Journal of Modern Applied Statistical Methods

Volume 13 | Issue 1 Article 32

5-1-2014

JMASM 33: A Two Dependent Samples Maximum Test Calculator: Excel

Saverpierre Maggio
Wayne State University, bn4424@wayne.edu

Shlomo Sawilowsky
Wayne State University, shlomo@wayne.edu

Recommended Citation
Maggio, Saverpierre and Sawilowsky, Shlomo (2014) "JMASM 33: A Two Dependent Samples Maximum Test Calculator: Excel," *Journal of Modern Applied Statistical Methods*: Vol. 13 : Iss. 1 , Article 32.
DOI: 10.22237/jmasm/1398918660

Journal of Modern Applied Statistical Methods
May 2014, Vol. 13, No. 1, 514-518.

ISSN 1538 − 9472

JMASM 33: A Two Dependent Samples Maximum Test Calculator: Excel

Saverpierre Maggio
Wayne State University
Detroit, MI

Shlomo Sawilowsky
Wayne State University
Detroit, MI

An Excel Macro was created to provide researchers with an easy to use resource in order to calculate the two dependent samples maximum test as provided in Maggio and Sawilowsky (2014), which permits conducting both the two dependent samples t-test and Wilcoxon signed-ranks test on the same data while eliminating concerns related to Type I error inflation and choice of statistical tests.

Keywords: Maximum test, Dependent samples t test, Wilcoxon signed-ranks test, Excel calculator, Experiment-wise Type I error inflation

Introduction

Inferential errors are easy to commit, and they are compounded when conducing multiple tests (either serially or in parallel) on the same data. In the case of the two dependent samples t-test and the Wilcoxon Signed-Ranks (WSR) test, in general the former should be used if data are known or expect to be normally distributed, otherwise the latter should be used, assuming the treatment alternative is a shift in means. (Blair & Higgins, 1985; Bridge & Sawilowsky, 1999; Gerke & Randles, 2010; Wiederman & Alexandrowicz, 2011). Researchers also cannot conduct both tests on the same data without increasing the Experiment-wise Type I error rate (Sawilowsky & Fahoome, 2003).

A solution strategy is known as the maximum test, whereby the researcher puts “various score statistics together and takes the maximum of them” (Kossler, 2010, p. 2), then the maximum of the two tests are compared to a critical value obtained on a joint sampling distribution for the two tests. This strategy eliminates two concerns; (1) Type I error inflation, and (2) choice of statistic (Algina, J. et al,

Dr. Maggio is an Adjunct Faculty member in the Department of Evaluation and Research, College of Education. Email him at: bn4424@wayne.edu. Dr. Sawilowsky is Professor in the Department of Evaluation and Research, College of Education. Email him at shlomo@wayne.edu.

1995; Blair, 2002; Tarone, 1981; Willan, 1988; Fleming & Harrington, 1991; Lee, 1996; Ryan et al., 1999; Blair, 2002; Weichert & Hothorn, 2002; Neuhauser et al., 2004; Opdyke, 2005; Salmaso & Solari, 2005; Yang et al., 2005; Kossler, 2010; Maggio & Sawilowsky, 2014).

Purpose

The purpose of this article is to provide researchers with an easy to use Excel macro that calculates the two dependent samples maximum test. It is based on critical values provided in Maggio and Sawilowsky (2014).

Methodology

Download the Macro (*http://digitalcommons.wayne.edu/jmasm/vol13/iss1/32*) or contact the first author via e-mail. A screenshot of the Excel worksheet is located in Figure 1.

Input

The process of obtaining the maximum test p-values, critical values and a determination of whether or not to "reject" or "fail to reject" a null hypothesis is as follows:

1. Obtain the t value (or p-value) for two samples dependent t test on data (e.g., via statistical software) and input that value in the appropriate cell of the worksheet. For example, the t value is placed in cell D80, or if the p value associated with the t test it is inputted in cell D81.

2. Obtain the Z (or p value) for the Wilcoxon Signed-Ranks test and place it in cell D82. (or D83)

3. Input or select the sample size in cell D84. (samples are limited to df = 8 to 30, 45, 60, 90, & 120)

4. Input or select the desired alpha level for a two tailed test (0.05 or 0.01) in cell D85.

5. Input or select the number of tails ("2" for two-sided test; "1" for one-sided test) in cell D86.

6. Left click on the button that reads "Click here→ Output".

Conclusion

The macro reports the output in cells D90 through D95. If the p-value for t is inputted in cell D81 then D90 contains the corresponding t-value. The Max(t)/critical value, p(Max), and statistical decision appear in cells D93 D94, and D95, respectively.

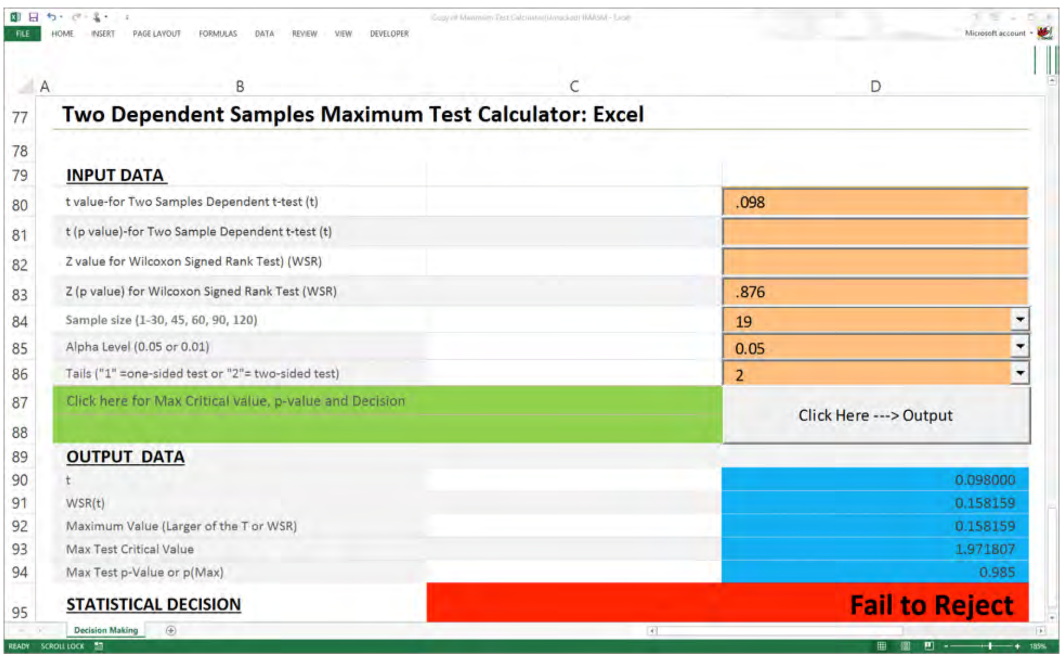

Figure 1. Screenshot of the Excel Worksheet

The two dependent samples maximum test that can be used in lieu of choice between the two dependent samples t- test and Wilcoxon signed-ranks when the distribution from which samples were drawn is unknown. Both the classical parametric and non-parametric tests can be safely conducted on the same data, with the maximum of the two refereed to the new table of critical values that are designed to maintain the Type I error rate to nominal α while guaranteeing the maximum power of the two tests (Maggio & Sawilowsky, 2014).

The maximum test is easy to compute with or without an excel macro. Maggio and Sawilowsky (2014) provided the maximum test critical values for a two tailed test and a clear example to follow. Readers are encouraged to review that article.

References

Algina, J., Blair, R. C. & Coombs, W. T. (1995). A maximum test for scale: Type I error rate and power. *Journal of Educational and Behavioral Statistics, 20*(27): 27-39.

Blair, R. C. (1991). New critical values for the generalized t and generalized rank- sum procedures. *Communications in Statistics*, 20, 981-994.

Blair, C. R. (2002). Combining two nonparametric tests of location. *Journal of Modern Applied Statistical Methods, 1*(1): 13–18.

Blair, R. C. & Higgins, J. J. (1985). Comparison of the power of the paired samples t test to that of wilcoxon's sign-ranks test under various population shapes. *Psychological Bulletin, 97*(1): 119-128.

Bridge, P. K. & Sawilowsky, S. (1999). Increasing physician's awareness of the impact of statistical tests on research outcomes: Investigating the comparative power of the wilcoxon rank-sum test and independent samples t-test to violations from normality. *Journal of Clinical Epidemiology, 52*(2): 229-236.

Fleming, T. R. & Harrington, D. P. (1991). *Counting Processes and Survival Analysis.* New York, NY: Wiley.

Gerke, T. A. & Randles, H. (2010). A method for resolving ties in asymptotic relative efficiency. *Statistics and Probability Letters, 80*(13): 1065-1069.

IMSL. (1980). *International Mathematical and Statistical Libraries*. Houston, Texas.

Kossler, W. (2010). Max-type rank tests, u-tests, and adaptive tests for the two-sample location problem - An asymptotic power study. *Journal of Computational Statistics & Data Analysis, 54*(9): 2053-2065.

Lee, W. J. (1996). Some versatile tests based on the simultaneous use of weighted log-rank statistics. *Biometrics, 52*(2): 721-725.

Maggio, S. & Sawilowsky, S. (2014). A new maximum test via the dependent samples t-test and the wilcoxon sign rank test. *Applied Mathematics*, *5*(10): 110-114. doi: 10.4236/am.2014.51013.

Neuhäuser, M. Büning, H., & Hothorn, L. (2004). Maximum Test versus adaptive tests for the two-sample location problem. *Journal of Applied Statistics, 31*(2), 215-227.

Opdyke, J. D. (2005). A single, powerful, nonparametric statistic for continuous- data telecommunications parity testing. *Journal of Modern Applied Statistical Methods, 4*(2), 372-393.

Ryan, L. M., Freidlin, B., Podgor, M. J., & Gastwirth, J. L. (1999). Efficiency robust tests for survival or ordered categorical data. *Biometrics, 55*(3), 883-886.

Salmaso, L., & Solari, A. (2005). Multiple aspects testing for case-control designs. *Metrika*, 62, 331-340.

Sawilowsky, S. S., & Fahoome, G. F. (2003). Statistics through Monte Carlo Simulation with FORTRAN. Oak Park, Michigan: *Journal of Modern Applied Statistical Methods.*

Tarone, R. E. (1981). On the distribution of the maximum of the log-rank statistic and the modified Wilcoxon statistic. Biometrics, 37, 79-85.

Weichert, M. & Hothorn, L.A. (2002). Robust hybrid tests for the two-sample location problem. *Communications in Statistics – Simulation and Computation*, 31, 175-187.

Wiederman, W. T., & Alexandrowicz, R. W. (2011). A modified normal scores test for paired data. *European Journal of Research Methods for the Behavioral and Social Sciences, 7*(1), 25-38.

Willan, A. R. (1988). Using the maximum test statistic in the two-period crossover clinical trial. *Biometrics, 44*(1), 211-218.

Yang, S., Hsu, L., & Zhao, L. (2005). Combining asymptotically normal tests: case studies in comparison to two groups. *Journal of Statistical Planning and Inference, 133*(1), 139-158.