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Misconceptions Leading to Choosing the t Test Over the Wilcoxon Mann-Whitney Test for Shift in Location Parameter

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There exist many misconceptions in choosing the t over the Wilcoxon Rank-Sum test when testing for shift. Examples are given in the following three groups: (1) false statement, (2) true premise, but false conclusion, and (3) true statement irrelevant in choosing between the t test and the Wilcoxon Rank Sum test.

Key words: t test, Wilcoxon Rank-Sum test, robustness, power

Introduction

For treatment effects modeled as a shift in location parameter, the t test can be decidedly nonrobust to departures from population normality unless certain conditions have been met (Sawilowsky & Blair, 1992). When normality is met or nearly met (which occurs rarely), the t test maintains a very small power advantage over the Wilcoxon Rank Sum / Mann-Whitney U test. When normality is violated, the Wilcoxon Rank Sum Test can be three or four times more powerful than the independent samples t test (Blair, 1980; Blair & Higgins, 1980a, 1980b, 1981; Blair, Higgins, & Smitely, 1980; Sawilowsky & Blair, 1992). The power advantages of the nonparametric test actually increases with sample size for the low to mid-level parts of the t test's power spectrum.

Although the power advantage is not as spectacular as with the independent samples case, the Wilcoxon Signed-Ranks test for two dependent samples nevertheless maintains a considerable power advantage over the dependent samples t test for similar conditions (Blair & Higgins, 1985a, 1985b).

The dates of the Monte Carlo studies cited above are from 1980 – 1992. Promise for these small sample results was available decades prior on the basis of large sample asymptotic theory. This understanding had even penetrated to the level of a *book review* written in 1968! “The Wilcoxon rank-sum test...show[s] only slight losses in both large and small sample efficiency relative to the t-test in the normal case, while in many non-normal cases, efficiency exceeds 100%” (Meeter, 1968).

Thus, sane researchers opt to use the Wilcoxon Rank Sum test when testing for shift in location. Overly cautious researchers, with no justification, opt to perform both the t test and the Wilcoxon Rank Sum test, and accept the Wilcoxon only if it rejects and the t doesn't. (This is a misguided practice, as it leads to an increase in experiment-wise Type I errors.) Pedantic researchers, oblivious to the Monte Carlo results of the past 25 years, and asymptotic results for the past half-century, simply ignore the Wilcoxon Rank Sum test in favor of the t test.

In the course of reviewing articles submitted to the sixteen journals that I have provided ad hoc reviews over the past 15 years, I have compiled a list of constantly recycling reasons given for preferring the t test over the Wilcoxon Rank Sum test when testing for shift in location. They are presented below without expansive commentary, in the hopes that they never again resurface.

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The misconceptions are categorized in three groups: (1) false statement, (2) true premise, but false conclusion, and (3) true statement irrelevant in choosing between the t test and the Wilcoxon Rank Sum test.

(1) False Statement

- the Wilcoxon is only for use when the data are originally in the form of ranks
- the Wilcoxon's ranking procedure throws away useful information
- the Wilcoxon is only for use in the presence of outliers
- the Wilcoxon should only be used for small samples
- the t is robust with respect to Type I errors
- the t is more powerful
- if a modern procedure should be used, it should be a permutation test, not the Wilcoxon

(2) True Premise, but False Conclusion

- the Wilcoxon is a test of $f_i(x) = g_i(x)$ (true), so even if it does reject and the t doesn't, it is probably due to some difference other than the mean (e.g., scale) (false)
- the Wilcoxon's underlying assumptions are weaker (true), therefore the hypothesis being tested is less interesting (false)
- in terms of central tendency, the Wilcoxon pertains to the median (true), which is less interesting than the mean (false)
- the t is expandable to the k samples case (true), but the Wilcoxon is not (false)
- the t is expandable to the multivariate case (true), but the Wilcoxon is not (false)
- the t is expandable to the factorial case (true), but the Wilcoxon is not (false)

(3) True Statement Irrelevant in Choosing Between the t and Wilcoxon

- the t is a classical test
- results based on the t have been accumulating for almost a century, permitting direct comparison of results over time
- the t on the ranks is equivalent to the Wilcoxon on the original scores
- the hypotheses being tested for the t and Wilcoxon aren't exactly the same
- the t is the Uniformly Most Powerful Unbiased test under normality
- the t is robust with respect to Type II errors for departures from normality
- for very small sample sizes the t can be conducted at $\alpha = .05$ or $.01$, but the Wilcoxon cannot because there are no critical values
- at relatively small sample sizes, the Wilcoxon test cannot be conducted at exactly the $\alpha = .05$ or $.01$ levels due to the discrete nature of the sampling distribution
- even its inventor called the Wilcoxon test a "quick and dirty" or "crude" procedure

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