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Bayesian Thinking:
Modeling and Computation

Edited by
D.K. Dey
C.R. Rao

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Bayesian Thinking: Modeling and Computation

Edited by

D.K. Dey

Department of Statistics
University of Connecticut
Storrs, CT, USA

C.R. Rao

Center for Multivariate Analysis
Department of Statistics, The Pennsylvania State University
University Park, PA, USA



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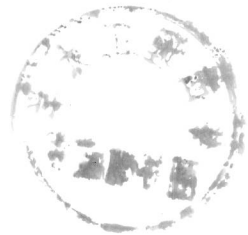
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Preface

Fisher and Mahalanobis described Statistics as the key technology of the twentieth century. Since then Statistics has evolved into a field that has many applications in all sciences and areas of technology, as well as in most areas of decision making such as in health care, business, federal statistics and legal proceedings. Applications in statistics such as inference for Causal effects, inferences about the spatio-temporal processes, analysis of categorical and survival data sets and countless other functions play an essential role in the present day world. In the last two to three decades, Bayesian Statistics has emerged as one of the leading paradigms in which all of this can be done in a unified fashion. There has been tremendous development in Bayesian theory, methodology, computation and applications in the past several years.

Bayesian statistics provides a rational theory of personal beliefs compounded with real world data in the context of uncertainty. The central aim of characterizing how an individual should make inferences or act in order to avoid certain kinds of undesirable behavioral inconsistencies and consequent are all successfully accomplished through this process. The primary theory of Bayesian statistics states that utility maximization should be the basis of rational decision-making in conjunction with the Bayes' theorem, which acts as the key to the basis in which the beliefs should fit together with changing evidence scenario. Undoubtedly, it is a major area of statistical endeavor, which has hugely increased its profile, both in context of theories and applications.

The appreciation of the potential for Bayesian methods is growing fast both inside and outside the statistics community. The first encounter with Bayesian ideas by many people simply entails the discovery that a particular Bayesian, method is superior to classical statistical methods on a particular problem or question. Nothing succeeds like success, and this observed superiority often leads to a further pursuit of Bayesian analysis. For scientists with little or no formal statistical background, Bayesian methods are being discovered as the only viable method for approaching their problems. For many of them, statistics has become synonymous with Bayesian statistics.

The Bayesian method as many might think is not new, but rather a method that is older than many of the commonly, known and well formulated statistical techniques. The basis for Bayesian statistics was laid down in a revolutionary paper written by Rev Thomas Bayes, which appeared in print in 1763 but was not acknowledged for its significance. A major resurgence of the method took place in the context of discovery of paradoxes and logical problems in classical statistics. The work done by a number of authors such as Ramsey, DeFinetti, Good, Savage, Jeffreys and Lindley provided a more thorough and philosophical basis for acting under uncertainty. In the develop-

ments that went by, the subject took a variety of turns. On the foundational front, the concept of rationality was explored in the context of representing beliefs or choosing actions where uncertainty creeps in. It was noted that the criterion of maximizing expected utility is the only decision criterion that is compatible with the axiom system. The statistical inference problems are simply the particular cases, which can be visualized in general decision theoretic framework. These developments led to a number of other important progresses on Bayesian front. To name a few, it is important to mention the Bayesian robustness criterion, empirical and hierarchical Bayesian analysis and reference analysis etc. that all deepen the roots of Bayesian thoughts. The subject came to be the forefront of practical statistics with the advent of high-speed computers and sophisticated computational techniques especially in the form of Markov chain Monte Carlo methods. Because of that it is evident that a large body of literature in the form of books, research papers, conference proceedings are developed during the last fifteen years. This is the reason we felt that it is indeed the right time to develop a volume in the Handbook of Statistics series to highlight recent thoughts on theory, methodology and related computation on Bayesian analysis. With this specific purpose in mind we invited leading experts on Bayesian methodology to contribute for this volume. This in our opinion has resulted in a volume with a nice mix of articles on theory, methodology, application and computational methods on current trend in Bayesian statistics. For the convenience of readers, we have divided this volume into 10 distinct groups: Foundation of Bayesian statistics including model determination, Nonparametric Bayesian methods, Bayesian computation, Spatio-temporal models, Bayesian robustness and sensitivity analysis, Bioinformatics and Biostatistics, Categorical data analysis, Survival analysis and software reliability, Small area estimation and Teaching Bayesian thought. All chapters in each group are written by leading experts in their own field.

We hope that this broad coverage of the area of Bayesian Thinking will only provide the readers with a general overview of the area, but also describe to them what the current state is in each of the topics listed above.

We express our sincere thanks to all the authors for their fine contributions, and for helping us in bringing out this volume in a timely manner. Our special thanks go to Ms. Edith Bomers and Ms. Andy Deelen of Elsevier, Amsterdam, for taking a keen interest in this project, and also for helping us with the final production of this volume.

Dipak K. Dey
C.R. Rao

Contributors

- Albert, James H., *Department of Mathematics and Statistics, Bowling Green State University, Bowling Green, OH 43403*; e-mail: albert@bgnet.bgsu.edu (Ch. 30).
- Arellano-Valle, Reinaldo B., *Departamento de Estadística, Facultad de Matemáticas, Pontificia Universidad Católica de Chile, Chile*; e-mail: reivalle@mat.puc.cl (Ch. 22).
- Baladandayuthapani, Veerabhadran, *Department of Statistics, Texas A&M University, College Station, TX 77843*; e-mail: veera@stat.tamu.edu (Ch. 24).
- Bernardo, José M., *Departamento de Estadística e I.O., Universitat de València, Spain*; e-mail: jose.m.bernardo@uv.es (Ch. 2).
- Bolfarine, Heleno, *Departamento de Estatística, IME, Universidade de São Paulo, Brasil*; e-mail: hbolfar@ime.usp.br (Ch. 22).
- Branco, M.D., *University of São Paulo, Brazil*; e-mail: mbranco@ime.usp.br (Ch. 23).
- Brandwein, Ann Cohen, *Baruch College, The City University of New York*; e-mail: ann_brandwein@baruch.cuny.edu (Ch. 8).
- Branscum, Adam J., *Department of Statistics, University of California, Davis, CA 95616*; e-mail: ajbranscum@ucdavis.edu (Ch. 9).
- Carter, Chris, *CSIRO, Australia*; e-mail: Chris.Carter@csiro.au (Ch. 18).
- Chen, Ming-Hui, *Department of Statistics, University of Connecticut, Storrs, CT 06269-4120*; e-mail: mhchen@stat.uconn.edu (Ch. 15).
- Chib, Siddhartha, *John M. Olin School of Business, Washington University in St. Louis, St. Louis, MO 63130*; e-mail: chib@wustl.edu (Ch. 29).
- Choudhuri, Nidhan, *Department of Statistics, Case Western Reserve University*; e-mail: nidhan@nidhan.cwru.edu (Ch. 13).
- Cripps, Edward, *Department of Statistics, University of New South Wales, Sydney, NSW 2052, Australia*; e-mail: ecripps@unsw.edu.au (Ch. 18).
- Damien, Paul, *McCombs School of Business, University of Texas at Austin, Austin, TX 78730*; e-mail: paul.damien@mcombs.utexas.edu (Ch. 10).
- Datta, Gauri Sankar, *University of Georgia, Athens, GA*; e-mail: gauri@stat.uga.edu (Ch. 3).
- Dunson, David B., *Biostatistics Branch, MD A3-03, National Institute of Environmental Health Sciences, Research Triangle Park, NC 287709*; e-mail: dunson1@niehs.nih.gov (Ch. 25).
- Ferreira, Marco A.R., *Instituto de Matemática, Universidade Federal do Rio de Janeiro, Brazil*; e-mail: marco@im.ufrj.br (Ch. 19).

- Gamerman, Dani, *Instituto de Matemática, Universidade Federal do Rio de Janeiro, Brazil*; e-mail: dani@im.ufrj.br (Ch. 19).
- Ghosal, Subhashis, *Department of Statistics, North Carolina State University, NC 27695*; e-mail: sghosal@stat.ncsu.edu (Ch. 13).
- Ghosh, Jayanta, *Indian Statistical Institute, 203 B.T. Road, Kolkata 700 108, India*; e-mail: jayanta@isical.ac.in and *Department of Statistics, Purdue University, West Lafayette, IN 47907*; e-mail: ghosh@stat.purdue.edu (Ch. 5).
- Ghosh, Malay, *Department of Statistics, University of Florida, Gainesville, FL 32611*; e-mail: ghoshm@stat.ufl.edu (Ch. 27).
- Ghosh, Sujit K., *Department of Statistics, North Carolina State University*; e-mail: sghosh@stat.ncsu.edu (Ch. 31).
- Gustafson, Paul, *Department of Statistics, University of British Columbia, Vancouver, BC, Canada, V6T 1Z2*; e-mail: gustaf@stat.ubc.ca (Ch. 26).
- Hanson, Timothy E., *Department of Mathematics and Statistics, University of New Mexico, Albuquerque, NM 87131*; e-mail: hanson@math.unm.edu (Ch. 9).
- He, Chong Z., *Department of Statistics, University of Missouri-Columbia, Columbia, MO 65210*; e-mail: hezh@missouri.edu (Ch. 32).
- Hossain, Shahadut, *Department of Statistics, University of British Columbia, Vancouver, BC, Canada, V6T 1Z2*; e-mail: shahadut@stat.ubc.ca (Ch. 26).
- Iglesias, P., *Pontificia Universidad Católica de Chile, Chile*; e-mail: pliz@mat.pic.cl (Ch. 23).
- Johnson, Timothy D., *University of Michigan, School of Public Health*; e-mail: tdjtdj@umich.edu (Ch. 28).
- Johnson, Valen E., *Institute of Statistics and Decision Sciences, Duke University, Durham, NC 27708-0254*; e-mail: valen@stat.duke.edu (Ch. 28).
- Johnson, Wesley O., *Department of Statistics, University of California-Irvine, Irvine, CA 92697*; e-mail: wjohnson@uci.edu (Ch. 9).
- Kohn, Robert, *University of New South Wales, Sydney, NSW 2052, Australia*; e-mail: r.kohn@unsw.edu.au (Ch. 18).
- Kuo, Lynn, *Department of Statistics, University of Connecticut, Storrs, CT 06269-4120*; e-mail: lynn@stat.uconn.edu (Ch. 33).
- Liseo, Brunero, *Dip. studi geoeconomici, linguistici, statistici e storici per l'analisi regionale, Università di Roma "La Sapienza", I-00161 Roma, Italia*; e-mail: brunero.liseo@uniroma1.it (Ch. 7).
- Lopes, Hedibert F., *Graduate School of Business, University of Chicago*; e-mail: hlopes@gsb.uchicago.edu (Ch. 19).
- Maiti, Tapabrata, *Department of Statistics, Iowa State University, Ames, IA*; e-mail: taps@iastate.edu (Ch. 34).
- Mallick, Bani, *Department of Statistics, Texas A&M University, College Station, TX 77843*; e-mail: bmallick@stat.tamu.edu (Ch. 24).
- Marin, Jean-Michel, *Universite Paris Dauphine, France*; e-mail: marin@ceremade.dauphine.fr (Ch. 16).
- Martín, Jacinto, *Department of Mathematics, U. Extremadura, Spain*; e-mail: jrmartin@unex.es (Ch. 21).

- McCandless, Lawrence, *Department of Statistics, University of British Columbia, Vancouver, BC, Canada, V6T 1Z2; e-mail: lawrence@stat.ubc.ca* (Ch. 26).
- Mengersen, Kerrie, *University of Newcastle; e-mail: k.mengersen@qut.edu.au* (Ch. 16).
- Migon, Helio S., *Instituto de Matemática, Universidade Federal do Rio de Janeiro, Brazil; e-mail: migon@im.ufrrj.br* (Ch. 19).
- Mira, Antonietta, *Department of Economics, University of Insubria, Via Ravasi 2, 21100 Varese, Italy; e-mail: antonietta.mira@uninsubria.it* (Ch. 14).
- Mukherjee, Bhramar, *Department of Statistics, University of Florida, Gainesville, FL 32611; e-mail: mukherjee@stat.ufl.edu* (Ch. 27).
- Müller, Peter, *Department of Biostatistics, The University of Texas, M.D. Anderson Cancer Center, Houston, TX; e-mail: pm@stat.duke.edu* (Ch. 17).
- Pericchi, Luis Raúl, *School of Natural Sciences, University of Puerto Rico, Puerto Rico; e-mail: pericchi@goliath.cnnnet.clu.edu* (Ch. 4).
- Purkayastha, Sumitra, *Theoretical Statistics and Mathematics Unit, Indian Statistical Institute, Kolkata 700 108, India; e-mail: sumitra@isical.ac.in* (Ch. 5).
- Ray, Shubhankar, *Department of Statistics, Texas A&M University, College Station, TX 77843; e-mail: sray@stat.tamu.edu* (Ch. 24).
- Ríos Insua, David, *Decision Engineering Lab, U. Rey Juan Carlos, Spain; e-mail: david.rios@urjc.es* (Ch. 21).
- Robert, Christian P., *Universite Paris Dauphine, France; e-mail: xian@ceremade.dauphine.fr* (Ch. 16).
- Roy, Anindya, *Department of Mathematics and Statistics, University of Maryland, MD 21250; e-mail: anindya@math.umbc.edu* (Ch. 13).
- Rubin, Donald B., *Department of Statistics, Harvard University, Cambridge, MA 02138; e-mail: rubin@stat.harvard.edu* (Ch. 1).
- Ruggeri, Fabrizio, *CNR-IMATI, Milano, Italy; e-mail: fabrizio@im.imati.cnr.it* (Chs. 11, 21).
- Samanta, Tapas, *Applied Statistics Unit, Indian Statistical Institute, Kolkata 700 108, India; e-mail: tapas@isical.ac.in* (Ch. 5).
- Sinha, Debajyoti, *Department of Biostatistics, Bioinformatics & Epidemiology, MUSC; e-mail: sinhad@musc.edu* (Ch. 31).
- Sinha, Samiran, *Department of Statistics, Texas A&M University, College Station, TX; e-mail: ssinha@stat.tamu.edu* (Ch. 27).
- Sinharay, Sandip, *MS 12-T, Educational Testing Service, Rosedale Road, Princeton, NJ 08541; e-mail: ssinharay@ets.org* (Ch. 6).
- Stangl, Dalene K., *Institute of Statistics and Decision Sciences, Duke University; e-mail: dalene@stat.duke.edu* (Ch. 35).
- Stern, Hal S., *Department of Statistics, University of California, Irvine; e-mail: sternh@uci.edu* (Ch. 6).
- Strawderman, William E., *Department of Statistics, Rutgers University, New Brunswick, NJ 08903; e-mail: straw@stat.rutgers.edu* (Ch. 8).
- Sun, Dongchu, *Department of Statistics, University of Missouri-Columbia, Columbia, MO 65210; e-mail: sund@missouri.edu* (Ch. 32).
- Sweeting, Trevor J., *University College London; e-mail: trevor@stats.ucl.ac.uk* (Ch. 3).

- Vidakovic, Brani, *Department of Industrial and Systems Engineering, Georgia Institute of Technology*; e-mail: brani@isye.gatech.edu (Ch. 11).
- Vidal, I., *Universidad de Talca, Chile*; e-mail: ividal@utalca.cl (Ch. 23).
- Walker, Stephen, *Institute of Mathematics, Statistics and Actuarial Science, University of Kent, Canterbury, CT2 7NZ, UK*; e-mail: S.G.Walker@kent.ac.uk (Ch. 12).
- Waller, Lance A., *Department of Biostatistics, Rollins School of Public Health, Emory University, Atlanta, GA 30322*; e-mail: lwaller@sph.emory.edu (Ch. 20).

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