

# Calculation of the required sample size or statistical power of a mean comparison test with XLSTAT-Power

[demoPowerMoy.xls](#)

XLSTAT-Pro includes several tests to compare means, namely the t and z tests. XLSTAT-Power allows estimating the power of these tests and calculates the number of observations required to obtain sufficient power.

When testing a hypothesis using a statistical test, there are several decisions to take:

- The null hypothesis  $H_0$  and the alternative hypothesis  $H_a$ .
- The statistical test to use.
- The type I error also known as alpha. It occurs when one rejects the null hypothesis when it is true. It is set a priori for each test and is 5 %.

The type II error or beta is less studied but is of great importance. In fact, it represents the probability that one does not reject the null hypothesis when it is false. We cannot fix it up front, but based on other parameters of the model we can try to minimize it. The power of a test is calculated as  $1 - \beta$  and represents the probability that we reject the null hypothesis when it is false.

We therefore wish to maximize the power of the test. The XLSTAT-Power module calculates the power (and beta) when other parameters are known. For a given power, it also allows to calculate the sample size that is necessary to reach that power.

The statistical power calculations are usually done before the experiment is conducted. The main application of power calculations is to estimate the number of observations necessary to properly conduct an experiment.

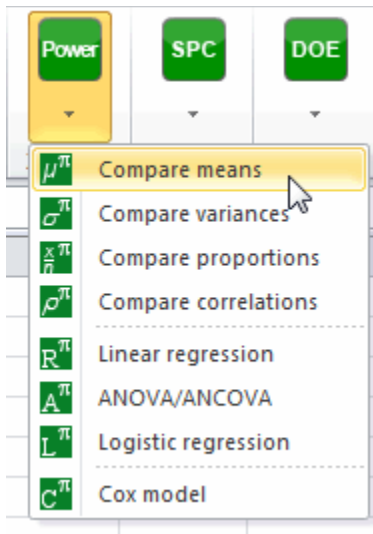
We place ourselves in a comparison of two independent samples. We want to know the number of observations required to obtain a power of 0.9 based on the t test based on the null hypothesis  $H_0: \text{Mean}_1 - \text{Mean}_2 = 0$ . Since we do not yet know the parameters of our samples, we will use the concept of effect size. Cohen (1988) introduced this concept which provides an order of magnitude for the effect size, that is to say, the relative difference between the means. So we will test three effect sizes: 0.2 for a small effect, 0.5 for a moderate effect and 0.8 for a strong effect. As the effect size is based on the difference between the means, it is expected that for a greater effect, the sample size required will be smaller.

## Dataset for the calculation of the statistical power of a mean comparison test

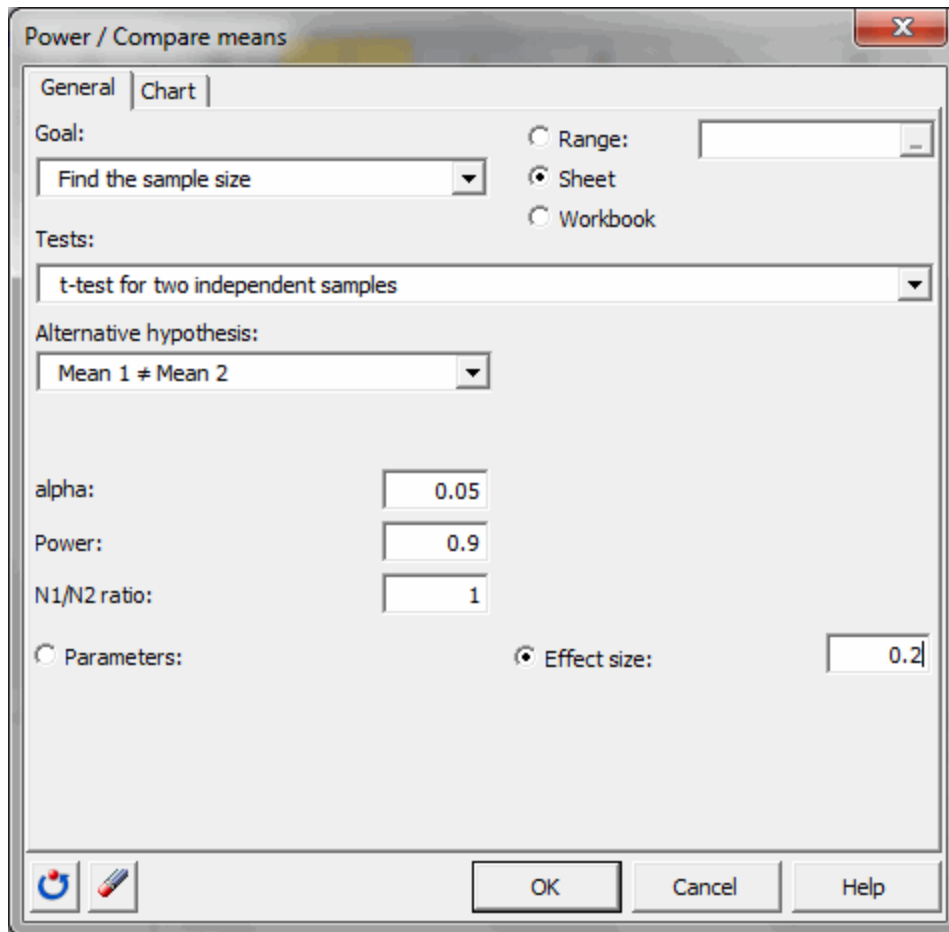
An Excel spreadsheet containing the results of this example can be downloaded by clicking [here](#).

## Setting up of the calculation of the statistical power of a mean comparison test

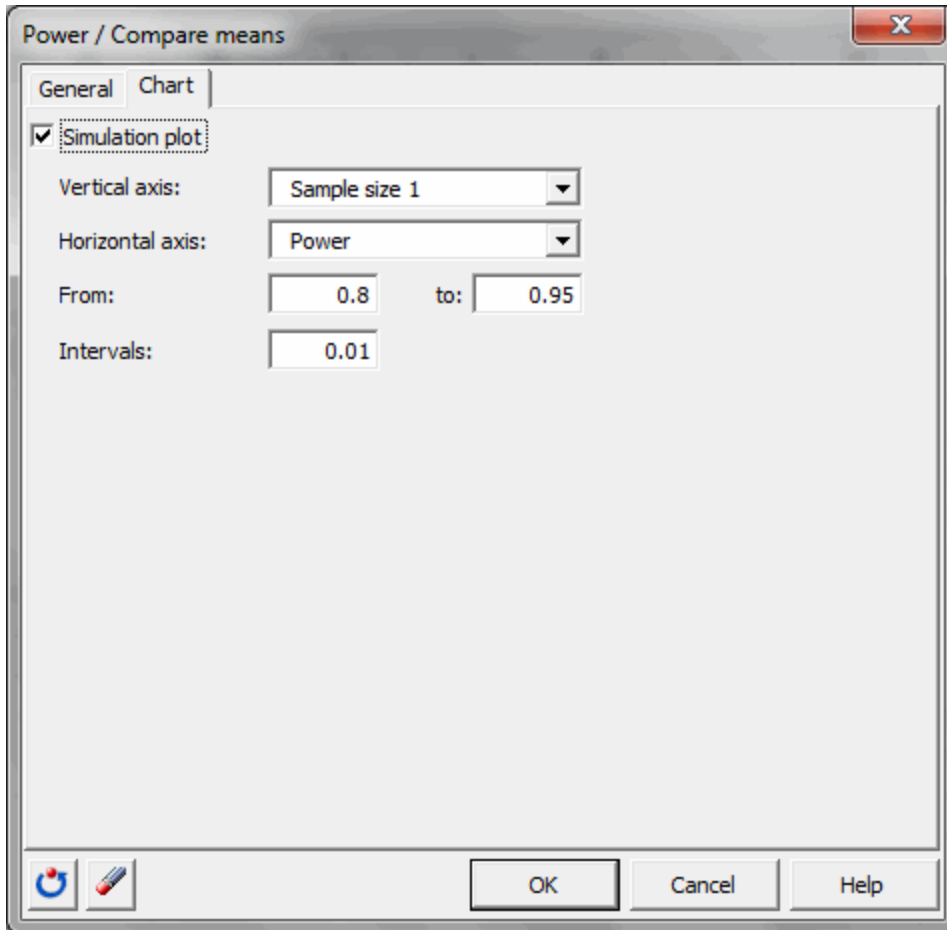
After opening XLSTAT, click the **Power** icon and choose **compare means**.



Once the button is clicked, the dialog box appears. You must then choose the objective **Find the sample size**, then select the test **t test for two independent samples**, we take as the alternative hypothesis **Mean 1 <> Mean 2**. The alpha is 0.05. The desired power is 0.9. We suppose our samples are of equal size so the **N1/N2 ratio is equal to 1**. Rather than detailed input parameters, we select the **effect size** option and enter the value 0.2 for a weak effect.



In the **Charts** tab, the option **simulation plot** is activated and the “size of sample 1” will be displayed on the **vertical axis** and the “power” on the **horizontal axis**. Power varies between 0.8 and 0.95 by increments of 0.01.



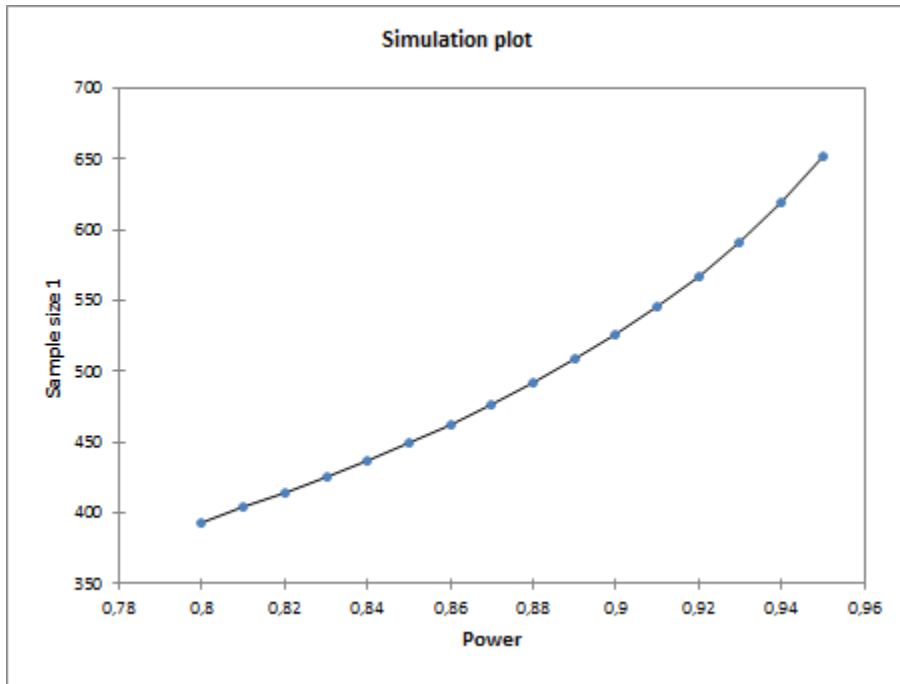
Once you have clicked the **OK** button, the calculations are made, and then the results are displayed.

## **Results of the calculation of the statistical power of a mean comparison test**

The first table shows the calculation results and an interpretation of the results.



The simulation plot shows the evolution of the sample size depending on the power. We see that for a power of 0.8, just slightly more than 393 observations per sample and as a power of 0.95 we get to 651 observations.



For effect sizes of 0.5 and 0.8, we obtain the following results:

Results:	
Parameters	Results
Power	0,900
alpha	0,05
Effect size	0,5
Sample size 1	85
Sample size 2	85
Power (obtained)	0,900

Results:	
Parameters	Results
Power	0,900
alpha	0,05
Effect size	0,8
Sample size 1	34
Sample size 2	34
Power (obtained)	0,902

The sample size will therefore fall as the difference between the means increases; we see that for a large difference, 34 observations per sample are sufficient.

XLSTAT-Power is a powerful tool both to investigate the sample size required for an analysis and to calculate the power of a test. Obviously, if the user has more information about the samples or populations, he may give details of the input parameters, rather than using the effect size.