Using SAS® Software to perform Meta-Analytic Integrations
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Abstract

Meta-analysis allows for the statistical integration of research findings across several studies. SAS/BASE® procedures were used to calculate meta-analytic indices according to algorithms suggested by Rosenthal and Rubin (Rosenthal, 1991). SAS/GRAPH® software provided a graphical representation of the obtained meta-analytic indicators and helped detect possible bias in the studies included in the review. The SAS® code has been simplified to accommodate users of all levels of SAS expertise.

1 Meta-Analysis Briefly

Meta-analysis is the “statistical analysis of the summary findings of many empirical studies” (Glass, McGaw, & Smith, 1981, p. 21). The statistical procedures involved in a meta-analysis are not new. Most of them were discovered decades ago by Fisher, Snedecor & Cochran, Pearson, and others (Rosenthal, 1991). However, it was not until 1976 when Glass (1976) coined the term meta-analysis to refer to analysis of the statistics of earlier studies. The meta-analyst integrates the results of the reviewed studies by calculating an average effect size and a combined probability value. Variability indices are also estimated to determine the “probability that the various included hypothesis tests were likely to have been sampled from different populations” (Mullen, 1989, p. 14).

Since its introduction, three distinct methodological approaches have evolved. Known as the Rosenthal - Rubin (Rosenthal, 1991), the Hunter - Schmidt - Jackson (Hunter, Schmidt, & Jackson, 1982), and the Hedges - Olkin (Hedges & Olkin, 1985) methods respectively, all three methods compute effect sizes and various indices of variation of effect sizes using different formulas. In a recent study, Johnson, Mullen, and Sallas (1992) compared the 3 meta-analytic methods and showed that the methods rendered different results using the same set of data, with the Hunter-Schmidt-Jackson method systematically resulting in significantly different results than the other two methods.

As suggested by Glass (1976), the effect size represents the difference of the mean of an experimental group from the mean of the control group it is compared to, divided by some measure of variation:

$$ES = \frac{M_{expr} - M_{ctrl}}{S}.$$  \hspace{1cm} (1)

Often, it is the standard deviation of the control group that is used (a method typically employed by Glass et al., although the pooled standard deviation should be preferred since it provides a better estimate of the population standard deviation (Rosenthal, 1991). Hunter and associates (1982), and Hedges & Olkin (1985) have provided alternative expressions of this formula and have added corrections for errors in the distribution and measurement. Rosenthal & Rubin (1991) have utilized the Pearson correlation coefficient \(r\) as a measure of effect size, because of its greater flexibility when dealing with correlated observations and repeated measures. A coefficient \(r\) is also much easier to “reconstruct” from data of the original study. According to the Rosenthal & Rubin method, \(r\) is further converted to a Fisher’s \(z_f\) transformation according to the following formula:

$$z_f = .5 \log(\frac{1 + r}{1 - r}).$$  \hspace{1cm} (2)

This is done because \(r\) becomes non-linear at the very extreme ends of its distribution (Rosenthal, 1991), while Fisher’s \(z_f\) transformation has a near normal distribution.

2 SAS Software and Meta-Analysis

Despite its widespread use, SAS has not been used extensively for meta-analytic computations. A very small number of studies have utilized SAS products to compute mean and variances of effect sizes. McDaniel (1985) utilized SAS Macros to compute meta-analytic