Finite Markov Processes And Their Applications Dover Books On Mathematics

This book is the first volume of a two-volume monograph devoted to the study of limit and ergodic theorems for regularly and singularly perturbed Markov chains, semi-Markov processes, and multi-alternating regenerative processes with semi-Markov modulation. The first volume presents necessary and sufficient conditions for weak convergence for first-rare-event times and convergence in the topology J for first-rare-event processes defined on regularly perturbed finite Markov chains and semi-Markov processes. The text introduces new asymptotic recurrent algorithms of phase space reduction. It also addresses both effective conditions of weak convergence for distributions of hitting times as well as convergence of expectations of hitting times for regularly and singularly perturbed finite Markov chains and semi-Markov processes. The book also contains a comprehensive bibliography of major works in the field. It provides an effective reference for both graduate students as well as theoretical and applied researchers studying stochastic processes and their applications.

Finite Markov Processes and Their ApplicationsCourier Corporation

Fundamental concepts of Markov chains; The classical approach to markov chains; The algebraic approach to Markov chains; Nonstationary Markov chains and the ergodic coeficient; Analysis of a markov chain on a computer; Continuous time Markov chains.

Besides the investigation of general chains the book contains chapters which are concerned with eigenvalue techniques, conductance, stopping times, the strong Markov property, couplings, strong uniform times, Markov chains on arbitrary finite groups (including a crash-course in harmonic analysis), random generation and counting, Markov random fields, Gibbs fields, the Metropolis sampler, and simulated annealing. With 170 exercises.

Markov Processes and their Applications

Elements of Applied Stochastic Processes

Cycle Representations of Markov Processes

An Introduction to Stochastic Processes and Their Applications

The Construction Theory of Denumerable Markov Processes

This book provides an undergraduate introduction to discrete and continuous-time Markov chains and their applications. A large focus is placed on the first step analysis technique and its applications to average hitting times and ruin probabilities. Classical topics such as recurrence and transience, stationary and limiting distributions, as well as branching processes, are also covered. Two major examples (gambling processes and random walks) are treated in detail from the beginning, before the general theory itself is presented in the subsequent chapters. An introduction to discrete-time martingales and their relation to ruin probabilities and mean exit times is also provided, and the book includes a chapter on spatial Poisson processes with some recent results on moment identities and deviation inequalities for Poisson stochastic integrals. The concepts presented are illustrated by examples and by 72 exercises and their complete solutions.

In this 2002 book, the author develops the necessary background in probability theory and Markov chains then discusses important computing applications.

Random variables. Probability generating functions. Exponential-type distributions and maximum likelihood estimation. Branching process, random walk and ruin problem. Markov chains. Algebraic treatment of finite Markov chains. Renewal processes. Some stochastic models of population growth. A general birth process, an equality and an epidemic model. Birth-death processes and queueing processes. A simple illness-death process - fix-neyman processes. Multiple transition probabilities in the simple illness death process. Multiple transition time in the simple illness death process - an alternating renewal process. The kolmogorov differential equations and finite markov processes. Kolmogorov differential equations and finite markov processes - continuation. A general illness-death process. Migration processes and birth-illness-death processes.

Papers presented at a workshop held January 1990 (location unspecified) cover just about all aspects of solving Markov models numerically. There are papers on matrix generation techniques and generalized stochastic Petri nets; the computation of stationary distributions, including aggregation/disagg

Continuous Semi-Markov Processes

Introduction to Markov Chains

Perturbed Semi-Markov Type Processes I

An Introduction to Markov Processes

FUNCTIONS OF FINITE MARKOV CHAINS AND EXPONENTIAL TYPE PROCESSES.

The modem theory of Markov processes has its origins in the studies of A. A. MARKOV (1906-1907) on sequences of experiments "connected in a chain" and in the attempts to describe mathematically the physical phenomenon known as Brownian motion (L. BACHELlER 1900, A. EIN STEIN 1905). The first correct mathematical construction of a Markov process with continuous trajectories was given by N. WIENER in 1923. (This process is often called the Wiener process.) The general theory of Markov processes was developed in the 1930's and 1940's by A. N. KOL MOGOROV, W. FELLER, W. DOEBLlN, P. LEVY, J. L. DOOB, and others. During the past ten years the theory of Markov processes has entered a new period of intensive development. The methods of the theory of semigroups of linear operators made possible further progress in the classification of Markov processes by their infinitesimal characteristics. The broad classes of Markov processes with continuous trajectories be came the main object of study. The connections between Markov pro cesses and classical analysis were further developed. It has become possible not only to apply the results and methods of analysis to the problems of probability theory, but also to investigate analytic problems using probabilistic methods. Remarkable new connections between Markov processes and potential theory were revealed. The foundations of the theory were reviewed critically: the new concept of strong Markov process acquired for the whole theory of Markov processes great importance.

A volume of this nature containing a collection of papers has been brought out to honour a gentleman - a friend and a colleague - whose work has, to a large extent, advanced and popularized the use of stochastic point processes. Professor Srinivasan celebrated his sixt~ first 1:!irth d~ on December 16,1990 and will be retiring as Professor of Applied Mathematics from the Indian Institute of Technolo~, Madras on June 30,1991. In view of his outstanding contributions to the theor~ and applications of stochastic processes over a time span of thirt~ ~ears, it seemed appropriate not to let his birth d~ and retirement pass unnoticed. A s~posium in his honour and the publication of the proceedings appeared to us to be the most natural and sui table ~ to mark the occasion. The Indian Societ~ for ProbabU it~ and Statistics volunteered to organize the S~posium as part of their XII Annual conference in Bomba~. We requested a number of long-time friends, colleagues and former students of Professor Srinivasan to contribute a paper preferabl~ in the area of stochastic processes and their applications. The positive response and the enthusiastic cooperation of these distinguished scientists have resulted in the present collection. The contributions to this volume are divided into four parts: Stochastic Theor~ (2 articles), P~sics (6 articles), Biolo~ (4 articles) and Operations Research (12 articles). In addition the ke~note address delivered b~ Professor Srinivasan in the S~posium is also included.

This title considers the special of random processes known as semi-Markov processes. These possess the Markov property with respect to any intrinsic Markov time such as the first exit time from an open set or a finite iteration of these times. The class of semi-Markov processes includes strong Markov processes, Lévy and Smith stepped semi-Markov processes, and some other subclasses. Extensive coverage is devoted to non-Markovian semi-Markov processes with continuous trajectories and, in particular, to semi-Markov diffusion processes. Readers looking to enrich their knowledge on Markov processes will find this book a valuable resource.

Markov processes are among the most important stochastic processes for both theory and applications. This book develops the general theory of these processes, and applies this theory to various special examples. The initial chapter is devoted to the most important classical example - one dimensional Brownian motion. This, together with a chapter on continuous time Markov chains, provides the motivation for the general setup based on semigroups and generators. Chapters on stochastic calculus and probabilistic potential theory give an introduction to some of the key areas of application of Brownian motion and its relatives. A chapter on interacting particle systems treats a more recently developed class of Markov processes that have as their origin problems in physics and biology. This is a textbook for a graduate course that can follow one that covers basic probabilistic limit theorems and discrete time processes.

Semi-Markov Processes: Applications in System Reliability and Maintenance

Conditional Markov processes and their application to the theory of optimal control

Conditional Markov Processes and Their Application to the Theory of Optimal Control

Continuous Time Markov Processes

Finite Markov Processes and Their Applications

This book is a prototype providing new insight into Markovian dependence via the cycle decompositions. It presents a systematic account of a class of stochastic processes known as cycle (or circuit) processes - so-called because they may be defined by directed cycles. These processes have special and important properties through the interaction between the geometric properties of the trajectories and the algebraic characterization of the Markov process. An important application of this approach is the insight it provides to electrical networks and the duality principle of networks. In particular, it provides an entirely new approach to infinite electrical networks and their applications in topics as diverse as random walks, the classification of Riemann surfaces, and to operator theory. The second edition of this book adds new advances to many directions, which reveal wide-ranging interpretations of the cycle representations like homologic decompositions, orthogonality equations, Fourier series, semigroup equations, and disintegration of measures. The versatility of these interpretations is consequently motivated by the existence of algebraic-topological principles in the fundamentals of the cycle representations. This book contains chapter summaries as well as a number of detailed illustrations. Review of the earlier edition: "This is a very useful monograph which avoids ready ways and opens new research perspectives. It will certainly stimulate further work, especially on the interplay of algebraic and geometrical aspects of Markovian dependence and its generalizations." Math Reviews

Reaches the forefront of research in the construction theory of denumerable Markov processes and gives impetus to the development of probability theory. Introduces Markov processes and their construction; surveys research in the field; and presents the author's original results, which include complete solutions to some important problems, many published here for the first time in English. Complete solutions are given for two key construction problems: birth-death processes and two-sided birth-death processes.

Comprehensive presentation of the technical aspects and applications of the theory of structured dependence between random processes.

Clear, rigorous, and intuitive, Markov Processes provides a bridge from an undergraduate probability course to a course in stochastic processes and also as a reference for those that want to see detailed proofs of the theorems of Markov processes. It contains copious computational examples that motivate and illustrate the theorems. The text is desi

Numerical Solution of Markov Chains

Semi-Markov Chains and Hidden Semi-Markov Models toward Applications

Finite Markov Chains

Markov Chains

Theory and Applications

Onishchik, A. A. Kirillov, and E. B. Vinberg, who obtained their first results on Lie groups in Dynkin's seminar. At a later stage, the work of the seminar was greatly enriched by the active participation of 1. 1. Pyatetskii Shapiro. As already noted, Dynkin started to work in probability as far back as his undergraduate studies. In fact, his first published paper deals with a problem arising in Markov chain theory. The most significant among his earliest probabilistic results concern sufficient statistics. In [15] and [17], Dynkin described all families of one-dimensional probability distributions admitting non-trivial sufficient statistics. These papers have considerably influenced the subsequent research in this field. But Dynkin's most famous results in probability concern the theory of Markov processes. Following Kolmogorov, Feller, Doob and Ito, Dynkin opened a new chapter in the theory of Markov processes. He created the fundamental concept of a Markov process as a family of measures corresponding to var ious initial times and states and he defined time homogeneous processes in terms of the shift operators ()t. In a joint paper with student A.

This graduate-level text and reference in probability, with numerous applications to several fields of science, presents nonmeasure-theoretic introduction to theory of Markov processes. The work also covers mathematical models based on the theory, employed in various applied fields. Prerequisites are a knowledge of elementary probability theory, mathematical statistics, and analysis. Appendixes. Bibliographies. 1960 edition.

This book presents an algebraic development of the theory of countable state space Markov chains with discrete- and continuous-time parameters. A Markov chain is a stochastic process characterized by the Markov prop erty that the distribution of future depends only on the current state, not on the whole history. Despite its simple form of dependency, the Markov property has enabled us to develop a rich system of concepts and theorems and to derive many results that are useful in applications. In fact, the areas that can be modeled, with varying degrees of success, by Markov chains are vast and are still expanding. The aim of this book is a discussion of the time-dependent behavior, called the transient behavior, of Markov chains. From the practical point of view, when modeling a stochastic system by a Markov chain, there are many instances in which time-limiting results such as stationary distributions have no meaning. Or, even when the stationary distribution is of some importance, it is often dangerous to use the stationary result alone without knowing the transient behavior of the Markov chain. Not many books have paid much attention to this topic, despite its obvious importance.

The book presents new methods of asymptotic analysis for nonlinearly perturbed semi-Markov processes with a finite phase space. These methods are based on special time-space screening procedures for sequential phase space reduction of semi-Markov processes combined with the systematical use of operational calculus for Laurent asymptotic expansions. Effective recurrent algorithms are composed for getting asymptotic expansions, without and with explicit upper bounds for remainders, for power moments of hitting times, stationary and conditional quasi-stationary distributions for nonlinearly perturbed semi-Markov processes. These results are illustrated by asymptotic expansions for birth-death-type semi-Markov processes, which play an important role in various applications. The book will be a useful contribution to the continuing intensive studies in the area. It is an essential reference for theoretical and applied researchers in the field of stochastic processes and their applications that will contribute to continuing extensive studies in the area and remain relevant for years to come.

An Introduction

Semi-Markov Processes and Reliability

Elements of the Theory of Markov Processes and Their Applications

Nonlinearly Perturbed Semi-Markov Processes

This book is the second volume of a two-volume monograph devoted to the study of limit and ergodic theorems for regularly and singularly perturbed Markov chains, semi-Markov processes, and multi-alternating regenerative processes with semi-Markov modulation. The second volume presents a complete classification of ergodic theorems for alternating regenerative processes, including more than twenty-five such theorems. The text addresses new asymptotic recurrent algorithms of phase space reduction for multi-alternating regenerative processes modulating by regularly and singularly perturbed finite semi-Markov processes. It also features a new study of super-long, long, and short time ergodic theorems for these processes. The book also contains a comprehensive bibliography of major works in the field. It provides an effective reference for both graduate students as well as theoretical and applied researchers studying stochastic processes and their applications.

Building upon the previous editions, this textbook is a first course in stochastic processes taken by undergraduate and graduate students (MS and PhD students from math, statistics, economics, computer science, engineering, and finance departments) who have had a course in probability theory. It covers Markov chains in discrete and continuous time, Poisson processes, renewal processes, martingales, and option pricing. One can only learn a subject by seeing it in action, so there are a large number of examples and more than 300 carefully chosen exercises to deepen the reader's understanding. Drawing from teaching experience and student feedback, there are many new examples and problems with solutions that use TI-83 to eliminate the tedious details of solving linear equations by hand, and the collection of exercises is much improved, with many more biological examples. Originally included in previous editions, material too advanced for this first course in stochastic processes has been eliminated while treatment of other topics useful for applications has been expanded. In addition, the ordering of topics has been improved; for example, the difficult subject of martingales is delayed until its usefulness can be applied in the treatment of mathematical finance.

The report contains an exhaustive list of references in the theory of Markov renewal processes, semi-Markov processes and their applications. Both published papers and technical reports have been listed. (Author).

At first there was the Markov property. The theory of stochastic processes, which can be considered as an exten sion of probability theory, allows the modeling of the evolution of systems through the time. It cannot be properly understood just as pure mathemat ics, separated from the body of experience and examples that have brought it to life. The theory of stochastic processes entered a period of intensive develop ment, which is not finished yet, when the idea of the Markov property was brought in. Not even a serious study of the renewal processes is possible without using the strong tool of Markov processes. The modern theory of Markov processes has its origins in the studies by A. A: Markov (1856-1922) of sequences of experiments "connected in a chain" and in the attempts to describe mathematically the physical phenomenon known as Brownian mo tion. Later, many generalizations (in fact all kinds of weakenings of the Markov property) of Markov type stochastic processes were proposed. Some of them have led to new classes of stochastic processes and useful applications. Let us mention some of them: systems with complete connections [90, 91, 45, 86]; K-dependent Markov processes [44]; semi-Markov processes, and so forth. The semi-Markov processes generalize the renewal processes as well as the Markov jump processes and have numerous applications, especially in relia bility.

Markov Processes for Stochastic Modeling

Markov Processes

Examples and Applications

Volume 1

Fundamentals of the Theory of Structured Dependence between Stochastic Processes

Here is a work that adds much to the sum of our knowledge in a key area of science today. It is concerned with the estimation of discrete-time semi-Markov and hidden semi-Markov processes. A unique feature of the book is the use of discrete time, especially useful in some specific applications where the time scale is intrinsically discrete.

The models presented in the book are specifically adapted to reliability studies and DNA analysis. The book is mainly intended for applied probabilists and statisticians interested in semi-Markov chains theory, reliability and DNA analysis, and for theoretical oriented reliability and bioinformatics engineers.
This graduate-level text explores the relationship between Markov processes and potential theory, in addition to aspects of the theory of additive functionals. Topics include Markov processes, excessive functions, multiplicative functionals and subprocesses, and additive functionals and their potentials. A concluding chapter examines dual processes and potential theory. 1968 edition.
The general theory of stochastic processes and the more specialized theory of Markov processes evolved enormously in the second half of the last century. In parallel, the theory of controlled Markov chains (or Markov decision processes) was being pioneered by control engineers and operations researchers. Researchers in Markov processes and controlled Markov chains have been, for a long time, aware of the synergies between these two subject areas. However, this may be the first volume dedicated to highlighting these synergies and, almost certainly, it is the first volume that emphasizes the contributions of the vibrant and growing Chinese school of probability. The chapters that appear in this book reflect both the maturity and the vitality of modern day Markov processes and controlled Markov chains. They also will provide an opportunity to trace the connections that have emerged between the work done by members of the Chinese school of probability and the work done by the European, US, Central and South American and Asian scholars.
This book provides a rigorous but elementary introduction to the theory of Markov Processes on a countable state space. It should be accessible to students with a solid undergraduate background in mathematics, including students from engineering, economics, physics, and biology. Topics covered are: Doeblin's theory, general ergodic properties, and continuous time processes. Applications are dispersed throughout the book. In addition, a whole chapter is devoted to reversible processes and the use of their associated Dirichlet forms to estimate the rate of convergence to equilibrium. These results are then applied to the analysis of the Metropolis (a.k.a simulated annealing) algorithm. The corrected and enlarged 2nd edition contains a new chapter in which the author develops computational methods for Markov chains on a finite state space. Most intriguing is the section with a new technique for computing stationary measures, which is applied to derivations of Wilson's algorithm and Kirchoff's formula for spanning trees in a connected graph.
Proceedings of the Symposium held in honour of Professor S.K. Srinivasan at the Indian Institute of Technology Bombay, India, December 27–30, 1990
Understanding Markov Chains
A Working Bibliography of Markov Renewal Processes and Their Applications
Essentials of Stochastic Processes
With Special Emphasis on Rapid Mixing
Clear, rigorous, and intuitive, Markov Processes provides a bridge from an undergraduate probability course to a course in stochastic processes and also as a reference for those that want to see detailed proofs of the theorems of Markov processes. It contains copious computational examples that motivate and illustrate the theorems. The text is designed to be understandable to students who have taken an undergraduate probability course without needing an instructor to fill in any gaps. The book begins with a review of basic probability, then covers the case of finite state, discrete time Markov processes. Building on this, the text deals with the discrete time, infinite state case and provides background for continuous Markov processes with exponential random variables and Poisson processes. It presents continuous Markov processes which include the basic material of Kolmogorov's equations, infinitesimal generators, and explosions. The book concludes with coverage of both discrete and continuous reversible Markov chains. While Markov processes are touched on in probability courses, this book offers the opportunity to concentrate on the topic when additional study is required. It discusses how Markov processes are applied in a number of fields, including economics, physics, and mathematical biology. The book fills the gap between a calculus based probability course, normally taken as an upper level undergraduate course, and a course in stochastic processes, which is typically a graduate course.
This text on stochastic processes and their applications is based on a set of lectures given during the past several years at the University of California, Santa Barbara (UCSB). It is an introductory graduate course designed for classroom purposes. Its objective is to provide graduate students of statistics with an overview of some basic methods and techniques in the theory of stochastic processes. The only prerequisites are some rudiments of measure and integration theory and an intermediate course in probability theory. There are more than 50 examples and applications and 243 problems and complements which appear at the end of each chapter. The book consists of 10 chapters. Basic concepts and definitions are pro vided in Chapter 1. This chapter also contains a number of motivating ex amples and applications illustrating the practical use of the concepts. The last five sections are devoted to topics such as separability, continuity, and measurability of random processes, which are discussed in some detail. The concept of a simple point process on R+ is introduced in Chapter 2. Using the coupling inequality and Le Cam's lemma, it is shown that if its counting function is stochastically continuous and has independent increments, the point process is Poisson. When the counting function is Markovian, the sequence of arrival times is also a Markov process. Some related topics such as independent thinning and marked point processes are also discussed. In the final section, an application of these results to flood modeling is presented.
Semi-Markov Processes: Applications in System Reliability and Maintenance is a modern view of discrete state space and continuous time semi-Markov processes and their applications in reliability and maintenance. The book explains how to construct semi-Markov models and discusses the different reliability parameters and characteristics that can be obtained from those models. The book is a useful resource for mathematicians, engineering practitioners, and PhD and MSc students who want to understand the basic concepts and results of semi-Markov process theory. Clearly defines the properties and theorems from discrete state Semi-Markov Process (SMP) theory. Describes the method behind constructing Semi-Markov (SM) models and SM decision models in the field of reliability and maintenance. Provides numerous individual versions of SM models, including the most recent and their impact on system reliability and maintenance.
Self-contained treatment covers both theory and applications. Topics include the fundamental role of homogeneous infinite Markov chains in the mathematical modeling of psychology and genetics. 1980 edition.
A Study of Processes Associated with a Finite Markov Chain
Their Use in Reliability and DNA Analysis
With a New Appendix "Generalization of a Fundamental Matrix"
Stochastic Processes and their Applications
An Introduction to Finite Markov Processes
Fundamentals of Queueing Theory, 2nd Edition Donald Gross and Carl M. Harris A graduate text and reference treating queueing theory from the development of standard models to applications. The emphasis is on real analysis of queueing systems, applications, and problem solving. It has been brought up-to-date by modernizing older treatments. 1985 (0 471-89067-7) 475 pp. Multivariate Descriptive Analysis Correspondence Analysis and Related Techniques for Large Matrices Ludovic Lebart, Alain Morineau and Kenneth M. Warwick Presents a set of statistical methods for exploratory analysis of large date sets and categorical data. This unique approach uses graphical aspects of multidimensional scaling techniques within the context of exploratory data analysis. 1984 (0 471-86743-8) 231 pp. Introduction to Linear Regression Analysis Douglas C. Montgomery and Elizabeth A. Peck A definitive introduction to linear regression analysis covering basic topics as well as recent approaches in the field. It blends theory and application in a way that enables readers to apply regression methodology in a variety of practical settings. Many detailed examples drawn directly from various fields of engineering, physical science, and the management sciences provide clear guidance to the use of the techniques. The interface with widely available computer programs for regression analysis is illustrated throughout with numerous actual computer printouts. 1982 (0 471-05850-5) 504 pp.
This book is an introduction to the modern approach to the theory of Markov chains. The main goal of this approach is to determine the rate of convergence of a Markov chain to the stationary distribution as a function of the size and geometry of the state space. The authors develop the key tools for estimating convergence times, including coupling, strong stationary times, and spectral methods. Whenever possible, probabilistic methods are emphasized. The book includes many examples and provides brief introductions to some central models of statistical mechanics. Also provided are accounts of random walks on networks, including hitting and cover times, and analyses of several methods of shuffling cards. As a prerequisite, the authors assume a modest understanding of probability theory and linear algebra at an undergraduate level. Markov Chains and Mixing Times is meant to bring the excitement of this active area of research to a wide audience.
Limit Theorems for Rare-Event Times and Processes
Ergodic Theorems for Multi-Alternating Regenerative Processes
On the Identifiability Problem for Functions of Finite Markov Chains
Perturbed Semi-Markov Type Processes II
Markov Processes and Potential Theory