Research Methods 2

Week 10: Exercise Sheet 1

Solution sheet

Question 1

This question applies the same technique to the technetium retention indices as was applied in the study document to the thallium indices. Clicking on **Stat** -> **Basic Statistics** -> **2-Sample t...**, entering the column of indices in the **Samples:** box and group membership in **Subscripts:** and remembering to check the **Assume equal variances box**, gives the following in the Session window

Two-Sample T-Test and CI: Tc99, Response

```
Two-sample T for Tc99

Response   N   Mean  StDev  SE Mean
-         14  -11.3   36.0      9.6
+         11   42.0   39.8       12


Difference = mu (-) - mu (+)
Estimate for difference:  -53.2403
95% CI for difference:  (-84.6352, -21.8453)
T-Test of difference = 0 (vs not =): T-Value = -3.51  P-Value = 0.002  DF = 23
Both use Pooled StDev = 37.6671
```

The sample SDs are similar, and if you plotted histograms of the data you would see that they cast no doubt on the assumption of Normality. In any case with such small samples, a degree of latitude is called for when making these judgments.

The key quantities in the above output have been highlighted in red. The P-value is 0.002. This indicates that if the mean retention index for technetium is the same among responders and non-responders, then a difference in means as large as that observed (namely -53.2%) occurs only 0.2% of the time. So, if the null hypothesis is true then the outcome of this study is a very rare event. A more rational inference is to conclude that the null hypothesis is false. The difference in means is –53.2%, and the 95% confidence interval indicates that this difference could be as large as –84.6% or as small as –21.8%.

Notice that the differences in the above paragraph all refer to the difference taken in the direction non-responders – responders, so a negative difference means that retention index is larger for the responders. The direction of the difference is given in the line starting `Difference = …` in the above output.

Question 2

If the data in the question are typed into columns C1 to C3 of Minitab and the unpaired *t*-test applied, as in question 1, to compare first C1 with C2 and then C1 with C3, then the following outputs are obtained.

Two-Sample T-Test and CI: C1, C2

```
Two-sample T for C1 vs C2

                        SE
     N   Mean  StDev  Mean
C1  10  129.0   63.8    20
C2  10  120.0   72.0    23


Difference = mu (C1) - mu (C2)
Estimate for difference:  9.00000
95% CI for difference:  (-54.91240, 72.91240)
T-Test of difference = 0 (vs not =): T-Value = 0.30  P-Value = 0.771  DF = 18
Both use Pooled StDev = 68.0237

MTB > TwoSample C1 C3;
SUBC>   Pooled.
```

Two-Sample T-Test and CI: C1, C3

```
Two-sample T for C1 vs C3

                        SE
     N   Mean  StDev  Mean
C1  10  129.0   63.8    20
C3  10  120.0   72.0    23


Difference = mu (C1) - mu (C3)
Estimate for difference:  9.00000
95% CI for difference:  (-54.91240, 72.91240)
T-Test of difference = 0 (vs not =): T-Value = 0.30  P-Value = 0.771  DF = 18
Both use Pooled StDev = 68.0237
```

The outputs are identical. The results of an unpaired *t*-test are unaffected by the order in which the data are entered.

End of solution sheet