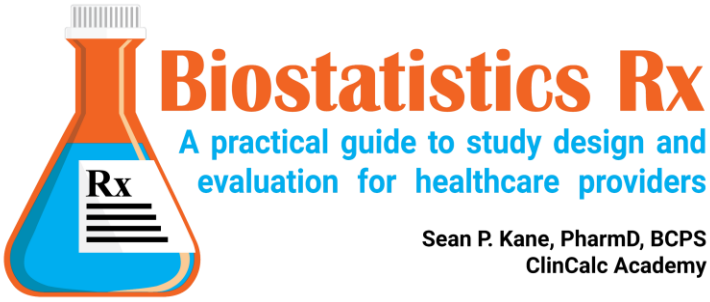
Guide to Selecting a Test for Inferential Statistics

ClinCalc Academy Biostatistics Cheatsheet

> **This document is designed to assist clinicians in selecting the most appropriate inferential statistical test to calculate a p-value. By design, this guide is non-comprehensive, meaning only the most common and relevant statistical tests have been included.**

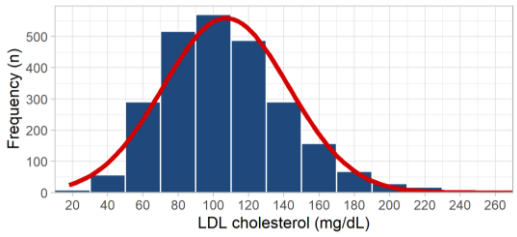


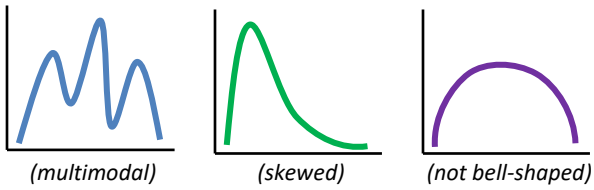
Terminology Used in this Document

Parametric vs. Non-Parametric Data

Some statistical tests rely on data being normally distributed (bell-shaped curve) – this is called "parametric" data. If the data is not parametric ("non-parametric"), alternative statistical tests need to be used.

Parametric (normally distributed)	**Non-Parametric** (not normally distributed)





Independent, Dependent, and Confounding Variables

Independent (explanatory)	**Dependent** (response/outcome)	**Confounding** (covariate)
Variable that is changed, manipulated or controlled	Result or outcome of interest that is measured	Impacts dependent variable; may need to be accounted for
Ex: Atorvastatin 20 mg vs. placebo	*Ex: Incidence of heart attack or stroke*	*Ex: Smoking rates between groups*

Paired vs. Unpaired Samples

In paired samples, the patient acts as their own "control" – patients are exposed to each treatment arm (independent variable) during the study period. A crossover or pre/post study design is most common.

In unpaired samples, the patient groups are independent and unrelated to each other – each patient receives one version of the independent variable usually in a "parallel" study design.

Statistical Tests to Compare Differences

> **These tests are used when the dependent (outcome) variable is a continuous variable. These tests rely on comparing the mean or median/ordinal (ranked) values of the outcome.**

# of Groups to Compare	Outcome is Parametric (comparing means)	Outcome is Non-parametric (comparing rank/medians)
Parallel study design (independent samples)		
2	Independent samples t-test *(AKA student's t-test)*	Mann-Whitney U test *(AKA Wilcoxon rank-sum test)*
3 or more	- One-way ANOVA - *With covariates: ANCOVA*	Kruskal-Wallis test
Cross-over or pre/post design (paired samples)		
2 (paired)	Paired t-test	Wilcoxon signed-rank test
3 or more (paired)	Repeated measures ANOVA	Friedman's test

Statistical Tests to Compare Frequencies

> **These tests are used when both the dependent (outcome) and independent (explanatory) variables are categorical (discrete). These tests rely on the observed vs. expected frequencies.**

# of Groups to Compare	Outcome is Categorical
Parallel study design (independent samples)	
2	- Chi square (X^2) test - Fisher's exact test - *With covariates: Cochran-Mantel-Haenszel test*
3 or more	Chi square (X^2) test
Cross-over or pre/post design (paired samples)	
2 (paired)	McNemar's test

Statistical Tests for Time-to-Event Analysis

Time-to-event analyses are used when study participants participate in the study for varying amounts of time and not all participants experience the dependent (outcome) variable. Patients who do not experience the outcome of interest are "censored", which is a unique feature of this type of analysis.

	No Covariates (confounding variables)	Control for covariates (confounding variables)
Statistical test for hazard ratio (HR) and p-value	Log-rank test	Cox proportional-hazards model

Statistical Tests to Determine Correlation

Correlation describes the co-relationship between two continuous variables. Correlation is described as an 'r' value (correlation coefficient) between -1 (negative correlation) and +1 (positive correlation). A correlation coefficient of zero (0) indicates no relationship exists.

	Variables are Parametric	Variables are Non-Parametric
Statistical test for p-value and correlation coefficient (r)	Pearson's correlation	Spearman's rank order correlation

Statistical Tests for Regression

Like correlation, regression describes the relationship between two or more variables. Unlike in correlation, regression can "predict" a dependent (outcome) variable and can be designed to handle multiple independent and confounding variables.

	Outcome is Categorical	Outcome is Continuous
Statistical test for dependent variable coefficients and p-value	Logistic regression (simple or multivariate)	Linear regression (simple or multivariate)

Statistical Tests to Correct for Interim Analysis

Each time an interim analysis is conducted, the risk of a type I error increases. There are a variety of statistical methods that can be used to allow for interim analyses and adjust for an increased risk of type I error. There is no "best" test to correct for multiplicity. Each test has advantages and disadvantages.

- Bonferroni method
- O'Brien-Fleming method
- Haybittle-Peto method
- Pocock method