Dissertation Defense

Substitution of Nonresponding Units in Probability Sampling

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The substitution of a nonresponding unit with one not originally selected in the sample is a commonly used method for dealing with unit nonresponse. Although frequently used in practice, substitution is largely neglected in the survey sampling literature. To date, few studies have attempted to develop a formal framework for describing and evaluating substitution methods, and little research has been done to improve estimates obtained through the use of substitution as a nonresponse adjustment procedure. This dissertation presents the results from three research studies conducted to enhance our understanding of substitution methods and develop new procedures to improve them.

The first study investigates substitution methods in stratified two-stage cluster sampling with nonresponse at the primary sampling unit (PSU) level. A simulation study is presented to evaluate the error properties of substitution procedures compared to other standard nonresponse adjustments. The results show that the use of a matching procedure in the selection of substitutes produces estimates with similar error properties to standard nonresponse-weighted estimates, but the substitution methods have the advantage of producing more accurate standard errors than strata collapsing strategies used in the presence of PSU nonresponse in stratified cluster sampling.

The second study extends an existing multiple imputation method proposed by Rubin and Zanutto (2002) that adjusts differences between nonrespondents and their substitutes on observable covariates to a more economically viable alternative. A new calibration approach is also proposed to perform such adjustments. Simulation results show that the multiple imputation extension performs as well as its predecessor, with the advantage of lower survey costs. Moreover, the proposed calibration procedure produces more precise estimates than the imputation methods with the same level of bias reduction, yielding estimates with smaller mean squared error.

The third study develops a novel procedure to accommodate nonignorable nonresponse in the substitution selection itself. The approach uses pattern-mixture models following Little and Andridge (2011) and Little (1994), and introduces a parameter that can be used in sensitivity analysis to assess assumptions about the nonresponse mechanism. Simulation studies show that the proposed approach can provide practitioners with useful information to evaluate the risk of nonresponse bias.