Constrained nonparametric estimation of the mean and the CDF using ranked-set sampling with a covariate

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Abstract   Ranked-set sampling (RSS) and judgment post-stratification (JPS) are related schemes in which more efficient statistical inference is obtained by creating a stratification based on ranking information. The rankings may be completely subjective, or they may be based on values of a covariate. Recent work has shown that regardless of how the rankings are done, the in-stratum cumulative distribution functions (CDFs) must satisfy certain constraints, and we show here that if the rankings are done according to a covariate, then tighter constraints must hold. We also show that under a mild stochastic ordering assumption, still tighter constraints must hold. Taking advantage of these new constraints leads to improved small-sample estimates of the in-stratum CDFs in all RSS and JPS settings. For JPS, the new constraints also lead to improved estimates of the overall CDF and the population mean.

Keywords   Concomitant · Convexity · Judgment post-stratification · Maximum likelihood estimation · Stratified sampling · Woodruff confidence intervals