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OF MATHEMATICS

STOCHASTIC  
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PROBABILITY

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G. George Yin  
Qing Zhang

# Discrete-Time Markov Chains

Two-Time-Scale Methods and  
Applications



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# Discrete Time Markov Chains Two Time Scale Methods And Applications Stochastic Modelling And Applied Probability

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## **Discrete Time Markov Chains Two Time Scale Methods And Applications Stochastic Modelling And Applied Probability:**

**Discrete-Time Markov Chains** G. George Yin, Qing Zhang, 2005-10-04 This book focuses on two time scale Markov chains in discrete time Our motivation stems from existing and emerging applications in optimization and control of complex systems in manufacturing wireless communication and financial engineering Much of our effort in this book is devoted to designing system models arising from various applications analyzing them via analytic and probabilistic techniques and developing feasible computational schemes Our main concern is to reduce the inherent system complexity Although each of the applications has its own distinct characteristics all of them are closely related through the modeling of uncertainty due to jump or switching random processes One of the salient features of this book is the use of multi time scales in Markov processes and their applications Intuitively not all parts or components of a large scale system evolve at the same rate Some of them change rapidly and others vary slowly The different rates of variations allow us to reduce complexity via decomposition and aggregation It would be ideal if we could divide a large system into its smallest irreducible subsystems completely separable from one another and treat each subsystem independently However this is often infeasible in reality due to various physical constraints and other considerations Thus we have to deal with situations in which the systems are only nearly decomposable in the sense that there are weak links among the irreducible subsystems which dictate the occasional regime changes of the system An effective way to treat such near decomposability is time scale separation That is we set up the systems as if there were two time scales fast vs slow xii Preface Following the time scale separation

we use singular perturbation methodology to treat the underlying systems **Engineering Mathematics II** Sergei

Silvestrov, Milica Rančić, 2017-02-10 This book highlights the latest advances in engineering mathematics with a main focus on the mathematical models structures concepts problems and computational methods and algorithms most relevant for applications in modern technologies and engineering It addresses mathematical methods of algebra applied matrix analysis operator analysis probability theory and stochastic processes geometry and computational methods in network analysis data classification ranking and optimisation The individual chapters cover both theory and applications and include a wealth of figures schemes algorithms tables and results of data analysis and simulation Presenting new methods and results reviews of cutting edge research and open problems for future research they equip readers to develop new mathematical methods and concepts of their own and to further compare and analyse the methods and results discussed The book consists of contributed chapters covering research developed as a result of a focused international seminar series on mathematics and applied mathematics and a series of three focused international research workshops on engineering mathematics organised by the Research Environment in Mathematics and Applied Mathematics at Mälardalen University from autumn 2014 to autumn 2015 the International Workshop on Engineering Mathematics for Electromagnetics and Health Technology the

International Workshop on Engineering Mathematics Algebra Analysis and Electromagnetics and the 1st Swedish Estonian International Workshop on Engineering Mathematics Algebra Analysis and Applications It serves as a source of inspiration for a broad spectrum of researchers and research students in applied mathematics as well as in the areas of applications of mathematics considered in the book

**Applied Modeling Techniques and Data Analysis 1** Yiannis Dimotikalis,Alex Karagrigoriou,Christina Parpoula,Christos H. Skiadas,2021-05-11 BIG DATA ARTIFICIAL INTELLIGENCE AND DATA ANALYSIS SET Coordinated by Jacques Janssen Data analysis is a scientific field that continues to grow enormously most notably over the last few decades following rapid growth within the tech industry as well as the wide applicability of computational techniques alongside new advances in analytic tools Modeling enables data analysts to identify relationships make predictions and to understand interpret and visualize the extracted information more strategically This book includes the most recent advances on this topic meeting increasing demand from wide circles of the scientific community Applied Modeling Techniques and Data Analysis 1 is a collective work by a number of leading scientists analysts engineers mathematicians and statisticians working on the front end of data analysis and modeling applications The chapters cover a cross section of current concerns and research interests in the above scientific areas The collected material is divided into appropriate sections to provide the reader with both theoretical and applied information on data analysis methods models and techniques along with appropriate applications

**Perturbed Semi-Markov Type Processes I** Dmitrii Silvestrov,2022-03-25 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

**Continuous-Time Markov Chains and Applications** George G. Yin,Qing Zhang,2012-12-06 This book is concerned with continuous time Markov chains It develops an integrated approach to singularly perturbed Markovian systems and reveals interrelations of stochastic processes and singular perturbations In recent years Markovian formulations have been used routinely for numerous real world systems under uncertainties Quite often the underlying Markov chain is subject to rather frequent fluctuations and the corresponding states are naturally divisible to a number of groups such that the chain fluctuates very rapidly among different states within a group but jumps less frequently from one group to another

Various applications in engineering economics and biological and physical sciences have posed increasing demands on an in depth study of such systems A basic issue common to many different fields is the understanding of the distribution and the structure of the underlying uncertainty Such needs become even more pressing when we deal with complex and or large scale Markovian models whose closed form solutions are usually very difficult to obtain Markov chain a well known subject has been studied by a host of researchers for many years While nonstationary cases have been treated in the literature much emphasis has been on stationary Markov chains and their basic properties such as ergodicity recurrence and stability In contrast this book focuses on singularly perturbed nonstationary Markov chains and their asymptotic properties Singular perturbation theory has a long history and is a powerful tool for a wide variety of applications *Coupling and Ergodic Theorems for Semi-Markov-Type Processes I* Dmitrii Silvestrov, 2025-10-26 Ergodic theorems are a cornerstone of the theory of stochastic processes and their applications This volume delves into ergodic theorems with explicit power and exponential upper bounds for convergence rates focusing on Markov chains renewal processes and regenerative processes The book offers a powerful and constructive probabilistic framework by employing the elegant coupling method in conjunction with test functions Theoretical findings are illustrated with applications to perturbed stochastic networks alternating Markov processes risk processes quasi stationary distributions and the renewal theorem all of which feature explicit convergence rate bounds Many results presented here are groundbreaking appearing in publication for the first time This is the first volume of a two volume monograph dedicated to ergodic theorems While this volume centers on Markovian and regenerative models the second volume extends the scope to semi Markov processes and multi alternating regenerative processes with semi Markov modulation Designed with researchers and advanced students in mind the content is thoughtfully structured by complexity making it suitable for self study or as a resource for upper level coursework Each chapter is self contained and complemented by a comprehensive bibliography ensuring its value as a long lasting reference An essential resource for theoretical and applied research this book significantly contributes to the field of stochastic processes and will remain a key reference for years to come *Perturbed Semi-Markov Type Processes II* Dmitrii Silvestrov, 2022-03-21 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 **Cycle Representations of**

**Markov Processes** Sophia L. Kalpazidou, 2007-03-06 This book provides 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 An important application of this approach is the insight it provides to electrical networks and the duality principle of networks This expanded second edition adds new advances which reveal wide ranging interpretations of cycle representations such as homologic decompositions orthogonality equations Fourier series semigroup equations and disintegration of measures The text includes chapter summaries as well as a number of detailed illustrations

*Control Techniques for Complex Networks* Sean Meyn, 2008 From foundations to state of the art the tools and philosophy you need to build network models

*Nonlinearly Perturbed Semi-Markov Processes* Dmitrii Silvestrov, Sergei Silvestrov, 2017-09-06 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

Continuous-Time Markov Chains and Applications G. George Yin, Qing Zhang, 2012-10-25 This book gives a systematic treatment of singularly perturbed systems that naturally arise in control and optimization queueing networks manufacturing systems and financial engineering It presents results on asymptotic expansions of solutions of Komogorov forward and backward equations properties of functional occupation measures exponential upper bounds and functional limit results for Markov chains with weak and strong interactions To bridge the gap between theory and applications a large portion of the book is devoted to applications in controlled dynamic systems production planning and numerical methods for controlled Markovian systems with large scale and complex structures in the real world problems This second edition has been updated throughout and includes two new chapters on asymptotic expansions of solutions for backward equations and hybrid LQG problems The chapters on analytic and probabilistic properties of two time scale Markov chains have been almost completely rewritten and the notation has been streamlined and simplified This book is written for applied mathematicians engineers operations researchers and applied scientists Selected material from the book can also be used for a one semester advanced graduate level course in applied probability and stochastic processes

*Mathematical Reviews* , 2006      **Catalogs of Courses** University of California, Berkeley, 1994

Includes general and summer catalogs issued between 1878 1879 and 1995 1997      **Current Index to Statistics, Applications, Methods and Theory** ,1996 The Current Index to Statistics CIS is a bibliographic index of publications in statistics probability and related fields      Journal of the American Statistical Association ,2005 A scientific and educational journal not only for professional statisticians but also for economists business executives research directors government officials university professors and others who are seriously interested in the application of statistical methods to practical problems in the development of more useful methods and in the improvement of basic statistical data      **The Handbook of Computer Networks, Key Concepts, Data Transmission, and Digital and Optical Networks** Hossein Bidgoli,2008 A complete and in depth introduction to computer networks and networking In this first volume of The Handbook of Computer Networks readers will get a complete overview of the key concepts of computers networks data transmission and digital and optical networks Providing a comprehensive examination of computer networks the book is designed for both undergraduate students and professionals working in a variety of computer network dependent industries With input from over 270 experts in the field the text offers an easy to follow progression through each topic and focuses on fields and technologies that have widespread application in the real world      **Proceedings** ,1990      Stanford Bulletin ,2006      **Statistical Theory and Method Abstracts** ,2001      **ICASSP '95** ,1995

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