Statistical Test

Definition & when we use it:

Statistical tests are used in hypothesis testing. They can be used to:

determine whether a predictor variable has a statistically significant relationship with an outcome variable.

estimate the difference between two or more groups.

Statistical tests assume a null hypothesis of no relationship or no difference between groups. Then they determine whether the observed data fall outside of the range of values predicted by the null hypothesis.

If you already know what types of variables you're dealing with, you can use the flowchart to choose the right statistical test for your data.
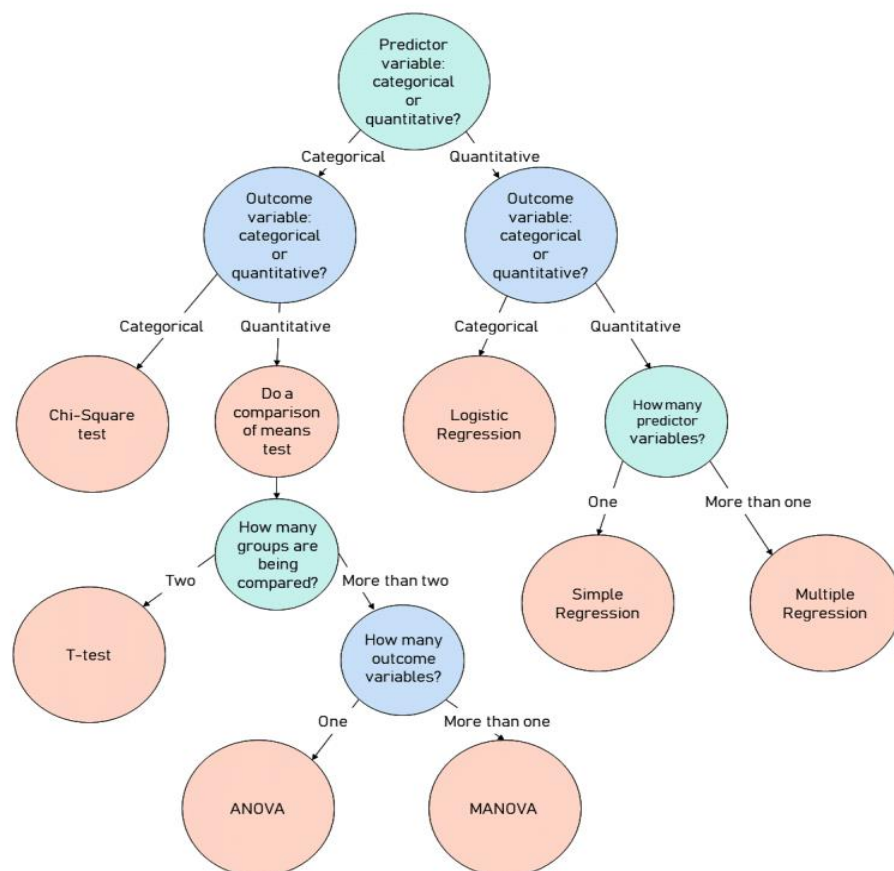
Statistical tests work by calculating a test statistic – a number that describes how much the relationship between variables in your test differs from the null hypothesis of no relationship.

It then calculates a p-value (probability value). The p-value estimates how likely it is that you would see the difference described by the test statistic if the null hypothesis of no relationship were true.

If the value of the test statistic is more extreme than the statistic calculated from the null hypothesis, then you can infer a statistically significant relationship between the predictor and outcome variables.

If the value of the test statistic is less extreme than the one calculated from the null hypothesis, then you can infer no statistically significant relationship between the predictor and outcome variables.

Types of Statistical Test:

Parametric tests usually have stricter requirements than nonparametric tests, and are able to make stronger inferences from the data. They can only be conducted with data that adheres to the common assumptions of statistical tests.

The most common types of parametric test include regression tests, comparison tests, and correlation tests.

1)Regression tests:

Regression tests look for cause-and-effect relationships. They can be used to estimate the effect of one or more continuous variables on another variable.

Types:	Predictor variable	Outcome variable	Research question example
Simple linear regression	• Continuous • 1 predictor	• Continuous • 1 outcome	What is the effect of income on longevity?
Multiple linear regression	• Continuous • 2 or more predictors	• Continuous • 1 outcome	What is the effect of income and minutes of exercise per day on longevity?
Logistic regression	• Continuous	• Binary	What is the effect of drug dosage on the survival of a test subject?

2)Comparison tests:

Comparison tests look for differences among group means. They can be used to test the effect of a categorical variable on the mean value of some other characteristic.

T-tests are used when comparing the means of precisely two groups (e.g. the average heights of men and women). ANOVA and MANOVA tests are used when comparing the means of more than two groups (e.g. the average heights of children, teenagers, and adults).

Types:	Predictor variable	Outcome variable	Research question example
Paired t-test	• Categorical • 1 predictor	• Quantitative • groups come from the same population	What is the effect of two different test prep programs on the average exam scores for students from the same class?
Independent t-test	• Categorical • 1 predictor	• Quantitative • groups come from different populations	What is the difference in average exam scores for students from two different schools?
ANOVA	• Categorical • 1 or more predictor	• Quantitative • 1 outcome	What is the difference in average pain levels among post-surgical patients given three different painkillers?
MANOVA	• Categorical • 1 or more predictor	• Quantitative • 2 or more outcome	What is the effect of flower species on petal length, petal width, and stem length?

Correlation tests:

it check whether variables are related without hypothesizing a cause-and-effect relationship &used to test whether two variables you want to use in a multiple regression test are autocorrelated.

Types:	variable	Research question example
Pearson's *r*	• 2continuous variables	How are latitude and temperature related?

Choosing a nonparametric test

Non-parametric tests don't make as many assumptions about the data, and are useful when one or more of the common statistical assumptions are violated. However, the inferences they make aren't as strong as with parametric tests.

	Predictor variable	Outcome variable	Use in place of…
Spearman's *r*	• Quantitative	• Quantitative	Pearson's *r*
Chi square test of independence	• Categorical	• Categorical	Pearson's *r*
Sign test	• Categorical	• Quantitative	One-sample *t*-test
Kruskal–Wallis *H*	• Categorical • 3 or more groups	• Quantitative	ANOVA
ANOSIM	• Categorical • 3 or more groups	• Quantitative • 2 or more outcome variables	MANOVA
Wilcoxon Rank-Sum test	• Categorical • 2 groups	• Quantitative • groups come from different populations	Independent t-test
Wilcoxon Signed-rank test	• Categorical • 2 groups	• Quantitative • groups come from the same population	Paired t-test

*What is the most popular Statistical test:

different types of tests in statistics like t-test,Z-test,chi-square test, anova test ,binomial test, one sample median test etc.