Instructions for carrying out statistical procedures and tests using Minitab

These instructions are closely linked to the author's book:

Essential Statistics for the Pharmaceutical Sciences
John Wiley & Sons Ltd http://eu.wiley.com
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For all references to chapters or tables, see the above book.

Using Minitab to perform a two-sample t-test

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Example: Table 6.1 Clearance of theophylline (ml/min/kg) for control subjects and for those pre-treated with rifampicin.

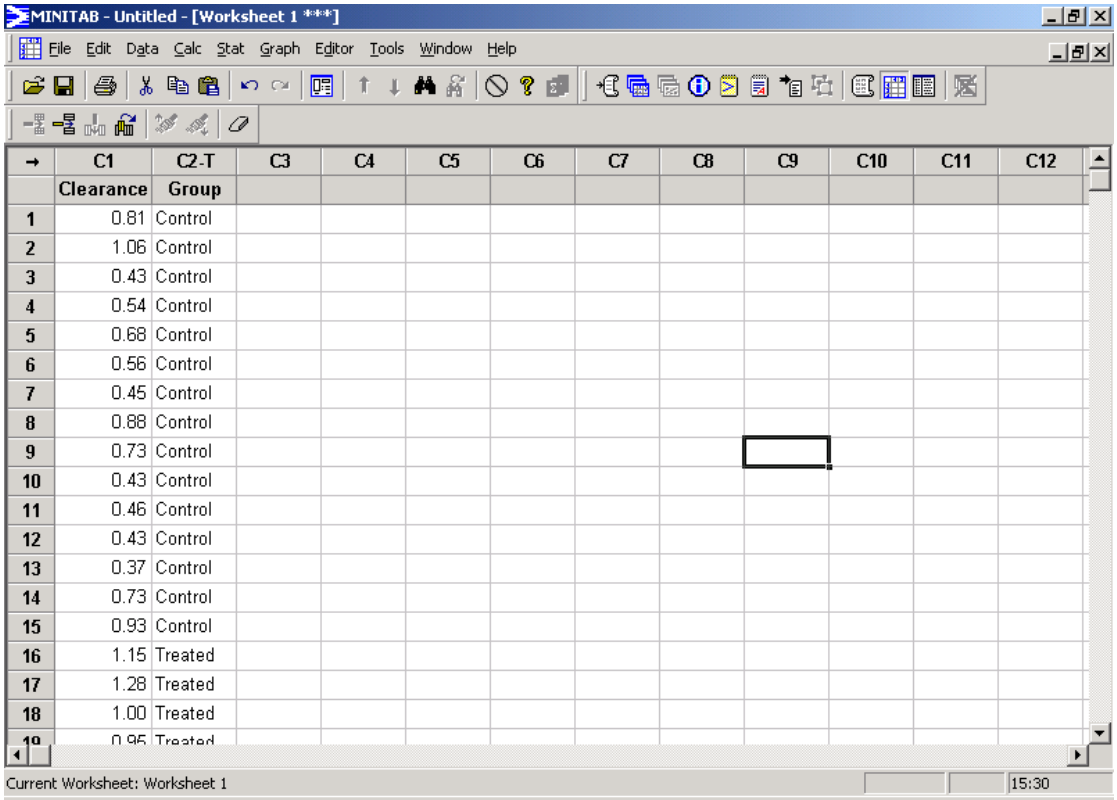
Method 1: All the data in a single column

Label column 1 as ' Clearance' and enter the control clearances into the first 15 rows and the treated values into rows 16-30.

Label column 2 as 'Group' and enter 'Control' in the first 15 rows. (This can be done by typing 'Control' in the first cell and then placing the cursor over the bottom right hand corner of the cell and dragging downwards.) Enter 'Treated' in rows 16-30.

The Worksheet should then appear as in Fig 1:

Fig 1 Worksheet laid out for a 2-sample t-test.



	C1	C2-T	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
	Clearance	Group										
1	0.81	Control										
2	1.06	Control										
3	0.43	Control										
4	0.54	Control										
5	0.68	Control										
6	0.56	Control										
7	0.45	Control										
8	0.88	Control										
9	0.73	Control										
10	0.43	Control										
11	0.46	Control										
12	0.43	Control										
13	0.37	Control										
14	0.73	Control										
15	0.93	Control										
16	1.15	Treated										
17	1.28	Treated										
18	1.00	Treated										
19	0.95	Treated										

Follow the menus *Stat / Basic Statistics / 2-Sample t …*

Click in the box labelled 'Samples:' and then double click on 'C1 Clearance' in the left hand box. Clearance should appear in the Samples box. (You have told Minitab that the data to be analysed are the Clearance values.)

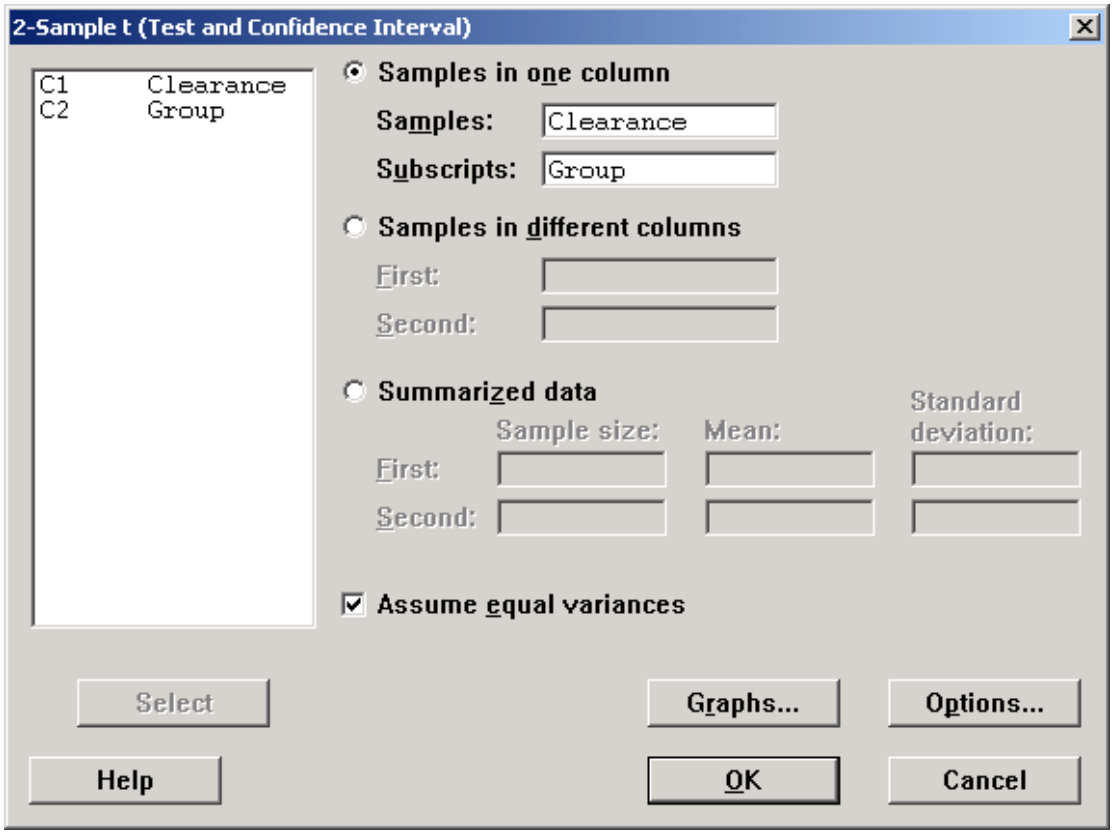
Click in the box labelled 'Subscripts:' and then double click on 'C2 Group' in the left hand box. Group should appear in the Subscripts box. (You have told

Minitab that the data should be split into two sets based on the value in the second column.)

In Section 6.5.1 of the book, it is explained that the classical t-test assumes that the two samples are from populations with equal SDs, but that there is a variant test (Welch's approximate t) which does not make this assumption. Minitab's default is Welch's version. If you want the classic test, you will need to check the box labelled 'Assume equal variances'.

The 2-Sample t box should now appear as in Fig 2:

Fig 2: Completed 2-Sample t box



Clicking OK should produce this output:

Two-Sample T-Test and CI: Clearance, Group

```
Two-sample T for Clearance

Group     N   Mean  StDev  SE Mean
Control  15  0.633  0.216    0.056
Treated  15  0.931  0.202    0.052

Difference = mu (Control) - mu (Treated)
Estimate for difference:  -0.298667
95% CI for difference:  (-0.455184, -0.142149)
T-Test of difference = 0 (vs not =): T-Value = -3.91  P-Value = 0.001  DF = 28
Both use Pooled StDev = 0.2093
```

You are told that a two-sample t-test has been performed and that the data was Clearance and that this was split based upon the Group. You are presented with the Mean, SD and S.E.M. for both samples. Then you get the line 'Difference = mu (Control) – mu (Treated)'. The term 'mu' is used in place of the Greek letter 'μ' – which represents the mean. So the difference is calculated as the mean for the control subjects minus the mean for the treated ones and the point estimate for that difference is given on the next line as -0.298667. The manner in which Minitab presents the result is doubly unfortunate. First, the number of decimal places quoted is ludicrous. Secondly, Minitab will insist on ordering the groups alphabetically, so with the labels we chose, you will always get the difference calculated as a negative figure although we saw an increase in clearance. For our purposes we will swap all minus values to plus and vice-versa. The point estimate for the change in clearance is +0.299 ml/min/kg

The key line is the next one. The 95% confidence interval for the difference in theophylline clearances is +0.142 to +0.455 ml/min/kg (Ignoring excess decimal places).

The CI excludes zero, so we have significant evidence of an effect of rifampicin. (See Chapter 6 for explanation.)

The P value is presented on the penultimate line as 0.001. As this is less than 0.05, a significant result is confirmed (See Chapter 7 for full explanation of P values.)

Method 2: Data in two columns

A two-sample t-test test can alternatively be performed in Minitab by entering the data into two separate, suitably labelled columns (eg Control and Treated) and then following the same menus:

Stat / Basic Statistics / 2-Sample t…

In this case, you need to select the button for 'Samples in different columns'. You then have to complete 2 boxes labelled 'First:' and 'Second:' The test will work if we enter the controls as the First sample and the treated as the Second, or *vice versa*. However, Minitab will calculate the change in clearance as the First sample minus the Second sample. So, if we want an increase in clearance to register as a positive figure it is best to enter 'Treated' as the First sample and 'Control' as the Second.

As with the first method, you will have to select the option for 'Assume equal variances' if you want a classic two-sample t-test.

The output is then:

Two-Sample T-Test and CI: Treated, Control

```
Two-sample T for Treated vs Control

          N   Mean  StDev  SE Mean
Treated  15  0.931  0.202    0.052
Control  15  0.633  0.216    0.056

Difference = mu (Treated) - mu (Control)
Estimate for difference:  0.298667
95% CI for difference:  (0.142149, 0.455184)
T-Test of difference = 0 (vs not =): T-Value = 3.91  P-Value = 0.001  DF = 28
Both use Pooled StDev = 0.2093
```

Interpretation of the output is essentially as for the first method.