Types of statistical tests and when to use each type with examples

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.

1. **T-test:**
   Independent t-test: Used to compare means of two independent groups.
   Paired t-test: Used to compare means of related or paired observations, such as before-and-after measurements or matched samples.
   Example: A researcher wants to compare the effectiveness of two different treatments for a medical condition. They collect data on two groups of patients and want to determine if there is a significant difference in their mean outcomes.
2. **Analysis of Variance (ANOVA):**
   One-way ANOVA: Used to compare means across three or more independent groups.
   Two-way ANOVA: Used to examine the effects of two independent factors on a dependent variable.
   Example: A psychologist wants to investigate the effect of different teaching methods (e.g., lecture, group discussion, hands-on activities) on students' test scores. The psychologist randomly assigns students to each teaching method and compares the means of the groups.
3. **ANCOVA (Analysis of Covariance):**
   Used to compare the means of two or more groups while controlling for the effects of one or more continuous variables (covariates).
   Example: Assessing the effect of a teaching method on student performance while controlling for the students' prior knowledge as a covariate.
4. **MANOVA (Multivariate Analysis of Variance):**
   Used to test for differences in means across multiple dependent variables simultaneously.
   Example: Investigating whether there are significant differences in the scores of multiple cognitive tests between different age groups.

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.

Regression analysis:

Simple linear regression: Used to model the relationship between a dependent variable and a single independent variable.
Multiple linear regression: Used to model the relationship between a dependent variable and multiple independent variables.
Logistic regression: Used when the dependent variable is binary or categorical.
Example: An economist wants to examine the relationship between income (dependent variable) and education level (independent variable) using data from a survey. They can employ simple linear regression to analyze how education level predicts income.

Correlation tests

Correlation tests check whether variables are related without hypothesizing a cause-and-effect relationship.

These can be used to test whether two variables you want to use in **(for example)** a multiple regression test are autocorrelated.

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.

1. **Chi-square test:**

Chi-square goodness of fit test: Used to assess whether observed categorical data matches an expected distribution.
Chi-square test of independence: Used to determine if there is a relationship between two categorical variables.
Example: A sociologist wants to study whether there is an association between gender (male/female) and career choices (doctor, engineer, artist). They collect

data from a sample of individuals and perform a chi-square test of independence to analyze the relationship.

2. **Kruskal-Wallis Test:**

   Nonparametric test used to compare the distributions of three or more independent groups when the assumptions of ANOVA are not met (e.g., non-normal data).
   Example: Comparing the median scores of students from different schools on a standardized test.

3. **Wilcoxon Signed-Rank Test:**

   Nonparametric test used to compare the distributions of two related groups when the assumptions of a paired t-test are not met.
   Example: Assessing whether there is a significant difference in the scores of students before and after a specific intervention.