

### 7.3. z and t tests for matched data

**EXAMPLE 7.3.** Weight loss by members of a fencing club during a 1-day competition

**BOX 7.4.** How to carry out a z and t test for matched data

**Step 1.** On a new spreadsheet, enter the data as shown. (The competitors' numbers are entered only as a means of identification and play no part in the calculation, so could be omitted).

The screenshot shows a Microsoft Excel spreadsheet with the following data:

	A	B	C	D	E	F	G	H	I	J
1										
2										
3	Competitor	Weight before competition (kg)	Weight after competition (kg)							
4	1	60	59.55							
5	2	59.15	58.7							
6	3	60.2	59.8							
7	4	62.4	61.9							
8	5	57.2	57.2							
9	6	60.35	59.85							
10	7	59.8	59.4							
11	8	60.1	60.1							
12	9	60.2	59.9							
13	10	59.9	59.9							
14	11	60	60							
15	12	61.2	60.75							
16	13	58.5	58.05							
17										

The 't-Test: Paired Two Sample for Means' dialog box is open, showing the following settings:

- Variable 1 Range: \$B\$3:\$B\$16
- Variable 2 Range: \$C\$3:\$C\$16
- Hypothesized Mean Difference: 0
- Labels:
- Alpha: 0.05
- Output Range: \$A\$19:\$E\$26
- Output options:  Output Range,  New Worksheet Ply,  New Workbook

**Step 2.** Having entered the data, on the tool bar select 'Tools' and then 'Data Analysis' from the drop-down menu. From the three versions of the t test available, select 't-Test: Paired Two-Sample for Means'. Complete the dialogue box as shown below. Note that the sample names are included in the data cells and the 'Labels' box is ticked.

**Step 3.** As you can see, descriptive statistics are returned for each sample, and also a value for the Pearson correlation, which gives a value for the possible **association** between the data. (This may be used if the data meet all the criteria for using this test. Otherwise these results should be ignored.)

The screenshot shows an Excel spreadsheet with the following data:

	A	B	C	D
19	t-Test: Paired Two Sample for Means			
20				
21		<i>Weight before competition (kg)</i>	<i>Weight after competition (kg)</i>	
22	Mean	59.92307692	59.62307692	
23	Variance	1.51650641	1.359423077	
24	Observations	13	13	
25	Pearson Correlation	0.985534317		
26	Hypothesized Mean Difference	0		
27	df	12		
28	t Stat	5.05245215		
29	P(T<=t) one-tail	0.000141679		
30	t Critical one-tail	1.782286745		
31	P(T<=t) two-tail	0.000283357		
32	t Critical two-tail	2.178812792		
33				
34				
35				

The results are given in two columns as summary statistics for each data set and then the statistical analysis is given. The  $t$  statistic is given and should be compared with the value for the two-tailed  $t_{\text{critical}}$  value. Note that the  $t$  statistic in this example is positive, showing that the mean mass before the competition is greater than the mean mass after the competition. Refer to values for  $p$  and the critical value of  $t$  for the two-tailed test. The critical value of  $t$  is smaller than the calculated  $t$  statistic, so the result is statistically significant and the null hypothesis can be rejected. The actual probability for this value of  $t$  is 0.000283, which indicates that the result is highly statistically significant.