Recent Advances in Survey Sampling Techniques

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1   Overview of the Field

There were six talks by very eminent statisticians: Professor Jon Rao of Carleton University, Professor Wayne Fuller of Iowa State University, Professor Gauri Datta of University of Georgia, Professor Partha Lahiri of University of Maryland, Dr. Torabi of University of Manitoba and Professor Kim of Iowa State University. The main theme of the talks was Small Area Estimation in Survey Sampling. Professor Prasads research in this area is quite well known. In fact, one of the main papers in this area is by Prasad (Prasad and Rao, 1990 JASA) and the main result is known as Prasad-Rao estimator. The talks were discussing the importance of Prasads work in the area, which is still making a significant impact, presenting extensions, nearly 25 years after its publication.

2   Presentation Highlights and Scientific Progress Made

The session started with lively introduction by Professor Jon Rao who was the supervisor for Professor Prasad. He presented an overview of the research area of Small Area Estimation. It elucidated the historical development starting with the paper by Fay and Herriot (JASA, 1979). The main unsolved problem in these papers was obtaining the correct uncertainty measure for the prediction of the small area values. Prasad and Rao (1990, JASA) was the first paper that gave an estimator that is still widely used and is very hard to beat even with much more complicated methodologies such as the bootstrap.

It was then continued with presentation by Professor Wayne Fuller who presented a double bootstrap method to estimate prediction error of the small area predictor. One of the main results was how to do double bootstrap in a computationally efficient fashion. The double bootstrap is done using only 1 additional sample, versus B additional samples, at the second stage. It is called the telescopic bootstrap. It was shown by simulations that the telescoping bootstrap works as well, and sometimes better, than the standard double bootstrap procedure.

Professor Gauri Datta discussed how Small Area Estimation is intimately related with the mixed and random effect models. Model selection methods for this class of models are not well developed. One of the issues that needs to be addressed is Are all random effects essential?. The idea is that if good covariates are available for a particular area, one may not use random effect (or, equivalently the random effect has zero variance). The presentation showed how to test for such zero random effects. The method was applied to a data from Massachusetts. It turns out only a few areas really needed the random effects adjustment. The common practice of using of random effects in applied fields may take a note of this issue.

Then, Professor Partha Lahiri presented a penalized likelihood approach (termed here as modified likelihood) to stabilize the estimation of the variance components. The penalty function varies from area or area.

Different penalty functions lead to different efficiencies. This works with the Normal mixed model only. Simulations results are encouraging although quite comparable to the bootstrap estimators.

In the second last presentation, Professor Mahmoud Torabi discussed the statistical inference for spatial version of generalized linear mixed models. He generalized Prasad-Rao estimator of prediction error to this case and compared with the bootstrap estimator. The approximation seems to work well.

Lastly, Professor J. K. Kim, Iowa State University gave an applied talk. He applied the techniques of Small Area Estimation to predict election results in Korea. The main contribution was on designing a survey that is accurate but not as expensive as exit polls. They used a survey using smart phones for younger generation and telephone poll for older generation. This improved the non-response rate. It also allowed use of auxiliary information to improve the inference.

3   Outcome of the Meeting

We wrapped up our two day workshop on Sunday morning with a round table discussion over coffee. New networks were formed. Promising new research avenues were developed. New friendships were developed. Everyone appreciated the opportunity to be at the workshop in such stunning surroundings, which made doing mathematical and statistical sciences all the more appetizing. It was an exceptional workshop, extremely lively and interactive.

References

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[2] RE Fay, and RA Herriot. Estimates of Income for Small Places: An Application of James-Stein Procedures to Census Data. JASA 1979.Vol. 74, No. 366. pp. 269-277.

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[4] Jiming Jiang and P. Lahiri. Estimation of Finite Population Domain Means: A Model-Assisted Empirical Best Prediction Approach. JASA. 2006. Vol 101. No. 473. pp. 301-311.

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