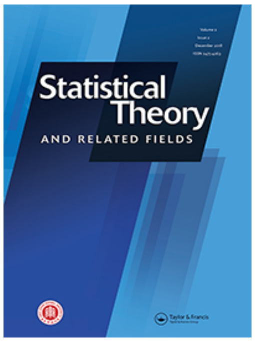

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SHORT COMMUNICATION

Summaries of three keynote lectures at the SAE – 2018

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ABSTRACT

Three keynote lectures are presented at the conference of Small Area Estimation and Other Topics of Current Interest in Surveys, Official Statistics and General Statistics (SAE 2018), an international conference held between June 16 and 18 at East China Normal University, Shanghai, China. The speakers of these lectures are world famous statistics professors, James O. Berger, J. N. K. Rao and Malay Ghosh. The lectures mainly review the previous studies and present the pioneering results covering Bayesian statistics, small area estimation, shrinkage priors, etc.

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1. Keynote lecture by Professor James O. Berger

Dr Berger is currently the Arts and Sciences Professor of Statistics in the Department of Statistical Science at Duke University, USA. He was the founding director of the Statistical and Applied Mathematical Sciences Institute, serving from2002 to 2010. He was the president of the Institute of Mathematical Statistics during 1995–1996, chair of the Section on Bayesian Statistical Science of the American Statistical Association in 1995 and president of the International Society for Bayesian Analysis during 2004. Among the awards and honours, Berger has received are Guggenheim and Sloan Fellowships, the COPSS President's Award in 1985, the Sigma Xi Research Award at Purdue University for the contribution of the year to science in 1993, the COPSS Fisher Lecturer in 2001, the Wald Lecturer of the IMS in 2007 and the Wilks Award from the ASA in 2015. He was elected as a foreign member of the Spanish Real Academia de Ciencias in 2002, elected to the USA National Academy of Sciences in 2003, was awarded an honorary Doctor of Science degree from Purdue University in 2004, and became an Honorary Professor at East China Normal University in 2011.

Berger's research has primarily been in Bayesian statistics, foundations of statistics, statistical decision theory, simulation, model selection and various interdisciplinary areas of science and industry, including astronomy, geophysics, medicine and validation of complex computer models.

1.1. Summary of the lecture by Professor Berger: an objective prior for hyperparameters in normal hierarchical model

In the lecture, Professor Berger first introduced a prototypical normal hierarchical model. The normal hierarchical model is a statistical model written in multiple levels (hierarchical form), which estimates the parameters of the posterior distribution using the Bayesian method. The goal of the talk is to show us how to find good hyperpriors for the hierarchical model. Berger then gave a hospital medical treatments example to illustrate the application of the normal hierarchical model in real data problem. Yet the empirical Bayes analysis has generic problems in hierarchical modelling, and the formal objective Bayesian analysis, such as the Jeffreys-rule approach or reference prior approach, is only implementable in simple hierarchical settings. To overcome the difficulty, Berger's former paper (Berger, Strawderman, & Tang, 2005) proposed to find hyperpriors in normal hierarchical models by looking at the frequentist notion of admissibility of resulting estimators. However, no overall conclusion was reached as to a specific prior so far. Berger in this talk recommended to use a specific hierarchical reference prior which can yield a proper posterior under very mild conditions. More importantly, Berger also showed that the hierarchical reference prior is admissible and on the 'boundary of admissibility'. Besides, he also introduced a broader class of priors which were shown to enjoy the good property on the 'boundary of admissibility'. Though Direct Metropolis

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sampling and Metropolised hit-and-run Sampler were used in the literature, Berger in this talk proposed a novel Gibbs sampling-based method and found efficient MCMC implementation schemes for these priors and theoretically showed that his proposal is more efficient than Hoff (2009)'s MCMC algorithm. Then Berger illustrated the proposed objective prior's significant advantages in both speed and accuracy over existing methods by presenting extensive numerical comparisons. After that, Berger considered the higher levels of the hierarchical model and showed that the aforementioned hierarchical reference prior and sampling method can be similarly implemented into the higher levels of the hierarchical model. Finally, Berger concluded the lecture by making some summary for the lecture.

2. Keynote lecture by Professor J. N. K. Rao

Dr J. N. K. Rao is a Distinguished Research Professor at Carleton University, Ottawa, Canada. He is also a consultant to Statistics Canada and a Member of Statistics Canada's Advisory Committee on Methodology. Among the awards and honours, Rao has received are 2004 Waksberg Award for survey methodology and 1994 Gold Medal of the Statistical Society of Canada. He was also elected as a fellow of the ASA, IMS, RSC and Honorary Member of the SSC.

Professor Rao has been at the forefront of research in sampling theory and methods since 1960. He has made fundamental contributions to the design-based classical theory of sampling, to the foundations of sampling during the debates of the 1960s and 1970s, to a variety of aspects of variance estimation, to the analysis of complex survey data and to small area estimation. Over this 40-year period his work has been, and continues to be, at the cutting edge of research.

2.1. Summary of the lecture by Professor Rao: some current developments and future directions

Dr Rao started the lecture by sharing his association with Professor Danny Pfeffermann. They first met each other when Danny visited Ottawa as a student in 1976 on a UN Fellowship awarded while working for the Israeli CBS. Besides, Danny visited Statistics Canada for one year in 1989–1990 and again in the summers of 1991–1993. And Danny was awarded the Waksberg Award 2011. Then Rao introduced Pfeffermann's major contributions which include (1) linear regression analysis of survey data (Pfeffermann & Nathan, 1981), (2) standard errors for seasonally adjusted time series data (Pfeffermann, 1991), (3)multi-level models for survey data (Pfeffermann, Skinner, Holmes, Goldstein, & Rasbash, 1998), (4) small area estimation: informative sampling (Pfeffermann & Sverchkov, 2007), empirical bootstrap bias correction for estimating design MSE of model-based estimators (Pfeffermann & Correa, 2012).

After discussed Danny's great contributions Rao then began presenting some current developments in small area estimation. The motivation of giving this talk is three-fold. First, the demand for reliable local or small area statistics has greatly increased, since direct area-specific estimates are inadequate due to small domain sample sizes or even zero sample sizes. Second, it is necessary to 'borrow strength' across related areas through linking models. Third, the opposition to models has been overcome by the demand for small area estimation.

To present the current developments of methodological interest and practical importance in small area estimation, Rao first introduced the basic area-level model. Briefly speaking, the area-level model means that m areas out of M are sampled, in order to estimate the parameter θ, the direct estimators on the m sampled are $\hat{\theta}_i$, $i = 1, \ldots, m$ were used to obtain the interesting parameter on the unsampled area. Rao then demonstrated merits of such model-based small area estimation. Rao demonstrated the merits of model-based small area estimation in terms of both internal evaluation (mean square error loss) and external evaluation (average relative error).

In addition, Rao also discussed the other area-level model contributions including unmatched or mismatched models, SAE using data from multiple sources, Big data as covariates, Sub-area-level models, Unit level models, Informative sampling within areas.

3. Keynote lecture by Professor Malay Ghosh

Dr Ghosh is a Distinguished Professor at the University of Florida, USA. He is worldwide famous for his research in small area estimation, case–control studies, Bayesian inference, empirical Bayes analysis, etc. Meanwhile, he is an elected fellow of the American Statistical Association and the Institute of Mathematical Statistics, and he is also elected member of the International Statistical Institute. In 2017, he received the Lifetime Achievement Award from the International Indian Statistical Association.

3.1. Summary of the lecture by the Professor Ghosh: Bayesian high-dimensional regression with shrinkage priors

In his lecture prologue, Dr Ghosh expressed his gratitude to Professor Danny. He then turned to his lecture topic. To begin with, he talked about two stories which motivated him to do some researches on high-dimensional Bayesian inference. The crucial problem was that there would be computational problems of shrinkage priors even in the multivariate linear model. He used an example of gene expression to illustrate the practical value of his research.

Moreover, Ghosh gave some notation for a general high-dimensional multivariate regression and pointed out the fact that some problems would appear when dimensionality is larger than the sample size. In such a situation, sparsity was a common and reasonable assumption in the coefficient matrix. He said, a penalised regression is one approach in the view of a frequentist, for example, group lasso penalty (Li, Nan, & Zhu, 2015) or adaptive group lasso penalty (Chen & Huang, 2012) could shrink entire rows of the coefficient matrix to exactly zero, which facilitates variable selection. Besides, in the framework of the Bayesian hierarchical model, he emphasised how to put a shrinkage prior distribution on the coefficient matrix. He reviewed previous researches about Bayesian group selection on the multivariate model and polynomial-tailed priors, which is also known as global–local shrinkage priors in the univariate regression (Carvalho, Ploson, & Scott, 2010; Park & Casella, 2008).

Ghosh next elaborated a new Bayesian approach for estimating the coefficient matrix using polynomial-tailed priors, named as the Multivariate Bayesian model with Shrinkage Priors (MBSP) (Bai & Ghosh, 2018). He then provided some sufficient conditions and presented the strong posterior consistency of their proposed method in both high-dimensional and ultra-high-dimensional settings. He also introduced how they implemented the MBSP model. He recommended to use three parameter beta normal (TPBN) as polynomial-tailed priors, although many other options are available.

After that, Ghosh compared MBSP-TPBN with some other methods, such as the multivariate Bayesian group lasso posterior median estimator with a spike-and-slab prior (MBGL-SS) (Liquet, Mengersen, Pettitt, & Sutton, 2017), the multivariate lasso method (MLASSO) (Friedman, Hastie, & Tishirani, 2010), the row-sparse reduced-rank regression (SRRR) (Chen & Huang, 2012) and the sparse partial least squares estimate (SPLS) (Chun & Kele, 2010). Meanwhile, he presented the performances of all the models, including mean squared errors (MSE), false discovery rate (FDR) and overall misclassification probability (MP). Particularly, MBSP-TPBN overwhelmingly outperformed other methods under the high-dimensional and ultra-high-dimensional settings.

Ghosh lastly returned to his aforementioned example. He applied MBSP-TPBN and some other models to a yeast cell cycle data set, and tried to figure out the relationship between transcription factors and their target genes at different time points. He calculated the number of proteins selected and mean squared predictor error and plotted the posterior median estimates and 95% credible bands for four transcription factors that were significantly selected by MBSP-TPBN model. He ended his lecture by summarising his key points and discussing about further researches.

Disclosure statement

No potential conflict of interest was reported by the authors.

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