Small Area Quantile Estimation

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Sample surveys are widely used to obtain information about totals, means and other parameters of finite populations. In many applications, similar information is also desired on sub-populations such as individuals in specific geographic areas and socio-demographic groups. Often, the surveys are conducted at national or similarly high levels. The random nature of the probability sampling can result in few sampling units from many sub-populations of interest. Estimating parameters of these sub-populations with satisfactory precision and evaluating their accuracy pose serious challenges to statisticians. Short of direct information, statisticians resort to pooling information across small areas via suitable model assumptions. Most existing discussions have focused on estimating small area means under models geared to various scenarios. These models would be overstretched if used for estimating small area quantiles. In this paper, we postulate that the small area population distributions contain a linear structure with error distributions satisfying a density ratio model. Under this model, we employ empirical likelihood to pool information in samples across all small areas. The resulting approach is shown effective for estimating small area quantiles. We develop some theory and use simulation based on real and created finite populations to illustrate its potential.

Keywords: Empirical likelihood; Density ratio model; Finite population; Sampling survey.