Robust Small Area Estimation for Discrete Outcomes

Nikos Tzavidis*, Southampton Statistical Sciences Research Institute, University of Southampton, Southampton SO17 1BJ, UK n.tzavidis@soton.ac.uk

Ray Chambers, National Institute for Applied Statistics Research Australia, University of Wollongong, Wollongong, Australia.

Nicola Salvati, Dipartimento di Economia e Management, Universita di Pisa, Pisa, Italy.

The increasing demand for reliable small area statistics has led to the development of a number of efficient model-based small area estimation (SAE) methods. For example, the empirical best linear unbiased predictor (EBLUP) based on a linear mixed model (LMM) is often recommended when the target of inference is the small area average of a continuous response variable. Using a mixed model, however, requires strong distributional assumptions. Robust SAE inference under the LMM has recently attracted some interest. An alternative approach to small area estimation that automatically allows for robust inference is to use M-quantile models. Many survey variables are categorical in nature and are therefore not suited to standard SAE methods based on LMMs. In this presentation we discuss recent work on a new approach to SAE for discrete outcomes based on M-quantile modelling. This is based on extending the existing M-quantile approach for continuous outcomes to the case where the response is binary or a count. As with M-quantile modelling of a continuous response random effects are avoided and between area variation in the response is characterised by variation in area-specific values of quantile-like coefficients. After reviewing M-quantile small area estimation for a continuous response, we show how the literature for robust inference for generalised linear models (GLMs) can be extended for fitting an M-quantile GLM. Approaches for defining the M-quantile coefficients, which play the role of pseudo-random effects in this framework, are discussed alongside the definition of small area predictors and corresponding Mean Squared Error estimators. Results from model-based studies aimed at empirically assessing the performance of the proposed small area predictors are presented.

Key Words: Generalized linear models, non-normal outcomes, bootstrap.