

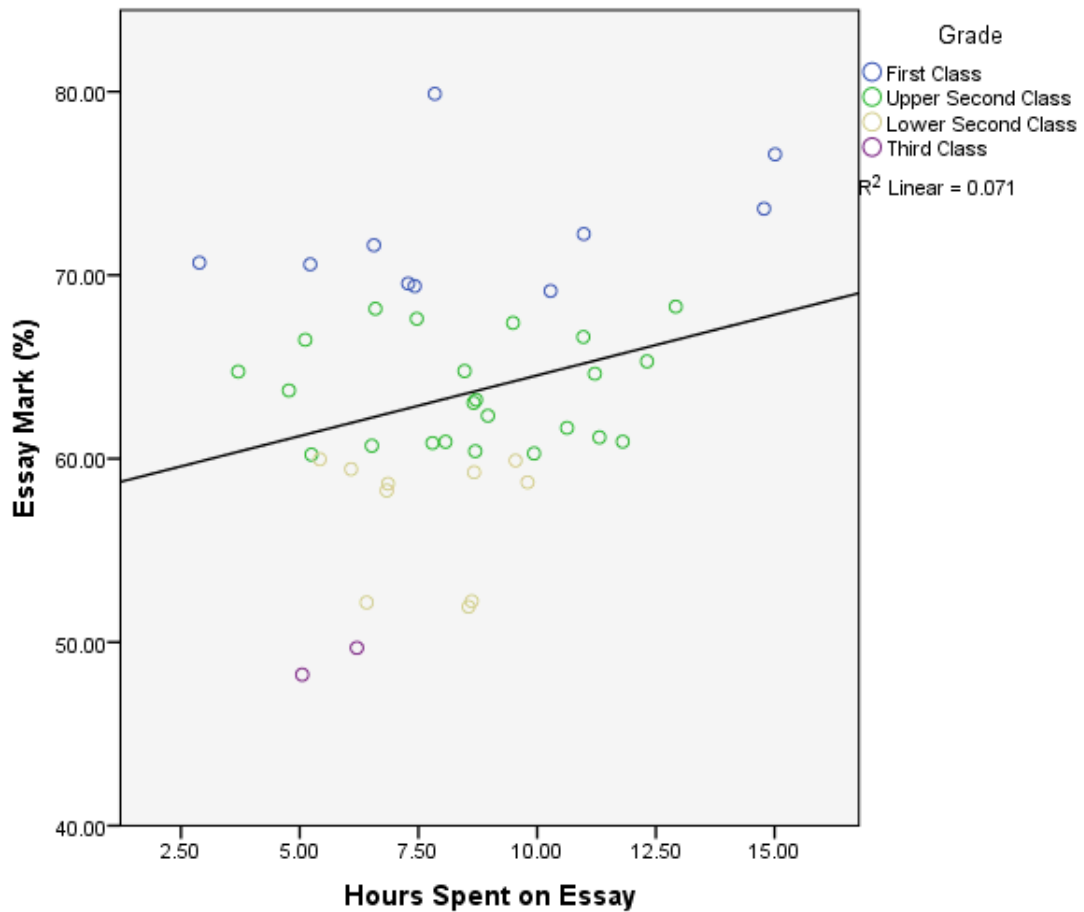
Chapter 7: Correlation

Smart Alex's Solutions

Task 1

*A student was interested in whether there was a positive relationship between the time spent doing an essay and the mark received. He got 45 of his friends and timed how long they spent writing an essay (**hours**) and the percentage they got in the essay (**essay**). He also translated these grades into their degree classifications (**grade**): in the UK, a student can get a first-class mark (the best), an upper-second-class mark, a lower second, a third, a pass or a fail (the worst). Using the data in the file **EssayMarks.sav**, find out what the relationship was between the time spent doing an essay and the eventual mark in terms of percentage and degree class (draw a scatterplot too).*

We're interested in looking at the relationship between hours spent on an essay and the grade obtained. We could simply do a scatterplot of hours spent on the essay (*x*-axis) and essay mark (*y*-axis). I've also chosen to highlight the degree classification grades using different colours (just place the variable **grades** in the *set colour* box). The resulting scatterplot should look like this:



Next, we should check whether the data are parametric using the *Explore* menu (see Chapter 3). The resulting table is as follows:

Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Essay Mark (%)	.111	45	.200*	.977	45	.493
Hours Spent on Essay	.091	45	.200*	.981	45	.662

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

The Kolmogorov–Smirnov and Shapiro–Wilk statistics are both non-significant (*Sig.* > .05 in all cases) for both variables, which indicates that they are normally distributed. As such we can use Pearson’s correlation coefficient. The result of this is:

Correlations

		Essay Mark (%)	Hours Spent on Essay	
Essay Mark (%)	Pearson Correlation	1	.267	
	Sig. (2-tailed)		.077	
	N	45	45	
	Bootstrap ^c	Bias	0	-.009
		Std. Error	0	.148
		BCa 95% Confidence Interval	Lower Upper	-.023 .517
Hours Spent on Essay	Pearson Correlation	.267	1	
	Sig. (2-tailed)	.077		
	N	45	45	
	Bootstrap ^c	Bias	-.009	0
		Std. Error	.148	0
		BCa 95% Confidence Interval	Lower Upper	-.023 .517

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

c. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

I chose a two-tailed test because it is never really appropriate to conduct a one-tailed test (see the book chapter). I also requested the bootstrapped confidence intervals even though the data were normal because they are robust. The results in the table above indicate that the relationship between time spent writing an essay and grade awarded was not significant, Pearson's $r = .27$, BCa CI $[-.023, .517]$, $p > .05$.

The second part of the question asks us to do the same analysis but when the percentages are recoded into degree classifications. The degree classifications are ordinal data (not interval): they are ordered categories. SO we shouldn't use Pearson's test statistic, but Spearman's and Kendall's ones instead:

Correlations

			Hours Spent on Essay	Grade
Kendall's tau_b	Hours Spent on Essay	Correlation Coefficient	1.000	-.158
		Sig. (2-tailed)	.	.178
		N	45	45
	Grade	Correlation Coefficient	-.158	1.000
		Sig. (2-tailed)	.178	.
		N	45	45
Spearman's rho	Hours Spent on Essay	Correlation Coefficient	1.000	-.193
		Sig. (2-tailed)	.	.204
		N	45	45
	Grade	Correlation Coefficient	-.193	1.000
		Sig. (2-tailed)	.204	.
		N	45	45

In both cases the correlation is non-significant. There was no significant relationship between degree grade classification for an essay and the time spent doing it, $\rho = .18$, *ns*, and $\tau = -.16$, *ns*. Note that the direction of the relationship has reversed. This has happened because the essay marks were recoded as 1 (first), 2 (upper second), 3 (lower second), and 4 (third), so high grades were represented by low numbers!

This illustrates one of the benefits of *not* taking continuous data (like percentages) and transforming them into categorical data: when you do, you lose information and often statistical power!

Task 2

*Using the **ChickFlick.sav** data from Chapter 3, find out if there is a relationship between gender and arousal.*

Gender is a categorical variable with two categories. Therefore, we need to look at this relationship using a point-biserial correlation. The resulting output table is as follows:

Correlations

		Gender of Participant	Psychological Arousal During Film	
Gender of Participant	Pearson Correlation	1	-.180	
	Sig. (2-tailed)		.266	
	N	40	40	
	Bootstrap ^c	Bias	0	.009
		Std. Error	0	.159
		BCa 95% Confidence Interval	Lower Upper	-.457 .153
Psychological Arousal During Film	Pearson Correlation	-.180	1	
	Sig. (2-tailed)	.266		
	N	40	40	
	Bootstrap ^c	Bias	.009	0
		Std. Error	.159	0
		BCa 95% Confidence Interval	Lower Upper	-.457 .153

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

c. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

I used a two-tailed test because one-tailed tests should never really be used. I have also asked for the bootstrapped confidence intervals as they are robust. As you can see, there was no significant relationship between gender and arousal because our p -value is larger than .05 and the bootstrapped confidence intervals cross zero, $r_{pb} = -.18$, BCa CI [-.457, .153], $p = .266$.

Task 3

Using the same data, what is the relationship between the film watched and arousal?

Correlations

		Psychological Arousal During Film	Name of Film		
Psychological Arousal During Film	Pearson Correlation	1	.638**		
	Sig. (2-tailed)		.000		
	N	40	40		
	Bootstrap ^c	Bias	0	-.003	
		Std. Error	0	.078	
		BCa 95% Confidence Interval	Lower	.	.456
			Upper	.	.771
Name of Film	Pearson Correlation	.638**	1		
	Sig. (2-tailed)	.000			
	N	40	40		
	Bootstrap ^c	Bias	-.003	0	
		Std. Error	.078	0	
		BCa 95% Confidence Interval	Lower	.456	.
			Upper	.771	.

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

c. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

There was a significant relationship between the film watched and arousal, $r_{pb} = .64$, BCa CI [.456, .771], $p < .001$. Looking at how the groups were coded, you should see that *Bridget Jones's Diary* had a code of 1, and *Memento* had a code of 2, therefore this result reflects the fact that as film goes up (changes from 1 to 2) arousal goes up. Put another way, as the film changes from *Bridget Jones's Diary* to *Memento*, arousal increases. So *Memento* gave rise to the greater arousal levels.

Task 4

*As a statistics lecturer, I am always interested in the factors that determine whether a student will do well on a statistics course. One potentially important factor is their previous expertise with mathematics. Imagine I took 25 students and looked at their degree grades for my statistics course at the end of their first year at university: first, upper second, lower second or third class. I also asked these students what grade they got in their GCSE maths exams. In the UK GCSEs are school exams taken at age 16 that are graded A, B, C, D, E or F (an A grade is better than all of the lower grades). The data for this study are in the file **grades.sav**. Carry out the appropriate analysis to see if GCSE maths grades correlate with first-year statistics grades.*

Let's look at these variables. In the UK, GCSEs are school exams taken at age 16 that are graded A, B, C, D, E or F. These grades are categories that have an order of importance (an A grade is better than all of the lower grades). In the UK, a university student can get a first-class mark, an upper second, a lower second, a third, a pass or a fail. These grades are categories, but they have an order to them (an upper second is better than a lower second). When you have categories like these that can be ordered in a meaningful way, the data are said to be *ordinal*. The data are not interval, because a first-class degree encompasses a 30% range (70–100%), whereas an upper second only covers a 10% range (60–70%). When data have been measured at only the ordinal level they are said to be non-parametric and Pearson's correlation is not appropriate. Therefore, the Spearman correlation coefficient is used.

The data are in two columns: one labelled **stats** and one labelled **gcse**. Each of the categories described above has been coded with a numeric value. In both cases, the highest grade (first class or A grade) has been coded with the value 1, with subsequent categories being labelled 2, 3 and so on. Note that for each numeric code I have provided a value label (just like we did for coding variables).

The procedure for doing the Spearman correlation is the same as for Pearson's correlation, except that in the *bivariate correlations* dialog box we need to select Spearman and deselect the option for a Pearson correlation. At this stage, you should also specify whether you require a one- or two-tailed test. For the example above, I predicted that better grades in GCSE maths would correlate with better degree grades for my statistics course. This hypothesis is directional and so a one-tailed test could be selected; however, in the chapter I advised against one-tailed tests so I would leave the default of Two-tailed.

Correlations

		GCSE Maths Grade	Statistics Grade		
Spearman's rho	GCSE Maths Grade	Correlation Coefficient	1.000	.455	
		Sig. (2-tailed)	.	.022	
		N	25	25	
		Bootstrap ^c	Bias	.000	-.014
			Std. Error	.000	.184
	BCa 95% Confidence Interval				
		Lower	.	-.008	
		Upper	.	.758	
	Statistics Grade	Correlation Coefficient	.455	1.000	
		Sig. (2-tailed)	.022	.	
N		25	25		
Bootstrap ^c		Bias	-.014	.000	
		Std. Error	.184	.000	
	BCa 95% Confidence Interval				
	Lower	-.008	.		
	Upper	.758	.		

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

c. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

The SPSS output shows above the Spearman correlation on the variables **stats** and **gcse**. The output shows a matrix giving the correlation coefficient between the two variables (.455), underneath is the significance value of this coefficient (.022) and then the sample size (25). I also requested the bootstrapped confidence intervals (–.008, .758). The significance

value for this correlation coefficient is less than .05; therefore, it can be concluded that there is a significant relationship between a student's grade in GCSE maths and their degree grade for their statistics course. However, the bootstrapped confidence interval crosses zero, suggesting that the effect in the population could be zero. The confidence interval only just crosses zero, though, and it is worth remembering that if we were to rerun the analysis we would get different results for the confidence interval. I have rerun the analysis, and the resulting output is below. You can see that this time the confidence interval does not cross zero (.036, .737), which suggests that there is likely to be a positive effect in the population (as GCSE grades improve, there is a corresponding improvement in degree grades for statistics). However, there is still a chance that the effect could be zero. The p -value also reflects this possibility because it was only just significant (.022), although the correlation coefficient is fairly large (.455). This situation demonstrates that it is important to replicate data.

Finally, it is good to check that the value of N corresponds to the number of observations that were made. If it doesn't then data may have been excluded for some reason.

Correlations

			GCSE Maths Grade	Statistics Grade	
Spearman's rho	GCSE Maths Grade	Correlation Coefficient	1.000	.455	
		Sig. (2-tailed)	.	.022	
		N	25	25	
		Bootstrap ^c	Bias	.000	-.007
			Std. Error	.000	.173
			BCa 95% Confidence Interval		
		Lower	.	.036	
		Upper	.	.737	
	Statistics Grade	Correlation Coefficient	.455	1.000	
		Sig. (2-tailed)	.022	.	
		N	25	25	
		Bootstrap ^c	Bias	-.007	.000
Std. Error			.173	.000	
BCa 95% Confidence Interval					
	Lower	.036	.		
	Upper	.737	.		

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

c. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

We could also look at Kendall's correlation by selecting Kendall's tau-b. The output is much the same as for Spearman's correlation.

The actual value of the correlation coefficient is less than Spearman's correlation (it has decreased from .455 to .354). Despite the difference in the correlation coefficients, we can still interpret this result as being a significant positive relationship (because the significance value of .029 is still slightly less than .05). However, Kendall's value is a more accurate gauge of what the correlation in the population would be. The bootstrapped confidence intervals do not cross zero (.050, .620), suggesting that there is likely to be a positive effect in the population. As with Pearson's correlation, we cannot assume that the GCSE grades caused the degree students to do better in their statistics course.

Correlations

		GCSE Maths Grade	Statistics Grade		
Kendall's tau_b	GCSE Maths Grade	Correlation Coefficient	1.000		
		Sig. (2-tailed)	.		
		N	25		
	Bootstrap ^c	Bias	.000	.002	
		Std. Error	.000	.136	
		BCa 95% Confidence Interval	Lower	.	.050
			Upper	.	.620
	Statistics Grade	Correlation Coefficient	.354	1.000	
		Sig. (2-tailed)	.029	.	
		N	25	25	
Bootstrap ^c		Bias	.002	.000	
		Std. Error	.136	.000	
		BCa 95% Confidence Interval	Lower	.050	.
			Upper	.620	.

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

c. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

We could report these results as follows:

- ✓ Bias corrected and accelerated bootstrap 95% CIs are reported in square brackets. There was a positive relationship between a person's statistics grade and their GCSE maths grade, $r_s = .46$, 95% BCa CI [.036, .737], $p < .05$.
- ✓ There was a positive relationship between a person's statistics grade and their GCSE maths grade, $\tau = .35$, 95% BCa CI [.050, .620], $p < .05$. (Note that I've quoted Kendall's tau here.)

Task 5

In Figure 2.3 we saw some data relating to people's ratings of dishonest acts and the likeableness of the perpetrator (for a full description see Jane Superbrain Box 2.1).

*Compute the Spearman correlation between ratings of dishonesty and likeableness of the perpetrator. The data are in **HonestyLab.sav**.*

Looking at the output below, we can see that the relationship between ratings of dishonesty and likeableness of the perpetrator was significant because the p -value is less than .05 ($p = .000$) and the bootstrapped confidence intervals do not cross zero (.768, .895). The value of Spearman's correlation coefficient is quite large and positive (.844), indicating a large

positive effect in the population: the more likeable the perpetrator was, the more positively their dishonest acts were viewed.

Correlations

			Rating of Likeableness of Perpetrator	Rating of Deed	
Spearman's rho	Rating of Likeableness of Perpetrator	Correlation Coefficient	1.000	.844**	
		Sig. (2-tailed)	.	.000	
		N	100	100	
		Bootstrap ^b	Bias	.000	-.005
			Std. Error	.000	.036
	BCa 95% Confidence Interval	Lower	.	.768	
		Upper	.	.895	
	Rating of Deed	Correlation Coefficient	.844**	1.000	
		Sig. (2-tailed)	.000	.	
		N	100	100	
Bootstrap ^b		Bias	-.005	.000	
		Std. Error	.036	.000	
BCa 95% Confidence Interval	Lower	.768	.		
	Upper	.895	.		

** . Correlation is significant at the 0.01 level (2-tailed).

b. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

We could report the results as follows:

- ✓ Bias corrected and accelerated bootstrap 95% CIs are reported in square brackets. There was a positive relationship between the likeableness of a perpetrator and how positively their dishonest acts were viewed, $r_s = .84$, 95% BCa CI [.768, .895], $p < .001$.

Task 6

*In Chapter 3 (Task 5) we looked at data from people who had been forced to marry goats and dogs and measured their life satisfaction and how much they like animals (**Goat or Dog.sav**). Is there a significant correlation between life satisfaction and the type of animal to which a person was married?*

Wife is a categorical variable with two categories (goat or dog). Therefore, we need to look at this relationship using a point-biserial correlation. The resulting table is as follows:

Correlations

		Type of Animal Wife	Life Satisfaction (%)	
Type of Animal Wife	Pearson Correlation	1	.630**	
	Sig. (2-tailed)		.003	
	N	20	20	
	Bootstrap ^c	Bias	0	.000
		Std. Error	0	.109
	BCa 95% Confidence Interval	Lower	.	.367
		Upper	.	.826
Life Satisfaction (%)	Pearson Correlation	.630**	1	
	Sig. (2-tailed)	.003		
	N	20	20	
	Bootstrap ^c	Bias	.000	0
		Std. Error	.109	0
	BCa 95% Confidence Interval	Lower	.367	.
		Upper	.826	.

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

c. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

I used a two-tailed test because one-tailed tests should never really be used (see book chapter for more explanation). I have also asked for the bootstrapped confidence intervals as they are robust. As you can see there, was a significant relationship between type of animal wife and life satisfaction because our p -value is less than .05 and the bootstrapped confidence intervals do not cross zero, $r_{pb} = .630$, BCa CI [.367, .826], $p = .003$. Looking at how the groups were coded, you should see that goat had a code of 1 and dog had a code of 2, therefore this result reflects the fact that as wife goes up (changes from 1 to 2) life satisfaction goes up. Put another way, as wife changes from goat to dog, life satisfaction increases. So, being married to a dog gave rise to greater life satisfaction.

Task 7

Repeat the analysis above, taking account of animal liking when computing the correlation between life satisfaction and the animal to which a person was married.

We can conduct a partial correlation between life satisfaction and the animal to which a person was married while 'controlling' for the effect of animal liking.

Correlations

Control Variables			Type of Animal Wife	Life Satisfaction (%)		
Love of Animals	Type of Animal Wife	Correlation	1.000	.701		
		Significance (2-tailed)	.	.001		
		df	0	17		
		Bootstrap ^a	Bias	.000	.000	
			Std. Error	.000	.107	
			BCa 95% Confidence Interval	Lower	.	.377
				Upper	.	.887
		Life Satisfaction (%)	Type of Animal Wife	Correlation	.701	1.000
				Significance (2-tailed)	.001	.
				df	17	0
Bootstrap ^a	Bias			.000	.000	
	Std. Error			.107	.000	
	BCa 95% Confidence Interval			Lower	.377	.
				Upper	.887	.

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

The output for the partial correlation above is a matrix of correlations for the variables **wife** and **life satisfaction** but controlling for the effect of animal liking. Note that the top and bottom of the table contain identical values, so we can ignore one half of the table. First, notice that the partial correlation between wife and life satisfaction is .701, which is greater than the correlation when the effect of animal liking is not controlled for ($r = .630$). The correlation has become more statistically significant (its p -value has decreased from .003 to .001) and that the confidence interval [.377, .887] still doesn't contain zero. In terms of variance, the value of R^2 for the partial correlation is .491, which means that type of animal wife now shares 49.1% of the variance in life satisfaction (compared to 39.7% when animal liking was not controlled). Running this analysis has shown us that type of wife alone explains a large portion of the variation in life satisfaction. In other words, the relationship between wife and life satisfaction is not due to animal liking.

Task 8

*In Chapter 3 (Task 6) we looked at data based on findings that the number of cups of tea drunk was related to cognitive functioning (Feng et al., 2010). The data are in the file **Tea Makes You Brainy 15.sav**. What is the correlation between tea drinking and cognitive functioning? Is there a significant effect?*

Because **Cups_of_Tea** and **Cognitive_Function** are both interval variables, we can conduct a Pearson's correlation coefficient. If we request bootstrapped confidence intervals then we don't need to worry about checking whether the data are normal because they are robust.

Correlations

		Number of Cups of Tea Drunk Per Day	Cognitive Function Score (Max = 80)	
Number of Cups of Tea Drunk Per Day	Pearson Correlation	1	.078	
	Sig. (2-tailed)		.783	
	N	15	15	
	Bootstrap ^c	Bias	0	-.002
		Std. Error	0	.234
		BCa 95% Confidence Interval	Lower	.
Upper	.		.598	
Cognitive Function Score (Max = 80)	Pearson Correlation	.078	1	
	Sig. (2-tailed)	.783		
	N	15	15	
	Bootstrap ^c	Bias	-.002	0
		Std. Error	.234	0
		BCa 95% Confidence Interval	Lower	-.464
Upper	.598		.	

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

c. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

I chose a two-tailed test because it is never really appropriate to conduct a one-tailed test (see the book chapter). The results in the table above indicate that the relationship between number of cups of tea drunk per day and cognitive function was not significant. We can tell this because our p -value is greater than .05, and the bootstrapped confidence intervals cross zero, indicating that the effect in the population could be zero (i.e. no effect). Pearson's $r = .078$, BCa CI $[-.464, .598]$, $p > .05$.

Task 9

*The research in the previous example was replicated but in a larger sample ($N = 716$), which is the same as the sample size in Feng et al.'s research (**Tea Makes You Brainy 716.sav**). Conduct a correlation between tea drinking and cognitive functioning. Compare the correlation coefficient and significance in this large sample, with the previous task. What statistical point do the results illustrate?*

The output for the Pearson's correlation is below.

Correlations

		Number of Cups of Tea Drunk Per Day	Cognitive Function Score (Max = 80)	
Number of Cups of Tea Drunk Per Day	Pearson Correlation	1	.078	
	Sig. (2-tailed)		.038	
	N	716	716	
	Bootstrap ^c	Bias	0	-.001
		Std. Error	0	.038
		BCa 95% Confidence Interval	Lower	.
Upper	.		.148	
Cognitive Function Score (Max = 80)	Pearson Correlation	.078	1	
	Sig. (2-tailed)	.038		
	N	716	716	
	Bootstrap ^c	Bias	-.001	0
		Std. Error	.038	0
		BCa 95% Confidence Interval	Lower	.002
Upper	.148		.	

*. Correlation is significant at the 0.05 level (2-tailed).

** . Correlation is significant at the 0.01 level (2-tailed).

c. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

We can see that although the value of Pearson's r has not changed, it is still very small (.078), the relationship between the number of cups of tea drunk per day and cognitive function is now just significant ($p = .038$) and the confidence intervals no longer cross zero (.002, .149) – though the lower confidence interval is very close to zero, suggesting that the effect in the population could still be very close to zero. This example indicates one of the downfalls of significance testing; you can get significant results when you have large sample sizes even if the effect is very small. Basically, whether you get a significant result or not is entirely subject to the sample size.

Task 10

*In Chapter 5 we looked at hygiene scores over three days of a rock music festival (**Download Festival.sav**). Using Spearman's correlation, were hygiene scores on day 1 of the festival significantly correlated with those on day 3?*

Correlations

			Hygiene (Day 1 of Download Festival)	Hygiene (Day 3 of Download Festival)	
Spearman's rho	Hygiene (Day 1 of Download Festival)	Correlation Coefficient	1.000	.344**	
		Sig. (2-tailed)	.	.000	
		N	123	123	
		Bootstrap ^c	Bias	.000	.003
			Std. Error	.000	.087
	BCa 95% Confidence Interval	Lower	.	.148	
		Upper	.	.526	
	Hygiene (Day 3 of Download Festival)	Correlation Coefficient	.344**	1.000	
		Sig. (2-tailed)	.000	.	
		N	123	123	
Bootstrap ^c		Bias	.003	.000	
		Std. Error	.087	.000	
BCa 95% Confidence Interval	Lower	.148	.		
	Upper	.526	.		

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

c. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

Looking at the output above, we can see that the hygiene scores on day 1 of the festival correlated significantly with hygiene scores on day 3. The value of Spearman's correlation coefficient is .344, which is a positive value suggesting that the smellier you are on day 1, the smellier you will be on day 3, $r_s = .344$, 95% BCa CI [.148, .526], $p < .001$.

Task 11

Using the data in **Shopping Exercise.sav** (Chapter 3, Task 4) is there a significant relationship between the time spent shopping and the distance covered?

The variables **Time** and **Distance** are both interval. Therefore, we can conduct a Pearson's correlation.

Correlations

		Time Spent Shopping	Distance Walked while Shopping (Miles)		
Time Spent Shopping	Pearson Correlation	1	.830**		
	Sig. (2-tailed)		.003		
	N	10	10		
	Bootstrap ^c	Bias	0	-.020	
		Std. Error	0	.119	
		BCa 95% Confidence Interval	Lower	.	.542
			Upper	.	.964
Distance Walked while Shopping (Miles)	Pearson Correlation	.830**	1		
	Sig. (2-tailed)	.003			
	N	10	10		
	Bootstrap ^c	Bias	-.020	0	
		Std. Error	.119	0	
		BCa 95% Confidence Interval	Lower	.542	.
			Upper	.964	.

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

c. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

I chose a two-tailed test because it is never really appropriate to conduct a one-tailed test (see the book chapter). The output table above indicates that there was a significant positive relationship between time spent shopping and distance covered. We can tell that the relationship was significant because our p -value is smaller than .05. More importantly, our robust confidence intervals do not cross zero (.542, .964), suggesting that the effect in the population is unlikely to be zero. Also, our value for Pearson's r is very large (.83) indicating a large effect. Pearson's $r = .83$, BCa CI [.54, .96], $p < .01$.

Task 12

What effect does accounting for the effect of gender have on the relationship between the time spent shopping and the distance covered?

To answer this question, we need to conduct a partial correlation between **Time** spent shopping (interval variable) and **Distance** covered (interval variable) while 'controlling' for the effect of **Gender** (dicotomous variable).

Correlations

Control Variables			Time Spent Shopping	Distance Walked while Shopping (Miles)
Gender	Time Spent Shopping	Correlation	1.000	.820
		Significance (2-tailed)	.	.007
		df	0	7
	Distance Walked while Shopping (Miles)	Correlation	.820	1.000
		Significance (2-tailed)	.007	.
		df	7	0

The output for the partial correlation above is a matrix of correlations for the variables **Time** and **Distance** but controlling for the effect of **Gender**. Note that the top and bottom of the table contain identical values, so we can ignore one half of the table. First, notice that the partial correlation between **Time** and **Distance** is .820, which is slightly smaller than the correlation when the effect of gender is not controlled for ($r = .830$). The correlation has become slightly less statistically significant (its p -value has increased from .003 to .007). In terms of variance, the value of R^2 for the partial correlation is .672, which means that time spent shopping now shares 67.2% of the variance in distance covered when shopping (compared to 68.9% when gender was not controlled). Running this analysis has shown us that time spent shopping alone explains a large portion of the variation in distance covered.