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Statistical Inference from Stochastic Processes

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VOLUME 80

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Statistical Inference from Stochastic Processes

CONTEMPORARY MATHEMATICS

Volume 80

Statistical Inference from Stochastic Processes

Proceedings of the AMS-IMS-SIAM Joint Summer Research Conference held August 9–15, 1987 with support from the National Science Foundation and the Army Research Office

N. U. Prabhu, Editor

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PREFACE

The papers in this volume are contributions by the invited speakers at the Joint Summer Research Conference on Statistical Inference from Stochastic Processes, held at Cornell University in the summer of 1987. The Conference brought together probabilists and statisticians who have made major contributions to the foundations of the subject and developed important areas of application.

It is well known that maximum likelihood estimators are asymptotically optimal in a wide variety of cases when the observations are independent and identically distributed. For stochastic processes similar results were developed initially for very special cases, and later to a reasonably wide class of processes. However, there still remain important processes for which such results are not available.

Statistical inference from stochastic processes is also important in applied probability. During the last few decades major advances have been made in the area of stochastic models arising in science and engineering. However, the emphasis in this research has mostly been on the formulation and analysis of models, rather on the statistical methodology for hypothesis testing and inference (the only exception to this is time series). But for these stochastic models to be of practical use it is essential to develop procedures for their statistical analysis. Equally important is the need for establishing lines of communication between probabilists and statisticians.

In the area of probability models initial work on inference was on Markov chains (arising, in particular, from models for attitude testing). However, models for epidemiology, insurance, reliability, survival analysis and other situations give rise to non-Markovian and point processes. In recent years there has been considerable activity in statistical inference from such processes; the research carried out in this connection not only solved specific problems in hand, but also resulted in major contributions to the conceptual framework of the subject as well as the associated techniques. This research further demonstrated the importance of the theory of martingales and advanced the usefulness of concepts such as partial likelihood to estimation in the presence of nuisance parameters encountered in semi-parametric models.

The objective of the Conference was to provide an opportunity to survey and evaluate the current state of the art and discuss future directions. The papers presented covered five topics within the broad domain of inference from stochastic processes. The following is a brief summary of the papers presented on these topics.

Foundations: Cindy Greenwood's paper investigates partially specified semimartingale experiments. Michael Phelan describes three applications of functional central limit theory based on martingale methods; these are non-ergodic maximum likelihood

estimation, inference form Poisson-type counting processes and posterior analysis in nonparametric Bayes life testing.

Chris Heyde's paper is concerned with optimality in estimation of a vector parameter of a general stochastic process, while Prakasa Rao discusses several aspects of inference from a continuous time stochastic process observed at a sequence of (possibly random) epochs.

Counting processes; survival analysis: In his joint paper with Ornulf Borgan, Richard Gill and Neils Keiding, Per Andersen surveys statistical models for life history data based on counting processes; examples of such models include survival data with possibly time-dependent covariates.

Martin Jacobsen summarizes his recent work on right censoring and the Kaplan-Meier and Nelson-Aalen estimators. Details of this work are scheduled to appear elsewhere. Aalen's additive risk model is investigated by Ian McKeague. For the weighted least squares estimation of the hazard functions based on continuous data, he obtains weak convergence results, using the theory of counting processes.

In his joint paper with Ya'acov Ritov, Jon Wellner starts with a brief survey of regression models for survival data, and goes on to develop a theory for two operators that play a fundamental role as links between counting process martingales and the Doob martingales which arise via censoring. Alan Karr surveys the role of Palm distributions in several key problems in statistical inference from point processes.

Likelihood and its ramifications: David Oakes surveys the concept of partial likelihood introduced by D.R. Cox and its application to statistical analysis of survival data with emphasis on the use of time-dependent explanatory variables.

Bruce Lindsay's topic is the method of composite likelihood, which is formed by adding together individual log-likelihoods, each of which corresponds to a marginal or conditional event.

Applications to statistics and probability models: Sequential tests are the common theme of the papers by Ramdas Bhat and Valeri Stefanov, with Bhat dealing with time-transformations and Stefanov with nonlinear (curved) exponential families. Jan Winnicki considers inference from branching processes with immigration.

Processes in economics: Peter Phillips surveys recent work on the theory of regression with integrated processes; this theory is of particular relevance to many financial time series and macroeconomic time series which exhibit nonstationary characteristics.

Nicholas Kiefer treats analysis of data on grouped durations such as durations of spells of unemployment, durations of strikes and durations of marriages. In such situations many observations are available over a fixed time interval.

Soren Johnsen investigates error correction models for vector-valued time series.

From the above brief description it is evident that the papers contain several common recurring concepts, such as likelihood, sequential tests, counting processes, martingales, survival analysis, lifetesting, censoring, covariates and time series. This

proves the essential unity of theme in the subject area of inference from stochastic processes.

All papers were refereed, and I take this opportunity to thank the referees for their services. I would also like to thank the Organizing Committee of the Conference for their cooperation; in particular, the selection of topics and speakers bears the influence of Michael Phelan to a significant extent.

N.U. Prabhu
Ithaca, New York
May 23, 1988

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