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    839
 1   1161
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 1161 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 1161/2000 = 0.58 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 Discrete Variables: C2

```
C2  Count
 0   1611
 1    389
N=   2000
```

Now the proportion of *t*-tests yielding $P < 0.05$ is 389/2000 = 0.19. 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
```

then in the Session window, you obtain the following tally table:

Tally for Discrete Variables: C6

```
C6  Count
 0   1884
 1    116
N=   2000
```

Of the 2000 *t*-tests, 116 have yielded P < 0.05, i.e a proportion 116/2000 = 0.058 = 5.8%.

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 broadly 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.