

12.1: Benefits of Distribution Free Tests

Learning Objectives

- State how distribution-free tests can avoid an inflated **Type I** error rate
- State how how distribution-free tests can affect power

Most tests based on the normal distribution are said to be robust when the assumption of normality is violated. To the extent to which actual probability values differ from nominal probability values, the actual probability values tend to be higher than the nominal p values. For example, if the probability of a difference as extreme or more extreme were 0.04, the test might report that the probability value is 0.06. Although this sounds like a good thing because the Type I error rate is lower than the nominal rate, it has a serious downside: reduced power. When the null hypothesis is false, then the probability of rejecting the null hypothesis can be substantially lower than it would have been if the distributions were distributed normally.

Tests assuming normality can have particularly low power when there are extreme values or outliers. A contributing factor is the sensitivity of the mean to extreme values. Although transformations can ameliorate this problem in some situations, they are not a universal solution.

Tests assuming normality often have low power for leptokurtic distributions. Transformations are generally less effective for reducing kurtosis than for reducing skew.

Because distribution-free tests do not assume normality, they can be less susceptible to non-normality and extreme values. Therefore, they can be more powerful than the standard tests of means that assume normality.

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