

Nonparametric Statistics

UM Clinical Scholars Core Competencies

In addition to the assumptions that 1) a population has been drawn by random sampling and that 2) the observations are independent, standard parametric statistical techniques assume that the distribution of the dependent variable is normally distributed and that the parameters of the comparison groups have equal variances. Deciding whether to use Parametric statistical techniques (e.g., t-testing, ANOVA, or ordinary least squares regression) the following things should be thought of.

Parametric or Nonparametric Tests?

1. If all assumptions are met, use Parametric techniques.
2. If the dependent variable is reasonably symmetric (ie, Pearson kurtosis between two and four [or Fisher kurtosis between -1 and $+1$], and skew is between -1 and $+1$) and variances of the two groups seem close (although perhaps not identical), then use robust Parametric techniques. Stata commands that are useful for testing for normality and equal variance include - **sum (with detail subcommand)** , **sdtest**, **swilk**, and **sktest**
3. See if you can transform the dependent variable (e.g., by converting it to the log, square root, cube, etc.) to make it near-normally distributed, and then use Parametric techniques on the transformed dependent variable. (**ladder** and **gladder** are useful STATA commands for this)
4. If none of the above can be achieved use a Non-Parametric statistical test.

What Are Nonparametric Tests?

Non-Parametric statistical tests have much less rigorous assumptions concerning the distributions of the variables and the variances of comparison groups. Indeed these techniques tend to rely upon the rank of the individual observations rather than their absolute numeric values. Therefore, Non-Parametric statistical tests; 1. Have less stringent assumptions, and 2. The computations are generally easier to understand. However, they have the following disadvantages; 1. You lose the metric and numerical values of the results (since only the ranks, not the numerical values are used) 2. You lose statistical power (as compared with using Parametric statistics when the Parametric assumptions are met).

Examples:

1. The Sign Test
(Stata command = **signtest**)

The sign test is used for paired data (such as in a pre-post study). The sign test is a simple test in which you count up the number of cases for which the second value is greater than the first value (positive signs) and you see whether the number of positives are greater than you would have expected by chance alone. You could count up negative signs if you prefer.

2. The Wilcoxon Signed Rank Test
(Stata command = **signrank**)

This test is also used for paired data and is analogous to the Parametric test, the paired t-Test. The Wilcoxon Signed Test is similar to the Sign Test but also ranks results by the magnitude of the difference of the paired values.

3. The Wilcoxon Rank Sum Test
(Stata command = **ranksum**)

This test is analogous to the Parametric test, the Student t-test. It is used in instances where you have independent data for which you want to compare data for two different groups. (eg. “comparing the income of doctors vs. lawyers”)

4. The Kruskal-Wallis Test
(Stata command = **kwallis**)

This test is analogous to the Parametric test; one-way ANOVA. This is used in instances where you want to compare results for more than two groups (e.g. “compare the income of doctors vs. lawyers vs. MBA’s”).

Parametric Test

Analogous Non-Parametric test

Student T-test

Wilcoxon Rank Sum Test

ANOVA

Kruskal-Wallis Test

Paired t-test

Wilcoxon Signed Rank Test or the Sign Test



Core Readings

RD Remington and MA Shork; Statistics and Applications to the Biological and Health Sciences, pg. 310-319.

Further Readings for the Interested.

1. Gibbons JD. Nonparametric Statistics. Quantitative Applications in the Social Sciences (Sage Pub #90).
2. Gibbons JD. Nonparametric Measures of Association. Quantitative Applications in the Social Sciences (Sage Pub #91).