
7.2. *t* test (Student's *t* test) for unmatched samples

EXAMPLE 7.2. The evolution of *Littorina littoralis* at Porthcawl, 2002

BOX 7.3. How to carry out a *t* test for unmatched data

Step 1. **Parametric** statistical tests are accessed through the Analysis Tool Pack which is activated via the add-in option under Tools on the tool bar. Select Tools. On the drop-down menu, select Add-ins and from the dialogue box check the square for Analysis toolkit. Returning to the Tools option, you should now find that Data Analysis is added to the drop-down menu. You are now ready to complete a parametric test.

Step 2. To determine whether a *t*-test can be used, first check that the **variances** of the two sets of data are similar using the F test (BOX 7.1.).

Use the f_x wizard to find the variances and construct a formula to divide the larger variance by the smaller as shown with the *z*-test.

Step 3. Insert the data into a new spreadsheet as shown.

The screenshot shows the Microsoft Excel interface with a data table. The table has three columns: A, B, and C. Column A is labeled 'Periwinkles on lower shore' and Column B is labeled 'Periwinkles on mid shore'. The data rows are numbered 1 through 16. Row 1 is empty. Rows 2-15 contain numerical data for the two categories. Row 16 is empty.

	A	B	C
1			
2	Periwinkles on lower shore	Periwinkles on mid shore	
3	5.5	3.3	
4	8.4	6.3	
5	5	6.1	
6	5	8	
7	5.6	13.5	
8	4.8	5.3	
9	8.4	6.7	
10	4	6.7	
11	5	5.7	
12	6.2	4.2	
13	5	6.3	
14	7.7	6	
15	6	7.2	
16			

On the tool bar, select 'Tools' and then 'Data Analysis' from the drop down menu. In Excel there are three versions of the *t*-test to choose from:

- t*-Test: Two-Sample Assuming Equal Variances
- t*-Test: Two-Sample Assuming Unequal Variances
- t*-Test: Paired Two-Sample for Means

From these three versions of the *t*-test select: '*t*-Test: Two-Sample Assuming Equal Variances'. Complete the dialogue box as shown below. Note that the sample names are included in the data cells and the 'Labels' box is ticked.

t-Test: Two-Sample Assuming Equal Variances

Input

Variable 1 Range: \$A\$2:\$A\$15

Variable 2 Range: \$B\$2:\$B\$15

Hypothesized Mean Difference: 0

Labels

Alpha: 0.05

Output options

Output Range: \$G\$18:\$K\$24

New Worksheet Ply:

New Workbook

OK

Cancel

Help

Step 4. Select output options. To return the output data below the input data, select 'Output Range:' and then click in the box (the cursor will now flash in the box). Drag over an area where you want the results to be displayed. Note that you could just select a couple of cells – Excel will determine the actual size that it requires for the results table. Note too, that it is essential to click in the box as well as selecting the 'Output Range' button. If this is not done the location is entered into the 'Input Range' box and the analysis cannot be completed.

You can choose to have the results entered on to a 'New Worksheet Ply', in which case the results will be given on a fresh sheet, accessed by the tabs at the bottom of the current sheet. Alternatively a 'New Workbook' can be selected as previously described. Click on OK.

t-Test: Two-Sample Assuming Equal Variances		
	<i>Periwinkles on lower shore</i>	<i>Periwinkles on mid shore</i>
Mean	5.892307692	6.561538462
Variance	2.012435897	5.822564103
Observations	13	13
Pooled Variance	3.9175	
Hypothesized Mean Difference	0	
df	24	
t Stat	-0.862041306	
P(T<=t) one-tail	0.198598325	
t Critical one-tail	1.710882316	
P(T<=t) two-tail	0.39719665	
t Critical two-tail	2.063898137	

Step 5. The output data are given in two columns as summary statistics for each data set and then the statistical analysis is given. Note that the t statistic in this example is negative. This sign can be ignored as it relates to the order in which the data was entered; the mean of data set 1 being smaller than the mean of data set 2.

Refer to values for p and the critical value of t for the **two-tailed test**. The critical value of t is greater than the calculated t statistic so the result is not significant and the null hypothesis cannot be rejected. The actual probability for this value of t is 0.397 which, being greater than 0.05, confirms that the result is not significant. Note that a critical value is also given for a one-tail test so if the data were suitable for a one-tail test the same procedure would be carried out. You must be certain which critical value is appropriate for the analysis you are performing.