

## T Tests in Excel

**Example 1 (1-sample T-Test):** The data file Score.xlsx has final scores for the STATS 101 class at a university. Test if the true mean  $\mu$  for STATS 101 class equals 90.

This problem is formulated as testing  $H_0: \mu = 90$  vs.  $H_1: \mu \neq 90$ .

Start with SCORE data in cells A2:A61. Microsoft Excel does not have a 1-sample t-test function, so you need to compute the mean (Figure 1a), sd (Figure 1b), the t-statistic (Figure 1c) in Excel from the following formula:

$$t_{OBS} = \frac{\bar{x} - \mu_0}{s / \sqrt{n}} = \frac{\bar{x} - 90}{s / \sqrt{n}}$$

and then using the Excel function `tdist` to compute the P-value using the formula  $P\text{-value} = 2 \times P(t_{n-1} > |t_{OBS}|)$  as shown in Figure 1d.

Note that `'=tdist(|tOBS|,n-1,2)` gives the P-value for 2-sided alternative (Figure 1d), and

`'=tdist(|tOBS|,n-1,1)` gives the P-value for 1-sided alternative.

	A	B	C	D	E
1	Score	n	60		
2		76 mu0	90		
3		85 xbar	74.88333333		
4		78 sd	10.61673075		
5		70 t_obs	-11.02911991		
6		78 P-Value	5.76993E-16		
7		75			
8		73			
9		7n			

Figure 1a: Computing xbar in Excel

	A	B	C	D	E
1	Score	n	60		
2		76 mu0	90		
3		85 xbar	74.88333333		
4		78 sd	10.61673075		
5		70 t_obs	-11.02911991		
6		78 P-Value	5.76993E-16		
7		75			

Figure 1a: Computing sd in Excel

	A	B	C	D	E	F
1	Score	n	60			
2		76 mu0	90			
3		85 xbar	74.88333333			
4		78 sd	10.61673075			
5		70 t_obs	-11.02911991			
6		78 P-Value	5.76993E-16			
7		75				

Figure 1c: Computing t<sub>obs</sub> in Excel

	A	B	C	D	E
1	Score	n	60		
2		76 mu0	90		
3		85 xbar	74.88333333		
4		78 sd	10.61673075		
5		70 t_obs	-11.02911991		
6		78 P-Value	5.76993E-16		
7		75			

Figure 1d: Computing P-value in Excel

## T Tests in Excel

**Example 2 (2 Independent Samples T-Test):** Measured weights of 20 '3 lbs hamburger meat' packets from Grocery store A and 15 from Grocery Store B are given in the data file Weights.xlsx. Test to see if the true means of '3 lbs hamburger meat' packets from Grocery store A and Grocery Store B are equal.

The null hypothesis  $H_0: \mu_1 = \mu_2$  is to be tested vs. the alternative  $H_1: \mu_1 \neq \mu_2$ .

Start with Grocery Store A data in cells A2:A21 and Grocery Store B data in cells B2:B16.

Go to Cell E2, and click on Formulas/More Functions/Statistical/TTEST, select range A2:A21 as Array1, and B2:B16 as Array2, Tails = 2 (for 2-sided alternative), and Type = 2 for running the t-test for Equal Variances Case, and click OK (see Figure 2a), which will return P-value of 0.063191.

The screenshot shows an Excel spreadsheet with two columns of data, A and B. Column A contains 20 values, and column B contains 15 values. A formula bar at the top shows the TTEST function: `=TTEST(A2:A21,B2:B16,2,2)+TTEST(A2:A21,B2:B15,2,2)`. A dialog box titled 'Function Arguments' is open, showing the following arguments:

- Array1: A2:A21
- Array2: B2:B16
- Tails: 2
- Type: 2

The dialog box also displays the formula result as 0.120485116 and includes a 'Help on this function' link. The spreadsheet shows the following data:

	A	B
1	A	B
2	3	2.65
3	2.95	2.83
4	3	3.1
5	2.94	2.81
6	3	3.67
7	3.02	2.93
8	2.95	2.92
9	2.95	3.15
10	2.95	3.04
11	3.05	2.87
12	3.05	3.3
13	2.96	3.45
14	2.94	3.53
15	2.95	3.51
16	3.07	3.01
17	3.03	
18	2.94	
19	2.93	
20	2.96	
21	3.05	

Figure 2a: Running 2-sample T-Test for Equal Variance case

## T Tests in Excel

The T-Test for Unequal variances Case is run the same way, the only difference is that Type = 3 in this case. The P-values for the 2-sample T-Test run both ways are shown below:

	P-Value
Equal Variances Assumed	0.063191
Unequal Variances	0.116863

Since the P-values in both cases > .05, the null hypothesis of equal means is not rejected for data of Example 2.

**Example 3 (Paired T-Test):** The data file Burger\_Sales.xlsx shows daily sales of two adjacent fast food places for 14 randomly selected days. Test to see if the average sales of the two fast food restaurants are equal.

The data in this example is *PAIRED* since the *sales for the two restaurants are for same day, and we will need to run the paired T Test for this example*. Start with data in cells A2:A15 (McB sales) and B2:B15 (DK sales), and click on Formulas/More Functions/Statistical/TTEST. Select input ranges, Tails = 2, Type = 1 (for Paired T-Test), click on OK (Figure 3), to get P-value of 0.033599. Since the P-value for Example 3 data is < .05, we conclude that the average sales at the two stores are not equal.

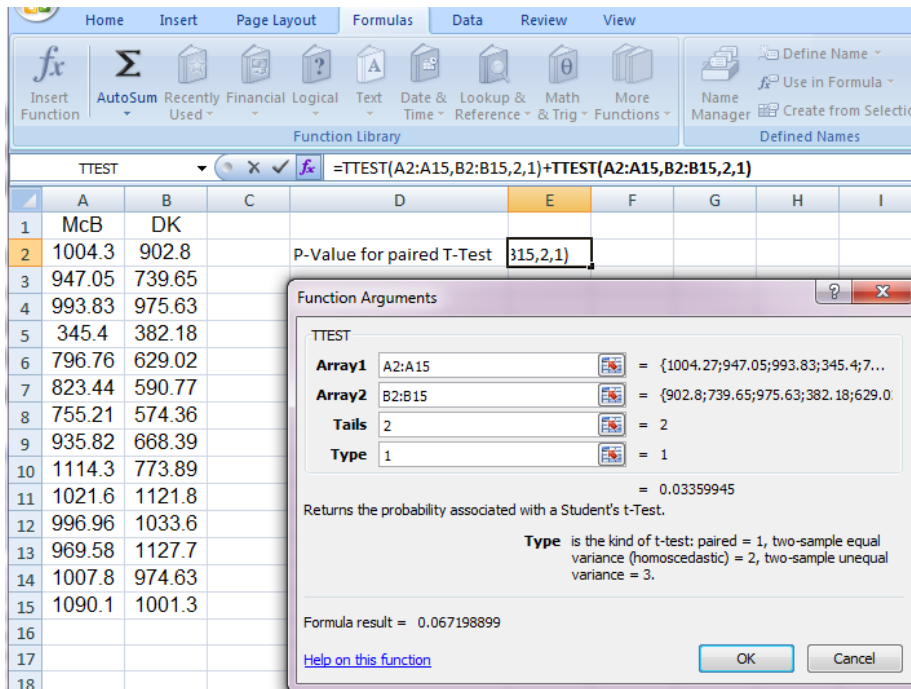


Figure 3: Running Paired T-Test for Example 3