Research Methods 2 Week 12: Exercise Sheet 1 Solution sheet

Question 1

{remember that in questions which involve data generation the answers given here may not be *precisely* the same as yours}

The Tally command applied to column C2 gives

Tally for Discrete Variables: C2

C2 Count 0 784 1 1216 N= 2000

Recall that C2 is 1 if the corresponding P-value in C1 is less than 0.05 and 0 otherwise. This shows that 1216 of the 2000 *t*-tests gave P < 0.05. In other words for samples of sizes 10 and 12 the *t*-test has a power of 1216/2000 = 0.61 to detect a difference between population means of 14 and 15 when the population SD is 1.

Repeating the exercise but with a population SD of 2 gives

Tally	for Di	screte Vari	ables: C4			
C4	Count					
0	1607					
1	393					
N=	2000					

Now the proportion of *t*-tests yielding P < 0.05 is 393/2000 = 0.20. In other words the power to detect the same difference in means as above has dropped substantially because of the increase in the population SD.

This is reasonable: if the variable you are analysing is intrinsically more variable then the ability to detect a specified difference is inevitably going to be reduced.

The dependence of the power of a test on the difference in population means and on sample sizes was discussed in the study document. This question demonstrates that the power of a test also depends on the common SD.

If you invoke the macro by entering

MTB > %ttestpow 15 15 1 10 12 c5 c6 2000

In the Session window, you obtain the following tally table:

Tally for Discrete Variables: C6

C6 Count 0 1882 1 118 N= 2000

Of the 2000 *t*-tests, 118 have yielded P < 0.05, i.e a proportion 118/2000 = 0.059 = 5.9%.

This command has performed 2000 *t*-tests for the case when the null hypothesis is true, i.e. the population means are the same The definition of the P-value is that in these circumstances P < 0.05 will occur in 5% of *t*-tests. This is braodly in line with the above result.

Question 2

The full extract from the paper[†] cited in the Exercise sheet is as follows

Statistical analyses

The sample size calculation was based on VAS (0-10 cm) for pain intensity, which was designated as the primary outcome measure. A sample size of 42 was determined to be sufficient to detect a difference of 1 cm with a *standard deviation of 2* cm to provide 90 percent power at the 0.05 significance level.

The items missing from the extract are shown in italics. While you could not know that the SD was 2 cm, it is clear that a standard deviation had to be specified. Also the level at which a difference was considered significant needed to be specified. Here a value of 0.05 or 0.01 might well have been anticipated. The phrase 'Type I error rate' would be an adequate alternative to significance level.

End of solution sheet

[†] Moulin, DE, Iezzi, A, Amireh, R, Sharpe, WKJ, Boyd, D, Merskey, H. (1996) Randomised trial of oral morphine for chronic non-cancer pain, Lancet, 347, 143-147.