SMALL AREA ESTIMATION BY CALIBRATION METHODS

Risto Lehtonen
University of Helsinki, Finland, risto.lehtonen@helsinki.fi

Ari Veijanen
Statistics Finland, ari.veijanen@stat.fi

There is increasing demand in the society for reliable statistics for various population subgroups such as regional areas. Examples are unemployment figures for municipalities and regional poverty indicators. If regional sample sizes are small, conventional direct estimators such as Horvitz-Thompson estimator are inaccurate. Small area methods have been developed to improve accuracy over conventional methods. Small area methods use auxiliary information from registers and statistical modelling to improve the accuracy. We discuss design-based calibration methods for the estimation of totals for population subgroups or domains (small or large). The methods include the traditional model-free or linear calibration (Deville and Särndal 1992) and model calibration (Wu and Sitter 2001) and certain more recent model calibration estimators introduced in Lehtonen and Veijanen (2012, 2015) including semi-direct model calibration methods. We introduce a new variant of model calibration called "hybrid" calibration (Lehtonen and Veijanen 2014). This method aims at combining some favorable properties of model calibration (accuracy improvement; applicability to nonlinear models) and model-free calibration (coherence property of estimates with published statistics), resembling a method proposed in Montanari and Ranalli (2009). These methods assume an access to unit-level auxiliary data. This is a realistic assumption in many "register" countries such as Finland. In the paper we compare the statistical properties (design bias and accuracy) of calibration estimators with design-based simulation experiments by using unit-level synthetic populations.

References

Deville J.-C. and Särndal C.-E. (1992). Calibration estimators in survey sampling. JASA 87, 376-382.

Lehtonen R. and Veijanen A. (2012). Small area poverty estimation by model calibration. Journal of the Indian Society of Agricultural Statistics 66, 125-133.

Lehtonen R. and Veijanen A. (2014). Small area estimation of poverty rate by model calibration and "hybrid" calibration. NORDSTAT Conference, Turku, June 2014.

Lehtonen R. and Veijanen A. (2015). Design-based methods to small area estimation and calibration approach. In: Pratesi M. (Ed.) Analysis of Poverty Data by Small Area Estimation. Chichester: Wiley. (forthcoming)

Montanari G.E. and Ranalli M.G. (2009). Multiple and ridge model calibration. Proceedings of Workshop on Calibration and Estimation in Surveys 2009. Statistics Canada.

Wu C. and Sitter R.R. (2001). A model-calibration approach to using complete auxiliary information from survey data. JASA 96, 185-193.