdam; James Lepowsky, Rutgers University; and Don Zagier, Max Planck Institute for Mathematics, Bonn, and Collège de France.

—Krishnaswami Alladi, Chair,
SASTRA Ramanujan Prize Committee

Bhargava and Dencker Receive Clay Awards

The Clay Mathematics Institute (CMI) has presented its Clay Research Awards for 2005 to MANJUL BHARGAVA, Princeton University, and NILS DENCKER, Lund University, Sweden. According to the prize citations, Bhargava was recognized “for his discovery of new composition laws for quadratic forms and for his work on the average size of ideal class groups,” and Dencker was honored “for his complete resolution” of a 1970 conjecture made by Treves and Nirenberg that “posits an essentially geometric necessary and sufficient condition...for a pseudodifferential operator of principal type to be locally solvable.”

The CMI is a private nonprofit foundation dedicated to increasing and disseminating mathematical knowledge. This year’s research awards were presented on October 11, 2005, at Oxford University.

—From a CMI announcement



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Alfred W. Goldie (1920–2005)

Alfred W. Goldie, whose eponymous theorem changed the face of noncommutative ring theory, died on October 8, 2005, in hospital, near his home in Bowness-on-Windermere, England. According to his family, his death was the result of a heart attack following surgery earlier that week.

Goldie’s Theorem and its proof initiated the systematic study of noncommutative noetherian rings by linking their properties, through the technique of forming a ring of fractions, to semisimple rings with the descending chain condition—a class well understood via the Wedderburn theorems. Goldie’s insights found applications to the study of infinite-dimensional representations of finite-dimensional Lie algebras, for example.

Alfred Goldie was born on December 10, 1920, in Staffordshire, England. He was educated at Wolverhampton Grammar School and then at St. Johns College, Cambridge. During World War II he did research on interior ballistics. Goldie’s only “formal” study of algebra was several meetings with Philip Hall, the eminent British algebraist.

After positions at Nottingham and Newcastle (where he proved Goldie’s theorem), Goldie became a research professor at the University of Leeds in 1963 and remained until his retirement in 1986. At Leeds he continued his work in algebra, building a “school” in ring theory, hosting many visitors, and organizing memorable conferences. Goldie visited the U.S. many times, with extended stays at Yale, Tulane, and the University of California at San Diego.

Alfred Goldie approached his work with optimism and with no fear of the really hard problems.

—Lance Small, University of California, San Diego



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MATHEMATICAL SCIENCES

The Worcester Polytechnic Institute (WPI) Department of Mathematical Sciences invites applications for a faculty position to begin in the fall of 2006 at the assistant professor level. An earned Ph.D. or equivalent degree is required. Preference will be given to candidates whose main research interest is in financial mathematics or closely related areas of stochastic processes, stochastic analysis, or the numerical solution of stochastic systems. Successful candidates must demonstrate strong research potential and evidence of quality teaching and will be expected to contribute to the department’s research activities and to its innovative, project-based educational programs, in particular to the graduate program in financial mathematics.

WPI is a private and highly selective technological university with an enrollment of 2700 undergraduates and about 1100 full- and part-time graduate students. Worcester, New England’s third largest city, offers ready access to the diverse economic, cultural and recreational resources of the region.

The Mathematical Sciences Department has 24 tenured/tenure-track faculty and supports BS, MS, and PhD programs in applied and computational mathematics and applied statistics. For additional information, see <http://www.wpi.edu/math>.

Qualified applicants should send a detailed curriculum vitae, a brief statement of specific teaching and research objectives, and three letters of recommendation, at least one of which addresses teaching potential, to: **Math Search Committee, Mathematical Sciences Department, WPI, 100 Institute Road, Worcester, MA 01609-2280, USA.**

Applicants will be considered on a continuing basis until all positions are filled. Review of applications will start December 1, 2005.

To enrich education through diversity, WPI is an affirmative action, equal opportunity employer.

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Mathematics Opportunities

Proposal Due Dates at the DMS

The Division of Mathematical Sciences (DMS) of the National Science Foundation (NSF) has a number of programs in support of mathematical sciences research and education. Listed below are some of the programs and their proposal due dates for the year 2006. Please refer to the program announcement or contact the DMS staff for more information.

December 13, 2005 (full proposal): East Asia and Pacific Summer Institutes for U.S. Graduate Students

December 20, 2005 (full proposals): Mathematical Sciences: Innovations at the Interface with the Physical and Computer Sciences and Engineering: Interactions between Mathematical Sciences and Physical Sciences (Astronomy; Materials Research)

January 5, 2006 (full proposal): Collaborative Research in Computational Neuroscience

January 13, 2006 (full proposal): Mathematical Sciences: Innovations at the Interface with the Physical and Computer Sciences and Engineering: Interactions between Mathematical Sciences and Physical Sciences (Chemistry)

January 26, 2006 (full proposal): Scientific Computing Research Environments for the Mathematical Sciences (SCREMS)

January 27, 2006 (full proposal): ADVANCE: Increasing the Participation and Advancement of Women in Academic Science and Engineering Careers: Partnerships for Adaptation, Implementation, and Dissemination

February 1, 2006 (full proposal): Collaboration in Mathematical Geosciences

February 19, 2006 (full proposal): Interdisciplinary Grants in the Mathematical Sciences (IGMS)

March 1, 2006 (full proposal): Mathematical Sciences: Innovations at the Interface with the Physical and Computer Sciences and Engineering: Interactions between Mathematical Sciences and Computer Science

March 29, 2006 (full proposal): Interdisciplinary Training for Undergraduates in Biological and Mathematical Sciences

June 2, 2006 (full proposal): University-Industry Cooperative Research Programs in the Mathematical Sciences

June 7, 2006 (full proposal): Research Experiences for Undergraduates: REU site proposals to the Antarctic Program

July 20, 2006 (full proposal): Faculty Early Career Development (CAREER) Program

August 17, 2006 (full proposal): Research Experiences for Undergraduates: REU site proposals

August 18, 2006 (letter of intent): Focused Research Groups in the Mathematical Sciences

August 24, 2006 (full proposal): Conferences, Workshops, and Special Meetings in the Mathematical Sciences: Special meetings only

September 15, 2006 (full proposal): Focused Research Groups (FRG) in the Mathematical Sciences

September 27, 2006 (full proposal): Education and Interdisciplinary Research

October 3, 2006 (full proposals): Algebra, Number Theory and Combinatorics; Analysis; Foundations

October 18, 2006 (full proposals): Mathematical Sciences Postdoctoral Research Fellowships

November 7, 2006 (full proposals): Geometric Analysis, Probability, Statistics, Topology, Applied Mathematics

November 7, 2006 (full proposal): Quantitative Environmental and Integrative Biology

December 7, 2006 (full proposal): Computational Mathematics

December 18, 2005–January 13, 2006 (full proposal): Mathematical Biology

For further information consult the DMS website at <http://www.nsf.gov/div/index.jsp?div=DMS>. The mailing address is Division of Mathematical Sciences, National Science Foundation, Room 1025, 4201 Wilson Boulevard, Arlington, VA 22230. The telephone number is 703-292-5111.

—From a DMS announcement

NDSEG Fellowships

As a means of increasing the number of U.S. citizens trained in disciplines of military importance in science and engineering, the Department of Defense (DoD) awards

National Defense Science and Engineering Graduate (NDSEG) Fellowships each year to individuals who have demonstrated ability and special aptitude for advanced training in science and engineering. The fellowships are awarded for a period of three years for study and research leading to doctoral degrees in mathematical, physical, biological, ocean, and engineering sciences. The number of fellowships awarded depends on available funding.

The NDSEG Fellowship Program is open only to applicants who are citizens or nationals of the United States. NDSEG Fellowships are intended for students at or near the beginning of their graduate studies in science or engineering. Applicants must have received or be on track to receive their bachelor's degrees by fall of 2006. Applications are encouraged from women, persons with disabilities, and minorities, including members of ethnic minority groups such as African American, American Indian and Alaska Native, Asian, Native Hawaiian and other Pacific Islander, Hispanic, or Latino.

Complete applications must be submitted electronically or postmarked by **January 6, 2006**. Application materials are available from, and completed applications should be returned to, the American Society for Engineering Education (ASEE) at NDSEG Fellowship Program, c/o American Society for Engineering Education, 1818 N Street, N.W., #600, Washington, DC 20036; telephone 202-331-3516; fax 202-265-8504; email: ndseg@asee.org. For further information see the website <http://www.asee.org/ndseg/preface.cfm>.

—From an NDSEG announcement

AMS-AAAS Mass Media Summer Fellowships

The American Association for the Advancement of Science (AAAS) sponsors the Mass Media Science and Engineering Summer Fellows Program through which graduate students work during the summer in major media outlets. The AMS provides support each year for one or two graduate students in the mathematical sciences to participate in the program. In past years AMS-sponsored fellows have held positions at *Scientific American*, *Business Week*, *Voice of America*, Discovery Channel Online, National Geographic Television, *Popular Science*, *The Chicago Tribune*, and *Time* magazine.

Fellows receive a weekly stipend of US\$450 plus travel expenses to work for ten weeks during the summer as reporters, researchers, and production assistants in media organizations. They observe and participate in the process by which events and ideas become news, improve their ability to communicate about complex technical subjects in a manner understandable to the public, and increase their understanding of editorial decision making and of how information is effectively disseminated. Each fellow attends an orientation and evaluation session in Washington, D.C., and begins the internship in mid-June. Fellows submit

interim and final reports to AAAS. A wrap-up session is held at the end of the summer.

Mathematical sciences faculty are urged to make their graduate students aware of this program. The deadline to apply for fellowships for the summer of 2006 is **January 15, 2006**. Further information about the fellowship program and application procedures is available online at <http://www.aaas.org/programs/education/MassMedia/index.shtml>, or applicants may contact Stacey Pasco, Manager, Mass Media Program, AAAS Mass Media Science and Engineering Fellows Program, 1200 New York Avenue, NW, Washington, DC 20005; telephone: 202-326-6441; fax: 202-371-9849. Further information is also available at <http://www.ams.org/government/massmediaann.html> and through the AMS Washington Office, 1527 Eighteenth Street, NW, Washington, DC 20036; telephone: 202-588-1100; fax: 202-588-1853; email: amsdc@ams.org.

—AMS-AAAS announcement

CMI Liftoff Program for Summer 2006

The Clay Mathematics Institute (CMI) is currently accepting nominations for the 2006 Liftoff program. Through this program, CMI will employ recent Ph.D. recipients as Liftoff Fellows to carry out mathematics research for one month during the summer of 2006. This program provides a transition for young mathematicians from student to faculty member or to a postdoctoral position. Funds for travel to conferences or to visit collaborators are also available to Liftoff Fellows.

Nominations should be made by university mathematics departments; candidates may not apply directly. Criteria for selection are the quality and significance of mathematical research already achieved by the candidate and the potential of the candidate to become a leader in mathematical research.

Nomination packets should include: (1) a cover letter signed by the department chair; (2) two letters of recommendation, including one from the thesis supervisor (existing letters of recommendation already written for job applications can be used); (3) a CV from the nominee, including name, address, telephone, email, date of birth, citizenship, education, thesis title, honors, previous employment, reference to published work or submitted articles, and proposed research; and (4) a one-sentence signed statement from a mathematician agreeing to supervise the nominee on behalf of CMI, with the proposed dates of employment.

Nominations can be sent electronically to the attention of Elizabeth Abraham at nominations@claymath.org or by post to Clay Mathematics Institute, One Bow Street, 4th Floor, Cambridge, MA 02138. The deadline for nominations to be received is **February 15, 2006**. For more information see the website <http://claymath.org/fas/>

lifton_fellows/; telephone: 617-995-2600; email: nominations@claymath.org.

—From a CMI announcement

NSF Computing Equipment and Instrumentation Programs

The Division of Mathematical Sciences (DMS) of the National Science Foundation (NSF) plans a limited number of awards for the support of computing environments for research in the mathematical sciences. SCREMS (Scientific Computing Research Environments for the Mathematical Sciences) supports computing environments dedicated to research in the mathematical sciences. Proposals may request support for the purchase of computing equipment and limited support for professional systems administrators or programmer personnel for research computing needs. These grants are intended to support research projects of high quality that require access to advanced computing resources. Requests for routine upgrades of standard desk-environment workstations or laptop computers are not appropriate for this program. Awards are made to provide support for specific research projects rather than to provide general computing capacity. Proposers are encouraged to include projects involving symbolic and algebraic computations, numerical computations and simulations, and graphical representations (visualization) in aid of the research.

Please see http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf05627 for details. The deadline for proposals is **January 26, 2006**.

—From an NSF announcement

NSF Support for Interactions with Physical and Computer Sciences and Engineering

The National Science Foundation (NSF) offers opportunities for support through its Mathematical Sciences Priority Area (MSPA) program for research involving interactions between mathematical sciences and computer science (MSPA-MCS), engineering (MSPA-ENG), and physical sciences (MSPA-MPS). The goal of MSPA is to advance research in three interlinked areas: fundamental mathematical and statistical sciences, interdisciplinary research involving the mathematical and statistical sciences with science and engineering, and critical investments in mathematical and statistical sciences that embed training in research activities. Investments in interdisciplinary research will focus primarily on mathematical and statistical challenges posed by large data sets, managing and modeling uncertainty, and modeling complex nonlinear systems. Innovative educational activities that foster closer connections between research

and education in the mathematical sciences will also be supported.

For details on each of these areas and application procedures, see the website <http://www.nsf.gov/pubs/2005/nsf05622/nsf05622.htm>. Due dates for proposals are: **December 20, 2005**, for interactions between mathematical sciences and physical sciences pertaining to interactions with astronomy and with materials research; **January 13, 2006**, for interactions between mathematical sciences and physical sciences pertaining to interactions with chemistry; and **March 1, 2006**, for interactions between mathematical sciences and computer science.

—From an NSF announcement

Departments Coordinate Job Offer Deadlines

A group of mathematical sciences departments has adopted an agreement to coordinate deadlines for acceptance of postdoctoral job offers. The purpose is to ensure that applicants do not have to make decisions about job offers before the results of the National Science Foundation (NSF) postdoctoral fellowship competition are announced. The agreement applies only to offers of postdoctoral positions and not tenure-track positions and only to applicants who are less than two years past the Ph.D. The departments have agreed not to require these applicants to decide about a job offer before Monday, February 13, 2006. The NSF has agreed to notify postdoctoral fellowship recipients no later than Wednesday, February 8, 2006. The list of participating departments, together with additional information, may be found on the Web at <http://www.ams.org/employment/postdoc-offers.html>.

—Allyn Jackson

Call for Contributions for ICMI Study

The International Commission on Mathematical Instruction (ICMI) has announced the seventeenth ICMI study, "Digital technologies and mathematics teaching and learning: Rethinking the terrain". The study will be concerned with the use of digital technologies in mathematics teaching and learning in countries across the world. Participants in the study will be invited on the basis of a submission of between six and eight pages. The deadline for submissions is **January 15, 2006**. For further information, download the "Discussion Document" and a detailed call for contributions from the webpage <http://www.math.msu.edu/~nathsinc/ICMI/>. The study conference will take place December 3–8, 2006, at the Hanoi Institute of Technology. Proposals will be reviewed and decisions about invitations to the conference will be sent by the middle of May 2006.

—From an ICMI announcement

For Your Information

My Summer at National Public Radio

Each year the AMS sponsors a Mass Media Fellow through the American Association for the Advancement of Science (AAAS). This piece was written by the 2005 AMS fellow, Brent Deschamp. Information on how to apply for the fellowship appears in “Mathematics Opportunities” in this issue.

National Public Radio has a cult following. Addicts exist in every office, dutifully tuning in daily for the latest news, and for this past summer I was a dealer in this most potent of opiates. The experience took its toll on me, as I too am now addicted. And yet, despite it all—despite the fact that I had the unique opportunity of writing science news for an NPR affiliate in Columbus, Ohio, despite the fact that it was quite enjoyable—I left the experience yearning to return to my old life of research and teaching.

My fellow AAAS Mass Media Fellows seemed enthralled with their experiences at various media outlets across the country, and many are now planning careers in science writing. But I alone in the group did not find science news fulfilling. It seemed science news lacked something, but what? Being a mathematician, I looked to define what the news is, for to know the definition is to begin to understand the object.

My definition is a little strange.

In the end, I concluded that the news is nothing more than sanitized, fact-checked gossip. It follows the same traditions of passing on information as those found in the stereotypical beauty salon or at the office watercooler, but it is held to a higher standard in that it is cleaned up and the sources are verified. But it's still the same thing. What makes for good gossip makes for good news.

My mentor in Ohio, a veteran of news radio for thirty years, taught me two lessons about news. The first: “When it comes to news, I believe in two things: fear and greed.” The second: “Every great news story has six qualities: timeliness, proximity, prominence, novelty, human interest, and conflict.” It almost reads like a theorem.

But wait, it sounds so much like gossip. Gossip always comes from a “reliable” source about someone you know who has recently done something odd, and there's usually trouble brewing because of it.

If the Johnson boy got the good reverend's daughter pregnant and they ran off to live with his cousin, that's gossip. If a reporter called the cousin and the daughter's obstetrician for verification, captured the heartbroken words of the reverend, and threw in some statistics on teenage pregnancy in America today, that's news.

Near the end of my fellowship I began imagining the nightly news anchored by three old women who talked, not of NASA scientists, but of “those nice boys over at NASA” who were trying again to send “some new-fangled thing into space”. Cut to Herb on the front porch: “Looks like rain tomorrow.” Cut to commercial, back for a report on “how those boys in Washington were still wastin' money for no good reason,” and that's a broadcast.

Cynical? Indeed. Would it be possible to substitute the usual material into this new format? Definitely.

With a definition in hand, I started to see why writing science news didn't suit me. Science news often contradicts the very properties that make for a good news story. Consider the announcement of a great scientific breakthrough: the corresponding news story would certainly have prominence, timeliness, and most likely novelty. The reporter would look for some application of this breakthrough to bring the discovery into the reader's/viewer's/listener's world and create human interest. But the big one, the one I found everyone tacitly wants in every news story, isn't there. Where's the conflict, the drama, the opportunity to bring in greed and fear? Unless you get “lucky” with radiation sickness or maybe the opportunity of widespread death, the story simply falls flat.

But more often, science is making small strides, and even the easier properties of prominence and novelty are lost. Human interest is usually impossible.

On the other hand, medical research is always big for the simple reasons that drug companies are viewed as greedy and everyone is afraid to die. It also doesn't matter how suspect the conclusions are, because a good story now about something that might kill you is just as good when it is disproved, since the inherent conflict of contradictory reports makes for a good story. The writer of medical news always has material. If your beat is quantum mechanics or molecular dynamics, you can roll over and go back to sleep—even if there was news, your editor would probably axe it.

And math? What chance does it have?

I think of the great moments in my mathematical education when I learned things that left me speechless: Galois Theory, the Radon-Nikodym Theorem, and the simple but poetic theorem by Lagrange about the order of subgroups. If any of these things were to be discovered tomorrow, they would never make the news.

If someone were to develop a polynomial-time algorithm for factoring large numbers, that would make the news for about as long as it would take to state the fact, hear a quote from the mathematician involved that it took a lot of work, and hear another quote from a leading mathematician in the field that this was one of the great breakthroughs in mathematics. Elapsed time: 45–60 seconds for radio.

Then it would be off to a reporter warning that the Internet is no longer secure and that your personal information can be easily stolen, ideally including a quote of an individual talking about how his life has been ruined by identity theft and how he will cease to interact with the modern world for fear of being victimized again. Elapsed time: 3–4 minutes.

If someone actually remembered the impetus for the story, it would be because the news drove the story into the ground day after day and the “peg”, the reason for listening, was this discovery. Every story would begin with some variation of “It’s something a grade schooler might complain about doing for homework, but the difficulty of factoring numbers has kept information safe for decades. Now, following a major breakthrough in mathematics, factoring is as easy as multiplication. In response, Congress has called an emergency session to evaluate the security of the nation’s communications. Adrienne Featherbright reports from Washington.”

Much like gossip, the news is often shallow. The need to maintain interest creates short stories that skim the surface of the facts and switch focus quickly. And like gossip, it is only the truly juicy stories that are given more time, depth, and repeat exposure.

As one Fellow remarked, “I want to stop writing these cute stories with a science angle and write about real science.” My advisor suggested a different approach by talking about the new puzzle Sudoku. It’s math, it’s fun, and the human interest property is easily satisfied by interviewing a local nut who never misses his Sudoku puzzle in the morning. Problem: most papers don’t have a Sudoku puzzle; and if conflict is the number one property of a news story, then proximity and timeliness are the next. Just like gossip, the story must be tailored to the audience; and if news about some yokel in the next county isn’t interesting, a report about a new puzzle in a paper distributed elsewhere certainly won’t fly.

The most telling experience I had as a Fellow came over lunch with the Research Communications Staff at Ohio State University. The goal of these four people is to inform the world of the accomplishments of the OSU faculty. All four also freelance regularly for other publications writing science news. With a collective experience of over fifty years of science writing, they admitted they had never

once written a straight math story and only once or twice had written one in the context of an application.

Their reasoning was that mathematics lacks a recognizable element: an atom is at least familiar to most audiences, but a matrix? Also, the context of the problem usually takes up as much space as the problem itself. Readers need to be drawn in quickly before they move on to another story, and taking three paragraphs to explain the setup is tantamount to suicide. Your headline might as well be “More interesting story to be found on next page”. While they never said it was impossible to write such a story, the message is clear: in a world of many new scientific developments that are much easier to explain and capture audience attention, the world of mathematics is often overlooked.

So, in the end, writing science news grates against me because I believe so heavily in the properties of good science. The news simply looks at the science through a lens I feel distorts what is important. The science, for me, is the story, but more often than not, the news views it only as a means to tell a different story.

I was born a cynical man, and I left this fellowship a little worse for wear. And yet I still find myself listening to NPR hoping to hear from Richard Knox, David Kestenbaum, or Richard Harris about something new in the science world. I doubt I’ll ever hear about math, and it’s rare that they are on; but still, when I hear the anchor lead into a story about science, I get a little thrill because I know what it took to get it on the air, the fight to tell a story that doesn’t have the properties of great news. They’re rebels in many ways, and to science writers everywhere I say, “Keep up the good fight.”

Last, I think of the multiple definitions of compactness that eventually found the best properties to do the most good, and I hope that the news will slowly undergo such a transformation. Like AAAS and AMS, I see the need for good science news, and I can only dream that the news begins to see that as well. As a friend once told me, “Every cynic is really a closet romantic.” In this case, I’ll admit to that.

—Brent J. Deschamp, University of Wyoming

Correction

An alert reader pointed out a typo in my *Notices* article “What Is the Role of Algebra in Applied Mathematics?”, which appeared in the November 2005 issue of *Notices*. On the left column of page 1196, in the two displays between (9) and (10), the last generator should be $(x^2y^2, 0, 0, 0)$, not $(x^2, y^2, 0, 0)$.

—David Cox, Amherst College

Inside the AMS

Current Events Session at Joint Meetings

The Joint Mathematics Meetings in San Antonio in January 2006 will include a special session entitled “*Bulletin of the AMS Current Events*”, featuring four expository lectures on topics at the frontier of mathematical research. The session is organized by AMS past-president David Eisenbud, director of the Mathematical Sciences Research Institute in Berkeley.

The format for the talks follows the model of the famous Bourbaki Seminars in that mathematicians with especially strong expository skills speak on work not their own and written versions of the talks are prepared beforehand and distributed at the session. But there are some novel features, too. The talks are generally more accessible than those of the Bourbaki Seminars, and the coverage is broader and includes applied areas. Often a talk begins with a general, nontechnical presentation of the topic, lasting about twenty minutes. There is a short break, and then the talk continues with a more detailed presentation of how the topic is used in a particular setting. These “Current Events” sessions have drawn large audiences and have turned out to be one of the most popular activities at the Joint Meetings. The written versions of the talks are collected in an attractive booklet distributed at the session.

A tradition has also developed for the talks to appear in print. Some of them have been expanded to appear as articles in the *Bulletin of the AMS*.

For the session in San Antonio, the speakers and their lecture titles follow:

LAUREN ANCEL MEYERS, University of Texas at Austin, *Contact Network Epidemiology: Bond Percolation Applied to Infectious Disease Prediction and Control*.

KANNAN SOUNDARARAJAN, University of Michigan, *Small Gaps between Prime Numbers*.

MADHU SUDAN, Massachusetts Institute of Technology, *Checkable Proofs*.

MARTIN GOLUBITSKY, University of Houston, *Symmetry in Neuroscience*.

The session will take place Saturday, January 14, 2006, from 1:00 p.m. to 5:50 p.m. Information about this and other Joint Meetings activities is available on the AMS Meetings website, <http://www.ams.org/meetings>.

—Allyn Jackson

AMS Releases New “Mathematical Moments”

Mathematicians know that their subject is the basis for such scientific and engineering feats as data compression and speech recognition. But when you are trying to communi-

cate such things to students or the public at large, it is sometimes difficult to put your hands on appropriate resources.

Enter “Mathematical Moments”—brief, colorful flyers created by the AMS Public Awareness Office and designed to promote appreciation and understanding of the role mathematics plays in science, nature, technology, and human culture. “Mathematical Moments” provide a handy,

eye-catching, and concise way to show the many applications of mathematics. They can be used to reach such audiences as elected officials, students, parents, and school teachers and administrators.

The latest set of “Mathematical Moments” covers topics in archaeology, data compression, CAT-scans, architecture, modern fountain design, the portable *20 Questions* game, bin packing, and machine translation. Altogether the AMS offers nearly fifty different “Mathematical Moments”



flyers. They make excellent handouts for presentations, and their attractive design makes them suitable for bulletin board and wall display.

The AMS has received many positive comments about the "Mathematical Moments", like this one: "I have greatly enjoyed the Mathematical Moments poster series. The posters are very useful; I read the blurb to my calculus students and pass around the poster. They learn something about how math is relevant in the world, and associate it with a cool picture. Having excellent pictures is what makes the 'Moments' effective. Thanks for a great program!"

PDF files containing "Mathematical Moments" may be downloaded free of charge at <http://www.ams.org/ams/mathmoments.html>. Topic suggestions and feedback are welcome and can be sent to the AMS Public Awareness Office at paoffice@ams.org.

—Allyn Jackson

Trjitzinsky Memorial Awards Presented

The AMS has made awards to eight undergraduate students through the Waldemar J. Trjitzinsky Memorial Fund. The fund is made possible by a bequest from the estate of Waldemar J., Barbara G., and Juliette Trjitzinsky. The will of Barbara Trjitzinsky stipulates that the income from the bequest should be used to establish a fund in honor of the memory of her husband to assist needy students in mathematics.

For the 2005 awards, the AMS chose seven geographically distributed schools to receive one-time awards of US\$3,000 each. The mathematics departments at those schools then chose students to receive the funds to assist them in pursuit of careers in mathematics. The schools are selected in a random drawing from the pool of AMS institutional members.

Waldemar J. Trjitzinsky was born in Russia in 1901 and received his doctorate from the University of California, Berkeley, in 1926. He taught at a number of institutions before taking a position at the University of Illinois, Urbana-Champaign, where he remained for the rest of his professional life. He showed particular concern for students of mathematics and in some cases made personal efforts to ensure that financial considerations would not hinder their studies. Trjitzinsky was the author of about sixty mathematics papers, primarily on quasi-analytic functions and partial differential equations. A member of the AMS for forty-six years, he died in 1973.

Following are the names of the selected schools for 2005, the names of the students receiving Trjitzinsky Awards, and brief biographical sketches of the students.

Abilene Christian University: CARISSA JOY STRAWN. Strawn excelled in high school and was a member of the National Honor Society and the Beta Club. She was the Class of 2005 Historian and competed at the state level in National

History Day. While in high school she also tutored in mathematics, chemistry, and physics.

Amherst College: JENNIFER A. ROBERGE. Roberge is a junior at Amherst College working on a double major in mathematics and computer science. Her love for mathematics grew as her high school courses became more challenging. She joined the math team and competed in regional competitions as a high school junior. She enjoys learning foreign languages, particularly French and ancient Greek, and works as a tutor.

Arizona State University: YUKIKO KOZAKAI. Kozakai was born in Japan and for seventeen years worked for one of Japan's largest department stores. During this time she learned about marketing and management and realized that she needed a better knowledge of English to advance in these areas. She came to the United States intending to stay long enough to refine her knowledge of English while working toward an associate degree in business administration. She became aware of the beauty of mathematics through business mathematics courses and soon developed a passion for the subject. After going back to Japan she decided to return to the U.S. to pursue mathematics. In August 2003 she was accepted into Arizona State University and is working toward a mathematics degree. She has an excellent record and has become interested in pursuing actuarial science.

University of Missouri, Kansas City: MELANIE MARIE MEYER. Melanie began studying computer science, with a mathematics minor, at Truman State University. After her child was born, she moved back to the Kansas City area to be closer to her family and is now raising her three-year-old son while attending the University of Missouri as a mathematics major. She works part-time but has not missed a semester of college and has not reduced the number of courses. Her grades have been very strong, and she is planning to go on to earn at least a master's degree in mathematics. "Melanie shows talent, perseverance, and strength of character," the mathematics department told the AMS. "The scholarship will allow her to stop working and spend more time on her studies." The department contributed an additional US\$1,000 to the Trjitzinsky Award.

University of North Carolina at Greensboro: CHRISTIAN SYKES. After dropping out of high school, Sykes enrolled in a community college, where he took a precalculus course to fulfill academic requirements. Sensing his mathematical talent, his teacher urged him to take more courses in the subject. He took his teacher's advice after transferring to the University of North Carolina at Greensboro, and he soon found mathematics enthralling. He has excelled as a mathematics major and is currently interested in evolutionary game theory. He plans to pursue graduate studies in pure mathematics. He also has interests in ecology, sound synthesis and audio signal processing, and musical composition.

University of Rhode Island: CHRISTOPHER PIECUCH. Piecuch enrolled in the University of Rhode Island in 2001 as a mechanical engineering major. Shortly thereafter he switched to a double major in mathematics and physics and later added a third major in German. He was involved in several research projects in both the physics and the physical

oceanography departments at the university. He was elected to Pi Mu Epsilon, Phi Kappa Phi, and Phi Beta Kappa. He spent a year in Germany, where he took courses at the Technische Universität Braunschweig and held an internship at Bosch GMBH in Stuttgart. He plans to pursue a graduate degree in either education or mathematics and then to teach at the high school or college level.

Ohio State University: SOPHIA LEIBMAN and GABOR REVESZ. Leibman is a very talented student who completed two years of challenging and rigorous honors mathematics courses—including advanced analysis, linear algebra, differential equations, complex analysis, and vector analysis—while still in high school. She placed first in an OSU mathematics olympiad for first- and second-year students. She is now doing a double major in mathematics and physics and is a mentor in the honors advanced analysis sequence. Revesz is an older student who began his studies at a community college and transferred to OSU in 2004. He has taken many challenging courses, including honors courses in advanced analysis, abstract algebra, and number theory. He has been an active participant in VIGRE working groups and was involved in a project to translate classic works. He placed first in a recent OSU olympiad for advanced undergraduates. He will graduate in spring 2006 and plans to pursue graduate studies in mathematics. The OSU mathematics department contributed matching funds to the Trjitzinsky Award, so that Leibman and Revesz each received a US\$3,000 scholarship.

—Allyn Jackson

Erdős Memorial Lectures

In October 2005, Persi Diaconis of Stanford University delivered the Paul Erdős Memorial Lecture at the Eastern Sectional Meeting at Bard College. The title of his lecture was “Erdős picture of ‘most things’”.

The Erdős Memorial Lectures are presented annually at AMS sectional meetings. This lecture series is made possible through the generosity of Andrew Beal, a Dallas banker who has committed US\$100,000 as a prize for the solution of the so-called Beal Conjecture. The AMS holds the prize funds, and Beal has requested that income from the funds be used to support the lecture series. See the Web page <http://www.math.unt.edu/~mauldin/beal.html> for more information about the Beal Conjecture and prize.

Previous Erdős Lecturers are Bernd Sturmfels, Avi Wigderson, Hillel Furstenberg, Carl Pomerance, John H. Conway, and Ronald L. Graham. Béla Bollobás, University of Memphis and University of Cambridge, will present the 2006 Erdős Memorial Lecture at the Central Section Meeting at the University of Notre Dame in April 2006. For further information, see the Web page <http://www.ams.org/meetings/erdos-lect.html>.

—Allyn Jackson

AMS Annual Report Issued

The Annual Report of the AMS for 2004–2005 was issued in the fall of 2005. It contains a wealth of information about the Society, its activities, and its finances. The report may be downloaded from the Web at <http://www.ams.org/ams/AnnualReport04-05.pdf>.

—Allyn Jackson

Deaths of AMS Members

ARTHUR A. BROWN, retired, from Cambridge, MA, died in March 1999. Born on September 2, 1913, he was a member of the Society for 59 years.

WEI-NUNG LIU, from St. Louis, MO, died on September 1, 2004. Born on June 24, 1936, he was a member of the Society for 33 years.

RODNEY J. ROTH, retired, from Montclair, NJ, died in 2003. Born on March 13, 1927, he was a member of the Society for 44 years.

Reference and Book List

The *Reference* section of the Notices is intended to provide the reader with frequently sought information in an easily accessible manner. New information is printed as it becomes available and is referenced after the first printing. As soon as information is updated or otherwise changed, it will be noted in this section.

Contacting the Notices

The preferred method for contacting the Notices is electronic mail. The editor is the person to whom to send articles and letters for consideration. Articles include feature articles, memorial articles, communications, opinion pieces, and book reviews. The editor is also the person to whom to send news of unusual interest about other people's mathematics research.

The managing editor is the person to whom to send items for "Mathematics People", "Mathematics Opportunities", "For Your Information", "Reference and Book List", and "Mathematics Calendar". Requests for permissions, as well as all other inquiries, go to the managing editor.

The electronic-mail addresses are notices@math.ou.edu in the case of the editor and notices@ams.org in the case of the managing editor. The fax numbers are 405-325-7484 for the editor and 401-331-3842 for the managing editor. Postal addresses may be found in the masthead.

Upcoming Deadlines

December 15, 2005: Applications for NRC-Ford Foundation Diversity Postdoctoral Fellowships. See the website <http://www7.nationalacademies.org/fellowships/> or contact Fellowships Office, GR 346A, National Research Council of the National Academies, 550 Fifth Street, NW, Washington, DC 20001; telephone:

202-334-2872; email: infofell@nas.edu.

December 15, 2005: Applications for AMS Epsilon Fund. See <http://www.ams.org/outreach/epsilon.html>, or contact Membership and Programs Department, AMS, 201 Charles Street, Providence, RI 02904-2294; telephone 800-321-4267, ext. 4170; email: prof-serv@ams.org.

Where to Find It

A brief index to information that appears in this and previous issues of the Notices.

AMS Bylaws—November 2005, p. 1239

AMS Email Addresses—December 2004, p. 1365

AMS Ethical Guidelines—June/July 2004, p. 675

AMS Officers 2004 and 2005 (Council, Executive Committee, Publications Committees, Board of Trustees)—May 2005, p. 564

AMS Officers and Committee Members—October 2005, p. 1073

Conference Board of the Mathematical Sciences—September 2005, p. 892

Information for Notices Authors—June/July 2005, p. 660

Mathematics Research Institutes Contact Information—August 2005, p. 770

National Science Board—January 2006, p. 62

New Journals for 2004—June/July 2005, p. 662

NRC Board on Mathematical Sciences and Their Applications—March 2005, p. 361

NRC Mathematical Sciences Education Board—April 2005, p. 465

NSF Mathematical and Physical Sciences Advisory Committee—February 2005, p. 261

Program Officers for Federal Funding Agencies—October 2005, p. 1069 (DoD, DoE); November 2005, p. 1223 (NSF)

Stipends for Study and Travel—September 2005, p. 900

December 20, 2005: Proposals for NSF Program on Mathematical Sciences: Innovations at the Interface with the Physical and Computer Sciences and Engineering: Astronomy and Materials Research. See "Mathematics Opportunities" in this issue.

December 31, 2005: Supporting references for Alan T. Waterman Award. See <http://www.nsf.gov>.

December 31, 2005: Applications/nominations for AIM Five-Year Fellow. See <http://www.aimath.org/fellows/>.

January 1, 2006: Submissions for Competition 2006 of the European Mathematical Society. See <http://www.mat.dtu.dk/people/V.L.Hansen/rpa/secondartcomp.html>.

January 1, 2006: Applications for ICM 2006 Travel Grants. See <http://www.icm2006.org> or email: grants@icm2006.org.

January 6, 2006: Applications for National Defense Science and Engineering Graduate (NDSEG) Fellowships. See "Mathematics Opportunities" in this issue.

January 10, 2006: Applications for AAUW Educational Foundation Fellowships and Grants. See http://www.aauw.org/fga/fellowships_grants/selected.cfm or contact the AAUW Educational Foundation, 1111 Sixteenth St. N.W., Washington, DC 20036; telephone 800-326-2289 (AAUW); fax 202-872-1425; email: info@aauw.org.

January 13, 2006: Proposals for NSF Program on Mathematical Sciences: Innovations at the Interface with the Physical and Computer Sciences and Engineering: Chemistry. See "Mathematics Opportunities" in this issue.

January 15, 2006: Applications for AMS-AAAS Mass Media Fellowships. See "Mathematics Opportunities" in this issue.

January 26, 2006: Proposals for NSF Scientific Computing Research Environments for the Mathematical Sciences (SCREMS). See "Mathematics Opportunities" in this issue.

January 27, 2006: Proposals for Partnerships for Adaptation, Implementation, and Dissemination Awards of the NSF ADVANCE Program. See

the website http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5383.

January 31, 2006: Applications for postdoctoral fellowships at the Institut Mittag-Leffler. See the website <http://www.mittag-leffler.se/grants>.

February 1, 2006: Applications for AWM Travel Grants and Mentoring Travel Grants. See <http://www.awm-math.org/travelgrants.html>; telephone 703-934-0163; email: awm@math.umd.edu; or contact Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

February 10, 2006: Applications for Math for America Foundation Newton Fellowships. See the website <http://www.mathforamerica.org/>.

February 15, 2006: Nominations for Clay Mathematics Institute (CMI) Lifftoff Program. See "Mathematics Opportunities" in this issue.

March 1, 2006: Proposals for NSF Program on Mathematical Sciences: Innovations at the Interface with the Physical and Computer Sciences and Engineering: Computer Science. See "Mathematics Opportunities" in this issue.

March 1, 2006: Applications for EDGE Program. See the website <http://www.edgeforwomen.org/> or contact the EDGE Program, Department of Mathematics, Bryn Mawr College, 101 North Merion Avenue, Bryn Mawr, PA 19010; email: edge@edgeforwomen.org; telephone 610-876-3527.

March 31, 2006: Nominations for Third World Academy of Sciences Prizes. See <http://www.twas.org/>.

May 1, 2006: Applications for AWM Travel Grants. See <http://www.awm-math.org/travelgrants.html>; telephone 703-934-0163; email: awm@math.umd.edu; or contact Association for Women in Mathematics, 11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

October 1, 2006: Applications for AWM Travel Grants. See <http://www.awm-math.org/travelgrants.html>; telephone 703-934-0163; email: awm@math.umd.edu; or contact Association for Women in Mathematics,

11240 Waples Mill Road, Suite 200, Fairfax, VA 22030.

National Science Board

The National Science Board is the policymaking body of the National Science Foundation. Listed below are the current members of the NSB. For further information, visit the website <http://www.nsf.gov/nsb/>.

Dan Arvizu (Consultant)
Director and Chief Executive
National Renewable Energy
Laboratory (NREL)

Barry C. Barish
Linde Professor of Physics
California Institute of Technology

Steven Beering
President Emeritus
Purdue University

Ray Bowen
Former President
Texas A&M University

G. Wayne Clough
President
Georgia Institute of Technology

Kelvin K. Droegemeier
Regents' Professor of Meteorology
Roger and Sherry Teigen
Presidential Professor
Director, Center for Analysis
and Prediction of Storms
Director, Sasaki Institute
University of Oklahoma

Delores M. Etter
Professor of Electrical Engineering
United States Naval Academy

Nina V. Fedoroff
Willaman Professor of Life Sciences
Director, Life Sciences Consortium
Director, Biotechnology Institute
Pennsylvania State University

Kenneth M. Ford
Director, Institute for Human and
Machine Cognition
University of West Florida

Daniel E. Hastings
Director, Engineering Systems
Division
Professor, Aeronautics and

Astronautics and Engineering
Systems
Massachusetts Institute
of Technology

Elizabeth Hoffman
President Emerita
Professor of Economics
and Public Affairs
University of Colorado at Denver

Louis Lanzerotti
Distinguished Professor of Physics
Center for Solar Terrestrial
Research
Department of Physics
New Jersey Institute of Technology

Alan I. Leshner
Chief Executive Officer
American Association for the
Advancement of Science

Jane Lubchenco
Wayne and Gladys Valley Professor
of Marine Biology
Distinguished Professor of Zoology
Oregon State University

Diana S. Natalicio (vice chair)
President
University of Texas at El Paso

Douglas D. Randall
Professor of Biochemistry
Director, Interdisciplinary Program
on Plant Biochemistry-Physiology
University of Missouri

Michael G. Rossmann
Hanley Distinguished Professor
of Biological Sciences
Purdue University

Daniel Simberloff
Nancy Gore Hunger Professor
of Environmental Science
Department of Ecology
and Evolutionary Biology
University of Tennessee

Jon C. Strauss
President
Harvey Mudd College

Kathryn D. Sullivan
President and CEO
Center of Science and Industry

Jo Anne Vasquez
Mesa Public Schools (Retired)

Warren M. Washington
Senior Scientist and Section Head
National Center for Atmospheric
Research

John A. White Jr.
Chancellor
University of Arkansas

Mark S. Wrighton
Chancellor
Washington University in St. Louis

Arden L. Bement Jr.
(member ex officio)
Director
National Science Foundation

Michael P. Crosby
Executive Officer and
Office Director
National Science Board

The contact information for the Board
is: National Science Board, National
Science Foundation, 4201 Wilson
Boulevard, Suite 1225, Arlington, VA
22230; telephone 703-292-5111;
World Wide Web <http://www.nsf.gov/nsb/>.

Book List

The Book List highlights books that have mathematical themes and are aimed at a broad audience potentially including mathematicians, students, and the general public. When a book has been reviewed in the Notices, a reference is given to the review. Generally the list will contain only books published within the last two years, though exceptions may be made in cases where current events (e.g., the death of a prominent mathematician, coverage of a certain piece of mathematics in the news) warrant drawing readers' attention to older books. Suggestions for books to include on the list may be sent to notices-booklist@ams.org.

*Added to "Book List" since the list's last appearance.

13: *The Story of the World's Most Popular Superstition*, by Nathaniel Lachenmeyer. Thunder's Mouth Press, October 2004. ISBN 1-568-58306-0.

1089 and All That. *A Journey into Mathematics*, by David Acheson. Oxford University Press, July 2002. ISBN 0-19-851623-1. (Reviewed February 2005.)

Action This Day, edited by Michael Smith and Ralph Erskine. Random House of Canada, February 2003. ISBN 0-593-04910-1.

Alfred Tarski: Life and Logic, by Anita Burdman Feferman and Solomon Feferman. Cambridge University Press, October 2004. ISBN 0-521-80240-7.

Beyond Reason: Eight Great Problems That Reveal the Limits of Science, by A. K. Dewdney. Wiley, April 2004. ISBN 0-471-01398-6.

**The Book of Presidents*. London Mathematical Society, 2005. ISBN 0-950-27341-4.

A Brief History of Infinity, by Paolo Zellini. Penguin Books (paperback), March 2005. ISBN 0-141-00762-1.

A³ & His Algebra: How a Boy from Chicago's West Side Became a Force in American Mathematics, by Nancy E. Albert. iUniverse, Inc., January 2005. ISBN 0-595-32817-2. (Reviewed December 2005.)

The Calculus Gallery: Masterpieces from Newton to Lebesgue, by William Dunham. Princeton University Press, December 2004. ISBN 0-691-09565-5.

Chance: A Guide to Gambling, Love, the Stock Market and Just About Everything Else, by Amir D. Aczel. Thunder's Mouth Press, October 2004. ISBN 1-56858-316-8. (Reviewed August 2005.)

Coincidences, Chaos, and All That Math Jazz: Making Light of Weighty Ideas, by Edward B. Burger and Michael Starbird. W. W. Norton, August 2005. ISBN 0-393-05945-6.

The Colours of Infinity: The Beauty and Power of Fractals, by Michael Barnsley, Nigel Lesmoir-Gordon, Benoit B. Mandelbrot, Ian Stewart, Gary Flake, Robert Prechter, and Arthur C. Clarke. Clear Press, March 2004. ISBN 1-904-55505-5.

Complexities: Women in Mathematics, edited by Bettye Anne Case and Anne M. Leggett. Princeton University Press, January 2005. ISBN 0-691-11462-5.

Converging Realities: Toward a Common Philosophy of Physics and

Mathematics, by Roland Omnes. Princeton University Press, November 2004. ISBN 0-691-11530-3.

The Curious Incident of the Dog in the Nighttime, by Mark Haddon. Vintage, May 2004. ISBN 1-400-03271-7.

Dark Hero of the Information Age: In Search of Norbert Wiener, by Flo Conway and Jim Siegelman. Basic Books, December 2004. ISBN 0-738-20368-8.

The Equation That Couldn't Be Solved (How Mathematical Genius Discovered the Language of Symmetry), by Mario Livio. Simon and Schuster, September 2005. ISBN 0-743-25820-7.

The Essential Turing, edited by B. Jack Copeland. Oxford University Press, September 2004. ISBN 0-198-25080-0.

Experimentation in Mathematics: Computational Paths to Discovery, by Jonathan Borwein, David Bailey, and Roland Girgensohn. A K Peters, March 2004. ISBN 1-56881-136-5. (Reviewed September 2005.)

The Fermat Diary, by C. J. Mozzochi. AMS, August 2000. ISBN 0-8218-2670-0.

The Fermat Proof, by C. J. Mozzochi. Trafford Publishing, Inc., February, 2004. ISBN 1-412-02203-7.

From Eudoxus to Einstein: A History of Mathematical Astronomy, by C. M. Linton. Cambridge University Press, August 2004. ISBN 0-521-82750-7.

Geometry and Meaning, by Dominic Widdows. Center for the Study of Language and Information, November 2004. ISBN 1-575-86448-7.

**God Created the Integers*, by Stephen Hawking. Running Press, October 2005. ISBN 0-762-41922-9.

The Golden Ratio: The Story of Phi, the World's Most Astonishing Number, by Mario Livio. Broadway Books, September 2003. ISBN 0-7679-0816-3. (Reviewed March 2005.)

Graphic Discovery: A Trout in the Milk and Other Visual Adventures, by Howard Wainer. Princeton University Press, October 2004. ISBN 0-691-10301-1.

The Heart of Mathematics: An Invitation to Effective Thinking, by Edward B. Burger and Michael Starbird. Key College Publishing (Springer-Verlag), April 2000. ISBN

0-555953-407-9. (Reviewed February 2005.)

Incompleteness: The Proof and Paradox of Kurt Gödel, by Rebecca Goldstein. W. W. Norton, February 2005. ISBN 0-393-05169-2.

The Infinite Book: Where Things Happen That Don't, by John D. Barrow. Jonathan Cape, February 2005. ISBN 0-224-06917-9.

Introducing Game Theory and its Applications, by Elliott Mendelson. CRC Press, July 2004. ISBN 1-584-88300-6.

János Bolyai, Euclid, and the Nature of Space, by Jeremy J. Gray. MIT Press, May 2003. ISBN 0-262-57174-9. (Reviewed October 2005.)

John Pell (1611-1685) and His Correspondence with Sir Charles Cavendish: The Mental World of an Early Modern Mathematician, by Noel Malcolm and Jacqueline Stedall. Oxford University Press, second edition, January 2005. ISBN 0-198-56484-8.

The Knot Book: An Elementary Introduction to the Mathematical Theory of Knots, Colin C. Adams. AMS, September 2004. ISBN 0-8218-3678-1. (Reviewed September 2005.)

Knots and Links, by Peter R. Cromwell. Cambridge University Press, October 2004. ISBN 0-691-10301-1.

The Liar Paradox and the Towers of Hanoi: The Ten Greatest Math Puzzles of All Time, by Marcel Danesi. Wiley, August 2004. ISBN 0-471-64816-7.

Luck, Logic, and White Lies: The Mathematics of Games, by Jörg Bewersdorff. Translated by David Kramer. A K Peters, November 2004. ISBN 1-568-81210-8.

Math and the Mona Lisa: The Art and Science of Leonardo da Vinci, by Bulent Atalay. Smithsonian Books, April 2004. ISBN 1-588-34171-2.

The Math Instinct: Why You're a Mathematical Genius (Along with Lobsters, Birds, Cats, and Dogs), by Keith Devlin. Thunder's Mouth Press, March 2005. ISBN 1-560-25672-9.

Math Magic: How to Master Everyday Math Problems, by Scott Flansburg. Perennial Currents, revised edition, August 2004. ISBN 0-060-72635-0.

Mathematical Adventures for Students and Amateurs, David F. Hayes and Tatiana Shubin, editors. Mathe-

matical Association of America, 2004. ISBN 0-88385-548-8.

Mathematical Illustrations: A Manual of Geometry and PostScript, by Bill Casselman. Cambridge University Press, December 2004. ISBN 0-521-54788-1.

A Mathematician at the Ballpark: Odds and Probabilities for Baseball Fans, by Ken Ross. Pi Press, July 2004. ISBN 0-131-47990-3.

Mathematicians under the Nazis, by Sanford L. Segal. Princeton University Press, July 2003. ISBN 0-691-00451-X. (Reviewed April 2005.)

Mathematics: A Very Short Introduction, by Timothy Gowers. Oxford University Press, October 2002. ISBN 0-192-85361-9. (Reviewed February 2005.)

Mathematics by Experiment: Plausible Reasoning in the 21st Century, by Jonathan Borwein and David Bailey. A K Peters, December 2003. ISBN 1-56881-211-6. (Reviewed September 2005.)

Mathematics in Nature: Modeling Patterns in the Natural World, by John A. Adam. Princeton University Press, November 2003. ISBN 0-691-11429-3. (Reviewed June/July 2005.)

**Meta Math! The Quest for Omega*, by Gregory Chaitin. Pantheon, October 2005. ISBN 0-375-42313-3.

The (Mis)Behavior of Markets: A Fractal View of Risk, Ruin and Reward, by Benoit Mandelbrot and Richard Hudson. Basic Books, August 2004. ISBN 0-465-04355-0.

More Damned Lies and Statistics: How Numbers Confuse Public Issues, by Joel Best. University of California Press, August 2004. ISBN 0-520-23830-3.

More Mathematical Astronomy Morsels, by Jean Meeus. Willmann-Bell, 2002. ISBN 0-943396-743.

Musings of the Masters: An Anthology of Miscellaneous Reflections, edited by Raymond G. Ayoub. Mathematical Association of America, 2004. ISBN 0-88385-549-6.

The Newtonian Moment: Isaac Newton and the Making of Modern Culture, by Mordechai Feingold. New York Library and Oxford University Press, December 2004. ISBN 0-195-17735-5.

Numbers, the Language of Science, by Tobias Dantzig. Pi Press, fifth edition, March 2005. ISBN 0-131-85627-8.

The Oxford Murders, by Guillermo Martínez. Abacus, January 2005. ISBN 0-349-11721-7. (Reviewed November 2005.)

The Pea and the Sun: A Mathematical Paradox, by Leonard M. Wapner. A K Peters, April 2005. ISBN 1-568-81213-2.

Probability Theory: The Logic of Science, by E. T. Jaynes. Edited by G. Larry Bretthorst. Cambridge University Press, April 2003. ISBN 0-521-59271-2. (Reviewed in this issue.)

R. L. Moore: Mathematician and Teacher, by John Parker. Mathematical Association of America, 2004. ISBN 0-88385-550-X.

Reality Conditions: Short Mathematical Fiction, by Alex Kasman. Mathematical Association of America, May 2005. ISBN 0-88385-552-6.

The Road to Reality: A Complete Guide to the Laws of the Universe, by Roger Penrose. Knopf, February 2005. ISBN 0-679-45443-8.

Saunders Mac Lane: A Mathematical Autobiography, by Saunders Mac Lane. A K Peters, Ltd., May 2005. ISBN 1-568-81150-0. (Reviewed December 2005.)

Science in the Looking Glass, by E. Brian Davies. Oxford University Press, August 2003. ISBN 0-19-852543-5. (Reviewed December 2005.)

Sneaking a Look at God's Cards: Unraveling the Mysteries of Quantum Mechanics, by Giancarlo Ghirardi, translated by Gerald Malsbary. Princeton University Press, revised edition, January 2005. ISBN 0-691-12139-7.

Spaceland, by Rudy Rucker. Tor Books, June 2002. ISBN 0-765-30366-3. (Reviewed August 2005.)

Stalking the Riemann Hypothesis: The Quest to Find the Hidden Law of Prime Numbers, by Dan Rockmore. Pantheon, April 2005. ISBN 0-375-42136-X.

A Tour through Mathematical Logic, by Robert S. Wolf. Mathematical Association of America, January 2005. ISBN 0-88385-036-2.

The Transformation of Mathematics in the Early Mediterranean World: From Problems to Equations, by Reviel

Netz. Cambridge University Press, June 2004. ISBN 0-521-82996-8.

The Universal Book of Mathematics: From Abracadabra to Zeno's Paradoxes, by David Darling. Wiley, July 2004. ISBN 0-471-27047-4.

Using the Mathematics Literature, by Kristine K. Fowler. Marcel Dekker, June 2004. ISBN 0-824-75035-7.

The Works of Archimedes: Translation and Commentary. Volume I: *The Two Books On the Sphere and The Cylinder*. Edited and translated by Reviel Netz. Cambridge University Press, April 2004. ISBN 0-521-66160-9. (Reviewed May 2005.)

A World without Time: The Forgotten Legacy of Gödel and Einstein, by Palle Yourgrau. Basic Books, January 2005. ISBN 0-465-09293-4.

You Can Do the Math: Overcome Your Math Phobia and Make Better Financial Decisions, by Ron Lipsman. Praeger Publishers, November 2004. ISBN 0-275-98341-2.

About the Cover

From knots to Nobel

As Abraham Neyman explains in this issue, the mathematician Robert Aumann shares with Thomas Schelling the 2005 Nobel Prize in Economics, for his work in game theory. Perhaps somewhat surprisingly, but somewhat like John Nash before him, Aumann began his career at M.I.T. as a graduate student with the topologist Whitehead as advisor.

The background of the cover exhibits one of the images in the published version of Aumann's thesis ("Aphericity of alternating knots", *Annals of Mathematics*, volume 64, page 381).

The photographs show a few snapshots from his career. At the left is one taken at M.I.T. in 1952, along with (left to right) Lonnie Cross, D. J. Newman, (Aumann), Allan Shields, Seymour Haber, (unknown), and Harold Shapiro. At top, a photograph taken at Oberwolfach. At bottom, one with John Nash at the first Congress of the Game Theory Society.

Our thanks to Neyman for assembling the photographs.

—Bill Casselman, Graphics Editor
(notices-covers@ams.org)



Mathematics Calendar

The most comprehensive and up-to-date Mathematics Calendar information is available on e-MATH at <http://www.ams.org/mathcal/>.

January 2006

* **5-15 International Workshop on Teichmüller Theory and Moduli Problems**, Harish-Chandra Research Institute (HRI), Allahabad, India.

Description: The principal aim of the workshop is to bring closer two mathematical traditions, namely the Ahlfors-Bers school of the complex analytic approach to Teichmüller theory, and the algebro-geometric tradition of the moduli of vector bundles that has flourished in India. Another aim of the workshop is to introduce young researchers to some fundamental techniques and recent developments in the fields. The Workshop is funded by National Science Foundation (USA), Department of Science and Technology (India), Infosys foundations.

Organizers: Ravi Kulkarni (HRI, India), Sudeb Mitra (CUNY, USA), Indranil Biswas (TIFR, India).

Information: <http://www.mri.ernet.in/~teich>. To attend the Workshop contact email: teich@mri.ernet.in.

February 2006

* **3-5 CUNY Geometric Analysis 2006: The Laplace and Length Spectra**, CUNY Graduate Center, New York, New York.

Confirmed Speakers: C. Croke, Univ. of Pennsylvania, Carolyn Gordon, Dartmouth College, R. Gornet, Univ. of Texas at Arlington, N. Hingston, The College of New Jersey, M. Kotani, Tohoku Univ., A. Nabutovsky, Univ. Toronto and Penn State, I. Polterovich, Univ. Montreal, R. Rotman, Penn State and Univ. Toronto, P. Sarnak, Princeton Univ., T. Sunada, Meiji Univ., Z. I. Szabo, CUNY Grad. Center and Lehman College, A. Vasy, Stanford Univ. and MIT.

Organizers: Y. Petridis, C. Sormani, J. Dodziuk.

Registration: Free for students, \$20 for others who register before

Jan. 15 and \$30 onsite.

Information: <http://comet.lehman.cuny.edu/sormani/conf/2006/geom06.html>.

* **26-March 4 The 2006 Talbot workshop: Automorphisms of manifolds**, North Conway, New Hampshire.

Description: The Talbot workshop will constitute a weeklong retreat in New Hampshire, bringing together a small group of graduate students and junior faculty in an informal and collaborative environment to study the topology of homeomorphism and diffeomorphism groups of manifolds and related topics in surgery, geometric topology, algebraic K-theory, calculus of functors, and index theory.

Plenary speaker: Michael Weiss.

Organizers: Chris Douglas, John Francis, Andre Henriques, Mike Hill.

Contact: For more information about participating in the workshop, email Mike Hill (mikehill@math.mit.edu).

Information: <http://www-math.mit.edu/~jnkf/talbot>.

March 2006

* **2-5 SouthEastern Analysis Meeting, SEAM XXII**, University of Florida, Gainesville, Florida.

Description: The University of Florida math department is hosting the 22nd edition of SEAM as part of its special year in probability and analysis.

Information: For conference details, visit the special year web site <http://www.math.ufl.edu/~sam/payr>.

* **12-25 RSES/ESI Educational Workshop on Discrete Probability**, Erwin Schrodinger Institute (ESI), Vienna, Austria.

This section contains announcements of meetings and conferences of interest to some segment of the mathematical public, including ad hoc, local, or regional meetings, and meetings and symposia devoted to specialized topics, as well as announcements of regularly scheduled meetings of national or international mathematical organizations. A complete list of meetings of the Society can be found on the last page of each issue.

An announcement will be published in the *Notices* if it contains a call for papers and specifies the place, date, subject (when applicable), and the speakers; a second announcement will be published only if there are changes or necessary additional information. Once an announcement has appeared, the event will be briefly noted in every third issue until it has been held and a reference will be given in parentheses to the month, year, and page of the issue in which the complete information appeared. Asterisks (*) mark those announcements containing new or revised information.

In general, announcements of meetings and conferences held in North America carry only the date, title of meeting, place of meeting, names of speakers (or sometimes a general statement on the program), deadlines for abstracts or contributed papers, and source of further information. Meetings held outside the North American area may carry more detailed information. In any case, if there is any application deadline with

respect to participation in the meeting, this fact should be noted. All communications on meetings and conferences in the mathematical sciences should be sent to the Editor of the *Notices* in care of the American Mathematical Society in Providence or electronically to notices@ams.org or mathcal@ams.org.

In order to allow participants to arrange their travel plans, organizers of meetings are urged to submit information for these listings early enough to allow them to appear in more than one issue of the *Notices* prior to the meeting in question. To achieve this, listings should be received in Providence eight months prior to the scheduled date of the meeting.

The complete listing of the Mathematics Calendar will be published only in the September issue of the *Notices*. The March, June/July, and December issues will include, along with new announcements, references to any previously announced meetings and conferences occurring within the twelve-month period following the month of those issues. New information about meetings and conferences that will occur later than the twelve-month period will be announced once in full and will not be repeated until the date of the conference or meeting falls within the twelve-month period.

The Mathematics Calendar, as well as Meetings and Conferences of the AMS, is now available electronically through the AMS website on the World Wide Web. To access the AMS website, use the URL: <http://www.ams.org/>.

Minicourses: By Persi Diaconis (Stanford), Alexander Gamburd (Princeton), Gregory Lawler (Cornell), Christophe Pittet (Marseille).
Organizers: V. A. Kaimanovich (Bremen), K. Schmidt (Vienna), W. Woess (Graz).

Information: <http://www.math.tugraz.at/mathc/esi2006/>.

*27-31 **Spectral Theory and Mathematical Physics, A Conference in Honor of Barry Simon's 60th Birthday**, California Institute of Technology, Pasadena, California.

Aim: The conference aims to bring together scholars from around the world for fruitful scientific exchange in a broad range of areas reflecting Barry Simon's scientific interests over the years in Mathematical Physics and Analysis.

Confirmed Speakers: Michael Aizenman (Princeton), Yosi Avron (Technion, Haifa), Alexei Borodin (Caltech, Pasadena), Jean Bourgain (IAS, Princeton), David Damanik (Caltech, Pasadena), E. Brian Davies (King's College, London), Percy Deift (Courant Institute, New York), Laszlo Erdős (Univ. Munich), Richard Froese (UBC, Vancouver), Jürg Fröhlich (ETH-Zürich), Christian Gerard (Univ. Paris Sud, Orsay), Leonid Golinskii (ILT, Kharkov), Gian Michele Graf (ETH-Zürich), George Hagedorn (Virginia Tech, Blacksburg), Evans Harrell (Georgia Tech, Atlanta), Ira Herbst (Univ. Virginia, Charlottesville), Dirk Hundertmark (U. Illinois, Urbana-Champaign), Vojkan Jaksic (McGill U., Montreal), Svetlana Jitomirskaya (UC Irvine), Sergey Khrushchev (Atilim U., Ankara), Rowan Killip (UCLA), Alexander Kiselev (Univ. Wisconsin, Madison), Yoram Last (Hebrew U., Jerusalem), Peter Perry (Univ. Kentucky, Lexington), William Reinhardt (Univ. Washington, Seattle), Lon Rosen (UBC, Vancouver), Wilhelm Schlag (Caltech, Pasadena), Terence Tao (UCLA), Vilmos Totik (Univ. South Florida, Tampa; Univ. Szeged).

Topics: The conference is organized around a topic of the day with reviews of some of Barry Simon's work and typically several reviews on the state of the art of various aspects of the principal subject on each day. The topics are distributed as follows: Monday: Quantum Field Theory, Statistical Mechanics, and Random Matrix Theory; Tuesday: General Nonrelativistic Quantum Mechanics, including N-Body Systems and Resonances; Wednesday: Nonrelativistic Quantum Mechanics in Electric and Magnetic Fields; Semi-Classical Limit; Thursday: Singular Continuous Spectrum, Random and Ergodic Schrödinger Operators; Friday: Orthogonal Polynomials; Non-Selfadjoint Spectral Theory.

Contacts: Cherie Galvez (SimonFest@caltech.edu); Fritz Gesztesy (fritz@math.missouri.edu).

Information: <http://www.math.caltech.edu/mp2006conf.html>.

*30-April 5 **CRM-Clay School on Additive Combinatorics**, Centre de Recherches Mathématiques, Montréal, Quebec, Canada.

Description: Additive combinatorics is one of the most exciting areas in mathematics today, involving ideas from number theory, harmonic and functional analysis, ergodic theory, combinatorics, probability theory and discrete geometry. The school will give the background in these areas to help the students begin to appreciate some of the recent spectacular theorems, such as the result of Green and Tao that there are infinitely many k-term arithmetic progressions of primes and Bourgain's bounds on exponential sums. This school is intended to give to graduate students, postdoctoral fellows and junior faculty an opportunity to participate in these new developments.

Support: The School is supported by CRM, NSERC, NSF, the Clay Foundation and DIMATIA.

Information: email: paradis@crm.umontreal.ca.

April 2006

*22-27 **Design Theory, Graph Theory, and Computational Methods**, IPM, Tehran, Iran.

Organizers: Samad Hedayat (Univ. of Illinois at Chicago, USA), Hadi Kharaghani (Univ. of Lethbridge, Canada), Gholamreza B. Khosrovshahi (IPM and Univ. of Tehran, Iran), Shahriar Shahriari (Pomona College, USA).

Confirmed Speakers: Aart Blokhuis (Eindhoven Univ. of Technology, Netherlands), Andries E. Brouwer (Eindhoven Univ. of Technology, Netherlands), Jeff Dinitz (Univ. of Vermont, USA), Willem H. Haemers (Tilburg Univ., Netherlands), Brendan McKay (Australian National Univ., Australia), Patric Östergård (Helsinki Univ. of Technology, Finland), Qing Xiang (Univ. of Delaware, USA).

Information: <http://www.ipm.ac.ir/combinatoricsII/deadline.htm>.

*30-May 5 **Conference on Topology, Geometry and Physics**, Columbia University, New York, New York.

Description: The conference will be in honor of John Morgan's 60th Birthday. It will take place from May 1-4. It will be preceded by an intensive workshop on gauge theory, symplectic geometry and related topics on April 30th, and will conclude with an intensive workshop on geometrization and hyperbolic geometry on May 5th.

Organizers: Robert Friedman, David Gabai, Peter Ozsváth, András Stipsicz, Zoltán Szabó.

Information: More information will be posted on the conference home page as it becomes available: <http://www.math.columbia.edu/~petero/MorganConference.html>.

May 2006

*14-20 **International Symposium on Functional Equations**, University of Louisville, Louisville, Kentucky.

Topics: Functional equations and inequalities, mean values, functional equations on algebraic structures, Hyers-Ulam stability, regularity properties of solutions, conditional functional equations, iteration theory; applications of the above, in particular to the natural, social, and behavioral sciences.

Local Organizers: T. Riedel (thomas.riedel@louisville.edu) and P. K. Sahoo (sahoo@louisville.edu), University of Louisville, Department of Mathematics, Louisville, KY 40292, USA.

Scientific Committee: J. Aczél (Honorary Chair; Waterloo, ON, Canada), Z. Daróczy (Debrecen, Hungary), R. Ger (Chair; Katowice, Poland), J. Rätz (Bern, Switzerland), L. Reich (Graz, Austria), and A. Sklar (Chicago, IL, USA).

Information: Participation at these annual meetings is by invitation only. Those wishing to be invited to this or one of the following meetings, send details of their interest and, preferably, publications (paper copies) and/or manuscripts with their postal and email address to: R. Ger, Institute of Mathematics, Silesian University, Bankowa 14, PL-40-007 Katowice, Poland (romanger@us.edu.pl) before March 1, 2006.

*22-26 **13th International Conference on Gambling & Risk Taking**, Harrah's Lake Tahoe, Stateline, Nevada.

Description: This once-every-three-year event covers a broad variety of disciplines including mathematics of games. It attracts professional researchers, academics, government and regulatory officials, and gaming executives from around the world.

Call for papers: To view the call for papers, see <http://www.unr.edu/gaming> and click above the photo of Lake Tahoe.

Deadline: Submission deadline: January 15, 2006.

Organizers: Institute for the Study of Gambling & Commercial Gaming, College of Business Administration, University of Nevada, Reno.

Information: Contact: Judy Cornelius (corneliu@unr.nevada.edu) or Danielle Crowther (dcrowthe@unr.nevada.edu); or call 775-784-1442.

*22-27 **"Banach spaces and their applications in Analysis", in honor of Nigel Kalton's 60th birthday**, Miami University, Oxford, Ohio.

Areas of emphasis: Nonlinear theory (Lipschitz classifications of Banach and metric spaces and related topics), Isomorphic theory of Banach spaces including connections with combinatorics and set theory, Algebraic and homological methods in Banach spaces, Approximation theory and algorithms in Banach spaces (greedy

algorithms, interpolation etc.), Functional calculus and applications to Partial Differential Equations.

Principal speakers: Yuri Brudnyi (Technion-Israel Institute of Technology, Israel), Jesus M. F. Castillo (Univ. of Extremadura, Spain), Marianna Csornyei (Univ. College, London, UK), Stephen Dilworth (Univ. of South Carolina), Gilles Godefroy (Univ. Paris VI, France), William B. Johnson (Texas A&M Univ.), Joram Lindenstrauss (Hebrew Univ., Israel), Assaf Naor (Microsoft Research), Edward Odell (Univ. of Texas), Aleksander Pelczynski (Polish Academy of Sciences, Poland), David Preiss (Univ. College, London, UK), Gideon Schechtman (Weizmann Institute of Science, Israel), Thomas Schlumprecht (Texas A&M Univ.), Vladimir Temlyakov (Univ. of South Carolina), Nicole Tomczak-Jaegermann (Univ. of Alberta, Canada), Roman Vershynin (Univ. of California-Davis), Lutz Weis (Univ. Karlsruhe, Germany), Przemyslaw Wojtaszczyk (Warsaw Univ., Poland).

Information: <http://www.users.muohio.edu/randrib/bsaa2006.html>.

Organizers: Beata Randrianantoanina (randrib@muohio.edu), Narcisse Randrianantoanina (randrin@muohio.edu).

* 28-30 Annual Meeting of the Canadian Society for History and Philosophy of Mathematics (CSHPM), York University Toronto, Ontario, Canada.

Description: The CSHPM is dedicated to scholarship in the history and philosophy of mathematics and in bringing that scholarship to bear on teaching and research in mathematics. It is associated with the journals *Historia Mathematica* and *Philosophia Mathematica*. The meeting includes a Special Session (invited speaker to be announced) on Mathematics and the Wider Culture. Talks, in French or English, are solicited both for Contributed Paper Sessions and the Special Session.

Deadlines: Please submit title and abstract by February 1, 2006.

Organizers: Special Session: Sylvia Svitak, email: smsvitak@earthlink.net; Contributed Paper Sessions: Christopher Baltus, email: baltus@oswego.edu.

Information: Registration and lodging are through the Congress of the Social Sciences and Humanities: <http://www.fedcan.ca/congress2006>. For more information visit <http://www.cshpm.org>.

* 30-June 2 DAYS on DIFFRACTION-2006, St. Petersburg University & St. Petersburg Branch Steklov Math. Inst., St. Petersburg, Russia.

Program: Mathematical aspects of wave propagation. Asymptotic techniques. Scattering and diffraction. Electromagnetics. Sound propagation and vibration. Elastic waves and seismology. Nonlinear waves. Microwave and quantum waveguides. Inverse problems. Numerical approaches. Non-stationary phenomena.

Organizers: St. Petersburg Dept. of Steklov's Math. Institute. Division of Physics of St. Petersburg University. Euler International Mathematical Institute. Co-Chairs Prof. V. M. Babich and Prof. V. S. Buldyrev.

Deadlines: Proposals to organize a session and abstract submissions: Feb. 15, 2006. Notification of acceptance: March 15, 2006. Registration: April 1, 2006. Full paper submission: Sept. 15, 2006.

Information: <http://math.nw.ru/dd06>.

June 2006

* 5-9 Poisson 2006: Poisson Geometry in Mathematics and Physics, National Olympic Memorial Youth Center, Tokyo, Japan.

Purpose: This conference continues a series of biannual conferences which emphasize not only Poisson geometry itself, but also its relations to other areas of mathematics and to physics. This 5th conference will focus on Poisson structures and Dirac structures, Poisson groupoids, Lie and Courant algebroids, Hamiltonian systems and generalized moment maps, deformation quantization, Poisson sigma models, and string theory.

Confirmed speakers: A. Alekseev (Geneva), H. Bursztyn (Rio de Janeiro), A. Cattaneo (Zurich), M. Crainic (Utrecht), J.-P. Dufour (Montpellier), R. Fernandes (Lisbon), M. Gekhtman (South Bend), V.

Ginzburg (Santa Cruz), M. Gualtieri (Cambridge), N. Ikeda (Shiga), A. Karabegov (Abilene), M. Kontsevich (Bures-sur-Yvette), J. -H. Lu (Hong Kong), S. Merkulov (Stockholm), J. S. Park (Seoul), T. Ratiu (Lausanne), M. Rieffel (Berkeley), P. Schapira (Paris) B. Tsygan (Evanston), M. van den Bergh (Diepenbeek), S. Waldmann (Freiburg), A. Weinstein (Berkeley), P. Xu (University Park), H. Yoshimura (Tokyo), Y. Zhang (Beijing).

Scientific committee: A. Alekseev (Geneva), A. Cattaneo (Zurich), J. Grabowski (Warsaw), S. Gutt (Brussels), Y. Kosmann-Schwarzbach (Palaiseau), J. -H. Lu (Hong Kong), T. Z. Nguyen (Toulouse), T. Ratiu (Lausanne), A. Weinstein (Berkeley), P. Xu (University Park).

Organizing committee: P. Bieliavsky (Louvain-la-Neuve), G. Dito (Dijon), Y. Maeda (Yokohama), K. Mikami (Akita), N. Nakanishi (Gifu), A. Yoshioka (Tokyo).

Information: email: maeda@math.keio.ac; <http://www.u-bourgogne.fr/monge/g.dito/poisson2006>. Other information: A pre-school for this conference will also be held from May 31-June 2, 2006 at Keio University, Yokohama, Japan. Lecturers will be: M. Kontsevich (Bures-sur-Yvette), E. Meinrenken (Toronto), T. Z. Nguyen (Toulouse).

* 11-14 ICMSE 2006- International Conference in Mathematics, Sciences and Science Education, University of Aveiro, Aveiro, Portugal.

Description: The International Conference in Mathematics, Sciences and Science Education, ICMSE 2006, provides opportunities for mathematics and science teachers, educators and researchers to contribute and listen to research presentations and be actively involved in special interest groups developed around the conference theme of Mathematics Education, Science Education and History of Science. It is a precious occasion to hear about primary, secondary and university mathematics and science matters which aims to encourage and promote quality research in these areas.

Topics: Relevant topics include but are not restricted to History of Science and New Trends in Science Education and Technology applied to Mathematics, Physics, Chemistry and Computer Sciences.

Information: <http://gag.mat.ua.pt/ICMSE/index.html>.

* 13-17 The Fifteenth International Workshop on Matrices and Statistics, Uppsala, Sweden.

Purpose: To stimulate research, in an informal setting, and to foster the interaction of researchers in the interface between matrix theory and statistics. Additional emphasis will be put on related numerical linear algebra issues and numerical solution methods, relevant to problems arising in statistics. The workshop will include both invited and contributed talks.

Speakers: Theodore Anderson, Stanford University, USA; Gene Golub, Stanford University, USA; David Harville, IBM Thomas J. Watson Research Center, USA; Sabine Van Huffel, Katholieke Universiteit Leuven, Belgium; Ingram Olkin, Stanford University, USA; Friedrich Pukelsheim, University of Augsburg, Germany; Yousef Saad, University of Minnesota, USA; Muni Srivastava, University of Toronto, Canada.

Information: Please visit <http://www.bt.slu.se/iwms2006/iwms06.html>.

* 16-20 CAIMS-MITACS Joint Annual Conference, York University, Toronto, Ontario, Canada.

Workshop Topics: The meeting features a number of invited scientific sessions in the areas of: Bioinformatics. Communication and Security in Ad Hoc Networks. Data Mining (joint with the Statistical Society of Canada). Fluid Dynamics (the 17th Canadian Symposium on Fluid Dynamics). Image Processing and Inverse Problems. Industrial Mathematics. Financial Mathematics. Nonlinear Dynamics in the Health Sciences. Operations Research and Optimization. Scientific Computing. Symbolic Computation. Visual Mathematics.

Information: Any questions or requests for more information should be addressed by e-mail to ac06@mitacs.ca; <http://www.mitacs.ca/AC06>.

19-23 **Formal Power Series and Algebraic Combinatorics 2006**, Catamaran Resort Hotel, Pacific Beach, San Diego, California.

Topics: All aspects of combinatorics and their relations with other parts of mathematics, physics, computer science, and biology.

Speakers: Marge Bayer (University of Kansas), Fan Chung (Univ. Calif., San Diego), Jim Haglund (Ohio State University), Tom Koornwinder (Univ. van Amsterdam), Seok-Jin Kang (Seoul National University), Nigel Ray (University of Manchester), Bruce Sagan (Michigan State University), Michelle Wachs (University of Miami).

Information: Deadlines: Submission of abstracts: November 15, 2006, Notification of Acceptance: February 15, 2006. Request for Support: March 1, 2006. Reduced Registration Fees: April 1, 2006. Additional information can be found at <http://garsia.math.yorku.ca/fpsac06/>.

19-30 **SMS 2006/NATO Advanced Study Institute-Combinatorial Optimization: Methods and Applications**, Université de Montréal, Montréal (QC) Canada.

Topics: Will include (but will not be restricted to) integer and mixed integer programming, game theory, convexity in combinatorial optimization, facility location, VLSI design, and supply chain management.

Aim: This summer school is aimed primarily at doctoral students, postdoctoral fellows, and junior faculty.

Lecturers: Gérard Cornuejols (Carnegie Mellon University), Sanjeeb Dash (IBM T. J. Watson Research Center), Friedrich Eisenbrand (Max-Planck-Institut für Informatik), Lisa K. Fleischer (Carnegie Mellon University), Michael X. Goemans (M.I.T.), Yuri Kochetov (Russian Academy of Sciences), Bernhard Korte (University of Bonn), Gleb Koshevoy (Russian Academy of Sciences), Shmuel Onn (Technion-Israel Institute of Technology), Dieter Rautenbach (University of Bonn), Najiba Sbihi (Ecole Mohammadia D'ingénieurs) Jens Vygen (University of Bonn).

Information: Financial support available. For full consideration, requests for participation or financial assistance must be received before February 28, 2006. Information/application form: <http://www.dms.umontreal.ca/sms/>; belanger@dms.umontreal.ca.

23-26 **2006 International Conference on Topology and its Applications**, Aegion, Greece.

Description: All areas of Topology and its Applications are included (especially General Topology, Applied General Topology, Set-Theoretic Topology, Geometric Topology, Topological Groups, Dimension Theory, Dynamical Systems and Continua Theory, Computational Topology, History of Topology).

Deadlines: For the Participation Form is May 31, 2006. For the Abstract Form is May 31, 2006. For the Accommodation Form is March 31, 2006.

Organizing Committee: S. D. Iliadis (University of Patras)-Chairman, D. N. Georgiou (University of Patras) V. M. Costaras (Aegion) C. G. Fotopoulos (Aegion) C. A. Vasilakopoulos (Aegion).

Information: <http://www.math.upatras.gr/~aegion/>; email: aegion@math.upatras.gr.

July 2006

9-15 **DIMACS Reconnect Conference 2006: Reconnecting Teaching Faculty to the Mathematical Sciences Research Enterprise**, Morgan State University, Baltimore, Maryland.

Description: This conference exposes faculty teaching undergraduates to the mathematical sciences research enterprise by introducing them to a current research topic relevant to the classroom through a series of lectures by a leading expert and involving them in writing materials useful in the classroom. Participants have the possibility of following up by preparing these materials for publication in the DIMACS Educational Modules Series.

Topic: Simple and Complex Discrete-time Population Models in Ecology and Epidemiology.

Principal Speaker: Abdul-Aziz Yakubu, Howard University (ayakubu@Howard.edu).

Conference Organizers: A. Nkwanta, Morgan State University, (nkwanta@jewel.morgan.edu); F. S. Roberts, Rutgers University (froberts@dimacs.rutgers.edu).

Information: To receive more information, visit our web site at <http://dimacs.rutgers.edu/reconnect/> or contact the Reconnect Program Coordinator, at reconnect@dimacs.rutgers.edu; tel:732-445-4304.

*24-28 **The Eleventh International Conference on Difference Equations and Applications**, Kyoto University, Kyoto, Japan.

Purpose: The purpose of the Conference is to bring together both experts and novices in the theory and application of Difference Equations and Discrete Dynamical Systems together with experts in mathematical economics and finance. The participants will present their results and help chart the course for further developments in the twenty first century by raising the following important questions and issues: 1. Identifying new directions in the general theory of Difference Equations and discrete Dynamical Systems. 2. Applications of difference equations with special emphasis on Mathematical Economics and Finance. 3. Exploring the interplay between Economics and other applied areas utilizing Difference Equations.

Plenary Speakers: The plenary speakers will be experts chosen from the many areas of Difference Equations in general. Contributed talks in any area of Difference Equations are welcome and will be considered.

Organizers: The conference is organized by the Institute of Economic Research, the Faculty of Economics, and the Faculty of Mathematics, Kyoto University in cooperation with Kio University and Okayama University of Science. The conference will be held under the auspices of the Mathematical Society of Japan and the International Society of Difference Equations (ISDE).

Scientific Committee: The Scientific Committee consists of K. Aomoto (Japan), S. Elaydi (USA) (Chairman), J. Hietarinta (Finland) K. Okamoto (Japan), G. Ladas (USA), G. Sell (USA), A. N. Sharkovsky (Ukraine), J. Yorke (USA), M. Shishikura (Japan). The plenary speakers are J. Yorke (Maryland), M. Golubitsky (Houston), F. Takens (Groningenb). Program Committee: Kazuo Nishimura (Kyoto U.) (Chairman), Hiroshi Kokubu (Kyoto U.), Nobuyuki Tose (Keio U.), Yoshihisa Hamaya (Okayama U. of Science). Local Organizing Committee: Hiroshi Teruyama (Kyoto U.), Akihisa Shibata (Kyoto U.), Hideki Iwaki (Kyoto U.), Se-il Mun (Kyoto U.).

Information: For more information and details about the conference you may contact Professor Kazuo Nishimura: nishimura@kier.kyoto-u.ac.jp or Professor Saber Elaydi: selaydi@trinity.edu.

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Purpose: To bring together both experts and novices in the theory and application of Difference Equations and Discrete Dynamical Systems together with experts in mathematical economics and finance.

Plenary Speakers: J. Yorke (Maryland), M. Golubitsky (Houston), F. Takens (Groningenb).

Organizers: The Institute of Economic Research, the Faculty of Economics, and the Faculty of Mathematics, Kyoto University in cooperation with Kio University and Okayama University of Science.

Scientific Committee: K. Aomoto (Japan), S. Elaydi (USA) (Chairman), J. Hietarinta (Finland) K. Okamoto (Japan), G. Ladas (USA), G. Sell (USA), A. N. Sharkovsky (Ukraine), J. Yorke (USA), M. Shishikura (Japan).

Program Committee: Kazuo Nishimura (Kyoto Univ.) (Chairman), Hiroshi Kokubu (Kyoto Univ.), Nobuyuki Tose (Keio Univ.), Yoshihisa Hamaya (Okayama Univ. of Science). Local Organizing Committee: Hiroshi Teruyama (Kyoto Univ.), Akihisa Shibata (Kyoto Univ.), Hideki Iwaki (Kyoto Univ.), Se-il Mun (Kyoto Univ.).

Information: Kazuo Nishimura: nishimura@kier.kyoto-u.ac.jp or Saber Elaydi: selaydi@trinity.edu.

*31–August 4 **Numerical invariants of singularities and higher-dimensional algebraic varieties**, AIM Research Conference Center, Palo Alto, California.

Workshop topics: This workshop, sponsored by AIM and the NSF, will be devoted to certain numerical measures of the singularities of a divisor or holomorphic function. These invariants—notably the log-canonical threshold or complex singularity index—have appeared in recent years in a surprisingly wide variety of mathematical problems. The idea of the workshop is to bring together researchers working in the various different directions, in the hopes of generating some valuable cross-fertilization.

Organizers: Nero Budur, Lawrence Ein, Robert Lazarsfeld, Mircea Mustata, Aleksandr V. Pukhlikov, and Vyacheslav Shokurov.

Application deadline: April 25, 2006.

Information: <http://aimath.org/ARCC/workshops/singularvariety.html>.

August 2006

*2–4 **31st Sapporo Symposium on Partial Differential Equations**, Department of Mathematics, Hokkaido University, Sapporo, Japan.

Description: The Sapporo Symposium on Partial Differential Equations has been held annually to present the latest developments on PDE with a broad spectrum of interests not limited to the methods of a particular school.

Organizers: T. Ozawa, Y. Giga, S. Jimbo, G. Nakamura, Y. Tonegawa, K. Tsutaya; email: cri@math.sci.hokudai.ac.jp.

Information: http://coe.math.sci.hokudai.ac.jp/sympo/sapporo/program_en.html.

*16–19 **First announcement: Satellite Conference on Algebraic Geometry**, Segovia, Spain.

Description: Satellite Conferences are relevant scientific activities organized around ICM Madrid 2006. This conference will deal with recent trends in Algebraic Geometry.

Plenary lectures: There will be two plenary lectures in the mornings.

Invited speakers: J. I. Burgos, G. M. Greuel, P. Griffiths, J. Lipman, Z. Mebkhout, T. Pantev, M. Reid, A. Sommese.

Information: <http://www.escet.urjc.es/satellite/>.

*16–19 **Trends and Challenges in the Calculus of Variations and its Applications**, Toledo, Spain.

Invited Speakers: G. Allaire (Paris), A. Braides (Rome), S. Conti (Leipzig), C. De Lellis (Zurich), D. Faraco (Madrid), I. Fonseca (Pittsburgh), B. Kirchheim (Oxford), J. Kristensen (Oxford), C. Larsen (WPI, USA), G. Leoni (Pittsburgh), J. J. Manfredi (Pittsburgh), S. Serfaty (New York).

Scientific Committee: L. Ambrosio (SNS, Pisa), J. Ball (Oxford), D. Kinderlehrer (Pittsburgh), R. Kohn (New York), S. Müller (MPI, Leipzig), E. Zuazua (UAM, Madrid).

Organizers: E. Aranda, J. C. Bellido (Co-ordinator), P. Pedregal (University of Castilla-La Mancha).

Call for Applications: Young researchers have the possibility to apply for giving a short talk. The Scientific Committee will make a selection among the received applications. The deadline for applying for a talk is March 15th, 2006.

Registration: Pre-registration is already open on-line. Registration will start by the beginning of February.

Information: <http://matematicas.uclm.es/toledo2006>; email: JoseCarlos.Bellido@uclm.es.

September 2006

*4–8 **Barcelona Analysis Conference**, University of Barcelona, Barcelona, Spain.

Description: BAC06 has been recognized as a Satellite Conference of the International Congress of Mathematicians, Madrid 2006. The meeting will take place at the historical building of the University of Barcelona.

Main areas of interest: Harmonic Analysis, Geometric Measure Theory, Real and Functional Analysis, Complex Analysis, Signal Analysis, Aspects of the above related to PDE's.

Information: email: bac06@imub.ub.es; <http://www.imub.ub.es/bac06/>.

*4–29 **The Painlevé Equations and Monodromy Problems**, Isaac Newton Institute for Mathematical Sciences, Cambridge, England.

Organizers: Professor P. P. Boalch (ENS Paris), Professor P. A. Clarkson (Kent), Professor L. Mason (Oxford), Professor Y. Ohya (Osaka).

Information: <http://www.newton.cam.ac.uk/programmes/PEM/>.

*9–12 **SIAM Conference on Nonlinear Waves and Coherent Structures**, University of Washington, Seattle, Washington.

Description: Nonlinear waves and coherent structures is a broad area of applied mathematics. Its theoretical aspects are relevant to subjects as diverse as general relativity, high-energy particle physics, fluid and solid mechanics, plasmas, nonlinear electrical circuits, Bose-Einstein condensation, nonlinear optics, random media, atmosphere and ocean dynamics, chemical reactions, and biology. One of the most successful and topical applications is the propagation of information in optical fibers, but remarkable agreement between theory and experiments can be claimed in many of the fields mentioned above.

Goals: The goals of this meeting are to provide an opportunity for the cross-fertilization among the different fields of applications and to increase the understanding and communication between the mathematicians who build the theory and the scientists who use it. The conference is designed to facilitate presentations of advances in nonlinear waves and coherent structures, ranging from basic mathematical research to various applications. It is expected to draw attendees from the mathematical, biological, engineering and physical sciences, and thus provide a strong impetus to new and innovative work in the field.

Organizers: The organizing committee will make every effort to attract a large pool of members from different backgrounds and at different stages in their careers.

Information: Additional information is available at <http://www.siam.org/meetings/nw06/index.php>.

*11–15 **Groups of Diffeomorphisms 2006**, University of Tokyo, Tokyo, Japan.

Topics: Groups of diffeomorphisms, Moduli and classifying spaces, Mapping class groups, Characteristic classes, K-theory.

Scientific Committee: T. Tsuboi (Univ. Tokyo), D. Kotschick (Univ. Munich), N. Kawazumi (Univ. Tokyo), Y. Mitsumatsu (Chuo Univ.), T. Kitano (Tokyo Inst. Tech.).

Organizing Committee: Y. Mitsumatsu, M. Fujii, Y. Kasahara, T. Kitano, T. Morifuji.

Speakers: Joan Birman, Kiyoshi Igusa, Nariya Kawazumi, Dieter Kotschick, Shigeyuki Morita, Robert Penner, Takashi Tsuboi, Karen Vogtmann.

Information: <http://faculty.ms.u-tokyo.ac.jp/~gd2006/index.html>.

The following new announcements will not be repeated until the criteria in the next to the last paragraph at the bottom of the first page of this section are met.

July 2007

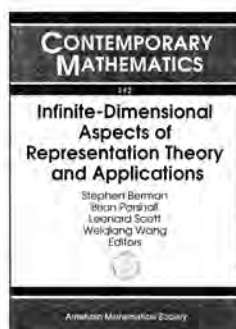
*9–13 **European Dynamics Days 2007**, Loughborough University, United Kingdom.

Organizers: Mark Groves, John Terry (Loughborough University), Mark Fromhold, Gregor Tanner (University of Nottingham).

Information: Email Mark Groves (M.D.Groves@lboro.ac.uk).

New Publications Offered by the AMS

Algebra and Algebraic Geometry



Infinite-Dimensional Aspects of Representation Theory and Applications

Stephen Berman, *University of Saskatchewan, SK, Canada*, and Brian Parshall, Leonard Scott, and Weiqiang Wang, *University of Virginia, Charlottesville, VA*, Editors

The University of Virginia (Charlottesville) hosted an international conference on Infinite-dimensional Aspects of Representation Theory and Applications. This volume contains papers resulting from the mini-courses and talks given at the meeting.

Beyond the techniques and ideas related to representation theory, the book demonstrates connections to number theory, algebraic geometry, and mathematical physics. Specific topics covered include Hecke algebras, quantum groups, infinite-dimensional Lie algebras, quivers, modular representations, and Gromov-Witten invariants.

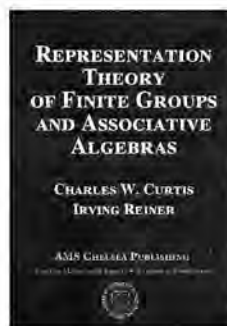
The book is suitable for graduate students and researchers interested in representation theory.

Contents: S. Ariki, Modular representation theory of Hecke algebras, a survey; V. Chari and J. Greenstein, An application of free Lie algebras to polynomial current algebras and their representation theory; N. Jacon, Canonical basic sets for Hecke algebras; M. Lau, On universal central extensions of $\mathfrak{sl}_n(A)$; H. Li, Pseudoderivations, pseudoautomorphisms and simple current modules for vertex algebras; W.-P. Li, Z. Qin, and W. Wang, Hilbert scheme intersection numbers, Hurwitz numbers, and Gromov-Witten invariants; K. C. Misra, On Demazure crystals for $U_q(D_4^{(3)})$; E. Mukhin and A. Varchenko, Populations of solutions of the XXX Bethe equations associated to Kac-Moody algebras; R. Rouquier,

Representations of rational Cherednik algebras; A. Savage, A geometric construction of crystal graphs using quiver varieties: Extension to the non-simply laced case.

Contemporary Mathematics, Volume 392

December 2005, 154 pages, Softcover, ISBN 0-8218-3701-X, LC 2005053615, 2000 *Mathematics Subject Classification*: 14C05, 14N35, 16E40, 16G20, 16G60, 17B37, 17B69, 20C08, 82B23, All AMS members US\$39, List US\$49, Order code CONM/392



Representation Theory of Finite Groups and Associative Algebras

Charles W. Curtis and Irving Reiner

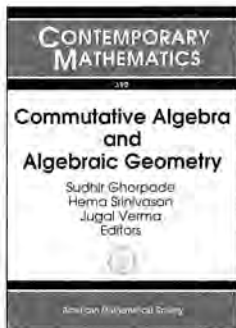
First published in 1962, this classic book remains a remarkably complete introduction to various aspects of the representation theory of finite groups.

One of its main advantages is that the authors went far beyond the standard elementary representation theory, including a masterly treatment of topics such as general non-commutative algebras, Frobenius algebras, representations over non-algebraically closed fields and fields of non-zero characteristic, and integral representations. These and many other subjects are treated extremely thoroughly, starting with basic definitions and results and proceeding to many important and crucial developments. Numerous examples and exercises help the reader of this unsurpassed book to master this important area of mathematics.

Contents: Background from group theory; Representations and modules; Algebraic number theory; Semi-simple rings and group algebras; Group characters; Induced characters; Induced representations; Non-semi-simple rings; Frobenius algebras; Splitting fields and separable algebras; Integral representations; Modular representations; Bibliography; Index.

AMS Chelsea Publishing

December 2005, 689 pages, Hardcover, ISBN 0-8218-4066-5, 2000 *Mathematics Subject Classification*: 16-02; 11R33, 20-02, 20Cxx, All AMS members US\$80, List US\$89, Order code CHEL/356.H



Commutative Algebra and Algebraic Geometry

Sudhir Ghorpade, *Indian Institute of Technology Bombay, Mumbai, India*, Hema Srinivasan, *University of Missouri, Columbia, MO*, and Jugal Verma, *Indian Institute of Technology Bombay, Mumbai, India*, Editors

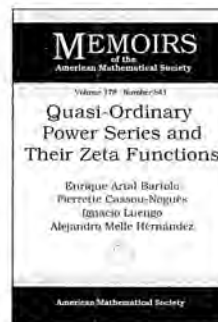
The first Joint AMS-India Mathematics Meeting was held in Bangalore (India). This book presents articles written by speakers from a special session on commutative algebra and algebraic geometry. Included are contributions from some leading researchers around the world in this subject area. The volume contains new and original research papers and survey articles suitable for graduate students and researchers interested in commutative algebra and algebraic geometry.

Contents: S. S. Abhyankar and M. Kumar, Simultaneous surface resolution in quadratic and biquadratic Galois extensions; J. Asadollahi and T. J. Puthenpurakal, An analogue of a theorem due to Levin and Vasconcelos; R. Basu, R. A. Rao, and R. Khanna, On Quillen's local global principle; M. Brodmann, Asymptotic behaviour of cohomology: Tameness, supports and associated primes; W. Bruns, Conic divisor classes over a normal monoid algebra; S. D. Cutkosky, Multi-graded algebras associated to surface singularities; A. K. Dutta, Some results on subalgebras of polynomial algebras; S. Goto, F. Hayasaka, K. Kurano, and Y. Nakamura, Rees algebras of the second syzygy module of the residue field of a regular local ring; J. N. Iyer, A note on syzygies of projective varieties; S. Jose and R. A. Rao, A local global principle for the elementary unimodular vector group; V. Kodiyalam and K. N. Raghavan, Picture invariants and the isomorphism problem for complex semisimple Lie algebras; C. S. Seshadri, Geometric reductivity (Mumford's conjecture)-revisited; A. K. Singh and U. Walther, On the arithmetic rank of certain Segre products; B. Singh, On a question of Huneke-Jaffe concerning seminormality; V. Trivedi, Strong semistability and Hilbert-Kunz multiplicity for singular plane curves.

Contemporary Mathematics, Volume 390

January 2006, approximately 192 pages, Softcover, ISBN 0-8218-3629-3, LC 2005053623, 2000 *Mathematics Subject Classification*: 13-XX, 14-XX, All AMS members US\$47, List US\$59, Order code CONM/390

Analysis



Quasi-Ordinary Power Series and Their Zeta Functions

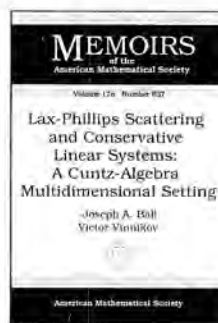
Enrique Artal Bartolo, *University of Zaragoza, Spain*, Pierrette Cassou-Noguès, *Bordeaux, France*, and Ignacio Luengo and Alejandro Melle Hernández, *Universidad Complutense de Madrid, Spain*

This item will also be of interest to those working in number theory.

Contents: Introduction; Motivic integration; Generating functions and Newton polyhedra; Quasi-ordinary power series; Denef-Loeser motivic zeta function under the Newton maps; Consequences of the main theorems; Monodromy conjecture for quasi-ordinary power series; Bibliography.

Memoirs of the American Mathematical Society, Volume 178, Number 841

October 2005, 85 pages, Softcover, ISBN 0-8218-3876-8, LC 2005050801, 2000 *Mathematics Subject Classification*: 14B05, 14E15, 32S50, **Individual member** US\$31, List US\$52, Institutional member US\$42, Order code MEMO/178/841



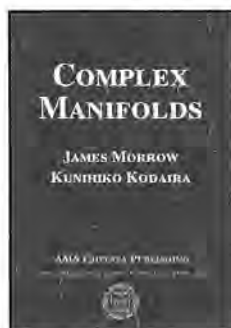
Lax-Phillips Scattering and Conservative Linear Systems: A Cuntz-Algebra Multidimensional Setting

Joseph A. Ball, *Virginia Polytechnic Institute and State University, Blacksburg, VA*, and Victor Vinnikov, *Ben Gurion University of the Negev, Be'er Sheva, Israel*

Contents: Introduction; Functional models for row-isometric/row-unitary operator tuples; Cuntz scattering systems; Unitary colligations; Scattering, systems and dilation theory: the Cuntz-Toeplitz setting; Bibliography.

Memoirs of the American Mathematical Society, Volume 178, Number 837

October 2005, 101 pages, Softcover, ISBN 0-8218-3768-0, LC 2005051349, 2000 *Mathematics Subject Classification*: 47A48; 13F25, 47A40, 47L30, 47L55, 93C05, **Individual member** US\$34, List US\$56, Institutional member US\$45, Order code MEMO/178/837



COURSE ADOPTION

Complex Manifolds

James Morrow, *University of Washington, Seattle, WA*, and
Kunihiko Kodaira

This volume serves as an introduction to the Kodaira-Spencer theory of deformations of complex structures. Based on notes taken by James Morrow from lectures given by

Kunihiko Kodaira at Stanford University in 1965-1966, the book gives the original proof of the Kodaira embedding theorem, showing that the restricted class of Kähler manifolds called Hodge manifolds is algebraic. Included are the semicontinuity theorems and the local completeness theorem of Kuranishi.

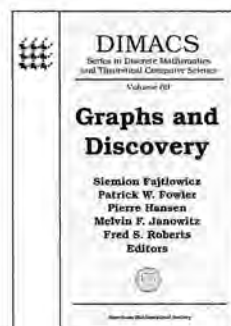
Readers are assumed to know some algebraic topology. Complete references are given for the results that are used from elliptic partial differential equations. The book is suitable for graduate students and researchers interested in abstract complex manifolds.

Contents: Definitions and examples of complex manifolds; Sheaves and cohomology; Geometry of complex manifolds; Applications of elliptic partial differential equations to deformations; Bibliography; Index; Errata.

AMS Chelsea Publishing

January 2006, 194 pages, Hardcover, ISBN 0-8218-4055-X, LC 2005053671, 2000 *Mathematics Subject Classification*: 32Qxx, All AMS members US\$26, List US\$29, Order code CHEL/355.H

Applications



Graphs and Discovery

Siemion Fajtlowicz, *University of Houston, TX*, Patrick W. Fowler, *University of Sheffield, UK*, Pierre Hansen, *HEC Montréal, Quebec, Canada*, and Melvin F. Janowitz and Fred S. Roberts, *Rutgers University, Piscataway, NJ*, Editors

This volume presents topics addressed at the working group meeting and workshop on Computer-generated Conjectures from Graph Theoretic and Chemical Databases held at Rutgers University (Piscataway, NJ). The events brought together theoreticians and practitioners working in graph theory and chemistry to share ideas and to set an agenda for future developments in the use of computers for generating scientific conjectures.

Articles included in the volume were written by developers of some of the most important programs used around the world today. The disciplines represented include theoretical and applied computer science, statistics, discrete and non-discrete mathematics, chemistry, and information science.

The book is suitable for researchers and students interested in the use of computers in graph theory.

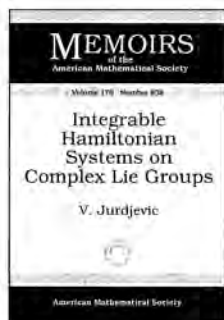
This item will also be of interest to those working in discrete mathematics and combinatorics.

Contents: J. W. Berry, Considerations for future designers of general purpose graph software; E. Breimer, M. Goldberg, D. Hollinger, and D. Lim, Discovering optimization algorithms through automated learning; G. Brinkmann, O. Delgado-Friedrichs, and U. von Nathusius, Numbers of faces and boundary encodings of patches; D. Cvetković and S. Simić, Graph theoretical results obtained by the support of the expert system "graph"—An extended survey; E. DeLaVina, Graffiti.pc: A variant of graffiti; E. DeLaVina, Some history of the development of graffiti; E. DeLaVina, S. Fajtlowicz, and W. Waller, On some conjectures of Griggs and graffiti; S. Fajtlowicz, On the representation and characterization of fullerene C_{60} ; J. E. Graver, The structure of fullerene signatures; J. E. Graver, Catalog of all fullerenes with ten or more symmetries; P. Hansen, How far is, should and could be conjecture-making in graph theory an automated process?; P. Hansen, M. Aouchiche, G. Caporossi, H. Mélot, and D. Stevanović, What forms do interesting conjectures have in graph theory?; P. Hansen and H. Mélot, Variable neighborhood search for extremal graphs. 9. Bounding the irregularity of a graph; S. M. Husband, C. P. Husband, N. Dean, and J. M. Tour, Mathematics for the nanocell approach to molecular electronics; R. J. Kingan and S. R. Kingan, A software system for matroids; C. E. Larson, A survey of research in automated mathematical conjecture-making; R. Laue, T. Grüner, M. Meringer, and A. Kerber, Constrained generation of molecular graphs; W. Myrvold, T. Prsa, and N. Walker, A dynamic programming approach for timing and designing clique algorithms; R. D. Pepper, On new didactics of mathematics: Learning graph theory via graffiti; T. Pisanski, M. Boben, and A. Žitnik, Interactive conjecturing with Vega; D. Stevanović and G. Caporossi, On the $(1, 2)$ -spectral spread of fullerenes.

DIMACS: Series in Discrete Mathematics and Theoretical Computer Science, Volume 69

January 2006, 370 pages, Hardcover, ISBN 0-8218-3761-3, 2000 *Mathematics Subject Classification*: 68R10, 68T05, 68T35, 05C35, 05C30, 05C62, All AMS members US\$87, List US\$109, Order code DIMACS/69

Differential Equations



Integrable Hamiltonian Systems on Complex Lie Groups

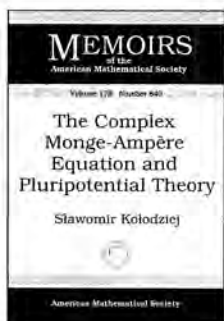
V. Jurdjevic, *University of Toronto, ON, Canada*

Contents: Introduction; Cartan decomposition and the generalized elastic problems; The maximum principle and the Hamiltonians; The

left-invariant symplectic form; Symmetries and the conservation laws; *Part 2. Complex Lie groups and complex Hamiltonians:* Complexified elastic problems; Complex elasticae of Euler and its n -dimensional extensions; Cartan algebras, root spaces and extra integrals of motion; Elastic curves for the case of Lagrange; Elastic curves for the case of Kowalewski; Bibliography.

Memoirs of the American Mathematical Society, Volume 178, Number 838

October 2005, 133 pages, Softcover, ISBN 0-8218-3764-8, LC 2005050811, 2000 *Mathematics Subject Classification:* 51N30, 53C30, 53D05, 70S10, **Individual member US\$36**, List US\$60, Institutional member US\$48, Order code MEMO/178/838



The Complex Monge-Ampère Equation and Pluripotential Theory

Sławomir Kołodziej, *Jagiellonia University, Krakow, Poland*

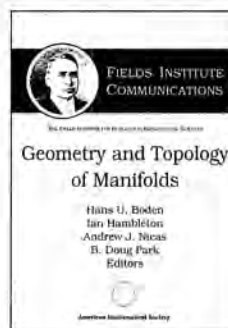
Contents: Positive currents and plurisubharmonic functions; Siciak's extremal function and a related

capacity; The Dirichlet problem for the Monge-Ampère equation with continuous data; The Dirichlet problem continued; The Monge-Ampère equation for unbounded functions; The complex Monge-Ampère equation on a compact Kähler manifold; Bibliography.

Memoirs of the American Mathematical Society, Volume 178, Number 840

October 2005, 64 pages, Softcover, ISBN 0-8218-3763-X, LC 2005052415, 2000 *Mathematics Subject Classification:* 32W20, 32Uxx; 53C55, **Individual member US\$29**, List US\$49, Institutional member US\$39, Order code MEMO/178/840

Geometry and Topology



Geometry and Topology of Manifolds

Hans U. Boden, Ian Hambleton, and Andrew J. Nicas, *McMaster University, Hamilton, ON, Canada*, and B. Doug Park, *University of Waterloo, ON, Canada*, Editors

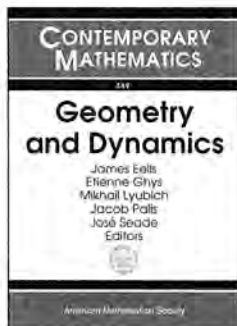
This book contains expository papers that give an up-to-date account of recent developments and open problems in the geometry and topology of manifolds, along with several research articles that present new results appearing in published form for the first time. The unifying theme is the problem of understanding manifolds in low dimensions, notably in dimensions three and four, and the techniques include algebraic topology, surgery theory, Donaldson and Seiberg-Witten gauge theory, Heegaard Floer homology, contact and symplectic geometry, and Gromov-Witten invariants. The articles collected for this volume were contributed by participants of the Conference "Geometry and Topology of Manifolds" held at McMaster University on May 14-18, 2004 and are representative of the many excellent talks delivered at the conference.

Titles in this series are published by the AMS for The Fields Institute for Research in Mathematical Sciences (Toronto, Ontario, Canada).

Contents: S. Akbulut and S. Durusoy, An involution acting nontrivially on Heegaard-Floer homology; W. Chen, Pseudoholomorphic curves in four-orbifolds and some applications; O. Collin, Floer homology for knots and 3-manifolds and cyclic Dehn surgeries along knots; C. L. Curtis, A $PSL_2(\mathbb{C})$ Casson invariant; J. F. Davis, The Borel/Novikov conjectures and stable diffeomorphisms of 4-manifolds; T. Ekholm and J. B. Etnyre, Invariants of knots, embeddings and immersions via contact geometry; P. M. N. Feehan and T. G. Leness, $SO(3)$ -monopoles: The overlap problem; S. Jabuka and T. Mark, Heegaard Floer homology of mapping tori II; V. S. Krushkal, Surfaces in 4-manifolds and the surgery conjecture; J. Lee and T. H. Parker, Symplectic gluing and family Gromov-Witten invariants; Y.-J. Lee, Heegaard splittings and Seiberg-Witten monopoles; T.-J. Li, Existence of symplectic surfaces; A. Némethi, On the Heegaard Floer homology of $S^3_{-d}(K)$ and unicuspidal rational plane curves; M. Niepel, Examples of symplectic 4-manifolds with positive signature; B. Owens and S. Strle, Definite manifolds bounded by rational homology three spheres; P. Ozsváth and Z. Szabó, On Park's exotic smooth four-manifolds; J. Rasmussen, Knot polynomials and knot homologies; D. Ruberman and N. Saveliev, Casson-type invariants in dimension four; S. Schack and X. Zhang, Culler-Shalen norms and invariant trace fields; L. R. Taylor, Complex spin structures on 3-manifolds; M. Usher, Lefschetz fibrations and pseudoholomorphic curves; S. Vidussi, The isotopy problem for symplectic 4-manifolds.

Fields Institute Communications, Volume 47

December 2005, 347 pages, Hardcover, ISBN 0-8218-3724-9, LC 2005048294, 2000 *Mathematics Subject Classification*: 57-06, 53-06, 58-06, 14-06; 57M27, 57R58, 57R57, 57R17, 57M25, 57N13, 53D45, 14N35, 32S25, 57M50, 57R15, 57R55, 57R40, 57R65, 57R67, 57R80, 57M60, 57N10, 53D35, 53D40, 58D15, 58D27, 58D29, 14J28, 14E15, 14B15, 14J17, 32S45, All AMS members US\$87, List US\$109, Order code FIC/47



Geometry and Dynamics

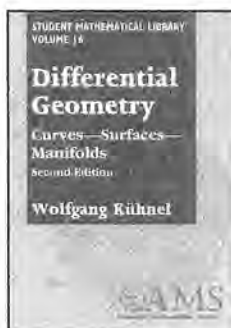
James Eells, *Cambridge, England*, Etienne Ghys, *Ecole Normale Supérieure de Lyon, France*, Mikhail Lyubich, *SUNY at Stony Brook, NY*, Jacob Palis, *IMPA, Rio de Janeiro, Brazil*, and José Seade, *UNAM, Mexico City, Mexico*, Editors

This volume is based on talks given at the Conference in Honor of the 60th Anniversary of Alberto Verjovsky, a prominent mathematician in Latin America who made significant contributions to dynamical systems, geometry, and topology. Articles in the book present recent work in these areas and are suitable for graduate students and research mathematicians.

Contents: A. Avila and C. G. Moreira, Phase-parameter relation and sharp statistical properties for general families of unimodal maps; N. M. Atakishiyev and A. U. Klimyk, Hamiltonian operators in noncommutative world; O. Baues and W. M. Goldman, Is the deformation space of complete affine structures on the 2-torus smooth?; M. Brunella, Some remarks on parabolic foliations; A. Douady, Geometria y dinámica en el complemento de un compacto en \mathbb{C} ; C. D. Hill and E. Porten, The H-principle and pseudoconcave CR manifolds; G. Hinojosa, Wild knots as limit sets of Kleinian groups; C. Kapoudjian and V. Sergiescu, An extension of the Buraou representation to a mapping class group associated to Thompson's group T ; F. Loray, Sur les théorèmes I et II de Painlevé; G. P. Paternain and J. Petean, On the growth rate of contractible closed geodesics on reducible manifolds; Program.

Contemporary Mathematics, Volume 389

November 2005, 200 pages, Softcover, ISBN 0-8218-3851-2, LC 2005053624, 2000 *Mathematics Subject Classification*: 17B37, 20Fxx, 32V10, 34Mxx, 37E05, 37Fxx, 53C10, 53D25, 57M30, All AMS members US\$47, List US\$59, Order code CONM/389



COURSE ADOPTION

Differential Geometry

Curves - Surfaces - Manifolds, Second Edition

Wolfgang Kühnel, *University of Stuttgart, Germany*

From a review of the German edition:

The book covers all the topics which could be necessary later for learning higher level differential geometry. The material is very carefully sorted and easy-to-read.

—*Mathematical Reviews*

Our first knowledge of differential geometry usually comes from the study of the curves and surfaces in \mathbb{R}^3 that arise in calculus. Here we learn about line and surface integrals, divergence and curl, and the various forms of Stokes' Theorem. If we are fortunate, we may encounter curvature and such things as the Serret-Frenet formulas.

With just the basic tools from multivariable calculus, plus a little knowledge of linear algebra, it is possible to begin a much richer and rewarding study of differential geometry, which is what is presented in this book. It starts with an introduction to the classical differential geometry of curves and surfaces in Euclidean space, then leads to an introduction to the Riemannian geometry of more general manifolds, including a look at Einstein spaces. An important bridge from the low-dimensional theory to the general case is provided by a chapter on the intrinsic geometry of surfaces.

The first half of the book, covering the geometry of curves and surfaces, would be suitable for a one-semester undergraduate course. The local and global theories of curves and surfaces are presented, including detailed discussions of surfaces of rotation, ruled surfaces, and minimal surfaces.

The second half of the book, which could be used for a more advanced course, begins with an introduction to differentiable manifolds, Riemannian structures, and the curvature tensor. Two special topics are treated in detail: spaces of constant curvature and Einstein spaces.

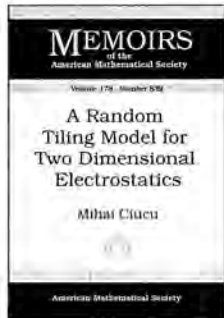
The main goal of the book is to get started in a fairly elementary way, then to guide the reader toward more sophisticated concepts and more advanced topics. There are many examples and exercises to help along the way. Numerous figures help the reader visualize key concepts and examples, especially in lower dimensions. For the second edition, a number of errors were corrected and some text and a number of figures have been added.

Contents: Notations and prerequisites from analysis; Curves in \mathbb{R}^n ; The local theory of surfaces; The intrinsic geometry of surfaces; Riemannian manifolds; The curvature tensor; Spaces of constant curvature; Einstein spaces; Bibliography; List of notation; Index.

Student Mathematical Library, Volume 16

January 2006, 380 pages, Softcover, ISBN 0-8218-3988-8, LC 2005052798, 2000 *Mathematics Subject Classification*: 53-01, All AMS members US\$39, List US\$49, Order code STML/16.R

Mathematical Physics



A Random Tiling Model for Two Dimensional Electrostatics

Mihai Ciucu, *Atlanta, GA*

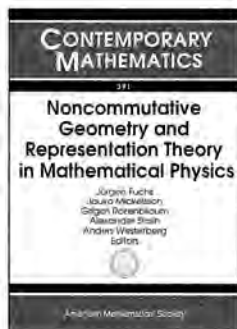
This item will also be of interest to those working in probability.

Contents: *Part A. A Random Tiling Model for Two Dimensional Electrostatics:* Introduction; Definitions,

statement of results and physical interpretation; Reduction to boundary-influenced correlations; A simple product formula for correlations along the boundary; A $(2m + 2n)$ -fold sum for ω_b ; Separation of the $(2m + 2n)$ -fold sum for ω_b in terms of $4mn$ -fold integrals; The asymptotics of the $T^{(n)}$'s and $T^{(m)}$'s; Replacement of the $T^{(k)}$'s and $T^{(l)}$'s by their asymptotics; Proof of Proposition 7.2; The asymptotics of a multidimensional Laplace integral; The asymptotics of ω_b . Proof of Theorem 2.2; Another simple product formula for correlations along the boundary; The asymptotics of $\bar{\omega}_b$. Proof of Theorem 2.1; A conjectured general two dimensional Superposition Principle; Three dimensions and concluding remarks; Bibliography; *Part B. Plane Partitions I: A Generalization of MacMahon's Formula:* Introduction; Two families of regions; Reduction to simply-connected regions; Recurrences for $M(R_{1,q}(x))$ and $M(\bar{R}_{1,q}(x))$; Proof of Proposition 2.1; The guessing of $M(R_{1,q}(x))$ and $M(\bar{R}_{1,q}(x))$; Bibliography.

Memoirs of the American Mathematical Society, Volume 178, Number 839

October 2005, 144 pages, Softcover, ISBN 0-8218-3794-X, LC 2005050800, 2000 *Mathematics Subject Classification:* 05A15, 82B23, 82D99; 05A16, 41A63, 60F99, 82B23, **Individual member US\$36**, List US\$60, Institutional member US\$48, Order code MEMO/178/839



Noncommutative Geometry and Representation Theory in Mathematical Physics

Jürgen Fuchs, *Karlstads Universitet, Sweden*, Jouko Mickelsson, *KTH*,

AlbaNova-SCFAB, *Stockholm, Sweden*, Grigori Rozenblioum and Alexander Stolin, *Göteborgs Universitet, Sweden*, and Anders Westerberg, *Karlstads Universitet, Sweden*, Editors

Mathematics provides a language in which to formulate the laws that govern nature. It is a language proven to be both

powerful and effective. In the quest for a deeper understanding of the fundamental laws of physics, one is led to theories that are increasingly difficult to put to the test.

In recent years, many novel questions have emerged in mathematical physics, particularly in quantum field theory. Indeed, several areas of mathematics have lately become increasingly influential in physics and, in turn, have become influenced by developments in physics. Over the last two decades, interactions between mathematicians and physicists have increased enormously and have resulted in a fruitful cross-fertilization of the two communities.

This volume contains the plenary talks from the international symposium on Noncommutative Geometry and Representation Theory in Mathematical Physics held at Karlstad University (Sweden) as a satellite conference to the Fourth European Congress of Mathematics.

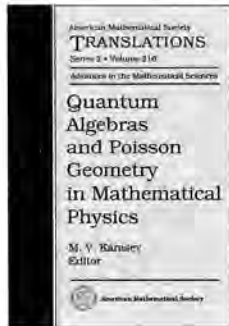
The scope of the volume is large and its content is relevant to various scientific communities interested in noncommutative geometry and representation theory. It offers a comprehensive view of the state of affairs for these two branches of mathematical physics. The book is suitable for graduate students and researchers interested in mathematical physics.

Contents: N. Bazunova, Construction of graded differential algebra with ternary differential; C. Blohmann, Calculation of the universal Drinfeld twist for quantum $\mathfrak{su}(2)$; M. Cederwall, Thoughts on membranes, matrices and non-commutativity; C. Chryssomalakos and E. Okon, Stable quantum relativistic kinematics; A. Davydov, Cohomology of crossed algebras; T. Ekedahl, Kac-Moody algebras and the cde-triangle; L. D. Faddeev, Discretized Virasoro algebra; G. Felder and A. Varchenko, Multiplication formulae for the elliptic gamma function; G. Fiore, New approach to Hermitian q -differential operators on \mathbb{R}_q^N ; J. Fröhlich, J. Fuchs, I. Runkel, and C. Schweigert, Picard groups in rational conformal field theory; A. Gerasimov, S. Kharchev, D. Lebedev, and S. Oblezin, On a class of representations of quantum groups; M. Gorelik and V. Serganova, Shapovalov forms for Poisson Lie superalgebras; T. J. Hodges and M. Yakimov, Triangular Poisson structures on Lie groups and symplectic reduction; Y.-Z. Huang, Vertex operator algebras, fusion rules and modular transformations; L. Kadison, Depth two and the Galois coring; N. Kamiya, Examples of Peirce decomposition of generalized Jordan triple system of second order—Balanced cases; I. Kantor and G. Shpiz, Graded representations of graded Lie algebras and generalized representations of Jordan algebras; E. Karolinsky, A. Stolin, and V. Tarasov, Dynamical Yang-Baxter equation and quantization of certain Poisson brackets; R. Kashaev and N. Reshetikhin, Braiding for quantum gl_2 at roots of unity; C. Korff, Solving Baxter's TQ-equation via representation theory; P. P. Kulish, Noncommutative geometry and quantum field theory; E. Langmann, Conformal field theory and the solution of the (quantum) elliptic Calogero-Sutherland system; D. Larsson and S. D. Silvestrov, Quasi-Lie algebras; O. A. Laudal, Time-space and space-times; J. Lukierski and V. D. Lyakhovskiy, Two-parameter extension of the κ -Poincaré quantum deformation; V. E. Nazaikinskii, A. Y. Savin, B.-W. Schulze, and B. Y. Sternin, The index problem on manifolds with edges; D. Proskurin, Y. Savchuk, and L. Turowska, On C^* -algebras generated by some deformations of CAR relations; O. K. Sheinman, Krichever-Novikov algebras and their representations; S. D. Sinel'shchikov and L. Vaksman, Quantum groups and bounded symmetric domains; D. Sternheimer, Quantization is deformation; K. Szlachányi, Monoidal Morita equivalence;

V. N. Tolstoy, Fortieth anniversary of extremal projector method for Lie symmetries.

Contemporary Mathematics, Volume 391

December 2005, 384 pages, Softcover, ISBN 0-8218-3718-4, LC 2005053625, 2000 *Mathematics Subject Classification*: 16Dxx, 16Gxx, 16W30, 17Bxx, 17Cxx, 18D10, 32Gxx, 53D55, 81Rxx, 81Txx, All AMS members US\$79, List US\$99, Order code CONM/391



Quantum Algebras and Poisson Geometry in Mathematical Physics

M. V. Karasev, *Moscow Institute of Electronics and Mathematics, Russia*, Editor

This collection presents new and interesting applications of Poisson geometry to some fundamental well-known problems in mathematical physics. In addition to advanced Poisson geometry, the methods used by the authors include unexpected algebras with non-Lie commutation relations, nontrivial (quantum) Kählerian structures of hypergeometric type, dynamical systems theory, semiclassical asymptotics, and more.

The volume is suitable for graduate students and researchers interested in mathematical physics.

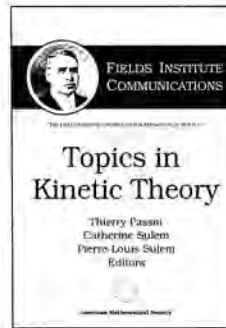
Other AMS publications by M. Karasev include *Nonlinear Poisson Brackets. Geometry and Quantization*, *Coherent Transform, Quantization, and Poisson Geometry*, and *Asymptotic Methods for Wave and Quantum Problems*.

This item will also be of interest to those working in differential equations and geometry and topology.

Contents: M. Karasev, Noncommutative algebras, nanostructures, and quantum dynamics generated by resonances; M. Karasev and E. Novikova, Algebras with polynomial commutation relations for a quantum particle in electric and magnetic fields; Y. Vorobjev, Poisson structures and linear Euler systems over symplectic manifolds; Y. Vorobjev, Poisson equivalence over a symplectic leaf.

American Mathematical Society Translations—Series 2 (*Advances in the Mathematical Sciences*), Volume 216

December 2005, 277 pages, Hardcover, ISBN 0-8218-4040-1, LC 91-640741, 2000 *Mathematics Subject Classification*: 53Dxx, 81Rxx, 81Sxx; 33Cxx, 53Cxx, All AMS members US\$87, List US\$109, Order code TRANS/216



COURSE ADOPTION

Topics in Kinetic Theory

Thierry Passot, *CNRS, Nice, France*, Catherine Sulem, *University of Toronto, ON, Canada*, and Pierre-Louis Sulem, *Observatoire de la Côte d'Azur, Nice, France*, Editors

This book covers a variety of topics related to kinetic theory in neutral gases and magnetized plasmas, with extensions to other systems such as quantum plasmas and granular flows. A comprehensive presentation is given for the Boltzmann equations and other kinetic equations for a neutral gas, together with the derivations of compressible and incompressible fluid dynamical systems, and their rigorous justification. Several contributions are devoted to collisionless magnetized plasmas. Rigorous results concerning the well-posedness of the Vlasov-Maxwell system are presented. Special interest is devoted to asymptotic regimes where the scales of variation of the electromagnetic field are clearly separated from those associated with the gyromotion of the particles. This volume collects lectures given at the Short Course and Workshop on Kinetic Theory organized at the Fields Institute of Mathematical Sciences in Toronto during the Spring of 2004.

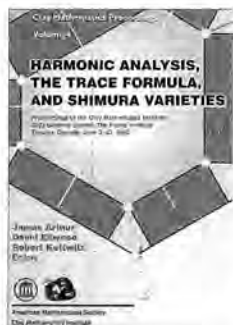
Titles in this series are published by the AMS for The Fields Institute for Research in Mathematical Sciences (Toronto, Ontario, Canada).

Contents: F. Golse and C. D. Levermore, Hydrodynamic limits of kinetic models; R. T. Glassey, Collisionless plasmas and the Vlasov Maxwell system; Y. Elskens, Irreversible behaviours in Vlasov equation and many-body Hamiltonian dynamics; Landau damping, chaos and granularity; P. L. Sulem, Introduction to the guiding center theory; A. J. Brizard, Variational formulations of exact and reduced Vlasov-Maxwell equations; H. Qin, A short introduction to general gyrokinetic theory; W. M. Tang, Introduction to gyrokinetic theory with applications in magnetic confinement research in plasma physics; T. Passot, From kinetic to fluid descriptions of plasmas; A. I. Smolyakov, M. Yagi, and J. D. Callen, Nonlocal closures in long mean free path regimes; G. Manfredi, How to model quantum plasmas; I. Goldhirsch, Inelastic kinetic theory: The granular gas.

Fields Institute Communications, Volume 46

December 2005, 312 pages, Hardcover, ISBN 0-8218-3723-0, 2000 *Mathematics Subject Classification*: 82C40, 76P05, 82D10; 82C70, All AMS members US\$87, List US\$109, Order code FIC/46

Number Theory



COURSE ADOPTION

Harmonic Analysis, the Trace Formula, and Shimura Varieties

James Arthur, *University of Toronto, ON, Canada*, David Ellwood, *Clay Mathematics*

Institute, Cambridge, MA, and Robert Kottwitz, *University of Chicago, IL*, Editors

The modern theory of automorphic forms, embodied in what has come to be known as the Langlands program, is an extraordinary unifying force in mathematics. It proposes fundamental relations that tie arithmetic information from number theory and algebraic geometry with analytic information from harmonic analysis and group representations. These “reciprocity laws”, conjectured by Langlands, are still largely unproved. However, their capacity to unite large areas of mathematics insures that they will be a central area of study for years to come.

The goal of this volume is to provide an entry point into this exciting and challenging field. It is directed, on the one hand, at graduate students and professional mathematicians who would like to work in the area. The longer articles in particular represent an attempt to enable a reader to master some of the more difficult techniques. On the other hand, the book will also be useful to mathematicians who would like simply to understand something of the subject. They will be able to consult the expository portions of the various articles.

The volume is centered around the trace formula and Shimura varieties. These areas are at the heart of the subject, but they have been especially difficult to learn because of a lack of expository material. The volume aims to rectify the problem. It is based on the courses given at the 2003 Clay Mathematics Institute Summer School. However, many of the articles have been expanded into comprehensive introductions, either to the trace formula or the theory of Shimura varieties, or to some aspect of the interplay and application of the two areas.

This book is suitable for independent study.

This item will also be of interest to those working in algebra and algebraic geometry.

Titles in this series are published by the AMS for the Clay Mathematics Institute (Cambridge, MA).

Contents: J. Arthur, An introduction to the trace formula; J. S. Milne, Introduction to Shimura varieties; F. Murnaghan, Linear algebraic groups; R. E. Kottwitz, Harmonic analysis on reductive p -adic groups and Lie algebras; S. DeBacker, Homogeneity for reductive p -adic groups: An introduction; M. Goresky, Compactifications and cohomology of modular varieties; T. J. Haines, Introduction to Shimura varieties with bad reduction of parahoric type; T. C. Hales, A statement of the fundamental lemma; P. Sarnak, Notes on the generalized Ramanujan conjectures; List of participants.

Clay Mathematics Proceedings, Volume 4

January 2006, 689 pages, Softcover, ISBN 0-8218-3844-X, 2000 *Mathematics Subject Classification:* 11-02; 11F70, 11F72, 11F85, 11G18, 14G35, 22E35, 22E50, 22E55, All AMS members US\$95, List US\$119, Order code CMP/4

New AMS-Distributed Publications

Algebra and Algebraic Geometry

Séminaire Bourbaki

Volume 2003/2004, Exposés 924-937

As in the preceding volumes of this seminar, one finds here fourteen survey lectures on topics of current interest: three lectures on algebraic geometry, four on partial differential equations, one on probability, one on number theory, one on dynamical systems, one on operator algebras, one on geometric inequalities, one on the representation theory of groups and one on harmonic analysis. The volume is suitable for graduate students and research mathematicians.

This item will also be of interest to those working in differential equations, probability, geometry and topology, number theory, and analysis.

A publication of the Société Mathématique de France, Marseilles (SMF), distributed by the AMS in the U.S., Canada, and Mexico. Orders from other countries should be sent to the SMF. Members of the SMF receive a 30% discount from list.

Contents: *Novembre 2003:* A. Beauville, La conjecture de Green générique; J. Bertoin, SLE et Invariance conforme; I. Gallagher, Résultats récents sur la limite incompressible; R. Krikorian, Déviations de moyennes ergodiques, flots de Teichmüller et cocycle de Kontsevich-Zorich; B. Maurey, Inégalité de Brunn-Minkowski-Lusternik, et autres inégalités géométriques et fonctionnelles; *Mars 2004:* Y. André, Motifs de dimension finie; P. Gérard, Équations de champ moyen pour la dynamique quantique d'un grand nombre de particules; E. Peyre, Obstructions au principe de Hasse et à l'approximation faible; J. Serre, Complète réductibilité; N. Tzvetkov, On the long time behavior of KdV type equations; *Juin 2004:* S. Alinhac, Méthodes géométriques dans l'étude des équations d'Einstein; K. Belabas, Paramétrisation de structures algébriques et densité de discriminants; H. Pajot, Capacité analytique et le problème de Painlevé; S. Vaes, États quasi-libres libes et facteurs de type III. **Astérisque**, Number 299

September 2005, 350 pages, Softcover, ISBN 2-85629-173-2, 2000 *Mathematics Subject Classification:* 14H51, 13D02, 60K35, 82Bxx, 43-XX, 30C35, 76B03, 76N10, 78M35, 37F30, 32G15, 37H15, 58A14, 14D07, 26D15, 39B62, 52A40, 46Bxx, 60E15, 60G15, 14C15, 14C25, 16B50, 19D23, 35Q40, 35Q55, 81Q05, 81V70, 14G05, 11Dxx, 20-XX, 57M07, 35Q53, 35B35, 35L60, 35L70, 35Q75, 11R04, 11R45, 11R29, 28A75, 30C85, 42B20, 46L54, 46L30, 46L35, **Individual member US\$86**, List US\$95, Order code AST/299

Differential Equations

Dirac Operators

J. P. Bourguignon, *Institut des Hautes Études Scientifiques, Bures-Sur-Yvette, France*, **T. Branson**, *University of Iowa, Iowa City, IA*, **A. Chamseddine**, *American University of Beirut, Lebanon*, **O. Hijazi**, *Université Henri Poincaré, Vandoeuvre-Les-Nancy, France*, and **R. J. Stanton**, *Ohio State University, Columbus, OH*, Editors

This volume represents the proceedings of a summer school and workshop on Dirac operators held at the American University of Beirut in 2001. An introduction to all necessary background material to begin research in Dirac operators is presented including elementary differential geometry, Clifford algebras, Lie groups, special geometries, leading to a presentation of the fundamental role of Dirac operators in the Atiyah-Singer Index Theorem and particle physics. More advanced topics are presented in the proceedings of the workshop where, for example, topics on the spectrum of Dirac operators, pseudo-Riemannian geometry, and first eigenvalue estimates are presented. This book is suitable for self-study by students and non-experts as a panorama on Dirac operators, but also contains, for experts, an outstanding bibliography on the subject.

This item will also be of interest to those working in geometry and topology.

A publication of International Press. Distributed worldwide by the American Mathematical Society.

Contents: *Part 1. Summer School:* **H. B. Lawson, Jr.**, Introduction to the Dirac operator; **C. Bär**, Introduction to differential manifolds; **O. Hijazi**, Clifford algebras and spinor representations; **J.-P. Bourguignon**, A brief introduction to Riemannian and spinorial geometries; **R. Bryant**, Holonomy and special geometries; **R. J. Stanton**, A visit to representation theory; **H. B. Lawson, Jr.**, The Atiyah-Singer index theorem and applications; **C. Bär**, The spectrum of the Dirac operator; **T. Branson**, Conformal structure and spin geometry; **A. H. Chamseddine**, A brief introduction to particle interactions; *Part 2. Workshop:* **B. Ammann**, Ambient Dirac eigenvalue estimates and the Willmore functional; **H. Baum** and **F. Leitner**, The geometric structure of Lorentzian manifolds with twistor spinors in low dimension; **F. El Chami**, Geometric spectrum of isospectral spherical space forms; **A. El Kacimi**, Towards a basic index theory; **N. Ginoux**, Reilly-type spinorial inequalities; **S. Montiel**, Dirac operators and hypersurfaces; **A. Moroianu**, From Kirchberg's inequality to the Goldberg conjecture; Bibliography.

International Press

April 2005, 320 pages, Hardcover, ISBN 1-57146-175-2, 2000 *Mathematics Subject Classification:* 53C27, 53C29, 53C35, 53C40, 53C50, 53C55, 53C12, 58C40, 58J20, 58J32, 58J50, 58J53, 58J60, 83C60, 83E50, 47B25, 22E45, 22E46, 22E60, All AMS members US\$64, List US\$80, Order code INPR/63

General and Interdisciplinary

Contributions to the History of Indian Mathematics

G. G. Emch, *University of Florida, Gainesville, FL*, **R. Sridharan**, *Chennai Mathematical Institute, India*, and **M. D. Srinivas**, *Centre for Policy Studies, Chennai, India*, Editors

This volume resulted from the first Joint India-AMS Meeting in Mathematics held in Bangalore. One of its themes was the "History of Indian Mathematics". The refereed articles in the book were written by invited speakers and cover a wide spectrum of topics ranging from Vedic Prosody and ancient Buddhist logic to the contributions of Srinivasa Ramanujan and Indian contributions to quantum statistics.

The first section, which deals with the ancient period, has two articles, one on Vedic Prosody and the work of Pingala and the other on Buddhist Logic.

The next section, which discusses the mathematics of the classical and medieval periods, begins with two articles, one on the work of Brahmagupta on Bhavana and its applications, another on the contributions of Bhaskara II to the mathematics of Karani or surds. The next article is on the use of power series techniques by the medieval Kerala School of Mathematics. The next two articles focus on the nature of algorithms in Indian Mathematics and Astronomy. The final article of this section is on the notion of proofs in Indian Mathematics and the tradition of Upapattis in Mathematics and Astronomy of India.

The third section is devoted to the modern period. The first article points to some surprising contributions of Srinivasa Ramanujan on partial fractions while the second surveys the history of some of the contributions of Indian mathematicians to Quantum Statistics.

A publication of Hindustan Book Agency. Distributed on an exclusive basis by the AMS in North America. Online bookstore rights worldwide.

Contents: *Introductory Overview:* **R. Sridharan**, Mathematics in ancient and medieval India; *Ancient Period:* **R. Sridharan**, Sanskrit prosody, pingala sutras and binary arithmetic; **F. E. J. Linton**, Shedding some local and linguistic light on the tetralemma conundrums; *Classical and Medieval Period:* **A. K. Datta**, Brahmagupta's bhavana: Some reflections; **F. Patte**, The Karani: How to use integers to make accurate calculations on square roots; **K. Plofker**, Relations between approximations to the sine in Kerala mathematics; **M. S. Srinivas**, Algorithms in Indian mathematics; **K. Ramasubramanian**, Algorithms in Indian astronomy; **M. D. Srinivas**, Proofs in Indian mathematics; *Modern Period:* **G. E. Andrews**, Ramanujan and partial fractions; **G. G. Emch**, Contributions of Indian mathematicians to quantum statistics.

Hindustan Book Agency

October 2005, 300 pages, Hardcover, ISBN 81-85931-58-5, 2000 *Mathematics Subject Classification:* 01A32, All AMS members US\$45, List US\$56, Order code HIN/27

Geometry and Topology

Surveys in Differential Geometry Eigenvalues of Laplacians and Other Geometric Operators

Alexander Grigor'yan, *Imperial College of Science and Technology, London, England*, and S.-T. Yau, *Harvard University, Cambridge, MA*, Editors

This volume is a collection of surveys of diverse topics in geometry related to the eigenvalues of the Laplacian and other geometric operators. A good understanding of the spectral properties of differential operators has deep consequences in geometry, physics, number theory, probability theory, etc. Analytic methods have penetrated also into discrete mathematics, where the study of the spectral properties of difference operators leads to a deeper understanding of the combinatorial question on graphs. The present collection represents a substantial part of the subject, and it will be beneficial to geometers and experts from the adjacent area.

This item will also be of interest to those working in differential equations.

A publication of International Press. Distributed worldwide by the American Mathematical Society.

Contents: M. T. Barlow, Anomalous diffusion and stability of Harnack inequalities; G. Besson, From isoperimetric inequalities to heat kernels via symmetrisation; F. Chung, Discrete isoperimetric inequalities; T. H. Colding and W. P. Minicozzi II, An excursion into geometric analysis; A. Grigor'yan, Y. Netrusov, and S.-T. Yau, Eigenvalues of elliptic operators and geometric applications; M. Ledoux, Spectral gap, logarithmic Sobolev constant, and geometric bounds; L. Lovász, Discrete analytic functions: An exposition; W. H. Meeks III and J. Pérez, Conformal properties in classical minimal surface theory; R. Neel and D. Stroock, Analysis of the cut locus via the heat kernel; L. Saloff-Coste, Analysis on Riemannian co-compact covers; F. Shahidi, Functoriality and small eigenvalues of Laplacian on Riemann surfaces; S. Zelditch, The inverse spectral problem.

International Press

April 2004, 467 pages, Hardcover, ISBN 1-57146-115-9, All AMS members US\$52, List US\$65, Order code INPR/64

Polarizable Twistor \mathcal{D} -modules

Claude Sabbah, *École Polytechnique, Palaiseau, France*

In this book, the author proves a decomposition theorem for the direct image of an irreducible local system on a smooth complex projective variety under a morphism with values in another smooth complex projective variety. For this purpose, he constructs a category of polarized twistor \mathcal{D} -modules and shows a decomposition theorem in this category.

The book is suitable for graduate students and research mathematicians interested in geometry and topology.

A publication of the Société Mathématique de France, Marseilles (SMF), distributed by the AMS in the U.S., Canada, and Mexico. Orders from other countries should be sent to the SMF. Members of the SMF receive a 30% discount from list.

Contents: Introduction; Preliminaries; Coherent and holonomic \mathcal{R}_X -modules; Smooth twistor structures; Specializable \mathcal{R}_X -modules; Polarizable twistor \mathcal{D} -modules; Polarizable regular twistor \mathcal{D} -modules on curves; The decomposition theorem for polarizable regular twistor \mathcal{D} -modules; Integrability; Appendix. Monodromy at infinity and partial Fourier Laplace transform; Bibliography; Notation.

Astérisque, Number 300

September 2005, 208 pages, Softcover, ISBN 2-85629-174-0, 2000 *Mathematics Subject Classification:* 32S40, **Individual member US\$59**, List US\$66, Order code AST/300

Mathematical Physics

Mathematical Foundations of Quantum Mechanics

K. R. Parthasarathy, *Indian Statistical Institute, New Delhi, India*

This is a brief introduction to the mathematical foundations of quantum mechanics based on lectures given by the author to Ph.D. students at the Delhi Centre of the Indian Statistical Institute in order to initiate active research in the emerging field of quantum probability. In addition to quantum probability, an understanding of the role of group representations in the development of quantum mechanics is always a fascinating theme for mathematicians.

The first chapter deals with the definitions of states, observables and automorphisms of a quantum system through Gleason's theorem, Hahn-Hellinger theorem, and Wigner's theorem. Mackey's imprimitivity theorem and the theorem of inducing representations of groups in stages are proved directly for projective unitary antiunitary representations in the second chapter. Based on a discussion of multipliers on locally compact groups in the third chapter all the well-known observables of classical quantum theory like linear momenta, orbital and spin angular momenta, kinetic and potential energies, gauge operators etc., are derived solely from Galilean covariance in the last chapter. A very short account of observables concerning a relativistic free particle is included.

In conclusion, the spectral theory of Schrodinger operators of one and two electron atoms is discussed in some detail.

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Contents: Probability theory on the lattice of projections in a Hilbert space; Systems with a configuration under a group action; Multipliers on locally compact groups; The basic observables of a quantum mechanical system; Bibliography.

Hindustan Book Agency

October 2005, 184 pages, Hardcover, ISBN 81-85931-59-3, 2000 *Mathematics Subject Classification:* 81-02, 81R05, All AMS members US\$27, List US\$34, Order code HIN/26

Scuola Normale Superiore



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Geometry of Yang-Mills-fields,
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THE CHINESE UNIVERSITY
OF HONG KONG

Applications are invited for: -

Department of Mathematics

**Research Assistant Professor(s)
Assistant Professor(s) / Associate Professor(s)
Professor(s)**

(Ref. 05/181(576)/2)(closing date: January 15, 2006)

Applicants should (i) have a relevant PhD degree, preferably in the area of Applied Mathematics. Those specialized in other relevant areas with excellent qualifications may also be considered. Applicants for Research Assistant Professorship should have a good potential in research and teaching. Applicants for Assistant Professorship / Associate Professorship should have outstanding profiles in research and teaching; and those for Professorship should have established scholarship of international reputation in their specialties. Appointment(s) will initially be made on a fixed-term contract basis for two to three years from August 2006, renewable subject to mutual agreement.

Salary and Fringe Benefits

Salary will be highly competitive, commensurate with qualifications and experience. The University offers a comprehensive fringe benefit package, including medical care, plus a contract-end gratuity for appointments of two years or longer; and housing benefits for eligible appointees.

Further information about the University and the general terms of service for appointments is available at <http://www.cuhk.edu.hk/personnel>. The terms mentioned herein are for reference only and are subject to revision by the University.

Application Procedure

Please send full resume, copies of academic credentials, a publication list and/or abstracts of selected published papers, together with names, addresses and fax numbers/e-mail addresses of three referees to whom the applicants' consent has been given for their providing references (unless otherwise specified), to the Personnel Office, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong (Fax: (852) 2603 6852) on or before **January 15, 2006**. The Personal Information Collection Statement will be provided upon request. Please quote the reference number and mark 'Application - Confidential' on cover.

Classified Advertisements

Positions available, items for sale, services available, and more

CALIFORNIA

CALIFORNIA STATE UNIVERSITY, LONG BEACH Department of Mathematics

TENURE-TRACK ASSISTANT PROFESSOR in PURE MATHEMATICS starting August 21, 2006. Must have Ph.D. in Mathematics. Duties include teaching graduate and undergraduate courses over a broad range of math subjects, research in mathematics leading to publication, and committee service. Salary commensurate with qualifications and experience. For more information, visit <http://www.csulb.edu/depts/math>. Review of applications begins January 9, 2006. To apply, send curriculum vitae, three letters of recommendation, transcript from Ph.D.-awarding university to Dr. Robert Mena, Chair, Department of Mathematics and Statistics, California State University, Long Beach, 1250 Bellflower Blvd., Long Beach, CA 90840-1001. An EO Employer.

000213

UNIVERSITY OF CALIFORNIA, LOS ANGELES Department of Mathematics

The following positions are available for the 2006-07 academic year, subject to

availability of resources and administrative approval.

(1) Tenure-track/Tenured Faculty positions.

(2) E. R. Hedrick Assistant Professorships. Salary is US\$53,200. And appointments are for three years. The teaching load is four quarter courses per year. (3) Research Assistant Professorships in Computational and Applied Mathematics (CAM). The salary is US\$53,200, and appointments are for three years. The teaching load is normally reduced to two or three quarter courses per year by research funding as available.

(4) Hedrick or CAM applicants who are U.S. citizens or permanent residents may also apply for a VIGRE Assistant Professor position. These are also three-year appointments with a salary of US\$53,200. The teaching load is 3 quarter courses per year.

(5) Assistant Adjunct Professorships in the Program in Computing (PIC). Applicants for these positions must show very strong promise in teaching and research in an area related to computing. The teaching load is four one-quarter programming courses each year and one seminar every two years. Initial appointments are for one year and possibly longer, up to a maximum service of four years. The salary is US\$56,800.

(6) Assistant Adjunct Professorships and Research Postdocs. Normally appointments are for one year, with the possibility of

renewal. Strong research and teaching background required. The salary range is US\$48,900-\$53,200. Teaching load for Adjuncts is five quarter courses per year.

Applicants should complete the application located on the website at <http://www.math.ucla.edu/~search>.

Preference will be given to applicants whose applications are completed by January 9, 2006.

UCLA is an Equal Opportunity/Affirmative Action Employer. Under Federal law, the University of California may employ only individuals who are legally authorized to work in the United States as established by providing documents specified in the Immigration Reform and Control Act of 1986.

000110

UNIVERSITY OF CALIFORNIA, RIVERSIDE Department of Mathematics F. Burton Jones Chair In Topology

Applications and nominations are invited for the F. Burton Jones Chair in Topology. The University seeks a distinguished scholar recognized for outstanding research in Topology. This prestigious chair was established with the generous endowment by the late emeritus Professor F. Burton Jones, the first in the history of UC Riverside fully endowed by an emeritus professor. The holder of the Jones Chair will be expected to play a leading role in maintaining first-rate teaching and

Suggested uses for classified advertising are positions available, books or lecture notes for sale, books being sought, exchange or rental of houses, and typing services.

The 2006 rate is \$100 per inch or fraction thereof on a single column (one-inch minimum), calculated from top of headline. Any fractional text of 1/2 inch or more will be charged at the next inch rate. No discounts for multiple ads or the same ad in consecutive issues. For an additional \$10 charge, announcements can be placed anonymously. Correspondence will be forwarded.

Advertisements in the "Positions Available" classified section will be set with a minimum one-line headline, consisting of the institution name above body copy, unless additional headline copy is specified by the advertiser. Headlines will be centered in boldface at no extra charge. Ads will appear in the language in which they are submitted.

There are no member discounts for classified ads. Dictation over the telephone will not be accepted for classified ads.

Upcoming deadlines for classified advertising are as follows: February 2006 issue-November 29, 2005; March 2006 issue-December 30, 2005; April 2006

issue-January 31, 2006; May 2006 issue-February 28, 2006; June/July 2006 issue-April 28, 2006; August 2006 issue-May 26, 2006.

U.S. laws prohibit discrimination in employment on the basis of color, age, sex, race, religion, or national origin. "Positions Available" advertisements from institutions outside the U.S. cannot be published unless they are accompanied by a statement that the institution does not discriminate on these grounds whether or not it is subject to U.S. laws. Details and specific wording may be found on page 1373 (vol. 44).

Situations wanted advertisements from involuntarily unemployed mathematicians are accepted under certain conditions for free publication. Call toll-free 800-321-4AMS (321-4267) in the U.S. and Canada or 401-455-4084 worldwide for further information.

Submission: Promotions Department, AMS, P.O. Box 6248, Providence, Rhode Island 02940; or via fax: 401-331-3842; or send email to c1assads@ams.org. AMS location for express delivery packages is 201 Charles Street, Providence, Rhode Island 02904. Advertisers will be billed upon publication.

research programs in the department and consequently, the appointee will be a person of great distinction, with national or international recognition for scholarly achievement. It is hoped to have the position filled by July 1, 2006. It is expected that the appointment will be with tenure at the rank of full professor and that the appointee will perform all the duties thereof. Established criteria of the University of California determine rank and salary. Initial review of applications will begin on February 6, 2006, and will continue until position is filled.

Please send nominations, applications (curriculum vitae, publications lists and names of at least five references) and supporting materials to:

Professor Bun Wong
Chair, Selection Committee
F. Burton Jones Chair
Department of Mathematics
University of California, Riverside,
Riverside, CA 92521-0135

The University of California, Riverside, is an Affirmative Action/Equal Opportunity Employer

000220

CONNECTICUT

YALE UNIVERSITY Department of Molecular, Cellular and Developmental Biology

The Department of Molecular, Cellular and Developmental Biology of Yale University invites applications for either a junior or senior faculty appointment in Computational Biology. The Department is particularly interested in individuals with expertise in mathematics or computer science who combine theory and experiment to solve important problems in cellular, molecular or developmental biology, including neuroscience. The successful candidate is expected to lead an active research group and participate in interdisciplinary research and training. The successful candidate should also demonstrate excellence in teaching at both the undergraduate and graduate levels. Review of applicants will begin January 2, 2006, and the search will remain open until the position is filled.

Information on the Department can be found on our website: <http://www.mcdb.yale.edu>.

Please submit curriculum vitae and description of research interests to "Search Committee" either by email to aileen.donnelly@yale.edu or to Department of Molecular, Cellular and Developmental Biology, Yale University, P.O. Box 208103, New Haven, CT 06520-8103. Candidates for assistant professor should also request three letters of recommendation addressed to the Search Committee. Yale University is an Affirmative Action/Equal Opportunity Employer. Women and underrepresented

minority scholars are especially encouraged to apply.

YALE UNIVERSITY Department of Mathematics

The Department of Mathematics of Yale University invites applications for a position as a tenured Associate or Full Professor in the area of Algebraic Geometry. We seek scholars with a record of outstanding achievement in research who are accomplished teachers at both the undergraduate and graduate level. We are interested in candidates with breadth of expertise in the above mentioned area. Please send curriculum vitae, description of research interests, and at least three letters of recommendation by January 31, 2006, to:

Yale University
Department of Mathematics
P.O. Box 208283
New Haven, CT 06520-8283 Attn:
Search Committee

Yale University is an Affirmative Action/Equal Opportunity Employer. Applications from women and underrepresented minority scholars are especially encouraged.

000221

DELAWARE

UNIVERSITY OF DELAWARE Department of Mathematical Sciences

The University of Delaware seeks applications for the position of Professor and Chair of the Department of Mathematical Sciences. The Department currently has approximately 50 faculty and professional staff, and offers programs for the B.A., B.S., M.S. and Ph.D. degrees in mathematics and applied mathematics. The focus of the Department has been in applied mathematics and applied analysis. The Department also has an active discrete mathematics group, a growing Modeling, Experiment and Computation Laboratory, small groups in probability and several other areas, and an ongoing commitment to secondary math education. Applicants should have a Ph.D. in some area of mathematical sciences commensurate with the research strengths of the Department, a distinguished record of scholarship and a proven record of obtaining outside funding, a commitment to excellence in instruction at all levels, and sufficient experience to indicate the ability to work cooperatively and effectively with faculty, professional staff and the administration. The Department expects to continue active recruitment for faculty appointments over the next few years, and the Chair should be a dynamic individual with a vision for the future to help the Department advance its reputation and visibility as well as furthering ties with other departments of the University. Applications received by Feb-

ruary 17, 2006, are guaranteed full consideration, and we anticipate making an appointment effective on or about September 1, 2006. Applicants should submit a CV and a statement of academic leadership philosophy to: Dr. Errol Lloyd, Chair Search Committee, Department of Mathematical Sciences, University of Delaware, Newark, DE 19716. In addition, candidates should have four letters of reference sent directly to the above address. The CV and letters of reference will be shared with departmental faculty. The University of Delaware is an Equal Opportunity Employer, which encourages applications from Minority Group Members and Women.

000205

DISTRICT OF COLUMBIA

THE GEORGE WASHINGTON UNIVERSITY Department of Mathematics Chair

The Department of Mathematics at The George Washington University invites nominations and applications for the position of Department Chair. The appointment will be at the rank of Professor, with tenure. The Department of Mathematics is seeking an accomplished individual with vision and energy to lead the faculty to a new level of achievement. The new Chair will advance the substantial research environment in the department, possess strong leadership and administrative skills, and have a demonstrated ability to work effectively with colleagues, staff, and students in the department and with other university units. The successful candidate should have an internationally recognized research record, a commitment to excellence in teaching at all levels, and, preferably, experience in directing doctoral dissertations and a record of success in obtaining external funding. The Department consists of 18 full-time faculty and 20 graduate students and offers bachelor's, master's, and doctoral degrees. The faculty's research strengths include analysis, applied mathematics, combinatorics, logic, and topology. Faculty have significant involvement in the rich array of resources in the national capital area, including interactions with Washington research institutions such as NASA, NIH, NIST, NSF, and NSA. Twice per year, the department holds a conference called *Knots in Washington*. Every summer, the department is host to a national program for undergraduate women contemplating graduate study in mathematics. As part of its efforts to advance research and graduate study, the Columbian College of Arts and Sciences (CCAS), in which the Department of Mathematics is located, is about to launch an interdisciplinary initiative revolving around the mathematical sciences. This project will bring together researchers in the natural sciences and data-intensive social sciences to engage one another's problems and promote

mathematical inquiry, analysis, and modeling broadly in the College. The new Chair of the Department of Mathematics is expected to assume a leadership role in developing this College-wide initiative to which the Dean is strongly committed.

Nominations, applications, and inquiries should be sent to: Professor Frank Baginski, Search Committee Chair, Department of Mathematics, The George Washington University, 1922 F Street NW, Washington, DC 20052 (baginski@gwu.edu). Applicants should send a curriculum vitae and a statement of leadership philosophy. A small set of candidates will subsequently be asked to provide at least three references whom the Search Committee can contact for recommendations.

Review of applications will begin January 10, 2006, and will continue until the position is filled. The George Washington University is an Equal Opportunity/Affirmative Action Employer.

000211

FLORIDA

UNIVERSITY OF WEST FLORIDA
Department of Mathematics

The University of West Florida, Department of Mathematics and Statistics, invites applications for two anticipated tenure-track positions at the assistant professor level, beginning August 2006. Ph.D. in mathematics required with preference given to candidates in applied mathematics. Salary competitive. Candidates should have strong commitment to teaching at the undergraduate and master's levels, scholarly activity and service. A police background screening is required.

To apply, please go to <http://jobs.uwf.edu> to create your application. Please be prepared to attach the following documents in digital format: letter of interest and vita. Interested persons should also send transcripts and at least three sealed letters of reference to Dr. Kuiyuan Li, Chairperson, Department of Mathematics and Statistics, University of West Florida, 11000 University Parkway, Pensacola, FL 32514. Active review of candidates' materials will begin January 16, 2006, and will continue until the position is filled. UWF is an Equal Opportunity, Access, Affirmative Action Employer.

000167

GEORGIA

GEORGIA INSTITUTE OF TECHNOLOGY
School of Mathematics

The School of Mathematics at Georgia Tech is now in the second year of an ambitious faculty recruitment program—one which will be sustained over a five-year period. During the first year, four appointments

were made, including one at the full professor level and two at the associate professor level. Building on past successes, this recruiting effort is intended to make rapid advances in the scope and quality of our research and graduate education programs. Candidates will be considered at all ranks, with priority given to those candidates who (1) bring exceptional quality research credentials to Georgia Tech; (2) complement existing strengths in the School of Mathematics; (3) reinforce bridges to programs in engineering and the physical, computing and life sciences; (4) have strong potential for external funding; and (5) have a demonstrated commitment to high quality teaching at both the undergraduate and graduate levels. Consistent with these priorities, candidates will be considered in all areas of Pure and Applied Mathematics and Statistics. Candidates should arrange for a resume, at least three letters of reference, and a summary of future research plans to be sent to the Hiring Committee, School of Mathematics, Georgia Institute of Technology, Atlanta, GA, 30332-0160, USA. Candidates for Associate and Full Professor positions should also submit a statement outlining their vision for service as a senior faculty member at Georgia Tech. Review of applications will begin in September 2005, and the roster of candidates being considered will be updated on a monthly basis. Georgia Tech, an institution of the University System of Georgia, is an Equal Opportunity/Affirmative Action Employer.

000108

ILLINOIS

SOUTHERN ILLINOIS UNIVERSITY
CARBONDALE
Department of Mathematics
Mathematics Education Position

Applications are invited for a tenure-track position at the rank of associate professor to begin on August 16, 2006, to support the department's programs in mathematics education as part of an on-going Teaching Excellence in Mathematics and Science initiative. The person hired into this position will be expected to maintain an active research program in an area of pure or applied mathematics, and to seek external funding in the area of mathematics education. Teaching and service duties of the position will involve the training of teachers at the elementary and secondary levels. Applicants must demonstrate a record of established research productivity in an area of pure or applied mathematics and a record of teaching excellence commensurate with the rank of associate professor, have an established record of success in acquiring external grants and/or contracts, and have an interest in and aptitude for educating prospective teachers of mathematics. Ph.D. in pure or applied mathematics required by August 15, 2006.

To apply, please send letter of application; curriculum vitae; and statements of research and teaching interests; and have three letters of recommendation sent, to: Mathematics Education Position, Department of Mathematics, Mailcode 4408, Southern Illinois University Carbondale, 1245 Lincoln Drive, Carbondale, Illinois 62901. Review of applications will begin December 5, 2005, and continue until position is filled. SIUC is an Affirmative Action/Equal Opportunity Employer that strives to enhance its ability to develop a diverse faculty and staff and to increase its potential to serve a diverse student population. All applications are welcomed and encouraged and will receive consideration.

00021

KANSAS

KANSAS STATE UNIVERSITY
Department of Mathematics

Subject to budgetary approval, applications are invited for an Algebra Coordinator position commencing August 13, 2006. The coordinator will work with the Center for Quantitative Education on the design and implementation of a new instructional program in College Algebra in a modern technological environment. The coordinator will collaborate with the director of the center, teach in the program, assist in training graduate students, and manage student interactions.

Applicants must have a commitment to excellence in teaching. A Ph.D. in mathematics or a Ph.D. dissertation accepted with only formalities to be completed is required. Preference will be given to applicants with background in mathematics education, especially in the training of graduate students, and/or teaching with technology. Letter of application, current vita, three letters of reference, and a statement of teaching philosophy should be sent to:

Louis Pigno
 Kansas State University
 Department of Mathematics
 Cardwell Hall 138
 Manhattan, KS 66506

Applications for the position will be reviewed beginning December 5, 2005, and will continue until the position is closed. Kansas State University is an Equal Opportunity Employer. Paid for by Kansas State University.

000217

KANSAS STATE UNIVERSITY
Department of Mathematics

Subject to budgetary approval, applications are invited for one or more visiting assistant professorships commencing August 13, 2006. Instructors will be Fellows of the Center for Quantitative Education and will participate in the design and

implementation of an innovative algebra course, including an online homework system, and teach in the undergraduate program. Successful candidate(s) will have time to pursue research in the department along with these duties.

Applicants must have a commitment to excellence in teaching. A Ph.D. in mathematics or a Ph.D. dissertation accepted with only formalities to be completed is required. Preference will be given to applicants with background in mathematics education and/or teaching with technology, as well as applicants whose research interests mesh well with current department faculty. Letter of application, current vita, three letters of reference, and a statement of teaching philosophy should be sent to:

Louis Pigno
Kansas State University
Department of Mathematics
Cardwell Hall 138
Manhattan, KS 66506

Applications for the position will be reviewed beginning December 5, 2005, and will continue until the position is closed. Kansas State University is an Equal Opportunity Employer. Paid for by Kansas State University.

000218

MARYLAND

JOHNS HOPKINS UNIVERSITY Department of Mathematics Director of Undergraduate Studies

Subject to availability of resources and administrative approval, the Department of Mathematics solicits applications for a Director of Undergraduate Studies for the 2006-2007 academic year.

Candidates for the position of Director of Undergraduate Studies should demonstrate excellence in teaching and organizational abilities. Responsibilities include the training and supervision of teaching assistants, maintenance and development of the undergraduate curriculum, and coordination of registration issues. The teaching load is three courses per academic year.

To submit your applications go to <http://www.mathjobs.org/jobs/jhu>. Applicants are strongly advised to submit their other materials electronically at this site.

If you do not have computer access, you may mail your application to: Appointments Committee, Department of Mathematics, Johns Hopkins University, 404 Krieger Hall, Baltimore, MD 21218, and should include a vita, at least four letters of recommendation of which one concerns teaching, and a teaching statement. Write to email: math@math.jhu.edu for questions concerning these positions. Applications received by January 15, 2006, will be given priority. The Johns Hopkins University is an Affirmative Action/Equal

Opportunity Employer. Minorities and women candidates are encouraged to apply.

For more information about the position or institution/company: <http://www.mathematics.jhu.edu/mathnew/jobs.html>.

000070

MASSACHUSETTS

HARVARD UNIVERSITY Applied Mathematics Lectureships Division of Engineering and Applied Sciences

The Division of Engineering and Applied Sciences (DEAS) at Harvard University expects to appoint two Lecturers in Applied Mathematics for 2006-2007. These will be annual appointments, renewable for up to two years combining teaching and research.

We are particularly interested in candidates who have a commitment to and demonstrable excellence in teaching undergraduate and graduate courses. Applicants whose research interests complement those of the current faculty in Applied Mathematics will be most competitive for these positions. For more see <http://www.deas.harvard.edu/research/appliedmathematics/index.html>.

The application deadline is December 31, 2005. Applications including a CV, a list of publications, a statement describing current and planned research, a statement outlining teaching experience, and at least three letters of recommendation should be sent to:

Applied Mathematics Lectureship
Committee
c/o Marina McLaughlin
Division of Engineering and Applied Sciences
29 Oxford Street
Harvard University
Cambridge, MA 02138
email: marina@deas.harvard.edu.

Harvard is an Equal Opportunity/Affirmative Action employer and encourages applications from women and members of minority groups.

000199

HARVARD UNIVERSITY George F. Carrier Postdoctoral Fellowship in Widely Applied Mathematics Division of Engineering and Applied Sciences

The Division of Engineering and Applied Sciences at Harvard University seeks applicants for a newly endowed honorific postdoctoral position in widely applied mathematics, the George F. Carrier* Fellowship. These will be awarded for two years, with the possibility of renewal for

a third year. We are looking for outstanding applicants interested in an opportunity for independent research that reflects the spirit of George Carrier's approach and complements that of the current faculty in Applied Mathematics, broadly interpreted, including those in the Division of Engineering and Applied Sciences, the Department of Physics, and elsewhere at the University. Current faculty interests are in applied mathematics in biological, earth science, engineering and physical contexts, and especially in soft materials and biophysics. For more see: <http://www.deas.harvard.edu/research/appliedmathematics/index.html>.

The application deadline is December 31, 2005. Applications including a CV, a list of publications, a statement describing current and planned research, and at least three letters of recommendation should be sent directly to:

Carrier Postdoctoral Fellowship Committee
c/o Marina McLaughlin
Division of Engineering and Applied Sciences
29 Oxford Street
Harvard University
Cambridge, MA 02138
email: marina@deas.harvard.edu.

The annual salary is US\$50,000 with additional funds of US\$5,000 per year available for research support. We particularly encourage applications from women and minorities. Harvard is an Equal Opportunity/Affirmative Action Employer.

*George Carrier (1919-2002) was the T. Jefferson Coolidge Professor of Mathematics at Harvard, and one of the pre-eminent applied mathematicians of his generation. He had a special talent for describing complicated physical phenomena mathematically, and did so with great facility over a wide range of problems that included fluid dynamics, elasticity, combustion and natural hazards. For more see http://www.news.harvard.edu/gazette/2002/03_21/08-carrier.html.

000200

MASSACHUSETTS INSTITUTE OF TECHNOLOGY Department of Mathematics Applied Mathematics

The applied mathematics group at MIT is seeking to fill possible positions at the level of Instructor, Assistant Professor or higher, beginning September 2006. Appointments will be made based on demonstrated outstanding research qualifications. Candidates in all areas of applied mathematics, including physical applied mathematics, computational molecular biology, numerical analysis, scientific computation, and theoretical computer science will be considered. Current activities of the group include: combinatorics, operations research, theory of algorithms, numerical analysis, astrophysics, condensed matter physics, computational

physics, fluid dynamics, geophysics, non-linear waves, theoretical and computational molecular biology, material sciences, quantum computing and quantum field theory, but new hiring may involve other areas.

Applications and other materials, including (a) curriculum vitae, (b) research description, and (c) three letters of recommendation, must be submitted online at www.mathjobs.org by January 1, 2006 (please do not mail duplicates). We request that your letters of reference be submitted online. Alternatively, they may be sent to: Committee on Applied Mathematics, Room 2-345, Department of Mathematics, MIT, 77 Massachusetts Ave., Cambridge, MA 02139-4307. To ensure full consideration of your application, all references must arrive by January 16. MIT is an Equal Opportunity, Affirmative Action Employer. (For more information about the MIT Mathematics Department: <http://www.math.mit.edu>.)

000151

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Department of Mathematics
C.L.E. Moore Instructorships
in Mathematics

These positions are open to mathematicians with doctorates who show definite promise in research. Applications and other materials, including (a) curriculum vitae, (b) three letters of reference, (c) a description of the research in your thesis, and (d) a research plan for the next year, must be submitted online at www.mathjobs.org by January 1, 2006 (please do not mail duplicates). We request that your letters of reference be submitted online. Alternatively, they may be sent to: Pure Mathematics Committee, Massachusetts Institute of Technology, Room 2-263, Cambridge, MA 02139-4307. To ensure full consideration of your application, all references must arrive by January 16. MIT is an Equal Opportunity, Affirmative Action Employer. (For more information about the MIT Mathematics Department: <http://www-math.mit.edu>.)

000150

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
DEPARTMENT OF MATHEMATICS

The Department of Mathematics may make appointments at the level of lecturer and assistant professor or higher, in pure mathematics for the year 2006-2007. These positions are open to mathematicians with doctorates who have demonstrated outstanding qualifications. Applications and other materials, including (a) curriculum vitae, (b) three letters of reference, (c) a description of your most recent research, and (d) a research plan for the immediate future, must be submitted online at <http://www.mathjobs.org> by January 1,

2006 (please do not mail duplicates). We request that your letters of reference be submitted online. Alternatively, they may be sent to: Pure Mathematics Committee, Massachusetts Institute of Technology, Room 2-263, 77 Massachusetts Ave., Cambridge, MA 02139-4307. To ensure full consideration of your application, all references must arrive by January 16. MIT is an Equal Opportunity, Affirmative Action Employer. (For more information about the MIT Mathematics Department: <http://www-math.mit.edu>.)

000149

WILLIAMS COLLEGE
Department of Mathematics
and Statistics

Williams College Department of Mathematics and Statistics invites applications for a newly authorized visiting position in mathematics for the 2006-2007 year, probably at the rank of assistant professor, however, in exceptional cases, a more advanced appointment might be considered. A Ph.D. is required. Send a vita and three letters of recommendation on teaching and research to: Visitor Hiring Committee, Department of Mathematics and Statistics, Williams College, Williamstown, MA 01267. Consideration of applications will begin on November 15th and continue until the position is filled. Williams College is dedicated to providing a welcoming intellectual environment for all of its faculty, staff and students; as an AA/EOE employer, Williams especially welcomes applications from women and minority candidates.

000102

MICHIGAN

MICHIGAN STATE UNIVERSITY
East Lansing, MI 48824
proMSc Program in
Industrial Mathematics

Direct your students toward one of the professional M.Sc. programs. Industry needs business-savvy mathematicians. See <http://www.sciencemasters.com/>.

000019

MICHIGAN TECHNOLOGICAL UNIVERSITY
Department of Mathematical Sciences
Mathematics Education Position

Applications are invited for a tenure-track faculty position in Mathematics Education at the assistant professor level starting August 21, 2006. Candidates must demonstrate evidence of excellence in teaching and outstanding research potential and are expected to seek external funding.

Candidates should have completed their Ph.D. degree in Mathematics Education by August 21, 2006. Review process begins January 15, 2006, and will continue until

the position is filled. Additional information can be obtained at <http://www.math.mtu.edu>.

Send vitae and 3 letters of reference to: Mathematics Education Search Committee, Department of Mathematical Sciences, Michigan Technological University, 1400 Townsend Drive, Houghton, MI 49931-1295.

Michigan Technological University is an Equal Opportunity Educational Institution/Equal Opportunity Employer/Affirmative Action Employer.

000202

MICHIGAN TECHNOLOGICAL UNIVERSITY
Department of Mathematical Sciences
Tenure-Track Assistant Professor
Position

Applications are invited for a tenure-track faculty position at the assistant professor level starting August 21, 2006. We are especially interested in the areas of algebra, combinatorics, and actuarial science. Candidates must demonstrate evidence of excellence in teaching and outstanding research potential and are expected to seek external funding.

Candidates should have completed their Ph.D. degree by August 21, 2006. Review process begins January 15, 2006, and will continue until the position is filled. Additional information can be obtained at <http://www.math.mtu.edu>.

Send vitae and 3 letters of reference to: Search Committee, Department of Mathematical Sciences, Michigan Technological University, 1400 Townsend Drive, Houghton, MI 49931-1295.

Michigan Technological University is an Equal Opportunity Educational Institution/Equal Opportunity Employer/Affirmative Action Employer.

000203

MISSISSIPPI

UNIVERSITY OF MISSISSIPPI
Department of Mathematics

The department of mathematics seeks to fill a tenure-track Assistant Professor position, beginning August 2006. All candidates should have a Ph.D. (or equivalent) by August 2006 in mathematics or statistics, and outstanding potential in both research and teaching. Candidates whose research interests coincide with those of existing faculty are sought in the areas of statistics, combinatorics, graph theory, and analysis. The successful applicant will teach 6 hours per semester and is also expected to conduct a vigorous research program. Applicants should complete the application form, cover letter, curriculum vitae, and at least one page of statement on research interest online at <http://jobs.olemiss.edu>. Three letters

of recommendation about the applicant's research, and at least one letter of recommendation about the applicant's teaching must be sent to:

University of Mississippi
Department of Mathematics
Chairman of Tenure Track Search
Committee
305 Hume Hall
University, MS 38677

The letters of recommendation must be submitted directly by the referees. Inquires about this position may be sent to mdepart@pop.olemiss.edu. Screening of applications will begin immediately and will continue until the position is filled. For information about the department please visit <http://www.olemiss.edu/depts/mathematics> and for information about the University of Mississippi see <http://www.olemiss.edu>.

The University of Mississippi is an EEO/AA/Title VI/Title IX/Section 504/ADA/ADEA employer.

NEVADA

UNIVERSITY OF NEVADA RENO Department of Mathematics

The Department of Mathematics and Statistics at the University of Nevada Reno invites applicants for two tenure-track positions in statistics effective fall 2006. Minimum qualifications: Ph.D. in statistics or a related area and evidence of strong potential for significant research, excellence in teaching, interdisciplinary collaborations, and graduate student supervision. For full consideration apply by 1/15/2006. For details and to apply online visit <http://jobs.unr.edu/professional>. EEO/AA. Women and underrepresented groups are encouraged to apply.

000212

NEW YORK

LEHMAN COLLEGE (CUNY) Department of Mathematics and Computer Science

Tenure-track position(s) available starting September 1, 2006, for Assistant/Associate Professors in Mathematics or Computer Science. Position(s) require an earned doctorate, outstanding research record or potential and commitment to excellence in teaching and service. Appointment rank and salary commensurate with qualifications and experience. Application procedure: Send curriculum vitae along with a cover letter and arrange for at least three letters of recommendation to be sent to: Prof. Robert Feinerman, Chair, Department of Mathematics and Computer Science, Lehman College, Bronx, NY 10468. Review of applications will begin on January 20, 2006, and will continue until positions are

filled. Use of the AMS Cover Sheet for Academic Employment is encouraged. Additional information at <http://www.Tehman.cuny.edu>. AA/EEO/ADA Employer.

000207

SUNY POTSDAM Department of Mathematics

SUNY Potsdam invites applications for three anticipated full-time tenure-track positions effective September 1, 2006, at the rank of Assistant Professor, with one position possibly at the rank of Associate Professor. Responsibilities include teaching twelve hours per semester of undergraduate through first year graduate courses. Required qualifications are a Ph.D. in any area of mathematics with a strong interest in and preparation for teaching undergraduate major mathematics courses. Candidates from all areas are encouraged to apply. Applications, which must include a letter of interest, a teaching statement, a curriculum vitae, three letters of recommendation (at least one of which addresses teaching experience and abilities), and a transcript (a copy is acceptable) should be sent to Dr. Victoria Klawitter, Mathematics Department, SUNY Potsdam, Potsdam, NY 13676 (klawitv@potdams.edu). To ensure full consideration, complete applications must be received by January 19, 2006. For information about the College and the Department, visit <http://www.potsdam.edu>. SUNY Potsdam is an Equal Opportunity Employer committed to excellence through diversity.

000208

TENNESSEE

UNIVERSITY OF TENNESSEE, KNOXVILLE Department of Mathematics

The Department of Mathematics of the University of Tennessee seeks to fill a tenure-track assistant professorship position in Algebra (with preference given to areas represented in the department, especially algebraic geometry and related fields) or Analysis (functional analysis, operator theory, operator algebras, function theory, SLEs and function theory, harmonic analysis, or discrete conformal geometry). A Ph.D. is required. Some postdoctoral experience is desirable, though not required. Substantial research promise and dedication to excellent teaching are paramount. Employment begins August 1, 2006.

The University welcomes and honors people of all races, creeds, cultures, and sexual orientations, and values intellectual curiosity, pursuit of knowledge, and academic freedom and integrity. Interested applicants should arrange to have a vita, three reference letters, a research statement (including abstracts), and evidence of quality teaching sent to: Algebra/Analysis Search, Department of Math-

ematics, The University of Tennessee, Knoxville, TN 37996-1300. Electronic applications are not acceptable. Use of the AMS application form is appreciated. Review of applications will begin December 15 and will continue until the position is filled. Please see our website www.math.utk.edu for information about the department.

The University of Tennessee is an EEO/AA/Title VI/Title IX/Section 504/ADA/ADEA institution in the provision of its education and employment programs and services.

000215

UNIVERSITY OF TENNESSEE, KNOXVILLE Department of Mathematics

The Mathematics Department of The University of Tennessee invites applications for a tenure-track Assistant Professor position in Computational/Applied Mathematics, starting August 1, 2006. Preference will be given to candidates with research interests in numerical partial differential equations with applications to materials science, biology, image processing, fluid mechanics, optimization, or related areas. Candidates with an interest in interacting with other areas in the department and the nearby Oak Ridge National Laboratory are encouraged to apply. A Ph.D. is required. Postdoctoral experience is preferred but not required. Substantial research promise and dedication to excellent teaching are paramount.

The university welcomes and honors people of all races, creeds, cultures, and sexual orientations, and values intellectual curiosity, pursuit of knowledge, and academic freedom and integrity. Interested applicants should arrange to have a vita, three reference letters, a research statement (including abstracts), and evidence of quality teaching sent to: Computational/Applied Math Search, Department of Mathematics, The University of Tennessee, Knoxville, TN 37996-1300. Electronic applications are not acceptable. Use of the AMS application form is appreciated. Review of applications will begin December 15 and will continue until the position is filled. Information about the department can be found at <http://www.math.utk.edu>.

The University of Tennessee is an EEO/AA/Title VI/Title IX/Section 504/ADA/ADEA institution in the provision of its education and employment programs and services.

000216

TEXAS

**THE UNIVERSITY OF TEXAS AT
ARLINGTON
Department of Mathematics**

The Department of Mathematics at The University of Texas at Arlington invites applications for two tenure-track assistant professor positions beginning September 1, 2006, subject to available funding. Tenured appointments at the rank of Associate or Full Professor may be considered for exceptional candidates. The salary will be competitive and commensurate with qualifications and experience. The minimum qualifications are an earned Ph.D. in mathematics, mathematics education, or a related field. At least two years of experience beyond the Ph.D. is preferable.

Demonstrated excellence in research, external funding, and teaching is essential. While outstanding applicants from all mathematical research areas will be considered, preference will be given to those with significant research and scholarly accomplishments in mathematics education, operations research, numerical/computational methods, bio-mathematics, statistics/bio-statistics and other areas of applied mathematics. There is particular interest for candidates in mathematics education who will teach courses, supervise theses, and conduct research in the department's fast-growing Master of Arts in Mathematics program for secondary teachers.

For more information about the department, visit our web site at <http://www.uta.edu/math>.

Applicants should send a letter of application plus a complete curriculum vitae, statement on research interests, statement of teaching philosophy, one or two representative publications, and an AMS cover sheet to:

Dr. James A. M. Epperson
Chair, Faculty Recruiting Committee
Department of Mathematics
The University of Texas at Arlington
Box 19408
Arlington, TX 76019-0408

Applicants should arrange to have at least three letters of recommendation sent to the above address. Inquiries about the position may be directed to Dr. Epperson, Faculty Recruiting Committee Chair, at mathsearch@uta.edu. Review of applications will begin on December 5, 2005, and will continue until the positions are filled.

UTA is an Equal Opportunity and Affirmative Action employer.

000126

WISCONSIN

**BELOIT COLLEGE
Department of Mathematics and
Computer Science**

Tenure-track mathematics faculty position, beginning August 2006. Beloit College is a selective liberal arts college with a mathematics major and minor.

Required: Commitment to excellence in teaching and research in mathematics in the context of a liberal arts college; Ph.D. in a mathematical science.

Responsibilities: Teaching three four-hour courses per semester and scholarship in a mathematical science, plus advising and committee assignments. We encourage diverse interests and creativity; the successful candidate will contribute to the mathematics major and will also contribute to all-college programs (e.g., first-year seminars, interdisciplinary studies, writing program, and international education). Individuals with expertise and/or interest in statistics, mathematical modeling, computer science, or applications of mathematics are especially encouraged to apply.

Apply (letter, statement of teaching philosophy, vita, 3 reference letters, graduate and undergraduate transcripts) to: Math TT Search, Campus box 82, Beloit College, Beloit, WI 53511. More information from our web page or email: ell15@beloit.edu (put "ttsearch" in header). Priority to applications complete by 2/1.

Beloit College is committed to the educational benefits of diversity and urges all interested individuals to apply. AA/EEO Employer.

000204

CANADA

**UNIVERSITY OF ALBERTA
Department of Mathematical and
Statistical Sciences
Ordinary Differential Equations**

The Department of Mathematical and Statistical Sciences at the University of Alberta invites applications for a tenure-track position at the Assistant Professor level, starting in July 2006, in the area of qualitative theory of differential equations and dynamical systems. The candidate should have a Ph.D. in pure or applied mathematics, a strong record, excellent communication and teaching skills and leadership potential. The successful candidate must have a strong commitment to excellence in undergraduate and graduate education.

Preference will be given to applicants whose research expertise would complement and strengthen those of the differential equations and dynamical systems group in our Department. Areas of particular interest are qualitative theory of

ordinary/delay/partial differential equations, control theory, mathematical biology, stochastic differential equations and random dynamical systems.

Applicants should submit a curriculum vitae, a research plan and teaching dossier, and at least three confidential letters of reference to:

Anthony To-Ming Lau, Chair
Department of Mathematical and Statistical Sciences
University of Alberta
Edmonton, Alberta, Canada T6G 2G1

The closing date for application is January 15, 2006, or until a suitable candidate is found. Early applications are encouraged. For more information about the Department and the University of Alberta, please see the Department's webpage: <http://www.math.ualberta.ca>.

Please Note: Applicants being considered will generally be contacted within 3-4 weeks of the deadline date. Those not contacted are thanked for their interest and encouraged to apply for future positions advertised by the University.

All qualified candidates are encouraged to apply; however, Canadians and permanent residents will be given priority. If suitable Canadian citizens or permanent residents cannot be found, other individuals will be considered.

The University of Alberta hires on the basis of merit. We are committed to the principle of equity in employment. We welcome diversity and encourage applications from all qualified women and men, including persons with disabilities, members of visible minorities, and Aboriginal persons.

000222

**UNIVERSITY OF ALBERTA
Department of Mathematical and
Statistical Sciences
Algebraic Geometry**

The Department of Mathematical and Statistical Sciences, at the University of Alberta, invites applications for a tenure-track position at the Assistant Professor level in Algebraic Geometry. We are looking for a person with a Ph.D., strong research record, excellent communication and teaching skills and leadership potential. The successful candidate must also have a strong commitment to excellence in undergraduate and graduate education.

All areas of Algebraic Geometry will be seriously considered. Current interest within the Department includes Hodge Theory, Algebraic K-Theory and Cohomological Methods.

Applicants should submit a curriculum vitae, a teaching profile outlining experience and/or interests, and at least three confidential letters of reference to:

Anthony To-Ming Lau, Chair
Department of Mathematical and Statistical Sciences

University of Alberta

Edmonton, Alberta, Canada T6G 2G1

The closing date for application is January 15, 2006, or until a suitable candidate is found. Early applications are encouraged. For more information about the Department and the University of Alberta, please see the Department's webpage: <http://www.math.ualberta.ca>.

Please Note: Applicants being considered will generally be contacted within 3-4 weeks of the deadline date. Those not contacted are thanked for their interest and encouraged to apply for future positions advertised by the University.

All qualified candidates are encouraged to apply; however, Canadians and permanent residents will be given priority. If suitable Canadian citizens or permanent residents cannot be found, other individuals will be considered.

The University of Alberta hires on the basis of merit. We are committed to the principle of equity in employment. We welcome diversity and encourage applications from all qualified women and men, including persons with disabilities, members of visible minorities, and Aboriginal persons.

000223

UNIVERSITY OF ALBERTA
Department of Mathematical and
Statistical Sciences
Algebraic Groups and Applications

The Department of Mathematical and Statistical Sciences, at the University of Alberta, invites applications for a tenure-track position at the Assistant Professor level in Algebraic Groups and Applications. We are looking for a person with a Ph.D., strong research record and leadership potential as well as excellent communication and teaching skills. The successful candidate must also have a strong commitment to excellence in undergraduate and graduate education.

All aspects of Algebraic Groups and their applications will be seriously considered. Current interests within the Department include Brauer groups, Quadratic forms, Galois cohomology and Lie theory.

Applicants should submit a curriculum vitae, a teaching profile outlining experience and/or interests, and at least three confidential letters of reference to:

Anthony To-Ming Lau, Chair
 Department of Mathematical and Statistical Sciences
 University of Alberta
 Edmonton, Alberta, Canada T6G 2G1

The closing date for applications is January 15, 2006, or until a suitable candidate is found. Early applications are encouraged. For more information about the Department and the University of Alberta, please see the Department's webpage: <http://www.math.ualberta.ca>.

Please Note: Applicants being considered will generally be contacted within

3-4 weeks of the deadline date. Those not contacted are thanked for their interest and encouraged to apply for future positions advertised by the University.

All qualified candidates are encouraged to apply; however, Canadians and permanent residents will be given priority. If suitable Canadian citizens or permanent residents cannot be found, other individuals will be considered.

The University of Alberta hires on the basis of merit. We are committed to the principle of equity in employment. We welcome diversity and encourage applications from all qualified women and men, including persons with disabilities, members of visible minorities, and Aboriginal persons.

000224

UNIVERSITY OF ALBERTA
Department of Mathematical and
Statistical Sciences
NSERC University Faculty Award

The Department of Mathematical and Statistical Sciences, at the University of Alberta, is actively seeking to nominate a candidate for an NSERC University Faculty Award in the Fall 2006 competition.

The University Faculty Award was created by NSERC to encourage Canadian universities to appoint outstanding women and Aboriginal researchers to tenure-track positions in science and engineering. Further information on the program can be found at the following webpage: http://www.nserc.gc.ca/professors_e.asp?nav=profnav&lbi=c7.

The nominee will have an excellent record of research and publication. We are particularly interested in candidates who work in a field related to an area of existing or emerging strength in the Department, although other areas will be considered. Some areas of research excellence, recently highlighted by the Faculty of Science, include algebra, functional analysis, fluid dynamics, statistics, mathematical biology, and scientific computing. The candidate will also have a strong commitment to and aptitude for teaching undergraduate students, and will be expected to supervise graduate theses.

This tenure-track appointment is scheduled to begin on or near July 1, 2007.

Applicants should submit a curriculum vitae, research and teaching profiles outlining experience and/or interests, and at least three confidential letters of reference to:

Anthony To-Ming Lau, Chair
 Department of Mathematical and Statistical Sciences
 University of Alberta
 Edmonton, Alberta, Canada T6G 2G1

The closing date for applications is March 1, 2006. Early applications are encouraged. According to NSERC regulations, applicants

must be Canadian citizens or permanent residents of Canada.

Please Note: Applicants being considered will generally be contacted within 3-4 weeks of the deadline date. Those not contacted are thanked for their interest and encouraged to apply for future positions advertised by the University.

The University of Alberta hires on the basis of merit. We are committed to the principle of equity in employment. We welcome diversity and encourage applications from all qualified women and men, including persons with disabilities, members of visible minorities, and Aboriginal persons.

000225

GUAM

UNIVERSITY OF GUAM
Department of Mathematics

Asst/Assoc Prof. Math vacancy at UOG. Ph.D. (req.) in Math Sci (prefer Pure/Applied, Math Stat). Send CV, 3 ref. letters, copies of grad transcripts, GovGuam application to Chair, Math Search, HRO, UOG, Mangilao, GU 96923. Visit <http://www.uog.edu> or email crmtaita@uog9.uog.edu. No email app. accepted. EEO/AA Emp.

000206

QATAR

CARNEGIE MELLON QATAR CAMPUS
Computer Science Visiting Faculty
Positions

Carnegie Mellon University established a branch campus in Qatar in the fall of 2004. We are offering a BS degree in Computer Science to an international student body. The university invites applications for several visiting faculty positions to begin Fall 2006.

We are looking for outstanding educators, interested in working closely with undergraduate students. Candidates should have a Ph. D. in Computer Science or related field and an outstanding research record or potential.

Relevant areas of expertise are data structures and algorithms, algorithm design and analysis, graphics, computer networks, program languages, distributed and parallel systems, information retrieval and databases, intelligent information systems, and software engineering. Exceptional candidates in other areas will also be considered.

The position offers competitive salaries, overseas assignment, travel and housing allowances and other benefits packages, as well as an attractive research support.

Interested candidates should send their resume, statement of teaching interest



TENURE TRACK FACULTY STATISTICS – MATHEMATICAL SCIENCES

The Mathematical Sciences Department of Worcester Polytechnic Institute (WPI) invites applications for one anticipated tenure-track faculty position in applied statistics in 2006. Candidates at the assistant professor level will be considered.

An earned Ph.D. or equivalent degree is required. Successful candidates must be able to contribute strongly to both the department's research activities and its innovative, project-based educational programs. Applications are especially encouraged in the areas of biostatistics, computational statistics, experimental design, Bayesian methods, or time series analysis.

WPI is a private and highly selective technological university with an enrollment of 2700 undergraduates and about 1100 full- and part-time graduate students. Worcester, located forty miles west of Boston, offers ready access to the diverse economic, cultural and recreational resources of the region.

The Mathematical Sciences Department has 24 tenured/tenure-track faculty and supports BS, MS, and Ph.D. programs in applied and computational mathematics and applied statistics. For additional information, see <http://www.wpi.edu/+math>.

Qualified applicants should send a detailed curriculum vitae, a one-page statement of specific teaching and research objectives, and the names of four references with mail/email addresses and telephone/fax numbers to **Statistics Search Committee, Mathematical Sciences Department, WPI, 100 Institute Road, Worcester, MA 01609-2280, USA.**

Applications will be considered on a continuing basis beginning **December 1, 2005** until the position is filled.

To enrich education through diversity, WPI is an affirmative action, equal opportunity employer.

NO PHONE CALLS PLEASE

and research, and names of three references to:

Faculty Hiring Committee
c/o Ruth Gaus
Qatar Office SMC 1070
5032 Forbes Avenue
Pittsburgh, PA 15289
Ruth.Gaus@cs.cmu.edu
fax: 412-253-0924

For more information on the BS in CS program, see <http://www.csd.cs.cmu.edu/education/bcs/index.html>. For more information on the Carnegie Mellon Qatar Campus, see <http://www.qatar.cmu.edu/>. Information on Qatar is available at: <http://www.experienceqatar.com/>.

000219

TAIWAN

NATIONAL CHIAO TUNG UNIVERSITY Department of Applied Mathematic

The Department of the Applied Mathematics at National Chiao Tung University in Taiwan invites applications for several tenure-track assistant or tenured associate professorships. The appointment will start in August 2006. The areas of interest include (but are not limited to) scientific computing, numerical analysis, mathematical modelling, partial differential equations, discrete mathematics, and probability theory.

A Ph. D in mathematics/applied mathematics or a related field is required and the successful candidate should have a good record in research and teaching.

Interested applicants should arrange a cover letter, a curriculum vitae, a statement of teaching philosophy, a future research plan, and three letters of references to: Chih-Wen Shih, Chair, Department of Applied Mathematics, National Chiao Tung University, Hsinchu, 300, Taiwan. Review of applications will begin on February 15, and will continue until the positions are filled.

000201



VISITING FACULTY STATISTICS & APPLIED MATH POSITIONS MATHEMATICAL SCIENCES

The Worcester Polytechnic Institute (WPI) Department of Mathematical Sciences invites applications for several Visiting Assistant Professorship positions to begin in the fall of 2006, in the areas compatible with the research interests in the department. An earned PhD or equivalent degree is required. Successful candidates must demonstrate strong research potential and evidence of quality teaching, and will be expected to contribute to the department's research activities and to its innovative, project-based educational programs. Appointments will be made for one or two years, contingent on satisfactory performance. The teaching load will be either five seven-week undergraduate courses or four of these plus one semester-long graduate course.

The Department has strong research programs in applied mathematics and applied statistics:

APPLIED MATHEMATICS: Preferred research interests are partial differential equations with applications in continuum mechanics and composite materials, computational modeling and simulation, mathematical biology, financial mathematics, (numerical) analysis, optimization, control theory, applied probability, and discrete mathematics.

STATISTICS: Applicants are especially encouraged in the areas of biostatistics, experimental design, Bayesian methods, Monte Carlo methods, data mining methods, sample survey methods, survival analysis and time series.

WPI is a private and highly selective technological university with an enrollment of 2700 undergraduates and about 1100 full- and part-time graduate students. Worcester, New England's third largest city, offers ready access to the diverse economic, cultural and recreational resources of the region. The Mathematical Sciences Department has 22 tenured/tenure-track faculty and supports BS, MS, and PhD programs in applied and computational mathematics and applied statistics. Interactions with industry, business and government are facilitated by the Center for Industrial Mathematics and Statistics. For additional information, see <http://www.wpi.edu/+math>.

Qualified applicants should send a detailed curriculum vitae, a brief statement of specific teaching and research objectives, and three letters of recommendation at least one of which addresses teaching potential, to **Math Search Committee, Mathematical Sciences Department, WPI, 100 Institute Road, Worcester, MA 01609-2280, USA.**

Applications will be considered on a continuing basis beginning December 1, 2005 until all positions are filled.

To enrich education through diversity, WPI is an affirmative action, equal opportunity employer.

Add this Cover Sheet to all of your Academic Job Applications

How to use this form

1. Using the facing page or a photocopy, (or visit the AMS web site for a choice of electronic versions at www.ams.org/coversheet/), fill in the answers which apply to *all* of your academic applications. Make photocopies.
2. As you mail each application, fill in the remaining questions neatly on one cover sheet and include it *on top of* your application materials.

The purpose of the cover form is to aid department staff in tracking and responding to each application for employment. Mathematics departments in Bachelor's-, Master's-, and Doctorate-granting institutions are expecting to receive the form from each applicant, along with the other application materials they require.

The AMS suggests that applicants and employers visit the Job Application Database for Mathematicians (www.mathjobs.org), an electronic resource being offered by the AMS in partnership with Duke University. The system provides a way for applicants to produce printed coversheet forms, apply for jobs, or publicize themselves in the "Job Wanted" list. Employers can post a job listing, and once applications are made, search and sort among their applicants. Note-taking, rating, e-mail, data downloading and customizable EOE functions are available to employers. Also, reference writers can submit

their letters online. A paperless application process is possible with this system, however; employers can choose to use any portion of the service. There will be annual employer fees. This system was developed at the Duke University Department of Mathematics.

Please direct all questions and comments to: emp-info@ams.org.

AMS STANDARD COVER SHEET

Last Name _____

First Name _____

Middle Names _____

Address through next June _____ Home Phone _____

e-mail Address _____

Current Institutional Affiliation _____ Work Phone _____

Highest Degree Held or Expected _____

Granting Institution _____ Date (optional) _____

Ph.D. Advisor _____

Ph.D. Thesis Title (optional) _____

Indicate the mathematical subject area(s) in which you have done research using the Mathematics Subject Classification printed on the back of this form or on the AMS website. Use the two-digit classification which best fits your interests in the Primary Interest line and additional two-digit numbers in the Secondary Interests line.

Primary Interest _____

Secondary Interests optional _____

Give a brief synopsis of your current research interests (e.g. finite group actions on four-manifolds). Avoid special mathematical symbols and please do not write outside of the boxed area.

Most recent, if any, position held post Ph.D.

University or Company _____

Position Title _____

Indicate the position for which you are applying and position posting code, if applicable

If applying for a position which requires U.S. citizenship or U.S. permanent residency, indicate your eligibility Yes No

If unsuccessful for this position, would you like to be considered for a temporary position?

Yes No

If yes, please check the appropriate boxes.

Postdoctoral Position 2+ Year Position 1 Year Position

List the names, affiliations, and e-mail addresses of up to four individuals who will provide letters of recommendation if asked. Mark the box provided for each individual whom you have already asked to send a letter.

This form is provided courtesy of the American Mathematical Society.

This cover sheet is provided as an aid to departments in processing job applications. It should be included with your application material.

Please print or type. Do not send this form to the AMS.



2000 Mathematics Subject Classification

- 00 General
- 01 History and biography
- 03 Mathematical logic and foundations
- 05 Combinatorics
- 06 Order, lattices, ordered algebraic structures
- 08 General algebraic systems
- 11 Number theory
- 12 Field theory and polynomials
- 13 Commutative rings and algebras
- 14 Algebraic geometry
- 15 Linear and multilinear algebra, matrix theory
- 16 Associative rings and algebras
- 17 Nonassociative rings and algebras
- 18 Category theory, homological algebra
- 19 *K*-theory
- 20 Group theory and generalizations
- 22 Topological groups, Lie groups
- 26 Real functions
- 28 Measure and integration
- 30 Functions of a complex variable
- 31 Potential theory
- 32 Several complex variables and analytic spaces
- 33 Special functions
- 34 Ordinary differential equations
- 35 Partial differential equations
- 37 Dynamical systems and ergodic theory
- 39 Difference and functional equations
- 40 Sequences, series, summability
- 41 Approximations and expansions
- 42 Fourier analysis
- 43 Abstract harmonic analysis
- 44 Integral transforms, operational calculus
- 45 Integral equations
- 46 Functional analysis
- 47 Operator theory
- 49 Calculus of variations and optimal control, optimization
- 51 Geometry
- 52 Convex and discrete geometry
- 53 Differential geometry
- 54 General topology
- 55 Algebraic topology
- 57 Manifolds and cell complexes
- 58 Global analysis, analysis on manifolds
- 60 Probability theory and stochastic processes
- 62 Statistics
- 65 Numerical analysis
- 68 Computer science
- 70 Mechanics of particles and systems
- 74 Mechanics of deformable solids
- 76 Fluid mechanics
- 78 Optics, electromagnetic theory
- 80 Classical thermodynamics, heat transfer
- 81 Quantum theory
- 82 Statistical mechanics, structure of matter
- 83 Relativity and gravitational theory
- 85 Astronomy and astrophysics
- 86 Geophysics
- 90 Operations research, mathematical programming
- 91 Game theory, economics, social and behavioral sciences
- 92 Biology and other natural sciences
- 93 Systems theory, control
- 94 Information and communication, circuits
- 97 Mathematics education

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Portugaliæ Mathematica, founded in 1937, publishes original research papers, in all fields of pure and applied mathematics. Each paper must be of a high scientific standard.

PORTUGALIÆ MATHEMATICA

VOLUME 62 – FASCÍCULO 4 – 2005

Nova Série

SUMÁRIO

On the topology of Lagrangian submanifolds. Examples and counter-examples.	MICHÉLE AUDIN	375
A general existence theorem for differential inclusions in the vector valued case	B. DACOROGNA AND G. PISANTE	421
Matroid polytopes, nested sets and Bergman fans	EVA MARIA FEICHTNER AND BERND STURMFELS	437
Geometric Fokker-Planck equations	GILLES LEBEAU	469
Dynamics in the moduli space of Abelian differentials	ARTUR AVILA AND MARCELO VIANA	531

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Sociedade Portuguesa de Matemática

Cosponsored Conferences

AAAS Meeting to Offer Strong Mathematics Program

The 2006 Annual Meeting of the American Association for the Advancement of Science, February 16-20, in St. Louis, MO, will feature many outstanding expository talks by prominent mathematicians. The following symposia sponsored by Section A (Mathematics) are part of the special mathematical event "Beyond Pi: Grand Challenges in the Mathematical Sciences".

- Paradise Lost? The Changing Nature of Mathematical Proof (organized by Keith Devlin)
- Million-Dollar Mathematics: Challenge Problems in the 21st Century (organized by John Ewing and James Carlson)
- NUMB3RS and the Challenge of Changing Public Perception of Mathematics (organized by Robert Osserman and Tony Chan)
- Astrodynamics, Space Missions, and Chaos (organized by Edward Belbruno)
- Tsunamis: Their Hydrodynamics and Impact on People (organized by Walter Craig, Jerry Bona, and John Mutter)
- How Insects Fly (organized by Jane Wang)
- Arches: Gateways From Science to Culture (organized by Kim Williams)

Other symposia that will be of interest to the mathematical community include:

Physics of Virtual Worlds

Frontiers in Biological Imaging: From Cells to Humans

Imaging Dynamical Diseases in the Brain

Refining Einstein: The Search for Relativity Violations

Science and Engineering Challenges and Opportunities in Homeland Security

Overcoming Gender Stereotypes: Girls in Science, Engineering, and Technology

Computer Science Behind Your Science

Expanding Universe of Digital Data Collections

Evaluating Curricular Effectiveness: Judging the Quality of K-12 Mathematics Evaluations

Four Eye-Opening Science Education Research Studies: Connecting Science and Educational Research

The above symposia are only a few of the 200 or so AAAS program offerings in the physical, life, social, and biological sciences. For further details about the 2006 AAAS program, see the October 21, 2005, issue of *Science*. (See also www.aaas-meeting.org under "Program and Events".)

AAAS annual meetings are the showcases of American science, and they encourage participation by mathematicians and mathematics educators. (AAAS acknowledges the generous contributions of AMS for travel support and SIAM for support of media awareness.) In presenting mathematics-related themes to the AAAS Program Committee, I have found the committee to be genuinely interested in offering symposia on mathematical topics of current interest. Thus, Section A's committee seeks organizers and speakers who can present substantial new material in an accessible manner to a large scientific audience. Toward this end, I invite you to attend our Section A Committee business meeting 7:45 p.m.-10:00 p.m. Friday, February 17, 2006, in the Benton Room of the Renaissance Grand Hotel. I invite you also to send me, and encourage your colleagues to send me, symposia proposals for future AAAS annual meetings.

—Warren Page, secretary of Section A of the AAAS
wxpny@aol.com

General Information Regarding Meetings & Conferences of the AMS

Speakers and Organizers: The Council has decreed that no paper, whether invited or contributed, may be listed in the program of a meeting of the Society unless an abstract of the paper has been received in Providence prior to the deadline.

Although an individual may present only one ten-minute contributed paper at a meeting, any combination of joint authorship may be accepted, provided no individual speaks more than once. An author can speak by invitation in more than one Special Session at the same meeting.

Special Sessions: The number of Special Sessions at an Annual Meeting is limited. Special Sessions at annual meetings are held under the supervision of the Program Committee for National Meetings and, for sectional meetings, under the supervision of each Section Program Committee. They are administered by the associate secretary in charge of that meeting with staff assistance from the Meetings and Conferences Department in Providence. (See the list of associate secretaries on page 192 of this issue.)

Each person selected to give an Invited Address is also invited to generate a Special Session, either by personally organizing one or by having it organized by others. Proposals to organize a Special Session are sometimes solicited either by a program committee or by the associate secretary. Other proposals should be submitted to the associate secretary in charge of that meeting (who is an ex officio member of the program committee) at the address listed below. These proposals must be in the hands of the associate secretary at least seven months (for sectional meetings) or nine months (for national meetings) prior to the meeting at which the Special Session is to be held in order that the committee may consider all the proposals for Special Sessions simultaneously. Special Sessions must be announced in the *Notices* in a timely fashion so that any Society member who so wishes may submit an abstract for consideration for presentation in the Special Session.

Talks in Special Sessions are usually limited to twenty minutes; however, organizers who wish to allocate more time to individual speakers may do so within certain limits. A great many of the papers presented in Special Sessions at meetings of the Society are invited papers, but any member of the Society who wishes to do so may submit an abstract for consideration for presentation in a Special Session, provided it is submitted to the AMS prior to the special early deadline for consideration. Contributors should know that there is a limit to the size of a single Special Session, so sometimes all places are filled by invitation. Papers submitted for consideration for inclusion in Special Sessions but not accepted will receive consideration for a contributed paper session, unless specific instructions to the contrary are given.

The Society reserves the right of first refusal for the publication of proceedings of any Special Session. If published by the AMS, these proceedings appear in the book series *Contemporary Mathematics*. For more detailed information

on organizing a Special Session, see www.ams.org/meetings/specialsessionmanual.html.

Contributed Papers: The Society also accepts abstracts for ten-minute contributed papers. These abstracts will be grouped by related *Mathematical Reviews* subject classifications into sessions to the extent possible. The title and author of each paper accepted and the time of presentation will be listed in the program of the meeting.

Other Sessions: In accordance with policy established by the AMS Committee on Meetings and Conferences, mathematicians interested in organizing a session at an annual or sectional meeting on employment opportunities inside or outside academia for young mathematicians should contact the associate secretary for the meeting with a proposal by the stated deadline. Also, potential organizers for poster sessions on a topic of choice should contact the associate secretary before the deadline.

Abstracts: Abstracts for all papers must be received by the meeting coordinator in Providence by the stated deadline. Unfortunately, late papers cannot be accommodated.

Electronic Submission Procedures: Visit the Meetings and Conferences homepage on the Web at <http://www.ams.org/meetings> and select "Submit an abstract".

Submission by U. S. Mail: Paper AMS abstract forms may be requested by contacting the Meeting Coordinator, AMS Meetings and Conferences Department, P. O. Box 6887, Providence, RI 02940; telephone: 401-455-4146; e-mail: meet@ams.org. Your completed abstract should be sent to the same address by the stated deadline. N. B. There is a \$20 processing fee for paper abstracts. There is no charge for abstracts submitted electronically.

See the inside front cover of *Abstracts of Papers Presented to the American Mathematical Society* for information on abstracts published by title and not presented at a meeting.

Site Selection for Sectional Meetings

Sectional meeting sites are recommended by the associate secretary for the section and approved by the Secretariat. Recommendations are usually made eighteen to twenty-four months in advance. Host departments supply local information, ten to fifteen rooms with overhead projectors for contributed paper sessions and Special Sessions, an auditorium with twin overhead projectors for Invited Addresses, space for registration activities and an AMS book exhibit, and registration clerks. The Society partially reimburses for the rental of facilities and equipment and for staffing the registration desk. Most host departments volunteer; to do so, or for more information, contact the associate secretary for the section.

Meetings & Conferences of the AMS

IMPORTANT INFORMATION REGARDING MEETINGS PROGRAMS: AMS Sectional Meeting programs do not appear in the print version of the *Notices*. However, comprehensive and continually updated meeting and program information with links to the abstract for each talk can be found on the AMS website. See <http://www.ams.org/meetings/>. Final programs for Sectional Meetings will be archived on the AMS website accessible from the stated URL and in an electronic issue of the *Notices* as noted below for each meeting.

San Antonio, Texas

Henry B. Gonzalez Convention Center

January 12-15, 2006

Thursday - Sunday

Meeting #1014

Joint Mathematics Meetings, including the 112th Annual Meeting of the AMS, 89th Annual Meeting of the Mathematical Association of America, annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), the winter meeting of the Association for Symbolic Logic (ASL), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).

Associate secretary: Matthew Miller

Announcement issue of *Notices*: October 2005

Program first available on AMS website: November 1, 2005

Program issue of electronic *Notices*: January 2006

Issue of *Abstracts*: Volume 27, Issue 1

Deadlines

For organizers: Expired

For consideration of contributed papers in Special Sessions:
Expired

For abstracts: Expired

Program Updates

NUMB3RS and Math, The "We All Use Math Every Day™" Program, Thursday, 5:00 p.m. to 6:30 p.m., organized by

Linda Beheler, Texas Instruments. "We all use math every day..." These words open the weekly introduction to the hit CBS show, NUMB3RS, in which an FBI agent and his math professor brother solve crimes using math to figure out clues and drive the investigation.

These words are also the title of a Texas Instruments program in partnership with CBS to promote student interest in math. The program includes weekly online activities that correspond to the math in each episode of NUMB3RS and a special teacher kit. See how to use NUMB3RS to help excite students about the real world relevancy of math, receive a teacher kit, and meet a cast member from NUMB3RS. Autographs and photo session follow the event. Sponsored by Texas Instruments, MAA, and AMS.

AMS Program Updates

The AMS Committee on Science Policy-MAA Science Policy Committee Government Speaker scheduled for Saturday afternoon has been cancelled.

The Committee on Science Policy Panel discussion scheduled for Saturday afternoon has been cancelled.

Programs That Make a Difference, Thursday, 4:30 p.m. The AMS plans to highlight two programs each year that specifically: (1) aim to bring more persons from underrepresented minority backgrounds into some portion of the pipeline beginning at the undergraduate level and leading to an advanced degree in mathematics, or retain them in the pipeline; (2) have achieved documentable success in doing so; and (3) are replicable models.

For this inaugural session we will recognize two programs that have made significant efforts to encourage underrepresented minorities to continue in the study of

mathematics. These are the graduate program at the University of Iowa and the Summer Institute in Mathematics for Undergraduates (SIMU) REU program conducted at the Universidad de Puerto Rico, Humacao, from 1998 to 2002. Presenters are **David C. Manderscheid**, University of Iowa, and **Ivelisse M. Rubio**, Universidad de Puerto Rico, Humacao. This session is sponsored by the AMS Committee on the Profession.

International Perspectives on Undergraduate Mathematics is the title of the Committee on Education Panel Discussion on Sunday morning at 8:30. This panel will consider some of the issues facing undergraduate education, with particular attention to those that are common to many different countries. Professor **Ki Hyoung Ko** from the Korean Advanced Institute for Science and Technology will describe the efforts of his institution to integrate research and education. Then four junior faculty will offer vignettes on undergraduate education from their home countries.

The discussion will be moderated by **Deborah Hughes Hallett**, University of Arizona, who will also provide a broad perspective on the questions raised. There will be plenty of time for audience discussion.

Panelists are **Lotfi Hermi** and **Jia Ling Dai**, University of Arizona; **Bin Lu**, California State University Sacramento; and **Hideo Nagahashi**, Colby College. This panel is organized by **William G. McCallum**, University of Arizona, and sponsored by the Committee on Education.

MAA Program Updates

The Environmental Math SIGMAA has organized a **Saturday afternoon bus trip**. It will be led by Texas A&M geologist **Bruce Herbert**. (Dr. Herbert will give a guest lecture Thursday afternoon on earth and environmental systems.)

The focus of the trip is a slow-moving, massive underground river, the Edwards Aquifer. San Antonio and many Texas cities in the surrounding region are semi arid. They, like the eighteenth century Spanish missions, were able to thrive because of the large and abundant springs fed by this aquifer. It currently supplies the water for agricultural, industrial, recreational, and domestic needs of two million users.

The excursion will visit the San Marcos mission, about 45 minutes from San Antonio. There are more than 200 springs near San Marcos, most of which burst forth from three large fissures. Along the way, Dr. Herbert will give a minicourse on the hydrology of the aquifer. There will be occasional stops to examine interesting geological features. The bus departs at 1:30 p.m. and returns at 5:00 p.m.

For just US\$15 you can join in this trip led by a knowledgeable and enthusiastic educator and geologist. Send email to **Michael Pearson**, pearson@maa.org, or **Hal Nesbitt**, Hnesbitt@maa.org, to reserve a seat. For more information contact **Ben Fusaro**, fusaro@math.fsu.edu.

The Shapes of Sacred Space: The Geometry of Ancient Maya Art and Architecture, organized by **Amy Shell-Gellasch**, Grafenwoer, Germany, Thursday, 9:30 a.m. to 10:50 a.m. **Edwin L. Barnhart**, Director of Maya Exploration Center, and **Christopher Powell**, Senior Research

Associate of Maya Exploration Center, will discuss an exciting new line of research on what is being called "Maya Sacred Geometry". Based on Powell's own original research, it will explain how, like the ancient Egyptians and Greeks, the Maya used proportions derived from nature in their art and architecture. Decades of research have failed to produce a Maya "unit of measure" and now Powell's research finally explains why. Buildings and stone carved panels exhibiting the Golden Proportion, as well as the dynamic proportions of square root rectangles, are now being "discovered" all over the ancient Maya World. Evidence for a still surviving tradition of Maya geometry will also be presented. This session is sponsored by the SIGMAA on the History of Mathematics.

Other Organizations

The AWM Workshop Panel at 1:00 p.m. on Sunday is *Shaping a Career in Mathematics*, moderated by **Marie A. Vitulli**, University of Oregon, and includes **Janet Anderson**, Hope College, **Dusa McDuff**, SUNY Stony Brook, **Mara D. Neusel**, Texas Tech University, and **Michelle D. Wagner**, National Security Agency, as panelists.

The after-dinner speaker at the **NAM Banquet** on Saturday evening is **Wade Ellis Jr.**, West Valley College, *Teaching mathematics in the twenty-first century: Anecdotes from the past and future*.

NAM's Claytor-Woodard Lecture will be given Sunday at 1:00 p.m. by **Gaston M. N' Guerekata**, Morgan State University, on *A rebirth of Bochner's theory of almost automorphy of solutions to evolution equations*.

Ancillary Conference

Teaching College-Level Statistics using the GAISE Guidelines, Wednesday January 11, 1:00 p.m.-5:00 p.m., presented by **Mary Parker** and **Gustavo Cepparo**, Austin Community College and University of Texas at Austin, and **Jennifer Kaplan**, University of Texas at Austin. In this half-day workshop, discussion will focus on implementation of the GAISE guidelines in college-level statistics courses. The presenters have experience teaching the introductory statistics course, a regression and time series course, and several mathematical statistics courses. Examples from various levels will be discussed and participants will work in small groups to formulate a plan to revise/enhance a two-three day segment of a course they routinely teach.

The six main recommendations of the GAISE report are: 1) Emphasize statistical literacy and develop statistical thinking; 2) Use real data; 3) Stress conceptual understanding rather than mere knowledge of procedures; 4) Foster active learning in the classroom; 5) Use technology for developing conceptual understanding and analyzing data; and 6) Use assessments to improve and evaluate student learning.

GAISE, an acronym for Guidelines for Assessment and Instruction in Statistics Education has been endorsed by the American Statistical Association (ASA), MAA, and NCTM. The GAISE college report may be found at <http://it.stlawu.edu/~rlock/gaise/GAISECollege.htm>.

For more information, including how to register, see <http://www.amstat.org/education/index.cfm?fuseaction=learnstat>.

Social Events

Nebraska Conference for Undergraduate Women Open House Reunion, Friday, 6:00 p.m. to 7:00 p.m.

The Ohio State University Friends and Alumni Reception, Saturday, 6:00 p.m. to 8:00 p.m.

University of Wisconsin-Madison Department of Mathematics Reunion Reception, Friday, 5:45 p.m. to 7:00 p.m.

The days on which **NAM and AMS Banquets** were listed in the announcement text were incorrect. The timetable does display the correct days and times of **Saturday at 6:00 p.m. for NAM and Sunday at 7:30 p.m. for AMS**.

Miami, Florida

Florida International University

April 1–2, 2006

Saturday – Sunday

Meeting #1015

Southeastern Section

Associate secretary: Matthew Miller

Announcement issue of *Notices*: January 2006

Program first available on AMS website: February 16, 2006

Program issue of electronic *Notices*: April 2006

Issue of *Abstracts*: Volume 27, Issue 2

Deadlines

For organizers: Expired

For consideration of contributed papers in Special Sessions:

December 13, 2005

For abstracts: February 7, 2006

Invited Addresses

Andrea R. Nahmod, University of Massachusetts, Amherst, *Bilinear operators in analysis and PDEs*.

Edward Odell, University of Texas at Austin, *Embeddings in Banach space theory*.

Karen V. H. Parshall, University of Virginia, *The British development of the theory of invariants, 1841–1895*.

Michael S. Vogelius, Rutgers University, *Electromagnetic imaging—An applied analyst's perspective*.

Special Sessions

Approximation Theory and Orthogonal Polynomials (Code: SS 5A), **Doron S. Lubinsky**, Georgia Institute of Technology, and **Edward B. Saff**, Vanderbilt University.

Commutative Algebra and Algebraic Geometry (Code: SS 1A), **Laura Ghezzi**, Florida International University, **Huy Tài Hà**, Tulane University, and **Aron Simis**, University Federal de Pernambuco.

Composition Operators and Complex Dynamical systems (Code: SS 16A), **Brian P. Kelly**, University of Louisiana, Monroe, and **Christopher N. B. Hammond**, Connecticut College.

Financial Mathematics (Code: SS 17A), **Alec N. Kercheval** and **Craig A. Nolder**, Florida State University.

Geometry of Banach Spaces and Connections with Other Areas (Code: SS 11A), **Edward W. Odell**, University of Texas at Austin, **Thomas B. Schlumprecht**, Texas A&M University, and **Stephen Dilworth**, University of South Carolina.

Geometry of Riemannian Manifolds with Additional Structures (Code: SS 2A), **Tedi C. Draghici**, **Gueo V. Grantcharov**, and **Philippe Rukimbira**, Florida International University.

Harmonic Analysis and Partial Differential Equations (Code: SS 10A), **Mario Milman**, Florida Atlantic University, and **Marius Mitrrea**, University of Missouri.

History of Mathematics (Code: SS 18A), **Karen H. Parshall**, University of Virginia.

Imaging, Homogenization, and Shape Optimization (Code: SS 14A), **Michael S. Vogelius**, Rutgers University, and **Shari Moskow**, University of Florida.

Interpolation Theory and Applications (Code: SS 15A), **Michael Cwikel**, Technion, **Laura De Carli**, Florida International University, and **Mario Milman**, Florida Atlantic University.

Invariants of Low-Dimensional Manifolds (Code: SS 9A), **Thomas G. Lennes**, Florida International University, and **Nikolai N. Saveliev**, University of Miami, Coral Gables.

Mathematical Models in Image and High-Dimensional Data Analysis (Code: SS 13A), **Hanna E. Makaruk** and **Robert M. Owczarek**, Los Alamos National Laboratory, and **Nikita Sakhaneiko**, University of New Mexico and Los Alamos National Laboratory.

Monomials and Resolutions (Code: SS 3A), **Joseph P. Brennan**, North Dakota State University, and **Heath M. Martin**, University of Central Florida.

Nonlinear Waves (Code: SS 19A), **Andrea R. Nahmod**, University of Massachusetts, Amherst, and **Sijue Wu**, University of Michigan at Ann Arbor.

Partial Differential Equations and Several Complex Variables (Code: SS 6A), **Shiferaw Berhanu**, Temple University, and **Hamid Meziari**, Florida International University.

Qualitative Analysis of Partial Differential Equations (Code: SS 4A), **Congming Li**, University of Colorado.

Recent Developments on Fluid and Geophysical Fluid Dynamics (Code: SS 12A), **C. Cao** and **T. Tachim Medjo**, Florida International University, and **X. Wang**, Florida State University.

Singular Integrals, Geometric Analysis, and Free Boundary Problems (Code: SS 8A), **Marianne Korten** and **Charles N. Moore**, Kansas State University.

Spectral Geometry of Manifolds with Boundary and Singular Spaces (Code: SS 20A), **Juan B. Gil**, Pennsylvania State University, Altoona, and **Patrick T. McDonald**, New College, University of South Florida.

Structure of Function Spaces and Applications (Code: SS 7A), **Jan Lang**, The Ohio State University, and **Osvaldo Mendez**, University of Texas at El Paso.

Accommodations

Participants should make their own arrangements directly with a hotel of their choice as early as possible. Special rates have been negotiated with the hotels listed below. Rates quoted do not include sales tax of 13%. The AMS is not responsible for rate changes or for the quality of the accommodations. When making a reservation, participants should state that they are with the **American Mathematical Society (AMS) Meeting at Florida International University** group. Cancellation and early checkout policies vary; be sure to check when you make your reservation.

N.B. All of these hotels are about eight miles from campus (however, the Wellesley is in a different direction).

The Best Western ChateauBleau Hotel and the Holiday Inn Coral Gables offer complimentary shuttle service from/to the airport. However, it is strongly recommended that participants rent a car for personal convenience. For those unable to do so, the university will run a limited shuttle service to the campus on Saturday and Sunday mornings and a return trip in the early evenings. The Best Western and Holiday Inn hotels are serviced by city bus #24 every 30 minutes on weekends. See <http://www.co.miami-dade.fl.us/transit/routes/route.asp?route=24> for a route map and weekend schedule. The fare is US\$1.50 standard, and US\$.75 reduced (students, people with disabilities).

Participants are encouraged to **book a hotel room early!** The same weekend as our meeting is the Miami-Dade County Fair & Exposition held in an area adjacent to the FIU campus. This event attracts visitors from all over Florida and hotel rooms may sell out.

Best Western ChateauBleau Hotel, 1111 Ponce De Leon Boulevard, Coral Gables, FL 33134; phone: 305-448-2634 or toll free: 888-642-6442, fax: 305-448-2017; US\$89/single or double, US\$5/extra person; free high speed internet; free parking; in room mini-refrigerator and coffee maker, outdoor pool; restaurant and lounge in hotel; many restaurants within walking distance; about eight miles east of the FIU campus. **Deadline for reservations is March 1, 2006.** Be sure to check cancellation and early checkout policies.

Holiday Inn Coral Gables, 2051 Le Jeune Rd., Coral Gables, FL 33134; phone: 305-443-2301, fax: 305-446-6827; US\$99/single/double/triple/quad; in room coffee maker; parking is US\$5.95/day; outdoor pool; restaurant and lounge in hotel; many restaurants/shops (Merrick Park Shopping Mall) within walking distance; about eight miles east of the FIU campus. **Deadline for reservations is February 28, 2006.** Be sure to check cancellation and early checkout policies.

Wellesley Inn & Suites, 11750 Mills Drive, Miami, FL; phone: 305-270-0359, fax: 305-270-1334; US\$89.99/single or double; in room mini-refrigerator, microwave, and coffee maker (most rooms); complimentary hot/cold breakfast buffet; free parking; pool; several restaurants within walking distance; about eight miles south of the FIU campus.

Deadline for reservations is March 15, 2006. Be sure to check cancellation and early checkout penalties.

Other reasonably priced hotels in the area are Amerisuites, 11520 SW 88th St., Kendall, 305-279-8688, US\$119/single or double, about eight miles from campus; and the Ramada Inn, 7600 N. Kendall Dr., 305-595-6000, US\$109/single or double, eleven miles southwest of campus.

Food Service

There are a few restaurants within walking distance of campus. The university plans to keep its excellent campus dining facilities in the GC building open for participants.

Local Information

The university's website is <http://www.fiu.edu/choice.html>; the department of mathematics is at <http://w3.fiu.edu/math/>. A general website about Miami is at <http://www.hellomiami.com/>.

The area around the Best Western and Holiday Inn hotels called Coral Gables thrives with restaurants, shops, and cafes, both on the Miracle Mile and Giralda Avenue within walking distance of the hotels. See <http://coralgablesfl.areaguides.net/> for details. The neighborhood where the Wellesley Inn is located is called Kendall. There is a mall adjacent to the hotel with some restaurants. An excellent restaurant within walking distance is Bahama Breeze, at the intersection of Kendall Drive and 122 Ave. See <http://kendallfl.areaguides.net> for more information on the area.

Other Activities

Book Sales: Examine the newest titles from the AMS! Many of the AMS books will be available at a special 50% discount available only at the meeting. Complimentary coffee will be served courtesy of AMS Membership Services.

AMS Editorial Activity: An acquisitions editor from the AMS book program will be present to speak with prospective authors. If you have a book project that you would like to discuss with the AMS, please stop by the book exhibit.

Parking

Parking will be available for free in Lot 8, between the Recreation Center (RC) and the Healthcare and Wellness Center (HWC) accessible from 117th Avenue. The unmarked street which goes by the W3 building is 17th St. See the map links below.

Registration and Meeting Information

The meeting is on the campus of Florida International University, University Park Campus. Sessions and Invited Addresses will take place in the Graham Center (GC) and Primera Casa (PC) buildings. See http://www.fiu.edu/docs/campus_maps-up.htm.

The registration desk will be in the Graham Center and will be open Saturday, April 1, 7:30 a.m. to 4:00 p.m., and Sunday, April 2, 8:00 a.m. to noon. Fees are US\$40 for AMS or CMS members, US\$60 for nonmembers; and US\$5 for

students, unemployed mathematicians, and emeritus members. Fees are payable on site by cash, check, or credit card.

Travel and Campus Map

Miami International Airport (MIA) is one of the largest and busiest airports in the world. It serves a wealth of domestic and international cities, many of them with multiple daily nonstop flights. The airport's home page is located at <http://www.miami-airport.com>. All major airlines serve MIA.

The airport is 11 miles from Florida International University. The campus is easily accessible from MIA via public transportation and taxi service. A taxi to the university costs approximately US\$20. The SuperShuttle Miami offers competitive prices from Miami International Airport to all locations in the Miami metropolitan area. For information see <http://www.supershuttle.com/html/cities/mia.html>. Some attendees may find competitive prices when flying to Fort Lauderdale International Airport (FLL), although the airport is further away from campus.

The official airline for the meeting is Delta Airlines. Take advantage of Delta's new SimpliFares™ and enjoy the following benefits:

- No Saturday-night stay required—more flexibility
- Always affordable—realize up to 50% savings on everyday fares in the contiguous 48 states
- Lower change fees—reduced from US\$100 to US\$50 to change travel plans
- Just eight fares—less guessing and easier planning

To make immediate reservations call Delta Air Lines at 800-221-1212. Be sure to reference **US738367060** or visit <http://www.delta.com> and enter SkyBonus account number **US738367060** in your passenger information screen to be recognized as a participant. Your benefits include:

- No service fees
- 1,000 sky miles for Delta members
- Skip the airport lines; check in online

Car Rental

Avis is the official car rental company for the sectional meeting in Miami, Florida. All rates include unlimited free mileage. Weekend daily rates are available from noon Thursday to Monday at 11:59 p.m. Rates for this meeting are effective March 25, 2006 to April 9, 2006, and begin at US\$27.99/day (weekend rate). Should a lower qualifying rate become available at the time of booking, Avis is pleased to offer a 5% discount off the lower qualifying rate or the meeting rate, whichever is lowest. Rates do not include any state or local surcharges, tax, optional coverages or gas refueling charges. Renters must meet Avis' age, driver, and credit requirements. Reservations can be made by calling 800-331-1600 or online at <http://www.avis.com>. Meeting Avis Discount Number **B159266**.

Getting to the University by Car: A good campus map is at http://www.fiu.edu/docs/campus_maps-up.htm.

From Miami International Airport: Take the I-836 WEST exit from the Airport; follow I-836 to the Florida Turnpike; take the Florida Turnpike SOUTH exit; follow the Florida Turnpike to the Tamiami Trail exit (SW 8th Street); take

the SW 8th Street EAST exit; follow SW 8th Street, FIU will appear on the right before SW 107th Avenue.

From I-95, Downtown Miami, Ft. Lauderdale, and West Palm Beach: Take I-95 to I-836 WEST; follow I-836 to the Florida Turnpike; take the Florida Turnpike SOUTH exit and follow as described above.

From western Palm Beach/Broward County or the Florida Turnpike north: Take the Florida Turnpike SOUTH and follow as described above.

Information for International Participants: Visa regulations are continually changing for travel to the United States. Visa applications may take from three to four months to process and require a personal interview, as well as specific personal information. International participants should view the important information about traveling to the U.S. found at http://www7.nationalacademies.org/visas/Traveling_to_US.html and <http://travel.state.gov/visa/index.html>. If you need a preliminary conference invitation in order to secure a visa, please send your request to dls@ams.org.

If you discover you do need a visa, the National Academies website (see above) provides these tips for successful visa applications:

* Visa applicants are expected to provide evidence that they are intending to return to their country of residence. Therefore, applicants should provide proof of "binding" or sufficient ties to their home country or permanent residence abroad. This may include documentation of the following:

- family ties in home country or country of legal permanent residence
- property ownership
- bank accounts
- employment contract or statement from employer stating that the position will continue when the employee returns;

* Visa applications are more likely to be successful if done in a visitor's home country than in a third country;

* Applicants should present their entire trip itinerary, including travel to any countries other than the United States, at the time of their visa application;

* Include a letter of invitation from the meeting organizer or the U.S. host, specifying the subject, location, and dates of the activity, and how travel and local expenses will be covered;

* If travel plans will depend on early approval of the visa application, specify this at the time of the application;

* Provide proof of professional scientific and/or educational status (students should provide a university transcript).

This list is not to be considered complete. Please visit the websites above for the most up-to-date information.

Weather

Weather conditions in Miami during early April are mild and dry which is why it is so very popular with visitors. Temperatures range from 70°F to 79°F.

Notre Dame, Indiana

University of Notre Dame

April 8–9, 2006

Saturday – Sunday

Meeting #1016

Central Section

Associate secretary: Susan J. Friedlander

Announcement issue of *Notices*: January 2006

Program first available on AMS website: February 23, 2006

Program issue of electronic *Notices*: April 2006

Issue of *Abstracts*: Volume 27, Issue 2

Deadlines

For organizers: Expired

For consideration of contributed papers in Special Sessions:
December 20, 2005

For abstracts: February 14, 2006

Invited Addresses

Douglas N. Arnold, Institute for Math and Applications, University of Minnesota, *Title to be announced*.

Béla Bollobás, University of Memphis and Cambridge University, *Inhomogeneous random graphs* (Erdős Memorial Lecture).

Steven C. Hofmann, University of Missouri, *Title to be announced*.

Michael Larsen, University of Indiana, *Title to be announced*.

Christopher M. Skinner, University of Michigan, *Title to be announced*.

Special Sessions

Algebraic Structures of Exactly Solvable Models (Code: SS 9A), **Michael Gekhtman**, University of Notre Dame, **Mikhail Shapiro**, Michigan State University, and **Alexander Stolin**, University of Gothenburg.

Analysis and Geometry of Non-linear Evolution and Equations (Code: SS 19A), **Alexandrou A. Himonas** and **Gerard K. Misiolek**, University of Notre Dame.

Combinatorial Algebraic Geometry (Code: SS 2A), **Juan C. Migliore**, University of Notre Dame, and **Uwe R. Nagel**, University of Kentucky.

Commutative Algebra and Algebraic Geometry (Code: SS 1A), **Alberto Corso**, University of Kentucky, **Claudia Polini**, University of Notre Dame, and **Bernd Ulrich**, Purdue University.

Developments and Applications in Differential Geometry (Code: SS 4A), **Jianguo Cao**, **Xiaobo Liu**, and **Brian Smyth**, University of Notre Dame.

Dynamical Systems (Code: SS 10A), **Francois Ledrappier**, University of Notre Dame, and **Amie Wilkinson**, Northwestern University.

Harmonic Analysis, PDE and Geometric Function Theory (Code: SS 14A), **John L. Lewis**, University of Kentucky, and **Steve C. Hofmann**, University of Missouri.

Holomorphic Methods and Heat Kernels in Harmonic Analysis and Quantization Theory (Code: SS 16A), **Brian Hall** and **William Kirwin**, University of Notre Dame.

Mathematical Biology (Code: SS 11A), **Mark Alber** and **Bei Hu**, University of Notre Dame.

Model Theory and Computability (Code: SS 8A), **Steven Allen Buechler** and **Julia Knight**, University of Notre Dame, **Steffen Lemp**, University of Wisconsin, and **Sergei Starchenko**, University of Notre Dame.

New Developments in Optimization (Code: SS 15A), **Leonid Faybusovich**, University of Notre Dame.

Nonlinear Waves (Code: SS 13A), **Mark S. Alber** and **Pavel Lushnikov**, University of Notre Dame, and **Ildar Gabotiv** and **Vladimir E. Zakharov**, University of Arizona.

Number Theory (Code: SS 21A), **Scott T. Parsell** and **Jonathan P. Sorenson**, Butler University.

Numerical Solution of Polynomial Systems (Code: SS 7A), **Christopher S. Peterson**, Colorado State University, and **Andrew J. Sommese**, University of Notre Dame.

PDEs and Geometric Analysis (Code: SS 22A), **Matt Gursky** and **Qing Han**, University of Notre Dame.

Several Complex Variables (Code: SS 6A), **Nancy K. Stanton** and **Jeffrey A. Diller**, University of Notre Dame.

Special Functions and Orthogonal Polynomials (Code: SS 5A), **Diego Dominici**, State University of New York at New Paltz.

Topics in Representation Theory (Code: SS 17A), **Samuel R. Evans**, University of Notre Dame, and **Jiu-Kang Yu**, Purdue University.

Topology and Physics (Code: SS 18A), **Stephan A. Stolz** and **Bruce Williams**, University of Notre Dame.

Undergraduate Mathematical Research (Code: SS 20A), **Francis X. Connolly**, University of Notre Dame, and **Zsuzsanna Szaniszló**, Valparaiso University.

Water Waves (Code: SS 12A), **David Nicholls**, University of Illinois at Chicago.

Accommodations

Participants should make their own arrangements directly with a hotel of their choice as early as possible. Special rates have been negotiated with the hotels listed below. Rates quoted do not include sales tax of 12%. The AMS is not responsible for rate changes or for the quality of the accommodations. When making a reservation, participants should state that they are with the **American Mathematical Society (AMS) Meeting at Notre Dame** group. Cancellation and early checkout policies vary; be sure to check when you make your reservation.

The Inn at Saint Mary's, 53993 US Route 31, South Bend, IN 46637; phone: 574-232-4000, fax: 574-289-0986, and toll free: 800-94ST-MAR or visit <http://www.innatsaintmarys.com/>; rates range from US\$96–\$126 single/double and includes full breakfast. **This hotel is not**

within easy walking distance of the meeting. Cancellation and early checkout policies vary; be sure to check when you make your reservation. **The deadline for reservations is March 8, 2006.**

Morris Inn, Notre Dame Avenue, Notre Dame, IN 46556 (located on campus across the street from McKenna Hall/CCE; phone: 219-631-2000, fax: 574-631-2017 or visit <http://morrisinn.nd.edu/>; US\$112-\$130 single/double and includes full breakfast. Located on campus and an easy walk to the meeting. Cancellation and early checkout policies vary; be sure to check when you make your reservation. **The deadline for reservations is March 8, 2006.**

Quality Inn University, 515 North Dixieway, South Bend, IN 46637; phone: 574-272-6600, fax: 574-272-5553 or visit <http://www.choicehotels.com/>; rates are US\$69.95 single/double. **This hotel is not within easy walking distance of the meeting.** Cancellation and early checkout policies vary; be sure to check when you make your reservation. **The deadline for reservations is March 8, 2006.**

Food Service

A list of restaurants will be available at the registration desk.

Local Information

Please visit the websites maintained by the University of Notre Dame <http://www.nd.edu> and the department of mathematics at <http://www.math.nd.edu>.

Other Activities

Book Sales: Examine the newest titles from the AMS! Many of the AMS books will be available at a special 50% discount available only at the meeting. Complimentary coffee will be served courtesy of AMS Membership Services.

AMS Editorial Activity: An acquisitions editor from the AMS Book program will be present to speak with prospective authors. If you have a book project that you would like to discuss with the AMS, please stop by the book exhibit.

Parking

Parking is available in the Visitor Lot, south of the conference center, for a US\$2 cash fee payable at exit or for US\$1 with a purchase of a token at the conference center.

Reception

The Department of Mathematics will host a reception for all conference participants on Saturday evening in McKenna Hall (CCE). The AMS thanks the department for its gracious hospitality.

Registration and Meeting Information

The registration desk will be located on the first floor of McKenna Hall, also known as the Center for Continuing Education (CCE), and will be open from 7:30 a.m. to 4:00 p.m. on Saturday, and 8:00 a.m. to noon on Sunday. All talks will take place in McKenna Hall (CCE) and DeBartolo Hall.

Registration fees: Fees are US\$40 for AMS or CMS members, US\$60 for nonmembers; and US\$5 for students/unemployed/emeritus, payable on site by cash, check, or credit card.

Travel

By Air: Notre Dame is about 15 minutes from **Michiana Regional Airport** (ask your travel agent to book you to South Bend, Indiana). From the airport take "Lincolnway West" East (left out of the airport) to downtown South Bend. Turn left on Indiana 933 (Michigan St.). Stay on Indiana 933 to Angela Boulevard which is the second stop light north of the St. Joseph River. Turn right onto Angela Boulevard then left at the first stop light onto Notre Dame Avenue. Visitor Parking is located on the right side of Notre Dame Ave. about 200 yards from Angela.

You can also fly to **Chicago**, then drive or take a limousine to the university. The university is about 2 hours (by car) from O'Hare airport, less from Midway. From O'Hare Airport: Take Route 190 east out of O'Hare to Route 90 east (Kennedy Expressway) toward downtown Chicago where it merges with Route 94 south (Dan Ryan Expressway). Take the Skyway exit off the Dan Ryan and remain on Route 90 to the Indiana Toll Road which eventually merges with Route 80. Get off at Exit 77 (South Bend/Notre Dame).

The official airline for the meeting is Delta Airlines. Take advantage of Delta's new SimpliFares™ and enjoy the following benefits

- No Saturday-night stay required—more flexibility
- Always affordable—Realize up to 50% savings on every day fares in the contiguous 48 states
- Lower change fees—reduced from US\$100 to US\$50 to change travel plans

• Just eight fares—less guessing and easier planning

To make immediate reservations call Delta Air Lines at 800-221-1212. Be sure to reference **US738367060** or visit <http://www.delta.com> and enter SkyBonus account number **US738367060** in your passenger information screen to be recognized as a participant. Your benefits include:

- No service fees
- 1,000 sky miles for Delta members
- Skip the airport lines; check in online

Driving: From the north: The university is located just south of the Indiana Toll road (Interstate 80/90). Exit Interstate 80/90 at exit 77 and turn right onto Michigan (Indiana 933). Make a left at the 4th stop light (Angela Boulevard). Make a left at the first stop light (Notre Dame Avenue). Visitor Parking is located on the right side of Notre Dame Ave. about 200 yards from Angela Boulevard.

From the south: Take US 31 north which becomes Indiana 933 just south of South Bend. Stay on Indiana 933 to Angela Boulevard which is the second stop light north of the St. Joseph River. Turn right onto Angela Boulevard then left at the first stop light onto Notre Dame Avenue. Visitor Parking is located on the right side of Notre Dame Ave. about 200 yards from Angela.

Other: The South Shore Line trains run directly from the Chicago Loop to Michiana Regional Transportation Center (Airport) in South Bend.

Special Travel Information for International Participants. Visa regulations are continually changing for travel to the United States. Visa applications may take from three to four months to process and require a personal interview, as well as specific personal information. International participants should view the important information about traveling to the U.S. found at http://www7.nationalacademies.org/visas/Traveling_to_US.html and <http://travel.state.gov/visa/index.html>. If you need a preliminary conference invitation in order to secure a visa, please send your request to dls@ams.org.

If you discover you do need a visa, the National Academies website (see above) provides these tips for successful visa applications:

* Visa applicants are expected to provide evidence that they are intending to return to their country of residence. Therefore, applicants should provide proof of "binding" or sufficient ties to their home country or permanent residence abroad. This may include documentation of the following:

- family ties in home country or country of legal permanent residence
- property ownership
- bank accounts
- employment contract or statement from employer stating that the position will continue when the employee returns;

* Visa applications are more likely to be successful if done in a visitor's home country than in a third country;

* Applicants should present their entire trip itinerary, including travel to any countries other than the United States, at the time of their visa application;

* Include a letter of invitation from the meeting organizer or the U.S. host, specifying the subject, location, and dates of the activity, and how travel and local expenses will be covered;

* If travel plans will depend on early approval of the visa application, specify this at the time of the application;

* Provide proof of professional scientific and/or educational status (students should provide a university transcript).

This list is not to be considered complete. Please visit the websites above for the most up-to-date information.

Weather

The weather in April is variable, with temperatures from 45°F to 55°F, and occasional rain with a remote possibility of snow.

Durham, New Hampshire

University of New Hampshire

April 22–23, 2006

Saturday – Sunday

Meeting #1017

Eastern Section

Associate secretary: Lesley M. Sibner

Announcement issue of *Notices*: February 2006

Program first available on AMS website: March 9, 2006

Program issue of electronic *Notices*: April 2006

Issue of *Abstracts*: Volume 27, Issue 2

Deadlines

For organizers: Expired

For consideration of contributed papers in Special Sessions:

January 3, 2006

For abstracts: February 28, 2006

Invited Addresses

Ailana M. Fraser, University of British Columbia, *Title to be announced.*

Dmitri Nikshych, University of New Hampshire, *Title to be announced.*

Florian Pop, University of Pennsylvania, *Title to be announced.*

Konstantina Trivisa, University of Maryland, College Park, *Title to be announced.*

Special Sessions

Algebraic Groups (Code: SS 5A), **George J. McNinch**, Tufts University, and **Eric Sommers**, University of Massachusetts-Amherst.

Arithmetic Geometry and Modular Forms (Code: SS 6A), **Paul E. Gunnells** and **Farshid Hajir**, University of Massachusetts, Amherst.

Arrangements and Configuration Spaces (Code: SS 10A), **Graham C. Denham**, University of Western Ontario, and **Alexander I. Suci**, Northeastern University.

Banach Lattices, Regular Operators, and Applications (Code: SS 3A), **A. K. Kitover**, Community College of Philadelphia, **M. Orhon**, University of New Hampshire, and **A. W. Wickstead**, Queen's University of Belfast.

Banach Spaces of Analytic Functions (Code: SS 2A), **Rita A. Hibscheiler**, University of New Hampshire, and **Thomas H. MacGregor**, SUNY Albany and Bowdoin College.

Discrete and Convex Geometry (Code: SS 1A), **Daniel A. Klain**, University of Massachusetts (Lowell), **Barry R. Monson**, University of New Brunswick, and **Egon Schulte**, Northeastern University.

Galois Theory in Arithmetic and Geometry (Code: SS 8A), **Florian Pop** and **David Harbater**, University of Pennsylvania, and **Rachel J. Pries**, Colorado State University.

Geometric Methods in Group Theory and Topology (Code: SS 9A), **Kim Ruane**, Tufts University, **Jennifer Taback**, Bowdoin College, and **Peter N. Wong**, Bates College.

Global Perspectives on the Geometry of Riemann Surfaces (Code: SS 14A), **Eran Makover** and **Jeffrey K. McGowan**, Central Connecticut State University.

Hopf Algebras and Galois Module Theory (Code: SS 4A), **Timothy Kohl**, Boston University, and **Robert G. Underwood**, Auburn University Montgomery.

Mathematical Challenges in Physical and Engineering Sciences (Code: SS 13A), **Marianna A. Shubov**, University of New Hampshire.

Quantum Invariants of Knots and 3-Manifolds (Code: SS 11A), **Charles D. Frohman**, University of Iowa, and **Razvan Gelca**, Texas Tech University.

Symplectic and Contact Topology (Code: SS 7A), **Weimin Chen**, **Michael G. Sullivan**, and **Hao Wu**, University of Massachusetts, Amherst.

Topological Algebras and Applications (Code: SS 12A), **Alexander A. Katz**, St. John's University, and **Genady Y. Grabarnik**, IBM T. J. Watson Research Center.

San Francisco, California

San Francisco State University

April 29–30, 2006

Saturday - Sunday

Meeting #1018

Western Section

Associate secretary: Michel L. Lapidus

Announcement issue of *Notices*: February 2006

Program first available on AMS website: March 16, 2006

Program issue of electronic *Notices*: April 2006

Issue of *Abstracts*: Volume 27, Issue 2

Deadlines

For organizers: Expired

For consideration of contributed papers in Special Sessions:
January 10, 2006

For abstracts: March 7, 2006

Invited Addresses

Lincoln Chayes, University of California Los Angeles, *Title to be announced.*

C. Robin Graham, University of Washington, *Title to be announced.*

Vadim Kaloshin, California Institute of Technology, *Title to be announced.*

Benoit B. Mandelbrot, Yale University, *From pure mathematics to roughness in art* (Einstein Public Lecture in Mathematics).

Yuval Peres, University of California Berkeley, *Title to be announced.*

Special Sessions

Computational Arithmetic Geometry (Code: SS 13A), **Kenneth A. Ribet**, University of California Berkeley, and **Kristin Estrella Lauter**, Microsoft Corporation.

Elliptic Methods in Geometry (Code: SS 3A), **C. Robin Graham**, University of Washington, and **Rafe Mazzeo**, Stanford University.

Enumerative Aspects of Polytopes (Code: SS 10A), **Federico Ardila** and **Matthias Beck**, San Francisco State University.

Fractal Geometry: Connections to Dynamics, Geometric Measure Theory, Mathematical Physics and Number Theory (Code: SS 4A), **Michel L. Lapidus** and **Erin P. Pearse**, University of California Riverside, and **Machiel van Frankenhuysen**, Utah Valley State College.

Geometric Dynamics and Ergodic Theory (Code: SS 11A), **Yitwah Cheung** and **Arek Goetz**, San Francisco State University, and **Slobodan Simic**, San Jose State University.

Geometry of Gröbner Bases (Code: SS 2A), **Bernd Sturmfels**, University of California Berkeley, and **Alexander Yong**, University of Minnesota and Fields Institute.

Hilbert Functions and Resolutions (Code: SS 12A), **Benjamin Richert**, California Polytechnic State University, and **Sean Sather-Wagstaff**, California State University, Dominguez Hills.

History and Philosophy of Mathematics (Code: SS 1A), **Shawnee L. McMurrin**, California State University, San Bernardino, and **James J. Tattersall**, Providence College.

Homological and K-theoretical Trends in Algebraic Combinatorics (Code: SS 6A), **Joseph Gubeladze** and **Serkan Hosten**, San Francisco State University.

Liapunov Exponents and Nonuniform Hyperbolicity (Code: SS 7A), **Anton Gorodetski** and **Vadim Kaloshin**, California Institute of Technology.

Lie Algebras and Applications (Code: SS 9A), **Dimitar Grantcharov**, San Jose State University, **Vera Serganova**, University of California Berkeley, and **Arturo Pianzola**, University of Alberta.

Partial Differential Equations and Their Applications (Code: SS 14A), **Steve Shkoller**, University of California Davis.

Probability and Statistical Physics (Code: SS 5A), **Marek Biskup**, University of California Los Angeles, **Noam Berger**, California Institute of Technology and University of California Los Angeles, and **Balint Virag**, University of Toronto.

Q-series and Partitions (Code: SS 8A), **Neville Robbins**, San Francisco State University.

Salt Lake City, Utah

University of Utah

October 7–8, 2006

Saturday – Sunday

Meeting #1019

Western Section

Associate secretary: Michel L. Lapidus

Announcement issue of *Notices*: August 2006

Program first available on AMS website: August 24, 2006

Program issue of electronic *Notices*: October 2006

Issue of *Abstracts*: Volume 27, Issue 3

Deadlines

For organizers: March 7, 2006

For consideration of contributed papers in Special Sessions:
June 20, 2006

For abstracts: August 15, 2006

Invited Addresses

William Arveson, University of California Berkeley, *Title to be announced.*

Alexei Borodin, California Institute of Technology, *Title to be announced.*

Izabella Joanna Laba, University of British Columbia, *Title to be announced.*

Darren Long, University of California Santa Barbara, *Title to be announced.*

Special Sessions

Harmonic Analysis: Trends and Perspectives (Code: SS 1A), **Alex Iosevich**, University of Missouri, and **Michael T. Lacey**, Georgia Institute of Technology.

Cincinnati, Ohio

University of Cincinnati

October 21–22, 2006

Saturday – Sunday

Meeting #1020

Central Section

Associate secretary: Susan J. Friedlander

Announcement issue of *Notices*: August 2006

Program first available on AMS website: September 7, 2006

Program issue of electronic *Notices*: October 2006

Issue of *Abstracts*: Volume 27, Issue 3

Deadlines

For organizers: March 21, 2006

For consideration of contributed papers in Special Sessions:
July 5, 2006

For abstracts: August 29, 2006

Invited Addresses

Suncica Canic, University of Houston, *Title to be announced.*

Bryna R. Kra, Northwestern University, *Title to be announced.*

Ezra N. Miller, University of Minnesota, *Title to be announced.*

Jon G. Wolfson, Michigan State University, *Title to be announced.*

Special Sessions

Ergodic Theory (Code: SS 1A), **Nikos Frantzikinakis**, Pennsylvania State University, **Bryna R. Kra**, Northwestern University, and **Mate Wierdl**, University of Memphis.

Storrs, Connecticut

University of Connecticut

October 28–29, 2006

Saturday – Sunday

Meeting #1021

Eastern Section

Associate secretary: Lesley M. Sibner

Announcement issue of *Notices*: August 2006

Program first available on AMS website: September 14, 2006

Program issue of electronic *Notices*: October 2006

Issue of *Abstracts*: Volume 27, Issue 4

Deadlines

For organizers: March 28, 2006

For consideration of contributed papers in Special Sessions:
July 11, 2006

For abstracts: September 6, 2006

Special Sessions

Combinatorial Methods in Equivariant Topology (Code: SS 1A), **Tara Holm**, University of Connecticut, Storrs, and **Tom C. Braden**, University of Massachusetts, Amherst.

Fayetteville, Arkansas

University of Arkansas

November 3–4, 2006

Friday – Saturday

Meeting #1022

Southeastern Section

Associate secretary: Matthew Miller

Announcement issue of *Notices*: September 2006

Program first available on AMS website: September 21, 2006

Program issue of electronic *Notices*: November 2006

Issue of *Abstracts*: Volume 27, Issue 4

Deadlines

For organizers: April 3, 2006

For consideration of contributed papers in Special Sessions:
July 18, 2006

For abstracts: September 12, 2006

Invited Addresses

Richard P. Anstee, University of British Columbia, *Title to be announced.*

Arun Ram, University of Wisconsin, *Title to be announced.*

Donald G. Saari, University of California Irvine, *Title to be announced.*

Andras Vasy, Massachusetts Institute of Technology, *Title to be announced.*

Special Sessions

Dirac Operators in Analysis and Geometry (Code: SS 1A), **John Ryan**, University of Arkansas, **Marius Mitrea**, University of Missouri, and **Mircea Martin**, Baker University.

New Orleans, Louisiana

*New Orleans Marriott
and Sheraton New Orleans Hotel*

January 4–7, 2007

Thursday – Sunday

Meeting #1023

Joint Mathematics Meetings, including the 113th Annual Meeting of the AMS, 90th Annual Meeting of the Mathematical Association of America (MAA), annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).

Associate secretary: Susan J. Friedlander

Announcement issue of *Notices*: October 2006

Program first available on AMS website: November 1, 2006

Program issue of electronic *Notices*: January 2007

Issue of *Abstracts*: Volume 28, Issue 1

Deadlines

For organizers: April 1, 2006

For consideration of contributed papers in Special Sessions:
To be announced

For abstracts: To be announced

Davidson, North Carolina

Davidson College

March 3–4, 2007

Saturday – Sunday

Southeastern Section

Associate secretary: Matthew Miller

Announcement issue of *Notices*: To be announced

Program first available on AMS website: To be announced

Program issue of electronic *Notices*: To be announced

Issue of *Abstracts*: To be announced

Deadlines

For organizers: August 3, 2006

For consideration of contributed papers in Special Sessions:
To be announced

For abstracts: To be announced

Oxford, Ohio

Miami University

March 16–17, 2007

Friday – Saturday

Central Section

Associate secretary: Susan J. Friedlander

Announcement issue of *Notices*: To be announced

Program first available on AMS website: To be announced

Program issue of electronic *Notices*: To be announced

Issue of *Abstracts*: To be announced

Deadlines

For organizers: To be announced

For consideration of contributed papers in Special Sessions:
To be announced

For abstracts: To be announced

Special Sessions

Geometric Topology (Code: SS 2A), **Jean-Francois LaFont**, SUNY Binghamton and Ohio State University, and **Ivonne J. Ortiz**, Miami University.

Large Cardinals in Set Theory (Code: SS 1A), **Paul B. Larson**, Miami University, **Justin Tatch Moore**, Boise State University, and **Ernest Schimmerling**, Carnegie Mellon University.

Hoboken, New Jersey

Stevens Institute of Technology

April 14–15, 2007

Saturday – Sunday

Eastern Section

Associate secretary: Lesley M. Sibner

Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: September 14, 2006
For consideration of contributed papers in Special Sessions:
To be announced
For abstracts: To be announced

Tucson, Arizona

University of Arizona

April 21–22, 2007

Saturday – Sunday

Western Section

Associate secretary: Michel L. Lapidus

Announcement issue of *Notices*: To be announced
Program first available on AMS website: To be announced
Program issue of electronic *Notices*: To be announced
Issue of *Abstracts*: To be announced

Deadlines

For organizers: September 21, 2006
For consideration of contributed papers in Special Sessions:
To be announced
For abstracts: To be announced

San Diego, California

San Diego Convention Center

January 6–9, 2008

Sunday – Wednesday

Joint Mathematics Meetings, including the 114th Annual Meeting of the AMS, 91st Annual Meeting of the Mathematical Association of America (MAA), annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).

Associate secretary: Michel L. Lapidus

Announcement issue of *Notices*: October 2007

Program first available on AMS website: November 1, 2007

Program issue of electronic *Notices*: January 2008

Issue of *Abstracts*: Volume 29, Issue 1

Deadlines

For organizers: April 1, 2007
For consideration of contributed papers in Special Sessions:
To be announced
For abstracts: To be announced

Bloomington, Indiana

Indiana University

April 4–6, 2008

Friday – Sunday

Central Section

Associate secretary: Susan J. Friedlander

Announcement issue of *Notices*: To be announced

Program first available on AMS website: To be announced

Program issue of electronic *Notices*: To be announced

Issue of *Abstracts*: To be announced

Deadlines

For organizers: September 4, 2007

For consideration of contributed papers in Special Sessions:

To be announced

For abstracts: To be announced

Rio de Janeiro, Brazil

Instituto Nacional de Matemática Pura e Aplicada (IMPA)

June 4–7, 2008

Wednesday – Saturday

First Joint International Meeting between the AMS and the Brazilian Mathematical Society

Associate secretary: Lesley M. Sibner

Announcement issue of *Notices*: To be announced

Program first available on AMS website: Not applicable

Program issue of electronic *Notices*: Not applicable

Issue of *Abstracts*: Not applicable

Deadlines

For organizers: To be announced

For consideration of contributed papers in Special Sessions:

To be announced

For abstracts: To be announced

Vancouver, Canada

University of British Columbia

October 4–5, 2008

Saturday – Sunday

Western Section

Associate secretary: Michel L. Lapidus

Announcement issue of *Notices*: To be announced

Program first available on AMS website: To be announced

Program issue of electronic *Notices*: To be announced

Issue of *Abstracts*: To be announced

Deadlines

For organizers: March 9, 2008

For consideration of contributed papers in Special Sessions:
To be announced
For abstracts: To be announced

Shanghai, People's Republic of China

Fudan University

December 17–21, 2008

Wednesday – Sunday

First Joint International Meeting between the AMS and the Shanghai Mathematical Society

Associate secretary: Susan J. Friedlander

Announcement issue of *Notices*: To be announced

Program first available on AMS website: To be announced

Program issue of electronic *Notices*: To be announced

Issue of *Abstracts*: To be announced

Deadlines

For organizers: To be announced

For consideration of contributed papers in Special Sessions:
To be announced

For abstracts: To be announced

Washington, District of Columbia

*Marriott Wardman Park Hotel
and Omni Shoreham Hotel*

January 7–10, 2009

Wednesday – Saturday

Joint Mathematics Meetings, including the 115th Annual Meeting of the AMS, 92nd Annual Meeting of the Mathematical Association of America (MAA), annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).

Associate secretary: Lesley M. Sibner

Announcement issue of *Notices*: October 2008

Program first available on AMS website: November 1, 2008

Program issue of electronic *Notices*: January 2009

Issue of *Abstracts*: Volume 30, Issue 1

Deadlines

For organizers: April 1, 2008

For consideration of contributed papers in Special Sessions:
To be announced

For abstracts: To be announced

San Francisco, California

*Moscone Center West
and the San Francisco Marriott*

January 6–9, 2010

Wednesday – Saturday

Joint Mathematics Meetings, including the 116th Annual Meeting of the AMS, 93rd Annual Meeting of the Mathematical Association of America (MAA), annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL), with sessions contributed by the Society of Industrial and Applied Mathematics (SIAM).

Associate secretary: Matthew Miller

Announcement issue of *Notices*: October 2009

Program first available on AMS website: November 1, 2009

Program issue of electronic *Notices*: January 2010

Issue of *Abstracts*: Volume 31, Issue 1

Deadlines

For organizers: April 1, 2009

For consideration of contributed papers in Special Sessions:
To be announced

For abstracts: To be announced

New Orleans, Louisiana

*New Orleans Marriott
and Sheraton New Orleans Hotel*

January 5–8, 2011

Wednesday – Saturday

Joint Mathematics Meetings, including the 117th Annual Meeting of the AMS, 94th Annual Meeting of the Mathematical Association of America, annual meetings of the Association for Women in Mathematics (AWM) and the National Association of Mathematicians (NAM), and the winter meeting of the Association for Symbolic Logic (ASL), with sessions contributed by the Society for Industrial and Applied Mathematics (SIAM).

Associate secretary: Susan J. Friedlander

Announcement issue of *Notices*: October 2010

Program first available on AMS website: November 1, 2010

Program issue of electronic *Notices*: January 2011

Issue of *Abstracts*: Volume 32, Issue 1

Deadlines

For organizers: April 1, 2010

For consideration of contributed papers in Special Sessions:
To be announced

For abstracts: To be announced

Research topic: A three-week summer program for
Low Dimensional Topology graduate students
undergraduate students

Education Theme: mathematics researchers
Knowledge for Teaching undergraduate faculty
Mathematics secondary school teachers
math education researchers

IAS/Park City Mathematics Institute (PCMI)

June 25- July 15, 2006

Park City, Utah

Organizers: Tomasz Mrowka, Massachusetts Institute of Technology;
Peter Ozsvath, Columbia University

Graduate Summer School Lecturers: John Etnyre, University of
Pennsylvania; Ron Fintushel, Michigan State University; David Gabai,
Princeton University; Cameron Gordon, University of Texas; Mikhail
Khovanov, Columbia University; Ron Stern, University of California
Irvine; Zoltan Szabo, Princeton University.

Clay Senior Scholars in Residence: Yakov Eliashberg, Stanford
University; Robion Kirby, University of California Berkeley

Other Organizers: Secondary School Teachers Program: Gail Burrill,
Michigan State University; Carol Hattan, Vancouver, WA; James King,
University of Washington. Undergraduate Summer School: William
Barker, Bowdoin College; Aaron Bertram, University of Utah; Roger
Howe, Yale University. Undergraduate Faculty Program: Daniel
Goroff, Harvey Mudd College and Harvard University.

Applications: www.ias.edu/parkcity

Deadline: February 15, 2006

IAS/ Park City Mathematics Institute
Institute for Advanced Study, Princeton, NJ 08540
Financial Support Available

Boston, Massachusetts

*John B. Hynes Veterans Memorial
Convention Center, Boston Marriott Hotel,
and Boston Sheraton Hotel*

January 4-7, 2012

Wednesday - Saturday

*Joint Mathematics Meetings, including the 118th Annual
Meeting of the AMS, 95th Annual Meeting of the Mathe-
matical Association of America, annual meetings of the
Association for Women in Mathematics (AWM) and the
National Association of Mathematicians (NAM), and the
winter meeting of the Association for Symbolic Logic (ASL),
with sessions contributed by the Society for Industrial and
Applied Mathematics (SIAM).*

Associate secretary: Michel L. Lapidus

Announcement issue of *Notices*: October 2011

Program first available on AMS website: November 1, 2011

Program issue of electronic *Notices*: January 2012

Issue of *Abstracts*: Volume 33, Issue 1

Deadlines

For organizers: April 1, 2011

For consideration of contributed papers in Special Sessions:

To be announced

For abstracts: To be announced

San Diego, California

*San Diego Convention Center
and San Diego Marriott Hotel and Marina*

January 9-12, 2013

Wednesday - Saturday

*Joint Mathematics Meetings, including the 119th Annual
Meeting of the AMS, 96th Annual meeting of the Mathe-
matical Association of America, annual meetings of the
Association for Women in Mathematics (AWM) and the
National Association of Mathematicians (NAM), and the
winter meeting of the Association for Symbolic Logic (ASL),
with sessions contributed by the Society for Industrial and
Applied Mathematics (SIAM).*

Associate secretary: Lesley M. Sibner

Announcement issue of *Notices*: To be announced

Program first available on AMS website: To be announced

Program issue of electronic *Notices*: To be announced

Issue of *Abstracts*: To be announced

Deadlines

For organizers: April 1, 2012

For consideration of contributed papers in Special Sessions:

To be announced

For abstracts: To be announced

Presenters of Papers

San Antonio, Texas; January 12-15, 2006

Numbers following the name indicate the speaker's position on the program.

◊ AMS-MAA Invited Lecturer, ● AMS Invited Lecturer, ✎ AMS Retiring Presidential Address,
 ◊ MAA Invited Lecturer, ◻ AWM Emmy Noether Lecturer, ■ NAM Invited Lecturer, ◊ ASL Invited Lecturer,
 ▲ SIAM Invited Lecturer, * Special Session Speaker, ▶ Graduate Student, ◀ Undergraduate Student

Abbey, M. K. 348	Arganbright, D. E. 1182	Beam, J. E. 1668	Boneh, S. 380
Abbey, M. 1245	* Asaeda, M. 1614	▶ Beavers, B. 538	* Borcea, L. 1057
◀ Abernathy, Z. J. 826	▶ Asano, E. 398	Becker, P. 1435	Borisuyk, A. 623
Abramson, J. P. 1162	Ash, J. M. 1304	*▶ Becnel, J. J. 1610	*◀ Borman, M. S. 1009
AbuGhneim, O. A. 281	Ashe, D. J. 275	Behrens, C. E. 92	Borwein, J. M. 5
▶ AbuShamala, W. N. 1646	*◀ Ashley, R. 1011	Beineke, J. 169	Borwein, J. M. 15
* Ackleh, A. 1541	Ashline, G. L. 733	Belcastro, S.-M. 94	* Borwein, P. 206
Adams, S. S. 1261	Ashton, B. 601	Belcastro, S.-M. 900	* Bos, H. J. 1023
Affouf, M. 1242	▶ Ashton, T. 1403	* Bellhouse, D. R. 1024	* Bosma, W. 880
▶ Aga, M. G. 83	Aslaksen, H. 1333	Belock, J. A. 991	Botelho, F. 1313
* Agashe, A. 1384	▶ Aslam, M. 1473	Bendame, M. 639	* Boussaf, K. 677
Agras, N. 1286	Athanassov, Z. S. 1675	Bendame, M. 998	* Boutabaa, A. 61
Agre, K. 717	Aubrey, J. 1681	* Benedetto, J. J. 652	Bouthellier, P. R. 563
* Ahlgren, S. 1376	* Auchmuty, G. 1032	* Beneish, E. 667	Boutin, D. 370
Aichele, D. B. 1248	Austin, H. W. 1483	Bennett, A. G. 546	Bowers, J. 173
* Aichinger, E. 475	* Avramov, L. L. 249	* Bennett, K. P. 1369	* Borman, D. C. 888
▶ Akbas, E. 815	Axtell, M. 939	Benson, S. R. 106	*▶ Boynton, J. 483
* Akin-Bohner, E. 447	* Ayoola, E. O. 1357	Benson, S. 1257	Boynton, N. J. 962
Alarcon, F. E. 741	Azarian, M. K. 930	* Bentz, W. F. 1104	* Bozeman, S. T. 28
* Albers, P. 1388	Bachman, D. 1128	* Berenstein, A. 38	* Bracken, P. F. 410
Albertson, M. O. 369	Bacon, M. R. 1671	*◀ Berg, D. E. 1527	▶ Brahma, S. K. 501
Alewine, J. A. 1414	* Badawi, A. R. 231	Bergner, J. A. 739	Braman, K. 500
Alexander, D. S. 750	*▶ Baginski, P. 52	Bernard, K. J. 358	Branson, W. 761
Alford, J. G. 913	Bailey, D. H. 7	* Berndt, B. C. 468	*◀ Bratz, J. 1014
Allali, M. 1461	Bailey, D. H. 14	* Berrizbeitia, P. J. 1382	* Bremigan, R. J. 1073
* Allen, E. J. 1592	▶ Bailey, S. E. 1512	Berry, M. L. 745	Brezhneva, O. 502
* Allen, L. J. 1588	* Bal, G. 1056	Besana, G. 699	Briggs, B. 1249
Allison, D. L. 1223	* Balan, R. V. 651	▶ Beswick, M. J. 1429	Brodie, M. 614
Allman, E. 3	* Baldrige, S. 1393	*▶ Beun, S. L. 1076	Brodie, M. 762
*▶ Alm, J. F. 1105	* Ball, K. M. 257	* Bezdek, A. 662	Brown, A. E. 828
Almanassra, M. F. 1657	* Ball, R. N. 235	* Bezrukov, S. L. 1107	Brown, D. A. 350
Al-Rubae, F. B. 356	* Ball, R. N. 696	▶ Bhat, Y. S. 522	Brown, D. E. 606
*▶ Al-Sharawi, Z. M. 886	* Balogh, A. 1038	Bhatta, D. D. 521	Brown, J. E. 952
Alvarez, J. 771	▶ Balreira, E. C. 819	Bhattacharya, C. 1424	Brown, M. K. 84
▶ Ameer, K. 1400	Banchoff, T. F. 830	Bhattacharyya, M. 90	Brown, S. 99
* Anabtawi, M. 1355	▶ Bandulasiri, A. W. 81	Bingham, A. D. 766	* Brownawell, W. D. 45
Anastassiou, G. A. 1306	Banks, T. 1639	Biondini, G. 804	* Brubaker, B. 430
Andersen, J. L. 1485	* Baragar, A. 854	* Biswas, A. 1359	* Brudnyi, A. 78
Andersen, J. 1138	Bardzell, M. 312	Bleak, C. 1428	* Brudnyi, Y. 79
Andersen, R. N. 322	Bardzell, M. 1276	* Bloch, A. M. 845	* Brueggeman, S. 302
* Anderson, D. D. 49	Barrett, D. 355	Blum, L. 599	* Brussel, E. S. 668
* Anderson, D. R. 448	Barshinger, R. N. 798	Bocea, M. 709	Bryant, R. 1322
▶ Anderson, J. 286	Barzilai, H. 103	Bodner, B. L. 1327	Buck, R. E. 1498
▶ Andikfar, H. 1427	Basener, W. 1260	Boersma, S. 328	Budden, M. 301
Anway, D. W. 1216	* Basu, S. 246	Boersma, S. 942	* Buhler, J. P. 1383
*▶ Apagodu, M. 427	*▶ Bates, D. J. 1360	Bold, S. 1685	Bukowski, J. F. 910
Arfaltir, F. J. 917	Bator, E. M. 818	Boliver, D. E. 572	▶ Bulanova, A. S. 1305
Arbogast, T. 131	* Baxley, J. V. 1577	Bolt, M. D. 1122	* Bumby, R. T. 891
Ardis, W. D. 793	▶ Bayram, S. 1144	* Bona, M. 426	▶ Bumpus, J. W. 162

▶ Bumpus, J. W. 746	Clark, J. M. 1208	◦ Devlin, K. J. 644	*◀ Erickson, C. 1019
* Buot, M.-L. G. 70	Clark, J. 555	◀ Dewar, J. D. 262	Erickson, T. S. 108
Burch, K. J. 1178	Clark, R. J. 279	Dewar, J. 1298	*▶ Eriksson, N. K. 72
* Burge, R. C. 471	Clark, S. 137	*▶ Dhirasakdanon, T. 1543	* Escassut, A. P. 680
* Burger, E. B. 892	▶ Cline, R. S. 1466	*▶ Díaz, O. 1399	▶ Escudro, H. E. 142
Burger, M. 617	Coe, P. R. 1184	Dick, T. P. 740	Fahep, D. 128
Burkholder, D. G. 612	* Cohen, P. B. 44	Diefenderfer, C. 1172	Estep, D. 377
Burns, A. M. 769	* Cohen, P. B. 1381	* Dilworth, S. J. 416	*◀ Eustis, A. 1013
* Burns, K. 847	Colbert, C. M. 626	Dimitriu, D. G. 1271	Evan, J. 608
Burstein, A. I. 728	Comanici, A. N. 824	Dimitrov, R. D. 1679	Evan, J. 928
Buscher, D. 101	Comar, T. D. 791	▶ Dinca, I. I. 116	Evans, T. J. 1670
* Buskes, G. J. 674	Comar, T. D. 1401	▶ Ding, W. 396	Ewing, D. E. 704
▶ Butler, S. K. 541	* Comfort, W. W. 237	Dinov, I. 1258	Exner, G. R. 1467
▶ Buzaianu, E. M. 797	Connors, M. 354	* Dinwoodie, I. H. 683	Fahmy, N. 1197
* Caglar, A. 1043	Connors, M. 738	▶ Diwadkar, J. M. 1432	Fairweather, G. 987
Calhoun, W. C. 1406	Constantin, E. 392	* Dobbs, D. E. 230	* Faridani, A. 840
Calkin, N. J. 8	Cook, S. V. 1452	Dobria, L. 16	Farley, J. D. 1194
Calvert, W. 1677	Cooper, C. 294	Dobrinen, N. 1321	Farley, J. D. 1648
Camacho, E. T. 787	Cooper, R. G. 719	* Dogru, F. 201	Fathauer, R. W. 1329
▶ Camenga, K. A. 132	* Cordero, E. 653	Doiron, B. 124	Fawaz, A. 1119
▶ Camenga, K. A. 148	▶ Coskun, H. 914	* Dometrius, C. E. 1077	* Fefferman, C. L. 992
* Campbell, H. E. 1629	▶ Cotwright, C. D. 285	* Dong, X. 1373	▶ Feigon, B. G. 295
▶ Campbell Hetrick, B. M. 1517	Cox, S. J. 121	Dorff, V. 984	* Feng, B.-F. 838
▶ Cane, I. V. 277	Coxson, G. E. 950	Dorff, V. 1451	Feng, P. 514
Canfield, W. E. 357	Crawford, P. 110	Dov, C. N. 163	* Feng, Z. 1039
* Caparrini, S. 1026	* Crilly, A. J. 1027	Dove, K. L. 559	Fenton, W. E. 1282
*◀ Carey, P. A. 1012	Crisman, K.-D. 149	▶ Drake, D. 284	▶ Ferguson, C. C. 1426
* Carin, L. 1608	*◀ Crizer, A. V. 1534	Dray, T. 1279	Ferland, K. K. 801
Carothers, D. C. 1155	*▶ Croicu, A.-M. 1591	Drinen, D. 757	* Ferrini-Mundy, J. 187
▶ Carter, F. J. 816	Crowdy, D. G. 805	* Drton, M. 465	Fiedler, J. R. 306
Carter, N. 1684	Crowley, L. 1274	* Drucker, T. 1553	▶ Finch, C. E. 168
Cartwright, N. A. 1312	* Cui, M. 1046	Dubrovskiy, S. 1116	Finn, D. L. 718
* Casazza, P. G. 839	* Culshaw, R. V. 1344	Dudley, D. 935	Finn, D. L. 1284
Case, J. O. 742	* Cushing, J. M. 1535	* Duenez, E. 1378	Finston, D. 600
* Castano-Bernard, R. 1092	* Cutkosky, S. D. 247	Dumett, M. A. 402	Fischer, J. F. 706
Castillo-Chavez, C. 597	▶ Dabkowska, M. A. 1405	Dunham, P. H. 341	Fishback, P. E. 961
* Castro, A. 411	*▶ Daems, J. 1028	* Dunham, W. 1029	Fisher, G. L. 770
Cecil, M. S. 270	* Dai, Z. 1361	▶ Dunn, C. M. 1118	▶ Fisher, L. S. 503
◊ Cenzer, D. 994	Daileda, R. C. 298	Duque, D. F. 1682	◦ Fisher, N. 1490
* Cervera, J. A. 1022	▶ Danforth, C. 1419	▶ Duran, A. 1337	* Flahive, M. E. 890
* Cetin, C. 1594	Daniel, J. W. 1503	Durfee, A. 906	Flahive, M. 1256
Cha, B. 1195	* Daniel, J. 1079	Dutkay, D. E. 1471	Flashman, M. E. 95
* Chabert, J.-L. 226	Dannon, H. V. 315	Dwyer, J. F. 359	Flashman, M. E. 975
▶ Chakrabarty, S. P. 1133	Dannon, H. V. 1652	* Dyyak, I. I. 1047	*▶ Fleming, T. 1617
◦ Chamberland, M. 1004	* D'Antonio, L. 195	▪ Edelsbrunner, H. 1001	Florez, R. 532
* Chan, D. M. 1346	Das, K. P. 1500	Edwards, B. 1317	Foisy, J. S. 802
Chan, W. 519	* Dasbach, O. 1612	Edwards, C. C. 1224	* Fokas, T. 407
* Chandler, F. J. 1078	Dassios, G. 806	* Edwards, S. 60	▲ Fokas, T. 645
Chang, S. 299	Dastrange, N. 1415	Efendiev, Y. R. 130	▶ Foley, J. D. 164
Charlwood, K. E. 1499	* Daubechies, I. 843	* Eggermont, P. P. 31	Forman, S. L. 969
Chartier, T. P. 1188	□ Daubechies, I. 637	*◀ Ehly, K. 1526	▶ Foulí, L. 1510
Chen, G. 371	* Davis, J. M. 443	Ehme, J. A. 602	* Fouque, J.-P. 1051
* Chen, G. 1031	* Davis, L. G. 1041	* Ehme, J. A. 1352	Fowler, D. 754
▶ Chen, W. 1474	Davis, S. W. 902	* Eisenbud, D. 827	Fowler, D. 1176
*▶ Chen, X. 835	Dawson, C. 125	Eisentraeger, K. 1486	Fowler, D. 1244
* Chen, Y. 682	DeAlba, L. M. 989	* Eisentraeger, K. 856	Fox, B. 943
Chen, Z. J. 126	▶ Dean, A. 353	* Elaydi, S. N. 458	Fox, B. 965
Cheney, M. 813	DeBellis, V. A. 1259	El-Houbi, A. F. 87	Fox, T. B. 1225
* Cheney, M. 1605	* DeBellis, V. A. 191	Ellington, A. J. 587	Fox, W. P. 327
Cherif, C. 1463	* Debnath, L. 1036	■ Ellis, Jr., W. 1341	Franchy, G. T. 1445
Childs, A. G. 1149	* Deckelman, S. M. 792	Ellis, R. B. 529	* Francisco, C. A. 252
Chin, C. E. 1191	DeDeo, M. R. 1167	Ellis, W. 1285	* Franke, J. E. 882
* Chinta, G. 431	* De Hoop, M. V. 32	Elnagar, G. N. 394	* Franks, J. 849
Chiru, E. 1123	Delcroix, S. D. 929	* Eloe, P. W. 1350	* Frazer, C. G. 1025
Chisholm, J. 1676	DeMeyer, L. A. 579	▶ El-Sissi, N. 1468	*▶ Frazier, A. M. 53
*◀ Chmura, A. L. 1017	Dempsey, D. W. 576	Emerson, A. 1163	* Frechette, S. M. 1380
Choi, J. 278	* Deng, K. 1542	Emerson-Stonell, S. S. 736	Freed, R. 1640
Choi, J. 506	Denley, T. M. 1237	Emerson-Stonell, S. S. 1209	Frey, S. E. 916
* Choi, S. 208	* Derksen, H. 1625	*▶ Emmons, C. J. 1293	* Friedberg, S. 429
Choi, Y. 1502	* Despeaux, S. E. 1547	Eng, G. 1650	▶ Friedman, O. 1632
* Chuai, J. 1074	* Detlefsen, M. E. 1106	Ensley, D. 548	* Fukshansky, L. 43
Chung, J. H. 973	* Devaney, R. L. 632	Ensley, D. 1263	Fuller, W. R. 767
* Clark, A. 200	* DeVault, R. 449	* Erbe, L. H. 220	Fulmer, J. 558

Fulmer, J.	1658	* Grosshans, F. D.	1628	Herzig, A. H.	593	* Jarrah, A.	73
Fulton, J.	1281	Groth, R. E.	779	Hetzler, S. M.	549	Jayawant, P.	730
Fulton, S. R.	807	* Gurel, B.	1099	Heyer, L. J.	376	*▶ Jenkins, P.	432
Funkhouser, C. P.	1273	Gurney, D.	382	Hilbert, S.	1196	▶ Jennings, D. W.	1649
*▶ Funk-Neubauer, D.	424	Gustafson, P.	758	Hill, D. R.	1173	Jernigan, R. W.	979
*◀ Fuoss, R. W.	1520	▶ Gutierrez, J. B.	776	* Hill, R. O.	190	*▶ Jin, Y.	1609
Gaff, H. D.	1139	▶ Haataja, S. P.	1638	Hillman, R. A.	495	◊ Jitomirskaya, S. Y.	1002
* Gagliardi, D. J.	1080	* Hagedorn, T. R.	460	Hillyard, C.	1492	*▶ Johns, J. A.	1096
▶ Gal, C. G.	513	Hagedorn, T.	1265	* Himonas, A. A.	409	* Johnson, A. S.	848
▶ Gal, N. J.	1645	* Hager, A. W.	234	Hindman, N.	925	Johnson, A.	347
Galstyan, A.	711	Haghighi, A. M.	263	Hintermueller, M.	618	Johnson, G. W.	1266
▶ Gantner, R. S.	261	* Haglund, J.	1371	Hinton, J. R.	908	Johnson, J. A.	983
* Gao, D. Y.	1034	* Haile, D. E.	147	* Hironaka, E.	210	Johnson, L.	570
* Gao, S.	1294	Hale, E. T.	1226	* Hirsch, M. W.	1573	Johnson, R. L.	595
* Garg, V. K.	694	▶ Hale, J. T.	1440	Hirst, J. L.	1324	Johnson, W. P.	486
* Garibaldi, S.	214	Haley, J. M.	1339	Hirst, J. L.	1456	Johnston, W. W.	1460
Garner, M. L.	774	* Halfpap, J.	260	* van Hoeij, M.	1290	* Jones, G. D.	1580
Garner, M. L.	1189	Hall, J. A.	1174	Hoensch, U. A.	542	Jones, M. A.	1335
* Garrity, T.	469	* Hall, L. M.	446	▶ Hofacker, E. B.	112	Jones, M. A.	1441
*◀ Gastenveld, J. D.	1522	▶ Hall, M. D.	1207	▶ Hofacker, E. B.	590	Jones, M. O.	268
Gaze, E. C.	1164	* Hallgrimsdottir, I. B.	684	* Hoffacker, J.	1584	* Jones, W. B.	691
* Geer, N.	1615	Hamdan, M. F.	1459	* Hoffman, M. E.	421	* Jorgensen, P. E.	1555
* Gelca, R.	1087	Hameed, M. I.	507	Hofmann, R. S.	172	Josephy, R. M.	909
Geluk, J. L.	267	Hamid, M. A.	363	Hofmann, R. S.	566	Judson, T. W.	305
* Geroldinger, A.	48	* Hamilton, T. D.	233	Hoim, T.	1636	* Jules, S.	1037
Gethner, E.	373	Hammack, R. H.	535	Holden, J.	311	* Junge, M.	40
*▶ Getz, J. R.	855	* Hampton, M.	1362	Holliday, J. E.	732	* Kaftal, V.	1557
▶ Ghandehari, M.	1130	Han, A. Y.	981	Holliday, S. H.	134	▶ Kaleem, F.	160
*▶ Ghenciu, E. A.	689	* Han, D.	1561	*◀ Holm, M. T.	1016	Kalemaris, A. M.	562
Ghenciu, I.	1634	* Han, I.	213	Holmes, C. S.	944	Kalemaris, A. M.	954
* Ghomi, M.	437	*▶ Han, Z.	1098	Holt, J.	1251	* Kaltofen, E.	1363
Gieger, J. L.	1495	Handron, D. G.	1111	* Hong, J.	1626	* Kalton, N.	254
* Gilliam, D. S.	837	* Hansen, S. K.	1084	Hontz, J.	1232	◀ Kane, D. M.	1336
Gillman, R.	1171	Hanson, A. C.	960	Horn, J. M.	958	Kane, J. M.	990
Giraldo, J. H.	743	Harada, M.	1487	▶ Horton, M. D.	276	Kaneda, M.	1470
Giraldo, J. H.	1239	Hardin, C. S.	1407	* Hosten, S.	69	Kang, J.-H.	540
Girgensohn, R.	13	* Hare, K. G.	209	* Hosten, S.	875	Kang, K.	323
▶ Giske, J. E.	1413	Harker, H. M.	497	* Houston, E.	868	* Kania-Bartoszyńska, J.	1081
* Givant, S. R.	478	*▶ Harlim, J.	1065	* Hovhannisyan, G.	223	*◀ Kaplan, N.	1018
*◀ Gjorgjieva, J. V.	1524	Harris, J. T.	744	Howard, P. B.	510	Kappe, L.-C.	926
* Glaz, S.	228	Harris, J. T.	1653	* Howard, R.	861	* Kapranov, M.	176
* Gleason, A. M.	188	Harris, W. R.	749	* Howe, E. W.	1386	Karaali, G.	1488
Glen, A. G.	334	Harshbarger, R.	933	▶ Hrynkiv, V.	397	* Karanikas, C.	1558
Gochenaur, D. L.	351	* Hart, R.	1020	Hu, C.	710	Karimpour, R. G.	893
Godbole, A. P.	1480	Hartke, S. G.	368	* HU, P.-C.	57	Karlovich, A. Y.	1477
Goff, C. D.	1497	Hartzler, R.	1270	Huang, C.-S.	127	Kaskosz, B.	547
Gold, B.	93	Härtzler, R.	1449	Huber, M.	336	▶ Kasturiratna, D.	85
* Colec, J. S.	1587	Hastings, N. B.	1253	Huckaby, D. A.	1230	* Katz, V. J.	1550
* Golubitsky, M.	196	Havlak, K. J.	320	Huibregtse, M. E.	700	* Kauffman, L. H.	1611
* Golubitsky, M.	1070	Hayes, L.	765	◀ Huizenga, J. W.	139	Kaur, M.	703
Gomez, C.	592	* Hayes, S. A.	1397	Hull, T. C.	721	Kaur, M.	1243
* Gonzalez, E.	1091	* Hayward, J. L.	1539	Humphrey, P. B.	972	Kay, M. I.	953
* Goodman, R. E.	337	▶ Head, J. D.	1240	Humphreys, P.	1340	* Kaymakalan, B.	218
* Goodstein, J. R.	1551	Heinkenschloss, M.	811	* Huneke, C.	253	* Kechris, A. S.	418
Gorgievski, N.	980	* Helminck, G. F.	1075	* Hunziker, M.	1622	*◀ Keel, C. E.	1523
▶ Gorton, C. E.	1457	Henderson, J. R.	97	* Hurder, S.	1575	*◀ Keinath, B. W.	1008
* Gottlieb, E. I.	474	* Henderson, J.	1351	Hurlbert, G. H.	1425	* Keller, R. S.	636
* Grabiner, J.	1546	Hendrix, T. M.	1233	Hydorn, D. L.	1479	Kelly, A. R.	578
▶ Gracia-Saz, A.	1418	Henle, J. M.	1125	* Iberkleid, W.	239	Kelly, B. P.	1458
▶ Gray, M. J.	1153	* Henriksen, M.	54	* Insall, M.	480	Kelm, K. B.	821
▶ Gray, S. B.	1269	* Hensley, D.	470	Ion, P.	179	Kennedy, J.	533
* Greechie, R. J.	481	◊ Henson, C.	993	Ion, P.	997	* Kent, C. M.	1396
◊ Green, B.	1506	* Henson, S. M.	453	* Ishimaru, A.	1053	* Kent, D.	1548
Green, K.	335	Herbert, B.	405	Ishiu, T.	1680	* Kerler, T.	1090
Green, L. B.	1217	▶ Hering, M.	1509	* Ismail, M. E.	687	Kerns, G. J.	91
Greeno, C. L.	937	Herman, E. P.	1229	Jablan, S. V.	1328	* Kessler, L.	1390
Greeno, C. L.	1316	Hern, T. A.	1200	* Jacob, B.	217	Khatiasvili, N.	982
Greeno, C. L.	1454	Hern, T.	974	* Jaggard, A. D.	534	Khatiasvili, N.	1469
Greenwald, S. J.	1193	* Hernández-Lerma, O.	1356	▶ Jakob, T.	1514	* Kholodnyi, V. A.	1059
* Greenwood, P. E.	1590	Herriott, S. R.	940	* James, J. A.	1423	Khosravani, A. N.	1118
Griffin, J. C.	165	Herriott, S. R.	1147	* Jang, S. R.	456	* Kidwell, P. A.	1552
* Griffith, P. A.	63	Hersberger, J. R.	175	Jardine, D.	551	Kilic-Bahi, S.	1210
Grigorieva, E.	951	* Hersh, P.	1374	Jaroma, J. H.	291	Killpatrick, K. S.	727

Presenters of Papers – San Antonio, TX

* Kilpatrick, J.	186	Langton, S. G.	591	Lodder, J.	557	Mays, M.	1277
Kimball, R. L.	564	Lanier, S. M.	986	* Loehr, N. A.	853	Mbodje, B.	708
King, J. P.	1309	▶ Lankham, I. P.	729	Loewe, B.	1325	McAllister, A. M.	748
Kinsey, C.	775	Lanz, A.	154	Lomen, D. O.	24	McBurney, S. A.	1330
▶ Klein, A. M.	1235	* Larson, S. L.	55	* Long, L.	1377	* McCallum, W.	634
Klein, B. G.	109	◊ Laskowski, M. C.	1504	* Long, P.	1370	McCarthy, M. L.	1422
* Klein, D. J.	477	* Lasser, R.	1395	Lopez, K. D.	329	▶ McCormack, R. K.	1589
Klima, V. W.	553	Laubenbacher, R.	1	Lorch, J.	1280	McCoy, P.	516
Knapp, M. P.	297	Laurie, C.	1465	* Lorentzen, L.	467	*◀ McCready, K. B.	1532
* Knop, F.	1623	Lavery, R.	1436	* Lorenz, M. W.	145	McCreary, P. R.	945
* Knox, M. L.	236	* Lawrence, B. A.	445	Loth, P.	924	McCullough, D. A.	1227
*▶ Knudsen, T. L.	648	Lay, S. R.	956	Lott, D. A.	1135	McDevitt, T.	1656
▶ Kobiela, M. A.	1666	▶ Le, L. H.	1661	* Lott, J. W.	189	• McDuff, D.	814
▶ Kobylus, K. E.	1152	* Le, T. T.	1082	* Lou, S.	408	McGee, D. L.	1238
Kocak, H.	560	Lebow, A.	1180	◊ Louveau, A.	1289	McGee, D.	1275
Kocak, H.	1272	Ledder, G.	25	◊ Lovász, L.	177	McGivney-Burrelle, J. M.	1222
Koch, A.	493	Ledder, G.	573	Lu, Q.	113	* McGovern, W. W.	238
Koch, G. A.	1655	* Ledet, A.	666	*▶ Lu, Y.	1597	McGuire, L.	342
▶ Koch, G. S.	524	▶ Ledoan, A. H.	167	* Lucas, T. G.	232	McKenzie, J. D.	1214
Kochanowski, P.	345	*▶ Lee, C. R.	1093	Luecking, D. H.	158	* McKenzie, R. N.	695
* Kocic, V. L.	1537	*▶ Lee, H. C.	1102	Luecking, S. J.	768	▶ McKinnie, K. L.	215
* Koldobsky, A.	862	Lee, H.	360	* van Luijk, R. M.	1385	* McLaughlin, J.	889
Kombe, I.	1115	* Lee, J. R.	76	Luke, D.	12	McLean, T. B.	896
* Kon, R.	451	*◀ Lee, M.	1525	Lyons, D. W.	1420	McMillen, S.	569
* Kondagunta, S.	1595	*▶ Lee, T.-L.	1364	* Ma, D.	1585	McMurdy, K.	170
* Kong, L.	1581	* Lee, W.-s.	1365	* Ma, Y.	245	McShea, B. J.	1192
* Kong, Q.	1349	LeGrand, D.	319	Mabrouk, S. L.	325	Meade, D. B.	544
Kopperman, R.	903	* Leininger, C. J.	211	Mabrouk, S. L.	550	Meade, D. B.	642
Korchagin, A. B.	1674	Leise, T.	915	Maceli, J. C.	1443	* Meakin, J. C.	27
* Korhonen, R. J.	243	Leite, M. C.	1148	Maciel, J.	932	* Meakin, J. C.	697
*◀ Kornell, A.	1007	▶ Leiterman, T.	1518	MacKichan, B.	181	* Meckes, M. W.	439
Kortsarts, Y.	313	* LeMasurier, M.	202	MacKichan, B.	640	* Medhin, N. G.	1061
* Korzeniowski, A.	1060	* Lemire, N. M.	1621	MacLean, M. S.	1183	Medvedev, G. S.	625
*▶ Koshkin, S. V.	1389	Lenhart, S. M.	11	* Madden, J. J.	676	Meel, D. E.	543
Koshy, T.	317	Lenhart, S.	375	Madden, K.	346	* Megginson, R. E.	633
*▶ Koskodan, R. C.	1593	• Lenstra Jr., H. W.	183	Madison, B. L.	1169	◦ Megginson, R. E.	404
* Kouri, D. J.	33	• Lenstra Jr., H. W.	646	Magidin, A.	923	▶ Mei, T.	1302
Kowalski, R. T.	796	• Lenstra Jr., H. W.	1003	Magnus, T. D.	340	* Meiler, M.	221
Krahn, G.	1254	* Leok, M.	1569	* Mahajan, S.	1375	* Mellor, B.	1618
Krakowski, B.	307	Leonhardi, S. D.	574	Makky, S. M.	720	Melman, A.	400
* Krause, U.	50	Levermore, C. D.	379	Malkevitch, J.	288	Melton, T. G.	508
* Krause, U.	455	Levin, J. M.	23	Manderscheid, D. C.	596	* Melville, D. J.	649
Krlinik, A.	274	Levy, R.	1489	* Manderscheid, D. C.	26	Mendes, P.	4
Krishnan, A. R.	1411	* Lewis, A. D.	1566	* Maney, J. L.	229	▶ Menéndez, J. M.	399
* Krishnaprasad, P. S.	844	Lewis, T.	624	▶ Manna, D. V.	1412	* Mermin, J. A.	66
Krowne, A.	182	* Lewis, W. J.	630	Marathe, M.	10	* Meyer, K.	476
Krowne, A.	643	* Leykin, A.	1596	Marchand, R. J.	352	* Meyer, W.	1554
Kruczek, K.	332	* Li, B.	62	Marikyan, G.	1683	* Meyers, L. A.	1067
*◀ Krummel, B.	1530	* Li, F.	1045	* Mark, T. E.	1392	Mickens, R. E.	941
*◀ Kudryavtseva, K.	1521	* Li, J.	454	*▶ Maroun, M.	1583	* Mickens, R. E.	884
Kuegler, P.	810	▶ Li, J.	1131	Marshall, D.	957	▶ Mihai, D.	701
Kuhlmann, G. D.	326	*▶ Li, S.	1044	Marshall, S. H.	755	▶ Mihai, D.	1121
Kuhlmann, G.	934	*◀ Li, Y.	1005	* Martcheva, M.	1343	▶ Mihaila, I.	1204
* Kulenovic, M. R.	450	▶ Li, Y.	487	* Martensen, B. F.	203	* Milgram, R. J.	185
* Kulenovic, M. R.	457	* Lieblich, M.	144	Martin, C. D.	1688	Miller, A. J.	349
Kulosman, H.	482	Lih, K.-W.	140	▶ Martin, D. R.	401	Miller, A. J.	1482
*▶ Kummini, M.	248	▶ Lim, A. P.	800	* Martin, E. J.	692	Miller, A.	825
* Kuperberg, W.	659	Lin, C.-Y.	1663	Martin, L. A.	565	Miller, D. J.	1647
Kurepa, A.	571	Lin, C.	1501	▶ Martinez, C. C.	1409	Miller, M. J.	159
Lacke, C. J.	968	* Lin, X.-S.	1616	* Martinez, J.	56	* Miller, P. D.	1567
Lacke, C. J.	1211	* Lind, D.	204	Martinez-Avenidaño, R. A.	1641	◊ Miller, R.	1491
* Ladas, G.	887	▶ Lindaman, B. J.	737	Mascioni, V.	141	Mills, D. D.	304
* Ladde, G. S.	1354	Linderman, B.	605	*▶ Mason, S. K.	1372	Mills, M. A.	763
* Lafferty, J.	1368	Lindgren, W.	773	Mast, M. B.	1168	Miltenberger, P.	751
* Lafuente-Rodriguez, R. H.	675	*▶ Lipshitz, R.	1391	Matsumoto, S.	1161	Minassian, D. P.	271
Laison, J. D.	367	* Liu, J.	1042	◀ Matteson, A. L.	1134	Miner, R.	996
* Lalin, M. N.	658	Liu, W.	512	Matthews, B.	1000	Minton, R.	971
Lambers, J. V.	713	Liu, Y.	1654	Matthews, B.	1505	Minton, R.	1438
Lamberson, R.	387	Livshits, M.	705	* Matthews, G. L.	1295	* Miroslav, K.	833
▶ Lancaster, S. M.	795	Livshits, M.	1203	Mattman, T. W.	333	* Misaghian, M.	931
Lane, D. M.	1267	Lo, M.-L.	1314	Mattman, T.	1252	Misra, J. C.	911
* Lang, U.	77	Loch, S.	1320	* Mauldin, R. D.	41	▶ Mitchell, R. C.	496
Langley, L. J.	280	Lock, P. F.	1177	* May, J. P.	1598	▶ Mitra, A.	895

Mittag, K. C.	1179	Oehrlein, C. D.	1442	* Polini, C.	874	* Roeger, L.-I. W.	1544
▶ M.K., S.	1157	* Oh, Y.-G.	1100	* Pollatsek, H.	631	Rogers, E. C.	561
Moazzam, M.	907	Ohashi, R.	1430	* Pomerance, C.	881	▶ Rogers, J. W.	444
▶ Mohammed-Awel, J. S.	912	▶ O'Keefe, A. B.	537	* Ponomarenko, V.	51	Rogers, M.	364
Molitierno, J. J.	136	* Olafsson, G.	1556	▶ Pope, S. R.	1599	Roh, K.	1319
Moll, V. H.	6	* Olberding, B.	866	Popovici, C.	403	Romero, J. R.	1472
▶ Money, J. H.	499	O'Leary, M.	1175	* Popovici, I.	224	▶ Rong, F.	823
Monk, P.	812	Olinick, M.	386	* Pör, A.	442	* Rosen, M. I.	858
* Montejano, L.	660	Olsen, C.	20	Porter, A.	707	Rosenberg, S.	310
Montgomery, A.	1318	▶ Olson, J. S.	1110	Porter, M. A.	609	* Rosendal, C.	419
Montgomery, K. A.	1140	* Ono, K.	428	Porter, M. A.	756	Rosenhouse, J.	723
▶ Montgomery, M. W.	488	* Orellana, R. C.	423	* Porter, M. A.	199	Rosenstein, J. G.	735
Monticino, M. G.	269	▶ Ortega, O. Y.	948	Porter, M. K.	309	* Rosenstein, J. G.	192
Moore, K. S.	789	* Osborne, J. M.	1571	Potocka, K.	1478	Rosoff, J. A.	1202
Moore, K. S.	1338	* Osler, T. J.	473	◀ Potter, T. J.	1416	* Rossi, J. F.	59
Moore, L.	180	Otto, P. T.	266	▶ Powell, J. S.	527	Rossman, A. J.	1220
Moore, L.	995	▶ Ouellette, K. R.	1113	Prado, L. M.	1114	Rossman, A. J.	1250
Moore, L.	1287	Pachter, L.	2	Presser, K. J.	100	Rotstein, H. G.	120
* Moore, M. E.	1549	* Pachter, L.	686	Presser, K. J.	155	Rubin, J. E.	119
Moran, J. F.	1170	* Packer, J. A.	650	Price, K. L.	485	Rubin, J. E.	585
* Morandi, P.	146	* Padhi, S.	225	Price, L. E.	105	Rublein, G.	946
Moretti, C. P.	545	* Pahlevani, F.	1048	* Pritsker, I. E.	207	* Rudd, M. B.	1353
Morgan, F.	1659	Pajooohesh, H.	901	Prophet, M. P.	1637	* Rudin, C.	1366
▶ Morge, S. P.	1496	▶ Palenstijn, W.	879	* Przytycki, J. H.	1613	Rulkov, N. F.	628
Morris, J. R.	525	Pangborn, G.	372	◀ Purdom, J.	292	Rundell, W.	808
Morrow, J.	938	* Papanicolaou, G. C.	1049	▶ Pylyavskyy, P.	850	* Ruskai, M. B.	34
* Morse, J.	851	▶ Papez, P.	441	▶ Qazaqzeh, K. M.	1088	* ◀ Russell, A.	1010
* Moseley, C. G.	1464	Pardhanani, A. L.	1218	Qazi, M. A.	616	* Ryan, J.	240
* Moseley, C. G.	1570	* Park, M.	869	* Qiao, Z.	414	* Ryan, N. C.	47
Moskol, A.	1264	Park, T.	523	Quinney, D. A.	831	Rybolt, B.	1662
Muir, C.	17	* Parker, B. D.	1094	Radunskaya, A.	785	* Ryzhik, L.	1050
Muir, Jr., J. R.	156	Parker, D. B.	528	* Raffoul, Y. N.	222	* Sabra, K. G.	1606
Muir, S.	161	Parker, G. E.	759	* Rahman, M. M.	1146	* Sacker, R. J.	1536
Mukherjee, A.	1151	Parker, M. R.	936	▶ Rahmati, H.	64	Saciolo, M. P.	1326
Mulcahy, C.	603	Parker, M.	966	Rainbolt, J.	1247	Sadovski, A. L.	1434
Mulcahy, C.	1186	Parsley, J.	1120	Rajagopalan, M.	904	▶ Saenz, R. A.	919
Mulekar, M. S.	1212	* Parwani, K.	1572	* Raman, P.	143	Salmassi, M.	316
▶ Mullikin, C. A.	1117	Pascali, D. D.	1476	▶ Rand, B.	1574	* Saltman, D. J.	670
Mummert, C.	1678	Patel, R.	1331	* Randrianantoanina, B.	259	* Sambandham, M.	1063
Munakata, M.	955	Patel, R.	1404	* Randrianarivony, N. L.	74	Santosa, F.	378
▶ Murdock, J. A.	715	* Paulsen, V. I.	1565	* Ranga, A. S.	688	Santosa, F.	809
Murphy, T. J.	777	Payne, D. E.	88	* Rankin, S. M.	30	Sarhangi, R.	1332
Murphy, T. J.	1219	Peacock, R. A.	365	* Raphael, R.	672	Sastri, C. C.	272
Mustafaev, Z.	361	▶ Peacock, S. B.	1433	* Rasmussen, C.	857	* Sauer, T. D.	1394
Muthuvel, K.	1417	▶ Pearse, E. P.	1129	Ratheal, J. D.	702	* Savageau, M. A.	406
* Nagel, U.	65	Peercy, B. E.	920	* Ratiu, T. S.	846	Schaal, D.	722
Najafi, M.	505	Pelloni, B.	803	Rawdon, E.	1402	* Schacher, M. M.	665
Namazi, J.	1310	Peltier, C. F.	151	◀ Rayburn, L. A.	1669	◀ Schallot, P.	611
* Naor, A.	256	Pence, B. J.	1221	Raychaudhuri, D.	22	Schaubroeck, B.	1462
Narayan, D. A.	289	Peng, C.	290	Raychaudhuri, D.	959	Schechter, E.	817
◊ Neeman, I.	1672	Pengelley, D. J.	556	Reed, M.	778	* Schechtman, G.	75
Nelsen, R. B.	82	* Pengelley, D. J.	1545	* Reid, G.	1600	* Schenck, H.	873
Nelson, S.	588	* Pengelley, D. J.	1630	* Reid, W. M.	690	* Scherzer, O.	1559
▶ Nenciu, A.	922	Pengelley, D.	1262	Reynolds, J. J.	613	Schielack, J. F.	1665
* Neuberger, J. M.	1035	Peskoff, F.	1455	Reynolds, J. J.	977	Schielack, V.	1494
* Neuberger, J. W.	1030	▶ Petersen, T. K.	422	Rhoades, B. E.	1633	Schild, M.	1444
Neumann, G.	782	Peterson, A. C.	1673	* Rhodes, J. A.	459	Schild, M.	1667
▶ Newton, B.	927	* Petsche, C.	42	* Riccomagno, E.	681	Schiller, B.	1228
■ N'Guerekata, G. M.	1519	Pfaff, T.	799	* Richardson, T. S.	466	Schlatter, M.	384
* Nguyen, T.	712	Pierce, A. E.	577	Richman, S. C.	117	Schlicker, S.	581
* Nicol, M.	197	Pierr-Galvao, M.	976	* Richter, O. K.	434	* Schlumprecht, T.	417
▶ Niknejad, A.	1142	* Pinsonnault, M.	1097	* Rinaldo, A.	463	Schmidt, K.	781
* Nikolova, M.	1560	Pinter, M.	1493	Ring, W.	620	* Schmidt, L. J.	440
▶ Ning, W.	80	▶ Piotrowski, A.	679	Risley, J.	641	* Schneider, R.	654
Nita, B. G.	518	▶ Pirnot, J. B.	1511	Risley, J.	999	* Schreiber, S.	452
Nogin, M. S.	330	▶ Pivarski, M. A.	1112	Ritter, L. R.	1137	Schrock, C. S.	174
Nolan, D.	786	Plofker, K. L.	829	Roberts, C.	388	* Schroeder, B. S.	1108
◀ Nolte, M. P.	1408	* Plofker, K.	647	Robeva, R. S.	790	Schroeder, W. C.	1481
Nurkhaidarov, E. S.	1686	* Poet, J. L.	615	Robeva, R.	1278	Schueller, A. W.	338
* Oaks, J. A.	194	* Poetzsche, C.	1398	* Robinson, S.	1579	* Schuermann, A.	661
O'Connor, C. S.	1450	Pogodzinski, M.	1446	Roby, T.	102	Schulze-Hewett, C. M.	584
* Odell, E.	415	Poimenidou, E.	580	* Rodriguez Villegas, F.	435	Schulze-Hewett, C. M.	1205
		Polaski, T. W.	1439	* Rodriguez Villegas, F.	657	* Schurz, H.	1586

Presenters of Papers - San Antonio, TX

* Schwarz, G.	1071	* Sommese, A. J.	1601	*▶ Tengan, E.	669	*▶ Wang, K.	1040
* Schwarz, G.	1624	* Sondow, J.	300	* Terhune, D.	1379	Wang, L.	1475
Scott, J.	1288	*▶ Song, Q.	1066	Terman, D.	123	* Wang, S.	834
Scott, S. E.	1689	* Sons, L. R.	242	Terng, C.-L.	788	* Wang, Y.	1564
*◀ Seacrest, T.	1528	Sorto, A.	586	Terras, A. A.	296	▶ Wang, Y.	89
Searcy, M. E.	1185	* Soundararajan, K.	1068	Teschke, G.	622	Ward, B. B.	381
* Sedaghat, H.	885	* Speegle, D.	1562	Theoret, J. M.	153	Warne, P. G.	1308
▶ Seetharaman, H.	716	Spitznagel, C.	339	▶ Thibodeaux, J. J.	921	Warren, A. H.	171
Segalla, A.	1268	*▶ Staic, M. D.	1620	Thompson, L. G.	1236	Waters, G.	520
* Seif, S. W.	1101	Stallings, L.	383	Thrift, P.	1410	Watson, V. R.	385
* Selgrade, J. F.	883	* Stancu, A.	438	* Tian, J. P.	71	Wattenberg, F.	832
*▶ Sellke, K.	1085	* Stanescu, D.	1358	* Tian, J. P.	1345	Webber, R. P.	1198
*▶ Sena-Dias, R.	1095	Stanish, K. B.	21	* Tian, J. P.	1619	* Weber, E.	1563
▶ Sendova, T.	1507	Stanish, K. B.	490	Timmons, T.	554	Weedermann, M.	1156
Senk, S. L.	18	Stanish, K. B.	753	*▶ Tingey, T.	1006	* Wehlau, D. L.	1072
* Serfati, M. P.	1109	* Stanley, R. P.	852	Tirado, B. J.	393	* Weil, W.	860
* Seroussi, G.	1296	◊ Starchenko, S.	1297	*▶ Tirrell, J. O.	1015	▶ Weng, P.	509
*◀ Sesum, V. S.	1529	* Stark, H. M.	1291	* Tisdell, C. C.	219	* Werner, E.	436
* Sethuraman, B. A.	216	Starr, N.	1199	To, H. T.	1660	West, R.	589
* Sezer, M.	1627	Steiner, J.	1690	* Todorovic, S.	420	* Weyman, J. M.	876
Sgallari, F.	621	▶ Sternkoski, L.	166	Tong, S.	1234	Whalen, T. C.	536
Shafii-Mousavi, M.	794	▶ Sternberg, P. M.	133	* Trench, W. F.	1576	White, J. A.	19
Shafii-Mousavi, M.	978	▶ Steurer, A. A.	293	▶ Treneur, S.	1508	* Whiteley, W. J.	664
Shah, N.	1283	* Stevenhagen, P.	877	*▶ Treneur, S.	433	Whitesides, S.	366
Shahin, M.	784	Stevens, T. C.	1431	Tsai, R.	129	Whittinghill, D. C.	1213
▶ Shallue, A. R.	303	Stevenson, H.	331	Tsai, R.	619	Whittington, K.	894
* Shapiro, J.	870	* Stewart, C. L.	46	Tseng, S.	515	Whittle, A. J.	1136
▶ Sharif, S.	698	Stickles, Jr., J. A.	135	* Tsogka, C.	1054	* Wiegand, R.	227
* Sharifi, R. T.	1387	▶ Stickles, P. R.	760	Tsutsui, H.	1484	* Wiegand, S. M.	867
Shea-Brown, E. T.	627	Stigler, B.	9	Turner, D. W.	967	Wightman, J. L.	517
* Shen, X.	842	* Stillman, M.	67	Turski, J.	1311	*▶ Wilkerson, D.	1347
* Sheng, Q.	1348	* Stoltzfus, N. W.	1089	▶ Tweddle, J. C.	395	▶ Williams, B.	283
Shepherd, M. D.	1315	Stolz, R. C.	918	Ufferman, E.	1323	Williams, G. B.	308
Shiflet, A. B.	374	Stout, R. H.	114	▶ Usmanov, S. M.	1631	* Williams, G. B.	472
Shilnikov, A.	629	Straley, H. W.	1447	* Usvyatsov, A.	37	* Williams, S. A.	1516
▶ Shimanovich, V. A.	1143	Strong, D. M.	970	* Vajravelu, K.	1062	* Williams, S. G.	655
* Shin, K. C.	241	Stroyan, K. D.	1299	Vakalis, I.	947	*▶ Williamson, M.	1531
*▶ Shott, M. J.	111	▶ Stuebner, M.	391	* Valeriote, M.	1103	Willis, D. G.	98
* Shvartsman, P.	255	Stueckle, S.	96	Vallin, R. W.	582	Wills, M. D.	1642
▶ Schwartz, L.	1635	Sturdivant, R. X.	747	* Van Brummelen, G. R.	193	Wilson, C. J.	122
* Sidman, J. S.	464	Su, C.	492	* van den Driessche, P.	1342	Wilson, J. H.	1201
Siegel, M. H.	567	* Su, F. E.	635	Van Dyke, F.	568	Winicki-Landman, G.	344
Siegel, M. H.	764	◦ Su, F. E.	184	▶ Van Vliet, D. R.	1421	Winter, D. J.	783
Siegel, M. H.	1215	Suceava, B. D.	552	* Varlamov, V. V.	836	Wittwer, J.	1301
Siegrist, K. T.	264	* Sudan, M.	1069	Varvak, A.	726	* Wong, P.-M.	244
* Šikić, H.	36	* Sullivant, S.	68	Vasilevska, V.	820	Wong, P.	604
* Sikora, A. S.	1083	Summers, R. D.	988	* Vatsala, A. S.	1064	Wood, J.	104
de Silva, R. M.	152	* Sun, Q.	35	* Vatter, V.	425	▶ Wood, W.	1124
* Silver, D. S.	656	Sun, S.	389	Veenstra, T. B.	314	Woodburn, C. J.	115
Silverberg, J. S.	905	Sundbye, L. E.	318	▶ Vega, O. E.	1126	Woods, K. M.	539
Simons, R. A.	1453	* Sunik, Z.	479	* Velez, W. Y.	29	* Woods, R. G.	673
Simoson, A. J.	1437	Switkes, J.	752	◀ Venkateswaran, V.	138	Worth, F.	985
* Sinclair, C. D.	205	Switkes, J.	964	Verma, R. U.	1160	Wu, H. J.	898
▶ Sindi, S. S.	1513	Sword, S.	150	Villalobos, M. C.	963	▶ Wu, L.	1132
Sinn, R.	343	Sykes, J. D.	583	Vincent, K. M.	1165	*▶ Wu, W.	1602
Sivasundaram, S.	1150	*▶ Szarka, J.	1533	* Vitulli, M. A.	871	Wu, Y.	494
◀ Sivek, S. W.	287	Szymanski, A.	899	* Voloch, J. F.	859	▶ Wu, Y.	822
Skoug, D. L.	265	▶ Tadesse, A.	1643	* Wadsworth, A. R.	212	Wynne, B.	1687
* Slavkovic, A. B.	461	Taeibi-Rahni, M.	504	▶ Wagner, B. C.	526	* Wynne, B.	671
▶ Slone, M.	530	Takata, K.	725	Wagner, W. M.	107	Xie, X.	511
* de Smit, B.	878	Talitskaya, A.	1691	Wainwright, B. A.	1206	▶ Xie, Z.	1158
*▶ Smith, B. R.	1292	▶ Tang, H.	273	Walker, J. D.	390	* Xu, T.	412
Smith, J. T.	321	Tapia, R. A.	598	Walker, J. L.	1300	* Xu, Y. S.	1607
Smith, R. N.	282	Tariq, Q. M.	1307	Walker, J.	594	* Xu, Y.	1021
* Snow, J. W.	693	Tasopoulos, A. A.	498	Wallace, J.	1246	▶ Xue, F.	1159
Snyder, D. F.	575	* Tavernini, L.	1058	Wallace, M. L.	734	Yackel, C.	780
So, S. S.	1127	◀ Taylor, G. W.	772	Walls, G. L.	362	Yagdjian, K.	714
So, W.	610	▶ Taylor, J. R.	484	Walsh, D. P.	607	Yahdi, M.	1651
Soiffer, N.	178	Taylor, P. T.	1303	* Walter, G. G.	841	* Yakubu, A.-A.	1538
Soiffer, N.	638	* Tchernev, A. B.	250	Walters, T. J.	1241	* Yang, B.	1578
* Soleccki, S.	39	Tefera, A.	731	Walters, T.	1255	* Yang, C. C.	58
* Solna, K.	1052	Teixeira, K.	1448	* Walton, J. R.	1033	Yao, H.	724
* Solymosi, J.	663	Teixeira, P.	1187	* Wang, H.	1582	*▶ Yaskin, V.	863

Presenters

*► Yaskina, M.	864
Yasskin, P. B.	642
Yasskin, P. B.	1664
Yayenie, O.	491
* Ye, Z. J.	678
York, D. C.	1181
* Yoshida, R.	462
* Yoshimura, H.	198
You, Y.	1145
Yousef, M.	86
*► Yu, J.	251
*► Yu, J.	685
► Yuen, C. O.	1515
* Yuzvinsky, S.	872
Zachariah, T. M.	324
Zachariah, T. M.	1166
Zaffran, D. J.	157
* Zeeman, M.	1540
* Zeng, Z.	1603
* Zenkov, D. V.	1568
Zerr, R. J.	1231
Zerr, R. J.	1644
► Zhang, C.	1154
* Zhang, G.	413
Zhang, P.	531
*► Zhao, A.	1604
* Zhao, H.	1055
* Zhong, J. K.	1086
► Zhu, Y.	1334
Zides, S. B.	1190
Zimmer, G.	1141
* Zinkevich, M. A.	1367
* Zobin, N.	258
Zoch, A. S.	897
* Zvavitch, A.	865
► Zwicknagl, S.	489

Program of the Sessions

San Antonio, Texas, January 12-15, 2006

Tuesday, January 10

AMS Short Course on Modeling and Simulation of Biological Networks, I

8:00 AM – 5:00 PM

Organizer: **Reinhard Laubenbacher**, Virginia Bioinformatics Institute

- 8:00AM Registration.
- 9:00AM *Introduction to the Short Course topics.*
(1) **Reinhard Laubenbacher**, Virginia Polytechnic Inst & State Univ
- 9:30AM *Reconstructing ancestral genomes.*
(2) **Lior Pachter**, University of California Berkeley
- 10:45AM Break.
- 11:15AM *Phylogenetics.*
(3) **Elizabeth Allman**, University of Southern Maine
- 2:00PM *Modeling and simulation of biochemical networks.*
(4) **Pedro Mendes**, Virginia Bioinformatics Institute
- 3:15PM Break.
- 3:30PM Panel Discussion: *The new face of computational biology.*

MAA Short Course: Experimental Mathematics in Action, I

9:00 AM – 5:00 PM

Organizer: **Jonathan M. Borwein**, Dalhousie University

- 8:00AM Registration.
- 9:00AM *What is experimental mathematics?*
(5) **Jonathan M. Borwein**, Dalhousie University
- 10:15AM Break.
- 10:45AM *Case Study I: Integrals and series using Mathematica.*
(6) **Victor H. Moll**, Tulane University
- 2:00PM *Algorithms for experimental mathematics, I.*
(7) **David H. Bailey**, Lawrence Berkeley National Laboratory
- 3:15PM Break.
- 3:45PM *Case Study II: Discrete math and number theory in Maple and C++.*
(8) **Neil J. Calkin**, Clemson University

The time limit for each AMS contributed paper in the sessions is ten minutes. The time limit for each MAA contributed paper varies. In the Special Sessions the time limit varies from session to session and within sessions. To maintain the schedule, time limits will be strictly enforced. For papers with more than one author, an asterisk follows the name of the author who plans to present the paper at the meeting.

Wednesday, January 11

MAA Board of Governors

8:00 AM – 5:00 PM

AMS Short Course on Modeling and Simulation of Biological Networks, II

9:00 AM – 5:00 PM

Organizer: **Reinhard Laubenbacher**, Virginia Bioinformatics Institute

- 9:00AM *A computational algebra approach to systems biology.*
(9) **Brandilyn Stigler**, Virginia Polytechnic Institute & State Univ
- 10:15AM Break.
- 10:45AM *Interaction-based computing approach to modeling and simulations of large biological and socio-technical systems.*
(10) **Madhav Marathe**, Virginia Bioinformatics Institute
- 2:00PM *Optimal control of population and disease models.*
(11) **Suzanne M. Lenhart**, University of Tennessee
- 3:15PM Break.
- 3:30PM Panel Discussion: *Opportunities in computational biology.*

MAA Short Course: Experimental Mathematics in Action, II

9:00 AM – 5:00 PM

Organizer: **Jonathan M. Borwein**, Dalhousie University

- 9:00AM *Case Study III: Inverse scattering on Matlab.*
(12) **D. Russell Luke**, University of Delaware
- 10:15AM Break.
- 10:45AM *Case Study IV: Analysis and probability on the computer.*
(13) **Roland Girgensohn**, Bundeswehr Medical Office
- 2:00PM *Algorithms for experimental mathematics, II.*
(14) **David H. Bailey**, Lawrence Berkeley National Laboratory
- 3:15PM Break.
- 3:45PM *Concluding examples. Putting everything together.*
(15) **Jonathan M. Borwein**, Dalhousie University

Papers flagged with a solid triangle (▶) have been designated by the author as being of possible interest to undergraduate students. Abstracts of papers presented in the sessions at this meeting will be found in Volume 27, Issue 1 of *Abstracts of papers presented to the American Mathematical Society*, ordered according to the numbers in parentheses following the listings.

AMS Council

1:00 PM – 10:00 PM

Joint Meetings Registration

3:00 PM – 8:00 PM

Full registration will be conducted from 3:00 p.m. to 7:00 p.m. Badge/program pickup for those registered in advance will be open until 8:00 p.m.

Thursday, January 12

Joint Meetings Registration

7:30 AM – 6:00 PM

Full registration will be conducted from 7:30 a.m. to 4:00 p.m. Badge/program pickup for those registered in advance will be open until 6:00 p.m.

Employment Center

7:30 AM – 6:00 PM

MAA Session on Post-secondary Mathematics Assessment: Needs and Challenges

7:40 AM – 10:55 AM

Organizers: **Gloria S. Dion**, Educational Testing Service
Daryl Ezzo, Educational Testing Service
Luis E. Saldivia, Educational Testing Service

- 7:40AM ▶ (16) *Measuring Student Competency at the Completion of Mathematics Developmental Courses.*
Lidia Dobria, Wilbur Wright College (1014-C1-1711)
- 8:00AM ▶ (17) *Course Placement: Looking Beyond Skills Assessment.*
Carrie Muir, University of Colorado, Boulder (1014-C1-1487)
- 8:20AM ▶ (18) *Assessing Pre-service Secondary School Teachers' Mathematical Knowledge for Teaching Algebra.* Preliminary report.
Sharon L. Senk* and **Joan Ferrini-Mundy**, Michigan State University (1014-C1-1435)
- 8:40AM ▶ (19) *Using Portfolios in Mathematics Education Programs to Assess Content and Connect to Future Practice.* Preliminary report.
Janet A. White, Millersville University (1014-C1-476)
- 9:00AM (20) *Math Major Portfolio Assessment.* Preliminary report.
Cheryl Olsen*, **J. Winston Crawley** and **Kate McGivney**, Shippensburg University (1014-C1-1558)
- 9:20AM ▶ (21) *An Analytic Rubric for Assessing Proofs.* Preliminary report.
Karen Batt Stanish, Keene State College (1014-C1-1520)
- 9:40AM (22) *Restructuring a Capstone Course to Assess Student Learning Outcomes.*
Debasree Raychaudhuri, Calstate Los Angeles (1014-C1-1738)

- 10:00AM ▶ (23) *Revision of the Quantitative Measure of the GRE General Test.*
Jutta M. Levin, Educational Testing Service (1014-C1-423)
- 10:20AM ▶ (24) *ConcepTests in College Algebra and Trigonometry.*
David O. Lomen*, University of Arizona, and **Maria K. Robinson**, Seattle University (1014-C1-472)
- 10:40AM ▶ (25) *Assessment using online assignment management systems.*
Glenn Ledder, University of Nebraska-Lincoln (1014-C1-1074)

AMS-MAA-MER Special Session on Mathematics and Education Reform, I

8:00 AM – 10:40 AM

Organizers: **Bonnie S. Saunders**, University of Illinois at Chicago
William H. Barker, Bowdoin College
Dale R. Oliver, Humboldt State University
Kenneth Millet, University of California Santa Barbara

- 8:00AM ▶ (26) *The Mathematics Program at the University of Iowa: A community of mentors.*
David C. Manderscheid, University of Iowa (1014-97-1437)
- 8:30AM ▶ (27) *Promoting excellence through a supportive environment.*
John C Meakin, University of Nebraska-Lincoln (1014-97-1058)
- 9:00AM ▶ (28) *Building a Nurturing Mathematics Community.*
Sylvia T. Bozeman, Spelman College (1014-97-1534)
- 9:30AM ▶ (29) *Increasing the number of mathematics majors: It takes a village.*
William Y. Velez, University of Arizona (1014-97-1238)
- 10:00AM (30) *Mentoring and Nurturing Students in Mathematics Departments.*
Samuel M. Rankin*, American Mathematical Society, **Sylvia T. Bozeman**, Spelman College, **David C. Manderscheid**, University of Iowa, **John C. Meakin**, University of Nebraska-Lincoln, and **William Y. Velez**, University of Arizona (1014-97-1608)

AMS-SIAM Special Session on Frames and Operator Theory in Analysis and Signal Processing, I

8:00 AM – 10:50 AM

Organizers: **Peter R. Massopust**, Tuboscope Vetco Pipeline Services
David R. Larson, Texas A&M University
Manos I. Papadakis, University of Houston
Zuhair Nashed, University of Central Florida
Ahmed I. Zayed, DePaul University
Minh Chuong Nguyen, Institute of Mathematics, Hanoi, Vietnam

- 8:00AM (31) *Tikhonov regularization of ill-posed operator equations with weakly bounded noise.* Preliminary report.
P. P. B. Eggermont*, **V. N. LaRiccia**, University of Delaware, and **M. Z. Nashed**, University of Central Florida (1014-47-1276)

Program of the Sessions – Thursday, January 12 (cont'd.)

- 8:30AM *Curvelets and the one-way acoustic wave equation.*
(32) Preliminary report.
Maarten V. De Hoop, Purdue University
(1014-35-1722)
- 9:00AM *New Approaches to the Acoustic Wave Equation.*
(33) Preliminary report.
Donald J. Kouri, Departments of Mathematics and
Physics, University of Houston (1014-35-1527)
- 9:30AM *The relation between frames and POVM's in*
▶ (34) *quantum information theory.* Preliminary report.
M. Beth Ruskai, Tufts University (1014-81-320)
- 10:00AM *Oversampling a tight affine frame.* Preliminary
(35) report.
Qiyu Sun, University of Central Florida
(1014-42-464)
- 10:30AM *The structure of the set of Parseval frame wavelets.*
(36) **Hrvoje Šikić***, University of Zagreb, Croatia, **Darrin**
M. Speegle, St. Louis University, and **Guido L.**
Weiss, Washington University in St. Louis
(1014-43-345)

**AMS-ASL Special Session on Interdisciplinary
Research Involving Analysis and Logic, I**

8:00 AM – 10:45 AM

Organizers: **Su Gao**, University of North Texas
Jose N. Iovino, University of Texas at
San Antonio
Itay Ben-Yacov, University of
Wisconsin-Madison

- 8:00AM *Model theory of representations of locally compact*
(37) *groups.*
Alex Usvyatsov*, UCLA, **Itay Ben Yaacov**,
University of Wisconsin, Madison, and **Moshe**
Zadka, The Hebrew University (1014-03-799)
- 8:35AM *Hilbert spaces with generic groups of*
(38) *automorphisms.*
Alexander Berenstein, Universidad Nacional de
Colombia (1014-03-601)
- 9:10AM *Automatic Continuity of Group Homomorphisms.*
(39) **Slawomir Solecki**, University of Illinois,
Urbana-Champaign (1014-03-1028)
- 9:45AM *Notions of symmetry and independence in*
(40) *noncommutative probability.* Preliminary report.
Marius Junge, University of Illinois at
Urbana-Champaign (UIUC) (1014-46-807)
- 10:20AM *Unique Representations of Families of Sets.*
(41) **R. Daniel Mauldin**, University of North Texas
(1014-03-526)

**AMS Special Session on Mahler Measure and Heights,
I**

8:00 AM – 10:50 AM

Organizers: **Michael J. Mossinghoff**, Davidson
College
Jeffrey D. Vaaler, University of Texas
at Austin

- 8:00AM *Global Discrepancy and Small Points on Elliptic*
(42) *Curves.*
Matthew Baker, Georgia Institute of Technology,
and **Clayton Petsche***, The University of Georgia
(1014-11-697)
- 8:30AM *Effective theorems for quadratic spaces over $\bar{\mathbb{Q}}$.*
(43) **Lenny Fukshansky**, Texas A&M University
(1014-11-480)

- 9:00AM *Heights and curves.*
(44) **Paula B. Cohen**, Texas A&M University
(1014-11-1413)
- 9:30AM *A Quantitative Measure of Linear Independence for*
(45) *Function Fields.* Preliminary report.
W. Dale Brownawell*, Penn State, University Park,
PA, and **Matthew A. Papanikolas**, Texas A&M,
College Station, TX (1014-11-1320)
- 10:00AM *On heights of multiplicatively dependent algebraic*
(46) *numbers.* Preliminary report.
Cameron L. Stewart, University of Waterloo
(1014-11-1032)
- 10:30AM *Maximal Height of Divisors of $x^n - 1$.* Preliminary
▶ (47) report.
Carl Pomerance, Dartmouth College, and **Nathan**
C. Ryan*, UCLA (1014-11-1007)

**AMS Special Session on Commutative Rings and
Monoids, I**

8:00 AM – 10:50 AM

Organizers: **Scott T. Chapman**, Trinity University
James B. Coykendall, North Dakota
State University

- 8:00AM *On the application of group algebras to zero-sum*
(48) *problems.*
Alfred Geroldinger, University of Graz
(1014-13-874)
- 8:30AM *Pseudo Almost Integral Elements.*
(49) **Daniel D. Anderson***, The University of Iowa, and
Muhammed Zafrullah, Pocatello, ID (1014-13-629)
- 9:00AM *Atomic decay in monoids.* Preliminary report.
(50) **Ulrich Krause**, University of Bremen, Germany
(1014-08-870)
- 9:30AM *Block Monoid Extraction Degrees.*
(51) **Kimberly Cervello**, SUNY-Geneseo, **Vadim**
Ponomarenko*, Trinity University, **Denise Terry**,
University of Redlands, and **Liya Zhu**, UC-Berkeley
(1014-13-117)
- 10:00AM *Elasticity in Polynomial and Power Series Rings.*
▶ (52) **Paul Baginski**, University of California, Berkeley
(1014-13-240)
- 10:30AM *Congruence modulo n τ -relations and*
▶ (53) *τ -factorization.*
Andrea M. Frazier*, University of Iowa, and
Suzanne Hamon, University of Iowa and John
Burroughs School (1014-13-295)

**AMS Special Session on Topological Spaces
Associated with $C(X)$, I**

8:00 AM – 9:50 AM

Organizers: **Chawne M. Kimber**, Lafayette College
Warren Wm. McGovern, Bowling
Green State University

- 8:30AM *Tychonoff spaces X such that each maximal ideal of*
(54) *$C(X)$ contains a minimal prime ideal P for which*
 $C(X)/P$ is a valuation domain. Preliminary report.
Melvin Henriksen, Harvey Mudd College
(1014-54-474)
- 9:00AM *Rings of Continuous Functions on Spaces of Finite*
(55) *Rank and the SV Property.*
Suzanne L. Larson, Loyola Marymount University
(1014-06-812)
- 9:30AM *Sublattices generated by polars in algebraic frames*
(56) *and in $C(X)$.*
Jorge Martinez, University of Florida (1014-06-273)

AMS Special Session on Value Distribution in Classical and p -adic Functions Theory, I

8:00 AM – 10:50 AM

Organizers: **Alain Escassut**, University Blaise Pascal
Chung-Chun Yang, Hong Kong University of Science and Technology
Ilpo Laine, University of Joensuu

- 8:00AM (57) *Holomorphic curves into pseudo-canonical varieties.*
Pei-Chu HU*, Shandong University, and **Chung-Chun Yang**, Hong Kong University of Science and Technology (1014-30-589)
- 8:30AM (58) *Some recent applications of value distribution theory to functional and differential equations.*
Chung Chun Yang, University of Science and Technology of Hong Kong (1014-30-529)
- 9:00AM (59) *Critical Points of Certain Discrete Potentials.*
John F. Rossi*, Virginia Tech, and **J. K. Langley**, University of Nottingham (1014-31-454)
- 9:30AM (60) *Extreme Curvature of Polynomials and Level Curves.*
Stephanie Edwards, University of Dayton (1014-30-1057)
- 10:00AM (61) *Converging Sets of Range Uniqueness for p -adic Analytic Functions.*
Abdelbaki Boutabaa*, **Kamal Boussaf** and **Alain Paul Escassut**, University Blaise Pascal, France (1014-11-590)
- 10:30AM (62) *Growth estimates on meromorphic solutions of certain partial differential equations.* Preliminary report.
Bao Qin Li, Florida International University (1014-32-803)

AMS Special Session on Syzygies in Commutative Algebra and Geometry, I

8:00 AM – 10:45 AM

Organizers: **Irena Peeva**, Cornell University
Sorin E. Popescu, SUNY at Stony Brook
Gregory G. Smith, Queen's University

- 8:00AM (63) *A survey of some recent observations on the Evans-Griffith Syzygy Theorem.* Preliminary report.
Phillip A. Griffith, University of Illinois (1014-13-922)
- 8:30AM (64) *Free resolutions of parameter ideals for some rings with finite local cohomology.*
Hamid Rahmati, University of Nebraska-Lincoln (1014-13-1671)
- 9:00AM (65) *Ferrers ideals.* Preliminary report.
Alberto Corso and **Uwe Nagel***, University of Kentucky (1014-13-1657)
- 9:30AM (66) *Compression.*
Jeffrey A. Mermin, Cornell University (1014-13-1382)
- 10:00AM (67) *The Lex-plus-powers conjecture for ideals containing the squares of the variables.*
Jeff Mermin, **Irena Peeva** and **Michael Stillman***, Cornell University (1014-13-1698)

AMS Special Session on Algebraic Statistics: Theory and Practice, I

8:00 AM – 10:50 AM

Organizers: **Seth M. Sullivant**, University of California Berkeley

Elizabeth S. Allman, University of Southern Maine

- 8:00AM (68) *Introduction to Algebraic Statistics.*
Seth Sullivant, Harvard University (1014-62-1712)
- 8:30AM (69) *Bounds for real solutions to likelihood equations of phylogenetic trees.* Preliminary report.
Serkan Hosten, San Francisco State University (1014-14-1439)
- 9:00AM (70) *The Maximum Likelihood Degree of the Cauchy Location Likelihood.*
Max-Louis G. Buot*, Carnegie Mellon University, and **Donald Richards**, Penn State University (1014-62-1585)
- 9:30AM (71) *Markov chains and evolution algebras.* Preliminary report.
Jianjun Paul Tian, Mathematical Biosciences Institute, the Ohio State University (1014-08-434)
- 10:00AM (72) *Evolution on partially ordered sets.*
Nicholas K. Eriksson* and **Niko Beerenwinkel**, University of California, Berkeley (1014-05-1182)
- 10:30AM (73) *System Identification: A computational Algebra Approach.*
Abdul Salam Jarrah*, Virginia Bioinformatics Institute, Virginia Tech, **Reinhard Laubenbacher**, Virginia Tech, and **Mike Stillman**, Cornell University (1014-12-1586)

AMS Special Session on Extension of Functions, I

8:00 AM – 10:50 AM

Organizers: **Alvario Arias**, University of Denver
Charles L. Fefferman, Princeton University
Edward W. Odell, University of Texas Austin
Thomas Slumprecht, Texas A&M University

- 8:00AM (74) *Coarse embeddings into a Hilbert space.*
William B. Johnson, Texas A&M University, and **N. Lovasoa Randrianarivony***, University of Missouri - Columbia (1014-46-1150)
- 8:30AM (75) *The class of L_1 spaces is closed under uniform equivalences.* Preliminary report.
William B. Johnson, Texas A&M University, **Bernard Maurey**, Universite de Marne-la-Vallée, and **Gideon Schechtman***, The Weizmann Institute (1014-46-579)
- 9:00AM (76) *Gluing functions with random partitions of unity.*
James R. Lee, Institute for Advanced Study (1014-46-1709)
- 9:30AM (77) *Assouad-Nagata dimension and Lipschitz extensions.*
Urs Lang, ETH Zurich, Switzerland (1014-51-1381)
- 10:00AM (78) *Simultaneous Lipschitz Extensions (Part I).*
Alexander Brudnyi*, University of Calgary, and **Yuri Brudnyi**, Technion (1014-46-486)
- 10:30AM (79) *Simultaneous Lipschitz Extensions (Part II).*
Yuri Brudnyi*, Technion, and **Alexander Brudnyi**, University of Calgary (1014-46-490)

AMS Session on Statistics

8:00 AM – 10:55 AM

- 8:00AM (80) *A new approach to test for interactions in two-way ANOVA models.*
Wei Ning* and **Hyune-Ju Kim**, Syracuse University (1014-00-440)

Program of the Sessions – Thursday, January 12 (cont'd.)

- 8:15AM (81) *A statistical method for glaucoma detection using tomographic images, a projection pursuit approach.*
Ananda W. A. Bandulasiri* and **Victor Patrangenu**, Texas Tech University (1014-62-1728)
- 8:30AM (82) *Extremes of Nonexchangeability.*
Roger B. Nelsen, Lewis & Clark College (1014-62-23)
- 8:45AM (83) *A Preliminary Report on High-Order Improvements of the Parametric Bootstrap for Long-memory Linear Regression Gaussian Processes.* Preliminary report.
Mosisa G. Aga, Wayne State University (1014-62-215)
- 9:00AM (84) *Monitoring a Continuous Poisson Process Subject to Change.*
Marlo K. Brown, Niagara University (1014-62-226)
- 9:15AM (85) *EDF Goodness-of-fit Tests for Testing the Distributional Assumptions in One-way Regression Model.*
Dhanuja Kasturiratna*, **Truc T. Nguyen** and **Arjun K. Gupta**, Bowling Green State University (1014-62-1001)
- 9:30AM (86) *Modeling Pipe Rehabilitation Liners Using the Weibull Distribution.* Preliminary report.
Mahmoud Yousef*, Central Missouri State University, and **Raja Nassar**, Louisiana Tech University (1014-62-1071)
- 9:45AM (87) *Sample Size Issues In Resource Selection Studies.*
Ashraf F. El-Houbi, Valparaiso University (1014-62-1101)
- 10:00AM (88) *Frequentist Statistics and Inverse Probability: A Partial Rapprochement.*
David E. Payne, Monmouth University (1014-62-1336)
- 10:15AM (89) *Some new tests for normality based on U-processes.*
Miguel A. Arcones and **Yishi Wang***, Binghamton University (1014-62-1449)
- 10:30AM (90) *Choosing the Optimal Weight for the Test in Aalen's Additive Hazard Regression Model.*
Mouchumi Bhattacharyya*, University of the Pacific, and **John Klein**, Medical College of Wisconsin (1014-62-1477)
- 10:45AM (91) *Data Augmentation for the Analysis of Coarse Woody Debris in an Old-Growth Riparian Forest.* Preliminary report.
G. Jay Kerns, Youngstown State University (1014-62-1532)

MAA Session on Philosophy of Mathematics

8:00 AM – 10:55 AM

Organizers: **Roger A. Simons**, Rhode Island College
Satish C. Bhatnagar, University of Nevada

- 8:00AM (92) *What Are Mathematical Objects? An Empiricist Hypothesis.*
Carl E. Behrens, Alexandria, VA (1014-A1-1158)
- 8:30AM (93) *Mathematical objects may be abstract, but they're NOT acausal.* Preliminary report.
Bonnie Gold, Monmouth University (1014-A1-276)
- 9:00AM (94) *How the way we 'see' mathematics changes mathematics.* Preliminary report.
Sarah-Marie Belcastro, Xavier University (1014-A1-1352)

- 9:30AM (95) *The Square Root of 2, Pi, and the King of France: Ontological and Epistemological Issues Encountered (and Ignored) in Introductory Mathematics Courses.* Preliminary report.
Martin E. Flashman, Humboldt State University and Occidental College (1014-A1-1010)
- 10:00AM (96) *Mathematics: An Aesthetic Endeavor.* Preliminary report.
Sam Stueckle, Trevecca Nazarene University (1014-A1-626)
- 10:30AM (97) *Propensities and the Two Varieties of Occult Qualities.*
James R. Henderson, University of Pittsburgh-Titusville (1014-A1-500)

MAA Session on Professional Development Programs for K-12 Teachers, I

8:00 AM – 10:55 AM

Organizers: **Zsuzsanna Szaniszló**, Valparaiso University
Laurie Burton, Western Oregon University
Judith L. Covington, Louisiana State University Shreveport
Patricia Hale, California State Polytechnic University, Pomona

- 8:00AM (98) *The Loras College Lesson Study Project.*
Daniel G. Willis, Loras College, Dubuque, Iowa (1014-D1-1035)
- 8:20AM (99) *Preparing Elementary Teachers to Teach Geometry: A 12-Month Program.*
Sue Brown, U. Houston-Clear Lake (1014-D1-94)
- 8:40AM (100) *Balancing Mathematical Content with Practical Application to the Classroom in Mathematics Cluster Courses for a Masters Program in Curriculum and Instruction.* Preliminary report.
Kimberly J. Presser*, **Katherine G. McGivney** and **Thomas A. Evitts**, Shippensburg University (1014-D1-744)
- 9:00AM (101) *Filling the Middle Grades Mathematics Gap.*
Steve C. Hennagin and **Darin Buscher***, Ouachita Baptist University (1014-D1-1221)
- 9:20AM (102) *Mathematicians working with teachers in California: The ACCLAIM experience.*
Tom Roby, University of Connecticut (1014-D1-1319)
- 9:40AM (103) *Interviews and School visits: Avenues for Assessing Professional Programs for K-12 Teachers.* Preliminary report.
Harel Barzilai* and **Homer W. Austin**, Salisbury University (1014-D1-761)
- 10:00AM (104) *The Math Science Partnership of Southwestern Pennsylvania: Summer Academies Prepare Teachers to Become Educational Leaders.* Preliminary report.
Norman Hipps, Saint Vincent College, and **Japheth Wood***, Chatham College (1014-D1-1189)
- 10:20AM (105) *Louisiana's Comprehensive Curriculum.*
Lee E. Price, University of Louisiana at Lafayette (1014-D1-1533)
- 10:40AM (106) *Putting the Focus on Mathematics: Content-based Professional Development for Grade 5-12 Teachers.* Preliminary report.
Steven R. Benson, Education Development Center/University of New Hampshire (1014-D1-1703)

MAA General Contributed Paper Session, I

8:00 AM – 10:55 AM

Chair: **Stephen L. Davis**
 Organizers: **Stephen L. Davis**, Davidson College
Eric S. Marland, Appalachian State University

- 8:00AM ▶ (107) *Three Singular Matrices in Business, Industry, and Government.*
William M. Wagner, Columbus, Ohio (1014-Z1-1306)
- 8:15AM ▶ (108) *Riemann Sums of Transcendental Functions.* Preliminary report.
Theodore S. Erickson, Wheeling Jesuit University (1014-Z1-556)
- 8:30AM ▶ (109) *Teaching Calculus with a Touchscreen Graphing Calculator.* Preliminary report.
Benjamin G. Klein, Davidson College (1014-Z1-109)
- 8:45AM ▶ (110) *Choosing Appropriate Derivative (Integral) Techniques.* Preliminary report.
Pam Crawford, Jacksonville University (1014-Z1-1559)
- 9:00AM ▶ (111) *Super Size Me: An Optimization Problem.*
Martha J. Shott, Davidson College (1014-Z1-1244)
- 9:15AM (112) *A Study on the Use of Multiple Forms of Technology in a Business Calculus Course.*
Erick Brian Hofacker, University of Wisconsin-River Falls (1014-Z1-820)
- 9:30AM ▶ (113) *My experience in offering the Financial Mathematics course for undergraduates.* Preliminary report.
Qin Lu, Lafayette College (1014-Z1-121)
- 9:45AM ▶ (114) *Using Sudoku Number Puzzles to Practice Reasoning Skills in a Basic Mathematics Course.*
Richard H. Stout, Gordon College, Wenham, MA (1014-Z1-452)
- 10:00AM ▶ (115) *Using Colorings of Pascal's Triangle to Visualize Algebraic Concepts.* Preliminary report.
Cynthia J. Woodburn, Pittsburg State University (1014-Z1-317)
- 10:15AM ▶ (116) *Geometry of Quadrics.* Preliminary report.
Ion I. Dinca, University of Notre Dame (1014-Z1-180)
- 10:30AM (117) *Teaching to Help Students Avoid the Misuse of the Distributive Law in Algebra Class.* Preliminary report.
Shumei C. Richman, Midlands Technical College (1014-Z1-1258)
- 10:45AM (118) *Binary Quadratic Forms: A Historical View.* Preliminary report.
Azar N. Khosravani*, Columbia College Chicago, and **Mark B. Beintema**, College of Lake County (1014-Z1-502)

SIAM Minisymposium on Mathematical Neuroscience: From Experiment to Theory, I

8:00 AM – 10:55 AM

Organizer: **Kresimir Josic**, University of Houston

- 8:00AM (119) *The geometry of oscillator recruitment.*
Jonathan E. Rubin*, University of Pittsburgh, and **Amitabha Bose**, NJIT (1014-37-528)

- 8:25AM (120) *Subthreshold oscillatory activity and spiking in medial entorhinal cortex layer II stellate cells.*
Horacio G. Rotstein*, Boston University, **Tim Oppermann**, Institute for Theoretical Biology, Humboldt University Berlin, **John A. White**, Department of Biomedical Engineering and Center for Biodynamics, Boston University, and **Nancy Kopell**, Department of Mathematics and Center for Biodynamics, Boston University (1014-92-704)
- 8:50AM (121) *Inferring Calcium Channel Distribution from Calcium Fluorescence Data.*
Steven J. Cox* and **Jane Hartsfield**, CAAM, Rice University (1014-92-549)
- 9:15AM Break.
- 9:45AM ▶ (122) *Ionic mechanisms of bursting in neostriatal cholinergic interneurons.*
Charles J. Wilson, Dept. Biology, Univ. Texas at San Antonio (1014-92-1232)
- 10:10AM (123) *Dynamic Clustering in a Model for an Insect's Antennal Lobe.*
David Terman*, Ohio State University, **Alla Borisyuk**, University of Utah, **Brian Smith**, Arizona State University, **Sungwoo Ahn**, **Xueying Wang** and **Jeong-sook Im**, Ohio State University (1014-92-685)
- 10:35AM (124) *Finite size effects in feedforward neural networks.*
Brent Doiron*, **Alex Reyes** and **John Rinzel**, New York University (1014-92-1362)

SIAM Minisymposium on Numerical Solution of Partial Differential Equations and Applications to Flow in Porous Media

8:00 AM – 10:53 AM

Organizer: **Todd J. Arbogast**, University of Texas at Austin

- 8:00AM (125) *Numerical simulation of coupled ground water/surface flow and transport.*
Clint Dawson, The University of Texas at Austin (1014-65-1102)
- 8:25AM ▶ (126) *Control Volume Finite Element Methods and Their Applications to Multiphase Flows in Porous Media.*
Zhangxin John Chen, Southern Methodist University (1014-65-466)
- 8:50AM (127) *A fully mass and volume conserving implementation of a characteristic method for transport problems.*
Todd Arbogast, The University of Texas at Austin, and **Chieh-Sen Huang***, National Sun Yat-sen University (1014-65-1345)
- 9:15AM (128) *Detecting and countering instability in operator splitting methods for reaction-diffusion equations.*
Donald Estep*, **Travis King**, Colorado State University, **David Ropp** and **John Shadid**, Sandia National Laboratories (1014-65-873)
- 9:40AM (129) *Computing The Effective Behavior of Stiff Oscillatory Dynamical Systems.*
Bjorn Engquist, **Richard Sharp** and **Richard Tsai***, University of Texas at Austin (1014-65-798)
- 10:05AM (130) *Multiscale finite element methods for flows in heterogeneous porous media.*
Y. R. Efendiev, Texas A&M University (1014-65-390)
- 10:30AM (131) *Mixed Variational Multiscale Modeling of Stochastic Porous Media.*
Todd Arbogast*, The University of Texas at Austin, **Kirsten J. Boyd**, Eureka College, **Michael S. Lubke** and **James M. Rath**, The University of Texas at Austin (1014-65-1649)

MAA-AMS Committee on Teaching Assistants and Part-Time Instructors Panel Discussion

8:00 AM – 9:20 AM

Permanent use of temporary faculty: The status of nonladder faculty in departments of mathematics.

Organizers: **Judith L. Baxter**, University of Illinois-Chicago
Kevin E. Charlwood, Washburn University
Natasha M. Speer, Michigan State University
Moderator: **Kevin E. Charlwood**
Panelists: **Fred Peskoff**, Borough of Manhattan Community College/CUNY
Curtis D. Bennett, Loyola-Marymount University

SIGMAA on Statistics Education Panel Discussion

8:00 AM – 9:20 AM

Implications of the new ASA (GAISE) guidelines for teaching statistics.

Organizers: **Thomas L. Moore**, Grinnell College
Christopher J. Lacke, Rowan University
Moderator: **Carolyn K. Cuff**, Westminster College
Panelists: **Robin H. Lock**, St. Lawrence University
Gary Kader, Appalachian State University
Mike Perry, Appalachian State University
Jessica Utts, University of California Davis

AMS Session on Combinatorics, I

8:15 AM – 10:55 AM

- 8:15AM *Angle sums on polytopal complexes*. Preliminary report. (132)
▶ **Kristin A. Camenga**, Cornell University (1014-52-1409)
- 8:30AM *A conjecture for the combinatorial structure of crystals for all Kirillov-Reshetikhin modules of type $D_n^{(1)}$* . (133)
Philip M. Sternberg, University of California, Davis (1014-05-1665)
- 8:45AM *Notes on the Villainy of a Graph*. Preliminary report. (134)
▶ **Sarah H. Holliday***, University of Tennessee at Martin, **Sally A. Clark**, Birmingham-Southern College, **John E. Holliday**, North Georgia College and State University, **Peter D. Johnson**, **Janet E. Trimm**, Auburn University, **Robert R. Rubalcaba**, University of Alabama in Huntsville, and **Matthew P. Walsh**, Indiana University Purdue University Fort Wayne (1014-05-1403)
- 9:00AM *Zero-Divisor Graphs of Commutative Rings: A Survey of Recent Results*. (135)
▶ **Joe A. Stickles Jr.**, University of Evansville (1014-13-758)
- 9:15AM *A Matrix Theory Approach to the Genus of a Graph*. (136)
▶ **Jason J. Moliterno**, Sacred Heart University (1014-15-413)

- 9:30AM *Some results on Multidecompositions with the Order 4 Graph-Pair*. (137)
Atif Abueida, University of Dayton, **Sally Clark***, Birmingham-Southern College, and **David Leach**, University of West Georgia (1014-05-361)
- 9:45AM *A New Class of Multiset Wilf Equivalent Pairs*. (138)
▶ **Vidya Venkateswaran**, Stanford University (1014-05-373)
- 10:00AM *On caps in $(\mathbb{Z}/n\mathbb{Z})^2$* . (139)
▶ **Jack W. Huizenga**, University of Chicago (1014-05-554)
- 10:15AM *On the sizes of graphs embeddable in surfaces of nonnegative Euler characteristic and their applications to edge choosability*. (140)
▶ **Ko-Wei Lih***, Academia Sinica, Taipei, and **Wei-Fan Wang**, Zhejiang Normal University (1014-05-107)
- 10:30AM *On the probability of finite metric spaces*. (141)
▶ **Vania Mascioni**, Ball State University (1014-05-327)
- 10:45AM *On Detectable Colorings of Graphs*. (142)
▶ **Henry Enriquez Escudro**, Western Michigan University (1014-05-596)

AMS Special Session on Division Algebras, Galois Theory, Cohomology and Geometry, I

8:30 AM – 10:50 AM

Organizers: **Kelly L. McKinnie**, University of Texas at Austin
David J. Saltman, University of Texas at Austin

- 8:30AM *Division algebras of prime degree over function fields of surfaces*. (143)
▶ **Parimala Raman***, Emory University, Atlanta, and Tata Institute of Fundamental Research, and **Manuel Ojanguren**, EPFL, Lausanne (1014-14-447)
- 9:00AM *A geometric approach to period-index problems*. (144)
▶ **Max Lieblich**, Princeton University (1014-14-1420)
- 9:30AM *Orders of finite groups of matrices*. Preliminary report. (145)
▶ **Martin W Lorenz**, Temple University (1014-20-764)
- 10:00AM *Division algebras with an anti-automorphism but with no involution*. (146)
▶ **Patrick Morandi***, New Mexico State University, **B. A. Sethuraman**, California State University, Northridge, and **Jean-Pierre Tignol**, Université Catholique de Louvain (1014-16-231)
- 10:30AM *On graded polynomial identities and algebras with a projective basis*. Preliminary report. (147)
▶ **Eli Aljadeff**, Technion - Israel Institute of Technology, **Darrell E. Haile***, Indiana University, and **Michael Natapov**, Technion-Israel Institute of Technology (1014-20-1486)

MAA Committee on Graduate Students Presentation

8:30 AM – 10:55 AM

Workshop on training T.A.s.
Organizer: **David C. Manderscheid**, University of Iowa
Presenters: **Solomon Friedberg**, Boston College
Maria S. Terrell, Cornell University

MAA Session on Getting Students to Discuss and to Write about Mathematics, I

8:45 AM – 10:40 AM

Organizers: **Martha Ellen Murphy Waggoner**, Simpson College

Charlotte A. Knotts-Zides, Wofford College

Harrison W. Straley, Wheaton College

- 8:45AM **(148)** *A Classification of Secondary Mathematics Writing Tasks.* Preliminary report.
Kristin A. Camenga, Cornell University (1014-H1-151)
- 9:00AM **(149)** *Writing about Mathematicians in General Education Courses.*
Karl-Dieter Crisman, Gordon College (1014-H1-280)
- 9:15AM **(150)** *Research Experiences in Mathematics for Mathematics Educators.*
Daniel Chazan, University of Maryland, and **Sarah Sword***, Education Development Center (1014-H1-1595)
- 9:30AM **(151)** *Using weekly laboratory sessions to stimulate student discussion.*
Charles F. Peltier, Saint Mary's College, Notre Dame, IN (1014-H1-986)
- 9:45AM **(152)** *Returned Assignments: A Tool for Fostering Mathematical Communication and Connections.* Preliminary report.
Rapti Manohara de Silva, California State University, Chico (1014-H1-1199)
- 10:00AM **(153)** *Thinking Statistically in Writing: Journals and Discussion Boards in an Introductory Statistics Course.* Preliminary report.
Julie M. Theoret* and **Andrea Luna**, Lyndon State College (1014-H1-1529)
- 10:15AM **(154)** *Writing Assignments with No Grading Required.* Preliminary report.
Aprillya Lanz, Clayton State University (1014-H1-1647)
- 10:30AM **(155)** *Web Quests for Introductory Statistics Students.* Preliminary report.
Kimberly J. Presser, Shippensburg University (1014-H1-1171)

MAA Minicourse #12: Part A

9:00 AM – 11:00 AM

Getting students involved in undergraduate research.

Organizers: **Aparna W. Higgins**, University of Dayton
Joseph A. Gallian, University of Minnesota Duluth

MAA Minicourse #1: Part A

9:00 AM – 11:00 AM

Designing and evaluating assessments for introductory statistics.

Organizers: **Beth L. Chance**, California Polytech State University
Robert C. Delmas, University of Minnesota
Allan J. Rossman, California Polytech State University

MAA Minicourse #7: Part A

9:00 AM – 11:00 AM

Geometry with history for teaching teachers.

Organizers: **David W. Henderson**, Cornell University
Daina Taimina, Cornell University

AMS Session on Complex Variables

9:00 AM – 10:55 AM

- 9:00AM **(156)** *A modification of the Roper-Suffridge extension operator.*
Jerry R. Muir Jr., University of Scranton (1014-32-694)
- 9:15AM **(157)** *On the Serre Problem about Stein manifolds.*
Dan J. Zaffran, Academia Sinica, Taipei (Taiwan) (1014-32-646)
- 9:30AM **(158)** *General interpolation in spaces of analytic functions.* Preliminary report.
Daniel H. Luecking, University of Arkansas (1014-30-1631)
- 9:45AM **(159)** *Unexpected local extrema for the Sendov conjecture.*
Michael J. Miller, Le Moyne College (1014-30-275)
- 10:00AM **(160)** *A general formula for a special class of holomorphic functions from a multiply connected domain to the right half plane.* Preliminary report.
Faisal Kaleem, Purdue University, West Lafayette, IN (1014-30-727)
- 10:15AM **(161)** *Subordination results from a differential equation related to the de la Vallée Poussin means.* Preliminary report.
Stacey Muir, University of Scranton (1014-30-1128)
- 10:30AM **(162)** *Riemann Surface Deformations.* Preliminary report.
J'Lee Wyatt Bumpus* and **G. Brock Williams**, Texas Tech University (1014-30-1542)
- 10:45AM **(163)** *Higher Hyperbolic Derivatives In The Unit Disk.*
Chelst N. Dov, DeVry University - North Brunswick (1014-30-1707)

AMS Session on Number Theory, I

9:00 AM – 10:55 AM

- 9:00AM **(164)** *The Periodic Character of the Rational Difference Equation $y_n = 1 + \frac{y_{n-k}}{y_{n-m}}$.*
Kenneth S. Berenhaut, **John D. Foley***, Wake Forest University, and **Stevó Stević**, Mathematical Institute of Serbian Academy of Science (1014-39-1706)
- 9:15AM **(165)** *Orthogonal Polynomials Arising from Generalized Trigonometric Identities.* Preliminary report.
James C. Griffin, University of Central Florida (1014-33-1156)
- 9:30AM **(166)** *A Trace Formula for Compact Quotients of $SL(3, R)$ and Weyl's Law.*
Lee Stemkoski, Dartmouth College (1014-11-330)
- 9:45AM **(167)** *Discrepancy of Fractions with Divisibility Constraints.* Preliminary report.
Andrew H. Ledoan*, **Emre Alkan**, University of Illinois at Urbana-Champaign, **Marian Văjăitu**, Romanian Academy, Simion Stoilow Institute of Mathematics, and **Alexandru Zaharescu**, University of Illinois at Urbana-Champaign (1014-11-407)
- 10:00AM **(168)** *Sierpinski numbers with at least two prime divisors.*
Michael Filaseta, **Carrie E. Finch*** and **Mark R. Zozek**, University of South Carolina (1014-11-416)
- 10:15AM **(169)** *A summation formula for divisor functions associated to lattices.*
Jennifer Beineke*, Western New England College, and **Daniel Bump**, Stanford University (1014-11-1581)
- 10:30AM **(170)** *Stable Reduction of $X_0(81)$.*
Ken McMurdy, Rose-Hulman Institute of Technology (1014-11-1685)

Program of the Sessions – Thursday, January 12 (cont'd.)

- 10:45AM (171) *Proof of the Fermat's Last Theorem (originally submitted to AMS on 2-16-1991).*
Andrew H. Warren, New York, NY (1014-11-40)

MAA Invited Paper Session on the Role of Online Technology Courses for Teachers of Preservice Mathematics Teachers

9:00 AM – 10:55 AM

Organizers: **Judy O'Neal**, North Georgia College & State University
Franklin D. Demana, The Ohio State University

- 9:00AM (172) *Sooner or later you will use on-line technology to teach mathematics!*

Roseanne S. Hofmann, Montgomery County Community College (1014-ZA-189)

- 9:30AM (173) *Engaging Preservice Teachers in Online Learning: Interactive Video and Active Discussions.* Preliminary report.

Janet Bowers, San Diego State University (1014-ZA-293)

- 10:00AM (174) *Mathematics Methods Online.*

Connie S. Schrock, Emporia State University (1014-ZA-555)

- 10:30AM (175) *Creating positive discussion environments in a mathematics content sequence for elementary education majors using traditional and distance formats.*

James R. Hersberger, Indiana-Purdue Fort Wayne (1014-ZA-720)

MAA CUPM and SIGMAA on Statistics Education Panel Discussion

9:30 AM – 10:50 AM

Requiring statistics of every mathematics major: Model courses.

Organizers: **Thomas L. Moore**, Grinnell College
Harriet S. Pollatsek, Mount Holyoke College

Panelists: **George Cobb**, Mount Holyoke College
Robin Lock, St. Lawrence University
Deborah Nolan, University of California Berkeley

Allan Rossman, California Polytechnic University, San Luis Obispo

MAA Panel Discussion

9:30 AM – 10:50 AM

National Science Foundation programs supporting learning and teaching in the mathematical sciences.

Organizers: **Elizabeth J. Teles**, NSF Division of Undergraduate Education
John R. Haddock, NSF Division of Undergraduate Education
Lee L. Zia, NSF Division of Undergraduate Education
John S. Bradley, NSF Division of Elementary, Secondary, and Informal Education
Lloyd E. Douglas, NSF Division of Mathematical Sciences

AMS Invited Address

10:05 AM – 10:55 AM

- (176) *Riemann-Roch for determinantal gerbes and infinite-dimensional bundles.*
Mikhail Kapranov, Yale University (1014-14-18)

AMS-MAA Invited Address

11:10 AM – NOON

- (177) *Graph limits and graph homomorphisms.*
Lászlo Lovász, Microsoft Research (1014-05-68)

Exhibits and Book Sales

12:15 PM – 5:30 PM

Math on the Web, I

12:30 PM – 5:00 PM

- 12:30PM (178) *MathML Software: A common format for many math programs.*

Neil Soiffer, Design Science, Inc.

- 2:00PM (179) *Communicating math on the Web: Promises, trials, and free beer.*

Patrick Ion, American Mathematical Society

- 2:45PM (180) *MAA reviews and classroom capsules: New features in MathDL.*

Lang Moore, Mathematical Association of America

- 3:45PM (181) *Creating mathematical documents for the Web with Scientific Workplace.*

Barry MacKichan, MacKichan Software, Inc.

- 4:30PM (182) *PlanetMath and free mathematics.*

Aaron Krowne, Emory University

AMS Colloquium Lectures: Lecture I

1:00 PM – 2:00 PM

- (183) *Entangled radicals, Part I.*
Hendrik W. Lenstra Jr., Universiteit Leiden (1014-12-13)

MAA Invited Address

2:15 PM – 3:05 PM

- (184) *Preference Sets, Graphs, and Voting in Agreeable Societies.*
Francis Edward Su, Harvey Mudd College (1014-A0-08)

AMS-MAA-MER Special Session on Mathematics and Education Reform, II

2:15 PM – 6:05 PM

Organizers: **Bonnie S. Saunders**, University of Illinois at Chicago
William H. Barker, Bowdoin College
Dale R. Oliver, Humboldt State University
Kenneth Millet, University of California Santa Barbara

- 2:15PM (185) *The search for common ground in K-12 mathematics education.* Preliminary report.
R. James Milgram, Stanford University (1014-97-1471)

- 2:45PM *Math War Veteran Tells All.*
▶ (186) **Jeremy Kilpatrick**, University of Georgia (1014-97-1387)
- 3:15PM *Reaching Common Ground: Issues in Teachers' Mathematical Education and Professional Development.*
▶ (187) **Joan Ferrini-Mundy**, Michigan State University (1014-97-1427)
- 3:45PM *Disagreeing about Common Ground.*
▶ (188) **Andrew M. Gleason**, Harvard University (1014-97-1613)
- 4:15PM *Standards and the National Math View.*
(189) **Johnny W. Lott**, University of Montana (1014-97-290)
- 4:45PM *Results from a Capstone Course for Future High School Mathematics Teachers, Jointly Taught by a Mathematician and a Mathematics Educator.*
▶ (190) **Richard O. Hill*** and **Sharon L. Senk**, Michigan State University (1014-97-1086)
- 5:15PM *Lessons learned from our long-term discrete collaboration in the mathematical preparation of teachers.* Preliminary report.
▶ (191) **Valerie A. DeBellis***, Shodor Education Foundation, and **Joseph G. Rosenstein**, Rutgers University (1014-97-959)
- 5:45PM *The rush to calculus and the rush to algebra.*
▶ (192) Preliminary report.
Joseph G. Rosenstein, Rutgers University (1014-97-1174)

AMS-MAA Special Session on Ancient and Nonwestern Mathematics, I

2:15 PM – 4:05 PM

Organizer: **Duncan J. Melville**, St. Lawrence University

- 2:15PM *Controversies in the Early History of Trigonometry.*
▶ (193) Preliminary report.
Glen R. Van Brummelen, Bennington College (1014-01-1062)
- 3:15PM *Equations in Arabic Algebra.* Preliminary report.
▶ (194) **Jeffrey A. Oaks**, University of Indianapolis (1014-01-393)
- 3:45PM *An Examination of Three Persian Arithmetic Texts.*
▶ (195) **Lawrence D'Antonio**, Ramapo College of New Jersey (1014-01-493)

AMS-SIAM Special Session on Contemporary Dynamical Systems, I

2:15 PM – 6:05 PM

Organizers: **Dmitry Zenkov**, North Carolina State University
Youngna Choi, Montclair State University
Anthony M. Bloch, University of Michigan
Todd L. Fisher, University of Maryland
Melvin Leok, University of Michigan
David S. Richeson, Dickinson College
James S. Wiseman, Agnes Scott College

- 2:15PM *Dynamics in Small Networks of Identical Coupled Systems.* Preliminary report.
(196) **Martin Golubitsky***, University of Houston, and **Maria C.A. Leite**, Purdue University (1014-34-344)

- 2:45PM *Limit laws for chaotic dynamical systems.*
(197) **Ian Melbourne**, University of Surrey, and **Matthew Nicol***, University of Houston (1014-37-517)
- 3:15PM *Dirac Structures, Variational Principles, and Implicit Lagrangian Systems.*
(198) **Hiroaki Yoshimura***, Mechanical Engineering, Waseda University, and **Jerrold E. Marsden**, Control and Dynamical Systems, Caltech (1014-70-1719)
- 3:45PM *A Dynamical Systems Study of Bose-Einstein Condensates in Optical Lattice and Superlattice Potentials.*
(199) **Mason A. Porter**, California Institute of Technology (1014-37-237)
- 4:15PM *Geometric Rigidity for Automorphisms of Groups.*
(200) **Alex Clark***, University of North Texas, and **R. J. Fokkink**, T. U. Delft (1014-37-1394)
- 4:45PM *Examples of outer billiards with periodic dynamics.*
(201) **Filiz Dogru**, Grand Valley State University (1014-37-953)
- 5:15PM *Closed Relations and Equivalence Classes of Quasicontinuous Functions.*
(202) **Annalisa Crannell**, Franklin & Marshall College, **Marc Frantz**, Indiana University, Bloomington, and **Michelle LeMasurier***, Hamilton College (1014-54-1084)
- 5:45PM *Mixing and embedding properties of tiling spaces.*
(203) Preliminary report.
Brian F. Martensen, Rose-Hulman Institute of Technology (1014-37-1676)

AMS Special Session on Mahler Measure and Heights, II

2:15 PM – 6:05 PM

Organizers: **Michael J. Mossinghoff**, Davidson College
Jeffrey D. Vaaler, University of Texas at Austin

- 2:15PM *Mahler Measure for Polynomials in Noncommuting Variables.* Preliminary report.
(204) **Douglas Lind**, University of Washington (1014-37-638)
- 2:45PM *Special functions and the range of multiplicative functions on $\mathbb{Z}[x]$.*
(205) **Christopher D. Sinclair**, Pacific Institute of the Mathematical Sciences, Vancouver (1014-11-618)
- 3:15PM *The Mahler Measure of Polynomials with Odd Coefficients.*
(206) **Peter Borwein**, Simon Fraser University (1014-11-643)
- 3:45PM *Mahler's measure and derivatives.* Preliminary report.
▶ (207) **Igor E. Pritsker**, Oklahoma State University (1014-11-1019)
- 4:15PM *Arithmetic Mean and Geometric Mean of Mahler Measure of Unimodular Polynomials.* Preliminary report.
▶ (208) **Stephen Choi**, Simon Fraser University (1014-11-862)
- 4:45PM *Univogue Beta Expansions of Pisot numbers.*
(209) **Kevin G. Hare**, University of Waterloo (1014-11-560)
- 5:15PM *Salem-Boyd polynomials and surface homeomorphisms.*
(210) **Eriko Hironaka**, Florida State University (1014-11-614)
- 5:45PM *Dilatations of pseudo-Anosov automorphisms.*
(211) **Christopher J. Leininger**, University of Illinois at Urbana Champaign (1014-51-611)

AMS Special Session on Division Algebras, Galois Theory, Cohomology and Geometry, II

2:15 PM – 6:05 PM

Organizers: **Kelly L. McKinnie**, University of Texas at Austin
David J. Saltman, University of Texas at Austin

- 2:15PM *Projective Schur Groups over Henselian Fields.*
 (212) **Eli Aljadeff**, **Jack Sonn**, Technion-Israel Institute of Technology, and **A. R. Wadsworth***, University of California, San Diego (1014-16-703)
- 2:45PM *Relative Brauer Groups of Function Fields of Binary Cubic Forms.*
 (213) **Ilseop Han***, California State University, San Bernardino, **Darrell Haile**, Indiana University, Bloomington, and **Adrian R. Wadsworth**, University of California, San Diego (1014-16-1344)
- 3:15PM *Kneser-Tits Conjecture and outer forms of E_6 .*
 (214) **Skip Garibaldi**, Emory University (1014-20-1076)
- 3:45PM *Indecomposable p -algebras.* Preliminary report.
 (215) **Kelly L. McKinnie**, University of Texas at Austin (1014-16-1302)
- 4:15PM *Valuations on Tensor Powers of a Division Algebra.*
 (216) **Patrick J. Morandi**, New Mexico State University, and **B. A. Sethuraman***, California State University Northridge (1014-16-259)
- 4:45PM *The Unramified Witt Group of Curves in Characteristic Two.*
 (217) **Bill Jacob***, University of California, Santa Barbara, and **Roberto Aravire**, Universidad Arturo Prat, Iquique, Chile (1014-12-389)
- 5:15PM Discussion

AMS Special Session on Dynamic Equations with Applications, I

2:15 PM – 6:05 PM

Organizers: **Allan C. Peterson**, University of Nebraska
Martin J. Bohner, University of Missouri-Rolla

- 2:15PM *Asymptotic Equivalence of Dynamic Systems.*
 ▶ (218) Preliminary report.
Billur Kaymakçalan*, Georgia Southern University, and **Agacik Zafer**, Middle East Technical University, Ankara, Turkey (1014-34-1187)
- 2:45PM *On the distinctions between "continuous" boundary value problems and "discrete" boundary value problems.*
 ▶ (219) **Christopher C. Tisdell**, The University of New South Wales (1014-34-495)
- 3:15PM *Integral Comparison Theorems.* Preliminary report.
 ▶ (220) **Lynn H. Erbe**, University of Nebraska-Lincoln 68588-0130 (1014-39-1105)
- 3:45PM *Diffusion Equations on Basic Linear Grids.*
 (221) Preliminary report.
Andreas Ludwig Ruffing and **Maria Meiler***, Munich University of Technology (1014-39-1046)
- 4:15PM *Discretization Scheme In Volterra Integro-differential Equations That Preserves Stability and Boundedness.*
 (222) **Eric R. Kaufmann**, University of Arkansas at Little Rock, and **Youssef N. Raffoul***, University of Dayton (1014-45-1079)

- 4:45PM *Error Estimates of Asymptotic Solutions of Second Order Dynamic Equations on Time Scale.*
 ▶ (223) Preliminary report.
Gro Hovhannisyan, Kent State University, Stark Campus (1014-34-150)
- 5:15PM *A Two Dimensional Dynamical System Underlying Cardiac Arrhythmias.*
 ▶ (224) **Irina Popovici***, **B. M. Baker** and **M. Kidwell**, US Naval Academy (1014-37-334)
- 5:45PM *Global Attractivity in Dynamic Equations on Time Scales with delays.*
 (225) **Seshadev Padhi**, Mississippi State University (1014-39-188)

AMS Special Session on Commutative Rings and Monoids, II

2:15 PM – 6:05 PM

Organizers: **Scott T. Chapman**, Trinity University
James B. Coykendall, North Dakota State University

- 2:15PM *A generalization to Dedekind domains of an Erdős inequality connected to $n!$.*
 (226) **Jean-Luc Chabert**, Université de Picardie, France (1014-13-522)
- 2:45PM *Direct-sum relations among modules over a one-dimensional local ring.*
 (227) **Alberto Facchini**, University of Padua, **Wolfgang Hassler**, University of Graz, **Lee Klingler**, Florida Atlantic University, and **Roger Wiegand***, University of Nebraska (1014-13-671)
- 3:15PM *Gaussian Properties of Total Rings of Quotients.*
 (228) Preliminary report.
Sarah Glaz, University of Connecticut (1014-13-1013)
- 3:45PM *Irreducible Divisor Graphs.*
 ▶ (229) **Jack L. Maney***, The University of South Dakota, and **Jim B. Coykendall**, North Dakota State University (1014-13-358)
- 4:15PM *Transfer of Krull dimension, lying-over and going-down to the fixed ring.*
 (230) **David E. Dobbs***, University of Tennessee, Knoxville, and **Jay Shapiro**, George Mason University (1014-13-607)
- 4:45PM *Anderson-Mott commutative rings: ϕ -commutative rings with a finite number of nonnil irreducible elements.* Preliminary report.
 (231) **Ayman R. Badawi**, American University of Sharjah, U.A.E (1014-13-475)
- 5:15PM *Constructing chains of primes in power series rings.* Preliminary report.
 ▶ (232) **Alan Loper**, The Ohio State University, and **Thomas G. Lucas***, University of North Carolina Charlotte (1014-13-949)
- 5:45PM *Non-Noetherian Cohen-Macaulay Rings.* Preliminary report.
 (233) **Tracy Dawn Hamilton***, California State University Sacramento, and **Thomas Marley**, University of Nebraska-Lincoln (1014-13-364)

AMS Special Session on Topological Spaces Associated with $C(X)$, II

2:15 PM – 5:05 PM

Organizers: **Chawne M. Kimber**, Lafayette College
Warren Wm. McGovern, Bowling Green State University

- 2:15PM *Network character and tightness of the compact-open topology.*
(234) **Anthony W. Hager***, Wesleyan University, and **Richard N. Ball**, University of Denver (1014-54-301)
- 2:45PM *An algebraic characterization of pointwise convergence in $C(X)$.* Preliminary report.
(235) **Richard N. Ball***, University of Denver, and **Anthony W. Hager**, Wesleyan University (1014-06-1360)
- 3:15PM *Conditional Completeness of $C(X, \mathbb{R}_T)$ Where \mathbb{R}_T is a Weak P -Space.*
(236) **Michelle L. Knox**, Midwestern State University (1014-06-311)
- 3:45PM *Extremal Pseudocompact Abelian Groups Are Compact Metrizable.*
(237) **W. W. Comfort***, Wesleyan University, and **Jan van Mill**, Vrije Universiteit (1014-22-958)
- 4:15PM *The regular topology on $C(X)$, I.* Preliminary report.
(238) **Warren Wm. McGovern***, Bowling Green State University, **Wolf Iberkleid** and **Ramiro Lafuente-Rodriguez**, La Universidad de La Paz (1014-54-816)
- 4:45PM *The regular topology on $C(X)$, II.* Preliminary report.
(239) **Wolf Iberkleid***, **Ramiro Lafuente-Rodriguez**, Universidad Mayor de San Andres, and **Warren Wm. McGovern**, Bowling Green State University (1014-54-722)

AMS Special Session on Value Distribution in Classical and p -adic Functions Theory, II

2:15 PM – 5:35 PM

Organizers: **Alain Escassut**, University Blaise Pascal
Chung-Chun Yang, Hong Kong University of Science and Technology
Ilpo Laine, University of Joensuu

- 2:15PM *Dirac operators and automorphic forms for some conformally flat manifolds.* Preliminary report.
(240) **John Ryan***, University of Arkansas, Fayetteville, and **R. S. Krausshar**, Gent University (1014-58-869)
- 2:45PM *Eigenvalues of non-self-adjoint Schrödinger operators with polynomial potentials.* Preliminary report.
(241) **Kwang C. Shin**, University of Missouri-Columbia (1014-34-824)
- 3:15PM *On Borel Exceptional Values for Meromorphic Functions in the Unit Disk.* Preliminary report.
(242) **L. R. Sons**, Northern Illinois University (1014-30-672)
- 3:45PM *Picard's theorem for finite-order periodic functions.*
(243) **R. G. Halburd**, Loughborough University, and **R. J. Korhonen***, University of Joensuu (1014-30-446)
- 4:15PM *A Second Main Theorem on Generalized Parabolic Manifolds.*
(244) **Pit-Mann Wong**, University of Notre Dame (1014-32-1176)
- 4:45PM *Rational Solutions of Algebraic Differential Equations.*
(245) **Yujie Ma**, KLMM, Academy of Mathematics and System Sciences, Chinese Academy of Sciences (1014-30-598)
- 5:15PM *Schahten P -Classes in p -adic Hilbert spaces.*
(246) Preliminary report.
Sudeshna Basu, Moragan State University (1014-46-168)

AMS Special Session on Syzygies in Commutative Algebra and Geometry, II

2:15 PM – 6:05 PM

Organizers: **Irena Peeva**, Cornell University
Sorin E. Popescu, SUNY at Stony Brook
Gregory G. Smith, Queen's University

- 2:15PM *Efficient toroidalization of morphisms.*
(247) **Steven D. Cutkosky**, University of Missouri (1014-14-1447)
- 2:45PM *Some Ideals with Large Projective Dimension.*
(248) **Manoj Kummini***, University of Kansas, Lawrence, and **Giulio Caviglia**, University of California, Berkeley (1014-13-617)
- 3:15PM *Finite free complexes with homology of finite length.* Preliminary report.
(249) **Luchezar L. Avramov***, University of Nebraska – Lincoln, **Ragnar-Olaf Buchweitz**, University of Toronto, **Srikanth Iyengar**, University of Nebraska, and **Claudia Miller**, Syracuse University (1014-13-1393)
- 3:45PM *On the minimal free resolutions of a class of monomial ideals.* Preliminary report.
(250) **Alexandre B. Tchernev**, University at Albany, SUNY (1014-13-520)
- 4:15PM *Tropical Convexity via Cellular Resolutions.*
▶ (251) **Florian Block**, TU München, and **Josephine Yu***, UC Berkeley (1014-13-444)
- 4:45PM *Some componentwise linear monomial ideals.*
(252) **Christopher A. Francisco***, University of Missouri, and **Adam Van Tuyl**, Lakehead University (1014-13-368)
- 5:15PM *Bounding Frobenius powers uniformly.* Preliminary report.
(253) **Craig Huneke***, University of Kansas, and **M. Katzman**, **R. Sharp**, **Y. Yao**, Univ. of Sheffield, Univ. of Michigan (1014-13-564)
- 5:45PM Discussion

AMS Special Session on Extension of Functions, II

2:15 PM – 5:35 PM

Organizers: **Alvario Arias**, University of Denver
Charles L. Fefferman, Princeton University
Edward W. Odell, University of Texas Austin
Thomas Slumprecht, Texas A&M University

- 2:15PM *Extending Lipschitz and linear maps.*
(254) **Nigel Kalton**, University of Missouri (1014-46-926)
- 2:45PM *Lipschitz selections and extensions of smooth functions.*
▶ (255) **Pavel Shvartsman**, Technion - Israel Institute of Technology (1014-46-546)
- 3:15PM *Probabilistic techniques in the Lipschitz extension problem.*
(256) **Assaf Naor**, Microsoft Research (1014-51-441)
- 3:45PM *How Markov chains reflect geometry.*
(257) **Keith M. Ball**, University College London (1014-46-1124)
- 4:15PM *C^1 extensions and stabilization of Glaeser refinements.*
(258) **Nahum Zobin***, College of William and Mary, and **Bo'az Klartag**, Institute for Advanced Study (1014-26-455)

- 4:45PM *Examples concerning extensions of Lipschitz maps from metric spaces into ℓ_1^n* . Preliminary report. **Beata Randrianantoanina**, Miami University of Ohio (1014-46-1523)
- 5:15PM *The Holomorphic Extension of CR Functions on Tube-Like CR Manifolds of CR Dimension 1: An Alternative to Wedge Extendability*. **Jennifer Halfpap**, University of Montana (1014-32-118)

MAA Minicourse #13: Part A

2:15 PM – 4:15 PM

The Fibonacci and Catalan numbers.
Organizer: **Ralph P. Grimaldi**, Rose-Hulman Institute of Technology

MAA Minicourse #2: Part A

2:15 PM – 4:15 PM

Java applets in teaching mathematics.
Organizers: **Joe Yanik**, Emporia State University
Michael E. Mays, West Virginia University

MAA Minicourse #8: Part A

2:15 PM – 4:15 PM

Mathematical and statistical modeling in biology: Competitive exclusion, coexistence, estimation, and control.
Organizers: **Azmy S. Ackleh**, University of Louisiana at Lafayette
H. Thomas Banks, North Carolina State University

AMS Session on Probability and Stochastic Processes

2:15 PM – 5:40 PM

- 2:15PM *Extinction of Generalized Branching Annihilating Random Walks*. Preliminary report. **Ryan S. Gantner**, University of Minnesota (1014-60-524)
- 2:30PM *Birth-Death Processes with Polynomial Transition Rates*. **Robert L. Bewernick**, University of California, Los Angeles, **Jeremy D. Dewar***, Loyola Marymount University, **Eunice Gray**, Sam Houston State University, **Nancy Y. Rodriguez**, Loyola Marymount University, and **Randall J. Swift**, California State Polytechnic University Pomona (1014-60-587)
- 2:45PM *Busy Period of a Delayed Service M/M/c Queueing System*. **Aliakbar Montazer Haghighi*** and **Dimitar P. Mishev**, Prairie View A&M University (1014-60-181)
- 3:00PM *Random, Finite Subsets with Exponential Distributions*. Preliminary report. **Kyle T. Siegrist**, University of Alabama in Huntsville (1014-60-1444)
- 3:15PM *Simple formulas for conditional function space integrals and applications*. **Seung Jun Chang**, **Jae Gil Choi**, Dankook University, and **David L. Skoug***, University of Nebraska-Lincoln (1014-60-686)

- 3:30PM *The Mean-Field Blume-Emery-Griffiths Model with Varying Parameters*. **Peter T. Otto***, Union College, **Marius Costeniuc**, Max-Planck Institute for Mathematics in the Sciences, and **Richard S. Ellis**, University of Massachusetts, Amherst (1014-60-688)
- 3:45PM *Tail behavior of negatively associated heavy tailed sums*. Preliminary report. **Jaap L. Geluk***, The Petroleum Institute, and **Kai W. Ng**, University of Hong Kong (1014-60-838)
- 4:00PM *Sums of Point Processes and Attribute-Based Thinnings Leading to an Unusual Poisson Process*. **Matthew O. Jones***, Austin Peay State University, and **Richard F. Serfozo**, Georgia Institute of Technology (1014-60-1004)
- 4:15PM *Optimal buy/sell rules for correlated random walks*. Preliminary report. **Michael G. Monticino*** and **Pieter Allaart**, University of North Texas (1014-60-1147)
- 4:30PM *The “Taylor” Map on a Hilbert Space of Holomorphic Functions on the Path Space of a Complex Simply Connected Lie Group*. **Matthew S. Cecil**, UCSD (1014-60-1283)
- 4:45PM *Minimal Axiom Sets for Poisson Processes*. **Donald P. Minassian**, Butler University, Indianapolis, IN 46208 (1014-60-457)
- 5:00PM *Toward a Classification of Infinite Discrete Probability Measures*. **H. Radjavi**, University of Waterloo, and **Chelluri C.A. Sastri***, Dalhousie University (1014-60-1550)
- 5:15PM *Uniqueness for Martingale Problem Associated with Pure Jump Processes*. **Huili Tang**, University of Connecticut (1014-60-1704)
- 5:30PM *Ruin Probabilities on Two Finite State, Birth-Death Chains Connected in Parallel*. Preliminary report. **Alan Krinik*** and **Chau Nguyen**, California State Polytechnic University, Pomona (1014-60-1746)

AMS Session on Combinatorics, II

2:15 PM – 5:55 PM

- 2:15PM *2-Regular Leaves of Partial 8-cycle Systems*. **D. J. Ashe***, University of Tennessee at Chattanooga, **C. D. Leach**, University of West Georgia, and **C. A. Rodger**, Auburn University (1014-05-602)
- 2:30PM *Ihara zeta functions of irregular graphs and the deletion of edges*. **Matthew D. Horton**, University of California, San Diego (1014-05-681)
- 2:45PM *Shellability properties on planar graded posets*. **I. V. Cane**, Wesleyan University (1014-06-1452)
- 3:00PM *Generating functions for the alternative multi-restricted numbers*. Preliminary report. **Ji Young Choi**, Shippensburg University of PA (1014-05-781)
- 3:15PM *On the Degree of Regularity for the Equation $x_1 + x_2 + \dots + x_n = ay = 0$* . Preliminary report. **Ronald J. Clark**, UCLA (1014-05-790)
- 3:30PM *Probe interval orders*. **David E. Brown**, Utah State University, and **Larry J. Langley***, University of the Pacific (1014-05-822)
- 3:45PM *Survey on (96, 20, 4) difference sets*. **Omar A. AbuGhneim*** and **Ken W. Smith**, Central Michigan University (1014-05-832)
- 4:00PM *Permutation Reconstruction*. **Rebecca N. Smith**, SUNY Brockport (1014-05-849)

- 4:15PM *Largest Circuit Pairs in Matroids.*
(283) **Manoel Lemos**, Universidade Federal de Pernambuco, **Talmage J. Reid**, **Bryan Williams*** and **Haidong Wu**, University of Mississippi (1014-05-878)
- 4:30PM *A combinatorial model of the associated Hermite polynomials.* Preliminary report.
▶ (284) **Dan Drake**, University of Minnesota (1014-05-910)
- 4:45PM *Clones in minors of matroids.* Preliminary report.
(285) **Joseph E. Bonin**, The George Washington University, **Carla D. Cotwright***, **Talmage J. Reid**, The University of Mississippi, and **Jakayla Robbins**, The University of Montana (1014-05-929)
- 5:00PM *Minimally 3-connected Binary Matroids.*
(286) **Joe Anderson*** and **Haidong Wu**, The University of Mississippi (1014-05-954)
- 5:15PM *Some plethysm results related to Foulkes's conjecture.*
(287) **Steven W. Sivek**, Massachusetts Institute of Technology (1014-05-1031)
- 5:30PM *Isosceles colorings of triangulations and their geometrical realizations.*
▶ (288) **Joseph Malkevitch**, York College (CUNY) (1014-05-1064)
- 5:45PM *Holey Knight's Tours.*
▶ (289) **Darren A. Narayan*** and **Shelley K. Speiss**, Rochester Institute of Technology (1014-05-1065)

AMS Session on Number Theory, II

2:15 PM – 5:55 PM

- 2:15PM *Additive Theorems and Davenport Constant over Finite Groups.*
(290) **Chuang Peng**, Morehouse College (1014-11-527)
- 2:30PM *Factoring Generalized Repunits.* Preliminary report.
▶ (291) **John H. Jaroma**, Austin College (1014-11-600)
- 2:45PM *Sequences of Reducible $\{0, 1\}$ -Polynomials over \mathbb{F}_p .*
▶ (292) **Judith Canner**, North Carolina State University, **Lenny Jones** and **Joseph Purdom***, Shippensburg University (1014-11-1468)
- 3:00PM *On the Galois group of the 2-class tower of a quadratic field.* Preliminary report.
(293) **Aliza A. Steurer**, University of Maryland (1014-11-928)
- 3:15PM *Bounds on a Remainder Term Associated with the Number of Base q Digits $\geq d$ Function.*
(294) **Curtis Cooper**, Central Missouri State University (1014-11-987)
- 3:30PM *A relative trace formula in the local setting.* Preliminary report.
(295) **Brooke G. Feigon**, UCLA (1014-11-1034)
- 3:45PM *Zeros of Zeta Functions of Irregular Graphs.* Preliminary report.
(296) **Audrey A. Terras**, U.C.S.D. (1014-11-1038)
- 4:00PM *Homogeneous additive equations in finite fields.*
(297) **Michael P. Knapp**, Loyola College (1014-11-1094)
- 4:15PM *Algebraic Integers on the Unit Circle.*
(298) **Ryan C. Daileida**, Dartmouth College (1014-11-1145)
- 4:30PM *Quadratic twists of an elliptic curve with small Selmer rank.* Preliminary report.
(299) **Sungkon Chang**, Armstrong Atlantic State University (1014-11-1206)
- 4:45PM *A New Generalization of the Woods-Robbins Infinite Product to Base B .*
▶ (300) **Jonathan Sondow**, New York, NY (1014-11-1281)

- 5:00PM *Local Coefficient Matrices and Shimura's Correspondence.* Preliminary report.
(301) **Mark Budden**, Armstrong Atlantic State University (1014-11-1287)
- 5:15PM *Local corrections of discriminant bounds and S_n -extensions of quadratic base fields.* Preliminary report.
(302) **Sharon Brueggeman***, University of Tennessee at Chattanooga, and **Darrin Doud**, Brigham Young University (1014-11-1460)
- 5:30PM *Message Encoding on Elliptic Curves over Characteristic 2 in Deterministic Polynomial Time.*
(303) **Andrew R. Shallue**, University of Wisconsin-Madison (1014-11-1461)
- 5:45PM *Polynomial Sequences Generated by Fibonacci & Lucas Numbers.* Preliminary report.
▶ (304) **Donald D. Mills**, Southern Illinois University (1014-11-670)

MAA Session on Professional Development Programs for K-12 Teachers, II

2:15 PM – 4:10 PM

- Organizers: **Zsuzsanna Szaniszló**, Valparaiso University
Laurie Burton, Western Oregon University
Judith L. Covington, Louisiana State University Shreveport
Patricia Hale, California State Polytechnic University, Pomona

- 2:15PM *A Lesson Study Program for Middle and High School Teachers.* Preliminary report.
▶ (305) **Thomas W. Judson**, Harvard University (1014-D1-1015)
- 2:35PM *A Master of Arts Program for High School and Middle School Teachers.*
(306) **Joseph R. Fiedler**, CSU Bakersfield (1014-D1-318)
- 2:55PM *Integrated Math, Physical Science, and Technology Professional Development Program for 7-11 Grade Teachers.*
(307) **Becky Krakowski**, University of Dayton (1014-D1-396)
- 3:15PM *Empowering K-12 Teachers to Use Technology Wisely.*
(308) **Jerry Dwyer**, **Gary Harris**, **Tara Stevens** and **G. Brock Williams***, Texas Tech University (1014-D1-640)
- 3:35PM *A Mathematics Partnership with ESL Teachers: The Second Year.*
▶ (309) **Mary K. Porter*** and **Colleen M. Hoover**, Saint Mary's College, Notre Dame (1014-D1-1160)
- 3:55PM *Fostering Mathematical Research by Teachers.*
(310) **S. Rosenberg***, Boston University, **M. Spillane** and **D. Wulf**, Watertown HS, Watertown, MA (1014-D1-1493)

MAA Session on Number-Theoretic Applications

2:15 PM – 4:30 PM

- Organizers: **Thomas Koshy**, Framingham State College
Thomas Moore, Bridgewater State College
- 2:15PM *Number Theory, Polynomials, and the Advanced Encryption Standard.*
▶ (311) **Joshua Holden**, Rose-Hulman Institute of Technology (1014-E1-859)

Program of the Sessions – Thursday, January 12 (cont'd.)

- 2:35PM *Number Theoretic Applications to Group Generated Cellular Automata*. Preliminary report.
▶ (312) **Mike Bardzell***, Salisbury University, and **Tyler Evans**, Humboldt State University (1014-E1-1185)
- 2:55PM *Applications of Number Theory in Computer Science Curriculum*. Preliminary report.
▶ (313) **Yana Kortsarts**, Widener University, Computer Science Department (1014-E1-383)
- 3:15PM *A Number Theory Application to Origami*. Preliminary report.
▶ (314) **Tamara B. Veenstra**, University of Redlands (1014-E1-185)
- 3:35PM *Non-Cantorian Cardinal Numbers*.
▶ (315) **H. Vic Dannon**, California (1014-E1-583)
- 3:55PM *New results on Jacobsthal and Fibonacci polynomials*. Preliminary report.
▶ (316) **Mohammad Salmassi*** and **Thomas Koshy**, Framingham State College (1014-E1-1257)
- 4:15PM *Tribinomials, Catalan Numbers, and Mersenne Numbers*.
▶ (317) **Thomas Koshy**, Framingham State College (1014-E1-1756)

MAA Session on Teaching Mathematics Courses Online

2:15 PM – 5:15 PM

Organizers: **Kate McGivney**, Shippensburg University
Cheryl L. Olsen, Shippensburg University

- 2:15PM *An Online College Algebra Course*.
(318) **Linda E. Sundbye**, Metropolitan State College of Denver (1014-F1-1597)
- 2:35PM *"Snap, Pop, Crackle": Calculus Online*. Preliminary report.
▶ (319) **Denise LeGrand**, University of Arkansas at Little Rock (1014-F1-901)
- 2:55PM *Suggestions for Some Tough Online Issues*.
▶ (320) **Karl J. Havlak**, Angelo State University (1014-F1-401)
- 3:15PM *The Efficacy of Online Mathematics Courses: How Well Are Students Learning Mathematics In Online Course Environments*.
(321) **John T. Smith**, Hawaii Pacific University (1014-F1-384)
- 3:40PM *Engaging Students in On-Line Course Learning*. Preliminary report.
▶ (322) **Robert N. Andersen*** and **Simei Tong**, University of Wisconsin-Eau Claire (1014-F1-253)
- 4:00PM Break.
- 4:20PM *A Mathematica and XML-based Content Management System for the Delivery of Online Mathematics Courses*.
(323) **Kyehong Kang**, Lamar University (1014-F1-1726)
- 4:40PM *The Tale of Two Online Courses in Elementary Mathematics*. Preliminary report.
▶ (324) **Thomas M. Zachariah*** and **Curtis Bennett**, Loyola Marymount University (1014-F1-1112)
- 5:00PM *Statistics: Meet Me Online*.
▶ (325) **Sarah L. Mabrouk**, Framingham State College (1014-F1-1731)

MAA Session on Teaching and Assessing Modeling and Problem Solving

2:15 PM – 5:50 PM

Organizers: **Michael Huber**, U.S. Military Academy

- 2:15PM *Assessing Student Problem Solving Abilities Using Complex Projects*.
(326) **Alex J. Heidenberg**, U.S. Military Academy
- 2:55PM *Assessing Success in a Modeling Course*.
▶ (328) **Stuart Boersma**, Central Washington University (1014-G1-609)
- 3:15PM *Selecting Problems for Use in Problem-Solving Courses for Pre-Service Teachers*.
▶ (329) **Kathleen D. Lopez**, University of Louisiana at Lafayette (1014-G1-1681)
- 3:35PM *A problem solving class for math majors*.
▶ (330) **Maria S. Nogin**, California State University, Fresno (1014-G1-1645)
- 3:55PM *Assessing Critical Thinking Skills While Improving Student Confidence in a Pre-Calculus College Course*. Preliminary report.
▶ (331) **Heather Stevenson*** and **Gerald Kobylski**, United States Military Academy (1014-G1-1455)
- 4:15PM *Using the Math Forum to Teach an Elementary Problem Solving Course for Pre-Service Teachers*.
▶ (332) **Klay Kruczek**, Western Oregon University (1014-G1-942)
- 4:35PM *A Problem Solving Course for Seniors and Juniors*. Preliminary report.
▶ (333) **Thomas W. Mattman**, California State University, Chico (1014-G1-1619)
- 4:55PM *Teaching Calculus Based Probability and Statistics with Technology*. Preliminary report.
▶ (334) **Andrew G. Glen**, United States Military Academy (1014-G1-1751)
- 5:15PM *A new framework for grading open-ended problem solutions*. Preliminary report.
(335) **Kris Green*** and **Allen Emerson**, St. John Fisher College (1014-G1-1546)
- 5:35PM *Modeling Problems and Remodeling Attitudes*. Preliminary report.
▶ (336) **Michael Huber***, **Alex Heidenberg**, **Richard Brown**, **Gabriel Costa** and **Jason Miseli**, U.S. Military Academy (1014-G1-749)

MAA Session on Getting Students to Discuss and to Write about Mathematics, II

2:15 PM – 5:55 PM

Organizers: **Martha Ellen Murphy Waggoner**, Simpson College
Charlotte A. Knotts-Zides, Wofford College
Harrison W. Straley, Wheaton College

- 2:15PM *Mathematics Seminar at Central College*. Preliminary report.
▶ (337) **Russell E. Goodman**, Central College (1014-H1-509)
- 2:30PM *The senior project as a method of teaching writing and oral presentation*. Preliminary report.
▶ (338) **Albert W. Schueller**, Whitman College (1014-H1-1476)

- 2:45PM *Teaching Mathematical Writing Electronically.*
▶ (339) **Carl Spitznagel**, John Carroll University (1014-H1-353)
- 3:00PM *Using Peer Review to Improve Students' Proof Writing.*
(340) **Teresa D. Magnus**, Rivier College (1014-H1-205)
- 3:15PM *Using Peer Review to Improve Students' Mathematical Writing.*
▶ (341) **Penelope H. Dunham**, Muhlenberg College (1014-H1-487)
- 3:30PM *What Makes a Given Proof the Best Proof?*
▶ (342) Preliminary report.
Linda McGuire, Muhlenberg College (1014-H1-906)
- 3:45PM *Mathematics Career Simulations.*
(343) **Robb Sinn**, North Georgia College & State University (1014-H1-299)
- 4:00PM *From "...without words" to "only with words"—an experience with proofs.*
▶ (344) **Greisy Winicki-Landman**, Cal Poly Pomona, California (1014-H1-96)
- 4:15PM *The Use of Client Driven Projects for Discussing and Writing in Linked Mathematics and Computer Technology Courses.*
▶ (345) **Morteza Shafii-Mousavi** and **Paul Kochanowski***, Indiana University South Bend (1014-H1-101)
- 4:30PM *Dynamical Systems Modules Facilitating Student Driven Discussion and Projects, Part I.*
(346) **Aimee Johnson**, Swarthmore College, **Kathleen Madden***, Drew University, and **Ayse Sahin**, DePaul University (1014-H1-55)
- 4:45PM *Dynamical Systems Modules Facilitating Student Driven Discussion and Projects, Part 2.* Preliminary report.
▶ (347) **Aimee Johnson***, Swarthmore College, **Kathleen Madden**, Drew University, and **Ayse Sahin**, DePaul University (1014-H1-56)
- 5:00PM *Students Write Mathematics - Instructors Do Not Need To Grade.*
(348) **Mary Kay Abbey**, Montgomery College, MD (1014-H1-532)
- 5:15PM *Pass it On.*
(349) **Andrew J. Miller**, Belmont University (1014-H1-418)
- 5:30PM *Experimental Mathematics and Writing: Motivating First Year Students.*
(350) **David A. Brown**, Ithaca College (1014-H1-369)
- 5:45PM *Transforming Math Into Words And Attitudes Into Delight.*
▶ (351) **Deborah Lynn Gochenaour**, Elizabethtown College (1014-H1-1307)
- 2:30PM *Using Alice Software in Middle Schools.*
▶ (353) **Agata Dean***, **Barbara Moskal**, Colorado School of Mines, **Steven Cooper**, St. Joseph's University, and **Wanda Dann**, Ithaca College (1014-Z1-1356)
- 2:45PM *Hand-Held Technology in Mathematics Teacher Preparation Courses.*
▶ (354) **Mary Ann Connors**, Westfield State College (1014-Z1-843)
- 3:00PM *Developing Pedagogical Content Knowledge Through Lesson Study: A Capstone Experience for In-service Teachers in Mathematics and Science.* Preliminary report.
▶ (355) **Diane Barrett**, St. John Fisher College (1014-Z1-1144)
- 3:15PM *Models for middle school gifted students in mathematics, chemistry and engineering summer camp activities.*
▶ (356) **Faiz B. Al-Rubaei**, University of North Florida (1014-Z1-356)
- 3:30PM *Korean K-12 Mathematics Education System: What Can We Learn for the Undergraduate Mathematical Preparation of Teachers in the United States?* Preliminary report.
▶ (357) **Ward E. Canfield**, National-Louis University (1014-Z1-1566)
- 3:45PM *Preparing K - 12 Mathematics Teachers.*
▶ (358) **Kenneth J. Bernard**, Virginia State University (1014-Z1-938)
- 4:00PM *College Math in High School: Why Not?*
▶ (359) **Jerry F. Dwyer***, **Leah Chenault** and **Billy Duke**, Texas Tech University (1014-Z1-969)
- 4:15PM *Three interesting Calculus Problems.* Preliminary report.
▶ (360) **Heakyung Lee**, Winthrop University (1014-Z1-817)
- 4:30PM *On the length and area of the unit disc in normed planes.* Preliminary report.
▶ (361) **Zokhrab Mustafaev**, Ithaca College (1014-Z1-315)
- 4:45PM *Finite Groups with Cyclic Autocommutator Subgroups.*
▶ (362) **Marian Deaconescu**, Kuwait University, and **Gary L. Walls***, West Texas A&M University (1014-Z1-362)
- 5:00PM *Using Euclidean Area Formulas to Find Genral Sequence Rules.* Preliminary report.
▶ (363) **Mohammed A. Hamid**, Temple University (1014-Z1-825)
- 5:15PM *Animated Examples of Curl.*
(364) **Michael Rogers**, Oxford College of Emory University (1014-Z1-678)
- 5:30PM *Clarifying the parallels between single-variable and multivariate calculus: Creating a more cohesive curriculum.* Preliminary report.
▶ (365) **Robert A. Peacock**, Young Harris College (1014-Z1-1729)

MAA General Contributed Paper Session, II

2:15 PM – 5:40 PM

- Chair: **Shawnee L. McMurrin**, California State University San Bernadino
- Chair: **Jeff L. Hirst**, Appalachian State University
- Organizers: **Stephen L. Davis**, Davidson College
Eric S. Marland, Appalachian State University

- 2:15PM *Is there a "real" problem with your mathematical software?* Preliminary report.
▶ (352) **Richard J. Marchand***, Slippery Rock University, and **Timothy J. McDevitt**, Elizabethtown College (1014-Z1-478)

SIAM Minisymposium on Geometric Representations of Graphs

2:15 PM – 5:30 PM

- Organizers: **Alice M. Dean**, Skidmore College
Ellen Gethner, University of Colorado at Denver
Joshua D. Laison, Colorado College

- 2:15PM *On Visibility Representations of Graphs.*
(366) **Sue Whitesides**, McGill University (1014-05-1042)

- 2:40PM *Bar k-Visibility Graphs*.
 ▶ (367) **Alice M. Dean**, Skidmore College, **William Evans**, University of British Columbia, **Ellen Gethner**, University of Colorado at Denver, **Joshua D. Laison***, Colorado College, **Mohammad A. Safari**, University of British Columbia, and **William T. Trotter**, Georgia Institute of Technology (1014-05-1474)
- 3:05PM *Further results on bar k-visibility graphs*.
 ▶ (368) Preliminary report.
Stephen G. Hartke*, **Jennifer Vandebussche** and **Paul Wenger**, University of Illinois at Urbana-Champaign (1014-05-1371)
- 3:30PM *Locally Planar Graphs*. Preliminary report.
 (369) **Michael O. Albertson**, Smith College (1014-05-631)
- 3:55PM *Connecting the isometric embedding dimension and the determining number of a graph*. Preliminary report.
 (370) **Debra Boutin**, Hamilton College (1014-05-827)
- 4:20PM *Highly Modulo Linked Graphs*.
 (371) **Guantao Chen***, Georgia State University, and **Zhiquan Hu**, Huazhong Normal University (1014-05-1367)
- 4:45PM *A Force-Directed Graph Drawing Approach for Computer Chip Layout*. Preliminary report.
 ▶ (372) **Greta Pangborn***, **Joanna Ellis-Monaghan**, Saint Michael's College, **Paul Gutwin**, Cadence Design Systems, and **Jamey Lewis**, Saint Michael's College (1014-68-1229)
- 5:10PM *Thickness-Two Graphs: New Approaches and Generalizations*. Preliminary report.
 (373) **Debra L. Boutin**, Hamilton College, **Priyadarshini Das** and **Ellen Gethner***, University of Colorado at Denver (1014-05-1108)

SIAM Minisymposium on Education: Preparing Mathematics Students for Interdisciplinary Research

2:15 PM – 5:10 PM

- Organizer: **William L. Briggs**, University of Colorado at Denver
- 2:15PM *Computational Science Education and Research for Undergraduate Biology Majors*.
 ▶ (374) **Angela B. Shiflet**, Wofford College (1014-97-1168)
- 2:45PM *Collaborative Research with Math and Biology Majors*. Preliminary report.
 ▶ (375) **Suzanne Lenhart**, University of Tennessee (1014-92-1186)
- 3:15PM *A Team Learning Approach to Teaching Bioinformatics*.
 (376) **Laurie J. Heyer**, Davidson College (1014-97-1338)
- 3:45PM *PRIMES (PRogram for Interdisciplinary Mathematics, Ecology, and Statistics)*.
 (377) **Donald Estep***, **Jay Breidt**, **Richard Davis** and **Simon Tavener**, Colorado State University (1014-97-875)
- 4:15PM *Industrial Mathematics Program at the University of Minnesota*.
 (378) **Fadil Santosa**, University of Minnesota (1014-97-829)
- 4:45PM *Interdisciplinary Education in a World of Stovepipes*.
 ▶ (379) Preliminary report.
C. David Levermore, University of Maryland, College Park (1014-97-1777)

MAA Invited Paper Session on Assessment of Learning in the Mathematics Major

2:15 PM – 5:10 PM

- Organizers: **Bernard L. Madison**, University of Arkansas
William E. Haver, Virginia Commonwealth University
- 2:15PM *Specialized Assessment Tools in a Complex Setting*.
 (380) **Shahar Boneh*** and **Larry Johnson**, Metropolitan State College of Denver (1014-ZB-263)
- 2:45PM *Developing and Assessing a Mathematics Inquiry Course*. Preliminary report.
 ▶ (381) **Barbara B. Ward***, **Mike Pinter** and **Mary Goodloe**, Belmont University (1014-ZB-297)
- 3:15PM *Moving from Reactive to Proactive Assessment*.
 ▶ (382) Preliminary report.
David Gurney* and **Rebecca Muller**, Southeastern Louisiana University (1014-ZB-282)
- 3:45PM *Assessment of Student Learning Using Oral Presentations*.
 ▶ (383) **Lyn Stallings*** and **Dan Kalman**, American University (1014-ZB-300)
- 4:15PM *How to Evolve Rubrics to Assess the Skills of Math Majors*.
 (384) **Mark Schlatter*** and **Derrick Head**, Centenary College of Louisiana (1014-ZB-296)
- 4:45PM *The Symbiotic Relationship between the Assessment Programs for Mathematics and Mathematics Education at Kennesaw State University*.
 (385) **Mary L. Garner**, **Lewis N. VanBrackle** and **Virginia R. Watson***, Kennesaw State University (1014-ZB-308)

MAA Invited Paper Session on Environmental Modeling

2:15 PM – 4:10 PM

- Organizer: **Ben A. Fusaro**, Florida State University
- 2:15PM *Modeling the predator-prey relationship*.
 (386) **Mike Olinick**, Middlebury College (1014-ZC-1328)
- 2:45PM *A mathematical look at extinction*.
 (387) **Roland Lamberson**, Humboldt State University, Arcata, CA (1014-ZC-1335)
- 3:15PM *White water rafting in the Grand Canyon*.
 (388) **Catherine Roberts**, College of the Holy Cross (1014-ZC-1342)
- 3:45PM *Algorithms for modeling flow and reactive transport in porous media*.
 (389) **Shuyu Sun*** and **Mary Wheeler**, Institute for Computational Engineering & Science, University of Texas, Austin, TX (1014-ZC-1348)

Project NExT Panel Discussion

2:15 PM – 3:45 PM

- Firefighting, paper trailing, and cat herding: Everything you wanted to know to be an administrator but were afraid to ask.*
- Organizers: **Linda Braddy**, East Central University
Rebekah Dupont, Augsburg College
- Panelists: **Charlotte J. Chell**, Carthage College
Amy Cohen, Rutgers University
Susan C. Geller, Texas A&M University
Dennis M. Luciano, Western New England College
Mickey McDonald, Occidental College

Jack Narayan, SUNY Oswego

MAA Committee on Graduate Students-YMN Panel Discussion

2:15 PM – 3:35 PM

How to interview for your first job.

- Organizer: **David C. Manderscheid**, University of Iowa
 Panelists: **Sharon M. Clarke**, Pepperdine University
James H. Freeman, Cornell College
David C. Manderscheid
John A. Vano, University of Wisconsin

MAA Panel Discussion

2:15 PM – 3:35 PM

Advice and admonitions for NSF projects: What worked, what did not, and what lessons were learned.

- Organizers: **Tingxiu Wang**, Oakton Community College
Elizabeth J. Teles, NSF Division of Undergraduate Education
Joe Kotowski, Oakton Community College
Gloria E. Liu, Oakton Community College
 Panelists: **Shirley B. Gray**, California State University-Los Angeles
Deborah Hughes-Hallett, University of Arizona
David A. Smith, Duke University
Ignatios E. Vakalis, Capital University
Sharon Cutler Ross, Georgia Perimeter College
Philip D. Wagreich, University of Illinois-Chicago

AMS Session on Optimization and Control

2:30 PM – 5:55 PM

- 2:30PM *The Mathematics of Space Shuttle Return to Flight: Impact Damage Modeling.* (390)
James D. Walker, Southwest Research Institute (1014-74-73)
 2:45PM *Optimization of composite structures subject to local stress constraints.* (391)
Michael Stuebner* and **Robert Lipton**, Louisiana State University (1014-74-1407)
 3:00PM *Second Order Optimality Conditions Based on Second Order Tangent Cones.* (392)
Elena Constantin, University of Pittsburgh at Johnstown (1014-49-642)
 3:15PM *On the Dynamic Programming Equation for a Deterministic Optimal Control Problem.* (393)
Betsi J. Tirado*, Universidad del Zulia, Maracaibo, Venezuela, and **Jesus A. Pascal**, Louisiana State University, Baton Rouge (1014-49-110)
 3:30PM *Nonlinear Periodic Optimal Control: A Pseudospectral Fourier Approach.* (394)
Gamal N. Elnagar, University of South Carolina Upstate (1014-49-220)

- 3:45PM *Fenchel Transform of a Convex Functional.* (395)
Y. Chen, M. Rao and **J. C. Tweddle***, University of Florida (1014-49-1091)
 4:00PM *Optimal Harvesting of a Semilinear Elliptic Fishery Model.* Preliminary report. (396)
Wandi Ding*, University of Tennessee - Knoxville, and **Suzanne Lenhart**, University of Tennessee - Knoxville & Oak Ridge National Laboratory (1014-49-1167)
 4:15PM *Optimal control of a biharmonic obstacle problem.* Preliminary report. (397)
David R. Adams, University of Kentucky, **Volodymyr Hrynkiw*** and **Suzanne M. Lenhart**, University of Tennessee (1014-49-1197)
 4:30PM *Optimal Control of Swinging Elements in a Parabolic Competition Model.* Preliminary report. (398)
Erika Asano, University of Tennessee, Knoxville (1014-49-1210)
 4:45PM *On convergence of computational methods for optimal control of re-entrant queues on bounded domain.* (399)
José María Menéndez* and **Martin V. Day**, Virginia Tech (1014-49-1739)
 5:00PM *An optimization framework for polynomial zerofinders.* (400)
Aaron Melman*, Santa Clara University, and **William B. Gragg**, Naval Postgraduate School (1014-65-863)
 5:15PM *Maximizing the generalized Fekete-Szegő functional over a class of hyperbolically convex functions.* Preliminary report. (401)
Roger W. Barnard, **David R. Martin*** and **G. Brock Williams**, Texas Tech University (1014-30-1414)
 5:30PM *Some PDE models for the simulation of alcohol transport in the body and extensions of the Kalman filtering to non-normal distributions.* Preliminary report. (402)
Miguel A. Dumett, University of Southern California (1014-49-1346)
 5:45PM *A Homogenization Result in the Gradient Theory of Phase Transitions.* (403)
Irene Fonseca, Carnegie Mellon University, and **Cristina Popovici***, University of Utah (1014-49-154)

MAA Section Officers

2:30 PM – 5:00 PM

MAA Invited Address

3:20 PM – 4:10 PM

- (404) *Participation in mathematics by American Indians: A case study in underrepresentation.*
Robert E. Megginson, University of Michigan, Ann Arbor (1014-A0-11)

AWM Panel Discussion

3:20 PM – 4:35 PM

- Lawrence Summers: One year later.*
 Organizer: **Barbara Lee Keyfitz**, Fields Institute and University of Houston
 Panelists: **Richard M. Dudley**, M.I.T.
Mary W. Gray, American University
Ellen E. Kirkman, Wake Forest University
M. Beth Ruskai, Tufts University

Alice Silverberg, University of California Irvine
Karen Uhlenberg, University of Texas at Austin

MAA-YMN Panel Discussion

3:50 PM – 5:10 PM

You have a job, now what? Professional development opportunities.

Organizers: **Kimberly A. Roth**, Wheeling Jesuit University
Joshua D. Laison, Colorado College
Sarah Ann Stewart, Belmont University

Panelists: **Janet L. Andersen**, Hope College
Eric W. Aurand, Eastfield College
Carolyn S. Gordon, Dartmouth College
Jacqueline A. Jensen, Sam Houston State University
Michael B. Scott, California State University Monterey Bay
Francis E. Su, Harvey Mudd College

MAA Special Presentation

4:00 PM – 4:45 PM

The great Pi/e debate.

Organizers: **Colin C. Adams**, Williams College
Thomas Garrity, Williams College

Moderator: **Edward B. Burger**, Williams College

Welcome Reception for Undergraduate Students

4:00 PM – 5:00 PM

SIGMAA on Environmental Mathematics Business Meeting and Special Invited Presentation

4:15 PM – 6:15 PM

Organizer: **Ben A. Fusaro**, Florida State University

(405) *Complex environmental and earth systems.*
Bruce Herbert, Texas A&M University (1014-A0-52)

AMS Committee on the Profession Presentation

4:30 PM – 6:00 PM

Programs that make a difference.

Presenters: **David C. Manderscheid**, University of Iowa
Ivelisse M. Rubio, Universidad de Puerto Rico, Humacao

AWM Business Meeting

4:40 PM – 5:10 PM

MAA Minicourse #14: Part A

4:45 PM – 6:45 PM

Teaching linear algebra with applications.

Organizer: **Gilbert Strang**, Massachusetts Institute of Technology

MAA Minicourse #3: Part A

4:45 PM – 6:45 PM

Using and adapting online materials.

Organizers: **David A. Smith**, Duke University (retired)
Lang Moore, Duke University (retired)

MAA Minicourse #9: Part A

4:45 PM – 6:45 PM

Discrete dynamical systems and problem solving.

Organizers: **David C. Arney**, U.S. Military Academy
Gary W. Krahn, U.S. Military Academy

Reception for Graduate Students and First-Time Participants

5:30 PM – 6:30 PM

The AMS and MAA warmly invite these special groups to meet the leadership of your sponsoring organizations.

AMS Josiah Willard Gibbs Lecture

8:30 PM – 9:30 PM

(406) *Function, design, and evolution of gene circuitry.*
Michael A. Savageau, University of California Davis (1014-92-25)

Friday, January 13

Employment Center

7:00 AM – 7:30 PM

Joint Meetings Registration

7:30 AM – 4:00 PM

AMS-SIAM Special Session on Nonlinear Dynamical Systems, I

8:00 AM – 11:55 AM

Organizers: **Zhijun Qiao**, University of Texas Pan American

Andras Balogh, University of Texas Pan American

Guihua Fei, University of Minnesota-Duluth

Zhaosheng Feng, University of Texas Pan American

8:00AM *Nonlinear Fourier Transforms, Integrability and Nonlocality in Multidimensions.* Preliminary report.
▶ (407) **Thanasis Fokas**, University of Cambridge (1014-35-551)

8:30AM *Vortices, circulations and tropical cyclone tracks from the Euler equation.*
(408) **S. Y. Lou***, **X. Y. Tang**, Department of Physics, Shanghai Jiao Tong University, **M. Jia**, Center of Nonlinear Science, Ningbo University, and **F. Huang**, Department of Marine Meteorology, Ocean University of China, (1014-00-581)

- 9:00AM *On the well-posedness of an integrable evolution equation.* (409)
Alex A. Himonas, University of Notre Dame (1014-35-260)
- 9:30AM *Partial Differential Equations which Admit Integrable Systems.* Preliminary report. (410)
Paul F. Bracken, University of Texas (1014-53-134)
- 10:00AM *Compactly supported ground states for an equation arising in plasma physics.* (411)
Alfonso Castro*, Harvey Mudd College, and **Victor Padron**, University of Minnesota (1014-35-1213)
- 10:30AM *A Finite Dimensional Integrable System Associated with a Polynomial Eigenvalue Problem.* (412)
Taixi Xu*, Southern Polytechnic State University, and **Weihua Mu**, Shijiazhuang Railway Institute (1014-35-1020)
- 11:00AM *New Traveling Wave Solutions for Camassa-Holm Equation.* Preliminary report. (413)
Guoping Zhang*, Delaware State University, **Zhijun Qiao**, The University of Texas-Pan American, and **Fengshan Liu**, Delaware State University (1014-35-219)
- 11:30AM *A new integrable equation and its solution.* (414)
Zhijun Qiao, UTPA (1014-35-1418)

AMS-ASL Special Session on Interdisciplinary Research Involving Analysis and Logic, II

8:00 AM – 11:35 AM

Organizers: **Su Gao**, University of North Texas
Jose N. Iovino, University of Texas San Antonio
Itay Ben-Yacov, University of Wisconsin Madison

- 8:00AM *Ordinal indices in Banach spaces.* Preliminary report. (415)
Edward Odell, The University of Texas at Austin (1014-46-319)
- 8:35AM *Lattice structures and spreading models.* (416)
Stephen J. Dilworth*, University of South Carolina, **Edward Odell**, The University of Texas at Austin, and **Bunjamin Sari**, University of North Texas (1014-46-412)
- 9:10AM *Two Persons Games in Banach Spaces.* Preliminary report. (417)
Thomas Schlumprecht, Texas A&M University (1014-46-489)
- 9:35AM Break
- 10:00AM *Ergodic theory and descriptive set theory.* Preliminary report. (418)
Alexander S. Kechris, California Institute of Technology (1014-37-483)
- 10:35AM *Classifying Borel transformations in Kakutani style.* (419)
Christian Rosendal, University of Illinois at Urbana-Champaign (1014-37-1778)
- 11:10AM *Pre-compact families of finite sets of integers and weakly null sequences in Banach spaces.* (420)
Jordi Lopez-Abad, University of Paris 7, and **Stevo Todorovic***, University of Toronto and CNRS, Paris (1014-46-850)

AMS Special Session on Algebraic and Enumerative Combinatorics, I

8:00 AM – 11:50 AM

Organizers: **Catherine H. Yan**, Texas A&M University
Marcelo Aguiar, Texas A&M University

- 8:00AM *Updown categories and algebraic structures.* Preliminary report. (421)
Michael E. Hoffman, U. S. Naval Academy (1014-06-112)
- 8:30AM *P-partitions and descent algebras, enriched P-partitions and peak algebras.* Preliminary report. (422)
T. Kyle Petersen, Brandeis University (1014-05-155)
- 9:00AM *Cyclotomic Solomon Algebras.* (423)
Andrew Mathas, University of Sydney, and **Rosa C. Orellana***, Dartmouth College (1014-05-498)
- 9:30AM *Leonard Pairs and Representations of Quantum Algebras.* Preliminary report. (424)
Darren Funk-Neubauer, University of Wisconsin-Madison (1014-16-932)
- 10:00AM *The Amazing Loehr-Warrington TEN to the Power n Conjecture.* (425)
Shalosh B. Ekhad, Rutgers University, **Vince Vatter***, University of St. Andrews, and **Doron Zeilberger**, Rutgers University (1014-05-1177)
- 10:30AM *New Records for Stanley-Wilf Limits.* (426)
Miklos Bona, University of Florida (1014-05-1119)
- 11:00AM *Enumerative and Probabilistic Applications of the Extended Wilf-Zeilberger Theory.* (427)
Moa Apagodu* and **Doron Zeilberger**, Rutgers University (1014-05-1106)
- 11:30AM Discussion

AMS Special Session on Arithmetic Geometry and Modular Forms, I

8:00 AM – 11:50 AM

Organizers: **Matthew A. Papanikolas**, Texas A&M University
Ahmad M. El-Guindy, Texas A&M University

- 8:00AM *Arithmetic of Maass-Poincare series.* (428)
Ken Ono* and **Kathrin Bringmann**, University of Wisconsin, Madison (1014-11-284)
- 8:30AM *Weyl Group Multiple Dirichlet Series: The Stable Case.* (429)
Benjamin Brubaker, **Daniel Bump**, Stanford University, and **Solomon Friedberg***, Boston College (1014-11-432)
- 9:00AM *Weyl Group Multiple Dirichlet Series: The Unstable Case.* (430)
Ben Brubaker, Stanford University (1014-11-1142)
- 9:30AM *Multiple Dirichlet series over function fields.* (431)
Gautam Chinta, CUNY (City College) (1014-11-1126)
- 10:00AM *Maass-Poincaré series and p-divisibility of traces of singular moduli.* (432)
Paul Jenkins, University of Wisconsin-Madison (1014-11-766)
- 10:30AM *Congruences for the Coefficients of Weakly Holomorphic Modular Forms.* (433)
Stephanie Treneer, University of Illinois at Urbana-Champaign (1014-11-921)
- 11:00AM *Jacobi forms over complex quadratic fields.* Preliminary report. (434)
Olav K. Richter*, University of North Texas, **Kathrin Bringmann**, University of Wisconsin, and **Charles H. Conley**, University of North Texas (1014-11-341)

- 11:30AM *Counting colorings.*
(435) **Fernando Rodríguez Villegas**, University of Texas at Austin (1014-11-1417)

AMS Special Session on Recent Trends in Convex and Discrete Geometry, I

8:00 AM – 11:50 AM

Organizers: **Valeriu Soltan**, George Mason University
Tibor Bisztriczky, University of Calgary
Paul Goodey, University of Oklahoma

- 8:00AM *Approximation of the Euclidean ball by polytopes.* Preliminary report.
(436) **Carsten Schuett**, University of Kiel, Germany, and **Elisabeth Werner***, Case Western Reserve University (1014-52-1025)
- 8:30AM *Relative isoperimetric inequality outside convex bodies.*
(437) **Mohammad Ghomi***, Georgia Tech, **Jaigyoung Choe**, Seoul National University, and **Manuel Ritore**, University of Granada (1014-53-565)
- 9:00AM *A characterization of ellipsoids via illumination bodies.* Preliminary report.
(438) **Alina Stancu**, University of Massachusetts Lowell (1014-52-791)
- 9:30AM *Central limit properties of convex bodies.*
(439) **Mark W. Meckes**, Stanford University (1014-52-854)
- 10:00AM Problem Session
- 10:30AM *f-Vectors of Regular Triangulations.*
(440) **Laura J. Schmidt***, University of Wisconsin-Stout, and **Carl Lee**, University of Kentucky (1014-52-195)
- 11:00AM *Ball-Polytopes.*
▶ (441) **Károly Bezdek**, **Zsolt Lángi**, **Márton Naszódi** and **Peter Papez***, University of Calgary (1014-52-913)
- 11:30AM *On a conjecture of Ehrhart.*
(442) **Imre Bárány**, Rényi Institute of Mathematics, Hungarian Academy of Sciences, and **Attila Pór***, Case Western Reserve University (1014-52-1575)

AMS Special Session on Dynamic Equations With Applications, II

8:00 AM – 11:50 AM

- Organizers: **Allan C. Peterson**, University of Nebraska
Martin J. Bohner, University of Missouri Rolla
- 8:00AM *Time Scale Transforms.* Preliminary report.
(443) **John M. Davis**, Baylor University (1014-39-1301)
- 8:30AM *A Qualitative Analysis of the Diamond- α Dynamic Derivatives on Time Scales.* Preliminary report.
▶ (444) **James W. Rogers**, Baylor University (1014-65-1438)
- 9:00AM *Convergence of Solutions of Dynamic Equations on Converging Time Scales.* Preliminary report.
▶ (445) **Bonita A. Lawrence***, **Ralph Oberste-Vorth**, **Kelli J. Hall** and **Elizabeth R. Duke**, Marshall University (1014-34-1246)
- 9:30AM *Problems in the development of series solutions for dynamic equations on time scales.* Preliminary report.
▶ (446) **B. D. Haile**, Northwest Missouri State University, and **L. M. Hall***, University of Missouri – Rolla (1014-37-979)
- 10:00AM *Recessive Solutions of Quasilinear Dynamic Equations.*
(447) **Elvan Akin-Bohner** (1014-34-1220)

- 10:30AM *Time-Scale Integral Inequalities.*
(448) **Douglas R. Anderson**, Concordia College (1014-34-941)
- 11:00AM *Global behavior of solutions of the nonlinear difference equation $x_{n+1} = p_n + x_{n-1}/x_n$.*
▶ (449) **Richard DeVault***, Northwestern State University of Louisiana, **Vlajko Kocic** and **Donna Stutson**, Xavier University of Louisiana (1014-39-277)
- 11:30AM *A Global Attractivity Result for Maps with Invariant Boxes.*
▶ (450) **M. R. S. Kulenovic*** and **Orlando Merino**, University of Rhode Island (1014-39-148)

AMS Special Session on Nonautonomous Discrete Dynamics, I

8:00 AM – 11:50 AM

- Organizers: **Saber N. Elaydi**, Trinity University
Jim M. Cushing, University of Arizona
- 8:00AM *Dominance in the periodic Lotka-Volterra difference equation and existence of heteroclinic orbits in the Leslie matrix model.* Preliminary report.
▶ (451) **Ryusuke Kon**, Kyushu University (1014-92-531)
- 8:30AM *On persistence of coupled sink populations.* Preliminary report.
(452) **Sebastian Schreiber**, College of William and Mary (1014-37-1549)
- 9:00AM *Discrete-time model of diurnal seabird distribution with environmental forcing.* Preliminary report.
(453) **Shandelle M. Henson*** and **James L. Hayward**, Andrews University (1014-92-484)
- 9:30AM *Periodic solutions of generalized nonautonomous logistic equations.* Preliminary report.
▶ (454) **Jia Li**, University of Alabama in Huntsville (1014-39-967)
- 10:00AM *Population dynamics under bounded enforcement.* Preliminary report.
(455) **Ulrich Krause**, University of Bremen, Germany (1014-37-872)
- 10:30AM *Allee effects in a discrete-time host-parasitoid model with age structure in the host.* Preliminary report.
▶ (456) **Sophia R.-J. Jang**, University of Louisiana at Lafayette (1014-92-1118)
- 11:00AM *Stability Analysis of Pielou's Equation with Period-Two Coefficient.* Preliminary report.
▶ (457) **M. R. S. Kulenovic*** and **Orlando Merino**, University of Rhode Island (1014-39-66)
- 11:30AM *Nonautonomous delay difference equations and applications to population models.* Preliminary report.
▶ (458) **Saber N. Elaydi**, Howard University (1014-39-1361)

AMS Special Session on Algebraic Statistics: Theory and Practice, II

8:00 AM – 11:50 AM

- Organizers: **Seth M. Sullivan**, University of California Berkeley
Elizabeth S. Allman, University of Southern Maine
- 8:00AM *Identifiability of the covarian model of phylogenetics.*
(459) **Elizabeth S. Allman** and **John A. Rhodes***, University of Alaska Fairbanks (1014-92-468)

- 8:30AM (460) *Computational Support of a Conjecture on Phylogenetic Invariants for the General Markov Model for $k > 2$ states*. Preliminary report.
Thomas R. Hagedorn, The College of New Jersey (1014-62-1567)
- 9:00AM (461) *Application of Algebraic Statistics for Statistical Disclosure Limitation*.
Aleksandra B. Slavkovic, Penn State University (1014-62-1535)
- 9:30AM (462) *Relaxation Techniques for Computing Bounds on Cell Entries in Contingency Tables*. Preliminary report.
Seth Sullivan, Harvard University, and **Ruriko Yoshida***, Duke University (1014-62-265)
- 10:00AM (463) *On the geometry of the MLE in log-linear model analysis*.
Alessandro Rinaldo, Department of Statistics, Carnegie Mellon University (1014-62-1063)
- 10:30AM (464) *Secant varieties of smooth toric varieties*.
David Cox, Amherst College, and **Jessica S. Sidman***, Mount Holyoke College (1014-14-606)
- 11:00AM (465) *Algebraic factor analysis*.
Mathias Drton*, University of Chicago, **Bernd Sturmfels**, University of California Berkeley, and **Seth Sullivan**, Harvard University (1014-62-245)
- 11:30AM (466) *Parameterization of Binary Ancestral Graph Models*. Preliminary report.
Thomas S. Richardson, Department of Statistics, University of Washington (1014-62-1357)

AMS Special Session on Continued Fractions, I

8:00 AM – 11:50 AM

Organizers: **Nancy Wyshinski**, Trinity College
James G. McLaughlin, Trinity College and West Chester University

- 8:00AM (467) *Convergence of continued fractions*. Preliminary report.
Lisa Lorentzen, NTNU, Trondheim, Norway (1014-40-1052)
- 9:00AM (468) *Some Problems Suggested by Ramanujan's Work on Continued Fractions*.
Bruce C. Berndt, University of Illinois (1014-11-745)
- 9:30AM (469) *Multidimensional Continued Fractions and Toric Varieties*.
Thomas Garrity, Williams (1014-11-1068)
- 10:00AM (470) *Complex Continued Fractions*.
Doug Hensley, Texas A&M University (1014-11-37)
- 10:30AM (471) *A Randomized Variant of the Jacobi-Perron Algorithm*. Preliminary report.
Richard C. Burge, Cool, CA (1014-11-200)
- 11:00AM (472) *Quasiconformal Connections Between Continued Fractions and Circle Packings*.
G. Brock Williams, Texas Tech University (1014-30-306)
- 11:30AM (473) *A proof of the continued fraction expansion of $\exp(1/M)$* .
Thomas J. Osler, Rowan University (1014-41-801)

AMS Special Session on the Many Lives of Lattice Theory, the Theory of Ordered Sets, and Universal Algebra, I

8:00 AM – 11:50 AM

Organizers: **Japheth L. M. Wood**, Chatham College
John W. Snow, Sam Houston State University
Jonathan D. Farley, Harvard University

- 8:00AM (474) *A hyperplane arrangement arising from partially ordered voting preferences*. Preliminary report.
Eric I. Gottlieb*, Rhodes College, **Japheth Wood**, Chatham College, **Michael Ackerman**, Bellarmine University, and **Sul Young Choi**, Le Moyne College (1014-06-1604)
- 8:30AM (475) *Preliminary report on types of polynomial completeness in universal algebras*. Preliminary report.
Erhard Aichinger, Johannes Kepler University Linz (1014-08-149)
- 9:00AM (476) *Message Authentication Codes and Quasigroups*.
Kristen Meyer, Iowa State University (1014-17-909)
- 9:30AM (477) *Partial Orderings in Chemistry: Substitution-Reaction Posets*.
Douglas J. Klein, Texas A&M University at Galveston (1014-06-582)
- 10:00AM (478) *Simple Relation Algebras*.
Steven R. Givant, Mills College (1014-06-1664)
- 10:30AM (479) *Thompson monoids and Tamari lattices*. Preliminary report.
Zoran Sunik, Texas A&M University (1014-06-203)
- 11:00AM (480) *Equational Logic for Finitary Multi-Algebras*. Preliminary report.
Matt Insall, University of Missouri - Rolla (1014-08-1109)
- 11:30AM (481) *Residuated Approximations and their Connection to Cluster Analysis*. Preliminary report.
R. J. Greechie*, Louisiana Tech University, and **M. F. Janowitz**, Rutgers University (1014-06-485)

MAA Minicourse #4: Part A

8:00 AM – 10:00 AM

Creating interactive workbooks using MS excel.
Organizer: **Sarah L. Mabrouk**, Framingham State College

AMS Session on Algebra

8:00 AM – 11:55 AM

- 8:00AM (482) *An inductive algorithm for constructing c -sequences*. Preliminary report.
Hamid Kulosman, University of Louisville (1014-13-1679)
- 8:15AM (483) *The n -generator property in rings of integer-valued polynomials*.
Jason Boynton* and **Lee Klingler**, Florida Atlantic University (1014-13-1517)
- 8:30AM (484) *Arithmetic Properties of Pullbacks II*. Preliminary report.
Evan Houston and **John R. Taylor***, UNC Charlotte (1014-13-1499)
- 8:45AM (485) *Factorization in Polynomial Rings of Two Noncommuting Variables*.
Kenneth L. Price, University of Wisconsin Oshkosh (1014-16-251)
- 9:00AM (486) *A q -Hilbert matrix*.
Warren P. Johnson, Connecticut College (1014-15-575)
- 9:15AM (487) *A realization of quantum groups via product valued quivers*.
Yiqiang Li* and **Zongzhu Lin**, Kansas State University (1014-16-811)

Program of the Sessions – Friday, January 13 (cont'd.)

- 9:30AM *Projective Resolutions for Cleft Binomial Rings.*
(488) **Martin William Montgomery**, University of Oregon (1014-16-968)
- 9:45AM *Flat Braided Symmetric Algebras.*
(489) **Sebastian Zwicknagl**, University of Oregon (1014-17-1228)
- 10:00AM *A Radical Structure for Some Rings with Partial Identities.*
(490) **Karen Batt Stanish**, Keene State College (1014-17-1512)
- 10:15AM *Hyperbolically convex standard fundamental domain of a subgroup of a modular group.*
(491) **Omer Yayenie**, Murray State University (1014-11-461)
- 10:30AM *On Relative Homotopy Groups of Modules.*
(492) **C. Joanna Su**, Providence College (1014-18-1737)
- 10:45AM *Endomorphisms of Monogenic Hopf Algebras.*
(493) **Alan Koch**, Agnes Scott College (1014-14-417)
- 11:00AM *Construct Integral Matrices with Integral Inverse and Applications to Coding.*
▶ (494) **Yan Wu**, Georgia Southern University (1014-00-254)
- 11:15AM *Symmetric Brace Algebras and A_∞ Structures.*
(495) Preliminary report.
Rebecca Ann Hillman, University of South Carolina in Sumter (1014-55-1562)
- 11:30AM *Calculation of Gerstenhaber Operations on $H^*(R, R)$, when $R = \mathbb{Q}[X]/p$.* Preliminary report.
▶ (496) **R. C. Mitchell**, Purdue University (1014-55-1531)
- 11:45AM *Derived functors of the locally finite functor.*
(497) Preliminary report.
Hayden M. Harker, Vassar College (1014-55-1200)

AMS Session on Numerical Analysis and Fluid Mechanics

8:00 AM – 10:55 AM

- 8:00AM *Numerical and experimental results obtained from modeling and testing a double cover plate bolted splice connection.*
▶ (498) **Alexandros Antonioy Tasopoulos**, Athens, Greece (1014-65-02)
- 8:15AM *Total Variation Based Semi-Blind Image Deconvolution.* Preliminary report.
(499) **James H. Money**, University of Kentucky (1014-65-586)
- 8:30AM *The non-symmetric eigenvalue problem: Finding middle deflations in the QR Algorithm.* Preliminary report.
(500) **Karen Braman**, South Dakota School of Mines (1014-65-1214)
- 8:45AM *Numerical Solutions of Numerical Solutions of Robust and Minimum-Norm Quadratic Partial Eigenvalue Assignment Problems.* Preliminary report.
(501) **Sanjoy Kumar Brahma*** and **Biswa Datta**, Northern Illinois University (1014-65-1670)
- 9:00AM *Numerical Methods for Solving Ill-conditioned Nonlinear Systems.* Preliminary report.
▶ (502) **Olga Brezhneva**, Miami University (1014-65-1701)
- 9:15AM *Nonlinear Analysis and Numerical Simulations of a Two-Layer Thin Liquid Film.*
(503) **Lael S. Fisher*** and **Alexander A. Golovin**, Northwestern University (1014-76-403)
- 9:30AM *Adomian Decomposition to Solve Navier-Stokes Equations.* Preliminary report.
(504) **M. Najafi**, Kent State University, **M. Taeibi-Rahni***, Sharif University of Tech., and **A. Hassanpour**, Islamic Azad University (1014-76-1066)

- 9:45AM *On the adomian decomposition as applied to highly nonlinear two phase fluid dynamic system.*
(505) Preliminary report.
H.R. Massah, Acoustical Research Center, and **M. Najafi***, Kent State University Ashtabula (1014-76-1416)
- 10:00AM *Symmetric waves of a two layer fluid over an obstruction.*
(506) **Jeongwhan Choi*** and **W.S. Bae**, Korea University (1014-76-1750)
- 10:15AM *Influence of Surfactant on the Breakup of a Low Viscosity Jet in Highly Viscous Surrounding.*
(507) **Muhammad I. Hameed**, Benjamin Levich Institute for Physico-Chemical Hydrodynamics, CCNY New York (1014-76-1764)
- 10:30AM *Improved Generalized Quasilinearization Method and Rapid Convergence for Reaction Diffusion Equations.* Preliminary report.
(508) **Tanya G. Melton***, Louisiana State University at Alexandria, and **Aghalaya S. Vatsala**, University of Louisiana at Lafayette (1014-35-1092)
- 10:45AM *On Sobolev Spaces of Divergence-Free Vector Fields.*
(509) Preliminary report.
Pangyen Weng, Ramapo College of New Jersey (1014-76-470)

AMS Session on Partial Differential Equations, I

8:00 AM – 11:55 AM

- 8:00AM *Asymptotic behavior near transition fronts for equations of Cahn-Hilliard type.* Preliminary report.
(510) **Peter B. Howard**, Texas A&M University (1014-35-145)
- 8:15AM *Analytic solutions of some free boundary problems.*
(511) **Xuming Xie**, Morgan State University (1014-35-201)
- 8:30AM *Spatiotemporal patterns and decay in diffusive fluid mixtures.*
▶ (512) **Weijiu Liu**, University of Central Arkansas (1014-35-202)
- 8:45AM *The nonautonomous wave equation with general Wentzell boundary conditions.*
(513) **Ciprian G. Gal**, University of Memphis (1014-35-286)
- 9:00AM *On the blow-up rate of large solutions for a porous media logistic equation.* Preliminary report.
(514) **Peng Feng**, Florida Gulf Coast University (1014-35-348)
- 9:15AM *Electrophoretic Behavior of a Dispersion of Non-Newtonian Drops: Effect of Charge-Regulated Surface.*
▶ (515) **Shiojenn Tseng***, Tamkang University, **Eric Lee**, **Chia-Ping Chiang** and **Jyh-Ping Hsu**, Department of Chemical Engineering, National Taiwan University (1014-35-494)
- 9:30AM *On Normal Mode Expansion of Solutions to the Paraxial Wave Equation.*
(516) **Peter McCoy*** and **Reza Malek-Madani**, U.S. Naval Academy (1014-35-541)
- 9:45AM *Using the Finite Element Approximation of Steklov Eigenfunctions to Solve the Laplace Equation Efficiently with Multiple Boundary Data.*
(517) **Petr Kloucek**, **Danny C. Sorensen**, Rice University, and **Jennifer L. Wightman***, Coastal Carolina University (1014-35-633)
- 10:00AM *Inverse scattering algorithms for attenuating artifacts produced by internal multiple reflections (reverberations).*
(518) **Bogdan G. Nita**, Montclair State University (1014-35-757)

- 10:15AM (519) *A Degenerate Semilinear Parabolic Problem with Solution Blows Up at the Boundary.*
W. Y. Chan, Southeast Missouri State University (1014-35-795)
- 10:30AM (520) *A Compressible Viscous Heat-Conducting Fluid and Its Quasi-Static Approximation.* Preliminary report.
Gavin Waters* and Richard Weinacht, University of Delaware (1014-35-879)
- 10:45AM (521) *Wave loads due to diffraction by an elliptic structure.*
Dambaru D. Bhatta, The University of Texas-Pan American, Edinburg, TX (1014-35-915)
- 11:00AM (522) *Homogenization of a nonlinear elliptic boundary value problem modeling galvanic currents.*
Y. Sujeet Bhat, University of Florida (1014-35-950)
- 11:15AM (523) *The Existence of Global Solution of Variational Equations.*
Taewan Park*, Michigan State University, and Zhengfang Zhou, Professor/Michigan State University (1014-35-1125)
- 11:30AM (524) *Liouville Theorem for 2-D Navier-Stokes Equations.* Preliminary report.
Gabriel S. Koch, University of Minnesota, Twin Cities (1014-35-1131)
- 11:45AM (525) *Nonlinear nonautonomous parabolic evolution equations in an infinite cylinder.*
Jason R. Morris, University of Alabama at Birmingham (1014-35-1190)
- 10:15AM (535) *Isomorphic components of tensor products of bipartite graphs.*
Richard H. Hammack, Randolph-Macon College (1014-05-1184)
- 10:30AM (536) *Subdivisibility: Towards an "algebra" of connectivity.*
Thor C. Whalen, Atlanta, GA (1014-05-1254)
- 10:45AM (537) *Bounds for Recurrences on Partially Ordered Sets.*
Augustine B. O'Keefe* and Kenneth S. Berenhaut, Wake Forest University (1014-05-1392)
- 11:00AM (538) *A matroid-based decomposition of 3-connected graphs.* Preliminary report.
Brian Beavers, Louisiana State University - Baton Rouge (1014-05-1465)
- 11:15AM (539) *Using neighborhood complexes to compute rational generating functions.*
Kevin M. Woods, University of California, Berkeley (1014-05-1480)
- 11:30AM (540) *On $L(2, 1)$ -labeling of graphs.*
Jeong-Hyun Kang, University of Central Florida (1014-05-1528)
- 11:45AM (541) *The limited hats game.*
Steven K. Butler, University of California, San Diego (1014-05-1545)

MAA Session on Mathlets for Teaching and Learning Mathematics

AMS Session on Combinatorics, III

8:00 AM – 11:55 AM

- 8:00AM (526) *Ascending Subgraph Decompositions of Digraphs.* Preliminary report.
Ron Gould and Brian Charles Wagner*, Emory University (1014-05-1080)
- 8:15AM (527) *Menger Path-Systems and Minimum Graph Size.* Preliminary report.
Jeffrey S. Powell*, Emory University, Ralph J. Faudree, University of Memphis, and Ronald J. Gould, Emory University (1014-05-1083)
- 8:30AM (528) *Cycles in Bipartite Tournaments.* Preliminary report.
Darren B. Parker*, University of Dayton, Randy F. Westhoff and Marty J. Wolf, Bemidji State University (1014-05-1089)
- 8:45AM (529) *Coverings containing packings for adaptive binary block coding.* Preliminary report.
Robert B. Ellis, Illinois Institute of Technology (1014-05-1113)
- 9:00AM (530) *Critical groups of cleft graphs.* Preliminary report.
Michael Slone, University of Kentucky (1014-05-1117)
- 9:15AM (531) *On Hamiltonian Walks in Graphs.*
Ping Zhang, Western Michigan University (1014-05-1133)
- 9:30AM (532) *A construction of a projective plane in harmonic matroids.*
Rigoberto Florez, University of South Carolina Sumter (1014-05-1164)
- 9:45AM (533) *On Maximal Packings of $K_v - E(K_w)$ with 6-cycles.* Preliminary report.
L. Brown, East Tennessee State University, G. Coker, Francis Marion University, R. Gardner, East Tennessee State University, and Janie Kennedy*, Samford University (1014-05-1170)
- 10:00AM (534) *An almost bijective proof of an asymptotic property of partitions.*
Aaron D. Jaggard, Tulane University (1014-05-1181)

8:00 AM – 10:55 AM

Organizers: David M. Strong, Pepperdine University
Thomas E. Leathrum, Jacksonville State University
Joe Yanik, Emporia State University

- 8:00AM (542) *Java Applets for a Cryptology Course.*
Ulrich A. Hoensch, Rocky Mountain College (1014-B1-132)
- 8:20AM (543) *More tools for linear algebra.*
David E. Meel, Bowling Green State University (1014-B1-724)
- 8:40AM (544) *Maplets for Calculus.*
Douglas B. Meade*, University of South Carolina, and Philip B. Yasskin, Texas A&M University (1014-B1-186)
- 9:00AM (545) *Using Mathematica to Explore Algebra and Number Theory.*
Christopher P. Moretti, Southeastern Oklahoma State University (1014-B1-108)
- 9:20AM (546) *Do mathlets deliver what we want them to teach?* Preliminary report.
Andrew G. Bennett, Kansas State University (1014-B1-146)
- 9:40AM (547) *Flash as a Tool for Creating Calculus and Analysis Mathlets.*
Barbara Kaskosz, University of Rhode Island (1014-B1-250)
- 10:00AM (548) *Flash as a Tool for Creating Discrete Math Applets.*
Doug Ensley, Shippensburg University (1014-B1-249)
- 10:20AM (549) *A Sonification Mathlet for Calculus, Pre-Calculus, and Analytic Geometry.* Preliminary report.
Steven M. Hetzler* and Robert M. Tardiff, Salisbury University (1014-B1-1563)
- 10:40AM (550) *MS Excel Interactive Tools for Statistics.*
Sarah L. Mabrouk, Framingham State College (1014-B1-1724)

MAA Session on Using History of Mathematics in your Mathematics Courses

8:00 AM – 11:55 AM

Organizers: **Richard J. Jardine**, Keene State College
Amy Shell-Gellasch, Grafenwoer, Germany

- 8:00AM ▶ (551) *Motivating the Learning of Applied Mathematics with History.*
Dick Jardine, Keene State College (1014-11-1766)
- 8:20AM (552) *Historical vs axiomatic viewpoint: Teaching today foundations of geometry.*
Bogdan D. Suceava, California State University Fullerton (1014-11-129)
- 8:40AM ▶ (553) *A Different Sort of Calculus Debate.* Preliminary report.
Vicky W. Klima, Appalachian State University (1014-11-1492)
- 9:00AM ▶ (554) *The history of calculus in an honors calculus course.* Preliminary report.
Todd Timmons, University of Arkansas-Fort Smith (1014-11-229)
- 9:20AM ▶ (555) *Using History to Make Differential Calculus Come Alive.*
Jeffrey Clark, Elon University (1014-11-29)
- 9:40AM ▶ (556) *Primary sources in the classroom: Blaise Pascal in Discrete Mathematics and Arthur Cayley in Abstract Algebra.*
David J. Pengelley, New Mexico State University (1014-11-823)
- 10:00AM ▶ (557) *Lamé's Counting of Triangulations.* Preliminary report.
Jerry Lodder, New Mexico State University (1014-11-1472)
- 10:20AM ▶ (558) *Using History to Teach Mathematics with Some Examples.*
Jim Fulmer, University of Arkansas at Little Rock (1014-11-1592)
- 10:40AM ▶ (559) *Using History as a Motivating Strategy in Lower-level Mathematics Courses.*
Kevin L. Dove* and **Beth S. Lundquist**, Lander University (1014-11-430)
- 11:00AM ▶ (560) *History Live! Examples of differential equations studied by Newton and Leibniz.*
Huseyin Kocak, University of Miami (1014-11-30)
- 11:20AM ▶ (561) *A Symbiosis of Beauty: Transformational Geometry and the Art, Architecture and Textiles of Central and South America.*
Elizabeth C. Rogers, Piedmont College (1014-11-1694)
- 11:40AM ▶ (562) *A Stealth Group in History.* Preliminary report.
Agnes M. Kalemari, SUNY Farmingdale (1014-11-1702)

MAA Session on Innovative Teaching/Learning Ideas Using Technology in the Teaching of Courses before College Algebra

8:00 AM – 11:55 AM

Organizers: **Ed Laughbaum**, The Ohio State University
Mohammad H. Ahmadi, University of Wisconsin-Whitewater

- 8:00AM ▶ (563) *The Modeling of a Remote Control using Flash-A Computer Application of the Use of Functions.*
Paul Raymond Bouthellier, University of Pittsburgh-Titusville (1014-11-165)

- 8:30AM ▶ (564) *Using Scroll Bars and Macros in Excel to Excite and Engage Students.*
Robert Lee Kimball, Wake Technical Comm Coll (1014-11-64)

- 9:00AM ▶ (565) *Teaching and Learning with Tablet PCs.* Preliminary report.
Lois A. Martin, Massasoit Community College, Brockton, MA (1014-11-59)

- 9:30AM (566) *What Are You Thinking? (Use of Polling Devices).*
Roseanne S. Hofmann, Montgomery County Community College (1014-11-453)

- 10:00AM ▶ (567) *Quadratic vs. Exponential- a Growth Model for Social Security.*
Murray H. Siegel, South Carolina GSSM (1014-11-125)

- 10:30AM ▶ (568) *Introducing Algebra Using Graphs.*
Frances Van Dyke, American University (1014-11-212)

- 11:00AM ▶ (569) *Graphing Calculator Activities to Develop Mathematical Reasoning and Number Sense.*
Sue McMillen, Buffalo State College (1014-11-31)

- 11:30AM (570) *Online Homework in Intermediate Algebra.* Preliminary report.
Laurie Johnson, Marymount University (1014-11-706)

MAA Session on Research and Other Mathematical Experiences for Students Outside the Classroom

8:00 AM – 11:55 AM

Organizers: **Kay B. Somers**, Moravian College
Susan E. Morey, Texas State University
Sivaram K. Narayan, Central Michigan University
Jody Sorensen, Grand Valley State University

- 8:00AM ▶ (571) *An Interdisciplinary Seminar in Mathematical Economics.*
Alexandra Kurepa, North Carolina A&T State University (1014-K1-1166)

- 8:15AM ▶ (572) *Reaching Out to the Entire Campus through Mathematics.* Preliminary report.
David E. Boliver, University of Central Oklahoma (1014-K1-399)

- 8:30AM ▶ (573) *Structured interdisciplinary research experiences in mathematics and biology.* Preliminary report.
Glenn Ledder, University of Nebraska-Lincoln (1014-K1-1069)

- 8:45AM ▶ (574) *Find What Works: Fostering Undergraduate Research in Your Own Backyard.* Preliminary report.
Steven D. Leonhardi, Winona State University (1014-K1-1408)

- 9:00AM (575) *Initial Probes of Mathematics: A Systematic Approach.*
David F. Snyder, Texas State University-San Marcos (1014-K1-1009)

- 9:15AM ▶ (576) *JSU Math Club—A Community of New Learners and Alumni.*
David W. Dempsey* and **Jan O. Case**, Jacksonville State University (1014-K1-997)

- 9:30AM (577) *Exciting Things are Happening for Students at Georgia Perimeter College.*
Alice Eiko Pierce, Georgia Perimeter College (1014-K1-1688)

- 9:45AM ▶ (578) *High School Day and Emerging Scholars Program at ULM.* Preliminary report.
Annela R Kelly, University of Louisiana at Monroe (1014-K1-1755)

- 10:00AM ▶ (579) *Advising Undergraduate Research: Tales From the Front Lines.*
Lisa A. DeMeyer, Central Michigan University (1014-K1-1501)
- 10:15AM ▶ (580) *PascGalois Summer Research Retreat at New College of Florida.* Preliminary report.
Eirini Poimenidou*, New College of Florida, **Michael Bardzell** and **Kathleen Shannon**, Salisbury University (1014-K1-1495)
- 10:30AM ▶ (581) *Research Opportunities for Students at Grand Valley State University.*
Steven Schlicker, Grand Valley State University (1014-K1-242)
- 10:45AM ▶ (582) *Celebrating Pi Day at Slippery Rock.* Preliminary report.
Robert W. Vallin, Slippery Rock University (1014-K1-211)
- 11:00AM ▶ (583) *Organizing and maintaining an undergraduate mathematics competition.* Preliminary report.
Jeffery D. Sykes, Ouachita Baptist University (1014-K1-1169)
- 11:15AM ▶ (584) *MathCounts! Not Just for Middle-Schoolers, Anymore...* Preliminary report.
Charlotte M. Schulze-Hewett, University of Wisconsin Colleges, Rock County Campus (1014-K1-139)
- 11:30AM ▶ (585) *Catch the Buzz: the Annual Integration Bee(s) at Pitt.*
Jonathan E. Rubin, University of Pittsburgh (1014-K1-934)
- 11:45AM ▶ (586) *Recruiting future math teachers with an early K-12 classroom experience.* Preliminary report.
Alejandra Sorto*, Texas State University, **Max Warshauer**, Texas State University, **Hiroko Warshauer**, **Alexander White** and **Terry McCabe**, Texas State University (1014-K1-679)

MAA Session on Courses Below Calculus: A Continuing Focus, I

8:00 AM – 9:55 AM

Organizers: **Mary Robinson**, University of New Mexico-Valencia Campus
Florence S. Gordon, New York Institute of Technology
Laurette Foster, Prairie View A&M University
Arlene H. Kleinstein, Farmingdale State University of New York
Norma M. Agras, Miami Dade Community College
Linda Martin, Albuquerque T-VI

- 8:00AM ▶ (587) *A Modeling-Based College Algebra Course and Its Effect on Student Achievement.*
Aimee J. Ellington, Virginia Commonwealth University (1014-L1-222)
- 8:20AM ▶ (588) *Finding the Right Path for Entry-Level Math Students.*
Susan Nelson* and **Alice Eiko Pierce**, Georgia Perimeter College (1014-L1-1577)
- 8:40AM ▶ (589) *Introductory Mathematical Modeling and Problem Solving Courses with Interdisciplinary Applications in College Algebra as a General Education Mathematics Course.* Preliminary report.
William P. Fox and **Richard West***, Francis Marion University (1014-L1-622)

- 9:00AM ▶ (590) *The Effect of Different College Algebra Curriculums on Students' Understanding of Function Concepts.* Preliminary report.
Erick Brian Hofacker, University of Wisconsin-River Falls (1014-L1-818)
- 9:20AM ▶ (591) *A Counterrevolutionary College Algebra Course.* Preliminary report.
Stacy G. Langton, University of San Diego (1014-L1-1005)
- 9:40AM ▶ (592) *Content courses for preservice teachers.*
Cristina Gomez*, SUNY-Cortland, **Cecelia Laurie** and **Wei Shen Hsia**, The University of Alabama (1014-L1-1099)

MAA Session on Models That Work: Building Diversity in Advanced Mathematics, I

8:00 AM – 11:55 AM

Organizers: **Abbe H. Herzig**, University at Albany, SUNY
Patricia Hale, California State Polytechnic University, Pomona

- 8:00AM ▶ (593) *Fostering the Success of Students of Underrepresented Groups: Common Threads.*
Abbe H. Herzig, University at Albany, State University of New York (1014-Y3-821)
- 8:30AM ▶ (594) *Supporting Women in Mathematics at the University of Nebraska-Lincoln.*
Judy Walker, University of Nebraska-Lincoln (1014-Y3-695)
- 9:00AM ▶ (595) *The Maryland Experience: Building a community of African American graduate students.*
Raymond L. Johnson, University of Maryland at College Park (1014-Y3-1093)
- 9:30AM ▶ (596) *Increasing the Number of Minority Ph.D.'s in Mathematics.*
David C. Manderscheid, University of Iowa (1014-Y3-853)
- 10:00AM ▶ (597) *Research as the driver of increased diversity in undergraduate and graduate applied mathematics programs.*
Carlos Castillo-Chavez, Arizona State University (1014-Y3-1749)
- 10:30AM ▶ (598) *The Center for Excellence and Equity in Education at Rice University: Successes in the Recruitment, Retention, and Matrification of Minority Scholars.*
Richard A. Tapia, Rice University, Center for Excellence and Equity in Education (1014-Y3-1776)
- 11:00AM ▶ (599) *Increasing the Participation of Women in Computer Science.*
Lenore Blum, Computer Science Department, Carnegie Mellon University (1014-Y3-731)
- 11:30AM ▶ (600) *Minority Doctorates in Mathematics and the Pipeline.*
David Finston, New Mexico State University (1014-Y3-1660)

MAA General Contributed Paper Session, III

8:00 AM – 11:55 AM

Chair: **Joan S. Morrison**, Goucher College
 Chair: **Timothy P. Chartier**, Davidson College
 Organizers: **Stephen L. Davis**, Davidson College
Eric S. Marland, Appalachian State University

- 8:00AM ▶ (601) *Meridian Lines in Cathedrals.*
Barbara Ashton, Borough of Manhattan Community College - CUNY (1014-Z1-773)

- 8:15AM *An Earnest, Humming Way to Do Magic.*
(602) **Jeffrey A. Ehme*** and **Colm Mulcahy**, Spelman College (1014-Z1-1768)
- 8:30AM *Poker Faced.* Preliminary report.
▶ (603) **Colm Mulcahy*** and **Jeffrey Ehme**, Spelman College (1014-Z1-1673)
- 8:45AM *A combinatorial analog of a theorem of F. Dyson.*
▶ (604) Preliminary report.
Peter Wong* and **Pallavi Jayawant**, Bates College (1014-Z1-1358)
- 9:00AM *Runs of Heads and Tails - Genuine or Bogus?*
▶ (605) **Bill Linderman**, King College (1014-Z1-1266)
- 9:15AM *Interval Tournaments.*
▶ (606) **David E. Brown***, Utah State University, **Arthur H. Busch**, LeHigh University, and **J. Richard Lundgren**, University of Colorado at Denver (1014-Z1-1165)
- 9:30AM *The Probability of a Tied Vote under a Multiple Vote Scheme.* Preliminary report.
▶ (607) **Dennis Patrick Walsh**, Middle Tennessee State University (1014-Z1-1640)
- 9:45AM *Picking the President.*
▶ (608) **Joseph Evan*** and **Daniel Ghezzi**, King's College (1014-Z1-940)
- 10:00AM *A Network Analysis of Committee Assignments in the United States House of Representatives.*
▶ (609) **Mason A. Porter**, California Institute of Technology (1014-Z1-62)
- 10:15AM *Cutting right triangles right!* Preliminary report.
▶ (610) **Wasin So**, San Jose State University (1014-Z1-1763)
- 10:30AM *On the Nash Equilibrium Theorem.* Preliminary report.
▶ (611) **Peter Schallot**, Slippery Rock University (1014-Z1-1509)
- 10:45AM *Parallelograms and Cutting Elliptical Cakes.*
▶ (612) **Douglas G. Burkholder**, Lenoir-Rhyne College (1014-Z1-1157)
- 11:00AM *Challenges for Students from the Final Simplex Tableau - Adjusting the Optimal Solution When the Constraints Change.*
(613) **James J. Reynolds**, Clarion University of Pennsylvania (1014-Z1-835)
- 11:15AM *The many faces of WJU.*
▶ (614) **Marc Brodie**, Wheeling Jesuit University (1014-Z1-1053)
- 11:30AM *Overview of Three Ongoing Undergraduate Investigations at MWSU.* Preliminary report.
▶ (615) **Jeffrey L. Poet**, Missouri Western State University (1014-Z1-880)
- 11:45AM *Behaviour of trigonometric polynomials with only real zeros near a critical point.* Preliminary report.
(616) **Mohammed A. Qazi***, Tuskegee University, and **Q. I. Rahman**, Universite de Montreal (1014-Z1-1103)

SIAM Minisymposium on Inverse Problems: Theory and Numerics for Novel Applications, I

8:00 AM – 10:55 AM

Organizers: **Heinz W. Engl**, Johannes Kepler University
Lothar Reichel, Kent State University

- 8:00AM *Level sets in inverse problems and optimization I.*
(617) **Martin Burger**, Johannes Kepler University and RICAM, Linz (1014-65-530)
- 8:30AM *Level sets in inverse problems and optimization II.*
▶ (618) **Michael Hintermueller**, University of Graz (1014-49-868)

- 9:00AM *Discretization of Dirac Delta Functions in Level Set Methods.*
(619) **Bjorn Engquist**, University of Texas at Austin, **Anna-Karin Tornberg**, Courant Institute, New York University, and **Richard Tsai***, University of Texas at Austin (1014-65-797)
- 9:30AM *A Mumford-Shah approach for the inversion of SPECT data.* Preliminary report.
(620) **Wolfgang Ring***, University of Graz, and **Ronny Ramlau**, Johann Radon Institute for Computational and Applied Math. (1014-49-1389)
- 10:00AM *Some computational issues on inverse problems in medical imaging.*
(621) **Luisa D'Amore**, University of Naples Federico II Italy, **Serena Morigi**, University of Bologna Italy, **Almerico Murli**, University of Naples Federico II Italy, and **Fiorella Sgallari***, CIRM University of Bologna Italy (1014-65-375)
- 10:30AM *Solving nonlinear inverse problems by multi-frame based shrinkage iterations.*
(622) **Gerd Teschke**, Konrad-Zuse Institute, Berlin, Germany (1014-45-386)

SIAM Minisymposium on Mathematical Neuroscience: From Experiment to Theory, II

8:00 AM – 11:00 AM

Organizer: **Kresimir Josic**, University of Houston

- 8:00AM *The dynamic range of bursting in a network of respiratory pacemaker cells.*
(623) **Alla Borisjuk**, University of Utah (1014-92-1638)
- 8:25AM *Synchrony in Networks of Cortical Fast-Spiking Neurons.* Preliminary report.
(624) **Tim Lewis**, University of California, Davis (1014-92-784)
- 8:50AM *Using one-dimensional maps for analyzing neuronal dynamics.*
(625) **Georgi S. Medvedev**, Drexel University (1014-34-1574)
- 9:15AM Break.
- 9:25AM *Conditional Back-Propagation of Dendritic Action Potentials in CA1 Pyramidal Neurons: Implications for Spike-Timing Dependent Synaptic Plasticity.*
(626) **Costa M. Colbert**, Department of Biology and Biochemistry, University of Houston (1014-92-1173)
- 9:50AM *How architecture restricts spiking patterns in networks of phase oscillators.*
(627) **Eric T. Shea-Brown***, Courant Institute, New York Univ., **Kresimir Josic** and **Martin Golubitsky**, University of Houston (1014-92-736)
- 10:15AM *Discrete-time neural models for large-scale network studies.*
(628) **Nikolai F. Rulkov***, Institute for Nonlinear Science, UCSD, and **Maxim Bazhenov**, The Salk Institute for Biological Studies (1014-92-1249)
- 10:40AM *Applications of the Poincaré mapping technique to analysis of neuronal dynamics.*
(629) **Andrey Shilnikov***, **Gennady Cymbalyuk** and **Paul Channell**, GSU (1014-37-577)

SIGMAA Officers Meeting

8:00 AM – 10:00 AM

AMS-MAA-MER Special Session on Mathematics and Education Reform, III

8:30 AM – 11:50 AM

Organizers: **Bonnie S. Saunders**, University of Illinois at Chicago

William H. Barker, Bowdoin College
Dale R. Oliver, Humboldt State University
Kenneth Millet, University of California Santa Barbara

Jacqueline M. Dewar, Loyola Marymount University
Thomas F. Banchoff, Brown University
John P. Holcomb, Cleveland State University

- 8:30AM ▶ (630) *Attracting and Retaining Students in the Mathematical Sciences*. Preliminary report.
W. James Lewis, University of Nebraska-Lincoln (1014-97-1242)
- 9:00AM ▶ (631) *Attracting More Students to the Mathematical Sciences: Strategies from the CUPM Illustrative Resources for Changing Department Culture and Curricula*.
Harriet Pollatsek, Mount Holyoke College (1014-97-907)
- 9:30AM ▶ (632) *Bringing Contemporary Mathematics into the Curriculum*.
Robert L. Devaney, Boston University (1014-97-689)
- 10:00AM ▶ (633) *Attracting more minority students into the mathematical sciences through undergraduate research experiences: Why and How?*
Robert Eugene Megginson, University of Michigan at Ann Arbor (1014-97-1037)
- 10:30AM (634) *How does technology affect student attitudes to mathematics?*
William McCallum, University of Arizona (1014-97-1699)
- 11:00AM (635) *Pizza, Problem-Solving, and Promoting a Math-Friendly Culture*.
Andrew J. Bernoff, **Francis Edward Su*** and **Lesley A. Ward**, Harvey Mudd College (1014-97-1615)
- 11:30AM (636) *Getting Students to Speak Mathematics: One Model that Works*.
Robert S. Keller, Loras College (1014-00-1591)

MAA-Project NExT Panel Discussion

8:30 AM – 10:00 AM

Getting started in mathematical biology.
 Organizers: **T. Christine Stevens**, St. Louis University
Joseph A. Gallian, University of Minnesota, Duluth
Aparna W. Higgins, University of Dayton

Panelists: **Laurie J. Heyer**, Davidson College
Janet L. Andersen, Hope College
Carl C. Cowen, Indiana University-Purdue University Indianapolis
Jonathan E. Rubin, University of Pittsburgh

AWM Emmy Noether Lecture

9:00 AM – 9:50 AM

- (637) *Mathematical results and challenges in learning theory*.
Ingrid Daubechies, Princeton University (1014-68-102)

MAA Minicourse #10: Part A

9:00 AM – 11:00 AM

A beginner's guide to the scholarship of teaching and learning in mathematics.
 Organizers: **Curtis D. Bennett**, Loyola Marymount University

MAA Minicourse #15: Part A

9:00 AM – 11:00 AM

A novel approach to problem solving.
 Organizer: **Andrew C.-F. Liu**, University of Alberta

MAA-YMN Panel Discussion

9:00 AM – 10:20 AM

Undergraduate career paths in mathematics.
 Organizers: **James E. Hamblin**, Shippensburg University
John A. Vano, University of Wisconsin-Madison

Exhibits and Book Sales

9:30 AM – 5:30 PM

Math on the Web, II

10:00 AM – 3:30 PM

- 10:00AM (638) *Math accessibility with MathML: Meeting your students' needs and legal requirements.*
Neil Soiffer, Design Science, Inc.
- 11:20AM (639) *Interactive math on the Web by Maplesoft.*
Mohamed Bendame, Maplesoft
- 12:15PM (640) *Creating mathematical documents for the Web with Scientific Workplace.*
Barry MacKichan, MacKichan Software, Inc.
- 1:00PM (641) *Student answers to math homework on the Web using proper mathematical notation: A scalable, universal approach.*
John Risley, WebAssign
- 2:00PM (642) *Maplets for calculus.*
Philip B. Yasskin*, Texas A&M University, and **Douglas B. Meade***, University of South Carolina
- 3:00PM (643) *Metamathematical visions: Metadata, learning, and knowledge communities.*
Aaron Krowne, Emory University

MAA Invited Address

10:05 AM – 10:55 AM

- (644) *The mathematics of everyday language.*
Keith J. Devlin, Center for the Study of Language and Information, Stanford University (1014-A0-10)

MAA Minicourse #5: Part A

10:30 AM – 12:30 PM

Finite group behavior: Windows software for teaching beginning group theory.
 Organizers: **Edward C. Keppelmann**, University of Nevada Reno
Ellen J. Maycock, Depauw University

AMS Special Presentation

10:30 AM – NOON

Who wants to be a mathematician.
 Organizers: **Michael A. Breen**, AMS

Annette W. Emerson, AMS
 William T. Butterworth, Barat College
 of DePaul University

AMS Special Presentation

10:30 AM – NOON

T.A. development using case studies: A workshop for faculty (Part 1).

Organizers: **Solomon Friedberg**, Boston College
Diane L. Herrmann, University of Chicago

MAA Panel Discussion

10:45 AM – 12:05 PM

Integrating mathematics with other disciplines.

Organizer: **Jenna P. Carpenter**, Louisiana Technical University
 Panelists: **Sheldon P. Gordon**, SUNY at Farmingdale
Gary W. Krahn, U.S. Military Academy
Eric S. Marland, Appalachian State University
Bernd S. Schroeder, Louisiana Technical University

MAA Special Presentation

10:45 AM – 12:05 PM

Proposal writing workshop for grant applications to the NSF Division of Undergraduate Education.

Organizers: **Elizabeth J. Teles**, NSF Division of Undergraduate Education
John R. Haddock, NSF Division of Undergraduate Education
Lee L. Zia, NSF Division of Undergraduate Education

SIAM Invited Address

11:10 AM – NOON

(645) *Generalized Fourier Transforms, the Dirichlet-to-Neumann Map, and the Imaging of the Brain.*
Thanasis Fokas, Cambridge University (1014-44-103)

AMS Colloquium Lectures: Lecture II

1:00 PM – 2:00 PM

(646) *Entangled radicals, Part II.*
Hendrik W. Lenstra Jr., Universiteit Leiden (1014-12-14)

AMS-MAA Special Session on Ancient and Nonwestern Mathematics, II

1:00 PM – 2:50 PM

Organizer: **Duncan J. Melville**, St. Lawrence University
 1:00PM *Decimal and sexagesimal computation in Indian mathematics.*
 ▶ (647) **Kim Plofker**, University of Utrecht, and International Institute for Asian Studies, Leiden (1014-01-713)

2:00PM *The Pārthapura school and the exact sciences in India.*
 (648) **Toke Lindegaard Knudsen**, Brown University (1014-01-999)

2:30PM *'Practical' mathematics: The view from inside and outside.* Preliminary report.
 ▶ (649) **Duncan J. Melville**, St. Lawrence University (1014-01-1600)

AMS-SIAM Special Session on Frames and Operator Theory in Analysis and Signal Processing, II

1:00 PM – 3:50 PM

Organizers: **Peter R. Massopust**, Tuboscope Vetco Pipeline Services
David R. Larson, Texas A&M University
Manos I. Papadakis, University of Houston
Zuhair Nashed, University of Central Florida
Ahmed I. Zayed, DePaul University
Minh Chuong Nguyen, Institute of Mathematics, Hanoi Vietnam

1:00PM *The use of filters and direct limits in the construction of fractal wavelets.* Preliminary report.
 (650) **Judith A. Packer***, University of Colorado at Boulder, and **Iain Raeburn**, University of Newcastle, Australia (1014-46-1205)

1:30PM *A Noncommutative Wiener Lemma and A Faithful Tracial State on Banach Algebras of Time-Frequency Shift Operators.* Preliminary report.
 (651) **Radu V. Balan**, Siemens Corporate Research (1014-47-324)

2:00PM *Waveform design and a general form of matched filtering.* Preliminary report.
 (652) **John J. Benedetto**, Norbert Wiener Center, University of Maryland (1014-42-409)

2:30PM Break
 3:00PM *Pseudo-differential operators, localization operators and time-frequency analysis.* Preliminary report.
 ▶ (653) **Luigi G. Rodino** and **Elena Cordero***, Universita' di Torino (1014-47-449)

3:30PM *Multiscale approximation in electronic structure calculation.*
 (654) **Reinhold Schneider**, Christian-Albrechts-Universität Kiel, Germany (1014-41-1519)

AMS Special Session on Mahler Measure and Heights, III

1:00 PM – 3:20 PM

Organizers: **Michael J. Mossinghoff**, Davidson College
Jeffrey D. Vaaler, University of Texas at Austin

1:00PM *Mahler measures of Alexander polynomials of alternating links.*
 (655) **Daniel S. Silver** and **Susan G. Williams***, University of South Alabama (1014-57-1239)

1:30PM *Lehmer's Question and Surface Dynamics.*
 (656) **Daniel S. Silver*** and **Susan G. Williams**, University of South Alabama (1014-57-1235)

2:00PM *Proving relations between $m(P)$ and $L'(E,0)$.*
 (657) **Fernando Rodriguez Villegas**, University of Texas at Austin (1014-11-1415)

3:00PM (658) *On the Mahler measure of resultants in small dimension.*

Carlos D'Andrea, Departament d'Àlgebra i Geometria, and **Matilde N. Lalin***, Institute for Advanced Study (1014-11-645)

AMS Special Session on Recent Trends in Convex and Discrete Geometry, II

1:00 PM – 3:50 PM

Organizers: **Valeriu Soltan**, George Mason University
Tibor Bisztriczky, University of Calgary
Paul Goodey, University of Oklahoma

- 1:00PM (659) *Optimal configurations of k congruent balls packed in a sphere in \mathbb{R}^n ($k \leq 2n$).*
Włodzimirz Kuperberg, Auburn University (1014-52-1114)
- 1:30PM (660) *The Colourful Hadwiger Transversal Theorem.*
Luis Montejano, University of Guerrero at Acapulco, Mexico (1014-52-1234)
- 2:00PM (661) *Symmetric Delone subdivisions and their application.* Preliminary report.
Achill Schuermann, University of Magdeburg (1014-52-261)
- 2:30PM (662) *Revisiting a problem of D. Ismailescu and R. Radoicic concerning dense point sets.* Preliminary report.
Andras Bezdek* and **Gergely Ambrus**, Auburn University (1014-52-1773)
- 3:00PM (663) *Additive Discrete Geometry.* Preliminary report.
Jozsef Solymosi, University of British Columbia (1014-52-1172)
- 3:30PM (664) *Locating points in a sensor network, with distance information.* Preliminary report.
Walter J. Whiteley, York University, Toronto (1014-52-594)

AMS Special Session on Division Algebras, Galois Theory, Cohomology and Geometry, III

1:00 PM – 3:50 PM

Organizers: **Kelly L. McKinnie**, University of Texas at Austin
David J. Saltman, University of Texas at Austin

- 1:00PM (665) *The admissibility of $PSL(2, 7)$.* Preliminary report.
Murray M. Schacher*, UCLA, and **Danny Goldstein**, IDA-CCR La Jolla (1014-12-804)
- 1:30PM (666) *Generic polynomials.*
Arne Ledet, Texas Tech University (1014-12-1148)
- 2:00PM (667) *Centers of generic algebras with involution.*
Esther Beneish, Central Michigan University (1014-17-970)
- 2:30PM (668) *A Gersten sequence for 2-dimensional regular local rings.* Preliminary report.
Eric S. Brussel, Emory University (1014-17-1611)
- 3:00PM (669) *The Brauer group of a 2-dimensional regular local ring.* Preliminary report.
Eduardo Tengan, Emory University (1014-17-1607)
- 3:30PM (670) *Division algebras over surfaces.* Preliminary report.
David J. Saltman, University of Texas at Austin (1014-12-881)

AMS Special Session on Topological Spaces Associated with $C(X)$, III

1:00 PM – 3:50 PM

Organizers: **Chawne M. Kimber**, Lafayette College
Warren Wm. McGovern, Bowling Green State University

- 1:00PM (671) *Elementarily equivalent I -groups of continuous functions on essential P -spaces.*
Brian Wynne, Colgate University (1014-03-1067)
- 1:30PM (672) *Examples of absolute CR -epic topological spaces.*
Robert Raphael, Concordia University (1014-00-279)
- 2:00PM (673) *Hewitt realcompactifications and P -coreflections.*
Robert Raphael, Concordia University, and **R. Grant Woods***, University of Manitoba (1014-54-548)
- 2:30PM (674) *Disjointness preserving operators and their associated algebra homomorphisms.* Preliminary report.
Gerard J. Buskes*, University of Mississippi, and **Karim Boulabiar**, Tunis, Tunisia (1014-06-462)
- 3:00PM (675) *Strongly clean rings of matrices over $C(X)$.*
Wolf Iberkleid, **Ramiro H. Lafuente-Rodriguez***, Universidad Mayor de San Andres, and **Warren Wm. McGovern**, Bowling Green State University (1014-06-1012)
- 3:30PM (676) *Lattice-ordered $C(X)$ -modules.* Preliminary report.
James J. Madden, Louisiana State University (1014-06-1530)

AMS Special Session on Value Distribution in Classical and p -adic Functions Theory, III

1:00 PM – 3:20 PM

Organizers: **Alain Escassut**, University Blaise Pascal
Chung-Chun Yang, Hong Kong University of Science and Technology
Ilpo Laine, University of Joensuu

- 1:00PM (677) *Non-convergent SRU 's for analytic elements in a p -adic field.*
Kamal Boussaf, University Blaise Pascal, Clermont-Ferrand, France (1014-11-516)
- 1:30PM (678) *An analogue of continued fractions in number theory for Nevanlinna theory.*
Zhuan J. Ye, Northern Illinois University (1014-30-1036)
- 2:00PM (679) *Hermite Multiplier Sequences.*
George L. Csordas and **Andrzej Piotrowski***, University of Hawaii (1014-30-450)
- 2:30PM (680) *Meromorphic functions of uniqueness.*
Alain Paul Escassut, University Blaise Pascal, Clermont-Ferrand, France (1014-30-513)
- 3:00PM Discussion.

AMS Special Session on Algebraic Statistics: Theory and Practice, III

1:00 PM – 3:50 PM

Organizers: **Seth M. Sullivan**, University of California Berkeley
Elizabeth S. Allman, University of Southern Maine

Program of the Sessions – Friday, January 13 (cont'd.)

- 1:00PM *On the fan of a design and on maximal-fan designs.*
(681) **Hugo Maruri-Aguilar**, Department of Statistics, The University of Warwick, and **Eva Riccomagno***, Department of Statistics, The University of Warwick and Department of Mathematics, Politecnico di Torino (1014-62-1043)
- 1:30PM *Sampling for Conditional Inference on Multiway Tables.*
(682) **Yuguo Chen***, University of Illinois at Urbana-Champaign, **Ian Dinwoodie**, Duke University, and **Seth Sullivan**, Harvard University (1014-62-792)
- 2:00PM *Network Delay Tomography with Correlation.*
(683) Preliminary report.
Ian H. Dinwoodie* and **Eric Vance**, Duke University (1014-62-140)
- 2:30PM *Genetic linkage analysis.*
(684) **Ingileif Bryndis Hallgrimsdottir**, Department of Statistics, University of Oxford (1014-62-1059)
- 3:00PM *EM Algorithm for Hidden Markov Models.*
▶ (685) **Ingileif B. Hallgrimsdóttir**, University of Oxford, **R. Alexander Milowski**, UC Davis, and **Josephine Yu***, UC Berkeley (1014-62-445)
- 3:30PM *The posterior map.*
(686) **Lior Pachter**, UC Berkeley (1014-92-1399)
- 1:00PM *Semilattices and Congruence Heredity.* Preliminary report.
▶ (692) **Eric J. Martin***, University of Northern British Columbia, and **John W. Snow**, Sam Houston State University (1014-06-1629)
- 1:30PM *M_4 and Congruence Heredity.*
▶ (693) **John W. Snow**, Sam Houston State University (1014-06-72)
- 2:00PM *Using Order in Distributed Computing.*
(694) **Vijay K. Garg***, University of Texas, **Neeraj Mittal**, University of Texas at Dallas, and **Alper Sen**, Freescale Semiconductors (1014-06-421)
- 2:30PM *Finite basis problems for quasivarieties, and the weak extension property.*
(695) **Ralph Nelson McKenzie**, Vanderbilt University (1014-06-865)
- 3:00PM *Forbidden quotients of bounded distributive lattices.* Preliminary report.
(696) **Richard N. Ball***, University of Denver, **Ales Pultr**, Charles University, and **Jiri Sichler**, University of Manitoba (1014-06-1373)
- 3:30PM *From biordered sets to two-complexes.* Preliminary report.
(697) **John C. Meakin**, University of Nebraska-Lincoln (1014-06-1278)

AMS Special Session on Continued Fractions, II

1:00 PM – 3:50 PM

Organizers: **Nancy Wyshinski**, Trinity College
James G. McLaughlin, Trinity College
and West Chester University

- 1:00PM *Ramanujan's continued fractions via orthogonal polynomials.*
(687) **Mourad E. H. Ismail***, University of Central Florida, and **Dennis Stanton**, University of Minnesota (1014-33-805)
- 2:00PM *Szegő polynomials and para-orthogonal polynomials on the real line, and the associated continued fractions.*
(688) **A. Sri Ranga***, **Cleonice F. Bracciali** and **Eliana X. de Andrade**, DCCE/IBILCE, Universidade Estadual Paulista (1014-33-755)
- 2:30PM *Parabolic Iterated Function Systems with Applications to the Backward Continued Fractions.*
(689) **Eugen Andrei Ghenciu**, University of North Texas, Denton, Texas (1014-37-809)
- 3:00PM *Distribution Analysis Using PPC-Continued Fractions.*
(690) **William B. Jones**, University of Colorado, Boulder, and **Walter M. Reid***, University of Wisconsin-Eau Claire (1014-30-957)
- 3:30PM *Continued Fraction Handbook Project.*
▶ (691) **William B. Jones**, University of Colorado, Boulder (1014-33-408)

AMS Special Session on the Many Lives of Lattice Theory, the Theory of Ordered Sets, and Universal Algebra, II

1:00 PM – 3:50 PM

Organizers: **Japheth L. M. Wood**, Chatham College
John W. Snow, Sam Houston State University
Jonathan D. Farley, Harvard University
Stefan E. Schmidt, Phoenix Math Systems Modeling, Inc.
Anthony A. Harkin, Harvard University

MAA Minicourse #11: Part A

1:00 PM – 3:00 PM

Teaching a course in the history of mathematics.

Organizers: **V. Frederick Rickey**, U.S. Military Academy
Victor J. Katz, University of the District of Columbia

MAA Minicourse #16: Part A

1:00 PM – 3:00 PM

Fair division: From cake-cutting to dispute resolution.

Organizer: **Steven J. Brams**, New York University

MAA Minicourse #6: Part A

1:00 PM – 3:00 PM

Technology tools for discrete mathematics.

Organizers: **Douglas E. Ensley**, Shippensburg University
Katherine G. McGivney, Shippensburg University

AMS Session on Algebraic Geometry

1:00 PM – 1:55 PM

- 1:00PM *Period and index of curves: Various constructions.*
(698) **S. Sharif**, UC Berkeley (1014-11-1507)
- 1:15PM *Higher Order Bad Loci.* Preliminary report.
(699) **Gian Mario Besana***, DePaul University, **Sandra DiRocco**, KTH Royal Institute of Technology, and **Antonio Lanteri**, Università degli Studi di Milano (1014-14-782)
- 1:30PM *Smooth monomial-ideal points of the Hilbert scheme of points of an affine space.* Preliminary report.
(700) **Mark E. Huibregtse**, Skidmore College (1014-14-1431)

- 1:45PM *Special metrics on intersection of quadrics.*
(701) Preliminary report.
Daniela Mihai* and **George Sparling**, University of Pittsburgh (1014-51-1305)

AMS Session on Mathematics Education

1:00 PM – 2:25 PM

- 1:00PM *Mathematical Connections: For Example, "How To Teach Radicals In Less Than 5 Minutes" (Grades 6-16).* Preliminary report.
▶ (702) **Juli D'Ann Ratheal**, West Texas A & M University (1014-97-06)
- 1:15PM *Motivating Undergraduates with Different Backgrounds to Do Mathematics Research.* Preliminary report.
(703) **Manmohan Kaur**, Benedictine University (1014-97-331)
- 1:30PM *Geometry on a HubCap.*
(704) **David E. Ewing**, Central Missouri State University (1014-97-561)
- 1:45PM *Algebra and Uniform Estimates Give a Face-lift to Calculus and Introductory Analysis.*
(705) **Michael Livshits**, Cambridge MA (1014-97-1272)
- 2:00PM *Closing the Gaps for English Language Learners (ELL) in Mathematics Learning by Improving In-Service Teacher Professional Development thus Increasing Teacher Content, Pedagogy, and Methods Knowledge.*
▶ (706) **Joyce F. Fischer**, Texas State University-San Marcos (1014-97-1557)
- 2:15PM *Native American-based Materials for Undergraduate Mathematics Courses.*
(707) **Charles Peter Funkhouser**, University of Montana-Missoula, College of Technology, and **A. Duane Porter***, University of Wyoming (1014-97-1760)

AMS Session on Partial Differential Equations, II

1:00 PM – 4:10 PM

- 1:00PM *Stability and Bifurcation in a Fractionally Damped Nonlinear Diffusion Process.*
(708) **Brahima Mbodje**, Rust College (1014-35-176)
- 1:15PM *Partial differential equations related to dielectric breakdown and polycrystal plasticity.*
(709) **Marian Bocea**, University of Utah (1014-35-152)
- 1:30PM *Nonlinear stability of viscous shock waves arising in conservation laws in the presence of both second and fourth order regularizations.* Preliminary report.
▶ (710) **Changbing Hu***, Missouri State University, and **Peter Howard**, Texas A&M University (1014-35-1204)
- 1:45PM *On the oscillations of the solution curve for a class of semilinear equations.*
(711) **Anahit Galstyan***, University of Texas-Pan American, **Philip Korman**, University of Cincinnati, and **Yi Li**, University of Iowa (1014-35-1327)
- 2:00PM *Attractor Stability via Morse-Smale Property for Diffusive Two-Species Competition Systems.* Preliminary report.
(712) **Georg Hetzer**, **Wenxian Shen** and **Tung Nguyen***, Auburn University (1014-35-1337)

- 2:15PM *Eigenvalue Characterization and Computation for the Laplacian on General Domains, and its Application to Inverse Spectral Problems.*
(713) **James V. Lambers***, Stanford University, **Maev L. McCarthy**, Murray State University, and **Patrick Guidotti**, University of California, Irvine (1014-35-1359)
- 2:30PM *Cauchy problem for nonlinear wave equation with variable speed of propagation.*
(714) **Karen Yagdjian**, University of Texas-Pan American (1014-35-1363)
- 2:45PM *N-Bump Solutions of Amari-Type Equation.*
(715) **J. Angela Murdock**, University of Memphis (1014-35-1548)
- 3:00PM *Approximate solutions of heat equation on unbounded domains using heatlets.*
(716) **Gnana Bhaskar Tenali**, Florida Institute of Technology, and **Hariharan Seetharaman***, Florida Institute of Technology (1014-35-1572)
- 3:15PM *Systems of Nonlinear Wave Equations With Damping and Source Terms.* Preliminary report.
(717) **Keith Agre***, St. Cloud State University, and **Mohammad A. Rammaha**, University of Nebraska-Lincoln (1014-35-1583)
- 3:30PM *On the shape of a cookie.* Preliminary report.
▶ (718) **David L. Finn**, Rose-Hulman Institute of Technology (1014-35-1733)
- 3:45PM *Sobolev Space Interior Regularity Results for a Variational Inequality Involving an Elliptic Pseudo-Differential Operator.* Preliminary report.
(719) **Randolph Garfield Cooper**, California State University, Los Angeles (1014-35-1744)
- 4:00PM *Design of a two-electrode electrostatic lens for optimum aberration characteristics.*
(720) **S. M. Makky***, Owens College, **A. K. Ahmad**, Al Nahrain University, Baghdad, Iraq, and **S. M. Juma**, University of Baghdad, Baghdad, Iraq (1014-78-1216)

AMS Session on Combinatorics, IV

1:00 PM – 4:10 PM

- 1:00PM *Counting and 3-Edge-Coloring Spherical Buckyballs.*
▶ (721) **Thomas C. Hull**, Merrimack College (1014-05-1587)
- 1:15PM *Rado Numbers for Some Linear Equations.*
▶ (722) **Daniel Schaal***, **Donna Flint** and **Joseph Mousel**, South Dakota State University (1014-05-1601)
- 1:30PM *The Isoperimetric Numbers of Certain Cayley Graphs of the Projective Special Linear Groups.* Preliminary report.
(723) **Dominic Lanphier**, Western Kentucky University, and **Jason Rosenhouse***, James Madison University (1014-05-1625)
- 1:45PM *An Identity of Partial Derangement and Its Applications.* Preliminary report.
▶ (724) **Kang Wu**, Southern China Normal University, and **Haishen Yao***, CUNY Queensborough Community College (1014-05-1207)
- 2:00PM *Set systems with the minimal number of sets and the (4,3)-threshold property.*
▶ (725) **Zoltán Füredi**, University of Illinois at Urbana-Champaign, **Robert H. Sloan**, University of Illinois at Chicago, **Ken Takata***, Adelphi University, and **György Turán**, University of Illinois at Chicago (1014-05-1211)
- 2:15PM *A proof of differential identities using lattice path encodings.*
▶ (726) **Anna Varvak**, Soka University of America (1014-05-715)

Program of the Sessions – Friday, January 13 (cont'd.)

- 2:30PM *Domino Fibonacci Tableaux*. Preliminary report.
(727) **Kendra S. Killpatrick***, Pepperdine University, and **Naiomi Cameron**, Occidental College (1014-05-558)
- 2:45PM *A geometric form for the extended patience sorting algorithm and its generalizations*.
▶ (728) **Alexander I. Burstein***, Iowa State University, and **Isaiah P. Lankham**, University of California, Davis (1014-05-164)
- 3:00PM *Combinatorics of Patience Sorting Piles*.
(729) **Isaiah P. Lankham***, University of California, Davis, and **Alexander I. Burstein**, Iowa State University (1014-05-161)
- 3:15PM *A triple lacunary generating function for Hermite polynomials*.
(730) **Pallavi Jayawant***, Bates College, and **Ira Gessel**, Brandeis University (1014-05-156)
- 3:45PM *On Proofs of Certain Combinatorial Identities*.
▶ (731) **Akalu Tefera***, Grand Valley State University, **Aklilu Zeleke**, Lyman Briggs School and Department of Statistics and Probability, and **George Grossman**, Central Michigan University (1014-05-559)
- 4:00PM *The Shields-Harary Numbers of the Complete Bipartite Graph $K_{m,n}$ for Continuous Concave Cost Functions Vanishing at One*.
(732) **John E. Holliday***, North Georgia College and State University, and **Peter D. Johnson**, Auburn University (1014-00-1288)

MAA Session on Professional Development Programs for K-12 Teachers, III

1:00 PM – 4:15 PM

Organizers: **Zsuzsanna Szaniszló**, Valparaiso University

Laurie Burton, Western Oregon University

Judith L. Covington, Louisiana State University Shreveport

Patricia Hale, California State Polytechnic University, Pomona

- 1:00PM *Experiences with an In-Service Professional Development Program: The Vermont Mathematics Partnership and its Impact on School Systems in Vermont*. Preliminary report.
▶ (733) **George L. Ashline**, St. Michael's College (1014-D1-170)
- 1:20PM *Team Planning and Team Teaching: College and School Mathematics Instructors Collaborate to Increase Mathematical Content Knowledge in Elementary Teachers*.
(734) **Martha L. Wallace**, St. Olaf College (1014-D1-459)
- 1:40PM *The Leadership Program in Discrete Mathematics*. Preliminary report.
▶ (735) **Valerie A. DeBellis**, Shodor Education Foundation, and **Joseph G. Rosenstein***, Rutgers University (1014-D1-951)
- 2:00PM *Hosting a Probability and Statistics Institute*. Preliminary report.
▶ (736) **Sharon S. Emerson-Stonnell**, Longwood University (1014-D1-1459)
- 2:20PM *Improving Mathematical Content Knowledge of K-8 Teachers: Experiences and Successes with a State-Funded Project*.
(737) **Brian J. Lindaman*** and **A. Susan Gay**, University of Kansas (1014-D1-975)

- 2:40PM *Integrating Technology/Engineering Concepts into the Teaching of Mathematics in Middle School*.
▶ (738) **Mary Ann Connors**, Westfield State College (1014-D1-492)
- 3:00PM *Prime: Partnership for Revitalized Instruction in Mathematics Education*. Preliminary report.
▶ (739) **Jennifer A. Bergner*** and **Michael Bardzell**, Salisbury University (1014-D1-1237)
- 3:20PM *Building K-12 Mathematics Leaders: Experiences of the Oregon Mathematics Leadership Institute (OMLI) Partnership Project in enhancing mathematics content knowledge for teaching*.
▶ (740) **Thomas P. Dick***, Oregon State University, and **Karen Marrongelle**, Portland State University (1014-D1-786)
- 3:40PM *Hands-On Mathematics Education for Pennsylvania Learning and Teaching (HOME PlaTe)*.
▶ (741) **Francisco E. Alarcon*** and **Larry Feldman**, Indiana University of PA (IUP) (1014-D1-1056)
- 4:00PM *EMCAT: Exploring Mathematical Concepts through Applications of Technology*.
▶ (742) **Jan O. Case*** and **David Dempsey**, Jacksonville State University (1014-D1-943)

MAA Session on Getting Students to Discuss and to Write about Mathematics, III

1:00 PM – 4:10 PM

Organizers: **Martha Ellen Murphy Waggoner**, Simpson College

Charlotte A. Knotts-Zides, Wofford College

Harrison W. Straley, Wheaton College

- 1:00PM *Do we make students talk about what they see?*
▶ (743) Preliminary report.
Jose H. Giraldo, Texas A&M University-Corpus Christi (1014-H1-1406)
- 1:15PM *Introducing Students to Difference Quotients via a Writing Assignment Involving Experimental Data*. Preliminary report.
▶ (744) **Joe T. Harris**, St. Andrews Presbyterian College (1014-H1-1027)
- 1:30PM *Introducing Students to Writing About Mathematics Using Calculus Problems*.
▶ (745) **Michael L. Berry**, West Virginia Wesleyan College (1014-H1-177)
- 1:45PM *Using Journals to Emphasize Writing and Homework in Calculus*.
▶ (746) **J'Lee W. Bumpus*** and **G. Brock Williams**, Texas Tech University (1014-H1-326)
- 2:00PM *Involving Students in Their Own Learning: Course End Presentation*. Preliminary report.
▶ (747) **Rodney X. Sturdivant***, **Alex J. Heidenberg** and **Brian Souhan**, United States Military Academy (1014-H1-974)
- 2:15PM *Student Reflections on Mathematics*.
▶ (748) **Alex M. McAllister**, Centre College (1014-H1-274)
- 2:30PM *The Use of Frequent Oral Presentations in Third-Semester Calculus*.
▶ (749) **William R. Harris**, Georgetown College (1014-H1-1192)
- 2:45PM *Reading and Writing about Calculus—A First Year Mathematics Seminar*.
(750) **Daniel S. Alexander*** and **Alexander F. Kleiner**, Drake University (1014-H1-994)

- 3:00PM *Who's The Man?: The Question That Made My Students Fight About Mathematics.* Preliminary report.
 ▶ (751) **Pam Miltenberger**, West Virginia Wesleyan College (1014-H1-187)
- 3:15PM *Create Your Own Mini Poster Session!*
 ▶ (752) **Jenny Switkes**, California State Polytechnic University, Pomona. (1014-H1-34)
- 3:30PM *Low Stakes Writing Questions.* Preliminary report.
 ▶ (753) **Karen Batt Stanish**, Keene State College (1014-H1-1525)
- 3:45PM *Helping Mathematics Students Become Math Presenters.* Preliminary report.
 ▶ (754) **David Fowler**, University of Nebraska-Lincoln (1014-H1-270)
- 4:00PM *Integrating a writing-intensive component into a traditional upper-division course.* Preliminary report.
 (755) **Susan Hammond Marshall**, Monmouth University (1014-H1-1723)

MAA Session on Mathematics of Sports and Games, I

1:00 PM – 3:55 PM

Organizers: **Sean L. Forman**, Saint Joseph's University
Douglas Drinen, Sewanee: University of the South

- 1:00PM *How Well Can Random Walkers Rank Football Teams?*
 ▶ (756) **Thomas S. Callaghan**, Stanford University, **Peter J. Mucha**, University of North Carolina at Chapel Hill, and **Mason A. Porter***, California Institute of Technology (1014-M1-61)
- 1:20PM *Paired comparison ranking systems: An old topic and a new application.* Preliminary report.
 ▶ (757) **Douglas Drinen**, Sewanee: the University of the South (1014-M1-1398)
- 1:40PM *A Maple Simulation for the 2004 Red Sox-Yankees Playoff Series.* Preliminary report.
 ▶ (758) **Phil Gustafson**, Mesa State College (1014-M1-861)
- 2:00PM *Down 4 with a Minute to Play.* Preliminary report.
 ▶ (759) **G. Edgar Parker***, James Madison University, and **Richard Miller**, Fort Defiance High School (1014-M1-281)
- 2:20PM *The Price is Right's Three Strikes Game and Other Possibilities.*
 ▶ (760) **Paula R. Stickle**, Indiana University (1014-M1-342)
- 2:40PM *Bill James as an Exemplar of Statistical Writing.*
 ▶ (761) **William Branson**, St Cloud State University (1014-M1-1514)
- 3:00PM *Pigs on the Court.*
 ▶ (762) **Marc Brodie**, Wheeling Jesuit University (1014-M1-1060)
- 3:20PM *Using NASCAR to Illustrate Optimization.* Preliminary report.
 ▶ (763) **Mark A. Mills***, Central College, and **Dale R. Buske**, St. Cloud State University (1014-M1-332)
- 3:40PM *NCAA Membership and a Piecewise-Defined Model.*
 ▶ (764) **Murray H. Siegel**, South Carolina GSSM (1014-M1-126)

MAA Session on Mathematical Connections in the Arts, I

1:00 PM – 3:55 PM

Organizers: **Douglas E. Norton**, Villanova University

- Reza Sarhangi**, Towson University
Nathaniel A. Friedman, State University of New York, Albany
- 1:00PM *Clear as a Bell: Applying Principles of Graphical Excellence to Campanology.* Preliminary report.
 ▶ (765) **Leslie Hayes**, Saint Joseph's University (1014-N1-1538)
- 1:15PM *Learning Styles of College Algebra Students Support the Use of Dance in Mathematics Courses: Ideas for using Dance in the College Algebra classroom.* Preliminary report.
 (766) **Ann D. Bingham*** and **Beth K. Wright**, Peace College (1014-N1-1224)
- 1:30PM *A Salamander's Tale: Art and Mathematics at Ohio Northern.* Preliminary report.
 ▶ (767) **William R. Fuller**, Ohio Northern University (1014-N1-819)
- 1:45PM *Modular Sculpture from Surface Patches.*
 ▶ (768) **Stephen J. Luecking**, DePaul University (1014-N1-992)
- 2:00PM *Variations on an All-Purpose Algorithm.* Preliminary report.
 ▶ (769) **Anne M. Burns**, Long Island University, C.W. Post Campus (1014-N1-227)
- 2:15PM *The Symmetries of Beaded Beads.*
 ▶ (770) **Gwen Laura Fisher**, California Polytechnic State University (1014-N1-256)
- 2:30PM *Griddy Mathematics (The art and the mathematics of grids).* Preliminary report.
 ▶ (771) **Josefina Alvarez**, New Mexico State University (1014-N1-692)
- 2:45PM *Imagemosaics: Painting with Pictures.*
 ▶ (772) **Gavin W. Taylor**, Davidson College (1014-N1-1055)
- 3:00PM *The Square's Talk: The Language of Flatland.*
 ▶ (773) **William Lindgren***, Slippery Rock University, and **Thomas Banchoff**, Brown University (1014-N1-752)
- 3:15PM *The History and Nature of Mathematics in the Works of Jorge Luis Borges.* Preliminary report.
 ▶ (774) **Mary L. Garner**, Kennesaw State University (1014-N1-1458)
- 3:30PM *Mathematical literature and literary mathematics: Oulipo.* Preliminary report.
 ▶ (775) **Christine Kinsey***, Canisius College, and **Teresa Moore**, Ithaca College (1014-N1-937)
- 3:45PM *A Cost-Based Approach to Adaptivity in Literary Hypertext.*
 ▶ (776) **Juan B. Gutierrez**, Florida State University (1014-N1-141)

MAA Session on Research on the Teaching and Learning of Undergraduate Mathematics, I

1:00 PM – 3:15 PM

Organizers: **William O. Martin**, North Dakota State University
Barbara E. Edwards, Oregon State University
Michael Oehrtman, Arizona State University

- 1:00PM *Findings from a Study of Gender Parity.*
 ▶ (777) **Teri J. Murphy**, University of Oklahoma (1014-O1-1312)

Program of the Sessions – Friday, January 13 (cont'd.)

- 1:20PM *Student Understanding of the Inverse Relationship of Exponential and Logarithmic Functions.* Preliminary report. **Michelle Reed***, Wright State University, **Gretchen Whipple**, Warren Wilson College, **Lynette Roller**, Dulaney High School, Timonium, Maryland, and **Barbara Edwards**, Oregon State University (1014-01-1579)
- 1:40PM *Theoretical Lenses for Examining Undergraduate Students' Statistical Thinking.* **Randall E. Groth*** and **Jennifer A. Bergner**, Salisbury University (1014-01-696)
- 2:00PM *Helping Bridge Course Students Begin to Write Proofs.* Preliminary report. **Carolyn Yackel**, Mercer University (1014-01-676)
- 2:20PM *Teaching Mathematics Using a Computer Algebra System—What are the Effects on the Students' Performance?* **Karsten Schmidt***, Faculty of Management Science & Economics, University of Applied Sciences Schmalkalden, and **Wolfgang Moldenhauer**, Thuringian Institute for In-service Teacher Training, Curriculum Development and Media (ThILLM) (1014-01-209)
- 2:40PM *Data-Mining an Online Homework System.* Preliminary report. **Andrew Bennett**, **Genevra Neumann***, **Eric Lawrence** and **Elena Verbych**, Kansas State University (1014-01-143)
- 3:00PM *Effects of Elaborate Contextual Information in Group Homework.* **Dale J. Winter***, University of Michigan, and **Matthew E. DeLong**, Taylor University (1014-01-95)

MAA Session on Models That Work: Building Diversity in Advance Mathematics, II

1:00 PM – 3:55 PM

- Organizers: **Abbe H. Herzig**, University at Albany, SUNY
Patricia Hale, California State Polytechnic University, Pomona
- 1:00PM *Girls Explorations in Mathematics and Science (GEMS): An Outreach Program Attracting a Diverse Group of High Achieving High School Girls.* Preliminary report. **Mazen Shahin***, Delaware State University, and **Melissa A. Harrington**, Department of Biology, Delaware State University (1014-Y3-1655)
- 1:30PM *Giving Women the EDGE in Mathematics.* **Ami Radunskaya***, Pomona College, **Sylvia T. Bozeman**, Spelman College, and **Rhonda J. Hughes**, Bryn Mawr College (1014-Y3-1695)
- 2:00PM *Model Summer Programs for Students from Underrepresented Groups.* **Deborah Nolan**, University of California, Berkeley (1014-Y3-1674)
- 2:30PM *Diversifying the research experience: Creating an REU environment that is conducive to the education of the whole person.* **Erika T. Camacho***, Loyola Marymount University, and **Stephen A. Wirkus**, California State Polytechnic University, Pomona (1014-Y3-1376)
- 3:00PM *The Advance Program and the Career Partner Program at UCI, and the Mentoring Program for Women Mathematicians at IAS.* Preliminary report. **Chuu-Lian Terng**, University of California at Irvine (1014-Y3-1662)

- 3:30PM *NSF ADVANCE at the University of Michigan.* Preliminary report. **Kristen S. Moore**, University of Michigan (1014-Y3-780)

MAA General Contributed Paper Session, IV

1:00 PM – 4:10 PM

- Chair: **Eric S. Marland**
Chair: **Jay A. Malmstrom**, Oklahoma City Community College
Organizers: **Stephen L. Davis**, Davidson College
Eric S. Marland, Appalachian State University
- 1:00PM *Teaching Undergraduate Courses in Biomathematics.* Preliminary report. **Raina S. Robeva***, Sweet Briar College, and **Michael L. Johnson**, University of Virginia School of Medicine (1014-Z1-1759)
- 1:15PM *Computational Tools for a Two-Course Calculus Sequence for Biology Majors.* **Timothy D. Comar**, Benedictine University (1014-Z1-363)
- 1:30PM *Bioinformatics and the Undergraduate Mathematics Curriculum.* Preliminary report. **Steven M. Deckelman**, University of Wisconsin-Stout (1014-Z1-402)
- 1:45PM *Chances in Life—Creating a Statistics/Biology Learning Community.* Preliminary report. **William D. Ardis**, Collin County Community College - Preston Ridge Campus (1014-Z1-1432)
- 2:00PM *Mathematical Preparation for First Statistics Courses.* **Paul Kochanowski**, Indiana University South Bend, and **Morteza Shafii-Mousavi***, Indiana University South Bend (1014-Z1-99)
- 2:15PM *A review of the literature pertaining to the interactions between teachers pedagogical beliefs, their content knowledge, and their attitudes toward specific topics, as applied to statistics.* **Stephen Max Lancaster**, University of Oklahoma (1014-Z1-984)
- 2:30PM *Using the CSI effect in Calculus: Applying forensic science to infinite series.* Preliminary report. **R. Travis Kowalski**, South Dakota School of Mines and Technology (1014-Z1-1317)
- 2:45PM *Curtailment Procedure for Selecting Among Bernoulli Populations.* **Elena Mihaela Buzaianu*** and **Pinyuen Chen**, Syracuse University (1014-Z1-833)
- 3:00PM *The weather report: Daily and seasonal temperature extremes.* Preliminary report. **Richard N. Barshinger**, Penn State Scranton (1014-Z1-675)
- 3:15PM *Special Averages with Sums of Powers of Integers.* Preliminary report. **Thomas Pfaff**, Ithaca College (1014-Z1-431)
- 3:30PM *Finite Dimensional Approximations to Wiener Measure on a Compact Manifold with Positive Curvature.* **Adrian P. C. Lim**, UCSD (1014-Z1-939)
- 3:45PM *Constructing 5-Regular 5/2-Tough Graphs.* **Lynne L. Doty**, Marist College, and **Kevin K. Ferland***, Bloomsburg University (1014-Z1-610)
- 4:00PM *Graphs with the disjoint linking property.* **Joel S. Foisy**, SUNY Potsdam (1014-Z1-753)

SIAM Minisymposium on New Transform Methods for Differential Equations

1:00 PM – 4:00 PM

Organizers: **Beatrice Pelloni**, University of Reading, UK
Li-yeung Sung, University of South Carolina

- 1:00PM (803) *The solution of linear boundary value problems on time-dependent domains.*
Beatrice Pelloni, University of Reading (1014-35-1422)
- 1:30PM (804) *Initial-boundary-value problems for linear and nonlinear differential-difference evolution equations.* Preliminary report.
Gino Biondini*, SUNY at Buffalo, and **Athanassios Fokas**, University of Cambridge (1014-34-1515)
- 2:00PM (805) *Harmonic and biharmonic problems in fixed and free domains.*
Darren G. Crowdy, Imperial College London (1014-35-828)
- 2:30PM (806) *On the Global Relation and Moment Theory for the Ellipse.*
George Dassios, University of Cambridge, UK (1014-35-588)
- 3:00PM (807) *Numerical Solution of the Global Relation for Linear Elliptic Equations.*
Scott R. Fulton, Clarkson University (1014-65-1436)
- 3:30PM Discussion of Open Problems.

SIAM Minisymposium on Inverse Problems: Theory and Numerics for Novel Applications, II

1:00 PM – 3:55 PM

Organizers: **Heinz W. Engl**, Johannes Kepler University
Lothar Reichel, Kent State University

- 1:00PM (808) *Inverse Obstacle problems for Laplace's Equation.* Preliminary report.
William Rundell, Texas A&M University (1014-35-885)
- 1:30PM (809) *An inverse problem in photolithography.*
Fadil Santosa, University of Minnesota (1014-49-846)
- 2:00PM (810) *Inferring gene regulatory networks as nonlinear inverse problem with sparsity constraints.*
Philipp Kuegler, RICAM, Austria (1014-92-725)
- 2:30PM (811) *Spatial Domain Decomposition and Model Reduction for Parabolic Parameter Identification Problems.*
Matthias Heinkenschloss, Rice University (1014-49-357)
- 3:00PM (812) *Inverse Scattering Applied to the Reconstruction of Coated Objects.*
Peter Monk* and **David Colton**, University of Delaware (1014-65-1598)
- 3:30PM (813) *Doppler-only radar imaging.*
Margaret Cheney*, Rensselaer Polytechnic Institute, and **Brett Borden**, Naval Postgraduate School (1014-35-914)

MAA-AWM Panel Discussion

1:00 PM – 2:20 PM

Teaching a course on women and/or minorities in mathematics.
 Organizers: **Therese L. Bennett**, Southern Connecticut State University

Sarah J. Greenwald, Appalachian State University

Panelists: **Sarah J. Greenwald**
John H. Kellermeier, Tacoma Community College
Helen Moore, American Institute of Mathematics
Bonnie J. Shulman, Bates College

MAA-Project NEXt Panel Discussion

1:00 PM – 2:30 PM

The mathematics profession in 2016: Where are we going?

Organizers: **John F. Bukowski**, Juniata College
Dale R. Buske, St. Cloud State University
Kenneth L. Price, University of Wisconsin-Oshkosh

Panelists: **David M. Bressoud**, Macalester College
Michael Starbird, University of Texas at Austin
Tina H. Straley, MAA
Paul Zorn, St. Olaf College

MAA Committee on the Profession Panel Discussion

1:00 PM – 2:20 PM

Scholarship scenarios.

Organizer: **David J. Lutzer**, The College of William and Mary

MAA Project NEXt-YMN Poster Session

2:00 PM – 4:00 PM

Organizers: **Kevin E. Charlwood**, Washburn University
Kenneth A. Ross, University of Oregon

Summer Program for Women in Mathematics

2:00 PM – 4:00 PM

Participants from past programs will describe their experiences.

Organizer: **Murli M. Gupta**, George Washington University

AMS Invited Address

2:15 PM – 3:05 PM

(814) *Homotopy properties of Hamiltonian group actions.*
Dusa McDuff, SUNY at Stony Brook (1014-57-04)

AMS Session on Topology, I

2:30 PM – 4:10 PM

2:30PM (815) *A Presentation For The Automorphisms Of The 3-Sphere That Preserve A Genus Two Heegaard Splitting.*

Erol Akbas, University of Illinois at Chicago (1014-57-1395)

2:45PM (816) *The Eilenberg-Moore spectral sequence for Morava K-theory.* Preliminary report.

F. John Carter, University of Oregon (1014-55-1121)

Program of the Sessions – Friday, January 13 (cont'd.)

3:00PM *Kelley's specialization of Tychonov's Theorem is equivalent to the Boolean Prime Ideal Theorem.*
(817) **Eric Schechter**, Vanderbilt University
(1014-03-1590)

3:15PM *Typical Closed Subsets of R^n .* Preliminary report.
(818) **Elizabeth M. Bator**, University of North Texas
(1014-26-1757)

3:30PM *Detecting invertibility from the topology of the pullback of hyperplane foliations.*
▶ (819) **Eduardo Cabral Balreira**, University of Notre Dame
(1014-58-802)

3:45PM *Special Manifolds.* Preliminary report.
(820) **Violeta Vasilevska**, The University of South Dakota
(1014-57-1603)

4:00PM *Pictures of the Second Homotopy Group of a Two-Complex.* Preliminary report.
(821) **Katherine Byler Kelm**, California State University, Fresno (1014-57-1353)

AMS Special Presentation

2:30 PM – 4:00 PM

T.A. development using case studies: A workshop for faculty (Part 2).

Organizers: **Solomon Friedberg**, Boston College
Diane L. Herrmann, University of Chicago

MAA Panel Discussion

2:30 PM – 3:50 PM

What business looks for in new hires.

Organizer: **Donald B. Small**, U.S. Military Academy
Panelists: **Anthony Edwards**, San Antonio Public Service
Sandra Martinez, Kelly Aviation Center
Steve Bryant, Zachary Construction Company
Frances Gonzalez, Assistant City Manager of the City of San Antonio

MAA Panel Discussion

2:30 PM – 3:50 PM

AMATYC's Beyond Crossroads: Implementing standards-based mathematics instruction.

Organizer: **Susan S. Wood**, J. Sargeant Reynolds Community College

Panelists: **Susan S. Wood**
Richelle M. Blair, Lakeland Community College
Kathy A. Mowers, Owensboro Community and Technical College
William E. Haver, Virginia Commonwealth University

AMS Session on Dynamical Systems, I

2:45 PM – 4:10 PM

2:45PM *Whirly Transformations.* Preliminary report.
(822) **Yue Wu**, Rice University, Houston (1014-37-912)

3:00PM Break

3:15PM *Critically Finite Maps and Attractors on Complex Projective Spaces.* Preliminary report.
(823) **Feng Rong**, University of Michigan, Ann Arbor (1014-37-627)

3:30PM *Turing patterns on growing square domains.*
(824) **Adela Nicoleta Comanici*** and **Martin Golubitsky**, University of Houston (1014-37-1049)

3:45PM *Levitan almost periodicity.* Preliminary report.
(825) **Alica Miller**, University of Louisville (1014-37-1682)

4:00PM *Bounds for Linear Recurrence Relations with Unbounded Order.*
▶ (826) **Kenneth S. Berenhaut**, Wake Forest University,
Ying Wai Fan, Emory University, and **Zachary J. Abernathy***, Wake Forest University (1014-39-1693)

AMS Retiring Presidential Address

3:20 PM – 4:10 PM

(827) *Threads from My Life: Linear (good) Resolutions and Small (seductive) Varieties.*
David Eisenbud, Mathematical Sciences Research Institute (1014-14-07)

Joint Prize Session

4:25 PM – 5:25 PM

SIGMAA on Research in Undergraduate Mathematics Business Meeting and Guest Lecture

5:45 PM – 7:45 PM

Organizer: **Barbara E. Edwards**, Oregon State University

(828) *On infinite processes and actual infinity.*
Anne E. Brown, Indiana University South Bend (1014-A0-1594)

MAA Information Session

5:45 PM – 7:15 PM

Current issues in actuarial science education.

Organizers: **Bettye Anne Case**, Florida State University
Steve P. Paris, Florida State University
Matthew J. Hassett, Arizona State University

SIGMAA on Business, Industry, and Government Reception

5:45 PM – 6:45 PM

Organizer: **Michael G. Monticino**, University of North Texas

SIGMAA on Statistics Education Business Meeting

5:45 PM – 7:45 PM

Organizer: **Thomas L. Moore**, Grinnell College

MAA Two-Year College Reception

5:45 PM – 7:00 PM

Joint Prize Session Reception

5:45 PM – 7:00 PM

SIGMAA on the History of Mathematics Annual Meeting and Guest Lecture

6:00 PM – 8:00 PM

Organizer: **Amy Shell-Gellasch**, Grafenwoer, Germany

- (829) *History of mathematics and original sources in India: A fieldwork report.*
Kim L. Plofker, University of Utrecht (1014-A0-54)

WEB SIGMAA Business Meeting and Guest Lectures

6:00 PM – 7:30 PM

Organizer: **Murray Eisenberg**, University of Massachusetts

- (830) *Internet-Based Software for the Geometry of Linear Algebra.*
Thomas F. Banchoff, Brown University (1014-A0-77)
- (831) *Report from across the Great Pond: On-line mathematics resources and delivery systems.*
Douglas A. Quinney, University of Keele, UK (1014-A0-78)
- (832) *The Web on Steroids—Croquet on Mars.*
Frank Wattenberg, United States Military Academy (1014-A0-1672)

Young Mathematicians' Network Town Meeting

7:30 PM – 8:30 PM

Concerns of young mathematicians.

Organizer: **David C. Kung**, St. Mary's College of Maryland

Saturday, January 14

Combined MAA Department Liaisons and PME/MAA Student Chapter Advisors Breakfast Meeting

7:00 AM – 8:30 AM

Joint Meetings Registration

7:30 AM – 4:00 PM

Employment Center

7:30 AM – 7:30 PM

AMS-SIAM Special Session on Nonlinear Dynamical Systems, II

8:00 AM – 10:55 AM

Organizers: **Zhijun Qiao**, University of Texas Pan American
Andras Balogh, University of Texas Pan American
Guihua Fei, University of Minnesota Duluth
Zhaosheng Feng, University of Texas Pan American

- 8:00AM (833) *Backstepping boundary controller and observer designs for the slender Timoshenko beam.*
Krstic Miroslav, University of California, San Diego (1014-35-442)

- 8:30AM (834) *Dynamic bifurcation and stability of the Taylor problem.*

Tian Ma, Sichuan University, and **Shouhong Wang***, Indiana University (1014-35-298)

- 9:00AM (835) *A Stable Method to Solve Nonlinear Elliptic PDE Systems for Multiple Vector Solitons.*

Xianjin Chen* and **Jianxin Zhou**, Texas A&M University, College Station (1014-35-397)

- 9:30AM (836) *Nonlinear dynamics for semi-linear equations in circular domains and anisotropic Sobolev spaces.* Preliminary report.

Vladimir V Varlamov, University of Texas – Pan American (1014-35-851)

- 10:00AM (837) *Zero dynamics interior point control for a viscous Burgers equation.*

David S. Gilliam*, Texas Tech University, **Christopher I. Byrnes**, **Alberto Isidori**, Electrical and Systems Engineering / Washington University, St. Louis, and **Victor Shubov**, Colby College (1014-93-228)

- 10:30AM (838) *On the quantization of the three-particle Fermi-Pasta-Ulam lattice.* Preliminary report.

Bao-Feng Feng, The University of Texas-Pan American (1014-37-923)

AMS-SIAM Special Session on Frames and Operator Theory in Analysis and Signal Processing, III

8:00 AM – 10:45 AM

Organizers: **Peter R. Massopust**, Tuboscope Vetco Pipeline Services

David R. Larson, Texas A&M University

Manos I. Papadakis, University of Houston

Zuhair Nashed, University of Central Florida

Ahmed I. Zayed, DePaul University

Minh Chuong Nguyen, Institute of Mathematics, Hanoi Vietnam

- 8:00AM (839) *The Kadison-Singer Problem in Mathematics and Engineering: Part II.*

Peter G. Casazza*, University of Missouri, **Fickus Matt**, Air Force Institute of Technology, **Crandell Janet Tremain**, University of Missouri, **Roman Vershynin**, University of California - Davis, and **Eric Weber**, Iowa State University (1014-47-310)

- 8:30AM (840) *Construction of Sampling Theorems for Unions of Shifted Lattices.*

Hamid Behmard, Western Oregon University, **Adel Faridani***, Oregon State University, and **David Walnut**, George Mason University (1014-94-714)

- 9:00AM (841) *Multidimensional Prolate Spheroidal Wavelets.*

Gilbert G. Walter, University of Wisconsin-Milwaukee (1014-41-304)

- 9:30AM (842) *Prolate spheroidal wavelets in a periodic setting.* Preliminary report.

Xiaoping Shen, Ohio University (1014-42-160)

- 10:00AM (843) *Two applications of frames for the analysis of astrophysical data.*

Sandrine Anthoine, Universite de Marseille, France, and **Ingrid Daubechies***, Princeton University (1014-46-1364)

AMS-SIAM Special Session on Contemporary Dynamical Systems, II

8:00 AM - 10:50 AM

Organizers: **Dmitry Zenkov**, North Carolina State University
Youngna Choi, Montclair State University
Anthony M. Bloch, University of Michigan
Todd L. Fisher, University of Maryland
Melvin Leok, University of Michigan
David S. Richeson, Dickinson College
James S. Wiseman, Agnes Scott College

- 8:00AM (844) *Natural Frames, Interacting Particles and Stealth.*
P. S. Krishnaprasad, University of Maryland, Department of Electrical and Computer Engineering and Institute for Systems Research (1014-93-1226)
- 8:30AM (845) *Geodesic Flows on the Symplectic Group.*
Anthony M. Bloch*, University of Michigan, **Arieh Iserles**, Cambridge University, **Jerrold E. Marsden**, California Institute of Technology, and **Tudor S. Ratiu**, Ecole Polytechnique Federale de Lausanne (1014-34-919)
- 9:00AM (846) *Symmetry breaking for toral actions in simple mechanical systems.*
Petre Birtea, **Mircea Puta**, Universitatea de Vest, Timisoara, Romania, **Tudor S. Ratiu***, Ecole Polytechnique Federale de Lausanne, Switzerland, and **Razvan Tudoran**, Universitatea de Vest, Timisoara, Romania (1014-37-1222)
- 9:30AM (847) *A new proof of Sharkovsky's theorem.*
Keith Burns*, Northwestern University, and **Boris Hasselblatt**, Tufts University (1014-37-995)
- 10:00AM (848) *The Relative Growth of Information.*
Aimee S.A. Johnson*, Swarthmore College, **K. Dajani**, Utrecht University, and **M. de Vries**, Free University Amsterdam (1014-37-840)
- 10:30AM (849) *Fixed Points of abelian actions on S^2 and R^2 .*
 Preliminary report.
John Franks*, Northwestern University, **Michael Handel**, Herbert H. Lehman College (CUNY), and **Kamlesh Parwani**, University of Houston (1014-37-891)

AMS Special Session on Algebraic and Enumerative Combinatorics, II

8:00 AM - 10:45 AM

Organizers: **Catherine H. Yan**, Texas A&M University
Marcelo Aguiar, Texas A&M University
Joseph P. Kung, University of North Texas
Laura F. Matusevich, University of Pennsylvania

- 8:00AM (850) *From Schur Positivity to Schur Log-Concavity.*
Thomas Lam, Harvard University, **Alexander Postnikov** and **Pavlo Pylyavskyy***, Massachusetts Institute of Technology (1014-05-382)
- 8:30AM (851) *k-Schur functions, Macdonald polynomials, and quantum cohomology.*
Luc Lapointe, Universidad de Talca, and **Jennifer Morse***, University of Miami (1014-05-1661)

- 9:00AM (852) *Longest alternating subsequences of permutations.*
 Preliminary report.
Richard P. Stanley, M.I.T. (1014-05-325)

- 9:30AM (853) *The q, t -Catalan theorem and the q, t -Square theorem.*
Nicholas A. Loehr*, College of William and Mary, **Mahir B. Can**, University of Pennsylvania, and **Gregory S. Warrington**, Wake Forest University (1014-05-360)

10:00AM Problem Session

AMS Special Session on Arithmetic Geometry and Modular Forms, II

8:00 AM - 10:50 AM

Organizers: **Matthew A. Papanikolas**, Texas A&M University
Ahmad M. El-Guindy, Texas A&M University

- 8:00AM (854) *Orbits of curves on K3 surfaces and a fractal associated to the ample cone.*
Arthur Baragar, University of Nevada, Las Vegas (1014-14-711)
- 8:30AM (855) *Intersection numbers of Hecke cycles on Hilbert modular varieties.*
Jayce Robert Getz, University of Wisconsin-Madison (1014-11-1081)
- 9:00AM (856) *Hilbert's Tenth Problem for function fields over p -adic fields.*
Kirsten Eisentraeger, University of Michigan (1014-11-889)
- 9:30AM (857) *A finiteness conjecture for abelian varieties over number fields.*
Christopher Rasmussen, Rice University (1014-14-1372)
- 10:00AM (858) *Independence of Heegner Points.*
Michael I. Rosen* and **Joseph H. Silverman**, Brown University (1014-11-1180)
- 10:30AM (859) *Towards Lang-Trotter for Elliptic Curves over Function Fields.*
J. Felipe Voloch, Univ. of Texas at Austin (1014-11-266)

AMS Special Session on Recent Trends in Convex and Discrete Geometry, III

8:00 AM - 10:50 AM

Organizers: **Valeriu Soltan**, George Mason University
Tibor Bisztriczky, University of Calgary
Paul Goodey, University of Oklahoma

- 8:00AM (860) *Determination of convex bodies by directed projection functions.*
Paul Goodey, University of Oklahoma, and **Wolfgang Weil***, University of Karlsruhe, Germany (1014-52-1386)
- 8:30AM (861) *Convex Bodies with Constant Projection Functions.*
Ralph Howard*, University of South Carolina, and **Daniel Hug**, Mathematisches Institut, Universität Freiburg (1014-52-1230)
- 9:00AM (862) *On the road between intersection bodies and polar projection bodies.*
Alexander Koldobsky, University of Missouri-Columbia (1014-52-178)
- 9:30AM (863) *Centroid bodies and comparison of volumes.*
Vladyslav Yaskin* and **Maryna Yaskina**, University of Missouri - Columbia (1014-52-379)

- 10:00AM *Non-intersection bodies all of whose central sections are intersection bodies.*
(864) **Maryna Yaskina**, University of Missouri - Columbia (1014-52-378)
- 10:30AM *General measures of a convex body.*
▶ (865) **Artem Zvavitch**, Kent State University (1014-52-748)

AMS Special Session on Commutative Rings and Monoids, III

8:00 AM – 10:50 AM

Organizers: **Scott T. Chapman**, Trinity University
James B. Coykendall, North Dakota State University

- 8:00AM *On the integrally closed overrings of two-dimensional Noetherian domains.* Preliminary report.
(866) **Bruce Olberding**, New Mexico State University (1014-13-1462)
- 8:30AM *Extensions of local domains with trivial generic fibers.* Preliminary report.
(867) **William Heinzer**, Purdue University, **Christel Rotthaus**, Michigan State University, and **Sylvia M. Wiegand***, University of Nebraska Lincoln (1014-13-1175)
- 9:00AM *Arithmetic Properties of Pullbacks.* Preliminary report.
(868) **Evan Houston*** and **John Taylor**, UNC Charlotte (1014-13-925)
- 9:30AM *Integral closure of graded integral domains.*
(869) **Mi Hee Park**, Chung-Ang University (1014-13-1045)
- 10:00AM *A classification of the minimal ring extensions of an integral domain.*
(870) **David E. Dobbs**, University of Tennessee, Knoxville, and **Jay Shapiro***, George Mason University (1014-13-604)
- 10:30AM *The Regularity Condition R_k of Serre.*
(871) **Marie A. Vitulli**, University of Oregon (1014-13-157)

AMS Special Session on Syzygies in Commutative Algebra and Geometry, III

8:00 AM – 10:50 AM

Organizers: **Irena Peeva**, Cornell University
Sorin E. Popescu, SUNY at Stony Brook
Gregory G. Smith, Queen's University

- 8:00AM *Cohomology of Orlik-Solomon algebras and geometry of line configurations.* Preliminary report.
▶ (872) **Sergey Yuzvinsky**, University of Oregon, Eugene, Oregon (1014-13-366)
- 8:30AM *Holonomy Lie algebras, Graphic Arrangements, and $Tor^A(k, k)_i$.*
(873) **Hal Schenck*** and **Paulo Lima-Filho**, Texas A&M University (1014-14-340)
- 9:00AM *Core of ideals.* Preliminary report.
(874) **Claudia Polini**, University of Notre Dame (1014-13-793)
- 9:30AM Discussion
- 10:00AM *A computational study for the quadratic generation conjecture for smooth projective toric varieties.* Preliminary report.
▶ (875) **Serkan Hosten*** and **Joseph Gubeladze**, San Francisco State University (1014-13-1442)

- 10:30AM *Some conjectures on the resolutions of defining ideals of Veronese embeddings.* Preliminary report.
(876) **Jerzy M. Weyman**, Northeastern University (1014-13-1758)

AMS Special Session on Field Extensions and Algorithms, I

8:00 AM – 10:50 AM

Organizers: **Peter Stevenhagen**, Universiteit Leiden
H. W. Lenstra Jr., Universiteit Leiden

- 8:00AM *The correction factor in Artin's primitive root conjecture.*
▶ (877) **Peter Stevenhagen**, Universiteit Leiden (1014-11-576)
- 8:30AM *Computing the Galois group of a radical field extension.*
(878) **Bart de Smit**, Universiteit Leiden (1014-12-410)
- 9:30AM *Computing near-primitive root densities.* Preliminary report.
(879) **Willem Jan Palenstijn**, Universiteit Leiden (1014-11-876)
- 10:00AM *Radical algorithms.* Preliminary report.
▶ (880) **Wieb Bosma**, Radboud University, Nijmegen, the Netherlands (1014-11-1383)
- 10:30AM *Irreducible radical extensions and Euler-function chains.* Preliminary report.
(881) **Florian Luca**, Universidad Nacional Autonoma de México, Morelia, and **Carl Pomerance***, Dartmouth College (1014-11-244)

AMS Special Session on Nonautonomous Discrete Dynamics, II

8:00 AM – 10:50 AM

Organizers: **Saber N. Elaydi**, Trinity University
Jim M. Cushing, University of Arizona

- 8:00AM *Signature Function for Predicting Resonant and Attenuant Population Cycles.*
(882) **John E. Franke**, North Carolina State University (1014-92-1136)
- 8:30AM *Genetic variations due to periodic immigration for a discrete, selection model.* Preliminary report.
(883) **James F. Selgrade***, North Carolina State University, and **James H. Roberds**, USDA Forest Service (1014-92-837)
- 9:00AM *A Discrete Model for the Spread of Periodic Diseases.*
(884) **Ronald E. Mickens**, Clark Atlanta University (1014-39-120)
- 9:30AM *The dynamics of a discrete model of pulse propagation in a ring of cardiac tissue.*
(885) **Hassan Sedaghat**, Virginia Commonwealth University (1014-39-683)
- 10:00AM *Existence and Stability of Periodic Solutions of $x_n = f(n-1 \text{ mod } p, x_{n-k})$.* Preliminary report.
(886) **Ziyad M. Al-Sharawi**, Central Michigan University (1014-37-38)
- 10:30AM *Open Problems and Conjectures.* Preliminary report.
▶ (887) **Gerasimos Ladas**, University of Rhode Island (1014-39-794)

AMS Special Session on Continued Fractions, III

8:00 AM – 10:50 AM

Organizers: **Nancy Wyshinski**, Trinity College
James G. McLaughlin, Trinity College and West Chester University

Program of the Sessions – Saturday, January 14 (cont'd.)

- 8:00AM (888) *Accumulation Point Sets for Infinite Matrix Products and Continued Fractions.*
Douglas C. Bowman*, Northern Illinois University, and **James McLaughlin**, West Chester University (1014-30-1365)
- 9:00AM (889) *A q -continued fraction and some new proofs of some old continued fraction identities.*
James McLaughlin*, West Chester University, West Chester, PA., **Douglas Bowman**, Northern Illinois University, and **Nancy J. Wyshinski**, Trinity College, Hartford, CT. (1014-11-1120)
- 9:30AM (890) *Inhomogeneous Diophantine approximation for irrationals with quasi-periodic continued fractions.* Preliminary report.
Mary E. Flahive*, Oregon State University, and **Richard T. Bumby**, Rutgers, The State University of New Jersey (1014-11-217)
- 10:00AM (891) *Resurrecting the divided cell algorithm for inhomogeneous Diophantine approximation.* Preliminary report.
Richard T. Bumby*, Rutgers, The State University of New Jersey, and **Mary E. Flahive**, Oregon State University (1014-11-218)
- 10:30AM (892) *Expressing real quadratic irrationals as period-two continued fractions and their connections with diophantine approximation.*
Edward B. Burger, Williams College (1014-11-746)

AMS Session on Topology, II

8:00 AM – 10:55 AM

- 8:00AM (893) *Non-Archimedean Topologies as Boolean Rings and Their Maximal Ideals.*
Rahim G. Karimpour, Southern Illinois University Edwardsville (1014-54-534)
- 8:15AM (894) *Filament sets, aposyndesis, and the decomposition theorem of Jones.*
Keith Whittington*, University of the Pacific, and **Janusz Prajs**, Sacramento State University (1014-54-323)
- 8:30AM (895) *Cohomological dimension with respect to nonabelian groups.*
Atish Mitra, University of Tennessee- Knoxville (1014-55-1256)
- 8:45AM (896) *Shift Points and the Fixed Point Property for Products.*
T. Bruce McLean*, Georgia Southern University, and **Sam B. Nadler Jr.**, West Virginia University (1014-54-847)
- 9:00AM (897) *Binary Statements of Closed Curves and Graphs.*
Avery S. Zoch, Atlas Distributions (1014-54-920)
- 9:15AM (898) *The equivalence of the net & open-filter process and the open C^* -filter process of compactification.*
Hueytzen J. Wu*, Texas A&M University - Kingsville, and **Wan-Hong Wu**, The Institute for Drug Development, Cancer Therapy & Research Center (1014-54-1097)
- 9:30AM (899) *Some applications of signatures.* Preliminary report.
W. Kulpa, Silesian University, and **A. Szymanski***, Slippery Rock University (1014-54-1330)
- 9:45AM (900) *Knitting Topological Surfaces.* Preliminary report.
Sarah-Marie Belcastro, Xavier University (1014-54-1355)
- 10:00AM (901) *Partial Metrics.*
Homeira Pajooheh*, **Ralph David Kopperman**, City College of CUNY, and **Steve Matthews**, Warwick University, U.K., (1014-54-1565)

- 10:15AM (902) *Covering properties of symmetrizable spaces.* Preliminary report.
Sheldon W. Davis, Miami University (1014-54-1569)
- 10:30AM (903) *Asymmetric Ellis theory.* Preliminary report.
Susan Andima, C W Post Campus of Long Island University, **Ralph Kopperman***, City College of CUNY, and **Peter Nickolas**, University of Wollongong, Australia (1014-54-1725)
- 10:45AM (904) *Shift operators on 0-dimensional compact metric spaces.* Preliminary report.
Minakshisundaram Rajagopalan, Tennessee State University (1014-00-329)

AMS Session on History of Math

8:00 AM – 9:25 AM

- 8:00AM (905) *A remarkable alternative to trigonometric tables in determining the angles of a right triangle, given the lengths of two of its sides, as described by Thomas Ratcliffe, Mariner, in 1684.* Preliminary report.
Joel S. Silverberg, Roger Williams University (1014-01-122)
- 8:15AM (906) *Kein's Erlangen program.* Preliminary report.
Alan Durfee, Mount Holyoke College (1014-01-1000)
- 8:30AM (907) *Beyond Omar Khayyam's Rubaiyat.* Preliminary report.
Mohammad Moazzam, Salisbury University (1014-01-595)
- 8:45AM (908) *Sharing resources and insights for teaching a History/Philosophy of Mathematics course.* Preliminary report.
John R. Hinton* and **David Stucki**, Otterbein College (1014-01-603)
- 9:00AM (909) *Programming Gauss's algorithms for quadratic forms.* Preliminary report.
R. Michael Josephy, Universidad de Costa Rica (1014-01-705)
- 9:15AM (910) *Christiaan Huygens and the Problem of the Hanging Chain.* Preliminary report.
John F. Bukowski, Juniata College (1014-01-136)

AMS Session on Mathematical Biology, I

8:00 AM – 10:40 AM

- 8:00AM (911) *Mathematical Modelling of the Hemodynamical Flow of Blood.*
J. C. Misra, Indian Institute of Technology, Kharagpur, India (1014-92-593)
- 8:15AM (912) *Deterministic and Stochastic Models of Development of Resistance to Genetically Modified Pesticidal Crops.* Preliminary report.
Jemal S. Mohammed-Awel* and **John Ringinad**, State University of New York at Buffalo (1014-92-292)
- 8:30AM (913) *Eradication of the Screwworm Fly By Sterile Insect Release Method.* Preliminary report.
John G. Alford* and **Robert Matlock**, Tulane University (1014-92-346)
- 8:45AM (914) *A Continuum Model with Free Boundary Formulation and the Inverse Problem for Amebold Cell Motility.*
Huseyin Coskun, University of Iowa (1014-92-365)
- 9:00AM (915) *Modeling the molecular mechanisms of circadian rhythms and their response to light.*
Tanya Leise, Amherst College (1014-92-918)

- 9:15AM ▶ (916) *Biomechanical Model of Arabidopsis Thaliana Root Hair Growth*. Preliminary report.
Sarah E. Frey* and **Claudia Uhde-Stone**, California State University, East Bay (1014-92-981)
- 9:30AM ▶ (917) *Population density methods for stochastic neurons with a 2-D state space: Application to neural networks with realistic synaptic kinetics*.
Daniel Tranchina, Courant Institute / NYU, and **Felix J. Pfaltrer***, City University of New York - BMCC (1014-92-1017)
- 9:45AM ▶ (918) *On Optical Flow of Fluorescent Microscope Protein Images*. Preliminary report.
Robert C. Stolz*, **Camille A. McKayle**, University of the Virgin Islands, **Robert Murphy**, **Elvira Garcia Osuna** and **Yanhua Hu**, Carnegie Mellon University (1014-92-1104)
- 10:00AM (919) *Competing Species Models with an Infectious Disease*.
Roberto A. Saenz* and **Herbert W. Hethcote**, University of Iowa (1014-92-1115)
- 10:15AM ▶ (920) *Calcium Wave Initiation and Evolution in a Neuron*.
Bradford E. Peercy, Rice University (1014-92-1130)
- 10:30AM (921) *An Erythropoiesis Structured Model with Nonlinear Cell Maturation Velocity and Hormone Decay Rate*.
Azmy S. Ackleh, **Keng Deng**, University of Louisiana at Lafayette, **Kazufumi Ito**, North Carolina State University, and **Jeremy J. Thibodeaux***, University of Louisiana at Lafayette (1014-92-1193)

AMS Session on Group Theory, I

8:00 AM – 10:40 AM

- 8:00AM (922) *Number of Character Tables of Finite Groups*.
Adriana Nenciu, University of Florida (1014-20-159)
- 8:15AM (923) *Capability of nilpotent groups of class two and prime exponent*. Preliminary report.
Arturo Magidin, University of Louisiana at Lafayette (1014-20-169)
- 8:30AM (924) *Splitting pure extensions of LCA groups*. Preliminary report.
Peter Loth, Sacred Heart University (1014-20-257)
- 8:45AM (925) *Density in Arbitrary Semigroups*. Preliminary report.
Neil Hindman*, Howard University, and **Dona Strauss**, University of Hull (1014-20-350)
- 9:00AM ▶ (926) *On Autocommutators in Groups*.
Luise-Charlotte Kappe, SUNY at Binghamton (1014-20-381)
- 9:15AM ▶ (927) *A Classification of Certain Maximal Subgroups of Finite Symmetric Groups*.
Benjamin Newton*, University of Wisconsin-Madison, and **Bret Benesh**, Harvard University (1014-20-422)
- 9:30AM (928) *An Introduction to Permutably Detectable Groups*. Preliminary report.
Joseph Evan, King's College (1014-20-512)
- 9:45AM (929) *Block-Diagonality of LFS-Groups of p-Type*. Preliminary report.
Stefaan Dirk Delcroix, California State University, Fresno (1014-20-569)
- 10:00AM (930) *On the Location of the Near Frattini Subgroups of Generalized Free Products of Groups With Amalgamations*.
Mohammad K. Azarian, University of Evansville (1014-20-735)

- 10:15AM (931) *The Representations of The Heisenberg Group over a Finite Field*.
Manouchehr Misaghian, Johnson C. Smith University (1014-20-776)
- 10:30AM (932) *Simple Groups and $H^2(G, \mathbb{Q}/\mathbb{Z})$* .
Fedor Bogomolov, CIMS-NYU, and **Jorge Maciel***, BMCC-CUNY (1014-20-813)

MAA Session on Courses Below Calculus: A Continuing Focus, II

8:00 AM – 10:55 AM

- Organizers: **Mary Robinson**, University of New Mexico-Valencia Campus
Florence S. Gordon, New York Institute of Technology
Laurette Foster, Prairie View A&M University
Arlene H. Kleinstein, Farmingdale State University of New York
Norma M. Agras, Miami Dade Community College
Linda Martin, Albuquerque T-VI
- 8:00AM ▶ (933) *Technology and Linear Programming in a Finite Mathematics Course*.
Ronald Harshbarger*, University of South Carolina Beaufort, and **Lisa S. Yocco**, Georgia Southern University (1014-L1-1578)
- 8:20AM ▶ (934) *A Course BEFORE Calculus, but not necessarily BELOW Calculus, Continued Growth and Evolution*. Preliminary report.
Geoffrey Kuhlmann*, **Gerald Kobylski**, **Alex Heidenberg** and **Jack Picciuto**, United States Military Academy (1014-L1-1201)
- 8:40AM (935) *Adoption and Implementation of a Reform Curriculum for Courses Below Calculus, One Department's Experience*.
David Dudley, Scottsdale CC (1014-L1-1300)
- 9:00AM Break
- 9:20AM ▶ (936) *Mathematics for Measurement—"Math for Practical Arts"*.
Mary R. Parker*, Austin Community College, and **Hunter Ellinger**, Exemplar Technologies (1014-L1-1087)
- 9:40AM ▶ (937) *A Common-Sensible FTY Curriculum For Colleges: Visions And Guidance From Scientific Clinical Research*.
Clyde L. Greeno, MAEI Mathematics Institute (1014-L1-1040)
- 10:00AM (938) *Towards a Geometry Course that Focuses on Mathematical Ways of Reasoning and Knowing*. Preliminary report.
James Morrow, Mount Holyoke College (1014-L1-1075)
- 10:20AM ▶ (939) *A Two-Semester Precalculus/Calculus I Sequence: A Case Study*.
Mike Axtell, Wabash College (1014-L1-287)
- 10:40AM ▶ (940) *The "Basic Four" Elementary Functions and their Applications*.
Scott R. Herriott, Maharishi University of Management (1014-L1-1326)

MAA Session on Mathematics of Chemistry

8:00 AM – 10:50 AM

- Organizer: **George Rublein**, College of William and Mary

Program of the Sessions – Saturday, January 14 (cont'd.)

- 8:00AM *Calculation of Molecular Configurations for Identical Atoms.*
▶ (941) **Ronald E. Mickens**, Clark Atlanta University (1014-Q1-119)
- 8:25AM *See The Light! (Beer's Law in Calculus).*
▶ (942) **Stuart Boersma***, Central Washington University, and **Garrett J. McGowan**, Alfred University (1014-Q1-612)
- 8:50AM *Mathematical Modeling of Chemical Stoichiometry.*
▶ (943) **Bill Fox**, Francis Marion University (1014-Q1-623)
- 9:15AM *Molecular vibrations in an elementary linear algebra course with early eigenvalues.*
(944) **Charles S. Holmes**, Miami University (Ohio) (1014-Q1-1433)
- 9:40AM *Exploring Proteins and Hyperbolic Surfaces Using 3D Computer Graphics.* Preliminary report.
▶ (945) **Paul R. McCreary**, Xavier University of Louisiana (1014-Q1-1469)
- 10:05AM *Chemistry applications in beginning calculus.*
▶ (946) **George Rublein**, College of William and Mary (1014-Q1-1753)
- 10:30AM *Connecting Mathematics, Computing and Chemistry: An Undergraduate Computational Science Program.*
▶ (947) **Ignatios Vakalis**, Capital University (1014-Q1-1754)

MAA Session on Mathematics Experiences in Business, Industry, and Government

8:00 AM – 10:20 AM

Organizers: **Philip E. Gustafson**, Mesa State College
Michael G. Monticino, University of North Texas

- 8:00AM Welcome remarks.
- 8:05AM *Cost-Benefit Analysis of a Rotavirus Immunization Program in the Arab Republic of Egypt.* Preliminary report.
▶ (948) **Omayra Y. Ortega***, NAMRU-3 / University of Iowa, **Mark Riddle** and **John Sanders**, Naval Medical Research Unit No. 3 (1014-R1-514)
- 8:40AM *Teller Staffing in Retail Banks.* Preliminary report.
▶ (949) **Michael G. Monticino**, University of North Texas (1014-R1-993)
- 9:15AM *Ionospheric Dispersion of LFM Pulses.* Preliminary report.
▶ (950) **Gregory E. Coxson**, Technology Service Corporation (1014-R1-1340)
- 9:50AM *Optimal Control Theory Applied to a Cooperative Game between Manufacturer and Retailer.*
(951) **Ellina Grigorieva**, Texas Woman's University (1014-R1-1003)

MAA Session on Countering "I Can't Do Math": Strategies for Teaching Underprepared, Math-Anxious Students, I

8:00 AM – 10:55 AM

Organizers: **Bonnie Gold**, Monmouth University
Suzanne Dorée, Augsburg College
Richard J. Jardine, Keene State College

- 8:00AM *The effects of exam retakes on mathematics anxiety levels of college students enrolled in developmental mathematics.*
▶ (952) **Joan E. Brown**, Eastern New Mexico University, Portales, NM (1014-S1-572)

- 8:20AM *Using Quizzes to Reinforce Learning and Reduce Test Anxiety.*
(953) **Mary I. Kay**, Del Mar College (1014-S1-1253)
- 8:40AM *A Decimal Point Can Kill You.* Preliminary report.
▶ (954) **Agnes M. Kalemari**, SUNY Farmingdale (1014-S1-1692)
- 9:00AM *Using the "Color the Board" game to challenge anxious students' notions of mathematics.* Preliminary report.
▶ (955) **Mika Munakata*** and **Michael A. Jones**, Montclair State University (1014-S1-1624)
- 9:20AM *Reducing Math Anxiety by Improving the Math.*
▶ (956) **Steven R. Lay**, Lee University (1014-S1-380)
- 9:40AM *The role of content in countering math anxiety.* Preliminary report.
(957) **David Marshall**, Monmouth University (1014-S1-1463)
- 10:00AM *'I Can't do Math': Where Does the Attitude Come From?*
▶ (958) **Jean M. Horn***, Northern Virginia Community College - Woodbridge Campus, and **Harrison W. Straley**, Wheaton College (1014-S1-352)
- 10:20AM *Confidence to Competence: Giving Back the Control in a Math-anxious Classroom.*
(959) **Debasree Raychaudhuri**, CalState Los Angeles (1014-S1-1668)
- 10:40AM *Strategies for Working with Under Prepared Students and Students who Have a Poor Attitude Towards Mathematics.*
▶ (960) **Ann C. Hanson**, Columbia College, Chicago (1014-S1-309)

MAA Session on Teaching Operations Research in the Undergraduate Classroom

8:00 AM – 10:55 AM

Organizers: **Christopher J. Lacke**, Rowan University
Paul E. Fishback, Grand Valley State University

- 8:00AM *Group Presentations in an Undergraduate Operations Research Course.* Preliminary report.
▶ (961) **Paul E. Fishback**, Grand Valley State University (1014-T1-751)
- 8:20AM *An Operations Research Course for Teachers.*
▶ (962) **Nancy J. Boynton**, SUNY Fredonia (1014-T1-1568)
- 8:40AM *A Modeling Project in Linear Programming.* Preliminary report.
▶ (963) **Maria Cristina Villalobos**, University of Texas-Pan American (1014-T1-1633)
- 9:00AM *Assigning Upper Division Mathematics Courses at "California University".*
▶ (964) **Jenny Switkes**, California State Polytechnic University, Pomona (1014-T1-35)
- 9:20AM *Undergraduate Nonlinear Optimization.*
(965) **Bill Fox**, Francis Marion University (1014-T1-625)
- 9:40AM *Open Ended Explorations in Optimization.* Preliminary report.
▶ (966) **Mark Parker**, Carroll College, Montana (1014-T1-1720)
- 10:00AM *Utility Trailer Cargo Bed Optimization Problem.* Preliminary report.
▶ (967) **Danny W. Turner**, Winthrop University (1014-T1-680)
- 10:20AM *Using a CAS in the Teaching of Operations Research.*
(968) **Christopher J. Lacke**, Rowan University (1014-T1-515)

10:40AM *TSP Generator: On-line generation of real-life traveling salesman problems.*
▶ (969) **Sean L. Forman**, Saint Joseph's University (1014-T1-624)

MAA Session on My Favorite Demo: Innovative Strategies for Mathematics Instructors, I

8:00 AM – 10:55 AM

Organizers: **David R. Hill**, Temple University
Lila F. Roberts, Georgia College & State University

- 8:00AM *Two hands-on demos for teaching about centroids in Calculus.*
▶ (970) **David M. Strong**, Pepperdine University (1014-U1-74)
- 8:15AM *Image Processing With Mathematica.*
▶ (971) **Roland Minton**, Roanoke College (1014-U1-182)
- 8:30AM *Visualizing the Method of Finding Volumes by Cross Section: An Eggsperiment.*
▶ (972) **Jean Uhl**, **Patricia B. Humphrey*** and **James Braselton**, Georgia Southern University (1014-U1-191)
- 8:45AM *Desktop Sharing and Collaborative Learning in a Wireless Classroom Network.*
▶ (973) **Jong H. Chung*** and **Randal E. Hickman**, United States Military Academy (1014-U1-933)
- 9:00AM *In Search of the Singular Value Decomposition.*
(974) **Thomas Hern*** and **David Meel**, Bowling Green State University (1014-U1-1026)
- 9:15AM *Visualizing Partial Derivatives without Graphs.*
▶ (975) Preliminary report.
Martin E. Flashman, Humboldt State University and Occidental College (1014-U1-1011)
- 9:30AM *Using the Geometer's Sketchpad Software for Introductory Calculus Demonstrations.*
▶ (976) **Monica Pierri-Galvao**, Gannon University (1014-U1-673)
- 9:45AM *Average and Instantaneous Rates of Change.*
▶ (977) **James J. Reynolds**, Clarion University of Pennsylvania (1014-U1-562)
- 10:00AM *The Use of Spreadsheets to Illustrate Finite Mathematics Concepts.*
(978) **Paul Kochanowski** and **Morteza Shafii-Mousavi***, Indiana University South Bend (1014-U1-100)
- 10:15AM *Statistics Before Your Eyes: Photographs of Statistical Concepts.*
▶ (979) **Robert W. Jernigan**, American University (1014-U1-208)
- 10:30AM *The Tablet PC: A Tool for Teaching a Large-Group Calculus Class.*
▶ (980) **Nicholas Gorgievski***, Nichols College, **Thomas C. DeFranco**, **Robert A. Stroud** and **Mary P. Truxaw**, University of Connecticut (1014-U1-506)

MAA General Contributed Paper Session, V

8:00 AM – 10:40 AM

Chair: **Sarah L. Mabrouk**, Framingham State College
Chair: **Mary Beth Searcy**, Appalachian State University
Organizers: **Stephen L. Davis**, Davidson College
Eric S. Marland, Appalachian State University

8:00AM *Math War in China: They Know What They Don't Know.* Preliminary report.
(981) **Annie Y. Han**, The City University of New York, BMCC (1014-Z1-1715)

- 8:15AM *The history of development of mathematics in Georgia.* Preliminary report.
▶ (982) **Nino Khatiashvili**, Tbilisi I. Javakhishvili State University (1014-Z1-130)
- 8:30AM *Resources for QL: Mathematics Across the Curriculum and the National Numeracy Network at the University of Nevada.*
(983) **Jerry A. Johnson**, University of Nevada, Reno (1014-Z1-216)
- 8:45AM *Math: The Unpopular Culture.* Preliminary report.
▶ (984) **Victor Dorff**, California Lutheran University (1014-Z1-1584)
- 9:00AM *"But I Got the Right Answer!"*
▶ (985) **Fred Worth**, Henderson State University (1014-Z1-1582)
- 9:15AM *Multiple Assessments: Uncovering Mathematical Misunderstandings.*
▶ (986) **Susie M. Lanier*** and **Donna B. Saye**, Georgia Southern University (1014-Z1-351)
- 9:30AM *Assessing the Mathematics Core: A Mixed Method Approach at the Colorado School of Mines.*
(987) **Scott A. Strong**, **Barbara M. Moskal** and **Graeme Fairweather***, Colorado School of Mines (1014-Z1-1494)
- 9:45AM *Student Statistical Analysis of A Student Tutoring Laboratory.*
▶ (988) **Richard D. Summers**, Reinhardt College (1014-Z1-935)
- 10:00AM *Review Sheets: Motivating students to learn and self assess.* Preliminary report.
▶ (989) **Luz Maria DeAlba**, Drake University (1014-Z1-742)
- 10:15AM *Dropping Lowest Grades.*
▶ (990) **Jonathan M. Kane***, University of Wisconsin - Whitewater, and **Daniel M. Kane**, Massachusetts Institute of Technology (1014-Z1-471)
- 10:30AM *A Master's Program for Middle School Mathematics Teachers.*
▶ (991) **Julie A. Belock**, Salem State College (1014-Z1-973)

PME Council

8:00 AM – 11:00 AM

AMS Invited Address

9:00 AM – 9:50 AM

- (992) *Whitney's extension problems.*
Charles L. Fefferman, Princeton University (1014-26-05)

ASL Invited Address

9:00 AM – 9:50 AM

- (993) *Model theory of metric structures.*
C. Ward Henson, University of Illinois at Urbana-Champaign

MAA Minicourse #12: Part B

9:00 AM – 11:00 AM

Getting students involved in undergraduate research.
Organizers: **Aparna W. Higgins**, University of Dayton

Joseph A. Gallian, University of
Minnesota Duluth

MAA Minicourse #1: Part B

9:00 AM – 11:00 AM

*Designing and evaluating assessments for
introductory statistics.*

Organizers: **Beth L. Chance**, California Polytech
State University
Robert C. Delmas, University of
Minnesota
Allan J. Rossman, California Polytech
State University

MAA Minicourse #7: Part B

9:00 AM – 11:00 AM

Geometry with history for teaching teachers.

Organizers: **David W. Henderson**, Cornell
University
Daina Taimina, Cornell University

MAA-YMN Panel Discussion

9:00 AM – 10:20 AM

Transitioning into graduate school.

Organizers: **Dov N. Chelst**, DeVry University
Heather Ames Lewis, Nazareth
College

MAA Session for Chairs

9:00 AM – 10:20 AM

Building bridges.

Organizers: **Catherine M. Murphy**, Purdue
University Calumet
Daniel P. Maki, Indiana University
Panelists: **Susan L. Ganter**, Clemson University
William E. Haver, Virginia
Commonwealth University

**SIGMAA on the Teaching of Advanced High School
Mathematics Panel Discussion**

9:00 AM – 10:20 AM

AP Calculus: Friend or Foe?

Organizer: **Daniel J. Teague**, North Carolina
School of Science and Mathematics
Panelists: **David M. Bressoud**, Macalaster
College
Susan Schwartz Wildstrom, Walt
Whitman High School
Daniel Kennedy, The Baylor School

MAA Poster Session

9:00 AM – 11:00 AM

Special mathematical outreach programs.

Organizers: **Elizabeth G. Yanik**, Emporia State
University
Jennifer Hontz, Meredith College
Kathleen A. Sullivan, Seattle University

**MAA Committee on Technologies in Mathematics
Education Panel Discussion**

9:00 AM – 10:20 AM

Electronic homework systems.

Organizers: **Michael D. Hvidsten**, Gustavus
Adolphus College
Bruce W. Yoshiwara, Los Angeles
Pierce College
Panelists: **Irene Doo**, Austin Community College
Vadim V. Ponomarenko, Trinity
University
Amelia Taylor, St. Olaf College
John W. Jones, Arizona State
University

MAA-Project NEXt Panel Discussion

9:30 AM – 11:00 AM

Making the most of your sabbatical.

Organizers: **Blair F. Madore**, SUNY Potsdam
Pamela B. Pierce, College of Wooster
Panelists: **Jennifer R. Galovich**, St. John's
University
Charles R. Hampton, College of
Wooster
Judy A. Holdener, Kenyon College
William A. Marion, Valparaiso
University
Thomas Q. Sibley, St. John's University

Exhibits and Book Sales

9:30 AM – 5:30 PM

ASL Invited Address

10:00 AM – 10:50 AM

(994) *Effectively closed sets.*
Douglas Cenzer, University of Florida

Math on the Web, III

10:00 AM – 5:00 PM

10:00AM *The Math Gateway: An NSDL portal for
(995) undergraduate math.*
Lang Moore, Mathematical Association of America
12:30PM *Math-aware Web searching.*
(996) **Robert Miner**, Design Science, Inc.
1:30PM *Communicating math on the Web: Promises, trials,
(997) and free beer.*
Patrick Ion, American Mathematical Society
2:30PM *Interactive math on the Web by Maplesoft.*
(998) **Mohamed Bendame**, Maplesoft
3:30PM *Writing questions with randomized parameters in
(999) proper mathematical notation for online homework
assignments.*
John Risley, WebAssign
4:30PM *Techniques for using the equation editor in
(1000) Blackboard and WebCT.*
Bob Matthews, Design Science, Inc.

AMS Invited Address

10:05 AM – 10:55 AM

- (1001) *Persistent homology, diagrams, and vineyards.*
Herbert Edelsbrunner, Duke University (1014-55-17)

AMS-MAA Invited Address

11:10 AM – NOON

- (1002) *Spectral properties of quasiperiodic operators: The competition between order and chaos.*
Svetlana Y. Jitomirskaya, University of California Irvine (1014-81-28)

AMS Colloquium Lectures: Lecture III

1:00 PM – 2:00 PM

- (1003) *Entangled radicals, Part III.*
Hendrik W. Lenstra Jr., Universiteit Leiden (1014-12-15)

MAA Student Lecture

1:00 PM – 1:50 PM

- ▶ (1004) *The many faces of pi.*
Marc Chamberland, Grinnell College (1014-A0-22)

AMS-MAA-SIAM Special Session on Research in Mathematics by Undergraduates, I

1:00 PM – 5:55 PM

Organizers: **Darren Narayan**, Rochester Institute of Technology
Carl V. Lutzer, Rochester Institute of Technology
Michael J. Fisher, California State University, Fresno
Bernard Brooks, Rochester Institute of Technology
Tamas I. Wiandt, Rochester Institute of Technology

- ▶ (1005) 1:00PM *Algebraic Model and Monte Carlo Model of Financial Management.* Preliminary report.
Yan Li*, Wells College, and **Sean Wilkoff**, University of California, Berkeley (1014-00-272)
- ▶ (1006) 1:20PM *Optimized Least Squares Approach For Valuation of American Options.*
T.J. Deems, Slippery Rock University, **Jennifer Geis**, Augsburg College, **Troy Tingey***, Arizona State University, and **Anastasia Wong**, Mills College (1014-00-307)
- ▶ (1007) 1:40PM *Size and Difficulty of Mass Problems.*
Elizabeth T. Brown, James Madison University, **Andre Kornell***, Princeton University, and **Justin Palumbo**, Rutgers University (1014-03-158)
- ▶ (1008) 2:00PM *Upper Bounds in Graph Pebbling and a Look at the 2-Pebbling Property.*
Joyce D. Charlesworth, Warren Wilson College, **Theang T. Ho**, University of Nebraska, **Brian W. Keinath***, Central Michigan University, and **David Y. Lin**, Princeton University (1014-05-116)
- ▶ (1009) 2:20PM *Investigations in Nonabelian Difference Sets of Order 25.* Preliminary report.
M. Strom Borman*, Reed College, and **Ken W. Smith**, Central Michigan University (1014-05-133)

- ▶ (1010) 2:40PM *The Isoperimetric Numbers of Block Design Graphs.*
Dominic Lanphier, Western Kentucky University, **Christopher Miller**, Fairfield University, **Jason Rosenhouse**, James Madison University, and **Amber Russell***, Mississippi State University (1014-05-142)
- ▶ (1011) 3:00PM *Necessary and Sufficient Conditions for Tiling with 4×6 and 5×7 Rectangles.*
Rachell Ashley*, **Aisosa Ayela-Uwangué**, **Frances Cabrera**, **Carol Callesano**, **Darren A. Narayan**, Rochester Institute of Technology, and **Allen J. Schwenk**, Western Michigan University (1014-05-573)
- ▶ (1012) 3:20PM *Partial covering arrays and a generalized Erdős-Ko-Rado property.*
Patricia Ann Carey* and **Anant P. Godbole**, East Tennessee State University (1014-05-1122)
- ▶ (1013) 3:40PM *The Negs and Regs of Continued Fractions.* Preliminary report.
Alex Eustis* and **Arthur T. Benjamin**, Harvey Mudd College (1014-05-1496)
- ▶ (1014) 4:00PM *Color-Permuting Automorphisms of Cayley Graphs.* Preliminary report.
J. Bratz*, Lafayette College, **P. Cahn**, Smith College, **N. Haber**, Brown University, **E. McMahon**, Lafayette College, and **S. Tekansik**, Mesa State College (1014-05-1740)
- ▶ (1015) 4:20PM *Pursuing the Perfect Parallelepiped.*
Clifford A. Reiter and **Jordan Olliver Tirrell***, Lafayette College (1014-11-343)
- ▶ (1016) 4:40PM *Fibonacci Numbers and Diophantine Equations.*
Michael T. Holm*, Northwestern College, and **Ryan K. Johnson**, The University of Akron (1014-11-867)
- ▶ (1017) 5:00PM *Units in $\mathbb{Q}[z, \sqrt{z^2 - 4v}]$.*
Anne L. Chmura*, University of Akron, and **Sally A. Hall**, Swarthmore College (1014-11-1396)
- ▶ (1018) 5:20PM *Class Number Divisibility in Cubic Function Fields.*
Nathan Kaplan*, Princeton University/Williams College, **Carl Erickson**, Stanford University/Williams College, **Allison Pacelli**, **Neil Mendoza** and **Todd Shayler**, Williams College (1014-11-1626)
- ▶ (1019) 5:40PM *3-rank in Class Groups of Quadratic Number Fields.*
Carl Erickson*, Stanford University and Williams College, **Nathan Kaplan**, Princeton University and Williams College, **Neil Mendoza**, **Allison Pacelli** and **Todd Shayler**, Williams College (1014-11-1412)

AMS-MAA Special Session on History of Mathematics, I

1:00 PM – 5:55 PM

- Organizers: **Joseph W. Dauben**, Herbert H. Lehman College (CUNY)
Patti Hunter, Westmont College
Karen H. Parshall, University of Virginia
- ▶ (1020) 1:00PM *Reconstructing Early Developments of Determinants in China: Evidence from the "Nine Chapters of Mathematical Methods" (Jiu zhang suan shu) and Later Commentaries.*
Roger Hart, University of Texas at Austin (1014-01-497)
 - ▶ (1021) 1:30PM *Western Concepts of Infinity Introduced to China in the Seventeenth Century.* Preliminary report.
Yibao Xu, Borough of Manhattan Community College of the City University of New York (1014-01-916)

Program of the Sessions – Saturday, January 14 (cont'd.)

- 2:00PM *Giacomo Rho (1592-1638) and his mathematical work in Beijing.*
▶ (1022) **Jose A. Cervera**, ITESM, Campus Monterrey, Dep. Estudios Humanisticos (1014-01-693)
- 2:30PM *Descartes, the Princess Elisabeth, and the Problem of Apollonius: The dangers of Underestimating a Geometrical Problem.*
▶ (1023) **Henk J.M. Bos**, Utrecht University, The Netherlands (1014-51-456)
- 3:00PM *A War of Words in Pictures: The Dispute between Montmort and De Moivre over the Probability Calculus.*
▶ (1024) **David R. Bellhouse**, Department of Statistical and Actuarial Sciences, University of Western Ontario (1014-01-465)
- 3:30PM *On a Result of Lagrange in the Theory of Infinite Series.* Preliminary report.
▶ (1025) **Craig G. Fraser**, University of Toronto (1014-01-637)
- 4:00PM *Early Theories of Vectors.*
▶ (1026) **Sandro Caparrini**, Dibner Institute for the History of Science, Cambridge, MA (1014-01-503)
- 4:30PM *Cayley's counting problems.* Preliminary report.
▶ (1027) **Anthony J. Crilly**, Middlesex University (1014-01-504)
- 5:00PM *Mathematical crystallography after Hilbert's 18th problem.* Preliminary report.
(1028) **Jeanine Daems**, Leiden University (1014-01-733)
- 5:30PM *Euler's Amicable Numbers.*
▶ (1029) **William Dunham**, Muhlenberg College (1014-01-510)

AMS-SIAM Special Session on Nonlinear Dynamical Systems, III

1:00 PM – 5:55 PM

Organizers: **Zhijun Qiao**, University of Texas Pan American
Andras Balogh, University of Texas Pan American
Guihua Fei, University of Minnesota Duluth
Zhaosheng Feng, University of Texas Pan American

- 1:00PM *A Nash-Moser inverse function result using continuous Newton's method.*
▶ (1030) **John W. Neuberger**, University of North Texas (1014-35-391)
- 1:30PM *Mathematical Analysis of the Fourier Spectrum of Chaos with Applications to the Chaotic Vibration of the Wave Equation with a Nonlinear Boundary Condition.*
(1031) **Goong Chen**, Texas A&M University (1014-35-632)
- 2:00PM *Spectral representations of solutions of linear evolution equations using Steklov eigenfunctions.* Preliminary report.
(1032) **Giles Auchmuty**, National Science Foundation (1014-49-597)
- 2:30PM *A Nonlinear Parabolic/Hyperbolic System Arising in a Size Dependent Population Dynamics Model.*
(1033) **Jay R. Walton**, Texas A&M University (1014-35-414)
- 3:00PM *Canonical Duality Theory and Method for Solving Non-convex and Non-conservative Hamilton Systems with Applications.*
(1034) **David Yang Gao**, Virginia Tech, Blacksburg, VA (1014-35-737)

- 3:30PM *Newton's Method and Partial Differential and difference Equations.*
(1035) **John M. Neuberger***, **James W. Swift** and **Nandor Sieben**, Northern Arizona University (1014-35-518)
- 4:00PM *Anti-symmetric KdV equation and application to ocean waves.* Preliminary report.
▶ (1036) **Lokenath Debnath**, University of Texas - Pan American (1014-35-615)
- 4:30PM *Decomposition method for Camassa-Holm equation.*
(1037) **Sadefo Kamdem Jules***, Université de Reims, UMR CNRS 6056, and **Qiao Zhijun**, University of Texas Pan-American (1014-35-135)
- 5:00PM *Approximation of Eigenvalues of a Class of Fourth Order Nonselfadjoint Differential Operators.* Preliminary report.
▶ (1038) **Andras Balogh*** and **Roberto Castillo**, University of Texas - Pan American (1014-65-1096)
- 5:30PM *Qualitative Study to a Reaction-Diffusion Equation.*
(1039) **Zhaosheng Feng***, University of Texas-Pan American, and **Qingguo Meng**, Tianjin University of Technology and Education (1014-35-278)

AMS-SIAM Special Session on Analysis and Implementation of Finite Element Methods

1:00 PM – 5:20 PM

Organizer: **Atife Caglar**, University of Wisconsin-Green Bay

- 1:00PM *Domain Decomposition Preconditioners for C^0 Interior Penalty Methods.*
(1040) **Kening Wang*** and **Susanne C. Brenner**, University of South Carolina (1014-65-1303)
- 1:30PM *Sensitivity Analysis and Control of Systems Governed by Partial Differential Equations.*
▶ (1041) **Lisa G. Davis***, Montana State University, and **John Singler**, Oregon State University (1014-65-1485)
- 2:00PM *Efficient Implementation of Characteristic Finite Element Methods.*
(1042) **Jiangguo Liu***, Colorado State University, **Hongsen Chen**, **Richard E. Ewing** and **Guan Qin**, Texas A&M University (1014-65-184)
- 2:30PM *No-Slip Boundary Conditions for Navier-Stokes Equations by a Penalty Method.*
(1043) **Atife Caglar***, University Of Wisconsin-Green Bay, and **Anastasios Liakos**, U.S. Naval Academy-Annapolis, MD (1014-65-01)
- 3:00PM *Numerical Simulation of Fractured Porous Medium.*
(1044) **Shuang Li*** and **Hong Wang**, University of South Carolina (1014-65-1289)
- 3:30PM *A Nonconforming Finite Element Method for the Reduced Time-Harmonic Maxwell Equations.*
(1045) **Susanne C. Brenner**, **Fengyan Li*** and **Li-Yeng Sung**, University of South Carolina, Columbia, SC (1014-65-971)
- 4:00PM *An alternating-direction finite element method combined with a modified method of characteristics for the problem of the pollution of groundwater in duple porous media.*
(1046) **Ming Cui**, Jinan, China (1014-65-124)
- 4:30PM *A new version of implementing h-adaptivity of finite element method for elliptic problems.* Preliminary report.
(1047) **Ivan I. Dyyak*** and **Mazen Shahin**, Delaware State University (1014-65-1675)
- 5:00PM *Sensitivity Analysis and a Second Order Semi-Implicit Scheme for Large Eddy Simulation.*
(1048) **Faranak Pahlevani*** and **Lisa Davis Stanley**, Montana State University (1014-65-1570)

AMS-SIAM Special Session on Time Reversal Methods: Analysis and Applications, I

1:00 PM – 6:00 PM

Organizers: **Peter A. McCoy**, U.S. Naval Academy
Reza Malek-Madani, U.S. Naval Academy

- 1:00PM (1049) *Interferometric array imaging in clutter.* Preliminary report.
George C. Papanicolaou, Stanford University (1014-60-1505)
- 1:30PM (1050) *Wave diffusion in two dimensions.*
Tomasz Komorowski, University of Marie Curie-Sklodowska, and **Lenya Ryzhik***, University of Chicago (1014-60-982)
- 2:00PM (1051) *Time Reversal in Randomly Layered Media.*
Jean-Pierre Fouque, Statistics and Applied Probability, UC Santa Barbara (1014-60-458)
- 2:30PM (1052) *Propagation and Detection in a Cluttered Environment.*
Knut Solna, University of California at Irvine (1014-00-1571)
- 3:00PM Break
- 3:30PM (1053) *Time-reversal techniques applied to communications through unknown obscuring medium.*
Akira Ishimaru*, **Sermsak Jaruwatanadilok** and **Yasuo Kuga**, University of Washington (1014-00-316)
- 4:00PM (1054) *Adaptive coherent interferometric imaging.*
Chrysoula Tsogka*, University of Chicago, **L. Borcea**, Rice University, and **G. Papanicolaou**, Stanford University (1014-86-1634)
- 4:30PM (1055) *A direct imaging algorithm for extended targets using active arrays.*
Hongkai Zhao, University of California, Irvine (1014-35-1621)
- 5:00PM (1056) *Kinetic models for wave propagation in random media.*
Guillaume Bal, Columbia University (1014-35-856)
- 5:40PM (1057) *Adaptive Coherent Interferometric Imaging in Cluttered Media.*
Liliana Borcea, Rice University (1014-60-322)

AMS-SIAM Special Session on Stochastic, Large Scale and Hybrid Systems with Applications, I

1:00 PM – 5:20 PM

Organizers: **Aghalaya S. Vatsala**, University of Louisiana at Lafayette
Gangaram S. Ladde, University of Texas at Arlington

- ▶ 1:00PM (1058) *Numerical Experiments with Differential Automata Models of Hybrid Systems.* Preliminary report.
Lucio Tavernini, University of Texas at San Antonio (1014-65-858)
- ▶ 1:30PM (1059) *Valuation and Hedging of Power-Sensitive Contingent Claims for Power with Spikes: A Non-Markovian Approach.*
Valery A. Kholodnyi, Middle Tennessee State University (1014-90-388)
- 2:00PM (1060) *Mean Reversal for Transformed Dynamical Systems.* Preliminary report.
Andrzej Korzeniowski, University of Texas at Arlington (1014-60-1700)

- 2:30PM (1061) *Molecular based model for the viscoelasticity of rubber.*
Negash G. Medhin, North Carolina State University (1014-00-775)
- ▶ 3:00PM (1062) *Boundary Value Problems Arising in Diffusion of Chemically Reactive Species in a Porous Medium.*
Kuppalapalle Vajravelu, University of Central Florida (1014-34-349)
- 3:30PM (1063) *Numerical Solution to Hybrid Fuzzy Systems.* Preliminary report.
M. Sambandham* and **Steve Pederson**, Morehouse College (1014-34-1044)
- 4:00PM (1064) *Generalized Monotone Method for Stochastic Initial Value Problems.* Preliminary report.
Gangaram S. Ladde, University of Texas at Arlington, and **Aghalaya S. Vatsala***, University of Louisiana at Lafayette (1014-34-426)
- ▶ 4:30PM (1065) *An Efficient Ensemble Kalman Filter for Numerical Weather Prediction.*
John Harlim*, University of Maryland, and **Brian Hunt**, Institute for Physical Science and Technology, University of Maryland (1014-76-347)
- 5:00PM (1066) *Numerical Solutions for Stochastic Controls and Differential Games of Regime-Switching Diffusions.* Preliminary report.
Q. S. Song*, **George Yin** and **Zhimin Zhang**, Wayne State University (1014-60-57)

AMS Special Session on Current Events

1:00 PM – 4:45 PM

Organizer: **David Eisenbud**, Mathematical Sciences Research Institute

- ▶ 1:00PM (1067) *Contact network epidemiology: Bond percolation applied to infectious disease prediction and control.*
Lauren Ancel Meyers, Section of Integrative Biology, University of Texas at Austin (1014-92-1354)
- ▶ 2:00PM (1068) *Small gaps between prime numbers.*
Kannan Soundararajan, University of Michigan, Ann Arbor (1014-11-1450)
- ▶ 3:00PM (1069) *Probabilistically Checkable Proofs.*
Madhu Sudan, MIT (1014-68-1107)
- ▶ 4:00PM (1070) *Symmetry in Neuroscience.* Preliminary report.
Martin Golubitsky, University of Houston (1014-92-808)

AMS Special Session on Algebraic Groups, Symmetric Spaces, and Invariant Theory

1:00 PM – 5:50 PM

Organizers: **Aloysius G. Helminck**, North Carolina State University
Dan Gagliardi, St. Lawrence University

- 1:00PM (1071) *Cartan decomposition of the moment map.*
Peter Heinzner, Ruhr-Universitaet Bochum, and **Gerald Schwarz***, Brandeis University (1014-22-501)
- 1:30PM (1072) *Decomposing a modular representation of Z/p^2 .*
David L. Wehlau, Royal Military College of Canada (1014-13-313)
- 2:00PM (1073) *Adapted complex structures in Lie theory.* Preliminary report.
Ralph J. Bremigan, Ball State University (1014-22-763)
- 2:30PM (1074) *Vector Invariant Rings.*
Jianjun Chuai, University of Montreal (1014-13-836)

- 3:00PM (1075) *Intertwining operators related to p -adic symmetric varieties.*
G. F. Helminck*, University of Twente, and **A. G. Helminck**, North Carolina State University (1014-22-1008)
- 3:30PM (1076) *On the Classification of Orbits of Symmetric Varieties Acting on Flag Varieties of $SL(2, k)$.*
Stacy L. Beun* and **Aloysius Helminck**, North Carolina State University (1014-20-739)
- 4:00PM (1077) *Bilinear Forms on $V = k^n$ and Involutions of $SL(n, k)$ and $SO(n, k, \beta)$.*
Christophofer E. Dometrius*, Wake Forest University, **Aloysius Helminck**, North Carolina State University, and **Ling Wu**, Seattle, Washington (1014-20-1023)
- 4:30PM (1078) *On the classification of k -involutions of $SP(2n, k)$.* Preliminary report.
Farrah Jackson Chandler, University of North Carolina-Wilmington (1014-20-1073)
- 5:00PM (1079) *Algorithms for reductive symmetric spaces.*
Jennifer Daniel, Lamar University (1014-20-1219)
- 5:30PM (1080) *Algorithms for computing characters of symmetric spaces.*
Daniel J. Gagliardi*, Saint Lawrence University, and **Aloysius G. Helminck**, North Carolina State University (1014-20-1488)

AMS Special Session on Quantum Invariants of Knots and 3-Manifolds, I

1:00 PM – 5:50 PM

Organizers: **Patrick M. Gilmer**, Louisiana State University
Charles D. Frohman, University of Iowa

- 1:00PM (1081) *Classical and quantum 3-manifold invariants.*
Charles Frohman, The University of Iowa, and **Joanna Kania-Bartoszyńska***, National Science Foundation (1014-57-1151)
- 1:30PM (1082) *On integrality of quantum invariants of rational homology 3-spheres.* Preliminary report.
Thang T. Q. Le, Georgia Institute of Technology (1014-57-1021)
- 2:00PM (1083) *Holonomic relations between quantum invariants.* Preliminary report.
Adam S. Sikora, SUNY Buffalo (1014-57-855)
- 2:30PM (1084) *Asymptotics of the quantum $SU(2)$ -invariants for surgeries on the figure 8 knot.*
Soren K. Hansen, Kansas State University (1014-57-511)
- 3:00PM (1085) *The Kauffman Bracket Skein Module of Torus Knots.* Preliminary report.
Kristen Sellke, The University of Iowa (1014-57-691)
- 3:30PM (1086) *Triad Spaces in the Kauffman Skein Theory.* Preliminary report.
Jianyuan Kathy Zhong* and **Bin Lu**, California State University Sacramento (1014-57-482)
- 4:00PM (1087) *Finding the basis of the Hilbert space of a certain quantum system.*
Razvan Gelca, Texas Tech University (1014-81-718)
- 4:30PM (1088) *Integral Bases for Certain TQFT-Modules of the Torus.*
Khaled M. Qazaqzeh, Louisiana State University (1014-57-608)

- 5:00PM (1089) *The positive root posets of Coxeter groups and special bases for the associated Temperley Lieb algebras (Preliminary Report).*
Neal W. Stoltzfus, Louisiana State University (1014-57-710)
- 5:30PM (1090) *Reducibility of Quantum- $SU(n)$ Representations of Mapping Class Groups.* Preliminary report.
Qi Chen and **Thomas Kerler***, The Ohio State University (1014-57-1095)

AMS Special Session on New Developments in Symplectic Topology, I

1:00 PM – 5:50 PM

Organizers: **Dusa McDuff**, SUNY at Stony Brook
Aleksey Zinger, SUNY at Stony Brook
Ely Kerman, University of Illinois at Urbana-Champaign
Margaret F. Symington, Georgia Institute of Technology and Mercer University

- 1:00PM (1091) *On the classification of symplectic 6-manifolds with semi-free circle actions.*
Eduardo Gonzalez, Rutgers University (1014-53-750)
- 1:30PM (1092) *Semi-global invariants of piece-wise smooth Lagrangian fibrations.*
Ricardo Castano-Bernard*, Max Planck Institut for Mathematics & University of Leipzig, and **Diego Matessi**, Universita degli Studi del Piamonte Orientale (1014-53-1241)
- 2:00PM (1093) *Toric Integrable Geodesic Flows.* Preliminary report.
Christopher Rae Lee, University of Illinois at Urbana-Champaign (1014-53-1334)
- 2:30PM (1094) *Holomorphic curves in Lagrangian torus fibrations.*
Brett D. Parker, MIT (1014-58-488)
- 3:00PM (1095) *Estimated transversality.*
Rosa Sena-Dias, Harvard University (1014-51-1708)
- 3:30PM (1096) *From Morse functions to Lefschetz fibrations, and related invariants.*
Joseph A. Johns, IL (1014-53-785)
- 4:00PM (1097) *Spaces of symplectic embeddings of disjoint balls in $\mathbb{C}P^2$.* Preliminary report.
Martin Pinsonnault, Fields Institute (1014-53-1521)
- 4:30PM (1098) *Bi-invariant metrics on the group of symplectomorphisms.*
Zhigang Han, State University of New York at Stony Brook (1014-54-448)
- 5:00PM (1099) *The Conley conjecture near nowhere-coisotropic submanifolds.*
Basak Gurel, SUNY at Stony Brook (1014-53-960)
- 5:30PM (1100) *Towards the continuous Hamiltonian dynamical systems.*
Yong-Geun Oh, University of Wisconsin-Madison (1014-58-469)

AMS Special Session on the Many Lives of Lattice Theory, the Theory of Ordered Sets, and Universal Algebra, III

1:00 PM – 5:50 PM

Organizers: **Japheth L. M. Wood**, Chatham College
John W. Snow, Sam Houston State University
Jonathan D. Farley, Harvard University

Stefan E. Schmidt, Phoenix Math Systems Modeling, Inc.
Anthony A. Harkin, Harvard University

H. Thomas Banks, North Carolina State University

- 1:00PM *Asymptotic growth of free spectra of monoids.*
 (1101) Preliminary report.
Steven W. Seif, University of Louisville (1014-20-1663)
- 1:30PM *Finite Algebras that Generate Congruence-Distributive Varieties.* Preliminary report.
Howard C. Lee, UCLA (1014-08-716)
- 2:00PM *An Intersection Property of Subalgebras in Congruence Distributive Varieties.* Preliminary report.
Matt Valeriote, McMaster University (1014-08-354)
- 2:30PM *Algebraic characterizations for topological separation properties.*
 (1104) **Wolfram F. Bentz**, Sir Wilfrid Laurier University (1014-08-1630)
- 3:00PM *Edge Colorings and Weak Representations.*
 (1105) Preliminary report.
Jeremy F. Alm, Iowa State University (1014-06-1223)
- 3:30PM *A Unique Normal Decomposition Lattice without the Representation.* Preliminary report.
 (1106) **Michael E. Detlefsen**, Slippery Rock University (1014-06-1155)
- 4:00PM *On general constructions of Macaulay posets.*
 (1107) Preliminary report.
Sergei L. Bezrukov, University of Wisconsin - Superior (1014-05-946)
- 4:30PM *Infinite Products of Ordered Sets with the Fixed Point Property.*
 (1108) **Bernd S. W. Schroeder**, Louisiana Tech University (1014-06-60)
- 5:00PM *On some properties of post lattices of r -classifications.*
 (1109) **Michel P. Serfati**, IREM- Université Paris VII / Denis Diderot (1014-06-39)
- 5:30PM *Representable Idempotent Commutative Residuated Lattices.*
 (1110) **Jeffrey S. Olson**, University of Illinois at Chicago (1014-06-1410)

MAA Minicourse #13: Part B

1:00 PM – 3:00 PM

The Fibonacci and Catalan numbers.
 Organizer: **Ralph P. Grimaldi**, Rose-Hulman Institute of Technology

MAA Minicourse #2: Part B

1:00 PM – 3:00 PM

Java applets in teaching mathematics.
 Organizers: **Joe Yanik**, Emporia State University
Michael E. Mays, West Virginia University

MAA Minicourse #8: Part B

1:00 PM – 3:00 PM

Mathematical and statistical modeling in biology: Competitive exclusion, coexistence, estimation, and control.
 Organizers: **Azmy S. Ackleh**, University of Louisiana at Lafayette

AMS Session on Analysis on Graphs, Polytopes, and Groups

1:00 PM – 2:10 PM

- 1:00PM *The Euler Characteristic of Graph Configuration Spaces.*
 (1111) **David G. C. Handron**, Carnegie Mellon University (1014-57-845)
- 1:15PM *Heat Kernel Asymptotics on Euclidean Polytopal Complexes.* Preliminary report.
 (1112) **Melanie Anne Pivarski**, Cornell University (1014-57-1275)
- 1:30PM *The Fourier Inversion Formula for the Continuous Spectrum of $L^2(\Gamma \backslash G)$.* Preliminary report.
 (1113) **Keith R. Ouellette**, University of California, Los Angeles (1014-43-628)
- 1:45PM *The Kelvin-Nevanlinna-Royden Criterion and the existence of solution in p -Dirichlet spaces to the Poisson equation for p -Laplacian on Graphs.*
 (1114) **Lucio M. G. Prado**, BMCC (1014-31-1309)
- 2:00PM *Sharp Hardy-type inequalities and uncertainty principle inequality on Carnot Groups.*
 (1115) **Ismail Kombe**, Oklahoma City University (1014-43-1721)

AMS Session on Geometry: Convex, Discrete, Differential

1:00 PM – 5:40 PM

- 1:00PM *Differential Invariants of Geometric Structures.*
 (1116) **Stanislav Dubrovskiy**, Keio University, Yokohama Japan (1014-53-33)
- 1:15PM *New Results on Gromov's Distortion.*
 (1117) **Chad A.S. Mullikin**, University of Georgia (1014-53-137)
- 1:30PM Break
- 1:45PM *A New Family of Curvature Homogeneous Pseudo-Riemannian Manifolds.* Preliminary report
 (1118) **Corey M. Dunn**, University of Oregon (1014-53-765)
- 2:00PM *Transversely holomorphic flows on 3-manifolds and singular projectable vector fields.* Preliminary report.
 (1119) **Amine Fawaz**, The University of Texas of the Permian Basin (1014-53-983)
- 2:15PM *Helicity of vector fields on S^3 .*
 (1120) **Jason Parsley**, University of Georgia (1014-53-1467)
- 2:30PM *Conformal algebras in 3D and their generalization.* Preliminary report.
 (1121) **Daniela Mihai*** and **George Sparling**, University of Pittsburgh (1014-53-1537)
- 2:45PM *Extremal properties of logarithmic spirals.*
 (1122) **Michael D. Bolt**, Calvin College (1014-53-1652)
- 3:00PM *Topological remarks on closed orientable cohomogeneity one 4-manifolds via harmonic forms.*
 (1123) **Eduard Chiru**, Ohio State University (1014-53-1658)
- 3:15PM *Hexagonal Refinement Preserves Combinatorial Type.* Preliminary report.
 (1124) **William Wood**, Florida State University (1014-52-1030)
- 3:30PM Break

Program of the Sessions – Saturday, January 14 (cont'd.)

- ▶ 3:45PM *Squaring the Plane.*
(1125) **Frederick V. Henle**, Mercersburg Academy, and **James M. Henle***, Smith College (1014-52-1524)
- 4:00PM *j, k – planes of order 4^3 .*
(1126) **Oscar E. Vega**, University of Iowa (1014-51-892)
- ▶ 4:15PM *The Three-Point Problem in Taxicab Circles.*
(1127) **Shing S. So***, **Mohamad Bkdadi** and **Mahmoud Yousef**, Central Missouri State University (1014-51-888)
- ▶ 4:30PM *Existence and Uniqueness of Ellipses in the Taxicab Geometry.*
(1128) **Shing So**, **Mahmoud Yousef** and **Dale Bachman***, Central Missouri State University (1014-51-1132)
- ▶ 4:45PM *Self-similar systems and complex dimensions.*
(1129) Preliminary report.
Michel L. Lapidus and **Erin P. J. Pearse***, University of California, Riverside (1014-37-153)
- ▶ 5:00PM *An application of parallel-axis theorem to geometric inequalities.* Preliminary report.
(1130) **Mostafa Ghandehari***, University of Texas at Arlington, and **Fred Kashefi**, University of Texas Arlington (1014-52-26)
- ▶ 5:15PM *Stable minimal hypersurfaces.*
(1131) **Junfang Li**, University of Oklahoma (1014-35-114)
- ▶ 5:30PM *Nonexistence of stable manifolds in an ellipsoid.*
(1132) Preliminary report.
Lina Wu, The University of Oklahoma (1014-53-289)

AMS Session on Mathematical Biology, II

1:00 PM – 4:40 PM

- ▶ 1:00PM *Optimal control of drug delivery to brain tumors for a two dimensional case using Galerkin finite element method.*
(1133) **Siddhartha P. Chakrabarty*** and **Floyd B. Hanson**, University of Illinois at Chicago (1014-92-1350)
- ▶ 1:15PM *A mathematical model of tumor angiogenesis, equilibria and stability in the one and two dimensional cases.* Preliminary report.
(1134) **Andrew Lewis Matteson**, Texas A&M University (1014-92-1368)
- ▶ 1:30PM *Three Dimensional Stress Distribution in Axisymmetric Cerebral Saccular Aneurysm.*
(1135) **Dawn Alisha Lott***, Delaware State University, **Hans R. Chaudhry**, **Michael Siegel**, New Jersey Institute of Technology, and **Charles J. Prestigiacomo**, University of Medicine and Dentistry of New Jersey (1014-92-1388)
- ▶ 1:45PM *Optimal Control of Plant Invasions.*
(1136) **Andrew J. Whittle*** and **Suzanne Lenhart**, University of Tennessee (1014-92-1400)
- ▶ 2:00PM *A mathematical framework for the modeling of atherosclerosis.*
(1137) **Laura R. Ritter***, Texas A&M University, **Akif I. Ibragimov**, Texas Tech University, **Catherine J. McNeal**, Dept. of Internal Medicine, Div. of Cardiology Department of Pediatrics, Div. of Endocrinology, Scott & White Hospital, and **Jay R. Walton**, Texas A&M University (1014-92-1404)
- ▶ 2:15PM *Modeling Tri-trophic Interactions.* Preliminary report.
(1138) **Janet Andersen*** and **Tom Bultman**, Hope College (1014-92-1428)

- ▶ 2:30PM *Optimal harvesting during an invasion of a sublethal plant pathogen.*
(1139) **Holly D. Gaff***, University of Maryland, Baltimore, **Hem Raj Joshi**, Xavier University, and **Suzanne Lenhart**, University of Tennessee, Knoxville (1014-92-1503)
- ▶ 2:45PM *Multifrequency Forcing of a Nonlinear Oscillator Model of the Inner Ear.* Preliminary report.
(1140) **K. A. Montgomery**, University of Utah (1014-92-1555)
- ▶ 3:00PM *Custom performance functions for ANN applications to coastal water level forecast.*
(1141) **G. Beate Zimmer***, **Philippe Tissot** and **Alexey Sadovski**, Texas A&M University - Corpus Christi (1014-92-1637)
- ▶ 3:15PM *Clustering, Fixed Rank Approximation Algorithm, and DNA Microarrays.*
(1142) **Amir Niknejad**, University of Illinois at Chicago (1014-92-1642)
- ▶ 3:30PM *Comparison of Different Optimization Techniques Applied to the Soft Protein Docking Problem.*
(1143) **Victoria A. Shimanovich***, University of Iowa, Iowa City, and **Alberto Maria Segre**, Department of Computer Science, Center for Statistical Genetics, UI (1014-92-1734)
- ▶ 3:45PM *Modeling in Kidney Functions.*
(1144) **Saziye Bayram**, SUNY- Buffalo (1014-35-1648)
- ▶ 4:00PM *Multiple-Spike Ground State Solutions of the Activator-Inhibitor Equations.*
(1145) **Yuncheng You**, University of South Florida (1014-35-767)
- ▶ 4:15PM *Stochastic approximations of Volterra Integro-differential equation arising in neurosciences.*
(1146) **M. M. Rahman**, University of North Florida (1014-92-1203)
- ▶ 4:30PM *Modeling the Divergence of Two Genetic Lineages.*
(1147) **Scott R. Herriott**, Maharishi University of Management (1014-92-1316)

AMS Session on Ordinary Differential Equations

1:00 PM – 4:10 PM

- ▶ 1:00PM *Networks of Three Identical Coupled Systems.*
(1148) **Maria C.A. Leite***, Purdue University, and **Martin Golubitsky**, University of Houston (1014-34-553)
- ▶ 1:15PM *Solution of Differential Equations Using Hypergeometric-Type Functions.*
(1149) **A. Gary Childs**, University of North Alabama (1014-34-264)
- ▶ 1:30PM *Integro differential systems with state dependent delay and the instability.*
(1150) **Seenith Sivasundaram**, Embry-Riddle University (1014-34-374)
- ▶ 1:45PM *Stability of solutions for shearing flow of nematic liquid crystals under an external field.*
(1151) **Arup Mukherjee***, Montclair State University, NJ, and **Bagisa Mukherjee**, Penn State University, Worthington Scranton, Dunmore (1014-34-911)
- ▶ 2:00PM *Nonlinear Second Order Boundary Value Problems with Multiple Solutions.* Preliminary report.
(1152) **John V. Baxley** and **Kristen Elizabeth Kobylus***, Wake Forest University (1014-34-1082)
- ▶ 2:15PM *Uniqueness Implies Uniqueness, Uniqueness Implies Existence for Nonlocal Boundary Value Problems for Third Order Differential Equations.*
(1153) **Michael J. Gray**, Baylor University (1014-34-1178)

- 2:30PM *Traveling Pulses for the Klein-Gordon Equation on a Lattice or Continuum with Long-range Interaction.* (1154)
Peter W. Bates and **Chunlei Zhang***, Michigan State University (1014-34-1267)
- 2:45PM *Pervasiveness of Polynomial Differential Equations.* (1155)
 ▶ Preliminary report.
David C. Carothers* and **G. Edgar Parker**, James Madison University (1014-34-1580)
- 3:00PM *Properties of periodic solutions generated by Hopf bifurcation of a neutral delay-differential equation.* (1156)
Marion Weederemann, Dominican University (1014-34-1617)
- 3:15PM *Asymptotic Behavior of Solutions of a Nonhomogenous Refinement Differential Equation.* (1157)
Gnana Bhaskar Tenali and **Sameer Kumar M.K.***, Florida Institute of Technology (1014-34-1627)
- 3:30PM *Index Theory for Symplectic Paths and the Stability of Periodic Solutions for N-body Problem.* (1158)
Tiancheng Ouyang and **Zhifu Xie***, Brigham Young University (1014-37-221)
- 3:45PM *A New Technique for Asymptotic Summation of Potentially Oscillatory Difference Systems.* (1159)
Harry Gingold and **Fei Xue***, West Virginia University (1014-39-567)
- 4:00PM *Nonlinear strongly monotone quasivariational inclusions.* (1160)
Ram U. Verma, University of Akron (1014-49-75)

MAA Session on Achieving Quantitative Literacy, I

1:00 PM – 3:55 PM

- Organizers: **Aaron G. Montgomery**, Central Washington University
Stuart Boersma, Central Washington University
Semra Kilic-Bahi, Colby Sawyer College
- ▶ 1:00PM *Paradoxes: Explanations and Discussions.* (1161)
 Preliminary report.
Saburo Matsumoto, The Master's College (1014-P1-79)
- 1:15PM *A Contemporary Approach to Quantitative Literacy in a College Mathematics Curriculum.* (1162)
Jay P. Abramson* and **Matt Isom**, Arizona State University (1014-P1-20)
- 1:30PM *How a writing assignment changed our understanding of quantitative literacy.* Preliminary report. (1163)
Allen Emerson* and **Kris Green**, St. John Fisher College (1014-P1-1543)
- ▶ 1:45PM *QL Spreadsheet Modules: Lessons from the Spreadsheets Across the Curriculum Workshop.* (1164)
Eric C. Gaze, Alfred University (1014-P1-288)
- ▶ 2:00PM *Learning to Make Inferences: Connecting Quantitative Literacy and Language Arts for Math and English Preservice Teachers.* Preliminary report. (1165)
Kimberly M. Vincent* and **Beth Buyserie**, Washington State University (1014-P1-1490)
- ▶ 2:15PM *Incorporating Civic Engagement in Quantitative Literacy Courses.* Preliminary report. (1166)
Thomas M. Zachariah*, **Suzanne Larson** and **Jacqueline M. Dewar**, Loyola Marymount University (1014-P1-1260)
- ▶ 2:30PM *Ethnomathematics: Fusion or Fear.* Preliminary report. (1167)
Michelle R. DeDeo, University of North Florida (1014-P1-1425)

- 2:45PM *The quantitative reasoning requirement at the University of Massachusetts Boston.* (1168)
Maura B. Mast* and **Mark Pawlak**, University of Massachusetts Boston (1014-P1-1443)
- ▶ 3:00PM *News Math: Working toward QL.* (1169)
Bernard L. Madison, University of Arkansas (1014-P1-49)
- ▶ 3:15PM *Developing a QL Program: Do's and Don'ts.* (1170)
Judith Flagg Moran, Trinity College Hartford CT (1014-P1-830)
- ▶ 3:30PM *Defining and Implementing Quantitative Literacy Programs.* (1171)
Rick Gillman, Valparaiso University (1014-P1-32)
- ▶ 3:45PM *An Overview of QL/QR Programs, Events and Publications.* Preliminary report. (1172)
Caren Diefenderfer*, Hollins University, **Rebecca Hartzler**, Seattle Central Community College, and **Cinnamon Hillyard**, University of Washington, Bothell (1014-P1-1269)

MAA Session on My Favorite Demo: Innovative Strategies for Mathematics Instructors, II

1:00 PM – 3:55 PM

- Organizers: **David R. Hill**, Temple University
Lila F. Roberts, Georgia College & State University
- ▶ 1:00PM *Sine Waves and Sound.* (1173)
David R. Hill*, Temple University, and **Lila F. Roberts**, Georgia College and State University (1014-U1-213)
- ▶ 1:15PM *Discovering the Euler Characteristic & Duality Through Platonic Solids: AKA "Exactly Five Platonic Solids—Part II".* (1174)
Jacqueline Anderson Hall, Longwood University, Farmville, VA (1014-U1-848)
- 1:30PM *Using Fluid Flow to Illustrate Properties of Vector Fields.* (1175)
Mike O'Leary, Towson University (1014-U1-499)
- ▶ 1:45PM *Getting Acquainted With the Harmonic Series.* (1176)
 Preliminary report.
David Fowler, University of Nebraska-Lincoln (1014-U1-271)
- ▶ 2:00PM *Poll the Audience: Using ConcepTests in Teaching Mathematics.* Preliminary report. (1177)
Patti Frazer Lock, St. Lawrence University (1014-U1-258)
- ▶ 2:30PM *Tower of Hanoi.* (1178)
Kimberly Jordan Burch, Indiana University of Pennsylvania (1014-U1-163)
- ▶ 2:45PM *Modeling Activity to Develop Sequential, Power and Exponential Functions.* (1179)
Kathleen Cage Mittag, The University of Texas at San Antonio (1014-U1-19)
- ▶ 3:00PM *More Paradoxical than the St. Petersburg Paradox?* (1180)
Arnold Lebow, Yeshiva University (1014-U1-956)
- ▶ 3:15PM *A First Application of Fourier Series Using Spreadsheets.* (1181)
Donald C. York, University of the Virgin Islands (1014-U1-831)
- ▶ 3:30PM *Animated Spreadsheet Demonstrations for Linear Algebra.* (1182)
Deane E. Arganbright, Korea Advanced Institute of Science and Technology (1014-U1-294)

MAA Session on Mathematics and Popular Culture

1:00 PM – 4:55 PM

Organizers: **Sarah J. Greenwald**, Appalachian State University
Christopher D. Goff, University of the Pacific

- ▶ 1:00PM *Exploiting math moments from reality television in the classroom.* Preliminary report.
Mark S. MacLean, Seattle University (1014-V1-339)
- ▶ 1:20PM *Prisoners' Dilemma and the TV Game Show "Friend or Foe".* Preliminary report.
Paul R. Coe*, Dominican University, **William T. Butterworth**, DePaul University, **Peter Alonzi** and **Daniel Condon**, Dominican University (1014-V1-1374)
- ▶ 1:40PM *Mathematics and Science in the Whedon Universe ("Buffy the Vampire Slayer", "Angel", and "Firefly").*
Mary E. Searcy, Appalachian State University (1014-V1-241)
- ▶ 2:00PM *Fab Math.* Preliminary report.
Colm Mulcahy, Spelman College (1014-V1-1669)
- ▶ 2:20PM *Googling with Linear Algebra.*
Pedro Teixeira, Union College (1014-V1-1666)
- ▶ 2:40PM *Putting a Spring in Yoda's Step.*
Timothy P. Chartier*, Davidson College, and **Dan B. Goldman**, University of Washington (1014-V1-268)
- ▶ 3:00PM *The Good, the Bad, and the Ugly.* Preliminary report.
Mary L. Garner* and **Josip Derado**, Kennesaw State University (1014-V1-1646)
- ▶ 3:20PM *"Science-in-Theatre" and Arcadia.*
Steven B. Zides, Wofford College (1014-V1-1022)
- ▶ 3:40PM *Mathematical Heroes—No Longer Unsung.* Preliminary report.
Cynthia E. Chin*, **Jeffrey C. Sanders** and **Alexander V. Pinigis**, Madison East High School (1014-V1-788)
- ▶ 4:00PM *Harry Potter and the Magic of Mathematics.*
Betsy J. McShea* and **Judith Vogel**, Richard Stockton College (1014-V1-927)
- ▶ 4:20PM *Good News, Everyone! David X. Cohen's Mathematical Influence on "The Simpsons" and "Futurama".*
Sarah J. Greenwald, Appalachian State University (1014-V1-966)
- ▶ 4:40PM *Hollywood Math and Science Film Consulting: From "Primer" to "Numb3rs", Shifting the Paradigm.*
Jonathan D. Farley, Stanford University, Center for International Security and Cooperation (1014-V1-1684)

MAA Session on My Three Favorite Original Calculus Problems

1:00 PM – 5:55 PM

Organizers: **J. D. Phillips**, Wabash College
Timothy J. Pennings, Hope College

- ▶ 1:00PM *Problems on tangent lines and infinite series.*
Byungchul Cha, Hendrix College (1014-W1-171)
- ▶ 1:15PM *Quarter horses, deer and wolves.* Preliminary report.
Stephen Hilbert, Ithaca College, Ithaca NY (1014-W1-1686)
- ▶ 1:30PM *My Favorite Integrals.*
Nimr Fahmy, Tougaloo College (1014-W1-173)

- ▶ 1:45PM *Acceleration of a Magnetic Tape: Numerical Evidence for the Chain Rule.*
Robert P. Webber, Longwood University (1014-W1-243)
- ▶ 2:00PM *Two calculus problems from the real world: Volume and root finding.*
Norton Starr, Amherst College (1014-W1-246)
- ▶ 2:15PM *Optimizing a real box and a computer disk.*
Thomas A. Hern, Bowling Green State Univ. (1014-W1-207)
- ▶ 2:30PM *Calculus Problems with a Parabolic Theme.*
John H. Wilson, Centre College (1014-W1-931)
- ▶ 2:45PM *Of Surfaces and Balls: Two Interesting Geometric and One Interesting Physical Application of the Integral.*
Jeff A. Rosoff, Gustavus Adolphus College (1014-W1-908)
- ▶ 3:00PM *A Rocket, a Holy Bucket and a Parabola.*
Michael Livshits, Cambridge, MA (1014-W1-1370)
- ▶ 3:15PM *Series and Spacecurves on my list of favorites.*
Ioana Mihaila, Cal Poly Pomona (1014-W1-376)
- ▶ 3:30PM *Three Calculus Problems: Applications to the Real (?) World.* Preliminary report.
Charlotte M. Schulze-Hewett, University of Wisconsin Colleges, Rock County Campus (1014-W1-262)
- ▶ 3:45PM Problem session.

MAA Session on First Steps for Implementing the Recommendations of the Guidelines for Assessment and Instruction in Statistics Education (GAISE) College Report

1:00 PM – 5:15 PM

Organizers: **Ginger Holmes Rowell**, Middle Tennessee State University
Thomas L. Moore, Grinnell College

- ▶ 1:00PM Session Introduction.
- ▶ 1:15PM *The Evolution of a Modern Statistics Course.* Preliminary report.
Barbara A. Wainwright, Salisbury University (1014-X1-451)
- ▶ 1:30PM *National Science Foundation Statistics Education Projects that Model Assessment and Instruction Guidelines.*
Megan D. Hall* and **Ginger Holmes Rowell**, Middle Tennessee State University (1014-X1-1561)
- ▶ 1:45PM *Using Web-based Practice Problems to Improve and Evaluate Student Learning.* Preliminary report.
Julie M. Clark, Hollins University (1014-X1-1632)
- ▶ 2:00PM *Developing a Conceptual Understanding of Average.* Preliminary report.
Sharon S. Emerson-Stonnell* and **Robert P. Webber**, Longwood University (1014-X1-985)
- ▶ 2:15PM *Emphasizing Conceptual Learning in Statistics by Using Technology and Classroom Data.* Preliminary report.
Semra Kilic-Bahi, Colby-Sawyer College (1014-X1-162)
- ▶ 2:30PM *Using Fathom to Explain Central Tendency and Variability.*
Christopher J. Lacke, Rowan University (1014-X1-760)
- ▶ 2:45PM *Did the educational program improve students' knowledge?*
Madhuri S. Mulekar, University of South Alabama (1014-X1-1152)
- ▶ 3:00PM Floor Discussion.

- 3:15PM (1213) *Not Quite a Semester-Long Project for Getting Your Students to Look at Real Data That They Obtain Themselves.*
Dexter C. Whittinghill, Rowan University (1014-X1-834)
- 3:30PM (1214) *Two Steps Forward and One Step Back: This Kind of Implementation of the Guidelines for Assessment and Instruction in Statistics Education (GAISE) Can Ever Last.*
John D. McKenzie, Babson College (1014-X1-1639)
- 3:45PM (1215) *Using Simulations to Discover the Truth About the Sampling Distribution of Means.*
Murray H. Siegel, South Carolina GSSM (1014-X1-127)
- 4:00PM (1216) *Statistics, Lively and Involved.*
Dorothy W. Anway, University of Wisconsin-Superior (1014-X1-1291)
- 4:15PM (1217) *A Statistical Consulting Project in an Introductory Statistics Course.*
Lisa B. Green* and **Anita Crockett**, Middle Tennessee State University (1014-X1-1215)
- 4:30PM (1218) *Comparison of two different project-based strategies for teaching introductory statistics.*
Anand L. Pardhanani, Southwestern University, Texas (1014-X1-1678)
- 4:45PM (1219) *The Statistics Concept Inventory: An Instrument for Assessing Student Understanding of Statistics Concepts.*
Teri J. Murphy, University of Oklahoma (1014-X1-1333)
- 5:00PM (1220) *Examples of Assessments to Improve Student Learning in Introductory Statistics.*
Allan J. Rossman* and **Beth L. Chance**, Cal Poly - San Luis Obispo (1014-X1-1510)

MAA Session on Handheld Technology in Content and Methods Courses for Prospective Teachers with a Special Interest Strand Devoted to Teaching and Learning Geometry

1:00 PM - 2:35 PM

- Organizers: **Charles Vonder Embse**, Central Michigan University
Deborah A. Crocker, Appalachian State University
Gregory D. Foley, The Liberal Arts and Science Academy of Austin at Lyndon B. Johnson High School
Stephen F. West, SUNY Geneseo

- 1:00PM (1221) *Enriching visualization in an integrated inservice/summer 5-8 lab school with Cabri Jr.* Preliminary report.
Barbara J. Pence, San Jose State University (1014-Y1-206)
- 1:20PM (1222) *Whaddya bet? Probability Investigations through Simulations.*
Jean M. McGivney-Burelle, University of Hartford (1014-Y1-728)
- 1:40PM (1223) *A Capstone Course for Mathematics Secondary Education Majors at the University of Utah.*
Dennis L. Allison, The University of Utah (1014-Y1-996)
- 2:00PM (1224) *Handheld Technology versus Computer Software.*
Constance C. Edwards, Coastal Carolina University (1014-Y1-1683)

- 2:20PM (1225) *Fully Integrating the Use of a Dynamic Geometry Software to teach College Geometry for Preservice Secondary Mathematics Teachers-Emphasis on Discovery, Conjecture, and Proof.* Preliminary report.
Thomas B. Fox, University of Houston-Clear Lake (1014-Y1-1742)

MAA General Contributed Paper Session, VI

1:00 PM - 5:45 PM

- Chair: **Richard J. Marchand**, Slippery Rock University
 Chair: **Benjamin G. Klein**, Davidson College
 Chair: **Michael J. Mossinghoff**, Davidson College
 Organizers: **Stephen L. Davis**, Davidson College
Eric S. Marland, Appalachian State University

- 1:00PM (1226) *Marrying Form and Function: Mathematics as Motivation in an Introductory Programming Course for Engineers and Applied Mathematicians.*
Steven J. Cox, **Elaine T. Hale*** and **Brad Peercy**, Rice University (1014-Z1-1588)
- 1:15PM (1227) *Personal Response Systems: Pearl or Peril?* Preliminary report.
Desiree A. McCullough* and **Chris K. Caldwell**, University of Tennessee at Martin (1014-Z1-989)
- 1:30PM (1228) *Adventures with Regression in the RI State Legislature.*
Barry Schiller, Rhode Island College (emeritus) (1014-Z1-1610)
- 1:45PM (1229) *Playing Games to Teach Multivariable Calculus.* Preliminary report.
Edwin P. Herman, University of Wisconsin, Stevens Point (1014-Z1-961)
- 2:00PM (1230) *Two (or Three) Maple Visualizations for a Linear Algebra Course: Decomposing Vectors into Components.*
David A. Huckaby, Angelo State University (1014-Z1-1421)
- 2:15PM (1231) *Detailed Feedback as an Integral Part of an Online Homework System in Calculus.*
Ryan J. Zerr, University of North Dakota (1014-Z1-395)
- 2:30PM (1232) *Graphing Calculator Software in Calculus.*
Jennifer Hontz* and **Timothy M. Hendrix**, Meredith College (1014-Z1-1191)
- 2:45PM (1233) *Take-A-Hike and Road Trip Motion Detector Activities in Calculus.*
Timothy M. Hendrix* and **Jennifer Hontz**, Meredith College (1014-Z1-1198)
- 3:00PM (1234) *Maple TA Enhances Significant Learning.* Preliminary report.
Simei Tong, University of Wisconsin-Eau Claire (1014-Z1-194)
- 3:15PM (1235) *The effects of computer assisted instruction on college algebra students.*
Amanda M. Klein, Texas Tech University, Lubbock, TX (1014-Z1-1593)
- 3:30PM (1236) *The Use of ALEKS in a College Algebra Course.* Preliminary report.
Linda G. Thompson, Carroll College (1014-Z1-50)
- 3:45PM (1237) *Using Computer Aided Learning to teach College Algebra.*
Tristan M. J. Denley* and **Kimberly A. Denley**, University of Mississippi (1014-Z1-1322)

Program of the Sessions – Saturday, January 14 (cont'd.)

- 4:00PM *Web Enhanced Learning in Mathematics with Public Domain Software.*
 ▶ (1238) **Maider J. Marin**, Mayaguez, Puerto Rico, and **Daniel L. McGee***, University of Puerto Rico - Mayaguez (1014-Z1-235)
- 4:15PM *Should technology affect the order of topics toward a more effective learning?* Preliminary report.
 (1239) **Jose H. Giraldo**, Texas A&M University-Corpus Christi (1014-Z1-1441)
- 4:30PM *Effectively combining online learning with face-to-face instruction: Using WebCT and WeBWork in a Business Math Class.*
 ▶ (1240) **Julia Darby Head*** and **G. Brock Williams**, Texas Tech University (1014-Z1-1596)
- 4:45PM *Online Homework That Works.* Preliminary report.
 ▶ (1241) **Terry J. Walters*** and **Stephen W. Kuhn**, University of Tennessee of Chattanooga (1014-Z1-1482)
- 5:00PM *Web-Based Homework and Achievement.*
 (1242) **M. Affouf**, Kean University, NJ (1014-Z1-864)
- 5:15PM *Creating and Using Online Quizzes.*
 (1243) **Manmohan Kaur**, Benedictine University (1014-Z1-333)
- 5:30PM *Teaching a class of 75,000 students.*
 ▶ (1244) **David Fowler**, University of Nebraska-Lincoln (1014-Z1-917)
- 1:00PM *Workshop Precalculus: Developing Pedagogically Powerful Instructional Materials for an Integrated Course in Functions, Data Analysis and Modeling.*
 (1253) **Nancy Baxter Hastings***, Dickinson College, **David Hastings**, Shippensburg University, **David Callahan**, California State University, Hayward, and **Allan Rossman**, California Polytechnic State University, San Luis Obispo
- 1:00PM *Core Mathematics.*
 (1254) **Gary Krahn*** and **Don Small**, United States Military Academy
- 1:00PM *Enhancing Mathematics Communication: Creating and Delivering Web-Based Homework.*
 (1255) **Terry Walters*** and **Stephen Kuhn**, University of Tennessee at Chattanooga
- 1:00PM *Adapting and implementing guided discovery notes in combinatorics for large classes.*
 (1256) **Mary Flahive**, Oregon State University
- 1:00PM *Seeing the Connections: Promoting Profound Understanding of Secondary Mathematics.*
 (1257) **Steven Benson***, **Al Cuoco**, Education Development Center, **Karen Graham**, University of New Hampshire, and **Neil Portnoy**, Stony Brook University
- 1:00PM *Statistics Online Computational Resource for Education.*
 (1258) **Ivo Dinov*** and **Annie Che**, UCLA School of Medicine
- 1:00PM *Making Math Engaging: Discrete Mathematics for K-8 Teachers.*
 (1259) **Valerie A. DeBellis***, Shodor Education Foundation, and **Joseph G. Rosenstein**, Rutgers University
- 1:00PM *Topology and Its Applications.*
 (1260) **William Basener*** and **George Thurston**, Rochester Institute of Technology
- 1:00PM *A motivational course in cryptology and coding theory.*
 (1261) **Sarah Spence Adams***, Franklin W. Olin College of Engineering, and **Gordon Prichett**, Babson College
- 1:00PM *Teaching Discrete Mathematics via Original Historical Sources.*
 (1262) **David Pengelley*** and **Gerald Lodder**, New Mexico State University
- 1:00PM *Development of Interactive Materials for the Constructivist Teaching of Mathematical Proof to Future Teachers.*
 (1263) **Doug Ensley*** and **Winston Crawley**, Shippensburg University
- 1:00PM *A radical approach to teaching object-oriented programming.*
 (1264) **Ann Moskol*** and **Kate Sanders**, Rhode Island College
- 1:00PM *Adapting ATLAST Problems into WeBWork for Linear Algebra I and II.*
 (1265) **Thomas Hagedorn*** and **Karen Clark**, The College of New Jersey
- 1:00PM *Mathematics for Elementary Teachers: Project MET.*
 (1266) **George W. Johnson**, University of South Carolina
- 1:00PM *Online Statistics Education: An Interactive Multimedia Course of Study.*
 (1267) **David M. Lane**, Rice University
- 1:00PM *Implementing WeBWork in a Teacher Training Curriculum.*
 (1268) **Angelo Segalla**, California State University, Long Beach

MAA Poster Session on Projects Supported by the NSF Division of Undergraduate Education

1:00 PM – 3:00 PM

Organizer: **Jon W. Scott**, Montgomery Community College

- 1:00PM *Writing to Learn Mathematics—No Instructor Grading.*
 (1245) **Mary Kay Abbey*** and **Bette Daudu**, Montgomery College
- 1:00PM *San Juan County Initiative for the Enhancement of Pre-Service and In-Service Math/Science Teacher Education through Curriculum Development and Internship Experiences in Technology.*
 (1246) **Jana Wallace**, San Juan College
- 1:00PM *Development of a Computer Lab Manual for Use in a First Course in Abstract Algebra.*
 (1247) **Julianne Rainbolt**, Saint Louis University
- 1:00PM *Geometric Structures for Elementary Teachers (GeoSET).*
 (1248) **Douglas B. Aichele*** and **John Wolfe**, Oklahoma State University
- 1:00PM *Interdisciplinary Application Projects in Calculus – Strengths, Weaknesses, and Lessons Learned.*
 (1249) **Bill Briggs***, **Bruce MacMillan**, **Lynn Bennethum** and **Mike Kawai**, University of Colorado at Denver
- 1:00PM *A Data-Oriented, Active Learning, Post-Calculus Introduction to Statistical Concepts, Applications, and Theory.*
 (1250) **Allan J. Rossman*** and **Beth L. Chance**, California Polytechnic State University, San Luis Obispo
- 1:00PM *A Comprehensive WeBWork Problem Library.*
 (1251) **Jeff Holt***, University of Virginia, **John Jones**, Arizona State University, and **William Ziemer**, California State University Long Beach
- 1:00PM *Knot Theory for Preservice and Practicing Secondary Mathematics Teachers.*
 (1252) **Thomas Mattman***, California State University, Chico, and **Neil Portnoy**, Stony Brook University

- 1:00PM (1269) *The National Curve Bank Project: A MATH Archive.*
Shirley B. Gray*, California State University Los Angeles, **Bill Austin**, University of Tennessee at Martin, **Phillip Johnson**, Appalachian State University, and **Lou Talman**, Metropolitan State College of Denver
- 1:00PM (1270) *Math Across the Community College Curriculum.*
Rebecca Hartzler*, Seattle Central Community College, and **Caren Diefenderfer**, Hollins University
- 1:00PM (1271) *ACCESS: Advancing Community College Engineering Student's Success.*
Dan G. Dimitriu, San Antonio College
- 1:00PM (1272) *PHASER: A Universal Simulator for Dynamical Systems.*
Huseyin Kocak* and **Brian Coomes**, University of Miami
- 1:00PM (1273) *Native American-based Materials for Undergraduate Mathematics Courses.*
Charles P. Funkhouser*, University of Montana College of Technology, and **A. Duane Porter**, University of Wyoming
- 1:00PM (1274) *Collaborative Project: Kentucky Information Technology Center.*
Lillie Crowley*, Lexington Community College, and **Darrell H. Abney**, Maysville Community & Technical College
- 1:00PM (1275) *Full Realization of Visualization Tools for 3D.*
Daniel McGee*, University of Puerto Rico Mayaguez, **David Lomen**, University of Arizona, **Deborah Moore-Russo**, University at Buffalo, and **Dennis Ebersole**, Northampton Community College
- 1:00PM (1276) *The PascGalois Project: Visualization in Abstract Mathematics.*
Michael Bardzell* and **Kathleen Shannon**, Salisbury University
- 1:00PM (1277) *Collaborative Development of Java Laboratories for College Algebra and Trigonometry.*
Michael Mays, West Virginia University
- 1:00PM (1278) *Biomathematics: Developing a Textbook and Case Study Manual for Introductory Courses in Mathematical Biology.*
Raina Robeva, Sweet Briar College
- 1:00PM (1279) *Bridging the Vector Calculus Gap.*
Tevian Dray, Oregon State University
- 1:00PM (1280) *Improving Preservice Teachers' Understanding of Fundamental Concepts in the Secondary Mathematics Curriculum.*
John Lorch* and **Ralph Bremigan**, Ball State University
- 1:00PM (1281) *Developing a Mathematics Curriculum to Serve the Biosciences: The First Step.*
James Fulton*, Suffolk County Community College, **Sheldon Gordon**, **Matthew Bahamonde**, **Jack Winn**, Farmingdale State University, **Linda Sabatino** and **Rob Lowry**, Suffolk County Community College
- 1:00PM (1282) *Integrating Computer Explorations into College Geometry.*
Sr. Barbara E. Reynolds, Cardinal Stritch University, and **William E. Fenton***, Bellarmine University
- 1:00PM (1283) *Training Environmental Statisticians Using Complicated Data Sets to Make More Informed Environmental Decisions.*
Nagambal Shah* and **Monica Stephens**, Spelman College
- 1:00PM (1284) *Motivating Geometry through Computation and Visualization.*
David L. Finn, Rose-Hulman Institute of Technology

- 1:00PM (1285) *Pathways Through Algebra Project.*
Wade Ellis*, West Valley College, and **Terrie Teegarden**, San Diego Mesa College
- 1:00PM (1286) *Renewal of College Algebra.*
Norma Agras*, Miami Dade College, and **J. Michael Pearson**, Mathematical Association of America
- 1:00PM (1287) *The Math Gateway.*
Lawrence Moore*, Duke University, and **Donald Albers**, Mathematical Association of America
- 1:00PM (1288) *Professional Development Program (PREP).*
J. Michael Pearson, Mathematical Association of America, **William Haver**, Virginia Commonwealth University, **Nancy Baxter Hastings**, Dickinson College, **Nathaniel Dean**, Texas Southern University, and **Jon Scott***, Montgomery College

MAA Panel Discussion

1:00 PM – 2:20 PM

Topics of ethics in mathematics.

- Organizers: **Brian Birgen**, Wartburg College
Karolyne Fogel, California Lutheran University
Walter Whiteley, York University
- Panelists: **Mariah Birgen**, Wartburg College
Lee Lorch, York University
Walter Whiteley

MAA Panel Discussion

1:00 PM – 2:20 PM

Mathematics and biology 2010: Building connections.

- Organizers: **Elton Graves**, Rose-Hulman Institute of Technology
John R. Birge, University of Chicago
- Panelists: **John R. Jungck**, Beloit College
Lisette de Pillis, Harvey Mudd College
David Asai, Harvey Mudd College

MAA Panel Discussion

1:00 PM – 2:20 PM

Algebra at various levels: How does it differ?

- Organizers: **Bernard L. Madison**, University of Arkansas
Susan L. Forman, CUNY Bronx Community College
- Panelists: **Bonnie Gold**, Monmouth University
Cathy L. Seely, University of Texas at Austin
Bernard L. Madison
Sheldon P. Gordon, SUNY at Farmingdale

ASL Invited Address

1:10 PM – 2:00 PM

- (1289) *Countable quotients of combinatorial structures.*
Alain Louveau, CNRS and University of Paris VI

AMS Special Session on Field Extensions and Algorithms, II

2:00 PM – 5:50 PM

Organizers: **Peter Stevenhagen**, University of Leiden
H. W. Lenstra, University of Leiden

- 2:00PM (1290) *Factoring polynomials over global fields.*
Mark van Hoeij, Florida State University (1014-11-842)
- 3:00PM (1291) *The Calculation of Algebraic Conjugates.*
 Preliminary report.
H. M. Stark, UCSD (1014-11-1039)
- ▶ 3:30PM (1292) *Connecting special values of partial zeta functions with Ankeny, Artin, and Chowla's formulae.*
 Preliminary report.
Barry R. Smith, University of California, San Diego (1014-11-719)
- 4:00PM (1293) *Higher order Stark-type conjectures.* Preliminary report.
Caleb J. Emmons, University of California, San Diego (1014-11-269)
- ▶ 4:30PM (1294) *Density of primitive elements for field extensions.*
Shuhong Gao, Clemson University (1014-12-1440)
- 5:00PM (1295) *Codes from field extensions.* Preliminary report.
Gretchen L. Matthews, Clemson University (1014-14-729)
- ▶ 5:30PM (1296) *Word-oriented PN sequence generation and polynomials of special forms over \mathbb{F}_{2^m} .* Preliminary report.
Gadiel Seroussi, Mathematical Sciences Research Institute, Berkeley, California (1014-12-1541)

ASL Invited Address

2:10 PM – 3:00 PM

- (1297) *Complex analytic geometry over o-minimal structures.*
Sergei Starchenko, University of Notre Dame

NAM Granville-Brown-Haynes Session of Presentations by Recent Doctoral Recipients in the Mathematical Sciences

2:15 PM – 4:00 PM

RMMC Board of Directors

2:15 PM – 4:10 PM

MAA Presentations by Teaching Award Recipients

2:30 PM – 4:00 PM

- Organizer: **Martha J. Siegel**, Towson University
 Moderator: **Carl C. Cowen**, IUPUI
- (1298) *Mathematics is - - - - .*
Jacqueline Dewar, Loyola Marymount University (1014-A0-232)
- (1299) *Small opportunities at a big university.*
Keith D. Stroyan, University of Iowa (1014-A0-233)
- (1300) *The Joy of Teaching The Joy of Numbers.*
Judy L. Walker, University of Nebraska-Lincoln (1014-A0-234)

MAA Committee on Mathematics Across the Disciplines Panel Discussion

2:30 PM – 3:50 PM

Models for a one-semester course in discrete mathematics.

- Organizer: **William A. Marion**, Valparaiso University
- Panelists: **William A. Marion**
Susanna S. Epp, DePaul University
Gerald W. Kruse, Juniata College

MAA Demonstration and Discussion

2:30 PM – 4:50 PM

Mathematical circles.

- Organizer: **Zsuzsanna Szaniszló**, Valparaiso University
- Presenters: **Paul A. Zeitz**, University of San Francisco
Zsuzsanna Szaniszló

MAA Panel Discussion

2:30 PM – 3:50 PM

Mathematicians involved in school mathematics.

- Organizers: **Roger E. Howe**, Yale University
Alan C. Tucker, SUNY Stony Brook
- Panelists: **Richard J. Schaar**, Texas Instruments
R. James Milgram, Stanford University
Johnny W. Lott, University of Montana

WEB SIGMAA Special Presentation

2:30 PM – 3:50 PM

Serious data and serious tools on the Web for a serious problem.

- Organizer: **Franklin A. Wattenberg**, U.S. Military Academy
- Panelists: **Geoff Kuhlmann**, U.S. Military Academy
Joe Lindquist, U.S. Military Academy
Heather Stevenson, U.S. Military Academy
Franklin A. Wattenberg

AMS Session on Fourier and Harmonic Analysis, Approximation

2:45 PM – 6:10 PM

- 2:45PM (1301) *The heating of the Beurling operator.*
Janine Wittwer^{*}, Westminster College, Salt Lake City, and **S. Petermichl**, University of Texas, Austin (1014-42-523)
- 3:00PM (1302) *Notes on Matrix Valued Dyadic Paraproducts.*
 Preliminary report.
Tao Mei, Texas A&M Univ. (1014-42-634)
- 3:15PM (1303) *Bochner-Riesz means With Respect to a Rough Distance Function.*
Paul T. Taylor, McMaster University (1014-42-668)
- 3:30PM (1304) *An integral estimate involving the Dirichlet kernel.*
J. Marshall Ash, DePaul University (1014-42-1078)

- 3:45PM (1305) *Sampling and Interpolation of Two-Band Signals.*
Sergei A. Avdonin, **Anna S. Bulanova***, University of Alaska Fairbanks, and **William Moran**, University of Melbourne (1014-42-1248)
- 4:00PM (1306) *L_p convergence with rates of smooth Picard singular operators.* Preliminary report.
George A. Anastassiou, University of Memphis (1014-41-16)
- 4:15PM (1307) *An inequality for a class of almost periodic entire functions.* Preliminary report.
Q. I. Rahman, University of Montreal, Montreal Canada, and **Q. M. Tariq***, Virginia State University, Petersburg, VA (1014-41-1297)
- 4:30PM (1308) *The Algebraic-Maclaurin-Pade' Rational Polynomial Approximation for ODE BVPs.* Preliminary report.
Paul G. Warne* and **Debra A. Warne**, James Madison University (1014-41-1489)
- 4:45PM (1309) *Summability of Taylor series by methods from Burmann-series expansions.*
Jerry P. King, Lehigh University (1014-40-605)
- 5:00PM (1310) *A $C^{k,\lambda}$ approximation of Sobolev functions in norm and capacity.*
Javad Namazi, Fairleigh Dickinson University (1014-26-190)
- ▶ 5:15PM (1311) *Geometric Fourier analysis for cognitive visual neuroscience.*
Jacek Turski, University of Houston-Downtown (1014-43-1419)
- 5:30PM (1312) *Ultra-wideband Pulse Propagation: The Signal Contribution.*
Natalie A. Cartwright* and **Kurt E. Oughstun**, University of Vermont (1014-78-770)
- 5:45PM (1313) *Constructing Pulse Solutions for Neural Networks Models.* Preliminary report.
Fernanda Botelho*, **James E. Jamison** and **Angela J. Murdock**, University of Memphis (1014-45-1218)
- 6:00PM (1314) *The Bargmann Transform and Windowed Fourier Localization.*
Min-Lin Lo, California State University, San Bernardino (1014-47-945)

MAA Session on Research on the Teaching and Learning of Undergraduate Mathematics, II

3:00 PM – 4:55 PM

Organizers: **William O. Martin**, North Dakota State University
Barbara E. Edwards, Oregon State University
Michael Oehrtman, Arizona State University

- ▶ 3:00PM (1315) *Preliminary Identification of Difficulties Encountered by Students Reading Mathematics.* Preliminary report.
Mary D. Shepherd, Northwest Missouri State University (1014-01-1602)
- ▶ 3:20PM (1316) *Developmental Continuity: A Key To Academic Success.*
Clyde L. Greeno, MAEI Mathematics Institute (1014-01-1041)
- 3:40PM (1317) *College Physics Majors' Mathematical Reasoning.*
Barbara Edwards*, **Corinne Manogue**, **Gulden Karakok** and **Tevian Dray**, Oregon State University (1014-01-1540)
- ▶ 4:00PM (1318) *Unified Representation of Function: Graphing.* Preliminary report.
Aaron Montgomery*, Central Washington University, and **Bernadette Baker**, Drake University (1014-01-1506)

- 4:20PM (1319) *Levels of understanding of the relation between ϵ and N in the definition of the limit of a sequence.*
Kyeong Hah Roh, Arizona State University (1014-01-1483)
- ▶ 4:40PM (1320) *Learning Theory and Linear Algebra.* Preliminary report.
Sergio Loch*, Grand View College, **Laurel A. Cooley**, Brooklyn College - CUNY, **William O. Martin**, North Dakota State University, and **Draga Vidakovic**, Georgia State University (1014-01-1401)

MAA Minicourse #14: Part B

3:30 PM – 5:30 PM

Teaching linear algebra with applications.
Organizer: **Gilbert Strang**, Massachusetts Institute of Technology

MAA Minicourse #3: Part B

3:30 PM – 5:30 PM

Using and adapting online materials.
Organizers: **David A. Smith**, Duke University
Lang Moore, Duke University

MAA Minicourse #9: Part B

3:30 PM – 5:30 PM

Discrete dynamical systems and problem solving.
Organizers: **David C. Arney**, U.S. Military Academy
Gary W. Krahn, U.S. Military Academy

ASL Contributed Paper Session, I

3:45 PM – 5:45 PM

- 3:45PM (1321) *Co-stationarity of the ground model.*
Natasha Dobrinen* and **Sy Freidman**, Kurt Goedel Research Center for Mathematical Logic, Univ. of Vienna
- 4:10PM (1322) *Ehrenfeucht-Frassé games and generic coding.*
Ross Bryant, University of North Texas
- 4:35PM (1323) *Semigroups of partial automorphisms of countable structures.*
Eric Ufferman*, **Jennifer Chubb**, **Valentina Harizanov**, George Washington University, **Andrei Morozov**, Sobolev Institute of Mathematics, and **Sarah Pingrey**, George Washington University
- 5:00PM (1324) *Representations of reals in reverse mathematics.*
Jeffrey L. Hirst, Appalachian State University
- 5:25PM (1325) *The Modal Logic of Forcing.*
Benedikt Loewe*, ILLC, Univ. Van Amsterdam, and **Joel David Hamkins**, Graduate Center of the City University of New York

MAA Undergraduate Poster Session

4:00 PM – 6:30 PM

Organizers: **Mario U. Martelli**, Claremont McKenna College
Diana M. Thomas, Montclair State University

Program of the Sessions – Saturday, January 14 (cont'd.)

SIGMAA on Quantitative Literacy Business Meeting and Reception

4:00 PM – 5:00 PM

Organizers: **Caren L. Diefenderfer**, Hollins University
Judith F. Moran, Trinity College
Maura B. Mast, University of Massachusetts Boston

MAA Session on Mathematical Connections in the Arts, II

4:15 PM – 6:10 PM

Organizers: **Douglas E. Norton**, Villanova University
Reza Sarhangi, Towson University
Nathaniel A. Friedman, State University of New York, Albany

- ▶ 4:15PM *Mathematics and the Creation of Literature.*
(1326) Preliminary report.
Michael P. Saclolo, St. Edward's University (1014-N1-1411)
- ▶ 4:30PM *Classifying the Frieze Patterns of Seville's Real Alcazar.*
(1327) **B. Lynn Bodner**, Monmouth University (1014-N1-1024)
- ▶ 4:45PM *Do you like Paleolithic Op-art? Preliminary report.*
(1328) **Slavik V. Jablan**, The Mathematical Institute, Belgrade, Serbia and Montenegro (1014-N1-768)
- ▶ 5:00PM *Fractal Tilings Based on Prototiles with Angles that are Multiples of 36 Degrees.*
(1329) **Robert W. Fathauer**, Tessellations Company (1014-N1-964)
- ▶ 5:15PM *A Collection of Curves.*
(1330) **Susan A. McBurney**, Western Springs, Illinois (1014-N1-1453)
- ▶ 5:30PM *Cycles in Math and Music.*
(1331) **Rehana Patel*** and **Heidi Upton**, St. John's University (1014-N1-1748)
- ▶ 5:45PM *Renaissance Banff Conference: A Three-Day Bridges Conference, and a Coxeter Day A Collaborative Effort for a Mathematics and Art Conference in Canada.*
(1332) **Reza Sarhangi**, Towson University (1014-N1-1391)
- ▶ 6:00PM *What are demi-regular tilings? Preliminary report.*
(1333) **Helmer Aslaksen**, National Univ. of Singapore (1014-N1-1380)

AMS Session on Operations Research, Game Theory, Economics

4:45 PM – 6:10 PM

- ▶ 4:45PM *On Deriving Volumetric Center Decomposition Algorithms for Stochastic Semidefinite Programs.*
(1334) **K. A. Ariyawansa** and **Yuntao Zhu***, Washington State University (1014-90-1606)
- ▶ 5:00PM *Proportional Pie-Cutting.*
(1335) **Steven J. Brams**, New York University, **Michael A. Jones***, Montclair State University, and **Christian Klamler**, University of Graz (Austria) (1014-91-1713)
- ▶ 5:15PM *On Solving Games Constructed Using Both Shortened and Continued Conjunctive Sums.*
(1336) Preliminary report.
Daniel M. Kane, Massachusetts Institute of Technology (1014-91-508)

- ▶ 5:30PM *Differential Equations and Computational Optimization for Closed End Funds.*
(1337) **A. Duran*** and **G. Caginalp**, University of Pittsburgh (1014-91-1029)
- ▶ 5:45PM *Optimal and Nearly-Optimal Strategies for Minimizing the Probability of Ruin in Retirement.*
(1338) **Kristen S. Moore*** and **Virginia R. Young**, University of Michigan (1014-35-1481)
- ▶ 6:00PM *The Limits of Monetary Policy Effectiveness, Implied by Abel's Impossibility Theorem.*
(1339) **James Michael Haley**, Pittsburgh, Pennsylvania (1014-90-1072)

SIGMAA on the Philosophy of Mathematics Annual Meeting, Reception, and Guest Lecture

6:00 PM – 8:00 PM

- Chair: **Roger A. Simons**, Rhode Island College
- Organizer: **Bonnie Gold**, Monmouth University
- ▶ (1340) *Computer assisted mathematics.*
Paul Humphreys, University of Virginia/IHPST, Paris (1014-A0-53)

AMS Mathematical Reviews Reception

6:00 PM – 7:00 PM

MAA-Project NExT Reception

8:30 PM – 10:30 PM

NAM Cox-Talbot Address

8:45 PM – 9:30 PM

- (1341) *Teaching mathematics in the 21st century: Anecdotes from the past and future.*
Wade Ellis Jr., West Valley College

Sunday, January 15

MAA Minority Chairs Breakfast Meeting

7:00 AM – 8:45 AM

Joint Meetings Registration

7:30 AM – 4:00 PM

AMS-MAA-SIAM Special Session on Recent Advances in Mathematical Biology and Epidemiology, I

8:00 AM – 10:50 AM

- Organizers: **Sophia Jang**, University of Louisiana at Lafayette
Linda Allen, Texas Tech University
Lih-Ing Roeger, Texas Tech University
- ▶ 8:00AM *Metapopulation Models for Disease Spread.*
(1342) **P. van den Driessche**, University of Victoria, BC (1014-92-783)
- ▶ 8:30AM *Linking immunology and epidemiology in mathematical models.* Preliminary report.
(1343) **Maia Martcheva*** and **Sergei S. Pilyugin**, University of Florida (1014-92-806)

- 9:00AM (1344) *A control-theoretic approach to combining immunotherapy with antiviral treatment for HIV.* **Rebecca V. Culshaw**, The University of Texas at Tyler (1014-92-1129)
- 9:30AM (1345) *Brain tumor, oncolytic virus, innate immune cells and cyclophosphamide.* Preliminary report. **Jianjun Paul Tian**, Mathematical Biosciences Institute, the Ohio State University (1014-35-436)
- ▶ 10:00AM (1346) *Cellular Automata with Propensity for Insectal Pollen Propagation.* Preliminary report. **David M. Chan*** and **Rodney Dyer**, Virginia Commonwealth University (1014-92-175)
- 10:30AM (1347) *Integer-Valued Population Models.* **Dorian Wilkerson***, Clark Atlanta University, and **Ronald Mickens**, Clark Atlanta University (1014-39-479)

AMS-SIAM Special Session on Boundary Value Problems for Ordinary Differential Equations, I

8:00 AM – 10:50 AM

Organizers: **John R. Graef**, University of Tennessee at Chattanooga
Johnny L. Henderson, Baylor University

- 8:00AM (1348) *Nonstandard semi-implicit shooting methods for second order singular ODE boundary value problems.* Preliminary report. **Qin Sheng***, Baylor University, and **Joseph W. Haus**, University of Dayton (1014-34-429)
- 8:30AM (1349) *Limits of Sturm-Liouville Eigenvalues When the Interval Shrinks to an End Point.* **Qingkai Kong***, **Hongyou Wu** and **Anton Zettl**, Northern Illinois University (1014-34-1110)
- 9:00AM (1350) *Descartes systems of functions and disconjugacy of linear fractional differential equations.* **Paul W. Eloe**, University of Dayton (1014-34-1050)
- 9:30AM (1351) *Multiple solutions for impulsive functional differential equations.* **Mouffak Benchohra**, Université de Sidi Bel Abbes, **Johnny Henderson***, Baylor University, **Sotiris Ntouyas**, University of Ioannina, and **Abdelghani Quahab**, Laboratoire de Mathématiques (1014-34-321)
- 10:00AM (1352) *Uniqueness and Existence Via Linearized Boundary Value Problems.* **Jeffrey A. Ehme**, Spelman College (1014-34-734)
- ▶ 10:30AM (1353) *Radial solutions of quasilinear semipositone boundary-value problems.* Preliminary report. **Matthew B. Rudd**, University of Texas at Austin (1014-34-962)

AMS-SIAM Special Session on Theory and Application of Stochastic Differential Equations, I

8:00 AM – 10:50 AM

Organizers: **Armando Arciniega**, University of Texas at San Antonio
Edward J. Allen, Texas Tech University

- 8:00AM (1354) *Stability Analysis of Stochastic Multi-Agent Dynamic Systems.* Preliminary report. **Jagdish Chandra**, The George Washington University, and **G. S. Ladde***, The University of Texas at Arlington (1014-93-936)

- 8:30AM (1355) *Stochastic 2D Euler and Navier-Stokes Hybrid Dynamics of Fluid Flows under Markovian Switching.* Preliminary report. **Sivapragasam Sathananthan**, Tennessee State University, **Mahmoud Anabtawi***, American University of Sharjah, UAE, and **Gangaram Ladde**, The University of Texas at Arlington (1014-60-1179)
- 9:00AM (1356) *Weakly overtaking optimal strategies for controlled diffusion processes.* Preliminary report. Preliminary report. **Onésimo Hernández-Lerma**, CINVESTAV-IPN, Mexico City (1014-93-283)
- 9:30AM (1357) *Quantum Stochastic Differential Inclusions Satisfying a General Lipschitz Condition.* **Ezekiel Olusola Ayoola**, University of Ibadan, Ibadan, Nigeria (1014-81-372)
- 10:00AM (1358) *Numerical Study of Interacting Particles Approximations for Integro-Differential Equations.* **Dan Stancu**, University of Wyoming (1014-65-1434)
- ▶ 10:30AM (1359) *Stochastic perturbation of power law optical solitons.* **Anjan Biswas**, Delaware State University (1014-78-1772)

AMS-SIAM Special Session on Symbolic-Numeric Computation and Applications, I

8:00 AM – 10:50 AM

Organizers: **Agnes Szanto**, North Carolina State University
Jan Verschelde, University of Illinois at Chicago
Zhonggang Zeng, Northeastern Illinois University

- 8:00AM (1360) *Adaptive precision in homotopy continuation.* **Daniel J. Bates***, **Andrew J. Sommese**, University of Notre Dame, and **Charles W. Wampler**, GM Research & Development (1014-65-285)
- 8:30AM (1361) *Local Regularization of the Autoconvolution Problem.* **Zhewei Dai***, Alma College, and **Patricia K. Lamm**, Michigan State University (1014-45-1553)
- 9:00AM (1362) *Stationary Configurations of Four Vortices.* **Marshall Hampton***, University of Minnesota, Duluth, and **Richard Moeckel**, University of Minnesota, Minneapolis (1014-76-147)
- 9:30AM (1363) *Approximate Factorization of Complex Multivariate Polynomials.* **Erich Kaltofen**, North Carolina State University (1014-65-359)
- 10:00AM (1364) *Computing the approximate rank of large inexact matrices.* **Tsung-Lin Lee***, **T. Y. Li**, Michigan State University, and **Zhonggang Zeng**, Northeastern Illinois University (1014-65-1208)
- 10:30AM (1365) *Symbolic-Numeric Sparse Polynomial Interpolation.* **Wen-shin Lee**, University of Antwerp, Belgium (1014-65-636)

AMS-AWM-MAA Special Session on Mathematical Results and Challenges in Learning Theory

8:00 AM – 11:00 AM

Organizer: **Cynthia Rudin**, Courant Institute, NYU

Program of the Sessions – Sunday, January 15 (cont'd.)

- 8:00AM *Ranking with a P-Norm Push.*
▶ (1366) **Cynthia Rudin**, Center for Neural Science and Courant Institute, New York University (1014-68-443)
- 8:30AM *Online Convex Programming: A Survey.*
(1367) **Martin A. Zinkevich**, University of Alberta (1014-68-1343)
- 9:00AM *Sparse Function Estimation in High Dimensions.*
(1368) **John Lafferty*** and **Larry Wasserman**, Carnegie Mellon University (1014-62-924)
- 9:30AM *Optimization Challenges in Capacity Control.*
(1369) **Kristin P. Bennett**, Rensselaer Polytechnic Institute (1014-49-772)
- 10:00AM *Theoretical Challenges Arising from Empirical Observations about Boosting Algorithms.*
▶ (1370) **Phil Long**, Google (1014-68-435)
- 10:30AM Discussion

AMS Special Session on Algebraic and Enumerative Combinatorics, III

8:00 AM – 10:50 AM

Organizers: **Catherine H. Yan**, Texas A&M University
Marcelo Aguiar, Texas A&M University
Joseph P. Kung, University of North Texas
Laura F. Matusevich, University of Pennsylvania

- 8:00AM *The combinatorics of type A nonsymmetric Macdonald polynomials.*
(1371) **Jim Haglund***, Ohio State, **M. Haiman**, UC Berkeley, and **N. Loehr**, William and Mary (1014-05-738)
- 8:30AM *Nonsymmetric Schur functions and standard bases.*
(1372) Preliminary report.
Sarah K. Mason, University of Pennsylvania (1014-05-1149)
- 9:00AM *The bounded complex of an affine oriented matroid.*
(1373) **Xun Dong**, University of Miami (1014-52-977)
- 9:30AM *Shelling Coxeter-like complexes and sorting on trees.*
(1374) **Patricia Hersh**, Indiana University–Bloomington (1014-05-796)
- 10:00AM *Combinatorics.* Preliminary report.
(1375) **Swapneel Mahajan**, Indian Institute of Technology Bombay (1014-05-1445)
- 10:20AM Discussion

AMS Special Session on Arithmetic Geometry and Modular Forms, III

8:00 AM – 10:50 AM

Organizers: **Matthew A. Papanikolas**, Texas A&M University
Ahmad M. El-Guindy, Texas A&M University

- 8:00AM *The Fricke involution and congruences for modular forms of weight four.*
▶ (1376) **Scott Ahlgren***, University of Illinois, and **Mugurel Barcau**, Bucharest, Romania (1014-11-1225)
- 8:30AM *Atkin and Swinnerton-Dyer congruence and the modularity for certain noncongruence cuspforms.*
(1377) **A.O.L. Atkin**, University of Illinois at Chicago, **W.C. Li**, Pennsylvania State University, and **L. Long***, Iowa State University (1014-11-1141)

- 9:00AM *Symmetry in Twisted Families of L-functions.*
(1378) Preliminary report.
Eduardo Duenez*, The University of Texas at San Antonio, and **Steven J. Miller**, Brown University (1014-11-1154)
- 9:30AM *L-values of Eisenstein Series and Reducible Double L-values.*
(1379) **David Terhune**, Penn State University (1014-11-123)
- 10:00AM *Special Values of Gaussian Hypergeometric Functions.* Preliminary report.
(1380) **Sharon M. Frechette***, College of the Holy Cross, and **Matthew Papanikolas**, Texas A&M University (1014-11-1504)
- 10:30AM *Zariski-density of exceptional points of hypergeometric functions.*
(1381) **Paula B. Cohen***, Texas A&M University, **Pierre-Antoine Desrousseaux**, Bamako, Mala, and **Marvin Tretkoff**, Texas A&M University (1014-11-1423)

AMS Special Session on Field Extensions and Algorithms, III

8:00 AM – 10:50 AM

Organizers: **Peter Stevenhagen**, University of Leiden
H. W. Lenstra, University of Leiden

- 8:00AM *Eisenstein Reciprocity Law, Gaussian Sums and Application to Primality Testing.* Preliminary report.
▶ (1382) **Pedro J. Berrizbeitia**, Universidad Simón Bolívar (1014-11-1736)
- 8:30AM *Power Residue Symbol Algorithms.* Preliminary report.
(1383) **J. P. Buhler**, CCR (1014-11-1745)
- 9:00AM *Rational torsion of elliptic curves.*
(1384) **Amod Agashe**, Florida State University (1014-11-839)
- 9:30AM *Toward an explicit 2-descent on the Jacobian of a generic curve of genus 2.* Preliminary report.
(1385) **Ronald M. van Luijk***, UC Berkeley, CRM, MSRI, and **Adam M. Logan**, University of Liverpool, CRM, and University of Waterloo (1014-11-1153)
- 10:00AM *Pointless curves of genus 3 and 4.*
(1386) **Everett W. Howe***, Center for Communications Research, La Jolla, **Kristin E. Lauter**, Microsoft Research, and **Jaap Top**, University of Groningen (1014-11-947)
- 10:30AM *Cup products and unramified extensions.*
(1387) Preliminary report.
Romyar T. Sharifi, McMaster University (1014-11-826)

AMS Special Session on New Developments in Symplectic Topology, II

8:00 AM – 10:50 AM

Organizers: **Dusa McDuff**, SUNY at Stony Brook
Aleksey Zinger, SUNY at Stony Brook
Ely Kerman, University of Illinois at Urbana-Champaign
Margaret F. Symington, Georgia Institute of Technology and Mercer University

- 8:00AM *On the topology of Lagrangian submanifolds.*
(1388) **Peter Albers**, Courant Institute, New York University (1014-53-550)

- 8:30AM (1389) *Conormal bundles to knots and the Gopakumar-Vafa conjecture.*
Sergiy V. Koshkin, Kansas State University (1014-53-291)
- 9:00AM (1390) *Holomorphic shadows in the eyes of model theory.*
Liat Kessler, Courant Institute of Mathematical Sciences, New York University (1014-53-1259)
- 9:30AM (1391) *Heegaard-Floer homology for manifolds with parametrized boundary.*
Robert Lipshitz, Stanford University (1014-57-467)
- 10:00AM (1392) *Fiber sum formulae for Ozsváth-Szabó invariants.*
Stanislav Jabuka, University of Nevada, Reno, and **Thomas E. Mark***, Southeastern Louisiana University (1014-57-97)
- 10:30AM (1393) *Symplectic 4-manifolds with arbitrary fundamental group near the BMY line.* Preliminary report.
Scott Baldrige*, Louisiana State University, and **Paul Kirk**, Indiana University (1014-57-481)

AMS Special Session on Nonautonomous Discrete Dynamics, III

8:00 AM - 10:50 AM

Organizers: **Saber N. Elaydi**, Trinity University
Jim M. Cushing, University of Arizona

- 8:00AM (1394) *Detection of periodic driving in systems of difference equations.*
Timothy D. Sauer, George Mason University (1014-39-1061)
- 8:30AM (1395) *Linear difference equations defined by polynomial hypergroups: Examples and basic properties.*
Rupert Lasser, GSF-Research Center and University of Technology Munich, Germany (1014-39-174)
- 9:00AM (1396) *On $x_{n+1} = \max \left\{ \frac{A_n}{x_n}, \frac{B_n}{x_{n-1}} \right\}$ With Both Parameters Period-Four or Period-Five.* Preliminary report.
Candace Marie Kent*, Virginia Commonwealth University, and **Jennifer S. Sanchez**, Nashville, Tennessee (1014-37-871)
- 9:30AM (1397) *Deterministic Dynamics and Chance.*
Sandra A. Hayes*, Technical University of Munich, Germany, and **Yunping Jiang**, Queens College of the City University of New York (1014-37-1654)
- 10:00AM (1398) *Discrete Inertial Manifolds.*
Christian Poetzsche, University of Minnesota (1014-39-505)
- 10:30AM (1399) *Central Limit Theorem for one-dimensional dynamical systems with weak random noise.* Preliminary report.
Oliver Diaz, University of Texas at Austin (1014-37-41)

AMS Session on Knots, Links, and Tangles

8:00 AM - 8:55 AM

- 8:00AM (1400) *Quandle Cocycle Invariants and Tangle Embeddings.*
Kheira Ameer, USF (1014-55-1576)
- 8:15AM (1401) *Existence and Upper Bounds of Regular Stick Numbers of Knots and Links.* Preliminary report.
Timothy D. Comar*, **Kenneth Miller** and **Debra Witczak**, Benedictine University (1014-57-138)

- 8:30AM (1402) *Scaling Behavior, Equilibrium Lengths, and Probabilities of Knotted Polymers.*
Akos Dobay, Ludwig-Maximilians-Universitaet Muenchen, **Kenneth C. Millett**, University of California, Santa Barbara, **Michael Piatek**, University of Washington, **Eric Rawdon***, Duquesne University, and **Andrzej Stasiak**, University of Lausanne (1014-57-698)
- 8:45AM (1403) *On the Structure of Tight Knots.* Preliminary report.
Ted Ashton, University of Georgia (1014-53-144)

AMS Session on Lattices, Ordered Structures, Logic and Model Theory

8:00 AM - 9:55 AM

- 8:00AM (1404) *Aspects of Certain Countable Universal H-Free Graphs.*
Rehana Patel, St. John's University (1014-03-1690)
- 8:15AM (1405) *Spaces of orders on groups.* Preliminary report.
Malgorzata A. Dabkowska*, George Washington University, **Mieczyslaw Dabkowski**, University of Texas at Dallas, and **Valentina Harizanov**, George Washington University (1014-03-1718)
- 8:30AM (1406) *Degrees of Monotone Complexity.*
William C. Calhoun, Bloomsburg University of Pennsylvania (1014-03-1564)
- 8:45AM (1407) *A Peculiar Connection Between the Axiom of Choice and Predicting the Future.* Preliminary report.
Christopher S. Hardin*, Smith College, and **Alan D. Taylor**, Union College (1014-03-1551)
- 9:00AM (1408) *Generating a Finite Subset of a Lattice of Convex Sets.* Preliminary report.
M. P. Nolte* and **Matt Insall**, University of Missouri-Rolla (1014-06-1691)
- 9:15AM (1409) *Type Isomorphisms and Program Isomorphisms.* Preliminary report.
Carlos C. Martinez, Wesleyan University (1014-68-1716)
- 9:30AM (1410) *j-calculus: a foundation for discrete analysis.*
Phil Thrift, The University of Texas at Dallas (1014-39-1614)
- 9:45AM (1411) *Predicates, categorically.*
Ayalur R Krishnan, Kingsborough CC, CUNY. (1014-18-1714)

AMS Session on Real Analysis

8:00 AM - 10:40 AM

- 8:00AM (1412) *Rational Landen Transformations on \mathbb{R} .*
Dante V. Manna, Tulane University, New Orleans, Louisiana (1014-33-210)
- 8:15AM (1413) *Resultants of Chebyshev polynomials.*
Jemal Emina Gisha*, University of South Florida, and **Mourad E.H. Ismail**, University of Central Florida (1014-33-1457)
- 8:30AM (1414) *An Inductive Limit Topology on the Denjoy Space.*
J. Alan Alewine*, McKendree College, and **Eric Schechter**, Vanderbilt University (1014-28-367)
- 8:45AM (1415) *A Comparison of Newton's Interpolation Theory and the Mean Value Theorem of Calculus.* Preliminary report.
Nasser Dastrange, Buena Vista University (1014-26-815)
- 9:00AM (1416) *Subspaces of finitely additive measures on N .* Preliminary report.
Ron E. Rietz and **Trevor J. Potter***, Gustavus Adolphus College (1014-28-1384)

Program of the Sessions – Sunday, January 15 (cont'd.)

- 9:15AM (1417) *A note on 2-to-1 function.* Preliminary report.
Kandasamy Muthuvel, University of Wisconsin-Oshkosh (1014-26-1735)
- 9:30AM (1418) *The symbol of a function of a pseudo-differential operator.* Preliminary report.
Alfonso Gracia-Saz*, UC Berkeley, and **Cornelius Paufler**, Johannes-Gutenberg-Universitaet Mainz (1014-81-963)
- 9:45AM (1419) *Making Forecasts for Chaotic Physical Processes.*
Chris Danforth* and **James A. Yorke**, University of Maryland (1014-86-377)
- 10:00AM (1420) *Classification of multiparticle entanglement types with minimum orbit dimension.*
David W. Lyons* and **Scott N. Walck**, Lebanon Valley College (1014-81-1478)
- 10:15AM (1421) *A Reformulation of the Empirical Mode Decomposition.*
Daniel R. Van Vliet, West Virginia University (1014-00-1618)
- 10:30AM (1422) *The identification of a time dependent sorption parameter from soil column experiments.*
K. Renee Fister, **Maeve L. McCarthy***, Murray State University, and **Seth F. Oppenheimer**, Mississippi State University (1014-35-1771)

AMS Session on Group Theory, II

8:00 AM – 10:40 AM

- 8:00AM (1423) *Deciding Membership in Finitely Generated Submonoids of the Free Product of two Groups.*
Justin Amery James, University of Nebraska - Lincoln (1014-20-990)
- 8:15AM (1424) *An analog of McCarthy's result.*
Chiru Bhattacharya, Randolph-Macon College, Ashland, VA (1014-20-1163)
- 8:30AM (1425) *An Application of Graph Pebbling to Zero-Sum Sequences in Abelian Groups.*
Glenn H. Hurlbert* and **Shawn Elledge**, Arizona State University (1014-20-1522)
- 8:45AM (1426) *Chain Conditions on Subnormal Subgroups.*
Colin C. Ferguson, University of Illinois at Urbana-Champaign (1014-20-1536)
- 9:00AM (1427) *Decomposition numbers of finite groups of Lie type of small rank in the defining characteristic.*
Hossein Andikfar, University of Illinois at Chicago, (1014-20-1605)
- 9:15AM (1428) *Geometric Analysis of Groups of Piecewise-linear Homeomorphisms of the Unit Interval.*
Collin Bleak, Binghamton University (1014-20-1653)
- 9:30AM (1429) *Weyl filtration dimension for simple modules with p -singular highest weights for some low rank algebraic groups.* Preliminary report.
Matthew J. Beswick, Kansas State University (1014-00-252)
- 9:45AM (1430) *Embedding a Connected Topological Group into a Connected Group.* Preliminary report.
Ryo Ohashi, King's College (1014-22-477)
- 10:00AM (1431) *When do locally isometric topologies for the real numbers yield isomorphic topological groups?* Preliminary report.
Jon W. Short, Sam Houston State University, and **T. Christine Stevens***, Saint Louis University (1014-22-1636)
- 10:15AM (1432) *Nilpotent Conjugacy Classes in p -adic Lie Algebras.*
Jyotsna Mainkar Diwadkar, University of Pittsburgh (1014-08-1502)

- 10:30AM (1433) *Modern Algebra and Social Choice.* Preliminary report.
S. Baker Peacock* and **M. Paredes**, University of Texas-Pan American (1014-06-1667)

MAA Session on Mathematics of Sports and Games, II

8:00 AM – 10:55 AM

- Organizers: **Sean L. Forman**, Saint Joseph's University
Douglas Drinen, Sewanee: University of the South
- 8:00AM (1434) *Optimal Allocation of Energy Resources for Athletes in Bicycling, Running, Skiing and Swimming Competition as a Time Optimal Control Problem.*
Alexey L. Sadovskii* and **G. Beate Zimmer**, Texas A&M University-Corpus Christi (1014-M1-1140)
- 8:20AM (1435) *Scrabble[®] Tournaments, Ramsey Theory, and Resolvable Designs.*
Paul Becker* and **Paul Olson**, Penn State Erie - The Behrend College (1014-M1-778)
- 8:40AM (1436) *Transient Stress Analysis of Baseball-Bat Collision.* Preliminary report.
Rich Laverty, Juniata College (1014-M1-1159)
- 9:00AM (1437) *Playing Ball in a Rotating Space Station.*
Andrew J. Simoson, King College (1014-M1-67)
- 9:20AM (1438) *Thinking Inside the Box: The Mathematics of a Tennis Serve.*
Roland Minton* and **Jake Bennett**, Roanoke College (1014-M1-183)
- 9:40AM (1439) *Baseball Decision-Making with Markov Chain Models.*
Thomas W. Polaski, Winthrop University (1014-M1-965)
- 10:00AM (1440) *Using Theil's T Statistic to Explore Salary Inequality in Professional Sports: New Tools, New Questions, New Answers.* Preliminary report.
Joshua Travis Hale, LBJ School of Public Affairs; University of Texas at Austin (1014-M1-1466)
- 10:20AM (1441) *Scoring Rules for Golf.*
Michael A. Jones, Montclair State University (1014-M1-591)
- 10:40AM (1442) *Mathematics in Officiating: Data Sets and Voting Records for Introductory Statistics and Quantitative Literacy Classes.*
Christopher D. Oehrlein, Oklahoma City Community College (1014-M1-1484)

MAA Session on Achieving Quantitative Literacy, II

8:00 AM – 10:15 AM

- Organizers: **Aaron G. Montgomery**, Central Washington University
Stuart Boersma, Central Washington University
Semra Kilic-Bahi, Colby Sawyer College
- 8:00AM (1443) *Numeracy: A Course for Honor Students.* Preliminary report.
John C. Maceli, Ithaca College (1014-P1-944)
- 8:20AM (1444) *The Mathematics of Association in Quantitative Literacy.* Preliminary report.
Milo Schield, Augsburg College (1014-P1-36)
- 8:40AM (1445) *Spreadsheets Across the Curriculum.* Preliminary report.
Gary T. Franchy, Davenport University (1014-P1-1727)

- 9:00AM ▶ (1446) *Profit Maximization and Level Curves: Applying Excel Data Tables, Conditional Formatting, and the Solver.*
Mike Pogodzinski, Department of Economics, San Jose State University (1014-P1-404)
- 9:20AM ▶ (1447) *The Unholy Alliance: Integrating Math and Religion.* Preliminary report.
Harrison W. Straley* and **Barbara Darling-Smith**, Wheaton College (1014-P1-27)
- 9:40AM ▶ (1448) *From Math Distress To Math Success: The Development of a Quantitative Reasoning Course to Motivate Student Learning.*
Klement Teixeira* and **Fred Peskoff**, Borough of Manhattan Community College (1014-P1-789)
- 10:00AM ▶ (1449) *Join the Mathematics Across the Community College Curriculum Project.*
Rebecca Hartzler, Seattle Central Community College (1014-P1-1264)

MAA Session on Countering “I Can’t Do Math”: Strategies for Teaching Underprepared, Math-Anxious Students, II

8:00 AM – 9:55 AM

Organizers: **Bonnie Gold**, Monmouth University
Suzanne Dorée, Augsburg College
Richard J. Jardine, Keene State College

- 8:00AM (1450) *Improving Developmental Math Classes: What We’ve Learned.*
Christopher S. O’Connor* and **B. Fiske Michael**, Shawnee State University (1014-S1-355)
- 8:20AM ▶ (1451) *Using Standards-Based Instruction and Assessment to Reach Anxious, Reluctant, and Under-Prepared Math Students.* Preliminary report.
Victor Dorff, California Lutheran University (1014-S1-1560)
- 8:40AM ▶ (1452) *In Other Words: Using Writing Assignments and Memory Aides to Help Students Learn Mathematics.* Preliminary report.
Sarah V. Cook, Washburn University (1014-S1-1473)
- 9:00AM ▶ (1453) *Coaching a Student to Overcome Math Anxiety.*
Roger A. Simons, Rhode Island College (1014-S1-1689)
- 9:20AM (1454) *Needed Reforms for Class-Instruction of Under-Prepared, Math-Anxious Students: Revelations from Casework with Clinical Instruction.*
Clyde L. Greeno, The MAEI Mathematics Institute (1014-S1-1134)
- 9:40AM ▶ (1455) *Coping With Math Anxiety in College: A Case Study Approach.*
Fred Peskoff, Borough of Manhattan Community College (1014-S1-723)

MAA General Contributed Paper Session, VII

8:00 AM – 10:55 AM

Chair: **Timothy P. Chartier**, Davidson College
 Chair: **Stephen L. Davis**
 Organizers: **Stephen L. Davis**, Davidson College
Eric S. Marland, Appalachian State University

- 8:00AM ▶ (1456) *Reforming an Introduction to Modern Algebra.* Preliminary report.
Jeffrey L. Hirst, Appalachian State University (1014-Z1-1077)

- 8:15AM (1457) *Generalized primary rings and ideals.*
Christine E. Gorton, University of Louisiana at Lafayette (1014-Z1-1680)
- 8:30AM (1458) *Using Discovery Activities to Teach Mathematical Induction.*
Brian P. Kelly, U. of Louisiana at Monroe (1014-Z1-1539)
- 8:45AM ▶ (1459) *A charlatanic proof: The case of proof by induction.* Preliminary report.
May F. Hamdan, Lebanese American University (1014-Z1-726)
- 9:00AM ▶ (1460) *Teaching the Lebesgue Integral to Undergraduates: A New Course.*
William W. Johnston, Centre College (1014-Z1-777)
- 9:15AM ▶ (1461) *Approximate Contour Image Generation: A Project in Linear Algebra.*
Mohamed Allali, Chapman University (1014-Z1-1659)
- 9:30AM ▶ (1462) *Does Experience Matter? Comparisons of freshmen and sophomores in Calculus III.* Preliminary report.
Kurt Herzinger and **Beth Schaubroeck***, U.S. Air Force Academy (1014-Z1-669)
- 9:45AM ▶ (1463) *An Alternative Method to Partial Fraction Decomposition of Integral Computation.*
Chokri Cherif, BMCC-CUNY (1014-Z1-574)
- 10:00AM ▶ (1464) *Time dilation, neutron stars, and space war: Teaching relativity and differential geometry aboard a Bussard ramjet.*
Christopher G. Moseley, United States Military Academy (1014-Z1-1331)
- 10:15AM Break
- 10:30AM ▶ (1465) *Engaging math faculty in teacher preparation.*
Cecelia Laurie*, The University of Alabama, **Cristina Gomez**, SUNY-Cortland, and **Wei Shen Hsia**, The University of Alabama (1014-Z1-1138)
- 10:45AM ▶ (1466) *No Boys Allowed: Assessing A Girls Only Math Club.*
Rachel S. Cline* and **Jerry Dwyer**, Texas Tech University (1014-Z1-1100)

AMS Session on Frames, Operators, and Approximation

8:15 AM – 10:55 AM

- 8:15AM (1467) *Back step extensions of subnormal weighted shifts.* Preliminary report.
George Robert Exner, Bucknell University (1014-47-657)
- 8:30AM (1468) *Positive Definite Kernels and Lattice Paths.*
Tiberiu Constantinescu and **Nermine El-Sissi***, University of Texas at Dallas (1014-47-406)
- 8:45AM (1469) *On the Cauchy integrals taken over the doubly-periodic line.* Preliminary report.
Nino Khatishvili, Tbilisi I. Javakhishvili State University, Georgia Tbilisi (1014-45-111)
- 9:00AM (1470) *The Answer to Blecher’s Open Question about Properties (L) and (R).*
Masayoshi Kaneda, University of California, Irvine (1014-47-1741)
- 9:15AM (1471) *Multiresolutions in non-linear dynamics.*
Dorin Ervin Dutkay*, Rutgers University, and **Palle E. T. Jorgensen**, University of Iowa (1014-43-1650)
- 9:30AM (1472) *Non-separable Frame Multiresolution Analysis and Fast Wavelet Algorithms in Multidimensions.* Preliminary report.
Juan R. Romero* and **Manos Papadakis**, University of Houston (1014-41-1635)

Program of the Sessions – Sunday, January 15 (cont'd.)

- 9:45AM (1473) *A Pre and Post Processing to Reduce the Gibbs Phenomenon.*
Muhammad Aslam*, Sherman D. Riemenschneider, West Virginia University, and Lixin Shen, Western Michigan University (1014-65-1516)
- 10:00AM (1474) *An Efficient Method for Band-limited Extrapolation by Regularization.*
Weidong Chen, Kansas State University (1014-65-70)
- 10:15AM (1475) *PCM Quantization Errors and The White Noise Hypothesis.*
David Jimenez, Georgia Institute of Technology, **Long Wang***, Southern Polytechnic State University, and **Yang Wang**, Georgia Institute of Technology (1014-42-741)
- 10:30AM (1476) *An approximation-solvability for variational inequalities.* Preliminary report.
Dan D. Pascali, Courant Institute, New York University (1014-47-1085)
- 10:45AM (1477) *Asymptotics of determinants and traces of Toeplitz matrices with symbols in weighted Wiener algebras.*
Alexei Yu. Karlovich, Universidade do Minho (Braga, Portugal) (1014-47-1426)

MAA Session on Strategies to Encourage Persistence in Mathematics

8:20 AM – 10:55 AM

Organizers: **David C. Carothers**, James Madison University
Ahmed I. Zayed, DePaul University
Keith E. Mellinger, University of Mary Washington

- 8:20AM (1478) *Teaching a Course in Cryptology - Strengthening mathematical interests in a variety of majors.* Preliminary report.
Katarzyna Potocka, Ramapo College of New Jersey (1014-Y5-473)
- 8:40AM (1479) *Courting New Majors at the University of Mary Washington.*
Debra L. Hydorn, University of Mary Washington (1014-Y5-1006)
- 9:00AM (1480) *Talent Expansion in Quantitative Biology.* Preliminary report.
Anant P. Godbole, East Tennessee State University (1014-Y5-1143)
- 9:20AM (1481) *Motivating Students by Incorporating Software in the Classroom.* Preliminary report.
W. Christopher Schroeder* and **Kendra S. Schroeder**, Morehead State University (1014-Y5-400)
- 9:40AM (1482) *Using Personal Invitations to Encourage Future Study in Mathematics.*
Andrew J. Miller, Belmont University (1014-Y5-419)
- 10:00AM (1483) *Discrete Mathematics for Freshmen (a.k.a: grabbing them early).* Preliminary report.
Homer W. Austin* and **Kathleen M. Shannon**, Salisbury University (1014-Y5-619)
- 10:20AM (1484) *Extra math courses for students—A mathematics placement coordinator's point of view.*
Hisa Tsutsui, Embry-Riddle Aeronautical University and Millersville University of Pennsylvania (1014-Y5-1743)
- 10:40AM (1485) *Competency Grading, Student Choice, and Persistence in Mathematics.* Preliminary report.
Janet L. Andersen, Hope College (1014-Y5-1767)

AWM Workshop

8:20 AM – 4:20 PM

This session has several parts listed separately by time in this program. Listed Workshop presentations are open to all JMM participants.

Organizers: **Claudia Polini**, University of Notre Dame
Marie A. Vitulli, University of Oregon
Judy L. Walker, University of Nebraska-Lincoln

AWM Workshop: Research Presentations by Recent Ph.D.'s, I

8:30 AM – 10:20 AM

- 8:30AM (1486) *Hilbert's Tenth Problem for function fields of characteristic zero.*
Kirsten Eisentraeger, University of Michigan (1014-11-712)
- 9:00AM (1487) *The topology of symplectic and hyperkahler quotients.*
Megumi Harada, University of Toronto (1014-53-592)
- 9:30AM (1488) *The Road to Super Quantum Groups.*
Gizem Karaali, University of California, Santa Barbara (1014-17-580)
- 10:00AM (1489) *The Motion of a Thin Liquid Film Driven by Surfactant and Gravity.*
Rachel Levy, Duke University (1014-76-568)

AMS Committee on Education Panel Discussion

8:30 AM – 10:00 AM

International perspectives on undergraduate mathematics.

Organizer: **William G. McCallum**, University of Arizona
Moderator: **Deborah Hughes Hallett**, University of Arizona
Panelists: **Lofti Hermi**, University of Arizona
Jia Ling Dai, University of Arizona
Bin Lu, California State University Sacramento
Hideo Nagashshi, Colby College
Presenter: **Ko Hyoung Ko**, Korean Advanced Institute for Science and Technology

MAA Invited Address

9:00 AM – 9:50 AM

- (1490) *Mathematicians and education reform: A cautionary tale.*
Naomi Fisher, University of Illinois at Chicago (1014-A0-09)

ASL Invited Address

9:00 AM – 9:50 AM

- (1491) *Spectra of Turing degrees.*
Russell Miller, Queens College (CUNY)

MAA Minicourse #10: Part B

9:00 AM – 11:00 AM

A beginner's guide to the scholarship of teaching and learning in mathematics.

Organizers: **Curtis D. Bennett**, Loyola Marymount University
Jacqueline M. Dewar, Loyola Marymount University
Thomas F. Banchoff, Brown University
John P. Holcomb, Cleveland State University

MAA Minicourse #15: Part B

9:00 AM – 11:00 AM

A novel approach to problem solving.

Organizer: **Andrew C.-F. Liu**, University of Alberta

MAA Minicourse #4: Part B

9:00 AM – 11:00 AM

Creating interactive workbooks using MS excel.

Organizer: **Sarah L. Mabrouk**, Framingham State College

MAA Session on Mathematics and Popular Culture, II

9:00 AM – 10:55 AM

Organizers: **Sarah J. Greenwald**, Appalachian State University
Christopher D. Goff, University of the Pacific

- ▶ 9:00AM (1492) *Using Popular Culture to Meet Quantitative Reasoning Teaching and Learning Goals.* Preliminary report.
Cinnamon Hillyard, University of Washington, Bothell (1014-V1-1651)
- ▶ 9:20AM (1493) *Mathematics in Popular Texts for a First-Year Seminar.*
Mike Pinter, Belmont University (1014-V1-666)
- ▶ 9:40AM (1494) *The Mathematics of Ripley's Believe It Or Not!*
Vince Schielack, Texas A&M University (1014-V1-1375)
- ▶ 10:00AM (1495) *The myth of the good mathematics teacher.*
Judith Lynn Gieger, Oglethorpe University (1014-V1-1217)
- ▶ 10:20AM (1496) *Media Influences and Gender Equity in Mathematics Education.* Preliminary report.
Shelby P. Morge, Indiana University, Bloomington (1014-V1-166)
- ▶ 10:40AM (1497) *Is Hollywood Good for Mathematics? (a brief discussion).* Preliminary report.
Christopher D. Goff, University of the Pacific (1014-V1-988)

MAA Session on Introductory Actuarial Science Programs

9:00 AM – 10:55 AM

Organizer: **Robert E. Buck**, Slippery Rock University

- ▶ 9:00AM (1498) *Adjusting to Changes in the Actuarial Exam Structure.*
Robert E. Buck, Slippery Rock University (1014-Y7-1070)

- ▶ 9:20AM (1499) *Growing an Actuarial Science Program into an Advanced Undergraduate Program.* Preliminary report.
Kevin E. Charwood, Washburn University (1014-Y7-398)
- ▶ 9:40AM (1500) *Actuarial Science curriculum in a regional institution.* Preliminary report.
Kumer P. Das, Lamar University (1014-Y7-1526)
- ▶ 10:00AM (1501) *Moving from undergraduate actuarial science program to advanced undergraduate actuarial science program - Central Washington University, Ellensburg, WA.* Preliminary report.
Centsong Lin and **Yvonne Chueh**, Central Washington University (1014-Y7-1656)
- ▶ 10:20AM (1502) *Actuarial Science: Implementation and Revision.* Preliminary report.
Youngna Choi, Montclair State University (1014-Y7-1196)
- ▶ 10:40AM (1503) *A possible accreditation system for actuarial-education programs.* Preliminary report.
James W. Daniel, University of Texas at Austin (1014-Y7-1054)

MAA CUPM Subcommittee on Curriculum Renewal Across the First Two Years Panel Discussion

9:00 AM – 10:20 AM

Developing standards for college algebra.

Organizers: **Norma M. Agras**, Miami Dade College
William C. Bauldry, Appalachian State University

SIGMAA on Research in Undergraduate Mathematics Education Panel Discussion

9:00 AM – 10:20 AM

A MAA Notes sampler.

Organizers: **Barbara E. Edwards**, Oregon State University
William O. Martin, North Dakota State University

Panelists: **Chris Rasmussen**, San Diego State University
Marilyn P. Carlson, Arizona State University
Michael Oehrtman, Arizona State University

NAM Panel Discussion

9:00 AM – 10:00 AM

Exhibits and Book Sales

9:00 AM – NOON

Employment Center

9:00 AM – NOON

ASL Invited Address

10:00 AM – 10:50 AM

- (1504) *Strictly stable theories and descriptive set theory.*
Michael C. Laskowski, University of Maryland

Math on the Web, IV

10:00 AM – 10:30 AM

10:00AM *Using MathML with Blackboard and WebCT.*
(1505) **Bob Matthews**, Design Science, Inc.

NAM Business Meeting

10:00 AM – 10:55 AM

MAA Invited Address

10:05 AM – 10:55 AM

(1506) *Patterns of primes.*
Ben Green, University of Bristol

AWM Workshop: Poster Session with Presentations from Women Recent Ph.D.'s and Graduate Students

10:30 AM – 11:00 AM

- 10:30AM *Constitutive Restrictions for Isotropic Hyperelastic Material Modeled Using Invariants of Logarithmic Strain.*
(1507) **Tsvetanka Sendova*** and **Jay R. Walton**, Texas A&M University (1014-74-563)
- 10:30AM *Arithmetic Properties of the Coefficients of Modular Forms.*
(1508) **Stephanie Treneer**, University of Illinois at Urbana-Champaign (1014-11-599)
- 10:30AM *Szygies of toric varieties.*
(1509) **Milena Hering***, University of Michigan, **Hal Schenck**, Texas A&M University, and **Gregory G. Smith**, Queen's University (1014-14-641)
- 10:30AM *The core of ideals.* Preliminary report.
(1510) **Louiza Foulis**, Purdue University (1014-13-644)
- 10:30AM *Two-Dimensional Languages and Their Automata.*
(1511) **Joni Burnette Pirnot**, Manatee Community College (1014-68-700)
- 10:30AM *Non-Simple Non-Stationary Bratteli-Vershik Systems.* Preliminary report.
(1512) **Sarah E. Bailey**, University of North Carolina, Chapel Hill (1014-37-740)
- 10:30AM *A Stochastic Dynamical System for the Evolution of Repeat Strings.* Preliminary report.
▶ (1513) **Suzanne S. Sindi**, University of Maryland (1014-37-747)
- 10:30AM *Layer potential techniques for parabolic PDE in nonsmooth cylinders.*
(1514) **Tunde Jakab**, University of Missouri (1014-35-754)
- 10:30AM *Jet schemes of monomial schemes.* Preliminary report.
(1515) **Cornelia Oichi Yuen**, University of Michigan, Ann Arbor (1014-14-762)
- 10:30AM *A Fast Multipole Method-based Poisson Solver for Use in Fluid Simulation.* Preliminary report.
(1516) **Sarah A. Williams**, UC Davis, Graduate Group in Applied Mathematics (1014-65-771)
- 10:30AM *Continuous Dependence Results for Inhomogeneous Ill-Posed Problems.* Preliminary report.
(1517) **Beth M. Campbell Hetrick**, Bryn Mawr College (1014-47-774)
- 10:30AM *Spinning Rods: Experiments & Theory.*
(1518) **Terry Jo Leiterman***, **Richard M. McLaughlin**, **Roberto Camassa**, **Leandra Vicci**, **Richard Superfine**, **Jing Hao** and **Jonathan Toledo**, University of North Carolina Chapel Hill (1014-76-980)

MAA Business Meeting

11:10 AM – 11:40 AM

Organizer: **Martha J. Siegel**, Towson University
Moderator: **Carl C. Cowen**, IUPUI

AMS Business Meeting

11:45 AM – 12:15 PM

NAM Claytor-Woodard Lecture

1:00 PM – 1:50 PM

(1519) *A Rebirth of Bochner's theory of almost automorphy of solutions to evolution equations.*
Gaston M. N'Guerekata, Morgan State University

AMS-MAA-SIAM Special Session on Research in Mathematics by Undergraduates, II

1:00 PM – 5:55 PM

Organizers: **Darren Narayan**, Rochester Institute of Technology
Carl V. Lutzer, Rochester Institute of Technology
Michael J. Fisher, California State University Fresno
Bernard Brooks, Rochester Institute of Technology
Tamas Wiandt, Rochester Institute of Technology

- 1:00PM *For King and Country: An Exploration in Sixteenth Century Cryptography.* Preliminary report.
▶ (1520) **Ryan W. Fuoss***, Taylor University, and **Amanda R. Youell**, Clemson University (1014-11-1643)
- 1:20PM *Minimum Positive Semi-Definite Rank of a Graph.*
▶ (1521) **Kseniya Kudryavtseva***, Central Michigan University, **Janeta Marinova**, Bard College, and **Yunjiang Jiang**, University of Georgia (1014-15-115)
- 1:40PM *Extension of groups yielding quasi p-groups.*
▶ (1522) **Joseph David Gastenveld**, Northern Kentucky University (1014-20-196)
- 2:00PM *Modeling temperatures for a building with seven zones.* Preliminary report.
▶ (1523) **Carrie E. Keel*** and **J. K. Denny**, Mercer University (1014-34-1589)
- 2:20PM *Turing Pattern Dynamics for Spatiotemporal Models with Growth and Curvature.* Preliminary report.
▶ (1524) **Julijana V. Gjorgjieva**, Harvey Mudd College (1014-35-1378)
- 2:40PM *The Isoperimetric Problem in Surfaces.* Preliminary report.
▶ (1525) **Michelle Lee**, Williams College (1014-51-1116)
- 3:00PM *A Combinatorial Approach to the Symmetries of the Icosahedron Using K-6.* Preliminary report.
▶ (1526) **Kevin Ehly**, Lafayette College (1014-51-1573)
- 3:20PM *The Prison Warden's Dilemma: A Characterization of 3-Convexity.*
▶ (1527) **Deborah E. Berg*** and **Tyler Seacrest**, Harvey Mudd College (1014-52-1318)
- 3:40PM *Minimal Triangulations of Products of Segments and Triangles.*
▶ (1528) **Tyler Seacrest***, Harvey Mudd College, and **Francis Edward Su**, Harvey Mudd College (1014-52-1324)

- ▶ 4:00PM *Honeycombs in Hyperbolic Surfaces*. Preliminary report.
(1529) **Vojislav S. Sesum**, Williams College (1014-53-1202)
- ▶ 4:20PM *Isoperimetric Surfaces and General Relativity*.
(1530) **Brian Krummel***, University of Maryland - Baltimore County, and **Mike Greenberg**, New York University - Courant Institute of Mathematical Sciences (1014-53-1622)
- ▶ 4:40PM *Twist Numbers of Links from the Jones Polynomial*.
(1531) **Mathew Williamson**, University of South Florida (1014-55-328)
- ▶ 5:00PM *Generalizing Kirk-Livingston Type 1 Link Invariants*. Preliminary report.
(1532) **Karen B. McCready***, The College of New Jersey, and **Matthias L. Youngs**, SUNY Geneseo (1014-55-1251)
- ▶ 5:20PM *Comparing Ratio Estimators Based on Systematic Samples*. Preliminary report.
(1533) **John Szarka***, James Madison University, and **Amy Jacks**, University of Missouri-Rolla (1014-62-1139)
- ▶ 5:40PM *A Modified Lotka-Volterra Competition Model with a Non-Linear Relationship Between Species*.
(1534) **Amy Vess Crizer***, James Madison University, and **Austin F Taylor**, University of Alabama (1014-92-1544)

AMS-MAA-SIAM Special Session on Recent Advances in Mathematical Biology and Epidemiology, II

1:00 PM – 5:50 PM

Organizers: **Sophia Jang**, University of Louisiana at Lafayette
Linda Allen, Texas Tech University
Lih-Ing Roeger, Texas Tech University

- ▶ 1:00PM *A Juvenile-Adult Model with Periodic Vital Rates*.
(1535) **J. M. Cushing**, University of Arizona (1014-92-507)
- ▶ 1:30PM *The Stochastic Beverton Holt Equation and the M. Neubert Conjecture*.
(1536) **Cymra Haskell** and **Robert J. Sacker***, University of Southern California (1014-37-1212)
- ▶ 2:00PM *Dynamics of the Discrete Model of West Nile-Like Epidemics*.
(1537) **V. L. Kocic**, Xavier University of Louisiana (1014-39-204)
- ▶ 2:30PM *Discrete-Time Epidemic Model In A Seasonal Environment*. Preliminary report.
(1538) **Abdul-Aziz Yakubu***, Howard University, and **John E. Franke**, North Carolina State University (1014-92-428)
- ▶ 3:00PM *Predicting the Behavior of Seabirds Using Compartmental Models*.
(1539) **James L. Hayward*** and **Shandelle M. Henson**, Andrews University (1014-92-521)
- ▶ 3:30PM *How does estradiol initiate the LH surge? A modeling approach*. Preliminary report.
(1540) **Mary Lou Zeeman***, U. T. San Antonio, **Danielle Lyles**, **Joseph H. Tien** and **David McCobb**, Cornell University (1014-92-1644)
- ▶ 4:00PM *Understanding *Hyla cinerea* green treefrog population dynamics via modeling and field studies*. Preliminary report.
(1541) **Azmy Ackleh**, University of Louisiana at Lafayette (1014-92-687)

- ▶ 4:30PM *Existence-uniqueness and monotone approximation for a phytoplankton-zooplankton aggregation model*.
(1542) **Azmy S. Ackleh**, **Keng Deng***, University of Louisiana at Lafayette, and **Xubo Wang**, Macon State College (1014-35-684)
- ▶ 5:00PM *Kolmogorov's differential equations and Markov population chains*.
(1543) **Maia Martcheva**, University of Florida, **Horst R. Thieme** and **Thanate Dhirasakdanon***, Arizona State University (1014-92-1002)
- ▶ 5:30PM *Winnerless Competition in Consumer-resource Interaction Models in Population Biology*. Preliminary report.
(1544) **Lih-Ing Wu Roeger***, Texas Tech University, and **Sze-Bi Hsu**, National Tsing Hua University (1014-92-759)

AMS-MAA Special Session on History of Mathematics, II

1:00 PM – 5:55 PM

Organizers: **Joseph W. Dauben**, Herbert H. Lehman College (CUNY)
Patti Hunter, Westmont College
Karen H. Parshall, University of Virginia

- ▶ 1:00PM *Did Euclid Need the Euclidean Algorithm to Prove Unique Factorization?*
(1545) **David J. Pengelley***, New Mexico State University, and **Fred Richman**, Florida Atlantic University (1014-01-730)
- ▶ 1:30PM *Lagrange, Sufficient Reason, and Space*. Preliminary report.
(1546) **Judith Grabiner**, Pitzer College, Claremont, California (1014-01-387)
- ▶ 2:00PM *Statesmen of British Mathematics: Scientific Society Involvement of Mathematicians in Nineteenth-Century Britain*.
(1547) **Sloan Evans Despeaux**, Western Carolina University (1014-01-707)
- ▶ 2:30PM *Mathematics as Popular Science: Benjamin Peirce In 19th-Century Boston*.
(1548) **Deborah Kent**, Simon Fraser University (1014-01-682)
- ▶ 3:00PM *Cardinality and Confusion in the Peircean Continuum*.
(1549) **Matthew E. Moore**, Brooklyn College of the City University of New York (1014-01-542)
- ▶ 3:30PM *Proof in Islam, India, and China*. Preliminary report.
(1550) **Victor J. Katz**, University of the District of Columbia (1014-01-717)
- ▶ 4:00PM *The Volterra Chronicles*. Preliminary report.
(1551) **Judith R. Goodstein**, California Institute of Technology (1014-01-635)
- ▶ 4:30PM *Objects and Mathematics Teaching at American Colleges and Universities*.
(1552) **Peggy Aldrich Kidwell***, National Museum of American History, Smithsonian, **Amy Ackerberg-Hastings**, University of Maryland University College, and **David Lindsay Roberts**, Laurel, Maryland (1014-01-616)
- ▶ 5:00PM *Flying the Platonic Flag: Philosophical and Nationalistic Ideology in Deutsche Mathematik*. Preliminary report.
(1553) **Thomas Drucker**, University of Wisconsin-Whitewater (1014-01-857)

- 5:30PM *Mathematics and the Social Sciences: The Origins of Finite Mathematics.*
 ► (1554) **Walter Meyer**, Adelphi University (1014-01-65)

AMS-SIAM Special Session on Frames and Operator Theory in Analysis and Signal Processing, IV

1:00 PM – 6:05 PM

- Organizers: **Peter R. Massopust**, Tuboscope Vetco Pipeline Services
David R. Larson, Texas A&M University
Manos I. Papadakis, University of Houston
Zuhair Nashed, University of Central Florida
Ahmed I. Zayed, DePaul University
Minh Chuong Nguyen, Institute of Mathematics, Hanoi Vietnam
- 1:00PM *Use of geometry and operator algebra theory in the computation of wavelet coefficients.*
 ► (1555) **Palle E. T. Jorgensen***, University of Iowa, and **Dorin E. Dutkay**, Rutgers University (1014-42-24)
- 1:30PM *Wavelets, multiresolution analysis and finite reflexion groups.*
 (1556) **Gestur Olafsson***, Louisiana State University, and **Mihaela Dobrescu**, Furman University, SC (1014-42-1271)
- 2:00PM *Operator-valued frames over Hilbert C^* -modules.*
 (1557) Preliminary report.
Victor Kaftal*, University of Cincinnati, **David Larson**, Texas A&M University, and **Shuang Zhang**, University of Cincinnati (1014-47-1628)
- 2:30PM *Haar-type orthonormal systems, data presentation as Riesz products and a prediction method on symbolic sequences.*
 (1558) **C. Karanikas*** and **N. Atreas**, Aristotle University of Thessaloniki (1014-41-1770)
- 3:00PM *Regularization functionals involving discontinuous operators.*
 (1559) **Otmar Scherzer**, Department of Computer Science - University Innsbruck (1014-49-866)
- 3:30PM *Data fidelity terms for image and signal restoration.*
 (1560) **Mila Nikolova**, CMLA UMR 8536-ENS de Cachan (1014-41-1424)
- 4:00PM *Lattice Tilings, Operator Algebras and Gabor Frames.*
 (1561) **Deguang Han**, University of Central Florida (1014-46-439)
- 4:30PM *The Feichtinger Conjecture for frames of translates.*
 (1562) **Marcin Bownik**, University of Oregon, and **Darrin Speegle***, Saint Louis University (1014-42-787)
- 4:55PM *Orthogonal Wavelet Frames.*
 (1563) **Eric Weber***, Iowa State University, **Ghanshyam Bhatt**, Rose-Hulman Institute of Technology, and **Brody Dylan Johnson**, Saint Louis University (1014-42-427)
- 5:20PM *On PCM and Sigma-Delta Quantization Errors.*
 (1564) **Yang Wang***, Georgia Institute of Technology, **Long Wang**, Southern Polytechnic State University, and **David Jimenez**, Georgia Institute of Technology (1014-42-438)
- 5:45PM *Frame Paths and Sigma-Delta Quantization.*
 (1565) **Vern I. Paulsen***, University of Houston, and **Bernhard G. Bodmann**, University of Waterloo (1014-47-1111)

AMS-SIAM Special Session on Contemporary Dynamical Systems, III

1:00 PM – 5:25 PM

- Organizers: **Dmitry Zenkov**, North Carolina State University
Youngna Choi, Montclair State University
Anthony M. Bloch, University of Michigan
Todd L. Fisher, University of Maryland
Melvin Leok, University of Michigan
David S. Richeson, Dickinson College
James S. Wiseman, Agnes Scott College

- 1:00PM *Control theory without controls.* Preliminary report.
 (1566) **Andrew D. Lewis**, Queen's University (1014-93-952)
- 1:25PM *Integrable Problems for Semiclassical Nonlinear Waves.* Preliminary report.
 (1567) **Peter D. Miller**, University of Michigan (1014-35-844)
- 1:50PM *Variational Integrators for Nonholonomic Systems on Lie Groups.*
 (1568) **Dmitry V. Zenkov***, North Carolina State University, and **Yuri N. Fedorov**, Universitat Politecnica de Catalunya (1014-70-1347)
- 2:15PM *Lie group variational integrators and their applications to geometric control.*
 (1569) **Melvin Leok**, University of Michigan, Ann Arbor (1014-65-496)
- 2:40PM *Sub-Finsler Geometry in Dimension Three.*
 (1570) **Jeanne N. Clelland**, University of Colorado at Boulder, and **Christopher G. Moseley***, United States Military Academy (1014-49-1446)
- 3:05PM *Geometric Control of the Chaplygin Sleigh and Double Gimbal System.*
 (1571) **Jason M. Osborne**, North Carolina State University (1014-70-1775)
- 3:30PM *On 3-manifolds that support partially hyperbolic diffeomorphisms.* Preliminary report.
 (1572) **Kamlesh Parwani**, University of Houston (1014-37-1310)
- 3:55PM *Actions of Lie groups and Lie algebras on manifolds.*
 (1573) **Morris W. Hirsch**, University of California (Berkeley), University of Wisconsin (Madison) (1014-22-1554)
- 4:20PM *Pattern Equivariant Cohomology of Tiling Spaces, With Rotations.*
 (1574) **Betseygail Rand**, University of Texas (1014-37-1623)
- 4:45PM *Local entropy of foliations and groupoids.*
 (1575) **Steve Hurder**, University of Illinois at Chicago (1014-37-1366)
- 5:05PM Discussion

AMS-SIAM Special Session on Boundary Value Problems for Ordinary Differential Equations, II

1:00 PM – 5:50 PM

- Organizers: **John R. Graef**, University of Tennessee at Chattanooga
Johnny L. Henderson, Baylor University

- 1:00PM (1576) *Absolute equal distribution of the eigenvalues of discrete Sturm-Liouville problems.*
William F. Trench, Trinity University, San Antonio, TX (1014-39-167)
- 1:30PM (1577) *Singular Second Order Boundary Value Problems with Multiple Solutions.* Preliminary report.
John V. Baxley* and **Kristen Kobylus**, Wake Forest University (1014-34-1137)
- ▶ 2:00PM (1578) *Positive Solutions of a Nonlinear Fourth Order Boundary Value Problem.*
John R. Graef, University of Tennessee at Chattanooga, and **Bo Yang***, Kennesaw State University (1014-34-1402)
- 2:30PM (1579) *Multiple positive solutions for a singular positone problem.*
M. Chhetri, University of North Carolina at Greensboro, and **S. Robinson***, Wake Forest University (1014-34-955)
- 3:00PM (1580) *Existence of solutions for multi-point boundary value problems.* Preliminary report.
Gary D. Jones, Murray State University (1014-34-179)
- 3:30PM (1581) *Existence of Solutions for Nonlinear Boundary Value Problems.*
John R. Graef and **Lingju Kong***, The University of Tennessee at Chattanooga (1014-34-571)
- ▶ 4:00PM (1582) *Nonlinear Systems of Differential Equations.*
Haiyan Wang, Arizona State University (1014-34-312)
- 4:30PM (1583) *Positive Solutions to an N^{th} -Order Right Focal Boundary Value Problem.*
Mariette Maroun, Baylor University (1014-34-930)
- 5:00PM (1584) *On Implicit Boundary Value Problems for Second Order Equations.*
J. Hoffacker*, Clemson University, and **C. Tisdell**, The University of New South Wales (1014-34-1161)
- 5:30PM (1585) *Uniqueness Implies Uniqueness and Existence for Nonlocal Boundary Value Problems for Fourth Order Ordinary Differential Equations.*
Ding Ma, Baylor University (1014-34-105)

AMS-SIAM Special Session on Theory and Application of Stochastic Differential Equations, II

1:00 PM – 5:50 PM

- Organizers: **Armando Arciniega**, University of Texas at San Antonio
Edward J. Allen, Texas Tech University
- 1:00PM (1586) *Stochastic Liénard Oscillators.*
Henri Schurz, Southern Illinois University (1014-60-1612)
- 1:30PM (1587) *On a class of reflecting stochastic differential equations.* Preliminary report.
Janusz S. Golec, Fordham University (1014-60-1697)
- 2:00PM (1588) *Stochastic Epidemic Models with a Backward Bifurcation.* Preliminary report.
Linda J. S. Allen*, Texas Tech University, and **P. van den Driessche**, University of Victoria (1014-60-338)
- 2:30PM (1589) *Disease Emergence in Stochastic and Deterministic Multihost SIS and SIR Models.*
Robert K. McCormack* and **Linda J. S. Allen**, Texas Tech University (1014-92-420)
- 3:00PM (1590) *Sustained Oscillations via Coherence Resonance in SIR.*
Rachel Kuske, University of British Columbia, **Luis F. Gordillo** and **Priscilla E. Greenwood***, Arizona State University (1014-60-566)

- 3:30PM (1591) *Stochastic optimization models with applications to mechanics, population dynamics, aerodynamics.*
Ana-Maria Croicu*, Florida State University, School of Computational Science and Department of Mathematics, and **M. Yousuff Hussaini**, Florida State University (1014-49-547)
- 4:00PM (1592) *Stochastic Differential Equation Models for Flow Through Porous Media and for Multigroup Reactor Kinetics.* Preliminary report.
Edward J. Allen, Texas Tech University (1014-60-267)
- 4:30PM (1593) *Stochastic Models of Intracellular Viral Dynamics and Stock Pricing.* Preliminary report.
Rachel C. Koskodan, Texas Tech University (1014-60-405)
- 5:00PM (1594) *Dynamic Fund Portfolio Optimization under Mean-Variance Preferences.* Preliminary report.
Coskun Cetin, Whittier College (1014-60-193)
- 5:30PM (1595) *θ -Frames in R^n .* Preliminary report.
Sundaresan Kondagunta, Cleveland State University (1014-15-76)

AMS-SIAM Special Session on Symbolic-numeric Computation and Applications, II

1:00 PM – 5:20 PM

- Organizers: **Agnes Szanto**, North Carolina State University
Jan Verschelde, University of Illinois Chicago
Zhonggang Zeng, Northeastern Illinois University
- 1:00PM (1596) *Higher-order deflation of polynomial systems.* Preliminary report.
Anton Leykin*, **Jan Verschelde** and **Ailing Zhao**, University of Illinois at Chicago (1014-65-392)
- 1:30PM (1597) *Finding All Real Solutions of Polynomial Systems.*
Ye Lu*, **Andrew J. Sommese**, University of Notre Dame, **Charles W. Wampler**, GM, and **Daniel J. Bates**, University of Notre Dame (1014-00-199)
- ▶ 2:00PM (1598) *A Comparison of Heuristics for Solving Problems in Approximate Polynomial Algebra.*
John P. May, University of Waterloo (1014-65-1641)
- 2:30PM (1599) *Nearest Multivariate System with Given Root Multiplicities.*
Scott R. Pope* and **Agnes Szanto**, North Carolina State University (1014-14-972)
- 3:00PM (1600) *Characterization and computation of nearby involutive polynomial and differential systems.* Preliminary report.
Greg Reid, University of Western Ontario (1014-12-667)
- 3:30PM (1601) *Exceptional Sets and Fiber Products.*
Andrew J. Sommese*, University of Notre Dame, and **Charles W. Wampler**, General Motors Research and Development (1014-14-214)
- 4:00PM (1602) *Differential elimination for approximate PDE systems.*
Wenyuan Wu, University of Western Ontario (1014-35-620)
- 4:30PM (1603) *Sensitivity of Algebraic Computation with Approximate Data.*
Zhonggang Zeng, Northeastern Illinois University (1014-65-1732)
- 5:00PM (1604) *Computing Isolated Singularities by Newton's Method with Deflation.*
Anton Leykin, **Jan Verschelde** and **Ailing Zhao***, University of Illinois at Chicago (1014-65-437)

AMS-SIAM Special Session on Time Reversal Methods: Analysis and Applications, II

1:00 PM – 2:50 PM

Organizers: **Peter A. McCoy**, U.S. Naval Academy
Reza Malek-Madani, U.S. Naval Academy

- 1:00PM *Imaging that exploits multiple scattering from point scatterers.* (1605)
Margaret Cheney*, Rensselaer Polytechnic Institute, and **Robert J. Bonneau**, Air Force Research Laboratory (1014-35-904)
- ▶ 1:30PM *Extracting coherent information from the cross-correlations of random wavefields. A tool for time-reversal imaging without a source.* (1606)
Karim Ghazi Sabra* and **William A. Kuperman**, Marine Physical Laboratory, Scripps Inst. of Ocean., UCSD (1014-00-1016)
- 2:00PM *Methods of inverse scattering/time reversal of sound waves through waveguide from perturbed partial-open space.* Preliminary report. (1607)
Yongzhi Steve Xu, University of Louisville (1014-35-756)
- 2:30PM *Time Reversal Imaging in Acoustics and Electromagnetics.* (1608)
Lawrence Carin*, Duke University, and **Luise Couchman**, Naval Research Laboratory (1014-00-1752)

AMS-SIAM Special Session on Stochastic, Large Scale and Hybrid Systems with Applications, II

1:00 PM – 1:50 PM

Organizers: **Aghalaya S. Vatsala**, University of Louisiana at Lafayette
Gangaram S. Ladde, University of Texas Arlington

- 1:00PM *Conditioned Fractional Brownian Motion and its Applications in Telecommunications.* (1609)
Yasong Jin*, **Soshant Bali**, **Tyrone Duncan** and **Victor S. Frost**, University of Kansas (1014-60-814)
- 1:30PM *An Infinite Dimensional Integral Identity for the Segal-Bargmann Transform.* (1610)
Jeremy James Becnel* and **Ambar N. Sengupta**, Louisiana State University (1014-46-557)

AMS Special Session on Quantum Invariants of Knots and 3-Manifolds, II

1:00 PM – 5:50 PM

Organizers: **Patrick M. Gilmer**, Louisiana State University
Charles D. Frohman, University of Iowa

- 1:00PM *Long Virtual Strings.* Preliminary report. (1611)
Louis H. Kauffman, University of Illinois at Chicago (1014-57-425)
- 1:30PM *Patterns in the colored Jones polynomials.* Preliminary report. (1612)
Oliver Dasbach*, LSU, and **Xiao-Song Lin**, UC Riverside (1014-57-1379)
- 2:00PM *Confluence of Khovanov homology and Hochschild homology.* (1613)
Jozef Henryk Przytycki, George Washington University (1014-57-800)
- ▶ 2:30PM *BN-modules for Seifert fibred spaces.* Preliminary report. (1614)
Marta Asaeda, UC Riverside (1014-57-1599)

3:00PM *An Alexander type multi-variable link invariant arising from $sl(2|1)$.* (1615)
Nathan Geer, Georgia Institute of Technology (1014-57-769)

3:30PM *Fingerloop braids and system of Yang-Baxter type equations.* Preliminary report. (1616)
Xiao-Song Lin, University of California, Riverside (1014-57-491)

4:00PM *Generalized Link Homotopy and Milnor's Isotopy Invariants.* Preliminary report. (1617)
Thomas Fleming*, University of California, San Diego, and **Akira Yasuhara**, Tokyo Gakugei University (1014-57-721)

4:30PM *Weight systems for Milnor invariants.* (1618)
Blake Mellor, Loyola Marymount University (1014-57-192)

5:00PM *On several types of universal invariants of framed links and 3-manifolds derived from quantum groups.* Preliminary report. (1619)
Jianjun Paul Tian, Mathematical Biosciences Institute, the Ohio State University (1014-55-424)

5:30PM *Strong 3-algebras and a 2-group associated to manifolds.* (1620)
Mihai D. Staic, SUNY at Buffalo (1014-57-337)

AMS Special Session on Invariant Theory

1:00 PM – 5:50 PM

Organizers: **Mara D. Neusel**, Texas Tech University
David L. Wehlau, Royal Military College

1:00PM *Cayley Maps and Cayley Degrees for Algebraic Groups.* Preliminary report. (1621)
Nicole M.A. Lemire, University of Western Ontario (1014-14-1146)

1:30PM *Multiplication of polynomials on Hermitian symmetric spaces and Littlewood-Richardson coefficients.* Preliminary report. (1622)
William Graham, University of Georgia, and **Markus Hunziker***, Baylor University (1014-22-1209)

2:00PM *The geometry of affine Hamiltonian varieties.* (1623)
Preliminary report.
Friedrich Knop, Rutgers University (1014-14-732)

2:30PM *Covariant dimension of finite groups.* Preliminary report. (1624)
Hanspeter Kraft, Mathematisches Institut Basel, and **Gerald Schwarz***, Brandeis University (1014-22-584)

3:00PM *Rational invariants for dynamical systems.* Preliminary report. (1625)
Harm Derksen, University of Michigan (1014-13-1123)

3:30PM *Hyperplane Sections and the Integral Closures of Ideals.* (1626)
Jooyoun Hong* and **Bernd Ulrich**, Purdue University (1014-13-852)

▶ 4:00PM *The Noether numbers for cyclic groups of prime order.* Preliminary report. (1627)
Peter Fleischmann, University of Kent at Canterbury, **Mufit Sezer***, Bogazici University, Istanbul, Turkey, **James Shank** and **Chris F. Woodcock**, University of Kent at Canterbury (1014-13-415)

4:30PM *Vector invariants in arbitrary characteristic.* Preliminary report. (1628)
Frank D. Grosshans, West Chester University of Pennsylvania (1014-13-533)

- 5:00PM *The Decomposition Series Conjecture.*
(1629) **H. E. A. Eddy Campbell**, Memorial University (1014-13-1390)
- 5:30PM *Global Structure of Algebras of Invariants over the Steenrod Algebra and its Generalizations.*
(1630) **David J. Pengelley*** and **Frank Williams**, New Mexico State University (1014-55-1018)

MAA Minicourse #11: Part B

1:00 PM – 3:00 PM

Teaching a course in the history of mathematics.
Organizers: **V. Frederick Rickey**, U.S. Military Academy
Victor J. Katz, University of the District of Columbia

MAA Minicourse #16: Part B

1:00 PM – 3:00 PM

Fair division: From cake-cutting to dispute resolution.
Organizer: **Steven J. Brams**, New York University

MAA Minicourse #5: Part B

1:00 PM – 3:00 PM

Finite group behavior: Windows software for teaching beginning group theory.
Organizers: **Edward C. Keppelmann**, University of Nevada Reno
Ellen J. Maycock, Depauw University

AMS Session on Functional Analysis and Operator Theory

1:00 PM – 5:25 PM

- 1:00PM *A general Connes-Kakutani-Rokhlin theorem.*
(1631) Preliminary report.
Shukhrat M. Usmanov, North Dakota State University (1014-46-677)
- 1:15PM *One property of the set of bounded elements in unital barreled projective limits of real C^* - and JB-algebras.*
(1632) **Alexander A. Katz**, St. John's University, NY, and **Oleg Friedman***, University of South Africa (1014-46-172)
- 1:30PM *Some sequence spaces which include c_0 and c .*
(1633) **B. E. Rhoades**, Indiana University, Bloomington (1014-46-314)
- 1:45PM *Dunford-Pettis Property, Gelfand-Phillips property and (L) -sets.*
(1634) **Ioana Ghenciu***, University of Wisconsin-River Falls, and **Paul W. Lewis**, University of North Texas (1014-46-779)
- 2:00PM *On superadditive ergodic type theorem in non-associative Segal-Dixmier L_p -space (for finite $p > 1$) affiliated with a semi-finite JBW-algebra.*
(1635) **Genady Ya Grabarnik**, IBM T. J. Watson Research Center, **Alexander A. Katz**, St. John's University, NY, and **Laura Shwartz***, University of South Africa (1014-46-860)
- 2:15PM *Isometries into section spaces of Banach bundles.*
(1636) Preliminary report.
Terje Hoim*, Florida Atlantic University, and **D. A. Robbins**, Trinity College (1014-46-948)

- 2:30PM *Non-existence of Monotonically Complemented Subspaces of $C[a, b]$.*
(1637) **Michael P. Prophet*** and **Douglas Mupasiri**, University of Northern Iowa (1014-46-976)
- 2:45PM *Constructions of C^* -algebras of inverse semigroups.* Preliminary report.
(1638) **Steven P. Haataja**, University of Nebraska Lincoln (1014-46-1339)
- 3:00PM *Orthogonal Polynomials in Several Non-Commuting Variables.*
(1639) **Tiberiu Constantinescu**, University of Texas at Dallas, and **Troy Banks***, Salisbury University (1014-46-1385)
- 3:15PM *Solution of a Class of Integral Equations.*
(1640) Preliminary report.
Rod Freed, California State University at Dominguez Hills (1014-45-998)
- 3:30PM Break.
- 4:00PM *Eigenmatrices and operators commuting with finite rank operators.*
(1641) **Ruben A. Martinez-Avenidaño**, Universidad Autonoma del Estado de Hidalgo (1014-47-236)
- 4:15PM *Extension of Spectral Scales to Unbounded Operators.* Preliminary report.
(1642) **Michael D. Wills**, Whitman College (1014-47-239)
- 4:30PM *β -bounded composition operators that belong to the Schatten Class $S_p(H^2)$.* Preliminary report.
(1643) **Abebaw Tadesse**, University Of Pittsburgh (1014-47-335)
- 4:45PM *Using Character Groups to Construct AF Groupoids.*
(1644) **Ryan J. Zerr**, University of North Dakota (1014-47-394)
- 5:00PM *Isometric Equivalence of Operators on Function Spaces - Preliminary report.* Preliminary report.
(1645) **Nadia J. Gal*** and **James Jamison**, The University of Memphis (1014-47-699)
- 5:15PM *Characterization of $BMO(R)$ and the $T(1)$ Theorem.*
▶ (1646) **Wael N. AbuShamala**, Indiana University (1014-43-411)

AMS Session on Lattices, Ordered Structures, Logic and Model Theory, II

1:00 PM – 1:40 PM

- 1:00PM *A method for constructing decidable expansions of the real field by restricted transcendental analytic functions.*
(1647) **Daniel J. Miller**, Groton, CT (1014-03-1162)
- ▶ 1:15PM *The Independence of the Conditions in Rado's Generalization of Hall's Marriage Theorem: A Problem (Attributed to Rado) from Mirsky's 1971 Monograph "Transversal Theory".*
(1648) **Jonathan David Farley**, Stanford University, Center for International Security and Cooperation (1014-06-1687)
- 1:30PM *q -Demanding Topological Varieties Which Admit Non-Abelian Fundamental groups.*
(1649) **David W. Jennings**, Vanderbilt University (1014-08-1730)

AMS Session on Number Theory, III

1:00 PM – 1:40 PM

- 1:00PM *Deriving The Prime Number Theorem (PNT) and Littlewood Oscillations Using a Nonlinear Dynamical Equation Method.* Preliminary report.
(1650) **Gengmun Eng**, Torrance, CA (1014-11-1747)

Program of the Sessions – Sunday, January 15 (cont'd.)

- 1:15PM *Distribution of the Zeros of the Zeta Function using Descriptive Set Theory.* Preliminary report.
(1651) **Mohammed Yahdi**, Ursinus College (1014-11-225)
- 1:30PM *Hilbert's Eighth Problem: Riemann's Zeta Hypothesis.*
▶ (1652) **H. Vic Dannon**, California (1014-33-578)

MAA General Contributed Paper Session, VIII

1:00 PM – 3:40 PM

- Chair: **Eric S. Marland**
Organizers: **Stephen L. Davis**, Davidson College
Eric S. Marland, Appalachian State University
- 1:00PM *Population Models Which Take Into Account Decay of Resources and Accumulation of Waste.* Preliminary report.
▶ (1653) **Joe T. Harris**, St. Andrews Presbyterian College (1014-Z1-841)
- 1:15PM *On Deviations from Expected Hardy-Weinberg Proportions.*
▶ (1654) **Joshua W. Collins** and **Yaping Liu***, Pittsburg State University (1014-Z1-1195)
- 1:30PM *Two Models of Oscillating Polymer Chains in E. coli.* Preliminary report.
▶ (1655) **Gretchen A. Koch***, Goucher College, and **Donald A. Drew**, Rensselaer Polytechnic Institute (1014-Z1-1183)
- 1:45PM *Differentiating Noisy Data.* Preliminary report.
▶ (1656) **Tim McDevitt**, Elizabethtown College (1014-Z1-1194)
- 2:00PM *Quality Adjusted Lifetime Hazard Function.* Preliminary report.
(1657) **Mahmoud F. Almanassra**, Wartburg College (1014-Z1-1135)
- 2:15PM *Reforming the Senior Seminar/Capstone Course as an Assessment Tool.*
▶ (1658) **Jim Fulmer**, University of Arkansas at Little Rock (1014-Z1-1609)
- 2:30PM Break.
- 2:45PM *Manifolds With Density.* Preliminary report.
(1659) **Frank Morgan**, Williams College (1014-Z1-525)
- 3:00PM *Homogenization of Dynamic Materials.*
(1660) **Hansun T. To**, Worcester State College, Worcester MA (1014-Z1-690)
- 3:15PM *Geophysical mass flows over erodible material.*
(1661) **Long H. Le**, University at Buffalo (1014-Z1-1717)
- 3:30PM *Coin Tossing as a Favorite Class Experience, What is It Good For?*
▶ (1662) **Bill Rybolt**, Babson College (1014-Z1-1677)

MAA General Contributed Paper Session, IX

1:00 PM – 3:25 PM

- Chair: **Laurie J. Heyer**, Davidson College
Organizers: **Stephen L. Davis**, Davidson College
Eric S. Marland, Appalachian State University
- 1:00PM *Effects of instruction on elementary and special education teachers' computational skills.* Preliminary report.
▶ (1663) **Cheng-Yao Lin*** and **Becker P. Jerry**, Southern Illinois University at Carbondale (1014-Z1-519)
- 1:15PM *Texas A&M's Summer Educational Enrichment Program for Middle School Students.*
▶ (1664) **Philip B. Yasskin**, Texas A&M University (1014-Z1-1349)

- 1:30PM *Developing Questioning Skills to Enhance Students' Mathematical Thinking: A Professional Development Experience for Middle School Mathematics Teachers.* Preliminary report.
▶ (1665) **Jane F. Schielack**, Texas A&M University (1014-Z1-1351)
- 1:45PM *An Eighth Grade Curriculum Incorporating Logical Thinking and Active Learning.*
▶ (1666) **Marta Anna Kobiela**, Texas A&M University (1014-Z1-1696)
- 2:00PM Break.
- 2:15PM *Confounders as Mathematical Objects.*
(1667) **Milo Schield***, Augsburg College, and **Tom Burnham**, Cognitive Consulting (1014-Z1-255)
- 2:30PM *Defining the Integral for Coherent Probabilities.*
(1668) **John E. Beam**, University of Wisconsin Oshkosh (1014-Z1-1513)
- 2:45PM *Finite Symmetry Groups.*
▶ (1669) **Lee Ann Rayburn**, Southeastern Oklahoma State University (1014-Z1-113)
- 3:00PM *On some generalizations of Fermat's, Lucas's and Wilson's Theorems.* Preliminary report.
▶ (1670) **Tyler J. Evans**, Humboldt State University (1014-Z1-1308)
- 3:15PM *Fugue in D_{12} Minor - Equivalence classes of Scales and Chords in Even Tempered Tunings.*
▶ (1671) **Michael R. Bacon**, University of South Carolina Sumter (1014-Z1-1405)

MAA Panel Discussion

1:00 PM – 2:20 PM

- Calculus for those students who have had calculus.*
Organizers: **Jack A. Picciuto**, U.S. Military Academy
Barbra Melendez, U.S. Military Academy
- Panelists: **Bernard L. Madison**, University of Arkansas
Mike Huber, U.S. Military Academy
Michael Starbird, University of Texas
David M. Bressoud, McAlester College

MAA Panel Discussion

1:00 PM – 2:20 PM

- Evaluating curricular effectiveness: Judging the quality of K-12 mathematics evaluations.*
Organizers: **Vicki Stohl**, Mathematical Sciences Education Board
David Mandel, Mathematical Sciences Education Board
- Moderator: **David Mandel**
- Panelists: **Jere Confrey**, Washington University, St. Louis
Carlos Castillo-Chavez, Arizona State University
Donald G. Saari, University of California Irvine

MAA SUMMA Special Presentation

1:00 PM – 2:20 PM

- MAA student research programs.*
Organizers: **William Hawkins Jr.**, MAA and University of the District of Columbia
Robert E. Megginson, University of Michigan

AWM Workshop Panel Discussion

1:00 PM – 2:15 PM

Shaping a career in mathematics.
 Moderator: **Marie Vitulli**, University of Oregon
 Panelists: **Janet L. Andersen**, Hope College
Dusa McDuff, SUNY Stony Brook
Mara D. Neusel, Texas Tech University
Michelle D. Wagner, National Security Agency

ASL Invited Address

1:10 PM – 2:00 PM

(1672) *Finite state automata and monadic definability of ordinals.*
Itay Neeman, University of California Los Angeles

AMS Session on Dynamical Systems, II

2:15 PM – 2:55 PM

2:15PM *The Henstock-Kurzweil Delta and Nabla Integral.*
 ▶ (1673) **Allan C. Peterson***, University of Nebraska-Lincoln, and **Bevan Thompson**, The University of Queensland (1014-39-1098)
 2:30PM *On equations of limit cycles with prescribed topology.*
 ▶ (1674) **Anatoly B. Korchagin**, Texas Tech University (1014-34-978)
 2:45PM *Recurrent Solutions of Difference Equations.*
 (1675) Preliminary report.
Zhivko S. Athanassov, Institute of Mathematics, Bulgarian Academy of Sciences (1014-39-1051)

ASL Contributed Paper Session, II

2:15 PM – 4:40 PM

2:15PM *A non-computable perfect tree T containing no non-computable branches that are wtt-reducible to T .*
 (1676) **John Chisholm**, Western Illinois University
 2:40PM *Turing degrees of isomorphism types of algebraic objects.*
 (1677) **Wesley Calvert***, Murray State University, **Valentina Harizanov**, George Washington University, and **Alexandra Shlapentokh**, East Carolina University
 3:05PM *Reverse Mathematics and Π_1^1 comprehension.*
 (1678) **Carl Mummert**, Appalachian State University
 3:30PM *Automorphisms of certain filters of $L^*(V_\infty)$.*
 (1679) **Rumen D. Dimitrov**, Western Illinois University
 3:55PM *A fine structure construction of a perfectly normal non-realcompact space.*
 (1680) **Tetsuya Ishiu**, University of Kansas
 4:20PM *Pseudo-dominating families of functions.*
 (1681) **Jason Aubrey**, University of Missouri

ASL Contributed Paper Session, III

2:15 PM – 4:40 PM

2:15PM *A polynomial translation of S_4 into intuitionistic logic.*
 (1682) **David Fernández Duque**, Stanford University
 2:40PM *Consistency of Martin-Lof's Intuitionistic type theory.*
 (1683) **Gohar Marikyan**, Empire State College
 3:05PM *Reflexive intermediate propositional logics.*
 (1684) **Nathan Carter**, Bentley College

3:30PM *Simple measure analyses for more than two measures.*
 (1685) **Stefan Bold***, Universiteit van Amsterdam, and **Benedikt Loewe**, ILLC, Universiteit van Amsterdam
 3:55PM *Interstitial and pseudo gaps in models of PA.*
 (1686) **Ermek S. Nurkhaidarov**, University of Montana-Western
 4:20PM *The model theory of some non-projectable I -groups.*
 (1687) **Brian Wynne**, Colgate University

AWM Workshop: Research Presentations by Recent Ph.D.s, II

2:30 PM – 4:20 PM

2:30PM *Tensor Decompositions and Compression.*
 ▶ (1688) Preliminary report.
Carla D. Moravitz Martin* and **Charles F. Van Loan**, Cornell University (1014-65-585)
 3:00PM *Measuring ergodicity and mixing at different scales.*
 (1689) **Sherry E. Scott**, University of North Carolina at Chapel Hill (1014-42-639)
 3:30PM *Hide-and-Seek and a Geometric Spectral Invariant on Surfaces.*
 ▶ (1690) **Jean Steiner**, Courant Institute of Mathematical Sciences - NYU (1014-58-702)
 4:00PM *The existence of a volume-preserving ergodic hyperbolic flow on any manifold of dimension at least 3.* Preliminary report.
 (1691) **Huyi Hu**, Michigan State University, **Yakov Pesin**, Pennsylvania State University, and **Anna Talitskaya***, Northwestern University (1014-37-701)

MAA CUPM Subcommittee on Curriculum Renewal Across the First Two Years Panel Discussion

2:30 PM – 3:50 PM

Reunion of participants in refocused college algebra.
 Organizer: **Donald B. Small**, U.S. Military Academy
 Panelists: **Laurette B. Foster**, Prairie View A&M University
William E. Haver, Virginia Commonwealth University

MAA Minicourse #6: Part B

3:30 PM – 5:30 PM

Technology tools for discrete mathematics.
 Organizers: **Douglas E. Ensley**, Shippensburg University
Katherine G. McGivney, Shippensburg University

AMS Banquet Reception

6:30 PM – 7:30 PM

AMS Banquet

7:30 PM – 10:30 PM

Matthew Miller AMS Associate Secretary
 Columbia, South Carolina
James J. Tattersall MAA Associate Secretary
 Providence, Rhode Island

Meetings and Conferences of the AMS

Associate Secretaries of the AMS

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Southeastern Section: Matthew Miller, Department of Mathematics, University of South Carolina, Columbia, SC 29208-0001, e-mail: miller@math.sc.edu; telephone: 803-777-3690.

The Meetings and Conferences section of the *Notices* gives information on all AMS meetings and conferences approved by press time for this issue. Please refer to the page numbers cited in the table of contents on this page for more detailed information on each event. Invited Speakers and Special Sessions are listed as soon as they are approved by the cognizant program committee; the codes listed are needed for electronic abstract submission. For some meetings the list may be incomplete. **Information in this issue may be dated. Up-to-date meeting and conference information can be found at www.ams.org/meetings/.**

Meetings:

2006

January 12-15	San Antonio, Texas Annual Meeting	p. 97
April 1-2	Miami, Florida	p. 99
April 8-9	Notre Dame, Indiana	p. 101
April 22-23	Durham, New Hampshire	p. 104
April 29-30	San Francisco, California	p. 105
October 7-8	Salt Lake City, Utah	p. 105
October 21-22	Cincinnati, Ohio	p. 106
October 28-29	Storrs, Connecticut	p. 106
November 3-4	Fayetteville, Arkansas	p. 106

2007

January 4-7	New Orleans, Louisiana Annual Meeting	p. 107
March 3-4	Davidson, North Carolina	p. 107
March 16-17	Oxford, Ohio	p. 107
April 14-15	Hoboken, New Jersey	p. 107
April 21-22	Tucson, Arizona	p. 107

2008

January 6-9	San Diego, California Annual Meeting	p. 108
April 4-6	Bloomington, Indiana	p. 108
June 4-7	Rio de Janeiro, Brazil	p. 108
October 4-5	Vancouver, Canada	p. 108

December 17-21	Shanghai, People's Republic of China	p. 108
2009		
January 7-10	Washington, DC Annual Meeting	p. 109
2010		
January 6-9	San Francisco, California Annual Meeting	p. 109
2011		
January 5-8	New Orleans, Louisiana Annual Meeting	p. 109
2012		
January 4-6	Boston, Massachusetts Annual Meeting	p. 109
2013		
January 4-6	San Diego, California Annual Meeting	p. 110

Important Information regarding AMS Meetings

Potential organizers, speakers, and hosts should refer to page 96 in the January 2006 issue of the *Notices* for general information regarding participation in AMS meetings and conferences.

Abstracts

Speakers should submit abstracts on the easy-to-use interactive Web form. No knowledge of \LaTeX is necessary to submit an electronic form, although those who use \LaTeX may submit abstracts with such coding, and all math displays and similarly coded material (such as accent marks in text) must be typeset in \LaTeX . Visit <http://www.ams.org/cgi-bin/abstracts/abstract.pl>.

Questions about abstracts and requests for paper forms may be sent to abs-info@ams.org.

Paper abstract forms must be sent to Meetings & Conferences Department, AMS, P.O. Box 6887, Providence, RI 02940. There is a \$20 processing fee for each paper abstract. There is no charge for electronic abstracts. Note that all abstract deadlines are strictly enforced.

Close attention should be paid to specified deadlines in this issue. Unfortunately, late abstracts cannot be accommodated.

Conferences: (see <http://www.ams.org/meetings/> for the most up-to-date information on these conferences.)

June 4-June 29, 2006: Joint Summer Research Conferences in the Mathematical Sciences, Snowbird, Utah (see November 2005 *Notices*, page 1296).

Co-sponsored conference: 22nd Annual Workshop on Mathematical Problems in Industry, June 12-16, 2006, Olin College, Needham, MA. For details see <http://projects.olin.edu/mpi2006/>.

BULLETIN OF THE AMS

CURRENT EVENTS

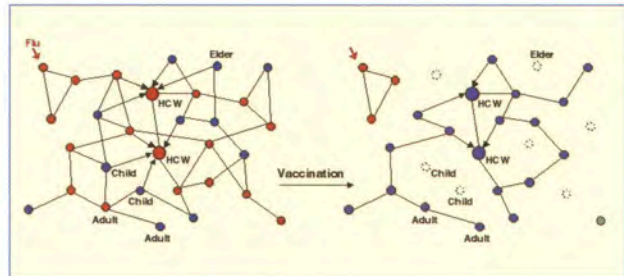
Saturday January 14, 2006, 1:00 p.m. – 5:50 p.m.

Organized by *David Eisenbud*, Mathematical Sciences Research Institute

1:00 PM – Lauren Ancel Meyers

Contact network epidemiology: Bond percolation applied to infectious disease prediction and control

In contact network epidemiology, bond percolation on random graphs is applied to modeling disease transmission through heterogeneous populations. Lauren Ancel Meyers introduces an important model and links recent theoretical results to issues of public health.



2:00 PM – Kannan Soundararajan

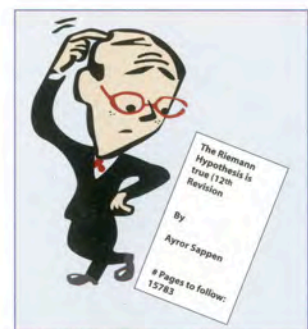
Small gaps between prime numbers

Kannan Soundararajan explains the spectacular advance in which Goldston, Pintz, and Yildirim showed that for any given positive number ϵ there are primes around size x with the gap to the next prime being smaller than $\epsilon \log x$. Seemingly small improvements in the intermediate results would yield the Twin Prime Conjecture.

3:00 PM – Madhu Sudan

Probabilistically checkable proofs

A probabilistically checkable proof (PCP) is easily verified but might be far longer than the sort of proof that mathematicians like to read. It is an amazing fact, however, that they don't need to be "too much" longer. Madhu Sudan describes PCPs, their relation to complexity theory, and recent simplifications by Irit Dinur.



4:00 PM – Martin Golubitsky

Symmetry in neuroscience

Symmetry may appear an unlikely part of the structure of the nervous system, but Martin Golubitsky describes three rather different areas where there are striking symmetries whose analysis leads to questions about the symmetry of differential equations: animal gaits, the vestibular system, and the visual cortex.

New and Noteworthy

Introduction to Stochastic Integration

Hui-Hsiung Kuo, Louisiana State University

The theory of stochastic integration, also called the Ito calculus, has a large spectrum of applications in virtually every scientific area involving random functions. This introductory textbook on stochastic integration provides a concise introduction to the Ito calculus, and covers the constructions of Brownian motion, stochastic integrals for Brownian motion and martingales, the Ito formula, multiple Wiener-Ito integrals, stochastic differential equations, and applications to finance, filtering theory, and electric circuits.

2006, Approx. 290 p. 2 illus., (Universitext) Softcover
ISBN 0-387-28720-5 ▶ **\$49.95**

A Course in Calculus and Real Analysis

Sudhir R. Ghorpade and **Balmohan Limaye**, both at the Indian Institute of Technology, Bombay, India

Real analysis may be regarded as a formidable counterpart to calculus. It is a subject where one revisits notions encountered in calculus, but with greater rigor and sometimes with greater generality. Here, the authors provide a self-contained and rigorous introduction to the calculus of functions of one variable. The presentation and sequencing of topics emphasizes the structural development of calculus. At the same time, due importance is given to computational techniques and applications.

2005, Approx. 520 p. 75 illus., (Undergraduate Texts in Mathematics), Hardcover
ISBN 0-387-30530-0 ▶ **Approx. \$59.95**

Convex Analysis and Nonlinear Optimization

Jonathan Borwein, Dalhousie University, Halifax, NS, Canada and **Adrian S. Lewis**, Cornell University, New York

▶ *This book represents a tour de force for introducing so many topics of present interest in such a small space and with such clarity and elegance.* ▶ Canadian Mathematical Society Notes (on the first edition)

▶ *A fascinating interweaving of theory and applications...* ▶ Mathematical Reviews (on the first edition)

This book provides a concise, accessible account of convex analysis and its applications and extensions, for a broad audience. The new edition adds material on semismooth optimization, as well as several new proofs.

2nd ed., 2005, Approx. 330 p., (CMS Books in Mathematics), Hardcover
ISBN 0-387-29570-4 ▶ **\$69.95**

Field Theory

Steven Roman, University of California, Irvine

▶ *Written in a clear and explanatory style. It contains over 235 exercises which provide a challenge to the reader. The book is recommended for a graduate course in field theory as well as for independent study.* ▶ MathSciNet (on the first edition)

This new edition has been completely rewritten to further enhance the pedagogy and accessibility to graduate students. The exercises have been improved and a new chapter on ordered fields has been included.

2nd ed., 2006, Approx. 330 p. 25 illus., (Graduate Texts in Mathematics, Vol. 158), Hardcover
ISBN 0-387-27677-7 ▶ **\$59.95**

Notes on Set Theory

Yiannis Moschovakis, University of California, Los Angeles

▶ *The book is very well written and, thus, an excellent introductory text on set theory.* ▶ ZentralblattMATH (on the first edition)

The book gives a solid introduction to "pure set theory" through transfinite recursion and the construction of the cumulative hierarchy of sets (including the basic results that have applications to computer science), but it also attempts to explain precisely how mathematical objects can be faithfully modeled within the universe of sets. In this new edition the author has added solutions to the exercises, and rearranged and reworked the text in several places to further enhance the presentation.

2nd ed., 2005, 284 p. 48 illus., (Undergraduate Texts in Mathematics) Softcover
ISBN 0-387-28723-X ▶ **\$49.95**
Hardcover
ISBN 0-387-28722-1 ▶ **\$79.95**

Problems and Theorems in Classical Set Theory

Peter Komjath, Eötvös Loránd University, Budapest, Hungary, and **Vilmos Totik**, University of South Florida

This volume contains a variety of problems from classical set theory. Many of these problems are also related to other fields of mathematics, including algebra, combinatorics, topology and real analysis. The problems vary in difficulty, and are organized in such a way that earlier problems help in the solution of later ones. For many of the problems, the authors also trace the history of the problems and then provide proper reference at the end of the solution.

2006, Approx. 525 p., (Problem Books in Mathematics), Hardcover
ISBN 0-387-30293-X ▶ **Approx. \$59.95**

