Simulation And Inference For Stochastic Differential Equations With R Examples 1st Edition

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An Introduction to Stochastic Modeling
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Illuminating Statistical Analysis Using Scenarios and Simulations

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ZAYNE ORTIZ

Monte-Carlo Simulation-Based Statistical Modeling Springer Science & Business Media
Features an integrated approach of statistical scenarios and simulations to aid readers in developing key intuitions needed to understand the wide ranging concepts and methods of statistics and inference Illuminating Statistical Analysis Using Scenarios and Simulations presents the basic concepts of statistics and statistical inference using the dual mechanisms of scenarios and simulations. This approach helps readers develop key intuitions and deep understandings of statistical analysis. Scenario-specific sampling simulations depict the results that would be obtained by a very large number of individuals investigating the same scenario, each with their own evidence, while graphical depictions of the simulation results present clear and direct pathways to intuitive methods for statistical inference. These intuitive

methods can then be easily linked to traditional formulaic methods, and the author does not simply explain the linkages, but rather provides demonstrations throughout for a broad range of statistical phenomena. In addition, induction and deduction are repeatedly interwoven, which fosters a natural "need to know basis" for ordering the topic coverage. Examining computer simulation results is central to the discussion and provides an illustrative way to (re)discover the properties of sample statistics, the role of chance, and to (re)invent corresponding principles of statistical inference. In addition, the simulation results foreshadow the various mathematical formulas that underlie statistical analysis. In addition, this book: • Features both an intuitive and analytical perspective and includes a broad introduction to the use of Monte Carlo simulation and formulaic methods for statistical analysis • Presents straight-forward coverage of the essentials of basic statistics and ensures proper understanding of key concepts such as sampling distributions, the effects of sample size and variance on uncertainty, analysis of proportion, mean and rank differences, covariance, correlation, and regression • Introduces advanced topics such as Bayesian statistics, data mining, model cross-validation, robust regression, and resampling • Contains numerous example problems in each chapter with detailed solutions as well as an appendix that serves as a manual for constructing simulations quickly and easily using Microsoft® Office Excel® Illuminating Statistical Analysis Using Scenarios and Simulations is an ideal textbook for courses, seminars, and workshops in statistics and statistical inference and is appropriate for self-study as well. The book also serves as a thought-provoking treatise for researchers, scientists, managers, technicians, and others with a keen interest in statistical analysis. Jeffrey E. Kottemann, Ph.D., is Professor in the Perdue School at Salisbury University. Dr. Kottemann has published articles in a wide variety of academic research journals in the fields of business administration, computer science, decision sciences, economics, engineering, information systems, psychology, and public administration. He received his Ph.D. in Systems and Quantitative Methods from the University of Arizona.

Deterministic Particle Flows for Stochastic Nonlinear Systems Courier Corporation

Since the first edition of Stochastic Modelling for Systems Biology, there have been many interesting developments in the use of "likelihood-free" methods of Bayesian inference for complex stochastic models. Having been thoroughly updated to reflect this, this third edition covers everything necessary for a good appreciation of stochastic kinetic modelling of biological networks in the systems biology context. New methods and applications are included in the book, and the use of R for practical illustration of the algorithms has been greatly extended. There is a brand new chapter on spatially extended systems, and the statistical inference chapter has also been extended with new methods, including approximate Bayesian computation (ABC). Stochastic Modelling for Systems Biology, Third Edition is now supplemented by an additional software library, written in Scala, described in a new appendix to the book. New in the Third Edition New chapter on spatially extended systems,

covering the spatial Gillespie algorithm for reaction diffusion master equation models in 1- and 2-d, along with fast approximations based on the spatial chemical Langevin equation Significantly expanded chapter on inference for stochastic kinetic models from data, covering ABC, including ABC-SMC Updated R package, including code relating to all of the new material New R package for parsing SBML models into simulatable stochastic Petri net models New open-source software library, written in Scala, replicating most of the functionality of the R packages in a fast, compiled, strongly typed, functional language Keeping with the spirit of earlier editions, all of the new theory is presented in a very informal and intuitive manner, keeping the text as accessible as possible to the widest possible readership. An effective introduction to the area of stochastic modelling in computational systems biology, this new edition adds additional detail and computational methods that will provide a stronger foundation for the development of more advanced courses in stochastic biological modelling.

Advances in Stochastic Simulation Methods Springer Science & Business Media

This book presents various results and techniques from the theory of stochastic processes that are useful in the study of stochastic problems in the natural sciences. The main focus is analytical methods, although numerical methods and statistical inference methodologies for studying diffusion processes are also presented. The goal is the development of techniques that are applicable to a wide variety of stochastic models that appear in physics, chemistry and other natural sciences. Applications such as stochastic resonance, Brownian motion in periodic potentials and Brownian motors are studied and the connection between diffusion processes and time-dependent statistical mechanics is elucidated. The book contains a large number of illustrations, examples, and exercises. It will be useful for graduate-level courses on stochastic processes for students in applied mathematics, physics and engineering. Many of the topics covered in this book (reversible diffusions, convergence to equilibrium for diffusion processes, inference methods for stochastic differential equations, derivation of the generalized Langevin equation, exit time problems) cannot be easily found in textbook form and will be useful to both researchers and students interested in the applications of stochastic processes.

Simulation and Inference for Stochastic Processes with YUIMA CRC Press

This book covers a highly relevant and timely topic that is of wide interest, especially in finance, engineering and computational biology. The introductory material on simulation and stochastic differential equation is very accessible and will prove popular with many readers. While there are several recent texts available that cover stochastic differential equations, the concentration here on inference makes this book stand out. No other direct competitors are known to date. With an emphasis on the practical implementation of the simulation and estimation methods presented, the text will be useful to practitioners and students with minimal mathematical background. What’s more, because of the many R programs, the information here is

appropriate for many mathematically well educated practitioners, too.

Stochastic Processes and Applications Springer

This 3rd edition of the successful Elements of Applied Stochastic Processes improves on the last edition by condensing the material and organising it into a more teachable format. It provides more in-depth coverage of Markov chains and simple Markov process and gives added emphasis to statistical inference in stochastic processes. Integration of theory and application offers improved teachability Provides a comprehensive introduction to stationary processes and time series analysis Integrates a broad set of applications into the text Utilizes a wealth of examples from research papers and monographs

Markov Chain Monte Carlo Springer Science & Business Media

Stochastic Modeling of Scientific Data combines stochastic modeling and statistical inference in a variety of standard and less common models, such as point processes, Markov random fields and hidden Markov models in a clear, thoughtful and succinct manner. The distinguishing feature of this work is that, in addition to probability theory, it contains statistical aspects of model fitting and a variety of data sets that are either analyzed in the text or used as exercises. Markov chain Monte Carlo methods are introduced for evaluating likelihoods in complicated models and the forward backward algorithm for analyzing hidden Markov models is presented. The strength of this text lies in the use of informal language that makes the topic more accessible to non-mathematicians. The combinations of hard science topics with stochastic processes and their statistical inference puts it in a new category of probability textbooks. The numerous examples and exercises are drawn from astronomy, geology, genetics, hydrology, neurophysiology and physics.

Elements of Applied Stochastic Processes Springer Nature

Bayesian analysis of complex models based on stochastic processes has in recent years become a growing area. This book provides a unified treatment of Bayesian analysis of models based on stochastic processes, covering the main classes of stochastic processing including modeling, computational, inference, forecasting, decision making and important applied models. Key features: Explores Bayesian analysis of models based on stochastic processes, providing a unified treatment. Provides a thorough introduction for research students. Computational tools to deal with complex problems are illustrated along with real life case studies Looks at inference, prediction and decision making. Researchers, graduate and advanced undergraduate students interested in stochastic processes in fields such as statistics, operations research (OR), engineering, finance, economics, computer science and Bayesian analysis will benefit from reading this book. With numerous applications included, practitioners of OR, stochastic modelling and applied statistics will also find this book useful.

Option Pricing and Estimation of Financial Models with R Springer Science & Business Media

This book focuses on the modeling and mathematical analysis of stochastic dynamical systems along with their simulations. The collected chapters will review fundamental and current topics

and approaches to dynamical systems in cellular biology. This text aims to develop improved mathematical and computational methods with which to study biological processes. At the scale of a single cell, stochasticity becomes important due to low copy numbers of biological molecules, such as mRNA and proteins that take part in biochemical reactions driving cellular processes. When trying to describe such biological processes, the traditional deterministic models are often inadequate, precisely because of these low copy numbers. This book presents stochastic models, which are necessary to account for small particle numbers and extrinsic noise sources. The complexity of these models depend upon whether the biochemical reactions are diffusion-limited or reaction-limited. In the former case, one needs to adopt the framework of stochastic reaction-diffusion models, while in the latter, one can describe the processes by adopting the framework of Markov jump processes and stochastic differential equations.
Stochastic Processes, Multiscale Modeling, and Numerical Methods for Computational Cellular Biology will appeal to graduate students and researchers in the fields of applied mathematics, biophysics, and cellular biology.
Inference on the Hurst Parameter and the Variance of Diffusions Driven by Fractional Brownian Motion Wiley-Interscience
Diffusion processes are a promising instrument for realistically modelling the time-continuous evolution of phenomena not only in the natural sciences but also in finance and economics. Their mathematical theory, however, is challenging, and hence diffusion modelling is often carried out incorrectly, and the according statistical inference is considered almost exclusively by theoreticians. This book explains both topics in an illustrative way which also addresses practitioners. It provides a complete overview of the current state of research and presents important, novel insights. The theory is demonstrated using real data applications.
Stochastic Processes, Multiscale Modeling, and Numerical Methods for Computational Cellular Biology Springer
Bridging the gap between research and application, Markov Chain Monte Carlo: Stochastic Simulation for Bayesian Inference provides a concise, and integrated account of Markov chain Monte Carlo (MCMC) for performing Bayesian inference. This volume, which was developed from a short course taught by the author at a meeting of Brazilian statisticians and probabilists, retains the didactic character of the original course text. The self-contained text units make MCMC accessible to scientists in other disciplines as well as statisticians. It describes each component of the theory in detail and outlines related software, which is of particular benefit to applied scientists.
Statistical Inference and Simulation for Spatial Point Processes CRC Press
With this hands-on introduction readers will learn what SDEs are all about and how they should use them in practice.
Stochastic Modeling CRC Press
While there have been few theoretical contributions on the Markov Chain Monte Carlo (MCMC) methods in the past decade, current understanding and application of MCMC to the solution of inference problems has increased by leaps and bounds. Incorporating changes in theory

and highlighting new applications, Markov Chain Monte Carlo: Stochastic Simulation for Bayesian Inference, Second Edition presents a concise, accessible, and comprehensive introduction to the methods of this valuable simulation technique. The second edition includes access to an internet site that provides the code, written in R and WinBUGS, used in many of the previously existing and new examples and exercises. More importantly, the self-explanatory nature of the codes will enable modification of the inputs to the codes and variation on many directions will be available for further exploration. Major changes from the previous edition: · More examples with discussion of computational details in chapters on Gibbs sampling and Metropolis-Hastings algorithms · Recent developments in MCMC, including reversible jump, slice sampling, bridge sampling, path sampling, multiple-try, and delayed rejection · Discussion of computation using both R and WinBUGS · Additional exercises and selected solutions within the text, with all data sets and software available for download from the Web · Sections on spatial models and model adequacy The self-contained text units make MCMC accessible to scientists in other disciplines as well as statisticians. The book will appeal to everyone working with MCMC techniques, especially research and graduate statisticians and biostatisticians, and scientists handling data and formulating models. The book has been substantially reinforced as a first reading of material on MCMC and, consequently, as a textbook for modern Bayesian computation and Bayesian inference courses.

Inference in Hidden Markov Models John Wiley & Sons

Spatial point processes play a fundamental role in spatial statistics and today they are an active area of research with many new applications. Although other published works address different aspects of spatial point processes, most of the classical literature deals only with nonparametric methods, and a thorough treatment of the theory and applications of simulation-based inference is difficult to find. Written by researchers at the top of the field, this book collects and unifies recent theoretical advances and examples of applications. The authors examine Markov chain Monte Carlo algorithms and explore one of the most important recent developments in MCMC: perfect simulation procedures.

Stochastic Models, Statistics and Their Applications Springer

Praise for the First Edition ". . . an excellent textbook . . . well organized and neatly written." —Mathematical Reviews ". . . amazingly interesting . . ." —Technometrics Thoroughly updated to showcase the interrelationships between probability, statistics, and stochastic processes, Probability, Statistics, and Stochastic Processes, Second Edition prepares readers to collect, analyze, and characterize data in their chosen fields. Beginning with three chapters that develop probability theory and introduce the axioms of probability, random variables, and joint distributions, the book goes on to present limit theorems and simulation. The authors combine a rigorous, calculus-based development of theory with an intuitive approach that appeals to readers' sense of reason and logic. Including more than 400 examples that help illustrate concepts and theory, the Second Edition features new material

on statistical inference and a wealth of newly added topics, including: Consistency of point estimators Large sample theory Bootstrap simulation Multiple hypothesis testing Fisher's exact test and Kolmogorov-Smirnov test Martingales, renewal processes, and Brownian motion One-way analysis of variance and the general linear model Extensively class-tested to ensure an accessible presentation, Probability, Statistics, and Stochastic Processes, Second Edition is an excellent book for courses on probability and statistics at the upper-undergraduate level. The book is also an ideal resource for scientists and engineers in the fields of statistics, mathematics, industrial management, and engineering.

Modeling with Itô Stochastic Differential Equations CRC Press

This book explains a procedure for constructing realistic stochastic differential equation models for randomly varying systems in biology, chemistry, physics, engineering, and finance. Introductory chapters present the fundamental concepts of random variables, stochastic processes, stochastic integration, and stochastic differential equations. These concepts are explained in a Hilbert space setting which unifies and simplifies the presentation.

Stochastic Modelling for Systems Biology, Third Edition CRC Press

This chapter is concerned with estimation method for multidimensional and nonlinear dynamical models including stochastic differential equations containing random effects (random parameters). This type of model has proved useful for describing continuous random processes, for distinguishing intra- and interindividual variability as well as for accounting for uncertainty in the dynamic model itself. Pharmacokinetic/pharmacodynamic modeling often involves repeated measurements on a series of experimental units, and random effects are incorporated into the model to simulate the individual behavior in the entire population. Unfortunately, the estimation of this kind of models could involve some difficulties, because in most cases, the transition density of the diffusion process given the random effects is not available. In this work, we focus on the approximation of the transition density of a such process in a closed form in order to obtain parameter estimates in this kind of model, using the Fokker-Planck equation and the Risken approximation. In addition, the chapter discusses a simulation study using Markov Chain Monte Carlo simulation, to provide results of the proposed methodology and to illustrate an application of mixed effects models with SDEs in the epidemiology using the minimal model describing glucose-insulin kinetics.

Advanced Spatial Modeling with Stochastic Partial Differential Equations Using R and INLA Cambridge University Press

Monte Carlo methods have been used for decades in physics, engineering, statistics, and other fields. Monte Carlo Simulation and Finance explains the nuts and bolts of this essential technique used to value derivatives and other securities. Author and educator Don McLeish examines this fundamental process, and discusses important issues, including specialized problems in finance that Monte Carlo and Quasi-Monte Carlo methods can help solve and the different ways Monte Carlo methods can be improved upon. This state-of-the-art book on Monte Carlo simulation methods is ideal for finance

professionals and students. Order your copy today.

Stochastic Modeling of Microstructures Springer

Coherent introduction to techniques also offers a guide to the mathematical, numerical, and simulation tools of systems analysis. Includes formulation of models, analysis, and interpretation of results. 1995 edition.

Monte Carlo Simulation and Finance CRC Press

Sampling-based computational methods have become a fundamental part of the numerical toolset of practitioners and researchers across an enormous number of different applied domains and academic disciplines. This book provides a broad treatment of such sampling-based methods, as well as accompanying mathematical analysis of the convergence properties of the methods discussed. The reach of the ideas is illustrated by discussing a wide range of applications and the models that have found wide usage. The first half of the book focuses on general methods; the second half discusses model-specific algorithms. Exercises and illustrations are included.

Simulation and Inference for Stochastic Differential Equations John Wiley & Sons

This is a volume consisting of selected papers that were presented at the 3rd St. Petersburg Workshop on Simulation held at St. Petersburg, Russia, during June 28-July 3, 1998. The Workshop is a regular international event devoted to mathematical problems of simulation and applied statistics organized by the Department of Stochastic Simulation at St. Petersburg State University in cooperation with INFORMS College on Simulation (USA). Its main purpose is to exchange ideas between researchers from Russia and from the West as well as from other coun tries throughout the World. The 1st Workshop was held during May 24-28, 1994, and the 2nd workshop was held during June 18-21, 1996. The selected proceedings of the 2nd Workshop was published as a special issue of the Journal of Statistical Planning and Inference. Russian mathematical tradition has been formed by such genius as Tchebysh eff, Markov and Kolmogorov whose ideas have formed the basis for contempo rary probabilistic models. However, for many decades now, Russian scholars have been isolated from their colleagues in the West and as a result their mathe matical contributions have not been widely known. One of the primary reasons for these workshops is to bring the contributions of Russian scholars into lime light and we sincerely hope that this volume helps in this specific purpose.

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