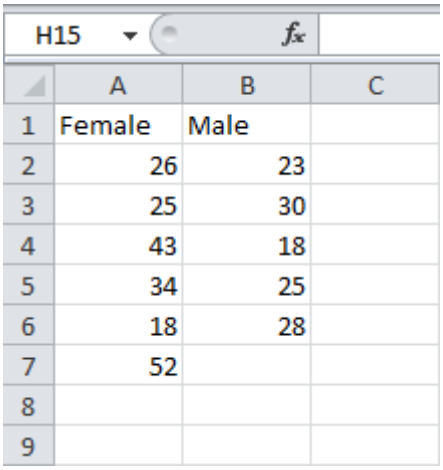
3- F-Test

This example teaches you how to perform an F-Test in Excel. The F-Test is used to test the null hypothesis that the variances of two populations are equal.

Below you can find the study hours of 6 female students and 5 male students.

H0: $\sigma 12 = \sigma 22$

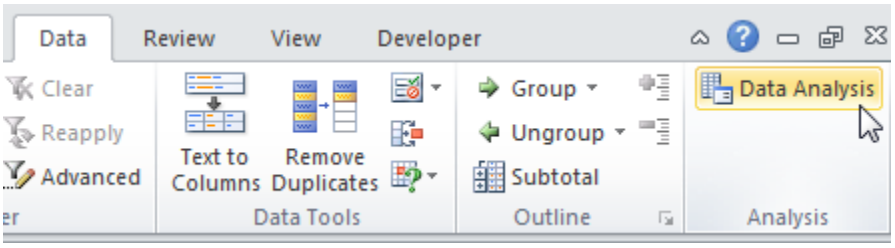
H1: $\sigma 12 \neq \sigma 22$



	A	B	C
1	Female	Male	
2	26	23	
3	25	30	
4	43	18	
5	34	25	
6	18	28	
7	52		
8			
9			

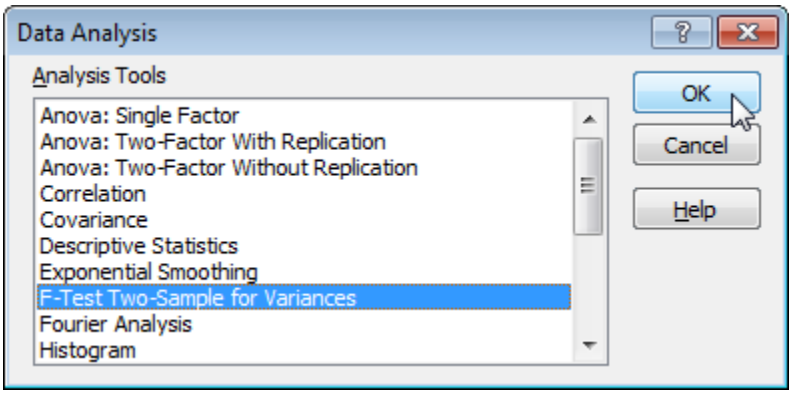
To perform an F-Test, execute the following steps.

1. On the Data tab, click Data Analysis.



Note: can't find the Data Analysis button? Click here to load the Analysis ToolPak add-in.

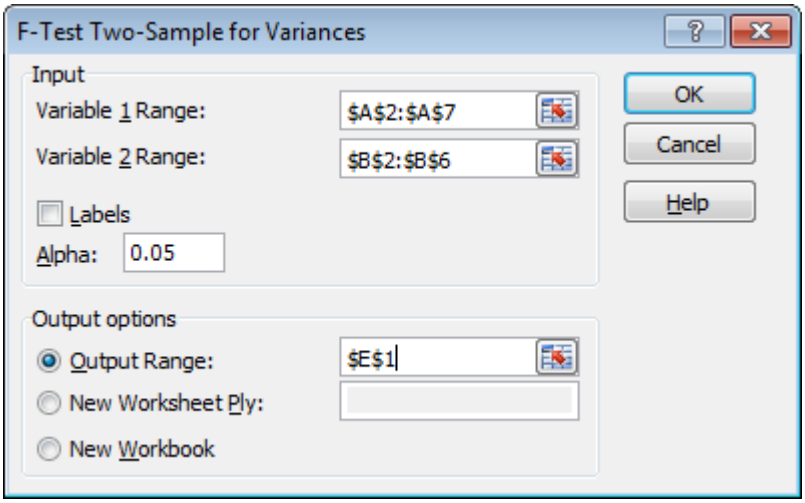
2. Select F-Test Two-Sample for Variances and click OK.



3. Click in the Variable 1 Range box and select the range A2:A7.

4. Click in the Variable 2 Range box and select the range B2:B6.

5. Click in the Output Range box and select cell E1.



6. Click OK.

Result:

E	F	G
F-Test Two-Sample for Variances		
	Variable 1	*Variable 2*
Mean	33	24.8
Variance	160	21.7
Observations	6	5
df	5	4
F	7.373271889	
P(F<=f) one-tail	0.037888376	
F Critical one-tail	6.256056502	

Important: be sure that the variance of Variable 1 is higher than the variance of Variable 2. This is the case, 160 > 21.7. If not, swap your data. As a result, Excel calculates the correct F value, which is the ratio of Variance 1 to Variance 2 (F = 160 / 21.7 = 7.373).

Conclusion: if F > F Critical one-tail, we reject the null hypothesis. This is the case, 7.373 > 6.256. Therefore, we reject the null hypothesis. The variances of the two populations are unequal.

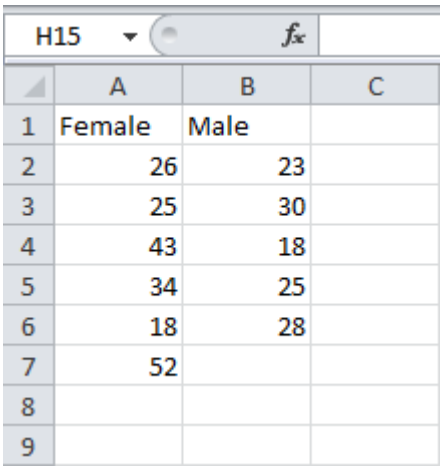
4- t-Test

This example teaches you how to perform a t-Test in Excel. The t-Test is used to test the null hypothesis that the means of two populations are equal.

Below you can find the study hours of 6 female students and 5 male students.

H0: $\mu 1 - \mu 2 = 0$

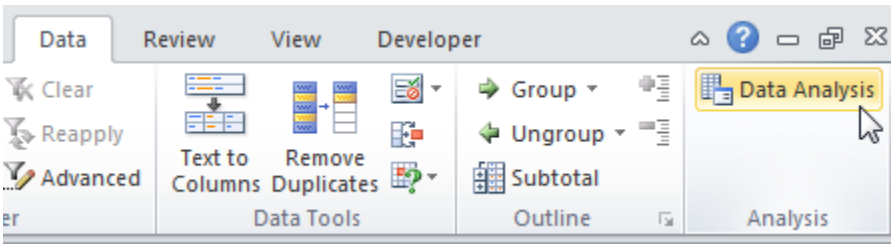
H1: $\mu 1 - \mu 2 \neq 0$



To perform a t-Test, execute the following steps.

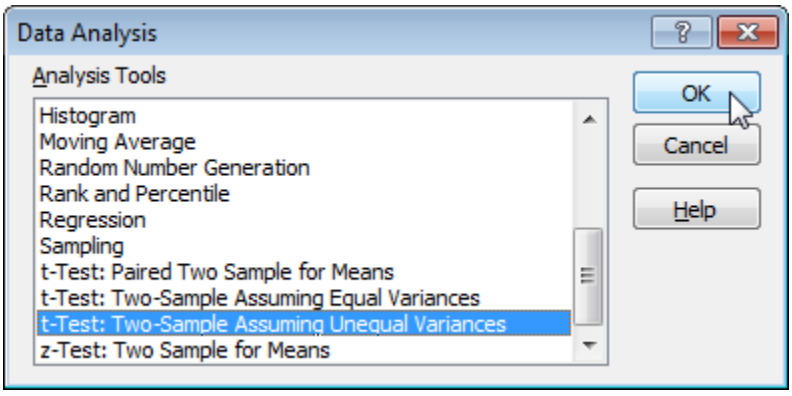
1. First, perform an F-Test to determine if the variances of the two populations are equal. This is not the case.

2. On the Data tab, click Data Analysis.



Note: can't find the Data Analysis button? Click here to load the Analysis ToolPak add-in.

3. Select t-Test: Two-Sample Assuming Unequal Variances and click OK.

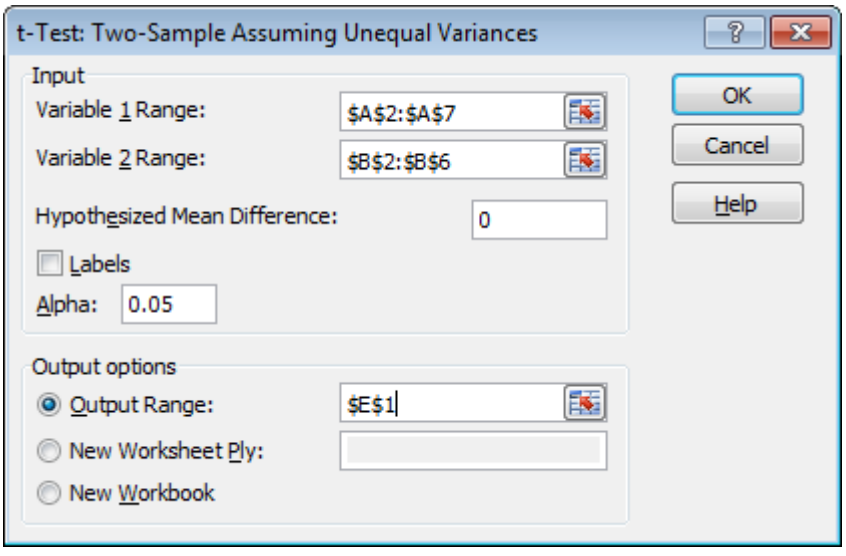


4. Click in the Variable 1 Range box and select the range A2:A7.

5. Click in the Variable 2 Range box and select the range B2:B6.

6. Click in the Hypothesized Mean Difference box and type 0 (H0: μ1 - μ2 = 0).

7. Click in the Output Range box and select cell E1.



8. Click OK.

Result:

E	F	G
t-Test: Two-Sample Assuming Unequal Variances		
	Variable 1	*Variable 2*
Mean	33	24.8
Variance	160	21.7
Observations	6	5
Hypothesized Mean Difference	0	
df	7	
t Stat	1.47260514	
P(T<=t) one-tail	0.092170202	
t Critical one-tail	1.894578605	
P(T<=t) two-tail	0.184340405	
t Critical two-tail	2.364624252	

Conclusion:

We do a two-tail test (inequality). lf t Stat < -t Critical two-tail or t Stat > t Critical two-tail, we reject the null hypothesis. This is not the case, -2.365 < 1.473 < 2.365. Therefore, we do not reject the null hypothesis. The observed difference between the sample means (33 - 24.8) is not convincing enough to say that the average number of study hours between female and male students differ significantly.

5- Paired Sample t Test

In paired sample hypothesis testing, a sample from the population is chosen and two measurements for each element in the sample are taken. Each set of measurements is considered a sample. Unlike the hypothesis testing studied so far, the two samples are not independent of one another. Paired samples are also called matched samples or repeated measures.

Example:

A clinic provides a program to help their clients lose weight and asks a consumer agency to investigate the effectiveness of the program. The agency takes a sample of 15 people, weighing each person in the sample before the program begins and 3 months later to produce the table below.

	A	B	C	D
1	**Two sample t test with paired samples**			
2				
3	Person	Before	After	Difference
4	1	210	197	13
5	2	205	195	10
6	3	193	191	2
7	4	182	174	8
8	5	259	236	23
9	6	239	226	13
10	7	164	157	7
11	8	197	196	1
12	9	222	201	21
13	10	211	196	15
14	11	187	181	6
15	12	175	164	11
16	13	186	181	5
17	14	243	229	14
18	15	246	231	15
19				
20	mean			10.933333
21	std dev			6.3298236

Determine whether the program is effective?

Solution

Let x = the difference in weight 3 months after the program starts. The null hypothesis is:

H0: $\mu = 0$; i.e. any differences in weight is due to chance

We use the Excel's t-Test: Paired Two Sample for Means data analysis tool or the T Test. The output from the Excel data analysis tool is shown below:

t-Test: Paired Two Sample for Means		
	Before	*After*
Mean	207.9333	197
Variance	815.781	595
Observations	15	15
Pearson Correlation	0.98372	
Hypothesized Mean Difference	0	
df	14	
t Stat	6.6897	
P(T<=t) one-tail	5.14E-06	
t Critical one-tail	1.76131	
P(T<=t) two-tail	1.03E-05	
t Critical two-tail	2.144787	

Note that the mean differences are the same, but the standard deviation for the paired sample case is lower, which results in a higher t-stat and a lower p-value. This is generally true.

Observation: Since the two sample paired data case is equivalent to the one sample case.