Bias Adjusted Distribution Estimation for Small Areas

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Abstract

Small area estimation techniques are employed when sample data are insufficient for acceptably precise direct estimation in domains of interest. These techniques typically rely on regression models that use both covariates and random effects to explain variation between domains. However, such models also depend on strong distributional assumptions, require a formal specification of the random part of the model and do not easily allow for outlier robust inference.

In a recent paper Chambers and Tzavidis (2005) proposed the use of M-quantile models as an alternative to random effects models for small area estimation. This avoids the problems associated with specification of random effects, allowing inter-domain differences to be characterized by the variation of area-specific M-quantile coefficients. However, they also observed that M-quantile estimates of the small area means are biased, with the magnitude of the bias being related to the presence of outliers in the data. In this paper we propose a bias correction to small area estimates based on the representation of the mean as a functional of the empirical distribution function. The method is then generalized for estimating other quantiles of the small area population distribution of the variable of interest.

Two approaches for small area estimation are considered (a) random effects models and (b) M-quantile models (Chambers and Tzavidis 2005). Distribution estimation for small areas is then performed under these approaches using two estimators of the finite population distribution function (a) a naive estimator and (b) the Chambers-Dunstan (1986) estimator. Variance estimation for the M-quantile small area estimates is discussed. The different approaches are illustrated using both simulated and real data.