

Small area estimation with a longitudinal area level model under restrictions

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Abstract

Large scale sample surveys are usually designed to produce reliable design-based estimates of various characteristics of interest for large geographical regions or subgroups of a population. However, for effective planning in a wide variety of fields, there is a growing demand to produce similar estimates for smaller geographical areas and subpopulations for which adequate samples are not available. In fact, sample sizes are often very small or even zero in many small areas of interest, which results in unreliable direct design-based small area estimates. This makes it necessary to employ indirect estimators that borrow information from related small areas through linking models, using recent census and current administrative data, in order to increase the effective sample size and thus precision. Such indirect estimators are often based on explicit linear mixed models that provide a link to a related small area through the use of supplementary data. The empirical best linear unbiased prediction (EBLUP) approach is the most popular method for the estimation of small area parameters of interest. However, in order to guarantee the calibration in publication and to protect against possible model misspecification, the mean of the small area estimates is often forced to equal the design-based estimate for a larger region for which the design-based estimate is sufficiently accurate. Thus, calibrated or benchmarked small area estimators are needed. In this paper, it is proposed a benchmark small area estimator based on a longitudinal area level model under restrictions. It is showed that such estimator, which guarantees the concordance between the model-based small area estimates and the design-based estimate for a larger region, is the best linear unbiased predictor (BLUP) accordingly to the overall criterion defined by Wang *et al.* (2008). It is considered a direct and a synthetic estimator for a larger region. The mean squared error (MSE) of the benchmarked predictor is also discussed. Finally, it is presented an empirical study using data from the Prices of the Habitation Transaction Survey conducted by the Portuguese Statistical Office.

Keywords

Calibration, Linear mixed models, MSPE of the benchmarked EBLUP, Small area estimation.

References

- Pfeffermann, D. and Tiler, R.B. (2006). Small area estimation with state space models subject to benchmark constraints. *J. Amer. Statist. Assoc.* *101*(476), 1387–397.
- Rao, J.N.K. and Yu, M. (1994). Small-area estimation by combining time-series and cross-sectional data. *Canad. J. Statist.* *22*(4), 511–528.
- Ugarte, M.D., Militino, A.F., and Goicoa, T. (2009). Benchmarked estimates in small areas using linear mixed models with restrictions. *Test* *18*(2), 342–364.
- Wang, J., Fuller, W.A., and Qu, Y. (2008). Small area estimation under a restriction. *Surv. Methodol.* *34*(1), 29–36.