Experimental Design
Project 1

Due Thursday, May 5

The idea behind this homework assignment is to take a single data set and analyze it with many of the methods that we have discussed so far. The homework itself will take the form a research-type report based on the data analysis you conduct. This will be a very limited report, however, consisting only of the equivalent of a *Results* section of a research paper. We will discuss the details of the format in class. Your report should take a standard form, such as referring to tables and figures that will be attached to the back of the report. Be sure, however, that you describe and interpret your results, and do not simply string together statements like, [a]See Table 1 for the means. See Table 2 for the ANOVA. See ... Below is a description of the problem, followed by the steps you should take in analyzing the data.

Problem.–We are interested in pursuing the question of how well the marine isopod, *Paracerceis sculpta*, can keep invaders out of the spongocoels it occupies during mating. We notice that *P. sculpta* tends to hang out primarily in one sponge, *Leucetta losangelensis*, but we occasionally find it in a few other sponges. We decide to look into the question of whether *P. sculpta* tends to live in *L. losangelensis* because it is more successful at keeping out invading males in this sponge versus its success in other sponges. If we find that this is indeed the case, then we might, for instance, want to look into the differences in sponge morphology that generate this effect. We collect our samples of *P. sculpta* from the Gulf of California, and also collect four species of sponges, including *L. losangelensis*, from there. In addition, we collect a another species of *Leucetta* from the Gulf of Mexico. We will also compare all of these real sponges to an artificial sponge of our own design created from a sponge-like polymer. Our experimental procedure is to put the sponge and the male isopod to be tested in a water-filled chamber, and let them get comfortable for a couple of hours. We then introduce another α-male to the chamber, and see how long it takes for that male to throw out the other male. We have six different test conditions:

Sponge Type	Description
1. *Artificial*	Our fake sponge.
2. *Leucetta losangelensis*	The normal sponge for *P. sculpta*.
3. *Leucetta streptifula*	A neighbor from the Gulf of Mexico.
4. *Euplectella syconi*	Another sponge from the Gulf of California.
5. *Poterion shusteri*	Ditto.
6. *Spongia callysi*	Ditto.

All isopods are collected from the same area in the Gulf of California, and brought to the lab. They are randomly assigned to different treatment groups. You measure the time it takes (in seconds) for an invader to make it into the spongocoel.

Your results should include at least the following:

1. Descriptive statistics: means, standard deviations, sample sizes, etc.
2. Tests of the ANOVA assumptions: homogeneity of variance and normality.
3. Transformations to meet those assumptions if necessary and/or possible.

4. Tests of several *a priori* hypotheses/questions:
    a) Is there any effect of any treatment?
    b) Is the artificial sponge treatment different from the natural sponge treatments?
    c) Do the invasion times in *Leucetta* sp. sponges differ from the other natural sponges?
    d) Is there any difference among the non-*Leucetta* natural sponges?
    e) Is there any difference between the *L. losangelensis* and *L. streptifula* treatments?
5. Perform some data snooping to see if we can find any interesting *post hoc* differences among the treatments groups. (Use at least two different parametric methods to do this).
6. Test the overall experiment and hypothesis (e) above using nonparametric methods.
7. Test the data-snooping using randomization and bootstrap analyses (programs included).

Note that the presentation of the results does not necessarily have to be in this order. It may be more appropriate to group some of the items together in your presentation.

References

You certainly are not required to look at these references in order to complete this assignment, but you might want to if you are interested in finding out more about interesting work done in this system.

S. M. Shuster. 1989. Male alternative reproduction strategies in a marine isopod crustacean (*Paracerceis sculpta*): the use of genetic markers to measure differences in fertilization success among α-, β-, and γ- males. Evolution 43:1683-1698.

S. M. Shuster, and M. J. Wade. 1991. Equal mating success among male reproductive strategies in a marine isopod. Nature 350:608-610.

S. M. Shuster, and C. Sassman. 1997. Genetic interaction between male mating strategy and sex ratio in a marine isopod. Nature 388:373-377.