Foundations And Methods Of Stochastic Simulation A First Course International Series In Operations Research Management Science

The handbook covers systematically and in simple language the foundations of Markov systems, stochastic differential equations, Fokker-Planck equations, approximation methods, chemical master equations and quantum-mechanical Markov processes. Strong emphasis is placed on systematic approximation methods for solving problems. Stochastic adiabatic elimination is newly formulated. The book contains the 'folklore' of stochastic methods in systematic form, and is suitable for use as a reference work. In this second edition extra material has been added with recent progress in stochastic methods taken into account.

This book constitutes the refereed proceedings of the Second International Symposium on Stochastic Algorithms: Foundations and Applications, SAGA 2003, held in Hatfield, UK in September 2003. The 12 revised full papers presented together with three invited papers were carefully reviewed and selected for inclusion in the book. Among the topics addressed are ant colony optimization, randomized algorithms for the intersection problem, local search for constraint satisfaction problems, randomized local search and combinatorial optimization, simulated annealing, probabilistic global search, network communication complexity, open shop scheduling, aircraft routing, traffic control, randomized straight-line programs, and stochastic automata and probabilistic transformations.

The field of applied probability has changed profoundly in the past twenty years. The development of computational methods has greatly contributed to a better understanding of the theory. A First Course in Stochastic Models provides a self-contained introduction to the theory and applications of stochastic models. Emphasis is placed on establishing the theoretical foundations of the subject, thereby providing a framework in which the applications can be understood. Without this solid basis in theory no applications can be solved. Provides an introduction to the use of stochastic models through an integrated presentation of theory, algorithms and applications. Incorporates recent developments in computational probability. Includes a wide range of examples that illustrate the models and make the methods of solution clear. Features an abundance of motivating exercises that help the student learn how to apply the theory. Accessible to anyone with a basic knowledge of probability. A First Course in Stochastic Models is suitable for senior undergraduate and graduate students from computer science, engineering, statistics, operations resear ch, and any other discipline where stochastic modelling takes place. It stands out amongst other textbooks on the subject because of its integrated presentation of theory, algorithms and applications.

Surveys and summaries of latest research in numerical analysis, optimization, computer algebra and scientific computing.

This volume considers fundamental theories and contrasts the natural interplay between real and abstract methods. No prior knowledge of probability is assumed. Numerous problems, most with hints. 1981 edition.

This accessible text presents a detailed introduction to the use of a wide range of software tools and modeling environments for use in the biosciences, as well as the fundamental mathematical background. The practical constraints presented by each modeling technique are described in detail, enabling the researcher to determine which software package would be most useful for a particular problem. Features: introduces a basic array of techniques to formulate models of biological systems, and to solve them; discusses agent-based models, stochastic modeling techniques, differential equations, spatial simulations, and Gillespie’s stochastic simulation algorithm; provides exercises; describes such useful tools as the Maxima algebra system, the PRISM model checker, and the modeling environments Repast Simphony and Smoldyn; contains appendices on rules of differentiation and integration, Maxima and PRISM notation, and some additional mathematical concepts; offers supplementary material at an associated website.

Theoretical Foundation Engineering provides up-to-date, state-of-the-art reviews of the existing literature on lateral earth pressure, sheet pile walls, ultimate bearing capacity of shallow foundations, holding capacity of plate and helical anchors in sand and clay, and slope stability analysis. The discussion of the ultimate bearing capacity of shallow foundations is the most comprehensive presentation on the subject to be found anywhere, and the review of earth anchors is unique to this book. In addition, each chapter includes several topics which have never appeared in any other book. The treatment is primarily theoretical and does not in any way compete with existing foundation design books. This is the only textbook of its kind. Not only will it be welcomed by teachers and first-year graduate students of geotechnical engineering, but it will be a useful reference for graduate students and consultants in the the field, as well as being a valuable addition to any civil engineering library.

The DMV seminar "Stochastische Approximation und Optimierung zufalliger Systeme" was held at Blaubeuren, 28. 5. -4. 6. 1989. The goal was to give an approach to theory and application of stochas tic approximation in view of optimization problems, especially in engineering systems. These notes are based on the seminar lectures. They consist of three parts: I. Foundations of stochastic approximation (H. Walk); n. Applicational aspects of stochastic approximation (G. PHug); In. Applications to adaptation :ugorithms (L. Ljung). The prerequisites for reading this book are basic knowledge in probability, mathematical statistics, optimization. We would like to thank Prof. M. Barner and Prof. G. Fischer for the or ganization of the seminar. We also thank the participants for their cooperation and our assistants and secretaries for typing the manuscript. November 1991 L. Ljung, G. PHug, H. Walk Table of contents I Foundations of stochastic approximation (H. Walk) §1 Almost sure convergence of stochastic approximation procedures 2 §2 Recursive methods for linear problems 17 §3 Stochastic optimization under stochastic constraints 22 §4 A learning model; recursive density estimation 27 §5 Invariance principles in stochastic approximation 30 §6 On the theory of large deviations 43 References for Part I 45 11 Applicational aspects of stochastic approximation (G. PHug) §7 Markovian stochastic optimization and stochastic approximation procedures 53 §8 Asymptotic distributions 71 §9 Stopping times 79 §1O Applications of stochastic approximation methods 80 References for Part II 90 III Applications to adaptation algorithms (L.

The present collection of four lecture notes is the very first contribution of this type in the field of sparse recovery. Compressed sensing is one of the important facets of the broader concept presented in the book, which by now has made connections with other branches such as mathematical imaging, inverse problems, numerical analysis and simulation. This unique collection will be of value for a broad community and may serve as a textbook for graduate courses.

In today’s global economy, operations strategy in supply chains must assume an ever-expanding and strategic role of risks. These operational and strategic facets entail a brand new set of operational problems and risks that have not always been understood or managed very well. This book provides the means to understand, to model and to analyze these outstanding issues and problems that are the essential elements in managing supply chains today.

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.?

Serving as the foundation for a one-semester course in stochastic processes for students familiar with elementary probability theory and calculus, Introduction to Stochastic Modeling, Third Edition, bridges the gap between basic probability and an intermediate level course in stochastic processes. The objectives of the text are to introduce students to the standard concepts and methods of stochastic modeling, to illustrate the rich diversity of applications of stochastic processes in the applied sciences, and to provide exercises in the application of simple stochastic analysis to realistic problems. Realistic applications from a variety of disciplines integrated throughout the text Plentiful, updated and more rigorous problems, including computer "challenges" Revised end-of-chapter exercises sets-in all, 250 exercises with answers New chapter on Brownian motion and related processes Additional sections on Matingales and Poisson process

Stochastic local search (SLS) algorithms are among the most prominent and successful techniques for solving computationally difficult problems. Offering a systematic treatment of SLS algorithms, this book examines the general concepts and specific instances of SLS algorithms and considers their development, analysis and application.

Presenting state-of-the-art methods in the area, the book begins with a presentation of weak discrete time approximations of jump-diffusion stochastic differential equations for derivatives pricing and risk measurement. Using a moving least squares reconstruction, a numerical approach is then developed that allows for the construction of arbitrage-free surfaces. Free boundary problems are considered next, with particular focus on stochastic impulse control problems that arise when the cost of control includes a fixed cost, common in financial applications. The text proceeds with the development of a fear index based on equity option surfaces, allowing for the measurement of overall fear levels in the market. The problem of American option pricing is considered next, applying simulation methods combined with regression techniques and discussing convergence properties. Changing focus to integral transform methods, a variety of option pricing problems are considered. The COS method is practically applied for the pricing of options under uncertain volatility, a method developed by the authors that relies on the dynamic programming principle and Fourier cosine series expansions. Efficient approximation methods are next developed for the application of the fast Fourier transform for option pricing under multifactor affine models with stochastic volatility and jumps. Following this, fast and accurate pricing techniques are showcased for the pricing of credit derivative contracts with discrete monitoring based on the Wiener-Hopf factorisation. With an energy theme, a recombining pentanomial lattice is developed for the pricing of gas swing contracts under regime switching dynamics. The book concludes with a linear and nonlinear review of the arbitrage-free parity theory for the CDS and bond markets.

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 book constitutes the refereed proceedings of the International Symposium on Stochastic Algorithms: Foundations and Applications, SAGA 2001, held in Berlin, Germany in December 2001. The nine revised full papers presented together with four invited papers were carefully reviewed and selected for inclusion in the book. The papers are devoted to the design and analysis, experimental evaluation, and real-world application of stochasitc algorithms; in particular, new algorithmic ideas involving stochastic decisions and exploiting probabilistic properties of the underlying problem are introduced. Among the application fields are network and distributed algorithms, local search methods, and computational learning.

Info-metrics is the science of modeling, reasoning, and drawing inferences under conditions of noisy and insufficient information. It is at the intersection of information theory, statistical inference, and decision-making under uncertainty. It plays an important role in helping make informed decisions even when there is inadequate or incomplete information because it provides a framework to process available information with minimal reliance on assumptions that cannot be validated. In this pioneering book, Amos Golan, a leader in info-metrics, focuses on unifying information processing, modeling and inference within a single constrained optimization framework. Foundations of Info-Metrics provides an overview of modeling and inference, rather than a problem specific model, and progresses from the simple premise that information is often insufficient to provide a unique answer for decisions we wish to make. Each decision, or solution, is derived from the available input information along with a choice of inferential procedure. The book contains numerous multidisciplinary applications and case studies, which demonstrate the simplicity and generality of the framework in real world settings. Examples include initial diagnosis at an emergency room, optimal dose decisions, election forecasting, network and information aggregation, weather pattern analyses, portfolio allocation, strategy inference for interacting entities, incorporation of prior information, option pricing, and modeling an interacting social system. Graphical representations illustrate how results can be visualized while exercises and problem sets facilitate

extensions. This book is this designed to be accessible for researchers, graduate students, and practitioners across the disciplines.

This book constitutes the refereed proceedings of the 20th Brazilian Symposium on Formal Methods, SBMF 2017, which took place in Recife, Brazil, in November/December 2017.The 16 papers presented together with three invited talks were carefully reviewed and selected from 37 submissions. They are organized in the following topical sections: formal methods integration and experience reports; model checking; refinement and verification; and semantics and languages. The chapter 'Rapidly Adjustable Non-Intrusive Online Monitoring for Multi-core Systems' is published open access under a CC BY 4.0 license.

In the third edition of this classic the chapter on quantum Marcov processes has been replaced by a chapter on numerical treatment of stochastic differential equations to make the book even more valuable for practitioners.

This book constitutes the refereed proceedings of the Third International Symposium on Stochastic Algorithms: Foundations and Applications, SAGA 2005, held in Moscow, Russia in October 2005. The 14 revised full papers presented together with 5 invited papers were carefully reviewed and selected for inclusion in the book. The contributed papers included in this volume cover both theoretical as well as applied aspects of stochastic computations whith a special focus on new algorithmic ideas involving stochastic decisions and the design and evaluation of stochastic algorithms within realistic scenarios.

This book deals with the application of spectral methods to problems of uncertainty propagation and quanti?cation in model-based computations. It speci?cally focuses on computational and algorithmic features of these methods which are most useful in dealing with models based on partial differential equations, with special att- tion to models arising in simulations of ?uid ?ows. Implementations are illustrated through applications to elementary problems, as well as more elaborate examples selected from the authors' interests in incompressible vortex-dominated ?ows and compressible ?ows at low Mach numbers. Spectral stochastic methods are probabilistic in nature, and are consequently rooted in the rich mathematical foundation associated with probability and measure spaces. Despite the authors' fascination with this foundation, the discussion only - ludes to those theoretical aspects needed to set the stage for subsequent applications. The book is authored by practitioners, and is primarily intended for researchers or graduate students in computational mathematics, physics, or ?uid dynamics. The book assumes familiarity with elementary methods for the numerical solution of time-dependent, partial differential equations; prior experience with spectral me- ods is naturally helpful though not essential. Full appreciation of elaborate examples in computational ?uid dynamics (CFD) would require familiarity with key, and in some cases delicate, features of the associated numerical methods. Besides these shortcomings, our aim is to treat algorithmic and computational aspects of spectral stochastic methods with details suf?cient to address and reconstruct all but those highly elaborate examples.

"This volume is a textbook on linear control systems with an emphasis on stochastic optimal control with solution methods using spectral factorization in line with the original approach of N. Wiener. Continuous-time and discrete-time versions are presented in parallel.... Two appendices introduce functional analytic concepts and probability theory, and there are 77 references and an index. The chapters (except for the last two) end with problems.... [T]he book presents in a clear way important concepts of control theory and can be used for teaching." —Zentralblatt Math "This is a textbook intended for use in courses on linear control and filtering and estimation on (advanced) levels. Its major purpose is an introduction to both deterministic and stochastic control and estimation. Topics are treated in both continuous time and discrete time versions.... Each chapter involves problems and exercises, and the book is supplemented by appendices, where fundamentals on Hilbert and Banach spaces, operator theory, and measure theoretic probability may be found. The book will be very useful for students, but also for a variety of specialists interested in deterministic and stochastic control and filtering." —Applications of Mathematics "The strength of the book under review lies in the choice of specialized topics it contains, which may not be found in this form elsewhere. Also, the first half would make a good standard course in linear control." —Journal of the Indian Institute of Science

A systematic, self-contained treatment of the theory of stochastic differential equations in infinite dimensional spaces. Included is a discussion of Schwartz spaces of distributions in relation to probability theory and infinite dimensional stochastic analysis, as well as the random variables and stochastic processes that take values in infinite dimensional spaces.

Random sequences; Processes in continuous time; Miscellaneous statistical applications; Limiting stochastic operations; Stationary processes; Prediction and communication theory; The statistical analysis of stochastic processes; Correlation analysis of time-series.

In this book, we study theoretical and practical aspects of computing methods for mathematical modelling of nonlinear systems. A number of computing techniques are considered, such as methods of operator approximation with any given accuracy; operator interpolation techniques including a non-Lagrange interpolation; methods of system representation subject to constraints associated with concepts of causality, memory and stationarity; methods of system representation with an accuracy that is the best within a given class of models; methods of covariance matrix estimation; methods for low-rank matrix approximations; hybrid methods based on a combination of iterative procedures and best operator approximation; and methods for information compression and filtering under condition that a filter model should satisfy restrictions associated with causality and different types of memory. As a result, the book represents a blend of new methods in general computational analysis, and specific, but also generic, techniques for study of systems theory ant its particular branches, such as optimal filtering and information compression. - Best operator approximation, - Non-Lagrange interpolation, - Generic Karhunen-Loeve transform - Generalised low-rank matrix approximation - Optimal data compression - Optimal nonlinear filtering

Networked control systems are increasingly ubiquitous today, with applications ranging from vehicle communication and adaptive power grids to space exploration and economics. The optimal design of such systems presents major challenges, requiring tools from various disciplines within applied mathematics such as decentralized control, stochastic control, information theory, and quantization. A thorough, self-contained book, Stochastic Networked Control Systems: Stabilization and Optimization under Information Constraints aims to connect these diverse disciplines with precision and rigor, while conveying design guidelines to controller architects. Unique in the literature, it lays a comprehensive theoretical foundation for the study of networked control systems, and introduces an array of concrete tools for work in the field. Salient features included: · Characterization, comparison and optimal design of information structures in static and dynamic teams. Operational, structural and topological properties of information structures in optimal decision making, with a systematic program for generating optimal encoding and control policies. The notion of signaling, and its utilization in stabilization and optimization of decentralized control systems. · Presentation of mathematical methods for stochastic stability of networked control systems using random-time, state-dependent drift conditions and martingale methods. · Characterization and study of information channels leading to various forms of stochastic stability such as stationarity, ergodicity, and quadratic stability; and connections with information and quantization theories. Analysis of various classes of centralized and decentralized control

systems. · Jointly optimal design of encoding and control policies over various information channels and under general optimization criteria, including a detailed coverage of linear-quadratic-Gaussian models. · Decentralized agreement and dynamic optimization under information constraints. This monograph is geared toward a broad audience of academic and industrial researchers interested in control theory, information theory, optimization, economics, and applied mathematics. It could likewise serve as a supplemental graduate text. The reader is expected to have some familiarity with linear systems, stochastic processes, and Markov chains, but the necessary background can also be acquired in part through the four appendices included at the end. · Characterization, comparison and optimal design of information structures in static and dynamic teams. Operational, structural and topological properties of information structures in optimal decision making, with a systematic program for generating optimal encoding and control policies. The notion of signaling, and its utilization in stabilization and optimization of decentralized control systems. · Presentation of mathematical methods for stochastic stability of networked control systems using random-time, state-dependent drift conditions and martingale methods. · Characterization and study of information channels leading to various forms of stochastic stability such as stationarity, ergodicity, and quadratic stability; and connections with information and quantization theories. Analysis of various classes of centralized and decentralized control systems. · Jointly optimal design of encoding and control policies over various information channels and under general optimization criteria, including a detailed coverage of linear-quadratic-Gaussian models. · Decentralized agreement and dynamic optimization under information constraints. This monograph is geared toward a broad audience of academic and industrial researchers interested in control theory, information theory, optimization, economics, and applied mathematics. It could likewise serve as a supplemental graduate text. The reader is expected to have some familiarity with linear systems, stochastic processes, and Markov chains, but the necessary background can also be acquired in part through the four appendices included at the end.

This graduate-level textbook covers modelling, programming and analysis of stochastic computer simulation experiments, including the mathematical and statistical foundations of simulation and why it works. The book is rigorous and complete, but concise and accessible, providing all necessary background material. Object-oriented programming of simulations is illustrated in Python, while the majority of the book is programming language independent. In addition to covering the foundations of simulation and simulation programming for applications, the text prepares readers to use simulation in their research. A solutions manual for end-of-chapter exercises is available for instructors.

Managing safety of diverse systems requires decision-making under uncertainties and risks. Such systems are typically characterized by spatio-temporal heterogeneities, inter-dependencies, externalities, endogenous risks, discontinuities, irreversibility, practically irreducible uncertainties, and rare events with catastrophic consequences. Traditional scientific approaches rely on data from real observations and experiments; yet no sufficient observations exist for new problems, and experiments are usually impossible. Therefore, science-based support for addressing such new class of problems needs to replace the traditional “deterministic predictions” analysis by new methods and tools for designing decisions that are robust against the involved uncertainties and risks. The new methods treat uncertainties explicitly by using “synthetic” information derived by integration of “hard” elements, including available data, results of possible experiments, and formal representations of scientific facts, with “soft” elements based on diverse representations of scenarios and opinions of public, stakeholders, and experts. The volume presents such effective new methods, and illustrates their applications in different problem areas, including engineering, economy, finance, agriculture, environment, and policy making.

Introduction and generalities; Conditional expectations and probabilities; Projective and direct limits; Martingales and likelihood ratios; Abstract martingales and applications.

This book describes the mathematical underpinnings of algorithms used for molecular dynamics simulation, including both deterministic and stochastic numerical methods. Molecular dynamics is one of the most versatile and powerful methods of modern computational science and engineering and is used widely in chemistry, physics, materials science and biology. Understanding the foundations of numerical methods means knowing how to select the best one for a given problem (from the wide range of techniques on offer) and how to create new, efficient methods to address particular challenges as they arise in complex applications. Aimed at a broad audience, this book presents the basic theory of Hamiltonian mechanics and stochastic differential equations, as well as topics including symplectic numerical methods, the handling of constraints and rigid bodies, the efficient treatment of Langevin dynamics, thermostats to control the molecular ensemble, multiple time-stepping, and the dissipative particle dynamics method.

This book examines optimization problems that in practice involve random model parameters. It details the computation of robust optimal solutions, i.e., optimal solutions that are insensitive with respect to random parameter variations, where appropriate deterministic substitute problems are needed. Based on the probability distribution of the random data and using decision theoretical concepts, optimization problems under stochastic uncertainty are converted into appropriate deterministic substitute problems. Due to the probabilities and expectations involved, the book also shows how to apply approximative solution techniques. Several deterministic and stochastic approximation methods are provided: Taylor expansion methods, regression and response surface methods (RSM), probability inequalities, multiple linearization of survival/failure domains, discretization methods, convex approximation/deterministic descent directions/efficient points, stochastic approximation and gradient procedures and differentiation formulas for probabilities and expectations. In the third edition, this book further develops stochastic optimization methods. In particular, it now shows how to apply stochastic optimization methods to the approximate solution of important concrete problems arising in engineering, economics and operations research.

Optimization problems arising in practice involve random parameters. For the computation of robust optimal solutions, i.e., optimal solutions being insensitive with respect to random parameter variations, deterministic substitute problems are needed. Based on the distribution of the random data, and using decision theoretical concepts, optimization problems under stochastic uncertainty are converted into deterministic substitute problems. Due to the occurring probabilities and expectations, approximative solution techniques must be applied. Deterministic and stochastic approximation methods and their analytical properties are provided: Taylor expansion, regression and response surface methods, probability inequalities, First Order Reliability Methods, convex approximation/deterministic descent directions/efficient points, stochastic approximation methods, differentiation of probability and mean value functions. Convergence results of the resulting iterative solution procedures are given.

This book has a dual purpose?serving as an advanced textbook designed to prepare doctoral students to do research on the mathematical foundations of inventory theory, and as a reference work for those already engaged in such research. All chapters conclude with exercises that either solidify or extend the concepts introduced.

This textbook provides a self-contained introduction to numerical methods in probability with a focus on applications to finance. Topics covered include the Monte Carlo simulation (including simulation of random variables, variance reduction, quasi-Monte Carlo simulation, and more recent developments such as the multilevel paradigm), stochastic optimization and approximation, discretization schemes of stochastic differential equations, as well as optimal quantization methods. The author further presents detailed applications to numerical aspects of pricing and hedging of financial derivatives, risk measures

(such as value-at-risk and conditional value-at-risk), implicitation of parameters, and calibration. Aimed at graduate students and advanced undergraduate students, this book contains useful examples and over 150 exercises, making it suitable for self-study.