Ivan Jacob Agaloos Pesigan

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References

Bollen et al.: Direct and indirect effects: Classical and bootstrap estimates of variability **Bollen-Stine-1990**

Kenneth A. Bollen and Robert Stine. "Direct and indirect effects: Classical and bootstrap estimates of variability". In: *Sociological Methodology* 20 (1990), p. 115. DOI: 10.2307/271084.

Abstract: The decomposition of effects in structural equation models has been of considerable interest to social scientists. Finite-sample or asymptotic results for the sampling distribution of estimators of direct effects are widely available. Statistical inferences about indirect effects have relied exclusively on asymptotic methods which assume that the limiting distribution of the estimator is normal, with a standard error derived from the delta method. We examine bootstrap procedures as another way to generate standard errors and confidence intervals and to estimate the sampling distributions of estimators of direct and indirect effects. We illustrate the classical and the bootstrap methods with three empirical examples. We find that in a moderately large sample, the bootstrap distribution of an estimator is close to that assumed with the classical and delta methods but that in small samples, there are some differences. Bootstrap methods provide a check on the classical and delta methods when the latter are applied under less than ideal conditions.

Li et al.: Large-sample significance levels from multiply imputed data using moment-based statistics and an F reference distribution **Li-Raghunathan-Rubin-1991**

K. H. Li, Trivellore Eachambadi Raghunathan, and Donald B. Rubin. "Large-sample significance levels from multiply imputed data using moment-based statistics and an F reference distribution".

In: *Journal of the American Statistical Association* 86.416 (Dec. 1991), pp. 1065–1073. DOI: 10.1080/01621459.1991.10475152.

Abstract: We present a procedure for computing significance levels from data sets whose missing values have been multiply imputed data. This procedure uses moment-based statistics, $m \leq 3$ repeated imputations, and an F reference distribution. When $m = \infty$, we show first that our procedure is essentially the same as the ideal procedure in cases of practical importance and, second, that its deviations from the ideal are basically a function of the coefficient of variation of the canonical ratios of complete to observed information. For small m our procedure's performance is largely governed by this coefficient of variation and the mean of these ratios. Using simulation techniques with small m, we compare our procedure's actual and nominal large-sample significance levels and conclude that it is essentially calibrated and thus represents a definite improvement over previously available procedures. Furthermore, we compare the large-sample power of the procedure as a function of m and other factors, such as the dimensionality of the estimand and fraction of missing information, to provide guidance on the choice of the number of imputations; generally, we find the loss of power due to small m to be quite modest in cases likely to occur in practice.

Robey et al.: Type I error and the number of iterations in Monte Carlo studies of robustness **Robey-Barcikowski-1992**

Randall R. Robey and Robert S. Barcikowski. "Type I error and the number of iterations in Monte Carlo studies of robustness". In: *British Journal of Mathematical and Statistical Psychology* 45.2 (Nov. 1992), pp. 283–288. DOI: 10.1111/j.2044-8317.1992.tb00993.x.

Abstract: A recent survey of simulation studies concluded that an overwhelming majority of papers do not report a rationale for the decision regarding the number of Monte Carlo iterations. A surprisingly large number of reports do not contain a justifiable definition of robustness and many studies are conducted with an insufficient number of iterations to achieve satisfactory statistical conclusion validity. The implication is that we do not follow our own advice regarding the manage-

ment of Type I and Type II errors when conducting Monte Carlo experiments. This paper reports a straightforward application of a well-known procedure for the purpose of objectively determining the exact number of iterations necessary to confidently detect departures from robustness in Monte Carlo results. A table of the number of iterations necessary to detect departures from a series of nominal Type I error rates is included.