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Professor Monroe Lerner is to be congratulated for arranging the contributed papers sessions of the Social Statistics Section very neatly subjectwise. This made the deliberations of the contributed papers sessions very interesting and meaningful. The papers in this session deals with research problems in Survey Sampling.

Systematic sampling is often used for convenience sometimes from necessity in sample surveys. The estimation of the variance is, however, a long standing problem. Mr. Wolter and Ms. McCann are to be commended for taking up this important question. They have made an emperical study of the performance of the eight variance estimators available in literature using several artifical and real populations. Koop's variance estimator is comparable to the jackknife variance estimator. Its relatively poor performance is not surprising. Similar results for jackknife variance estimator in estimation of ratios were obtained by Chakrabarty and Rao (1967) and Rao and Rao (1971).

It is rather surprising to see that Cocharan's variance estimator derived for auto-correlated populations is superior in populations with linear trend and even in populations in random order. It gives smallest mean square error in almost all cases they have studied. As the authors mentioned there is thus need for further study along this line using different population models and live data to evaluate the performances of the variance estimators now available in literature and to provide a guideline about the choice of an estimator in a given situation.

In survey-sampling a complete 'frame' (list of sampling units) is sometimes either unavailable or too expensive to construct. In such situations the sample from an incomplete list may be supplemented by another sample from a complete areal frame to gain increased accuracy and to reduce costs. Since Hartley's (1962) paper outlining the theory of multiple frame surveys several researchers have proposed some alternative estimators in two frame surveys.

The paper by H. Huang compares the efficiency of the Fuller-Burmeister estimator relative to that of Hartley's using real data. If is emperical study shows that the estimator given by Fuller-Burmeister is more efficient. This result is to be expected since Fuller-Burmeister estimate uses better estimates of post-strata sizes than given by Hartley. This is relatively a new area in survey sampling and further research in this area is needed. I would also like to mention that recently, Hartley (1974) gave a more general theory of multiple frame surveys.

The paper by Richard K. Burdick and Robert L. Sielken is an useful contribution to the new estimation techniques in finite population sampling developed by Royall. Professor Royall looks at the estimation problem in sampling as a problem of prediction for un-sampled units and uses linear least squares prediction method. One would like to see how the exact confidence intervals obtained by Burdick and Sielken compare with the exact confidence intervals that may be obtained using classical method of estimation under the same super population model.

Survey statisticians design complex sampling plans appropriate for estimation of parameters like population mean, total or ratios. Social scientists use data collected from surveys for research problems dealing with inter-relations of different variables. They often use statistical packages for analysis of survey data assuming such data as a random sample from an infinite population. This raises the question of design effect. Kish and Frankel have made extensive emperical studies of design effects. Campbell's paper is perhaps the first paper that deals with the theoretical study of design effect. Campbell provides the theoretical evidence to support Kish and Frankel's emperical results that the design effect for higher order statistics like regression estimates is generally less than the design effects for first order statistics like means.

The critical analysis of survey data is often done using methods appropriate for random samples from normal population because computer programs for data analysis geared to complex survey designs are generally not available. We hope that the organizations like the International Association of Survey Statisticians, Bureau of Census, Statistics-Canada and Survey Research Centers will develop statistical packages for critical analysis of survey data.

REFERENCES

- Chakrabarty, R. P. and J. N. K. Rao (1967). "The Bias and Stability of Jackknife Variance Estimator in Ratio Estimation." <u>Proceedings</u> of American Statistical Association (Social Statistics Section). 326-331.
- Hartley, H. O. (1974). "Multiple Frame Methodology and Selected Applications." <u>SANKHYA</u>, C36, 99-118.
- Rao, P. S. R. S. and J. N. K. Rao (1971). "Small Sample Results for Ratio Estimators." Biometrika 58, 625-630.