When to perform a statistical test:

You can perform statistical tests on data that have been collected in a statistically valid manner – either through an [experiment](https://www.scribbr.com/frequently-asked-questions/what-is-experimental-design/), or through observations made using [probability sampling methods](https://www.scribbr.com/methodology/probability-sampling/).

For a statistical test to be [valid](https://www.scribbr.com/methodology/internal-vs-external-validity/), your sample size needs to be large enough to approximate the true distribution of the population being studied.

To determine which statistical test to use, you need to know:

* whether your data meets certain assumptions.
* the [types of variables](https://www.scribbr.com/methodology/types-of-variables/) that you’re dealing with.

. The choice of which statistical test to utilize relies upon the structure of data, the distribution of the data, and variable type.

Parametric statistical tests :

Parametric statistical tests are a group of statistical tests that make certain assumptions about the data. These tests are used to make inferences about a population based on a sample. The main assumption that these tests make is that the data is normally distributed. This means that the data follows a specific pattern where the values are evenly spread out around the mean. There are several different parametric statistical tests, including t-tests, ANOVA, and Pearson’s correlation. The following is the high-level detail of these parametric tests:

* [**Independent t-tests**](https://vitalflux.com/two-sample-t-test-formula-examples/): An independent t-test is a statistical test used to determine whether the means of two groups are statistically different from each other. This test is often used when the data in each group are supplied by different people or when the groups are randomly assigned. The independent t-test is a parametric test, meaning that it requires that the data be normally distributed. The benefits of using an independent t-test include that it is relatively easy to use and has high statistical power. Let’s understand individual t-tests with an example.

For example:

* a researcher might be interested in comparing the average reading scores of two groups of students
* one group that is taking a course in English literature and one group that is taking a course in math

. In this case, the researcher would use an independent t-test to compare the average reading scores of the two groups. The independent t-test allows for the comparison of two groups of unequal sizes. However, the independent t-test is limited to the comparison of two groups and cannot be used to compare more than two groups.

* **Paired t-tests**: The paired t-test is a statistical test that is used to compare the means of two groups. The groups are usually matched or paired together in some way.

**For example:**

* + you might have a group of people who receive a new treatment and a group of people who receive a placebo treatment. The two groups are then compared to see if there is a difference in the mean scores.

The paired t-test is also used to compare the pre-treatment and post-treatment scores of a single group of people.

* **ANOVA tests**: ANOVA tests are a type of statistical test that is used to compare the means of more than two groups. There are several different types of ANOVA tests, including one-way ANOVA, two-way ANOVA, and repeated measures ANOVA. Each type of ANOVA test is used to compare different combinations of groups. The benefits of using an ANOVA test include that it is relatively easy to use and has high statistical power.

**For example:**

* + One real-world example of the one-way ANOVA in action is a study that can be conducted to compare the GRE scores of students from different income levels and find whether there are significant differences between the means of the three groups. One possible outcome of the tests can be that the students from families with higher incomes tended to score higher on the GRE than students from families with lower incomes. This study can be used to assess and examine inequalities in society.
* **MANOVA tests**: MANOVA is a statistical test that is used to determine whether or not there are significant differences between two or more group means. It is similar to ANOVA, but it can be used with more than one dependent variable. MANOVA is a powerful statistical tool that can be used to examine the relationships between multiple dependent variables and a single independent variable. It can also be used to examine the relationships between multiple dependent variables and multiple independent variables. MANOVA is an important statistical test that should be used when investigating the relationships between multiple variables.

**For example:**

* Does a drug work? (Medicine)
* Are rich people living in the countryside happier? (Sociology)
* **F-test**: The [F-test](https://vitalflux.com/interpreting-f-statistics-in-linear-regression-formula-examples/) is a statistical test that is used to determine whether or not there is a significant difference between the variance of two or more groups.

**For example:**

The hypothesis that the [means](https://www.bing.com/ck/a?!&&p=61b08bf5d9e5013aJmltdHM9MTY5NDY0OTYwMCZpZ3VpZD0yOTAxMTcxZS0wNjI3LTY0NDAtMTIxMS0wNTAxMDc1YjY1NmEmaW5zaWQ9NTY2Nw&ptn=3&hsh=3&fclid=2901171e-0627-6440-1211-0501075b656a&u=a1L3NlYXJjaD9xPUFyaXRobWV0aWMlMjBtZWFuJTIwd2lraXBlZGlhJmZvcm09V0lLSVJF&ntb=1) of a given set of [normally distributed](https://www.bing.com/ck/a?!&&p=52630fcaa92af165JmltdHM9MTY5NDY0OTYwMCZpZ3VpZD0yOTAxMTcxZS0wNjI3LTY0NDAtMTIxMS0wNTAxMDc1YjY1NmEmaW5zaWQ9NTY2OA&ptn=3&hsh=3&fclid=2901171e-0627-6440-1211-0501075b656a&u=a1L3NlYXJjaD9xPU5vcm1hbCUyMGRpc3RyaWJ1dGlvbiUyMHdpa2lwZWRpYSZmb3JtPVdJS0lSRQ&ntb=1) populations, all having the same [standard deviation](https://www.bing.com/ck/a?!&&p=346347114ba60941JmltdHM9MTY5NDY0OTYwMCZpZ3VpZD0yOTAxMTcxZS0wNjI3LTY0NDAtMTIxMS0wNTAxMDc1YjY1NmEmaW5zaWQ9NTY2OQ&ptn=3&hsh=3&fclid=2901171e-0627-6440-1211-0501075b656a&u=a1L3NlYXJjaD9xPVN0YW5kYXJkJTIwZGV2aWF0aW9uJTIwd2lraXBlZGlhJmZvcm09V0lLSVJF&ntb=1), are equal. This is perhaps the best-known F-test, and plays an important role in the [analysis of variance](https://www.bing.com/ck/a?!&&p=5118857c4c55cca0JmltdHM9MTY5NDY0OTYwMCZpZ3VpZD0yOTAxMTcxZS0wNjI3LTY0NDAtMTIxMS0wNTAxMDc1YjY1NmEmaW5zaWQ9NTY3MA&ptn=3&hsh=3&fclid=2901171e-0627-6440-1211-0501075b656a&u=a1L3NlYXJjaD9xPUFuYWx5c2lzJTIwb2YlMjB2YXJpYW5jZSUyMHdpa2lwZWRpYSZmb3JtPVdJS0lSRQ&ntb=1) (ANOVA).

* **Z-test**: The Z-test is a statistical test that is used to determine the statistical significance of a difference between two groups. It is most commonly used when the groups are small. The Z-test is based on the standard normal distribution, which is a statistical model that assumes that all observations are drawn from a population that has a normal distribution. This test is used to determine whether the difference between the means of the two groups is statistically significant.

**For example:**

* [One-sample location test: Do students in an honors program have an average IQ score different than a hypothesized value of 100?](https://www.bing.com/ck/a?!&&p=cf86f78da5e1c056JmltdHM9MTY5NDY0OTYwMCZpZ3VpZD0yOTAxMTcxZS0wNjI3LTY0NDAtMTIxMS0wNTAxMDc1YjY1NmEmaW5zaWQ9NTk0NQ&ptn=3&hsh=3&fclid=2901171e-0627-6440-1211-0501075b656a&psq=Z-test+examples&u=a1aHR0cHM6Ly9zdGF0aXN0aWNzYnlqaW0uY29tL2h5cG90aGVzaXMtdGVzdGluZy96LXRlc3Qv&ntb=1)[1](https://www.bing.com/ck/a?!&&p=740f13c9de647e43JmltdHM9MTY5NDY0OTYwMCZpZ3VpZD0yOTAxMTcxZS0wNjI3LTY0NDAtMTIxMS0wNTAxMDc1YjY1NmEmaW5zaWQ9NTk0Ng&ptn=3&hsh=3&fclid=2901171e-0627-6440-1211-0501075b656a&psq=Z-test+examples&u=a1aHR0cHM6Ly9zdGF0aXN0aWNzYnlqaW0uY29tL2h5cG90aGVzaXMtdGVzdGluZy96LXRlc3Qv&ntb=1)
* Two-sample location test: Do two IQ boosting programs have different mean scores?
* **Correlation test (Pearson’s)**: Correlation tests are statistical tests that assess the strength of the relationship between two variables. The most common type of correlation test is Pearson’s Correlation Coefficient, which measures the linear relationship between two variables. Correlation tests are used in a variety of fields, including psychology, sociology, and economics. Correlation tests can be used to study the cause-and-effect relationship between two variables or to predict future behavior based on past behavior.

**For example:**

* + A correlation test could be used to predict the likelihood of a person getting divorced based on their age and education level.

Non-Parametric Statistical Tests:

Non-parametric tests do not make any assumptions about the data. They can be used with data that is not normally distributed and with data that does not have equal variances. Non-parametric statistical tests are used when the assumptions of parametric statistical tests are not met, or when the data are not normally distributed. Some examples of non-parametric statistical tests include the Wilcoxon rank-sum test, the Kruskal-Wallis test. etc. Statisticians have developed many different non-parametric statistical tests, each with its own advantages and disadvantages. When choosing a non-parametric statistical test, it is important to consider the specific research question and the type of data that are available. The following is a brief introduction to different types of non-parametric tests:

* **Wilcoxon rank-sum test**: The Wilcoxon rank-sum test is a statistical test used to compare the difference between two groups of data. It is often used when the data is not normally distributed. The test works by ranking the data from both groups, and then summing the ranks for each group. The difference between the two sums is then compared to a table of values to determine whether or not there is a significant difference between the two groups. The Wilcoxon rank-sum test is a powerful statistical tool that can be used to compare data sets of all sizes. Wilcoxon rank-sum test is also known as the **Mann-Whitney U test**.

**For example:**

A study of the effects of Vitamin D on epileptic patients, where patients were randomly assigned to receive a placebo or 16,000 IU of Vitamin D daily, and the response is the number of epileptic seizures in a 28-day perio.

* **Kruskal-Wallis H test**: The Kruskal-Wallis H test is a statistical test that can be used to compare the means of two or more groups. It is similar to the ANOVA, but it is more robust and can be used when the assumptions of the ANOVA are not met. The Kruskal-Wallis test is also known as a non-parametric ANOVA, or analysis of variance. The Kruskal-Wallis test is used when the assumptions of the parametric ANOVA test are not met. The Kruskal-Wallis test can be used with either continuous or categorical data. To run the Kruskal-Wallis test, the data must be in the form of ranks. The Kruskal-Wallis test is based on the ranks of the data, not the actual values. When using categorical data, the Kruskal-Wallis test is often used to determine if there are significant differences between the means of the groups. When using quantitative data, the Kruskal-Wallis test can be used to determine if there are significant differences between the distributions of the groups.

**For example:**

* [Comparing the effects of three drugs on knee pain](https://www.bing.com/ck/a?!&&p=1bad143db80929d6JmltdHM9MTY5NDY0OTYwMCZpZ3VpZD0yOTAxMTcxZS0wNjI3LTY0NDAtMTIxMS0wNTAxMDc1YjY1NmEmaW5zaWQ9NTgxOQ&ptn=3&hsh=3&fclid=2901171e-0627-6440-1211-0501075b656a&psq=Kruskal-Wallis+H+test+examples&u=a1aHR0cHM6Ly93d3cuc3RhdG9sb2d5Lm9yZy9rcnVza2FsLXdhbGxpcy10ZXN0Lw&ntb=1)[.](https://www.bing.com/ck/a?!&&p=08e0ee24feaae838JmltdHM9MTY5NDY0OTYwMCZpZ3VpZD0yOTAxMTcxZS0wNjI3LTY0NDAtMTIxMS0wNTAxMDc1YjY1NmEmaW5zaWQ9NTgyMA&ptn=3&hsh=3&fclid=2901171e-0627-6440-1211-0501075b656a&psq=Kruskal-Wallis+H+test+examples&u=a1aHR0cHM6Ly93d3cuc3RhdG9sb2d5Lm9yZy9rcnVza2FsLXdhbGxpcy10ZXN0Lw&ntb=1)
* [Comparing the effects of three levels of physical exercise on depression](https://www.bing.com/ck/a?!&&p=bd7c2388ad5f09a7JmltdHM9MTY5NDY0OTYwMCZpZ3VpZD0yOTAxMTcxZS0wNjI3LTY0NDAtMTIxMS0wNTAxMDc1YjY1NmEmaW5zaWQ9NTgyMQ&ptn=3&hsh=3&fclid=2901171e-0627-6440-1211-0501075b656a&psq=Kruskal-Wallis+H+test+examples&u=a1aHR0cHM6Ly91c2Vycy5zdXNzZXguYWMudWsvfmdyYWhhbWgvUk0xd2ViL0tydXNrYWwtV2FsbGlzJTI1MjBIYW5kb291dDIwMTEucGRm&ntb=1)[.](https://www.bing.com/ck/a?!&&p=435256a39f9e3f73JmltdHM9MTY5NDY0OTYwMCZpZ3VpZD0yOTAxMTcxZS0wNjI3LTY0NDAtMTIxMS0wNTAxMDc1YjY1NmEmaW5zaWQ9NTgyMg&ptn=3&hsh=3&fclid=2901171e-0627-6440-1211-0501075b656a&psq=Kruskal-Wallis+H+test+examples&u=a1aHR0cHM6Ly91c2Vycy5zdXNzZXguYWMudWsvfmdyYWhhbWgvUk0xd2ViL0tydXNrYWwtV2FsbGlzJTI1MjBIYW5kb291dDIwMTEucGRm&ntb=1)
* [Comparing the number of unoccupied beds for three hospitals](https://www.bing.com/ck/a?!&&p=5805f1c8b5a85017JmltdHM9MTY5NDY0OTYwMCZpZ3VpZD0yOTAxMTcxZS0wNjI3LTY0NDAtMTIxMS0wNTAxMDc1YjY1NmEmaW5zaWQ9NTgyMw&ptn=3&hsh=3&fclid=2901171e-0627-6440-1211-0501075b656a&psq=Kruskal-Wallis+H+test+examples&u=a1aHR0cHM6Ly9zdXBwb3J0Lm1pbml0YWIuY29tL2VuLXVzL21pbml0YWIvMjEvaGVscC1hbmQtaG93LXRvL3N0YXRpc3RpY3Mvbm9ucGFyYW1ldHJpY3MvaG93LXRvL2tydXNrYWwtd2FsbGlzLXRlc3QvYmVmb3JlLXlvdS1zdGFydC9leGFtcGxlLw&ntb=1)[.](https://www.bing.com/ck/a?!&&p=34a2092542839dd2JmltdHM9MTY5NDY0OTYwMCZpZ3VpZD0yOTAxMTcxZS0wNjI3LTY0NDAtMTIxMS0wNTAxMDc1YjY1NmEmaW5zaWQ9NTgyNA&ptn=3&hsh=3&fclid=2901171e-0627-6440-1211-0501075b656a&psq=Kruskal-Wallis+H+test+examples&u=a1aHR0cHM6Ly9zdXBwb3J0Lm1pbml0YWIuY29tL2VuLXVzL21pbml0YWIvMjEvaGVscC1hbmQtaG93LXRvL3N0YXRpc3RpY3Mvbm9ucGFyYW1ldHJpY3MvaG93LXRvL2tydXNrYWwtd2FsbGlzLXRlc3QvYmVmb3JlLXlvdS1zdGFydC9leGFtcGxlLw&ntb=1)
* **Chi-square test of independence**: Chi-square test of independence is a statistical test used to determine whether two variables are independent. It is a non-parametric test, meaning that it does not make assumptions about the distributions of the variables. The chi-square test is used to calculate a statistic called the chi-square statistic. This statistic is then compared to a critical value to determine whether the two variables are independent. If the chi-square statistic is greater than the critical value, then the two variables are considered to be dependent. Chi-square test of independence can be used to test for independence in a variety of situations, including comparing proportions, testing for association, and testing for goodness of fit.

**For example:**

* Testing if gender is associated with political party preference by surveying 500 voters and recording their gender and political party preference.
* Testing if an educational flyer or a phone call can encourage more residents to recycle their household waste by randomly assigning 300 households to the flyer, phone call, or control group and measuring their recycling behavior.
* **The Friedman Test**: The Friedman test is a non-parametric statistical test used to compare more than two groups of data. The test is used when the data are not normally distributed and when the groups are related to each other, such as in a repeated measures design. The test is based on the ranks of the data, rather than the actual values.

**For example:**

**Scenario**: A random sample of men undergo an exercise program  
**Repeated Measures**: Data were collected at month 1, 2 and 3  
**Variable of interest**: Cholesterol levels

* **The Cochran’s Q Test**: The Cochran’s Q test is a non-parametric statistical test used to compare more than two groups of data. The test is used when the data are not normally distributed and when the groups are independent of each other.

**For example:**

Suppose a researcher wants to know if three different studying techniques lead to different proportions of pass rates among students.

* **The Jonckheere-Terpstra Test**: The Jonckheere-Terpstra test is a rank-based non-parametric statistical test used to compare more than two groups of data. The test is used when the data are not normally distributed and when the groups are ordered, such as in an experiment with treatments that are administered in increasing order of intensity.

**For example:**

A researcher believes that individuals who are more physically active are better able to cope with stress in the workplace. To test this theory, the researcher recruited 31 participants and measured how many minutes of physical activity they performed per week and their ability to cope with workplace-related stress.