Power Analysis

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When designing a quantitative study, the following questions usually come up (Kraemer, 1987):

- "How many participants do I need in my study sample?"

- "Which test and measure should I use to analyze my data?"

- "Will I have enough *power* with the number of participants chosen?"

Power analysis is a process that helps answer these and other questions.

Statistical power analysis techniques allow the quantitative researcher to decide: a) how large a sample is needed to enable statistical judgments that are accurate and reliable and (b) how likely is the selected statistical test to detect effects of a given size in a particular situation (StatSoft, 2003).

The power of a test is the probability of correctly rejecting a false null hypothesis (Lane, 2008), thus avoiding a Type II error. A type II error is denoted by the Greek letter β (beta), and is sometimes considered a false negative. The power of a test equals $1 - \beta$. One of the main purposes for power analysis is to help to determine sample size before or during a study. Power analysis aids in the ability to detect impacts of the sample size in a certain situation, and improve the reliability of statistical decisions.

According to Williams (1989), a sample size that is too small can cause the study to lack precision and affect the reliability of the study. Conversely, a sample size that is too large may waste time and resources for minimal gain. This supports the Goldilocks principle: *We need a sample size that is not too big and not too small, but is just right!*

Power analysis depends on the following variables: sample size, population variance, the magnitude of the difference between a null hypothesis and a true alternative hypothesis, significance level, and directionality of the test (Williams, 1989).

There are different types of power analysis. *A priori* power analysis is performed before a study is conducted. The analysis is used to determine the appropriate sample size to target. *Post-hoc power* analysis is computed after the study is conducted. Given the three factors alpha, sample size, and effect size, beta can be calculated. Alpha (α) is the probability of a type I error (i.e. rejection of a correct null hypothesis) beta (β) is the probability of a type II error (acceptance of a false null hypothesis). Effect size is the measure of the strength of the relationship between two variables.

G*Power is a program that can help you conduct a power analysis and select an appropriate sample size. It has the reputation of being flexible and accurate (Faul, Erdfelder, & Buchner, 2007). The G*Power tool performs high-precision statistical power analysis for common statistical tests such as t-tests, F-tests, and Chi-square analyses. The tool is available free of charge if used for

non-commercial purposes. For more information check out:

http://www.statsoft.com/textbook/power-analysis/

A competing program is SamplePower produced by, and available from, SPSS. There is a growing recognition of the importance of power analysis and sample size calculation in the proper design of a quantitative study. The UCLA School of education, presents an example of a priori power analysis regarding the sample size needed to test the efficacy of a new cancer drug. Check out this illustration at: http://www.ats.ucla.edu/stat/gpower/indeppropor1.htm

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