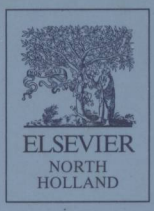

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Bayesian Thinking: Modeling and Computation

Edited by

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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.

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