

Parametric vs Nonparametric Tests

Parametric and nonparametric tests often answer a similar question about the same data, but they rely on different assumptions and are sensitive to different problems.



StatReason

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What this answers

This page answers "should I use a t-test or a Mann-Whitney U test, an ANOVA or a Kruskal-Wallis test?" Parametric tests assume the data, or the residuals, follow a specific distribution, usually normal, and use the actual values to estimate parameters like the mean. Nonparametric tests convert data to ranks and make fewer distributional assumptions, trading some statistical power for that added robustness.

What parametric tests assume

A t-test or ANOVA assumes the outcome, or more precisely the residuals from the model, are approximately normally distributed, particularly important at small sample sizes, and often assumes similar variance across groups being compared. When these assumptions hold, a parametric test is generally more statistically powerful than its nonparametric counterpart, meaning it is more likely to detect a genuine effect of a given size.

What rank-based tests trade away

A rank-based test such as Mann-Whitney U, Wilcoxon signed-rank, or Kruskal-Wallis replaces the actual values with their ranks before testing, which makes the result far less sensitive to extreme values and does not require an assumption of normality. The trade-off is reduced statistical power when the data actually are close to normal, and a change in what the test result technically compares, often a comparison of distributions or medians rather than means specifically.

Rank tests are not an automatic rescue

Switching to a rank-based test because a normality check failed is not automatically the correct fix. Many parametric tests are reasonably robust to mild non-normality, especially with larger sample sizes, and a rank-based test answers a subtly different question than the parametric test it replaces. Choose the test family based on your actual data structure and assumptions, not simply as a workaround for a failed diagnostic check.

Worked example

Comparing recovery times between two treatment groups, a histogram shows a heavily right-skewed distribution with a few very long recovery times. An independent t-test's mean comparison would be strongly influenced by those few long values. A Mann-Whitney U test, comparing the distributions using ranks, is less affected by those extreme values and better suited to this specific data shape.

Assumption audit

Calculated from your data: the specific test statistic and p-value for whichever test, parametric or rank-based, you run using the linked engines.

Evidence to review: a normality check and a histogram of your data, using the guidance in [Normality Tests and What They Can Tell You](#), to inform which family fits better.

You must verify: what your research question actually requires, since a mean comparison and a rank-based distribution comparison are not always interchangeable answers to the same practical question.

Source

This comparison follows the parametric and nonparametric method guidance in the NIST/SEMATECH e-Handbook of Statistical Methods and the shared statistical reasoning contract every StatReason engine is built against.

Limitations

This page covers the two-sample and multi-group comparison cases most commonly confused; specialized designs, such as paired or repeated-measures data, have their own

dedicated parametric and rank-based pairs covered on their own engine pages.

Next action: use [**Choose the Right Statistical Test**](#) to find your specific design, or compare directly with the [**Mann-Whitney U Test**](#) and [**Independent t-Test**](#).