Running a Fisher's F-test in XLSTAT to assess the equality of variance of 2 samples

demoFisher.xls

Dataset for running a Fisher's F-test in XLSTAT to assess the equality of variance of 2 samples

An Excel sheet with both the data and the results can be downloaded by clicking here.

The data are from [Fisher M. (1936). The Use of Multiple Measurements in Taxonomic Problems. Annals of Eugenics, 7, 179 -188] and correspond to the sepal characteristics of 100 Iris flowers described by two variables (sepal length, sepal width). There are two different species included in this example: setosa and versicolor.

Goal of this tutorial

Our goal is to assess if there is a difference between the species for the sepal length and sepal width. We will then compare the distribution of these variables for the 2 samples.

Testing the Normality of the samples

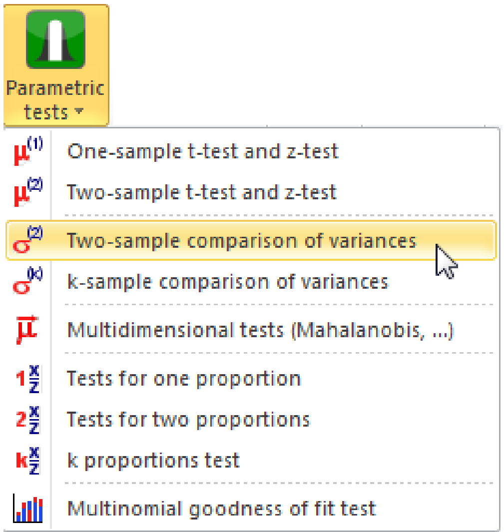
The first thing to do is to assess if the samples follow a Normal distribution as the Fisher F-test is sensitive to data that do not follow a normal distribution.

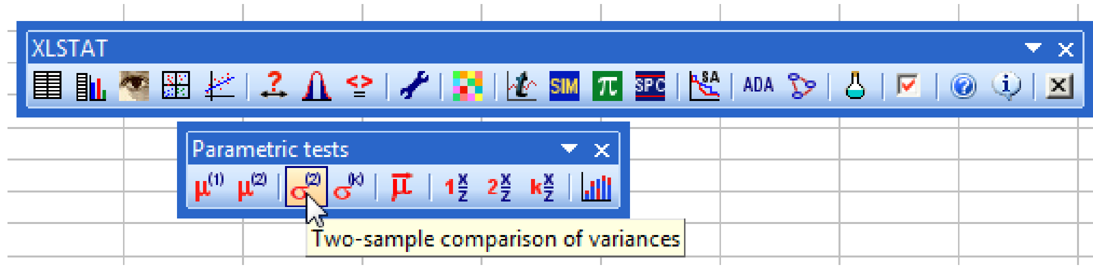
You will find those statistics computed in the Excel sheet. All 4 samples (Versicolor-Sepal length, Versicolor-Sepal width, Setosa-Sepal length, Setosa-Sepal width) follow a normal distribution.

Setting up a Fisher's F-test in XLSTAT to assess the equality of variance of 2 samples

Then we do a F-test to know if the variance are equal. If the variances are equal we can do a test to compare the averages.

To realize a two-sample comparison of variances test go to the menu bar **Parametric Tests / Two-sample comparison of variances**.





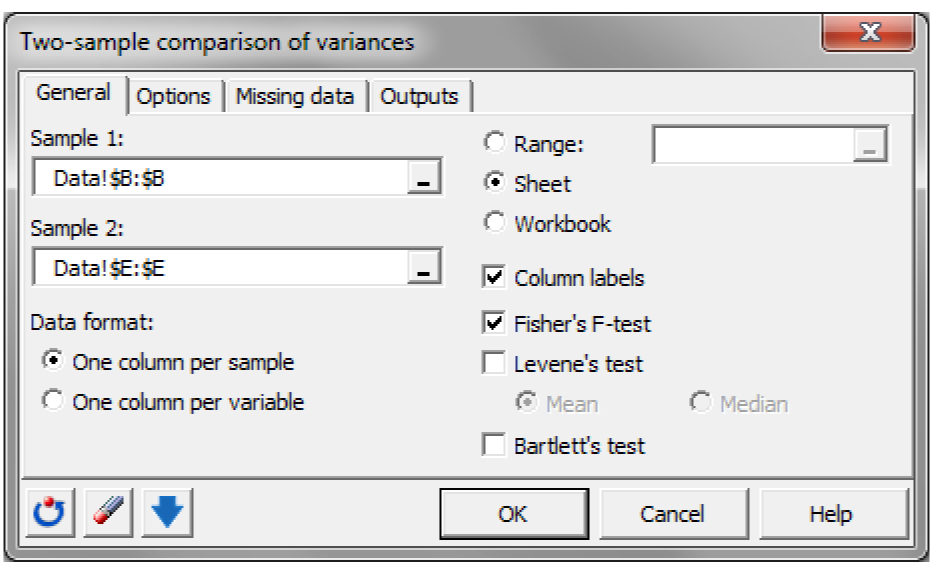
In the Two-sample comparison of variances dialog box, in the tab **General** select the data for the sample 1 and 2. For **Sample 1** select the column B containing the sepal length for the variety Versicolor and for the **Sample 2** the column E corresponding to the sepal length for the Setosa samples.

The **Data format** is **One column per sample** as each column corresponds to one of the samples.

We select the option **Sheet** to get the results in a new sheet of the workbook.

As the columns have a label the option **Column labels** should be enabled.

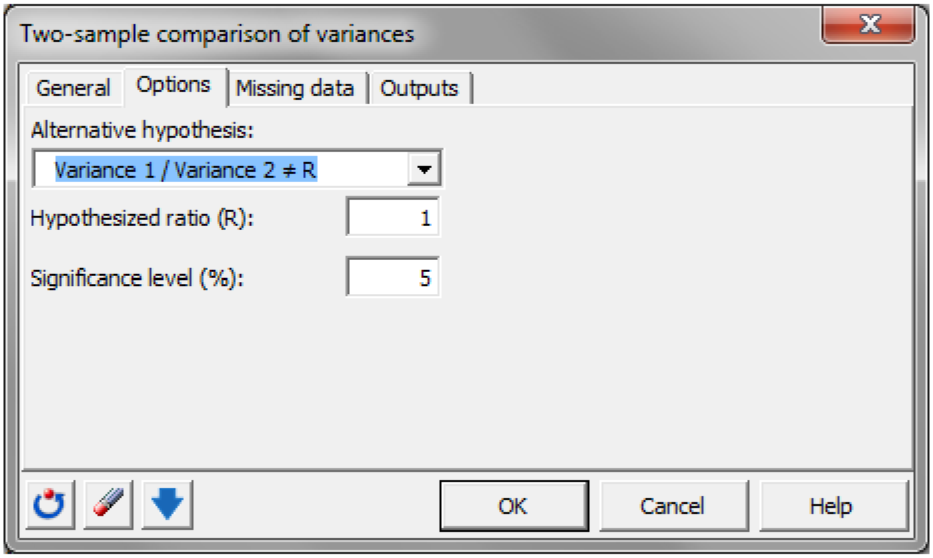
The test we decide to run is the **Fisher's F-test**.



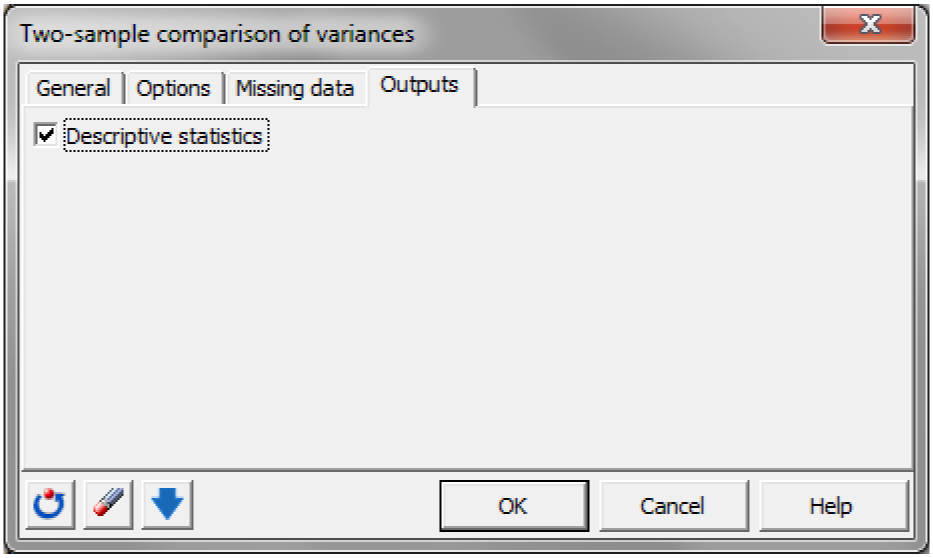
Once all these options are set we can move on to the tab **Options**.

We want to test the equality of variance which means that we need to test the **alternative hypothesis**: **Variance 1 / Variance 2 ≠ R** where **R** is 1.

The default significance level of 5% is to be kept.



We don't have missing data so we can go directly to the tab **Outputs** and enable the only available option: **Descriptive statistics**.



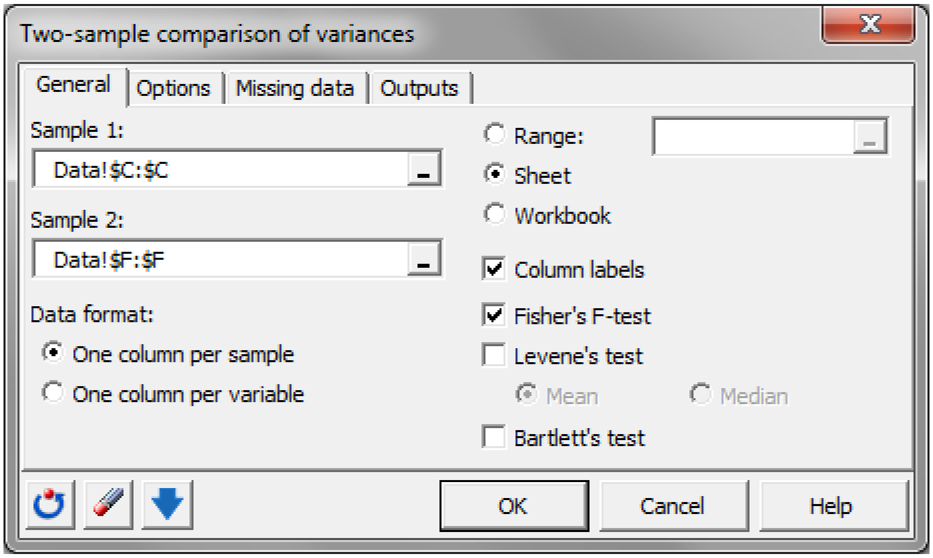
Press **OK**, when everything is set.

Results of a Fisher's F-test in XLSTAT to assess the equality of variance of 2 samples

The results that appear in a new sheet show that the H0 hypothesis should be rejected as the p-value 0.009 is inferior to our limit of 5%. Hence the variances cannot be considered as equal. The two populations -Versicolor and Setosa - sepal length do not follow the same distribution.

We are now going to do the same thing but for the sepal width.

The only change in the procedure described above is the data selection.
For **Sample 1** enlighten the column C and for **Sample 2** choose the column F.



This time the variances can be considered as equal as the p-value of the test (0.189) is superior to 0.05.

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
SEPAL WIDTH	50	0	50	20,000	34,000	27,700	3,138
SEPAL WIDTH(2)	50	0	50	23,000	44,000	34,280	3,791

Fisher's F-test / Two-tailed test:

95% confidence interval on the ratio of variances:

] 0,389; 1,208 [

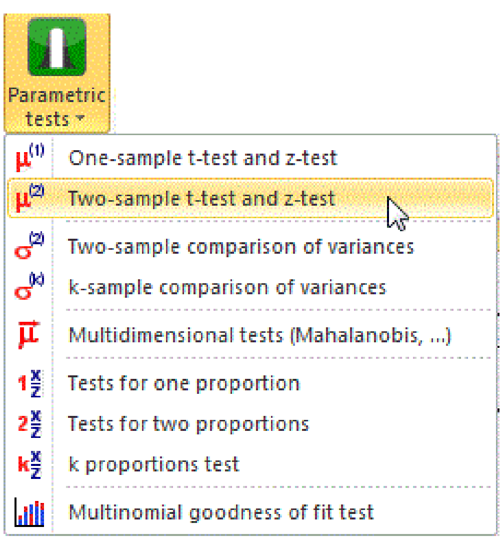
Ratio	0,685
F (Observed value)	0,685
F (Critical value)	1,762
DF1	49
DF2	49
p-value (Two-tailed)	0,189
alpha	0,05

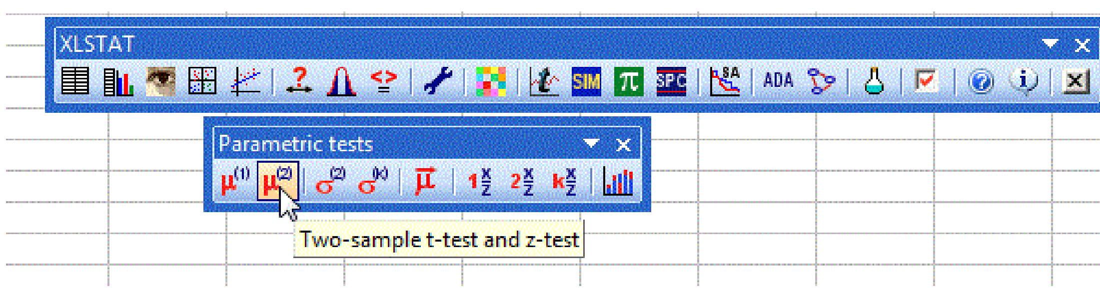
Test interpretation:
H0: The ratio between the variances is equal to 1.
Ha: The ratio between the variances is different from 1.
As the computed p-value is greater than the significance level alpha=0,05, one cannot reject the null hypothesis H0.
The risk to reject the null hypothesis H0 while it is true is 18,95%.

As the equality of variance or homoscedasticity is assumed we can run a test of comparison of mean.

You can notice in the **Descriptive statistic table** that the mean of the sepal width for Versicolor is inferior to the mean of Setosa for the same characteristic. Therefore we can run a one-tailed test for the test on the average.

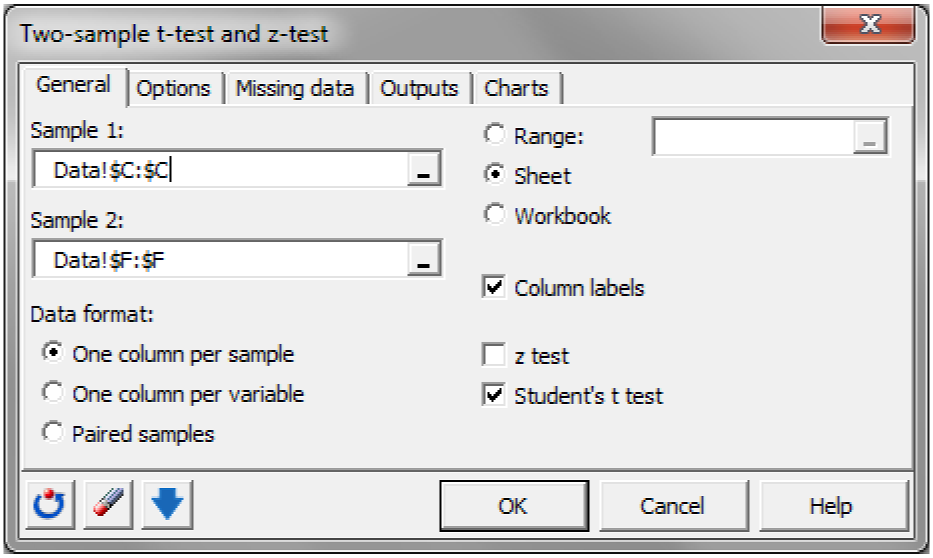
Go to the menu **Parametric tests / Two-sample t-test and z-test**





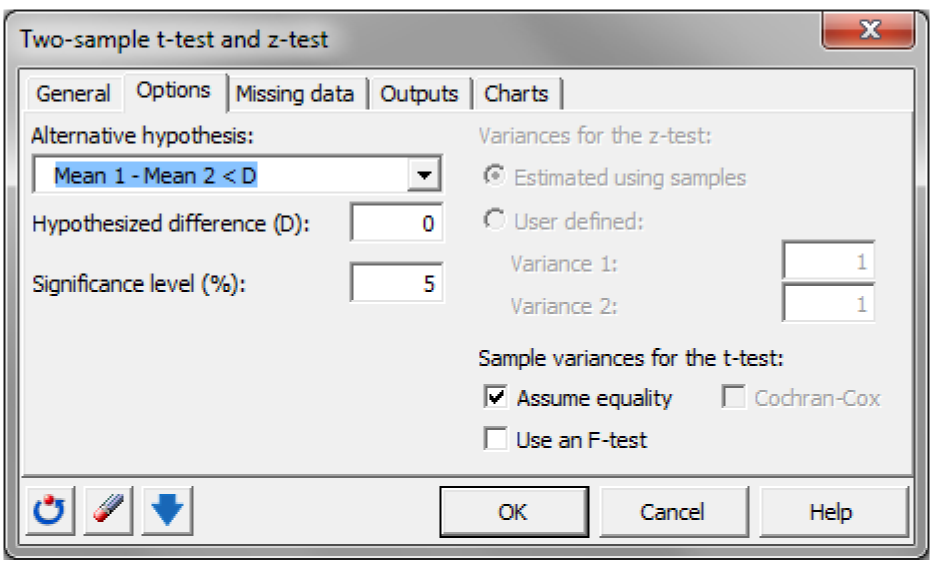
In the general tab do the same sample selection as previously for the sepal width.

Select the option **Student's test** as we do not know the true variances of the populations.



In the **Options** tab elect the alternative **Mean 1 – Mean 2 < D** where **D** is 0.

We can **Assume equality** for the variances as we just computed the test before.



Click on **OK**.

As can be seen in the results of this test, we conclude that there is significant difference between the two means, the sepal width of Versicolor iris being smaller than the sepal width of the Setosa iris. The two populations -Versicolor and Setosa - sepal width do not follow the same distribution.

t-test for two independent samples / Lower-tailed test:

95% confidence interval on the difference between the means:

] -Inf ; -5,424 [

Difference	-6,580
t (Observed value)	-9,455
t (Critical value)	-1,661
DF	98
p-value (one-tailed)	< 0,0001
alpha	0,05

Test interpretation:

H0: The difference between the means is equal to 0.

Ha: The difference between the means is lower than 0.

As the computed p-value is lower than the significance level alpha=0,05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0,01%.