Parametric Tests

A parametric test is one which makes assumptions about the parameters of the population distribution(s) from which the sample has been drawn. In the parametric test, assumption is made through sample population. If the information about the population from which the sample has been drawn is completely known through its parameters than the test is called the parametric tests. The common assumptions underlying parametric tests are as follows:

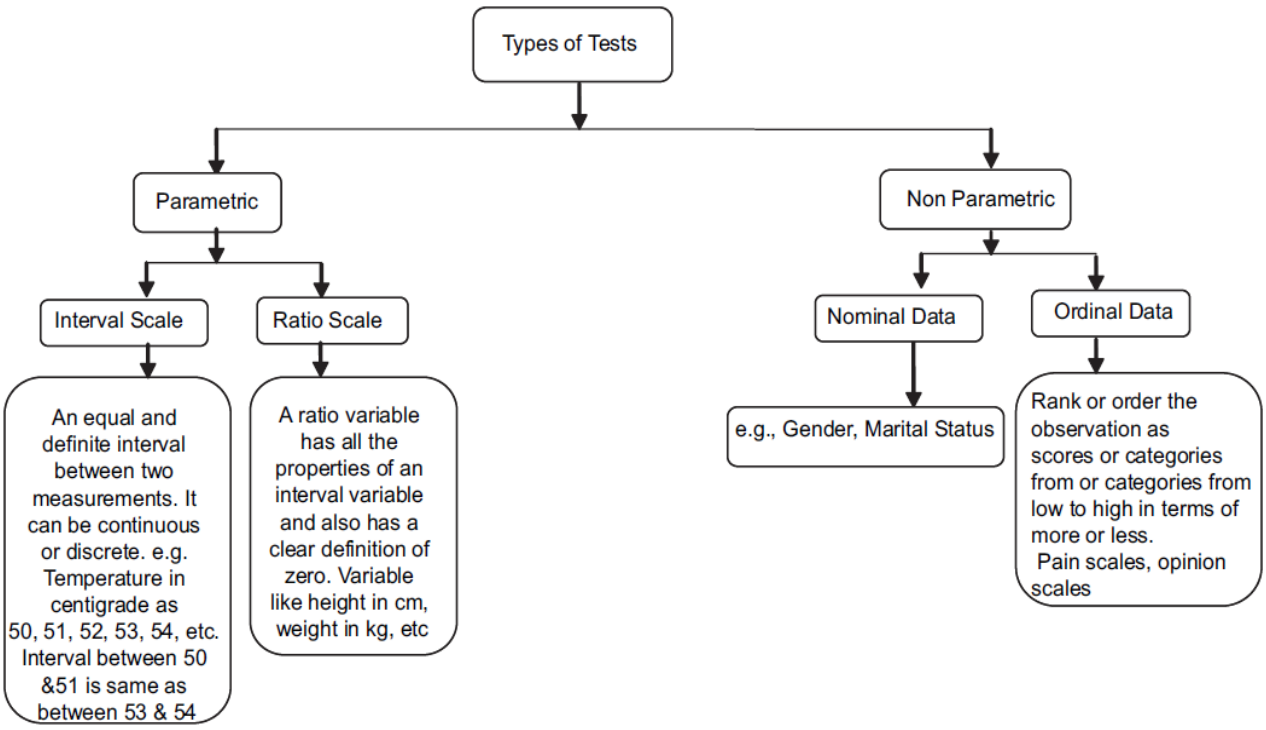
- The observations must be independent - independence of observation means that the data are not connected to any factor that could affect the outcome. For example, a person is hypertensive or not it does not depend on his/her choice of color. When we talk about the independence of observations between groups, it means that the patients in both the groups under study are separate. We do not want any patient to appear in both the groups
- The observation must be drawn from a normally distributed population
- The data must be measured on an interval or ratio scale.

Non-Parametric Tests

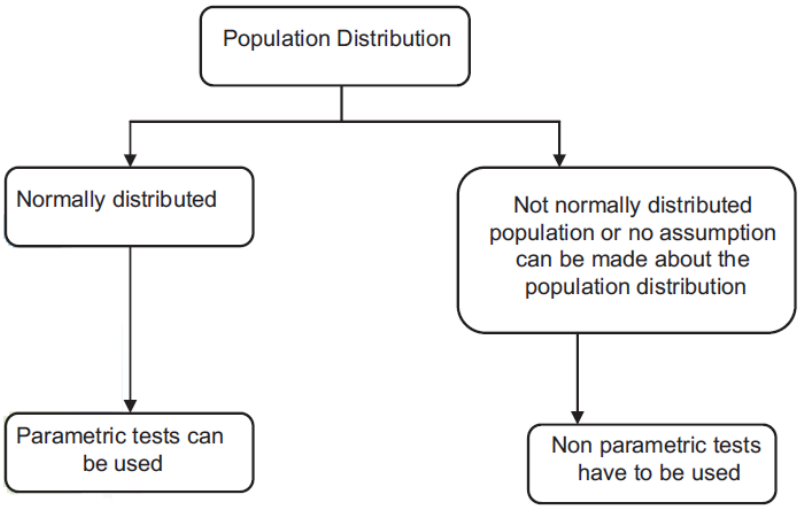
Non-parametric tests are usually referred as distribution-free tests. A nonparametric statistical test is the one that does not necessitate any conditions to be fulfilled about the parameters of the population from which the sample was drawn. Nonparametric tests can also be used when the data are nominal or ordinal. Nonparametric tests are also applied to the interval or ratio data which do not follow the normal distribution.

Using Parametric versus Non-Parametric Tests

1. **Scale of measurement of the data** - The flow chart below illustrates the use of parametric or non-parametric tests according to the measurement scales.



2. **Population Distribution** - The figure below describes the use of parametric and non-parametric test according to the type of population distribution.



3. **Homogeneity of Variances** - For applying parametric tests, it must be ensured that the variances of the population are equal. On the other hand, no such assumption is required to be fulfilled for application of non-parametric tests.

4. **Independence of samples** - For parametric tests to be used the samples drawn from the population must be independent. No such assumption is required for non-parametric tests.

Limitations of Non-Parametric Tests

Although nonparametric tests do not require any stringent assumptions to be fulfilled for application, yet parametric tests are preferred over them due to the following limitations of non-parametric tests:

- Parametric tests have more statistical power than nonparametric tests; therefore, they are more likely to detect a significant difference when it really exists.
- Parametric tests can perform well with skewed and non-normal data if the sample size is appropriate for performing the particular parametric tests. For example, for performing one sample t-test on a non-normal data sample size should be >20, for a two-sample t-test on non-normal data each group should have more than 15 observations, and for performing a one-way analysis of variance on a non-normal data having 2–9 groups, each group should have >15 observations.
- Parametric tests can perform better when the (dispersion) of the groups is different. Although nonparametric tests do not follow stringent assumptions, yet one assumption that the dispersion of all the groups must be same is difficult to be met for running nonparametric tests. If this assumption of equal dispersion is not met, nonparametric tests may result in invalid results. Parametric tests can perform better in such situations.
- Inference drawn from parametric tests is easy to interpret and more meaningful than that of nonparametric tests. Many nonparametric tests use rankings of the values in

the data rather than using the actual data. Knowing that the difference in mean ranks between two groups is five does not really help our intuitive understanding of the data. On the other hand, knowing that the mean systolic blood pressure of patients taking the new drug was 5 mmHg lower than the mean systolic blood pressure of patients on the standard treatment is both intuitive and useful.

Advantages of Non-parametric Tests

The most important point while analyzing the data is to understand the fact that whether your data are better represented by mean or median. This is the key to decide whether to use a parametric or a non-parametric test. If the data are better represented by median then use a nonparametric test.

For better understanding of the fact, let us explore an example. Suppose a researcher is interested in knowing the average income of the people in two groups and want to compare them. For this type of data, median will be the appropriate measure of central tendency, where 50% of the people will be having income below that and 50% will be having income above that. If we add some highly paid people in the group than those will act as outliers and mean will differ to a greater extent, however income of a particular person will be the same. In that case, the mean values of the two samples may differ significantly but medians will not. In such cases, using nonparametric tests is better than parametric tests.

- When the sample size is small and the researcher is not sure about the normality of the data, it is better to use nonparametric tests. Because when the sample size is too small it is not possible to ascertain the normality of the data because the distribution tests will also lack sufficient power to provide meaningful results
- When we have ordinal data, nominal data, or some outliers in the data that cannot be removed then nonparametric tests must be used.

Parametric Tests and their Non-parametric Equivalents

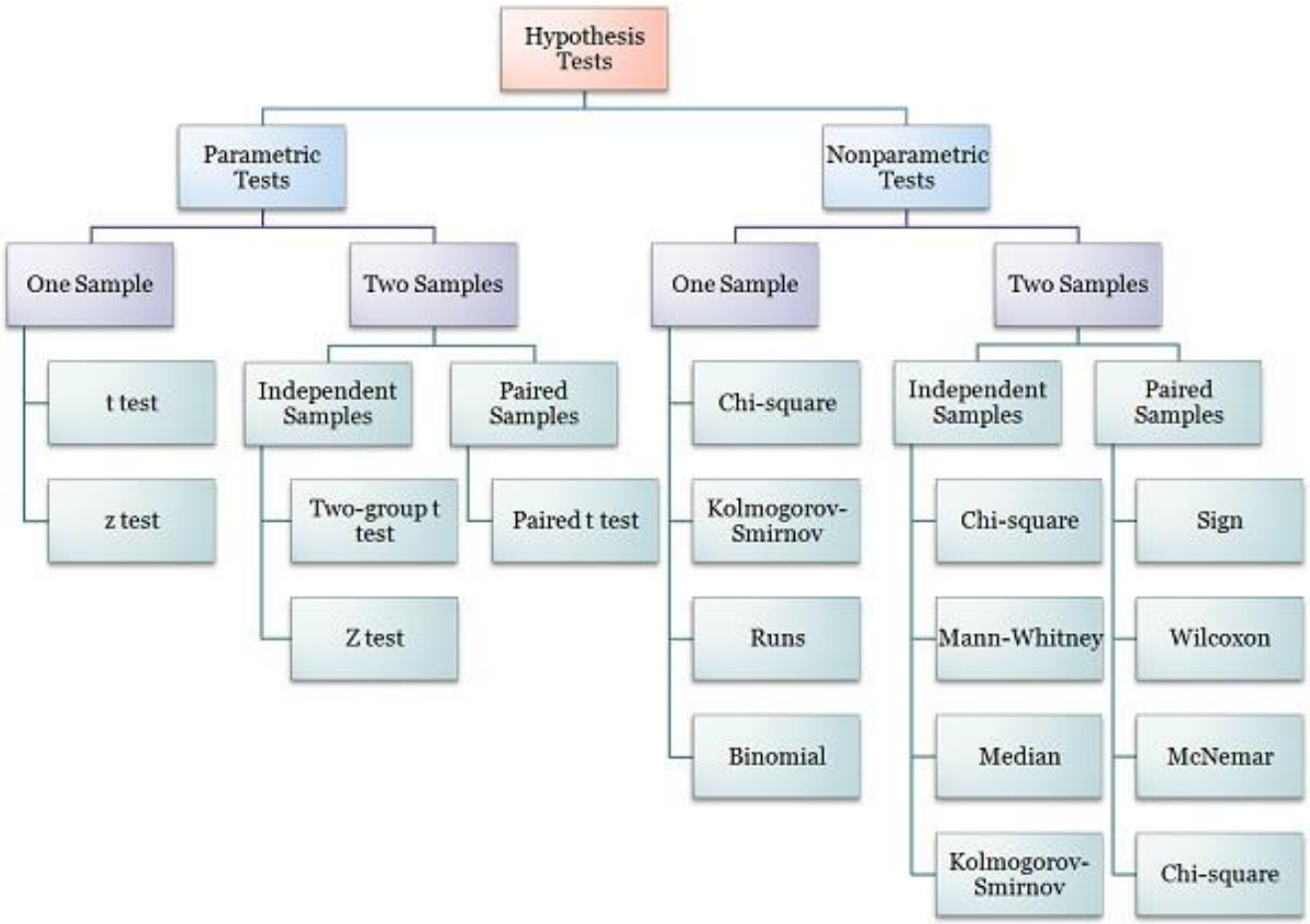
For all the parametric tests, there exists a parallel nonparametric equivalent. The table below describes in brief the type of situation under study with some examples and the relevant parametric tests and their nonparametric equivalents to be used in those situations.

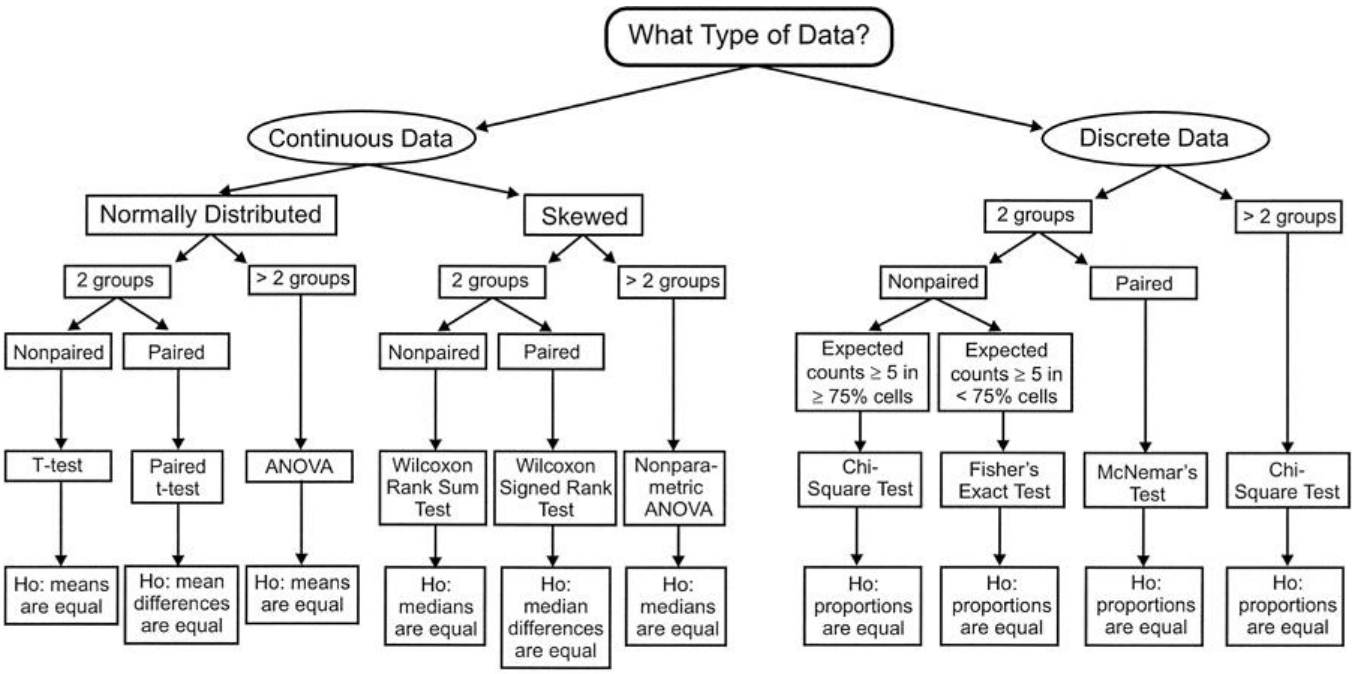
Table 1: Corresponding table for parametric tests and their nonparametric equivalents

Type of test	Level of measurement	Sample characteristics					Correlation
		One sample	Two sample		K samples (i.e., >2)		
			Independent	Dependent	Independent	Dependent	
Parametric	Interval or ratio	*Z*-test or *t*-test	Independent sample *t*-test	Paired sample *t*-test	One-way ANOVA	Repeated measure ANOVA	Pearson's test
Nonparametric	Categorical or nominal	Chi-square test	Chi-square test	Mc-Nemar test	Chi-square test	Cochran's Q	
	Rank or ordinal	Chi-square test	Mann-Whitney U-test	Wilcoxon signed rank test	Kruskal-Wallis	Friedman's ANOVA	Spearman's rho

ANOVA: Analysis of variance

Hierarchy of Parametric and Non-Parametric Tests





Source: Waning B, Montagne M: *Pharmacoepidemiology: Principles and Practice*: http://www.accesspharmacy.com