Stochastic Simulation Algorithms And Analysis

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.

From the reviews: "Paul Glasserman has written an astonishingly good book that bridges financial engineering and the Monte Carlo method. The book will appeal to graduate students, researchers, and most of all, practicing financial engineers [...] So often, financial engineering texts are very theoretical. This book is not." --Glyn Holton, Contingency Analysis

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.

This book is a collective work by many leading scientists, analysts, mathematicians, and engineers who have been working at the front end of reliability science and engineering. The book covers conventional and contemporary topics in reliability science, all of which have seen extended research activities in recent years. The methods presented in this book are real-world examples that demonstrate improvements in essential reliability and availability for industrial equipment such as medical magnetic resonance imaging, power systems, traction drives for a search and rescue helicopter, and air conditioning systems. The book presents real case studies of redundant multi-state air conditioning systems for chemical laboratories and covers assessments of reliability and fault tolerance and availability calculations. Conventional and contemporary topics in reliability engineering are discussed, including degradation, networks, and dynamic reliability, resilience, and multi-state systems, all of which are relatively new topics to the field. The book is aimed at engineers and scientists, as well as postgraduate students involved in reliability design, analysis, and experiments and applied probability and statistics.

Analysis and Simulation

24th International Conference, ASMTA 2017, Newcastle-upon-Tyne, UK, July 10-11, 2017, Proceedings

Handbook of Probabilistic Models

Principles, Methods, and Case Studies, Vol. II, AAPG Computer Applications in Geology 5

Stochastic Processes, Multiscale Modeling, and Numerical Methods for Computational Cellular Biology

Stochastic Simulation and Monte Carlo Methods

This book constitutes the refereed proceedings of the 22nd International Conference on Analytical and Stochastic Modelling Techniques and Applications, ASMTA 2015, held in Albena, Bulgaria, in May 2015. The 15 full papers presented in this book were carefully reviewed and selected from numerous submissions. The papers discuss the latest developments in analytical, numerical and simulation algorithms for stochastic systems, including Markov processes, queueing networks, stochastic Petri nets, process algebras, game theory, etc.

Developed from the author's course at the Ecole Polytechnique, Monte-Carlo Methods and Stochastic Processes: From Linear to Non-Linear focuses on the simulation of stochastic processes in continuous time and their link with partial differential equations (PDEs). It covers linear and nonlinear problems in biology, finance, geophysics, mechanics, chemistry, and other application areas. The text also thoroughly develops the problem of numerical integration and computation of expectation by the Monte-Carlo method. The book begins with a history of Monte-Carlo methods and an overview of three typical Monte-Carlo problems: numerical integration and computation of expectation, simulation of complex distributions, and stochastic optimization. The remainder of the text is organized in three parts of progressive difficulty. The first part presents basic tools for stochastic simulation and analysis of algorithm convergence. The second part describes Monte-Carlo methods for the simulation of stochastic differential equations. The final part discusses the simulation of non-linear dynamics.

This book consists of two strongly interweaved parts: the mathematical theory of stochastic processes and its applications to molecular theories of polymeric fluids. The comprehensive mathematical background provided in the first section will be equally useful in many other branches of engineering and the natural sciences. The second part provides readers with a more direct understanding of polymer dynamics, allowing them to identify exactly solvable models more easily, and to develop efficient computer simulation algorithms in a straightforward manner. In view of the examples and applications to problems taken from the front line of science, this volume may be used both as a basic textbook or as a reference book. Program examples written in FORTRAN are available via ftp from ftp.springer.de/pub/chemistry/polysim/.

This textbook provides a broad overview of the present state of insurance mathematics and some related topics in risk management, financial mathematics and probability. Both non-life and life aspects are covered. The emphasis is on probability and modeling rather than statistics and practical implementation. Aimed at the graduate level, pointing in part to current research topics, it can potentially replace other textbooks on basic non-life insurance mathematics and advanced risk management methods in non-life insurance. Based on chapters selected according to the particular topics in mind, the book may serve as a source for introductory courses to insurance mathematics for non-specialists, advanced courses for actuarial students, or courses on probabilistic aspects of risk. It will also be useful for practitioners and students/researchers in related areas such as finance and statistics who wish to get an overview of the general area of mathematical modeling and analysis in insurance.

Multiple-point Geostatistics

A First Course

Branching Processes

Introduction to Rare Event Simulation

Introduction to Matrix Analytic Methods in Stochastic Modeling

A Graduate Text

This practical introduction to stochastic reaction-diffusion modelling is based on courses taught at the University of Oxford. The authors discuss the essence of mathematical methods which appear (under different names) in a number of interdisciplinary scientific fields bridging mathematics and computations with biology and chemistry. The book can be used both for self-study and as a supporting text for advanced undergraduate or beginning graduate-level courses in applied mathematics. New mathematical approaches are explained using simple examples of biological models, which range in size from simulations of small biomolecules to groups of animals. The book starts with stochastic modelling of chemical reactions, introducing stochastic simulation algorithms and mathematical methods for analysis of stochastic models. Different stochastic spatio-temporal models are then studied, including models of diffusion and stochastic reaction-diffusion modelling. The methods covered include molecular dynamics, Brownian dynamics, velocity jump processes and compartment-based (lattice-based) models.

When this two-day meeting was proposed, it was certainly not conceived as a celebration, much less as a party. However, on reflection, this might have been a wholly appropriate gesture because geostatistical simulation came of age this year: it is now 21 years since it was first proposed and implemented in the form of the turning bands method. The impetus for the original development was the mining industry, principally the problems encountered in mine planning and design based on smoothed estimates which did not reflect the degree of variability and detail present in the real, mined values. The sustained period of development over recent years has been driven by hydrocarbon applications. In addition to the original turning bands method there are now at least six other established methods of geostatistical simulation. Having reached adulthood, it is entirely appropriate that geostatistical simulation should now be subjected to an intense period of reflection and assessment. That we have now entered this period was evident in many of the papers and much of the discussion at the Fontainebleau meeting. Many questions were clearly articulated for the first time and, although many ofthem were not unambiguously answered, their presentation at the meeting and publication in this book will generate confirmatory studies and further research.

Stochastic calculus has important applications to mathematical finance. This book will appeal to practitioners and students who want an elementary introduction to these areas. From the reviews: "As the preface says, 'This is a text with an attitude, and it is designed to reflect, wherever possible and appropriate, a prejudice for the concrete over the abstract'. This is also reflected in the style of writing which is unusually lively for a mathematics book." --ZENTRALBLATT MATH

Presents the basic mathematical ideas and algorithms of the matrix analytic theory in a readable, up-to-date, and comprehensive manner.

Analytical and Stochastic Modelling Techniques and Applications

Deterministic Versus Stochastic Modelling in Biochemistry and Systems Biology

Algorithms and Analysis for Simulation of Deterministic and Stochastic Ginzburg-Landau Models

Introduction to Stochastic Search and Optimization

Analytical and Stochastic Modeling Techniques and Applications

Proceedings of the Geostatistical Simulation Workshop, Fontainebleau, France, 27-28 May 1993

With the advance of new computing technology, simulation is becoming very popular for designing large, complex, and stochastic engineering systems, since closed-form analytical solutions generally do not exist for such problems. However, the added flexibility of simulation often creates models that are computationally intractable. Moreover, to obtain a sound statistical estimate at a specified level of confidence, a large number of simulation runs (or replications) is usually required for each design alternative. If the number of design alternatives is large, the total simulation cost can be very expensive. This book addresses the pertinent efficiency issue via smart allocation of computing resource in the simulation experiments for optimization, and aims to provide academic researchers and industrial practitioners a comprehensive coverage of OCBA approach for stochastic simulation optimization. Starting with an intuitive explanation of computing budget allocation and a discussion of its impact on optimization performance, a series of OCBA approaches developed for various problems are then presented, from the selection of the best design to optimization with multiple objectives.Finally, this book discusses the potential extension of OCBA notion to different applications such as data envelopment analysis, experiments of design, and rare-event simulation.

Biochemical systems are inherently multiscale and stochastic. In microscopic systems formed by living cells, the small numbers of reactant molecules can result in dynamical behavior that is discrete and stochastic rather than continuous and deterministic. An analysis tool that respects these dynamical characteristics is the stochastic simulation algorithm (SSA, Gillespie, 1976), a numerical simulation procedure that is essentially exact for chemical systems that are spatially homogeneous or well stirred. Despite recent improvements, as a procedure that simulates every reaction event, the SSA is necessarily inefficient for most realistic problems. There are two main reasons for this, both arising from the multiscale nature of the underlying problem: (1) stiffness, i.e. the presence of multiple timescales, the fastest of which are stable; and (2) the need to include in the simulation both species that are present in relatively small quantities and should be modeled by a discrete stochastic process, and species that are present in larger quantities and are more efficiently modeled by a deterministic differential equation (or at some scale in between). This project has focused on the development of fast and adaptive algorithms, and the fun- damental theory upon which they must be based, for the multiscale simulation of biochemical systems. Areas addressed by this project include: (1) Theoretical and practical foundations for ac- celerated discrete stochastic simulation (tau-leaping); (2) Dealing with stiffness (fast reactions) in an efficient and well-justified manner in discrete stochastic simulation; (3) Development of adaptive multiscale algorithms for spatially homogeneous discrete stochastic simulation; (4) Development of high-performance SSA algorithms.

Discrete event systems (DES) have become pervasive in our daily lives. Examples include (but are not restricted to) manufacturing and supply chains, transportation, healthcare, call centers, and financial engineering. However, due to their complexities that often involve millions or even billions of events with many variables and constraints, modeling these stochastic simulations has long been a "hard nut to crack". The advance in available computer technology, especially of cluster and cloud computing, has paved the way for the realization of a number of stochastic simulation optimization for complex discrete event systems. This book will introduce two important techniques initially proposed and developed by Professor Y C Ho and his team; namely perturbation analysis and ordinal optimization for stochastic simulation optimization, and present the state-of-the-art technology, and their future research directions. Contents:Part I: Perturbation Analysis:The IPA Calculus for Hybrid SystemsSmoothed Perturbation Analysis: A Retrospective and Prospective LookPerturbation Analysis and Variance Reduction in Monte Carlo SimulationAdjoints and AveragingInfinitesimal Perturbation Analysis and Optimization AlgorithmsSimulation-based Optimization of Failure-prone Continuous Flow LinesPerturbation Analysis, Dynamic Programming, and BeyondPart II: Ordinal Optimization:Fundamentals of Ordinal OptimizationOptimal Computing Budget Allocation FrameworkNested PartitionsApplications of Ordinal Optimization Readership: Professionals in industrial and systems engineering, graduate reference for probability & statistics, stochastic analysis and general computer science, and research. Keywords:Simulation;Optimization;Stochastic Systems;Discrete-Even Systems;Perturbation Analysis;Ordinal Optimization

This book presents a unified theory of rare event simulation and the variance reduction technique known as importance sampling from the point of view of the probabilistic theory of large deviations. It allows us to view a vast assortment of simulation problems from a unified single perspective.

22nd International Conference, ASMTA 2015, Albena, Bulgaria, May 26-29, 2015. Proceedings

Stochastic Modeling with Training Images

An Optimal Computing Budget Allocation

Stochastic Analysis, Stochastic Systems, and Applications to Finance

Stochastic Processes in Polymeric Fluids

17th International Conference, ASMTA 2010, Cardiff, UK, June 14-16, 2010, Proceedings

A unique interdisciplinary foundation for real-world problemsolving Stochastic search and optimization techniques are used in a vastnumber of areas, including aerospace, medicine, transportation, andfinance, to name but a few. Whether the goal is refining the designof a missile or aircraft, determining the effectiveness of a newdrug, developing the most efficient timing strategies for trafficsignals, or making investment decisions in order to increaseprofits, stochastic algorithms can help researchers andpractitioners devise optimal solutions to countless real-worldproblems. Introduction to Stochastic Search and Optimization: Estimation,Simulation, and Control is a graduate-level introduction to theprinciples, algorithms, and practical aspects of stochasticoptimization, including applications drawn from engineering,statistics, and computer science. The treatment is both rigorousand broadly accessible, distinguishing this text from much of thecurrent literature and providing students, researchers, andpractitioners with a strong foundation for the often-daunting taskof solving real-world problems. The text covers a broad range of today ' s most widely usedstochastic algorithms, including: Random search Recursive linear estimation Stochastic approximation Simulated annealing Genetic and evolutionary methods Machine (reinforcement) learning Model selection Simulation-based optimization Markov chain Monte Carlo Optimal experimental design The book includes over 130 examples, Web links to software anddata sets, more than 250 exercises for the reader, and an extensivelist of references. These features help make the text an invaluableresource for those interested in the theory or practice ofstochastic search and optimization.

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.

This book constitutes the refereed proceedings of the 23rd International Conference on Analytical and Stochastic Modelling Techniques and Applications, ASMTA 2016, held in Cardiff, UK, in August 2016. The 21 full papers presented in this book were carefully reviewed and selected from 30 submissions. The papers discuss the latest developments in analytical, numerical and simulation algorithms for stochastic systems, including Markov processes, queueing networks, stochastic Petri nets, process algebras, game theory, etc.

Stochastic kinetic methods are currently considered to be the most realistic and elegant means of representing and simulating the dynamics of biochemical and biological networks. Deterministic versus stochastic modelling in biochemistry and systems biology introduces and critically reviews the deterministic and stochastic foundations of biochemical kinetics, covering applied stochastic process theory for application in the field of modelling and simulation of biological processes at the molecular scale. Following an overview of deterministic chemical kinetics and the stochastic approach to biochemical kinetics, the book goes onto discuss the specifics of stochastic simulation algorithms, modelling in systems biology and the structure of biochemical models. Later chapters cover reaction-diffusion systems, and provide an analysis of the Kinfer and BlenX software systems. The final chapter looks at simulation of ecodynamics and food web dynamics. Introduces mathematical concepts and formalisms of deterministic and stochastic modelling through clear and simple examples Presents recently developed discrete stochastic formalisms for modelling biological systems and processes Describes and applies stochastic simulation algorithms to implement a stochastic formulation of biochemical and biological kinetics

Risk and Insurance

Stochastic Modelling of Reaction–Diffusion Processes
Stochastic Modeling
Stochastic Calculus and Financial Applications
Stochastic Simulation Optimization for Discrete Event Systems
23rd International Conference, ASMTA 2016, Cardiff, UK, August 24-26, 2016, Proceedings

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.

WILEY-INTERSCIENCE PAPERBACK SERIES The Wiley-Interscience Paperback Series consists of selected books that have been made more accessible to consumers in an effort to increase global appeal and general circulation. With these new unabridged softcover volumes, Wiley hopes to extend the lives of these works by making them available to future generations of statisticians, mathematicians, and scientists. ". . .this is a very competently written and useful addition to the statistical literature; a book every statistician should look at and that many should study!" —Short Book Reviews, International Statistical Institute ". . .reading this book was an enjoyable learning experience. The suggestions and recommendations on the methods [make] this book an excellent reference for anyone interested in simulation. With its compact structure and good coverage of material, it [is] an excellent textbook for a simulation course." —Technometrics ". . .this work is an excellent comprehensive guide to simulation methods, written by a very competent author. It is especially recommended for those users of simulation methods who want more than a 'cook book'. " —Mathematics Abstracts This book is a comprehensive guide to simulation methods with explicit recommendations of methods and algorithms. It covers both the technical aspects of the subject, such as the generation of random numbers, non-uniform random variates and stochastic processes, and the use of simulation. Supported by the relevant mathematical theory, the text contains a great deal of unpublished research material, including coverage of the analysis of shift-register generators, sensitivity analysis of normal variate generators, analysis of simulation output, and more.

An introduction to general theories of stochastic processes and modern martingale theory. The volume focuses on consistency, stability and contractivity under geometric invariance in numerical analysis, and discusses problems related to implementation, simulation, variable step size algorithms, and random number generation.

This book introduces some advanced topics in probability theories — both pure and applied — is divided into two parts. The first part deals with the analysis of stochastic dynamical systems, in terms of Gaussian processes, white noise theory, and diffusion processes. The second part of the book discusses some up-to-date applications of optimization theories, martingale measure theories, reliability theories, stochastic filtering theories and stochastic algorithms towards mathematical finance issues such as option pricing and hedging, bond market analysis, volatility studies and asset trading modeling.

Final Technical Report "Multiscale Simulation Algorithms for Biochemical Systems."
Stochastic Simulation Optimization
Stochastic Simulation: Algorithms and Analysis
Stochastic Simulation for Bayesian Inference
Tools and Examples for Developing Simulation Algorithms
Stochastic Models in Reliability Engineering

This book constitutes the refereed proceedings of the 24th International Conference on Analytical and Stochastic Modelling Techniques and Applications, ASMTA 2017, held in Newcastle-upon-Tyne UK, in July 2017. The 14 full papers presented in this book were carefully reviewed and selected from 27 submissions. The scope of the conference is on following topics: analytical, numerical and simulation algorithms for stochastic systems, including Markov processes, queueing networks, stochastic Petri nets, process algebras, game theoretical models.

This book provides a comprehensive introduction to multiple-point geostatistics, where spatial continuity is described using training images. Multiple-point geostatistics aims at bridging the gap between physical modelling/realism and spatio-temporal stochastic modelling. The book provides an overview of this new field in three parts. Part I presents a conceptual comparison between traditional random function theory and stochastic modelling based on training images, where random function theory is not always used. Part II covers in detail various algorithms and methodologies starting from basic building blocks in statistical science and computer science. Concepts such as non-stationary and multi-variate modeling, consistency between data and model, the construction of training images and inverse modelling are treated. Part III covers three example application areas, namely, reservoir modelling, mineral resources modelling and climate model downscaling. This book will be an invaluable reference for students, researchers and practitioners of all areas of the Earth Sciences where forecasting based on spatio-temporal data is performed.

In various scientific and industrial fields, stochastic simulations are taking on a new importance. This is due to the increasing power of computers and practitioners' aim to simulate more and more complex systems, and thus use random parameters as well as random noises to model the parametric uncertainties and the lack of knowledge on the physics of these systems. The error analysis of these computations is a highly complex mathematical undertaking. Approaching these issues, the authors present stochastic numerical methods and prove accurate convergence rate estimates in terms of their numerical parameters (number of simulations, time discretization steps). As a result, the book is a self-contained and rigorous study of the numerical methods within a theoretical framework. After briefly reviewing the basics, the authors first introduce fundamental notions in stochastic calculus and continuous-time martingale theory, then develop the analysis of pure-jump Markov processes, Poisson processes, and stochastic differential equations. In particular, they review the essential properties of Itô integrals and prove fundamental results on the probabilistic analysis of parabolic partial differential equations. These results in turn provide the basis for developing stochastic numerical methods, both from an algorithmic and theoretical point of view. The book combines advanced mathematical tools, theoretical analysis of stochastic numerical methods, and practical issues at a high level, so as to provide optimal results on the accuracy of Monte Carlo simulations of stochastic processes. It is intended for master and Ph.D. students in the field of stochastic processes and their numerical applications, as well as for physicists, biologists, economists and other professionals working with stochastic simulations, who will benefit from the ability to reliably estimate and control the accuracy of their simulations.

This graduate-level text covers modeling, programming and analysis of simulation experiments and provides a rigorous treatment of the foundations of simulation and why it works. It introduces object-oriented programming for simulation, covers both the probabilistic and statistical basis for simulation in a rigorous but accessible manner (providing all necessary background material); and provides a modern treatment of experiment design and analysis that goes beyond classical statistics. The book emphasizes essential foundations throughout, rather than providing a compendium of algorithms and theorems and prepares the reader to use simulation in research as well as practice. The book is a rigorous, but concise treatment, emphasizing lasting principles but also providing specific training in modeling, programming and analysis. In addition to teaching readers how to do simulation, it also prepares them to use simulation in their research; no other book does this. An online solutions manual for end of chapter exercises is also be provided.

Monte Carlo Methods in Financial Engineering
An Introduction to Stochastic Modeling
Foundations and Methods of Stochastic Simulation
Stochastic Simulation
Estimation, Simulation, and Control
Handbook of Stochastic Analysis and Applications

An Introduction to Stochastic Modeling provides information pertinent to the standard concepts and methods of stochastic modeling. This book presents the rich diversity of applications of stochastic processes in the sciences. Organized into nine chapters, this book begins with an overview of diverse types of stochastic models, which predicts a set of possible outcomes weighed by their likelihoods or probabilities. This text then provides exercises in the applications of simple stochastic analysis to appropriate problems. Other chapters consider the study of general functions of independent, identically distributed, nonnegative random variables representing the successive intervals between renewals. This book discusses as well the numerous examples of Markov branching processes that arise naturally in various scientific disciplines. The final chapter deals with queueing models, which aid the design process by predicting system performance. This book is a valuable resource for students of engineering and management science. Engineers will also find this book useful.

This dissertation explores a few topics in the study of rare events in stochastic systems, with a particular emphasis on the simulation aspect. This line of research has been receiving a substantial amount of interest in recent years, mainly motivated by scientific and industrial applications in which system performance is frequently measured in terms of events with very small probabilities.The topics mainly break down into the following themes: Algorithm Analysis: Chapters 2, 3, 4 and 5. Simulation Design: Chapters 3, 4 and 5. Modeling: Chapter 5. The titles of the main chapters are detailed as follows: Chapter 2: Analysis of a Splitting Estimator for Rare Event Probabilities in Jackson Networks Chapter 3: Splitting for Heavy-tailed Systems: An Exploration with Two Algorithms Chapter 4: State Dependent Importance Sampling with Cross Entropy for Heavy-tailed Systems Chapter 5: Stochastic Insurance-Reinsurance Networks: Modeling, Analysis and Efficient Monte Carlo.

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.

This book constitutes the refereed proceedings of the 17th International Conference on Analytical and Stochastic Modeling Techniques and Applications, ASMTA 2010, held in Cardiff, UK, in June 2010. The 28 revised full papers presented were carefully reviewed and selected from numerous submissions for inclusion in the book. The papers are organized in topical sections on queueing theory, specification languages and tools, telecommunication systems, estimation, prediction, and stochastic modelling.

21st International Conference, ASMTA 2014, Budapest, Hungary, June 30 -- July 2, 2014,Proceedings
Uncertainty Quantification and Stochastic Modeling with Matlab
Geostatistical Simulations
Stochastic Modeling and Geostatistics
Modeling, Simulation Design and Algorithm Analysis
Monte-Carlo Methods and Stochastic Processes

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.

Handbook of Probabilistic Models carefully examines the application of advanced probabilistic models in conventional engineering fields. In this comprehensive handbook, practitioners, researchers and scientists will find detailed explanations of technical concepts, applications of the proposed methods, and the respective scientific approaches needed to solve the problem. This book provides an interdisciplinary approach that creates advanced probabilistic models for engineering fields, ranging from conventional fields of mechanical engineering and civil engineering, to electronics, electrical, earth sciences, climate, agriculture, water resource, mathematical sciences and computer sciences. Specific topics covered include minimax probability machine regression, stochastic finite element method, relevance vector machine, logistic regression, Monte Carlo simulations, random matrix, Gaussian process regression, Kalman filter, stochastic optimization, maximum likelihood, Bayesian inference, Bayesian update, kriging, copula-statistical models, and more. Explains the application of advanced probabilistic models encompassing multidisciplinary research Applies probabilistic modeling to emerging areas in engineering Provides an interdisciplinary approach to probabilistic models and their applications, thus solving a wide range of practical problems

Branching processes form one of the classical fields of applied probability and are still an active area of research. The field has by now grown so large and diverse that a complete and unified treat ment is hardly possible anymore, let alone in one volume. So, our aim here has been to single out some of the more recent developments and to present them with sufficient background material to obtain a largely self-contained treatment intended to supplement previous mo nographs rather than to overlap them. The body of the text is divided into four parts, each of its own flavor. Part A is a short introduction, stressing examples and applications. In Part B we give a self-contained and up-to-date pre sentation of the classical limit theory of simple branching processes, viz. the Gal ton-Watson (Bienayme-G-W) process and i ts continuous time analogue. Part C deals with the limit theory of Il!arkov branching processes with a general set of types under conditions tailored to (multigroup) branching diffusions on bounded domains, a setting which also covers the ordinary multitype case. Whereas the point of view in Parts A and B is quite pedagogical, the aim of Part C is to treat a large subfield to the highest degree of generality and completeness possi"ble. Thus the exposition there is at times quite technical.

Uncertainty Quantification (UQ) is a relatively new research area which describes the methods and approaches used to supply quantitative descriptions of the effects of uncertainty, variability and errors in simulation problems and models. It is rapidly becoming a field of increasing importance, with many real-world applications within statistics, mathematics, probability and engineering, but also within the natural sciences. Literature on the topic has up until now been largely based on polynomial chaos, which raises difficulties when considering different types of approximation and does not lead to a unified presentation of the methods. Moreover, this description does not consider either deterministic problems or infinite dimensional ones. This book gives a unified, practical and comprehensive presentation of the main techniques used for the characterization of the effect of uncertainty on numerical models and on their exploitation in numerical problems. In particular, applications to linear and nonlinear systems of equations, differential equations, optimization and reliability are presented. Applications of stochastic methods to deal with deterministic numerical problems are also discussed. Matlab® illustrates the implementation of these methods and makes the book suitable as a textbook and for self-study. Discusses the main ideas of Stochastic Modeling and Uncertainty Quantification using Functional Analysis Details listings of Matlab® programs implementing the main methods which complete the methodological presentation by a practical implementation Construct your own implementations from provided worked examples

Perturbation Analysis, Ordinal Optimization, and Beyond
Markov Chain Monte Carlo
Rare Events in Stochastic Systems
From Linear to Non-Linear
Mathematical Foundations of Stochastic Simulation
Probability, Statistics, and Stochastic Processes

This book constitutes the refereed proceedings of the 21st International Conference on Analytical and Stochastic Modelling Techniques and Applications, ASMTA 2014, held in Budapest, Hungary, in June/July 2014. The 18 papers presented were carefully reviewed and selected from 27 submissions. The papers discuss the latest developments in analytical, numerical and simulation algorithms for stochastic systems, including Markov processes, queueing networks, stochastic Petri nets, process algebras, game theory, etc.

Stochastic Simulation for Bayesian Inference, Second Edition