Lecture Notes Markov Chains

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Lecture Notes Markov Chains ***2025-02-20***

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Lectures on Contemporary Probability Lecture Notes on Limit Theorems for Markov Chain Transition ProbabilitiesLecture Notes on Limit Theorems for Markov Chain Transition Probability FunctionsLecture Notes on Limit Theorems for Markov Chain Transition ProbabilitiesLimit Theorems for Markov Chain Transition Probabilities : Lecture NotesSemi-Markov Chains and Hidden Semi-Markov Models toward ApplicationsTheir Use in Reliability and DNA Analysis
This book shows how techniques from the perturbation theory of operators, applied to a quasi-compact positive kernel, may be used to obtain limit theorems for Markov chains or to describe stochastic properties of dynamical systems. A general framework for this method is given and then applied to treat several specific cases. An essential element of this work is the description of the peripheral spectra of a quasi-compact Markov kernel and of its Fourier-Laplace perturbations. This is first done in the ergodic but non-mixing case. This work is extended by the second author to the non-ergodic case. The only prerequisites for this book are a knowledge of the basic techniques of probability theory and of notions of elementary functional analysis.
Markov Paths, Loops and Fields Carleton University, Department of Mathematics
The purpose of these notes is to explore some simple relations between Markovian path and loop measures, the Poissonian ensembles of loops they determine, their occupation fields, uniform spanning trees, determinants, and Gaussian Markov fields such as the free field. These relations are first studied in complete generality for the finite discrete setting, then partly generalized to specific examples in infinite and continuous spaces.
Interactive Markov Chains Springer
Markov Chains are widely used as stochastic models to study a broad spectrum of system performance and dependability characteristics. This monograph is devoted to compositional specification and analysis of Markov chains. Based on principles known from process algebra, the author

systematically develops an algebra of interactive Markov chains. By presenting a number of distinguishing results, of both theoretical and practical nature, the author substantiates the claim that interactive Markov chains are more than just another formalism: Among other, an algebraic theory of interactive Markov chains is developed, devise algorithms to mechanize compositional aggregation are presented, and state spaces of several million states resulting from the study of an ordinary telefone system are analyzed.

Semi-Markov Chains and Hidden Semi-Markov Models toward Applications IMS Lecture Notes on Limit Theorems for Markov Chain Transition ProbabilitiesLecture Notes on Limit Theorems for Markov Chain Transition Probability FunctionsLecture Notes on Limit Theorems for Markov Chain Transition ProbabilitiesLimit Theorems for Markov Chain Transition Probabilities : Lecture NotesSemi-Markov Chains and Hidden Semi-Markov Models toward ApplicationsTheir Use in Reliability and DNA AnalysisSpringer Science & Business Media

Introduction to Ergodic rates for Markov chains and processes Springer Science & Business Media

Stochastic processes are mathematical models of random phenomena that evolve according to prescribed dynamics. Processes commonly used in applications are Markov chains in discrete and continuous time, renewal and regenerative processes, Poisson processes, and Brownian motion. This volume gives an in-depth description of the structure and basic properties of these stochastic processes. A main focus is on equilibrium distributions, strong laws of large numbers, and ordinary and functional central limit theorems for cost and performance parameters. Although these results differ for various processes, they have a common trait of being limit theorems for processes with regenerative increments. Extensive examples and exercises show how to formulate stochastic models of systems as functions of a system's data and dynamics, and how to represent and analyze cost and performance measures. Topics include stochastic networks, spatial and space-time Poisson processes, queueing, reversible processes, simulation, Brownian approximations, and varied Markovian models. The technical level of the volume is between that of introductory texts that focus on highlights of applied stochastic processes, and advanced texts that focus on theoretical aspects of processes.

Understanding Markov Chains Universitätsverlag Potsdam

The present lecture notes aim for an introduction to the ergodic behaviour of Markov Processes and addresses graduate students, post-graduate students and interested readers. Different tools and methods for the study of upper bounds on uniform and weak ergodic rates of Markov Processes are introduced. These techniques are then applied to study limit theorems for functionals of Markov processes. This lecture course originates in two mini courses held at University of Potsdam, Technical University of Berlin and Humboldt University in spring 2013 and Ritsumameikan University in summer 2013. Alexei Kulik, Doctor of Sciences, is a Leading researcher at the Institute of Mathematics of Ukrainian National Academy of Sciences.

Stochastic Processes and Their First Passage Times Cambridge University Press

Traditionally, models and methods for the analysis of the functional correctness of reactive systems, and those for the analysis of their performance (and - pendability) aspects, have been studied by di?erent research communities. This has resulted in the development of successful, but distinct and largely unrelated modeling and analysis techniques for both domains. In many modern systems, however, the di?erence between their functional features and their performance properties has become blurred, as relevant functionalities become inextricably linked to performance aspects, e.g. isochronous data transfer for live video tra- mission. During the last decade, this trend has motivated an increased interest in c- bining insights and results from the ?eld of formal methods – traditionally - cused on functionality – with techniques for performance modeling and analysis. Prominent examples of this cross-fertilization are extensions of process algebra and Petri nets that allow for the automatic generation of performance models, the use of formal proof techniques to assess the correctness of randomized - gorithms, and extensions of model checking techniques to analyze performance requirements automatically. We believe that these developments markthe - ginning of a new paradigm for the modeling and analysis of systems in which qualitative and quantitative aspects are studied from an integrated perspective. We are convinced that the further worktowards the realization of this goal will be a growing source of inspiration and progress for both communities.

Innovations and Applications American Mathematical Soc.

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.

Markov Chains and Mixing Times Springer

Communication networks underpin our modern world, and provide fascinating and challenging examples of large-scale stochastic systems. Randomness arises in communication systems at many levels: for example, the initiation and termination times of calls in a telephone network, or the statistical structure of the arrival streams of packets at routers in the Internet. How can routing, flow

control and connection acceptance algorithms be designed to work well in uncertain and random environments? This compact introduction illustrates how stochastic models can be used to shed light on important issues in the design and control of communication networks. It will appeal to readers with a mathematical background wishing to understand this important area of application, and to those with an engineering background who want to grasp the underlying mathematical theory. Each chapter ends with exercises and suggestions for further reading.

Lectures on the Coupling Method American Mathematical Soc.

This volume contains recent information on topics of fundamental importance in comparative endocrinology and reproduction. It comprises 35 chapters on the following topics: hypothalamus and pituitary, gonads and reproduction, pineal gland, hormones and general metabolism. The book will be a valuable source of recent information and reference for students, teachers and scientists engaged in teaching and research in comparative endocrinology and reproduction.

Markov Set-Chains American Mathematical Soc.

Based on lectures and computer labs held at the IAS/Park City Mathematics Institute, this book presents areas of current research in modern probability that are accessible to undergraduate students. The subjects include: random walks, Brownian motion, card shuffling, spanning trees, and Markov chain Monte Carlo. There are computer simulations for random walks, Markov chains, stochastic differential equations as applied to finance, and other topics.

Essentials of Stochastic Processes World Scientific

Markov Chain Monte Carlo (MCMC) originated in statistical physics, but has spilled over into various application areas, leading to a corresponding variety of techniques and methods. That variety stimulates new ideas and developments from many different places, and there is much to be gained from cross-fertilization. This book presents five expository essays by leaders in the field, drawing from perspectives in physics, statistics and genetics, and showing how different aspects of MCMC come to the fore in different contexts. The essays derive from tutorial lectures at an interdisciplinary program at the Institute for Mathematical Sciences, Singapore, which exploited the exciting ways in which MCMC spreads across different disciplines.

Markov Chain Monte Carlo Cambridge University Press

Stochastic processes are found in probabilistic systems that evolve with time. Discrete stochastic processes change by only integer time steps (for some time scale), or are characterized by discrete occurrences at arbitrary times. Discrete Stochastic Processes helps the reader develop the understanding and intuition necessary to apply stochastic process theory in engineering, science and operations research. The book approaches the subject via many simple examples which build insight into the structure of stochastic processes and the general effect of these phenomena in real systems. The book presents mathematical ideas without recourse to measure theory, using only minimal mathematical analysis. In the proofs and explanations, clarity is favored over formal rigor, and simplicity over generality. Numerous examples are given to show how results fail to hold

when all the conditions are not satisfied. Audience: An excellent textbook for a graduate level course in engineering and operations research. Also an invaluable reference for all those requiring a deeper understanding of the subject.

Innovations and Applications

Springer Science & Business Media

Probability theory, like much of mathematics, is indebted to physics as a source of problems and intuition for solving these problems. Unfortunately, the level of abstraction of current mathematics often makes it difficult for anyone but an expert to appreciate this fact. Random Walks and electric networks looks at the interplay of physics and mathematics in terms of an example—the relation between elementary electric network theory and random walks —where the mathematics involved is at the college level.

Stochastic Epidemic Models with Inference Springer

This textbook introduces the theory of stochastic processes, that is, randomness which proceeds in time. Using concrete examples like repeated gambling and jumping frogs, it presents fundamental mathematical results through simple, clear, logical theorems and examples. It covers in detail such essential material as Markov chain recurrence criteria, the Markov chain convergence theorem, and optional stopping theorems for martingales. The final chapter provides a brief introduction to Brownian motion, Markov processes in continuous time and space, Poisson processes, and renewal theory.Interspersed throughout are applications to such topics as gambler's ruin probabilities, random walks on graphs, sequence waiting times, branching processes, stock option pricing, and Markov Chain Monte Carlo (MCMC) algorithms.The focus is always on making the theory as well-motivated and accessible as possible, to allow students and readers to learn this fascinating subject as easily and painlessly as possible.

Stochastic Networks Cambridge University Press

Markov Chain Monte Carlo (MCMC) originated in statistical physics, but has spilled over into various application areas, leading to a corresponding variety of techniques and methods. That variety stimulates new ideas and developments from many different places, and there is much to be gained from cross-fertilization. This book presents five expository essays by leaders in the field, drawing from perspectives in physics, statistics and genetics, and showing how different aspects of MCMC come to the fore in different contexts. The essays derive from tutorial lectures at an interdisciplinary program at the Institute for Mathematical Sciences, Singapore, which exploited the exciting ways in which MCMC spreads across different disciplines. Contents:Introduction to Markov Chain Monte Carlo Simulations and Their Statistical Analysis (B A Berg)An Introduction to Monte Carlo Methods in Statistical Physics (D P Landau)Notes on Perfect Simulation (W S Kendall)Sequential Monte Carlo Methods and Their Applications (R Chen)MCMC in the Analysis of Genetic Data on Pedigrees (E A Thompson) Readership: Academic researchers in physics, statistics and bioinformatics. Keywords:Markov Chain Monte Carlo;Simulation Physics;Genetics;Perfect Simulation;Sequential Monte CarloKey Features:Exposition at graduate student level forms an excellent introduction for beginning PhD studentsContains

descriptions of the latest simulation physics techniques in MCMCPresents a survey of perfect simulation methodsProvides a careful treatment of sequential methodsIncludes a case study of MCMC applied in genetics

Stein's Method Cambridge University Press

This text is designed for an introductory probability course at the university level for sophomores, juniors, and seniors in mathematics, physical and social sciences, engineering, and computer science. It presents a thorough treatment of ideas and techniques necessary for a firm understanding of the subject. The text is also recommended for use in discrete probability courses. The material is organized so that the discrete and continuous probability discussions are presented in a separate, but parallel, manner. This organization does not emphasize an overly rigorous or formal view of probability and therefore offers some strong pedagogical value. Hence, the discrete discussions can sometimes serve to motivate the more abstract continuous probability discussions. Features: Key ideas are developed in a somewhat leisurely style, providing a variety of interesting applications to probability and showing some nonintuitive ideas. Over 600 exercises provide the opportunity for practicing skills and developing a sound understanding of ideas. Numerous historical comments deal with the development of discrete probability. The text includes many computer programs that illustrate the algorithms or the methods of computation for important problems. The book is a beautiful introduction to probability theory at the beginning level. The book contains a lot of examples and an easy development of theory without any sacrifice of rigor, keeping the abstraction to a minimal level. It is indeed a valuable addition to the study of probability theory. -- Zentralblatt MATH

Lecture Notes Springer

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

Limit Theorems for Markov Chain Transition Probabilities : Lecture Notes Courier Corporation

This book evolved from several stacks of lecture notes written over a decade and given in classes at slightly varying levels. In transforming the over lapping material into a book, I aimed at presenting some of the best features of the subject with a minimum of prerequisities and technicalities. (Needless to say, one man's technicality is another's professionalism.) But a text frozen in print does not allow for the latitude of the classroom; and the tendency to expand becomes harder to curb without the constraints of time and audience. The result is that this volume contains more topics and details than I had intended, but I hope the forest is still visible with the trees. The book begins at the beginning with the Markov property, followed quickly by the introduction of option al times and martingales. These three topics in the discrete parameter setting are fully discussed in my book A Course In Probability Theory (second edition, Academic Press, 1974). The latter will be referred to throughout this book as the Course, and may be considered as a general background; its specific use is limited to the mate rial on discrete parameter martingale theory cited in § 1. 4. Apart from this and some dispensable references to Markov chains as examples, the book is self-contained.

Introduction to Probability Cambridge University Press
The usefulness of from the of techniques perturbation theory operators, to kernel for limit theorems for a applied quasi-compact positive Q, obtaining Markov chains for stochastic of or dynamical by describing properties systems, of Perron-Frobenius has been demonstrated in several All use a operator, papers. these works share the features the features that must be same specific general ; used in each stem from the nature of the functional particular case precise space where the of is and from the number of quasi-compactness Q proved eigenvalues of of modulus 1. We here a functional framework for Q give general analytical this method and we the aforementioned behaviour within it. It asymptotic prove is worth that this framework is to allow the unified noticing sufficiently general treatment of all the cases considered in the literature the previously specific ; characters of model translate into the verification of of simple hypotheses every a functional nature. When to Markov kernels or to Perr- applied Lipschitz Frobenius associated with these statements rise operators expanding give maps, to new results and the of known The main clarify proofs already properties. of the deals with a Markov kernel for which 1 is a part quasi-compact Q paper of modulus 1. An essential but is not the simple eigenvalue unique eigenvalue element of the work is the of the of peripheral Q precise description spectrums and of its To conclude the the results obtained perturbations.