Modeling And Analysis Of Stochastic Systems By Vidyadhar G Kulkarni

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Two-Scale Stochastic Systems - Yuri Kabanov 2013-04-17
Two-scale systems described by singularly perturbed SDEs have been the subject of ample literature. However, this new monograph develops subjects that were rarely addressed and could be given the collective description "Stochastic Tikhonov-Levinson theory and its applications." The book provides a mathematical apparatus designed to analyze the dynamic behaviour of a randomly perturbed system with fast and slow variables. In contrast to the deterministic Tikhonov-Levinson theory, the basic model is described in a more realistic way by stochastic differential equations. This leads to a number of new theoretical questions but simultaneously allows us to treat in a unified way a surprisingly wide spectrum of applications like fast modulations, approximate filtering, and stochastic approximation.Two-scale systems described by singularly perturbed SDEs have been the subject of ample literature. However, this new monograph develops subjects that were rarely addressed and could be given the collective description "Stochastic Tikhonov-Levinson theory and its applications." The book provides a mathematical apparatus designed to analyze the dynamic behaviour of a randomly perturbed system with fast and slow variables. In contrast to the deterministic Tikhonov-Levinson theory, the basic model is described in a more realistic way by stochastic differential equations. This leads to a number of new theoretical questions but simultaneously allows us to treat in a unified way a surprisingly wide spectrum of applications like fast modulations, approximate filtering, and stochastic approximation.
Uncertainty Quantification and Stochastic Modeling with Matlab - Eduardo Souza de Cursi 2015-04-09
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
Stochastic Simulation and Monte Carlo Methods - Carl Graham 2013-07-16
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.
Stochastic Models with Applications to Genetics, Cancers, AIDS and Other Biomedical Systems - Wai-Yuan Tan 2002-02-26
This book presents a systematic treatment of Markov chains, diffusion processes and state space models, as well as alternative approaches to Markov chains through stochastic difference equations and stochastic differential equations. It illustrates how these processes and approaches are applied to many problems in genetics, carcinogenesis, AIDS epidemiology and other biomedical systems. One feature of the book is that it describes the basic MCMC (Markov chain and Monte Carlo) procedures and illustrates how to use the Gibbs sampling method and the multilevel Gibbs sampling method to solve many problems in genetics, carcinogenesis, AIDS and other biomedical systems. As another feature, the book develops many state space models for many genetic problems, carcinogenesis, AIDS epidemiology and HIV pathogenesis. It shows in detail how to use the multilevel Gibbs sampling method to estimate (or predict) simultaneously the state variables and the unknown parameters in cancer chemotherapy, carcinogenesis, AIDS epidemiology and HIV pathogenesis. As a matter of fact, this book is the first to develop many state space models for many genetic problems, carcinogenesis and other biomedical problems. Contents:Discrete Time Markov Chain Models in Genetics and Biomedical SystemsStationary Distributions and MCMC in Discrete Time Markov ChainsContinuous-Time Markov Chain Models in Genetics, Cancers and AIDSAbsorption Probabilities and Stationary Distributions in Continuous-Time Markov Chain ModelsDiffusion Models in Genetics, Cancer and AIDSAsymptotic Distributions, Stationary Distributions and Absorption Probabilities in Diffusion ModelsState Space Models and Some Examples from Cancer and AIDSSome General Theories of State Space Models and Applications Readership: Graduate students and researchers in probability & statistics and the life sciences.
Keywords:Stochastic;Genetics;Cancers;AIDS;Biomedical SystemsReviews:"Its strengths include the large number of models

described, many of which have previously been published only in research journals; its clear presentation of many detailed analyses; and good accounts of the biology behind the models."Mathematical Reviews

Stochastic Reliability Modeling, Optimization and Applications - Syouji Nakamura 2010

Aims to survey research topics in reliability theory and useful applied techniques in reliability engineering. This book focuses on how to apply the results of reliability theory to practical models. Theoretical results of coherent, inspection, and damage systems are summarized methodically, using the techniques of stochastic processes.

Linear Stochastic Systems - Anders Lindquist 2015-04-24

This book presents a treatise on the theory and modeling of second-order stationary processes, including an exposition on selected application areas that are important in the engineering and applied sciences. The foundational issues regarding stationary processes dealt with in the beginning of the book have a long history, starting in the 1940s with the work of Kolmogorov, Wiener, Cramér and his students, in particular Wold, and have since been refined and complemented by many others. Problems concerning the filtering and modeling of stationary random signals and systems have also been addressed and studied, fostered by the advent of modern digital computers, since the fundamental work of R.E. Kalman in the early 1960s. The book offers a unified and logically consistent view of the subject based on simple ideas from Hilbert space geometry and coordinate-free thinking. In this framework, the concepts of stochastic state space and state space modeling, based on the notion of the conditional independence of past and future flows of the relevant signals, are revealed to be fundamentally unifying ideas. The book, based on over 30 years of original research, represents a valuable contribution that will inform the fields of stochastic modeling, estimation, system identification, and time series analysis for decades to come. It also provides the mathematical tools needed to grasp and analyze the structures of algorithms in stochastic systems theory.

Stochastic Models of Systems - Vladimir S. Korolyuk 2012-12-06

In this monograph stochastic models of systems analysis are discussed. It covers many aspects and different stages from the construction of mathematical models of real systems, through mathematical analysis of models based on simplification methods, to the interpretation of real stochastic systems. The stochastic models described here share the property that their evolutionary aspects develop under the influence of random factors. It has been assumed that the evolution takes place in a random medium, i.e. unilateral interaction between the system and the medium. As only Markovian models of random medium are considered in this book, the stochastic models described here are determined by two processes, a switching process describing the evolution of the systems and a switching process describing the changes of the random medium. Audience: This book will be of interest to postgraduate students and researchers whose work involves probability theory, stochastic processes, mathematical systems theory, ordinary differential equations, operator theory, or mathematical modelling and industrial mathematics.

Applied Stochastic System Modeling - International Conference on Applied Stochastic System Modeling 2003

Modeling and Analysis of Stochastic Systems, Third Edition - Vidyadhar G. Kulkarni 2016-11-18

Building on the author's more than 35 years of teaching experience, Modeling and Analysis of Stochastic Systems, Third Edition, covers the most important classes of stochastic processes used in the modeling of diverse systems. For each class of stochastic process, the text includes its definition, characterization, applications, transient and limiting behavior, first passage times, and cost/reward models. The third edition has been updated with several new applications, including the Google search algorithm in discrete time Markov chains, several examples from health care and finance in continuous time Markov chains, and square root staffing rule in Queuing models. More than 50 new exercises have been added to enhance its use as a course text or for self-study. The sequence of chapters and exercises has been maintained between editions, to enable those now teaching from the second edition to use the third edition. Rather than offer special tricks that work in specific problems, this book provides thorough coverage of general tools that enable the solution and analysis of stochastic models. After mastering the material in the text, readers will be well-equipped to build and analyze useful stochastic models for real-life situations.

Introduction to Stochastic Models - Roe Goodman 2006-01-01

Newly revised by the author, this undergraduate-level text introduces the mathematical theory of probability and stochastic processes. Using both computer simulations and mathematical models of random events, it comprises numerous applications to the physical and biological sciences, engineering, and computer science. Subjects include sample spaces, probabilities distributions and expectations of random variables, conditional expectations, Markov chains, and the Poisson process. Additional topics encompass continuous-time stochastic processes, birth and death processes, steady-state probabilities, general queuing systems, and renewal processes. Each section features worked examples, and exercises appear at the end of each chapter, with numerical solutions at the back of the book. Suggestions for further reading in stochastic processes, simulation, and various applications also appear at the end.

Stochastic Modeling - Hossein Bonakdari 2022-04-28

Stochastic Modeling: A Thorough Guide to Evaluate, Pre-Process, Model and Compare Time Series with MATLAB Software allows for new avenues in time series analysis and predictive modeling which summarize more than ten years of experience in the application of stochastic models in environmental problems. The book introduces a variety of different topics in time series in the modeling and prediction of complex environmental systems. Most importantly, all codes are user-friendly and readers will be able to use them for their cases. Users who may not be familiar with MATLAB software can also refer to the appendix. This book also guides the reader step-by-step to learn developed codes for time series modeling, provides required toolboxes, explains concepts, and applies different tools for different types of environmental time series problems. Provides video tutorials on the use of codes Includes a companion site with 3,000 lines of programming, 70 principal codes and 100 pseudo codes Highlights multiple methods to Illustrate each problem

Modeling, Analysis, Design, and Control of Stochastic Systems - V. G. Kulkarni 2000-12-15

An introductory level text on stochastic modelling, suited for undergraduates or graduates in actuarial science, business management, computer science, engineering, operations research, public policy, statistics, and mathematics. It employs a large number of examples to show how to build stochastic models of physical systems, analyse these models to predict their performance, and use the analysis to design and control them. The book provides a self-contained review of the relevant topics in probability theory: In discrete and continuous time Markov models it covers the transient and long term behaviour, cost models, and first passage times; under generalised Markov models, it covers renewal processes, cumulative processes and semi-Markov processes. All the material is illustrated with many examples, and the book emphasises numerical answers to the problems. A software package called MAXIM, which runs on MATLAB, is available for downloading.

Stochastic Modeling - Nicolas Lanchier 2017-01-27

Three coherent parts form the material covered in this text, portions of which have not been widely covered in traditional textbooks. In this coverage the reader is quickly introduced to several different topics enriched with 175 exercises which focus on real-world problems. Exercises range from the classics of probability theory to more exotic research-oriented problems based on numerical simulations. Intended for graduate students in mathematics and applied sciences, the text provides the tools and training needed to write and use programs for research purposes. The first part of the text begins with a brief review of measure theory and revisits the main concepts of probability theory, from random variables to the standard limit theorems. The second part covers traditional material on stochastic processes, including martingales, discrete-time Markov chains, Poisson processes, and continuous-time Markov chains. The theory developed is illustrated by a variety of examples surrounding applications such as the gambler's ruin chain, branching processes, symmetric random walks, and queueing systems. The third, more research-oriented part of the text, discusses special stochastic processes of interest in physics, biology, and sociology. Additional emphasis is placed on minimal models that have been used historically to develop new mathematical techniques in the field of stochastic processes: the logistic growth process, the Wright –Fisher model, Kingman's coalescent, percolation models, the contact process, and the voter model. Further treatment of the material explains how these special processes are connected to each other from a modeling perspective as well as their simulation capabilities in C and MatlabTM.

Markov Processes for Stochastic Modeling - Oliver Ibe 2013-05-22

Markov processes are processes that have limited memory. In particular, their dependence on the past is only through the previous state. They are used to model the behavior of many systems including communications systems, transportation networks, image segmentation and analysis, biological systems and DNA sequence analysis, random atomic motion and diffusion in physics, social mobility, population studies, epidemiology, animal and insect migration, queueing systems, resource management, dams, financial engineering, actuarial science, and decision systems. Covering a wide range of areas of application of Markov processes, this second edition is revised to highlight the most important aspects as well as the most recent trends and applications of Markov processes. The author spent over 16 years in the industry before returning to academia, and he has applied many of the principles covered in this book in multiple research projects. Therefore, this is an applications-oriented book that also includes enough theory to provide a solid ground in the subject for the reader. Presents both the theory and applications of the different aspects of Markov processes Includes numerous solved examples as well as detailed diagrams that make it easier to understand the principle being presented Discusses different applications of hidden Markov models, such as DNA sequence analysis and speech analysis.

Applied Stochastic Processes and Control for Jump-Diffusions - Floyd B. Hanson 2007-01-01

This self-contained, practical, entry-level text integrates the basic principles of applied mathematics, applied probability, and computational science for a clear presentation of stochastic processes and control for jump diffusions in continuous time. The author covers the important problem of controlling these systems and, through the use of a jump calculus construction, discusses the strong role of discontinuous and nonsmooth properties versus random properties in stochastic systems.

Introduction to Modeling and Analysis of Stochastic Systems - V. G. Kulkarni 2012-12-27

This book provides a self-contained review of all the relevant topics in probability theory. A software package called MAXIM, which runs on MATLAB, is made available for downloading. Vidyadhar G. Kulkarni is Professor of Operations Research at the University of North Carolina at Chapel Hill.

Stochastic Modelling and Control - Mark Davis 2013-03-08

This book aims to provide a unified treatment of input/output modelling and of control for discrete-time dynamical systems subject to random disturbances. The results presented are of wide applica bility in control engineering, operations research, econometric modelling and many other areas. There are two distinct approaches to mathematical modelling of physical systems: a direct analysis of the physical mechanisms that comprise the process, or a 'black box' approach based on analysis of input/output data. The second approach is adopted here, although of course the properties ofthe models we study, which within the limits of linearity are very general, are also relevant to the behaviour of systems represented by such models, however they are arrived at. The type of system we are interested in is a discrete-time or sampled-data system where the relation between input and output is (at least approximately) linear and where additive random dis turbances are also present, so that the behaviour of the system must be investigated by statistical methods. After a preliminary chapter summarizing elements of probability and linear system theory, we introduce in Chapter 2 some general linear stochastic models, both in input/output and state-space form. Chapter 3 concerns filtering theory: estimation of the state of a dynamical system from noisy observations. As well as being an important topic in its own right, filtering theory provides the link, via the so-called innovations representation, between input/output models (as identified by data analysis) and state-space models, as required for much contemporary control theory.

Stochastic Processes, Multiscale Modeling, and Numerical Methods for Computational Cellular Biology - David Holcman 2017-10-04

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.

Stochastic Models in Biology - Narendra S. Goel 2016-01-26

Stochastic Models in Biology describes the usefulness of the theory of stochastic process in studying biological phenomena. The book describes analysis of biological systems and experiments though probabilistic models rather than deterministic methods. The text reviews the mathematical analyses for modeling different biological systems such as the random processes continuous in time and discrete in state space. The book also discusses population growth and extinction through Malthus' law and the work of MacArthur and Wilson. The text then explains the dynamics of a population of interacting species. The book also addresses population genetics under systematic evolutionary pressures known as deterministic equations and genetic changes in a finite population known as stochastic equations. The text then turns to stochastic modeling of biological systems at the molecular level, particularly the kinetics of biochemical reactions. The book also presents various useful equations such as the differential equation for generating functions for birth and death processes. The text can prove valuable for biochemists, cellular biologists, and researchers in the medical and chemical field who are tasked to perform data analysis.

Foundations and Methods of Stochastic Simulation - Barry Nelson 2013-01-31

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.

Stochastic Modelling and Analysis - 1988

An Introduction to Stochastic Modeling - Howard M. Taylor 2014-05-10

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.

Stochastic Analysis, Stochastic Systems, and Applications to Finance - Allanus Hak-Man Tsoi 2011

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.

Stochastic Modelling of Electricity and Related Markets - Fred Espen

Benth 2008
The markets for electricity, gas and temperature have distinctive features, which provide the focus for countless studies. For instance, electricity and gas prices may soar several magnitudes above their normal levels within a short time due to imbalances in supply and demand, yielding what is known as spikes in the spot prices. The markets are also largely influenced by seasons, since power demand for heating and cooling varies over the year. The incompleteness of the markets, due to nonstorability of electricity and temperature as well as limited storage capacity of gas, makes spot-forward hedging impossible. Moreover, futures contracts are typically settled over a time period rather than at a fixed date. All these aspects of the markets create new challenges when analyzing price dynamics of spot, futures and other derivatives.This book provides a concise and rigorous treatment on the stochastic modeling of energy markets. Ornstein?Uhlenbeck processes are described as the basic modeling tool for spot price dynamics, where innovations are driven by time-inhomogeneous jump processes. Temperature futures are studied based on a continuous higher-order autoregressive model for the temperature dynamics. The theory presented here pays special attention to the seasonality of volatility and the Samuelson effect. Empirical studies using data from electricity, temperature and gas markets are given to link theory to practice.

Stochastic Simulation Optimization for Discrete Event Systems - Chun-Hung Chen 2013-07-03
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

Stochastic Modeling - Barry L. Nelson 2012-10-11
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.

Stochastic Modeling for Reliability - Maxim Finkelstein 2013-04-12
Focusing on shocks modeling, burn-in and heterogeneous populations, Stochastic Modeling for Reliability naturally combines these three topics in the unified stochastic framework and presents numerous practical examples that illustrate recent theoretical findings of the authors. The populations of manufactured items in industry are usually heterogeneous. However, the conventional reliability analysis is performed under the implicit assumption of homogeneity, which can result in distortion of the corresponding reliability indices and various misconceptions. Stochastic Modeling for Reliability fills this gap and presents the basics and further developments of reliability theory for heterogeneous populations. Specifically, the authors consider burn-in as a method of elimination of ‘weak’ items from heterogeneous populations. The real life objects are operating in a changing environment. One of the ways to model an impact of this environment is via the external shocks occurring in accordance with some stochastic point processes. The basic theory for Poisson shock processes is developed and also shocks as a method of burn-in and of the environmental stress screening for manufactured items are considered. Stochastic Modeling for Reliability introduces and explores the concept of burn-in in heterogeneous populations and its recent development, providing a sound reference for reliability engineers, applied mathematicians, product managers and manufacturers alike.

Modeling and Analysis of Stochastic Systems, Second Edition - Vidyadhar G. Kulkarni 2009-12-18
Based on the author's more than 25 years of teaching experience, Modeling and Analysis of Stochastic Systems, Second Edition covers the most important classes of stochastic processes used in the modeling of diverse systems, from supply chains and inventory systems to genetics and biological systems. For each class of stochastic process, the text includes its definition, characterization, applications, transient and limiting behavior, first passage times, and cost/reward models. Along with reorganizing the material, this edition revises and adds new exercises and examples. New to the second edition: a new chapter on diffusion processes that gives an accessible and non-measure-theoretic treatment with applications to finance; a more streamlined, application-oriented approach to renewal, regenerative, and Markov regenerative processes; and, two appendices that collect relevant results from analysis and differential and difference equations. Rather than offer special tricks that work in specific problems, this book provides thorough coverage of general tools that enable the solution and analysis of stochastic models. After mastering the material in the text, students will be well-equipped to build and analyze useful stochastic models for various situations. A collection of MATLAB[registered]-based programs can be downloaded from the author's website and a solutions manual is available for qualifying instructors.

Stochastic Discrete Event Systems - Armin Zimmermann 2008-01-12
Stochastic discrete-event systems (SDES) capture the randomness in choices due to activity delays and the probabilities of decisions. This book delivers a comprehensive overview on modeling with a quantitative evaluation of SDES. It presents an abstract model class for SDES as a pivotal unifying result and details important model classes. The book also includes nontrivial examples to explain real-world applications of SDES.

Modeling and Analysis of Stochastic Systems - Vidyadhar G. Kulkarni 2020-12-18
Building on the author's more than 35 years of teaching experience, Modeling and Analysis of Stochastic Systems, Third Edition, covers the most important classes of stochastic processes used in the modeling of diverse systems. For each class of stochastic process, the text includes its definition, characterization, applications, transient and limiting behavior, first passage times, and cost/reward models. The third edition has been updated with several new applications, including the Google search algorithm in discrete time Markov chains, several examples from health care and finance in continuous time Markov chains, and square root staffing rule in Queuing models. More than 50 new exercises have been added to enhance its use as a course text or for self-study. The sequence of chapters and exercises has been maintained between editions, to enable those now teaching from the second edition to use the third edition. Rather than offer special tricks that work in specific problems, this book provides thorough coverage of general tools that enable the solution and analysis of stochastic models. After mastering the material in the text, readers will be well-equipped to build and analyze useful stochastic models for real-life situations.

Stochastic Modelling of Social Processes - Andreas Diekmann 2014-05-10
Stochastic Modelling of Social Processes provides information pertinent to the development in the field of stochastic modeling and its applications in the social sciences. This book demonstrates that stochastic models can fulfill the goals of explanation and prediction. Organized into nine chapters, this book begins with an overview of stochastic models that fulfill normative, predictive, and structural–analytic roles with the aid of the theory of probability. This text then examines the study of labor market structures using analysis of job and career mobility, which is one of the approaches taken by sociologists in research on the labor market. Other chapters consider the characteristic trends and patterns from data on divorces. This book discusses as well the two approaches of stochastic modeling of social processes, namely competing risk models and semi-Markov processes. The final chapter deals with the practical application of regression models of survival data. This book is a valuable resource for social scientists and statisticians.

Modelling and Application of Stochastic Processes - Uday B. Desai 1986-10-31
The subject of modelling and application of stochastic processes is too

vast to be exhausted in a single volume. In this book, attention is focused on a small subset of this vast subject. The primary emphasis is on realization and approximation of stochastic systems. Recently there has been considerable interest in the stochastic realization problem, and hence, an attempt has been made here to collect in one place some of the more recent approaches and algorithms for solving the stochastic realiza tion problem. Various different approaches for realizing linear minimum-phase systems, linear nonminimum-phase systems, and bilinear systems are presented. These approaches range from time-domain methods to spectral-domain methods. An overview of the chapter contents briefly describes these approaches. Also, in most of these chapters special attention is given to the problem of developing numerically ef ficient algorithms for obtaining reduced-order (approximate) stochastic realizations. On the application side, chapters on use of Markov random fields for modelling and analyzing image signals, use of complementary models for the smoothing problem with missing data, and nonlinear estimation are included. Chapter 1 by Klein and Dickinson develops the nested orthogonal state space realization for ARMA processes. As suggested by the name, nested orthogonal realizations possess two key properties; (i) the state variables are orthogonal, and (ii) the system matrices for the (n + l)st order realization contain as their "upper" n-th order blocks the system matrices from the n-th order realization (nesting property).

Stochastic Models in Reliability and Maintenance - Shunji Osaki 2012-11-02

Our daily lives can be maintained by the high-technology systems. Computer systems are typical examples of such systems. We can enjoy our modern lives by using many computer systems. Much more importantly, we have to maintain such systems without failure, but cannot predict when such systems will fail and how to fix such systems without delay. A stochastic process is a set of outcomes of a random experiment indexed by time, and is one of the key tools needed to analyze the future behavior quantitatively. Reliability and maintainability technologies are of great interest and importance to the maintenance of such systems. Many mathematical models have been and will be proposed to describe reliability and maintainability systems by using the stochastic processes. The theme of this book is "Stochastic Models in Reliability and Main tainability. " This book consists of 12 chapters on the theme above from the different viewpoints of stochastic modeling. Chapter 1 is devoted to "Renewal Processes," under which classical renewal theory is surveyed and computa tional methods are described. Chapter 2 discusses "Stochastic Orders," and in it some definitions and concepts on stochastic orders are described and ag ing properties can be characterized by stochastic orders. Chapter 3 is devoted to "Classical Maintenance Models," under which the so-called age, block and other replacement models are surveyed. Chapter 4 discusses "Modeling Plant Maintenance," describing how maintenance practice can be carried out for plant maintenance.

Stochastic Models, Statistics and Their Applications - Ansgar Steland 2015-02-04

This volume presents the latest advances and trends in stochastic models and related statistical procedures. Selected peer-reviewed contributions focus on statistical inference, quality control, change-point analysis and detection, empirical processes, time series analysis, survival analysis and reliability, statistics for stochastic processes, big data in technology and the sciences, statistical genetics, experiment design, and stochastic models in engineering. Stochastic models and related statistical procedures play an important part in furthering our understanding of the challenging problems currently arising in areas of application such as the natural sciences, information technology, engineering, image analysis, genetics, energy and finance, to name but a few. This collection arises from the 12th Workshop on Stochastic Models, Statistics and Their Applications, Wroclaw, Poland.

Bayesian Analysis of Stochastic Process Models - David Insua 2012-04-02

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.

The Data Science Handbook - Field Cady 2017-02-28

A comprehensive overview of data science covering the analytics, programming, and business skills necessary to master the discipline Finding a good data scientist has been likened to hunting for a unicorn: the required combination of technical skills is simply very hard to find in one person. In addition, good data science is not just rote application of trainable skill sets; it requires the ability to think flexibly about all these areas and understand the connections between them. This book provides a crash course in data science, combining all the necessary skills into a unified discipline. Unlike many analytics books, computer science and software engineering are given extensive coverage since they play such a central role in the daily work of a data scientist. The author also describes classic machine learning algorithms, from their mathematical foundations to real-world applications. Visualization tools are reviewed, and their central importance in data science is highlighted. Classical statistics is addressed to help readers think critically about the interpretation of data and its common pitfalls. The clear communication of technical results, which is perhaps the most undertrained of data science skills, is given its own chapter, and all topics are explained in the context of solving real-world data problems. The book also features: • Extensive sample code and tutorials using Python™ along with its technical libraries • Core technologies of “Big Data,” including their strengths and limitations and how they can be used to solve real-world problems • Coverage of the practical realities of the tools, keeping theory to a minimum; however, when theory is presented, it is done in an intuitive way to encourage critical thinking and creativity • A wide variety of case studies from industry • Practical advice on the realities of being a data scientist today, including the overall workflow, where time is spent, the types of datasets worked on, and the skill sets needed The Data Science Handbook is an ideal resource for data analysis methodology and big data software tools. The book is appropriate for people who want to practice data science, but lack the required skill sets. This includes software professionals who need to better understand analytics and statisticians who need to understand software. Modern data science is a unified discipline, and it is presented as such. This book is also an appropriate reference for researchers and entry-level graduate students who need to learn real-world analytics and expand their skill set. FIELD CADY is the data scientist at the Allen Institute for Artificial Intelligence, where he develops tools that use machine learning to mine scientific literature. He has also worked at Google and several Big Data startups. He has a BS in physics and math from Stanford University, and an MS in computer science from Carnegie Mellon.

Modeling, Analysis, Design, and Control of Stochastic Systems - V. G. Kulkarni 2014-01-13

An introductory level text on stochastic modelling, suited for undergraduates or graduates in actuarial science, business management, computer science, engineering, operations research, public policy, statistics, and mathematics. It employs a large number of examples to show how to build stochastic models of physical systems, analyse these models to predict their performance, and use the analysis to design and control them. The book provides a self-contained review of the relevant topics in probability theory: In discrete and continuous time Markov models it covers the transient and long term behaviour, cost models, and first passage times; under generalised Markov models, it covers renewal processes, cumulative processes and semi-Markov processes. All the material is illustrated with many examples, and the book emphasises numerical answers to the problems. A software package called MAXIM, which runs on MATLAB, is available for downloading.

Stochastic Models in Reliability Engineering - Lirong Cui 2020-09-01

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.

Introduction to Modeling and Analysis of Stochastic Systems - V. G. Kulkarni 2010-11-03

This book provides a self-contained review of all the relevant topics in probability theory. A software package called MAXIM, which runs on MATLAB, is made available for downloading. Vidyadhar G. Kulkarni is Professor of Operations Research at the University of North Carolina at Chapel Hill.

Stochastic Modeling and Analysis of Telecom Networks - Laurent Decreusefond 2012-12-27

This book addresses the stochastic modeling of telecommunicationnetworks, introducing the main mathematical tools for that purpose,such as Markov processes, real and spatial point processes andstochastic recursions, and presenting a wide list of results onstability, performances and comparison of systems. The authors propose a comprehensive mathematical construction ofthe foundations of stochastic network theory: Markov chains,continuous time Markov chains are extensively studied using anoriginal martingale-based approach. A complete presentation ofstochastic recursions from an ergodic theoretical perspective isalso provided, as well as spatial point processes. Using these basic tools, stability criteria, performance measuresand comparison principles are obtained for a wide class of models,from the canonical M/M/1 and G/G/1 queues to more sophisticatedsystems, including the current “hot topics” of spatialradio networking, OFDMA and real-time networks. Contents 1. Introduction. Part 1: Discrete-time Modeling 2. Stochastic Recursive Sequences. 3. Markov Chains. 4. Stationary Queues. 5. The M/GI/1 Queue. Part 2: Continuous-time Modeling 6. Poisson Process. 7. Markov Process. 8. Systems with Delay. 9. Loss Systems. Part 3: Spatial Modeling 10. Spatial Point Processes.