

Markov Decision Processes With Applications To Finance Universitext

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Optimization, Control, and Applications of Stochastic Systems Daniel Hernández-Hernández 2012-08-15 This volume provides a general overview of discrete- and continuous-time Markov control processes and stochastic games, along with a look at the range of applications of stochastic control and some of its recent theoretical developments. These topics include various aspects of dynamic programming, approximation algorithms, and infinite-dimensional linear programming. In all, the work comprises 18 carefully selected papers written by experts in their respective fields. *Optimization, Control, and Applications of Stochastic Systems* will be a valuable resource for all practitioners, researchers, and professionals in applied mathematics and operations research who work in the areas of stochastic control, mathematical finance, queueing theory, and inventory systems. It may also serve as a supplemental text for graduate courses in optimal control and dynamic games.

Operations Research Kuodi Jian 2016-12-28 This book is dedicated to operations research of broad applications, such as improving informational bases of performance measurement with grey relational analysis, application of lean methodologies in a neurosurgery high dependency unit, iteration algorithms in Markov decision processes with state-action-dependent discount factors and unbounded costs, financial feasibility analysis of Natura Rab business case study, and mathematical modeling of isothermal drying and its potential application in the design of the industrial drying regimes of clay products. Operations research is an important topic. In addition to its obvious benefits of winning a war, making most profit in a business endeavor, and constructing a correct mathematical model, it also provides a tool for efficient use of natural resources. Furthermore, both theory and practice of operations research and its related concepts are covered in the book, and a reader can benefit from this balanced coverage.

Examples in Markov Decision Processes A. B. Piunovskiy 2013 This invaluable book provides approximately eighty examples illustrating the theory of controlled discrete-time Markov processes. Except for applications of the theory to real-life problems like stock exchange, queues, gambling, optimal search etc, the main attention is paid to counter-intuitive, unexpected properties of optimization problems. Such examples illustrate the importance of conditions imposed in the theorems on Markov Decision Processes. Many of the examples are based upon examples published earlier in journal articles or textbooks while several other examples are new. The aim was to collect them together in one reference book which should be considered as a complement to existing monographs on Markov decision processes. The book is self-contained and unified in presentation. The main theoretical statements and constructions are provided, and particular examples can be read independently of others. *Examples in Markov Decision Processes* is an essential source of reference for mathematicians and all those who apply the optimal control theory to practical purposes. When studying or using mathematical methods, the researcher must understand what can happen if some of the conditions imposed in rigorous theorems are not satisfied. Many examples confirming the importance of such conditions were published in different journal articles which are often difficult to find. This book brings together examples based upon such sources, along with several new ones. In addition, it indicates the

areas where Markov decision processes can be used. Active researchers can refer to this book on applicability of mathematical methods and theorems. It is also suitable reading for graduate and research students where they will better understand the theory.

Controlled Markov Processes and Viscosity Solutions Wendell H. Fleming 2006-02-04 This book is an introduction to optimal stochastic control for continuous time Markov processes and the theory of viscosity solutions. It covers dynamic programming for deterministic optimal control problems, as well as to the corresponding theory of viscosity solutions. New chapters in this second edition introduce the role of stochastic optimal control in portfolio optimization and in pricing derivatives in incomplete markets and two-controller, zero-sum differential games.

Simulation-based Algorithms for Markov Decision Processes Hyeong Soo Chang 2010-10-19 Markov decision process (MDP) models are widely used for modeling sequential decision-making problems that arise in engineering, economics, computer science, and the social sciences. This book brings the state-of-the-art research together for the first time. It provides practical modeling methods for many real-world problems with high dimensionality or complexity which have not hitherto been treatable with Markov decision processes.

On the process of maintenance decision-making in the offshore operational environment of the oil and gas industry Mario Marcondes Machado 2022-07-08 The overall objective of this research is to develop a decision support framework for preventive maintenance program implementations in the offshore operational environment of the oil and gas industry. The author investigates the problems surrounding the maintenance decision-making process, which elements are systematically identified and categorized, including organizational aspects. The interface with operations is considered in order to promote integration between maintenance and production schedules. The research subjacent objectives have been to identify, among major oil and gas offshore operators, the state-of-practices regarding the maintenance decision-making process and identify, in the literature, the main techniques used for maintenance decisions and optimization in order to propose alternatives for supporting future implementations. Through a Systems Engineering approach, assisted by a literature review, interviews with experts (in Norway and in Brazil), an on-line survey and case studies, the results of this research complement a toolkit for maintenance engineers and managers aiming to facilitate information sharing and interdisciplinary cooperation in the operational environment. Among the results: A concept map for the maintenance decision-making process ontology; A plan for PM program implementations; The suggested cross-sector solution: the minimum equipment list; A Markovian dependability nomogram; and A Markov decision model application.

Constrained Markov Decision Processes Eitan Altman 1999-03-30 This book provides a unified approach for the study of constrained Markov decision processes with a finite state space and unbounded costs. Unlike the single controller case considered in many other books, the author considers a single controller with several objectives, such as minimizing delays and loss, probabilities, and maximization of throughputs. It is desirable to design a controller that minimizes one cost objective, subject to inequality constraints on other cost objectives. This framework describes dynamic decision problems arising frequently in many engineering fields. A

thorough overview of these applications is presented in the introduction. The book is then divided into three sections that build upon each other. The first part explains the theory for the finite state space. The author characterizes the set of achievable expected occupation measures as well as performance vectors, and identifies simple classes of policies among which optimal policies exist. This allows the reduction of the original dynamic into a linear program. A Lagrangian approach is then used to derive the dual linear program using dynamic programming techniques. In the second part, these results are extended to the infinite state space and action spaces. The author provides two frameworks: the case where costs are bounded below and the contracting framework. The third part builds upon the results of the first two parts and examines asymptotical results of the convergence of both the value and the policies in the time horizon and in the discount factor. Finally, several state truncation algorithms that enable the approximation of the solution of the original control problem via finite linear programs are given.

Simulation-based Algorithms for Markov Decision Processes Hyeong Soo Chang 2007-02-13 Markov decision process (MDP) models are widely used for modeling sequential decision-making problems that arise in engineering, economics, computer science, and the social sciences. This book brings the state-of-the-art research together for the first time. It provides practical modeling methods for many real-world problems with high dimensionality or complexity which have not hitherto been treatable with Markov decision processes.

Decision-making Shyama Prasad Mukherjee 2021-11-29 This book presents a comprehensive and updated account of concepts, methods and techniques of decision-making. It has derived strength from advances in several branches of knowledge including mathematics, computer science, behavioural economics, logic and related areas, besides statistical decision theory. The reader will find here an integrated picture of concepts, methods and analytics to aid decision-making in a wide array of situations, ranging from classical optimization to computational social choice and organizational responses to emergency and stress. Decision-making: Concepts, Methods and Techniques lucidly presents the decision-making tools aided and strengthened by decision theory in all its domains and dimensions, at the same time emphasizing the role of human behaviour in all its diversity.

Reinforcement Learning, second edition Richard S. Sutton 2018-11-13 The significantly expanded and updated new edition of a widely used text on reinforcement learning, one of the most active research areas in artificial intelligence. Reinforcement learning, one of the most active research areas in artificial intelligence, is a computational approach to learning whereby an agent tries to maximize the total amount of reward it receives while interacting with a complex, uncertain environment. In Reinforcement Learning, Richard Sutton and Andrew Barto provide a clear and simple account of the field's key ideas and algorithms. This second edition has been significantly expanded and updated, presenting new topics and updating coverage of other topics. Like the first edition, this second edition focuses on core online learning algorithms, with the more mathematical material set off in shaded boxes. Part I covers as much of reinforcement learning as possible without going beyond the tabular case for which exact solutions can be found. Many algorithms presented in this part are new to the second edition, including UCB, Expected Sarsa, and Double Learning. Part II extends these ideas to function approximation, with new sections on such topics as artificial neural networks and the Fourier basis, and offers expanded treatment of off-policy learning and policy-gradient methods. Part III has new chapters on reinforcement learning's relationships to psychology and neuroscience, as well as an updated case-studies chapter including AlphaGo and AlphaGo Zero, Atari game playing, and IBM Watson's wagering strategy. The final chapter discusses the future societal impacts of reinforcement learning.

Stochastic Model Checking Anne Remke 2014-11-03 The use of stochastic models in computer science is wide spread, for instance in performance modeling, analysis of randomized algorithms and communication protocols which form the structure of the Internet. Stochastic model checking is an important field in stochastic analysis. It has rapidly gained popularity, due to its

powerful and systematic methods to model and analyze stochastic systems. This book presents 7 tutorial lectures given by leading scientists at the ROCKS Autumn School on Stochastic Model Checking, held in Vahrn, Italy, in October 2012. The 7 chapters of this tutorial went through two rounds of reviewing and improvement and are summarizing the state-of-the-art in the field, centered around the tree areas of stochastic models, abstraction techniques and stochastic model checking.

Planning with Markov Decision Processes Mausam Natarajan 2022-06-01 Markov Decision Processes (MDPs) are widely popular in Artificial Intelligence for modeling sequential decision-making scenarios with probabilistic dynamics. They are the framework of choice when designing an intelligent agent that needs to act for long periods of time in an environment where its actions could have uncertain outcomes. MDPs are actively researched in two related subareas of AI, probabilistic planning and reinforcement learning. Probabilistic planning assumes known models for the agent's goals and domain dynamics, and focuses on determining how the agent should behave to achieve its objectives. On the other hand, reinforcement learning additionally learns these models based on the feedback the agent gets from the environment. This book provides a concise introduction to the use of MDPs for solving probabilistic planning problems, with an emphasis on the algorithmic perspective. It covers the whole spectrum of the field, from the basics to state-of-the-art optimal and approximation algorithms. We first describe the theoretical foundations of MDPs and the fundamental solution techniques for them. We then discuss modern optimal algorithms based on heuristic search and the use of structured representations. A major focus of the book is on the numerous approximation schemes for MDPs that have been developed in the AI literature. These include determinization-based approaches, sampling techniques, heuristic functions, dimensionality reduction, and hierarchical representations. Finally, we briefly introduce several extensions of the standard MDP classes that model and solve even more complex planning problems. Table of Contents: Introduction / MDPs / Fundamental Algorithms / Heuristic Search Algorithms / Symbolic Algorithms / Approximation Algorithms / Advanced Notes

Spatial Statistics and Spatio-Temporal Data Michael Sherman 2011-01-06 In the spatial or spatio-temporal context, specifying the correct covariance function is fundamental to obtain efficient predictions, and to understand the underlying physical process of interest. This book focuses on covariance and variogram functions, their role in prediction, and appropriate choice of these functions in applications. Both recent and more established methods are illustrated to assess many common assumptions on these functions, such as, isotropy, separability, symmetry, and intrinsic correlation. After an extensive introduction to spatial methodology, the book details the effects of common covariance assumptions and addresses methods to assess the appropriateness of such assumptions for various data structures. Key features: An extensive introduction to spatial methodology including a survey of spatial covariance functions and their use in spatial prediction (kriging) is given. Explores methodology for assessing the appropriateness of assumptions on covariance functions in the spatial, spatio-temporal, multivariate spatial, and point pattern settings. Provides illustrations of all methods based on data and simulation experiments to demonstrate all methodology and guide to proper usage of all methods. Presents a brief survey of spatial and spatio-temporal models, highlighting the Gaussian case and the binary data setting, along with the different methodologies for estimation and model fitting for these two data structures. Discusses models that allow for anisotropic and nonseparable behaviour in covariance functions in the spatial, spatio-temporal and multivariate settings. Gives an introduction to point pattern models, including testing for randomness, and fitting regular and clustered point patterns. The importance and assessment of isotropy of point patterns is detailed. Statisticians, researchers, and data analysts working with spatial and space-time data will benefit from this book as well as will graduate students with a background in basic statistics following courses in engineering, quantitative ecology or atmospheric science.

Stochastic Processes, Optimization, and Control Theory: Applications in Financial

Engineering, Queueing Networks, and Manufacturing Systems Houmin Yan 2006-09-10

This edited volume contains 16 research articles. It presents recent and pressing issues in stochastic processes, control theory, differential games, optimization, and their applications in finance, manufacturing, queueing networks, and climate control. One of the salient features is that the book is highly multi-disciplinary. The book is dedicated to Professor Suresh Sethi on the occasion of his 60th birthday, in view of his distinguished career.

Markov Decision Processes in Practice Richard J. Boucherie 2017-03-10 This book presents classical Markov Decision Processes (MDP) for real-life applications and optimization. MDP allows users to develop and formally support approximate and simple decision rules, and this book showcases state-of-the-art applications in which MDP was key to the solution approach. The book is divided into six parts. Part 1 is devoted to the state-of-the-art theoretical foundation of MDP, including approximate methods such as policy improvement, successive approximation and infinite state spaces as well as an instructive chapter on Approximate Dynamic Programming. It then continues with five parts of specific and non-exhaustive application areas. Part 2 covers MDP healthcare applications, which includes different screening procedures, appointment scheduling, ambulance scheduling and blood management. Part 3 explores MDP modeling within transportation. This ranges from public to private transportation, from airports and traffic lights to car parking or charging your electric car. Part 4 contains three chapters that illustrates the structure of approximate policies for production or manufacturing structures. In Part 5, communications is highlighted as an important application area for MDP. It includes Gittins indices, down-to-earth call centers and wireless sensor networks. Finally Part 6 is dedicated to financial modeling, offering an instructive review to account for financial portfolios and derivatives under proportional transactional costs. The MDP applications in this book illustrate a variety of both standard and non-standard aspects of MDP modeling and its practical use. This book should appeal to readers for practicing, academic research and educational purposes, with a background in, among others, operations research, mathematics, computer science, and industrial engineering.

The Enchanted April (1922) Elizabeth Von Arnim 2006-03 It began in a woman's club in London on a February afternoon-an uncomfortable club, and a miserable afternoon-when Mrs. Wilkins, who had come down from Hampstead to shop and had lunched at her club, took up The Times from the table in the smoking-room, and running her Ustless eye down the Agony Column saw this:

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.

Modern Trends in Controlled Stochastic Processes: Alexey Piunovskiy 2021-06-04 This book presents state-of-the-art solution methods and applications of stochastic optimal control. It is a collection of extended papers discussed at the traditional Liverpool workshop on controlled

stochastic processes with participants from both the east and the west. New problems are formulated, and progresses of ongoing research are reported. Topics covered in this book include theoretical results and numerical methods for Markov and semi-Markov decision processes, optimal stopping of Markov processes, stochastic games, problems with partial information, optimal filtering, robust control, Q-learning, and self-organizing algorithms. Real-life case studies and applications, e.g., queueing systems, forest management, control of water resources, marketing science, and healthcare, are presented. Scientific researchers and postgraduate students interested in stochastic optimal control,- as well as practitioners will find this book appealing and a valuable reference.

Reinforcement Learning and Stochastic Optimization Warren B. Powell 2022-03-15 REINFORCEMENT LEARNING AND STOCHASTIC OPTIMIZATION Clearing the jungle of stochastic optimization Sequential decision problems, which consist of “decision, information, decision, information,” are ubiquitous, spanning virtually every human activity ranging from business applications, health (personal and public health, and medical decision making), energy, the sciences, all fields of engineering, finance, and e-commerce. The diversity of applications attracted the attention of at least 15 distinct fields of research, using eight distinct notational systems which produced a vast array of analytical tools. A byproduct is that powerful tools developed in one community may be unknown to other communities. Reinforcement Learning and Stochastic Optimization offers a single canonical framework that can model any sequential decision problem using five core components: state variables, decision variables, exogenous information variables, transition function, and objective function. This book highlights twelve types of uncertainty that might enter any model and pulls together the diverse set of methods for making decisions, known as policies, into four fundamental classes that span every method suggested in the academic literature or used in practice. Reinforcement Learning and Stochastic Optimization is the first book to provide a balanced treatment of the different methods for modeling and solving sequential decision problems, following the style used by most books on machine learning, optimization, and simulation. The presentation is designed for readers with a course in probability and statistics, and an interest in modeling and applications. Linear programming is occasionally used for specific problem classes. The book is designed for readers who are new to the field, as well as those with some background in optimization under uncertainty. Throughout this book, readers will find references to over 100 different applications, spanning pure learning problems, dynamic resource allocation problems, general state-dependent problems, and hybrid learning/resource allocation problems such as those that arose in the COVID pandemic. There are 370 exercises, organized into seven groups, ranging from review questions, modeling, computation, problem solving, theory, programming exercises and a “diary problem” that a reader chooses at the beginning of the book, and which is used as a basis for questions throughout the rest of the book.

Markov Chains Wai-Ki Ching 2015-04-05 This new edition of Markov Chains: Models, Algorithms and Applications has been completely reformatted as a text, complete with end-of-chapter exercises, a new focus on management science, new applications of the models, and new examples with applications in financial risk management and modeling of financial data. This book consists of eight chapters. Chapter 1 gives a brief introduction to the classical theory on both discrete and continuous time Markov chains. The relationship between Markov chains of finite states and matrix theory will also be highlighted. Some classical iterative methods for solving linear systems will be introduced for finding the stationary distribution of a Markov chain. The chapter then covers the basic theories and algorithms for hidden Markov models (HMMs) and Markov decision processes (MDPs). Chapter 2 discusses the applications of continuous time Markov chains to model queueing systems and discrete time Markov chain for computing the PageRank, the ranking of websites on the Internet. Chapter 3 studies Markovian models for manufacturing and re-manufacturing systems and presents closed form solutions and fast numerical algorithms for solving the captured systems. In Chapter 4, the authors present a

simple hidden Markov model (HMM) with fast numerical algorithms for estimating the model parameters. An application of the HMM for customer classification is also presented. Chapter 5 discusses Markov decision processes for customer lifetime values. Customer Lifetime Values (CLV) is an important concept and quantity in marketing management. The authors present an approach based on Markov decision processes for the calculation of CLV using real data. Chapter 6 considers higher-order Markov chain models, particularly a class of parsimonious higher-order Markov chain models. Efficient estimation methods for model parameters based on linear programming are presented. Contemporary research results on applications to demand predictions, inventory control and financial risk measurement are also presented. In Chapter 7, a class of parsimonious multivariate Markov models is introduced. Again, efficient estimation methods based on linear programming are presented. Applications to demand predictions, inventory control policy and modeling credit ratings data are discussed. Finally, Chapter 8 revisits hidden Markov models, and the authors present a new class of hidden Markov models with efficient algorithms for estimating the model parameters. Applications to modeling interest rates, credit ratings and default data are discussed. This book is aimed at senior undergraduate students, postgraduate students, professionals, practitioners, and researchers in applied mathematics, computational science, operational research, management science and finance, who are interested in the formulation and computation of queueing networks, Markov chain models and related topics. Readers are expected to have some basic knowledge of probability theory, Markov processes and matrix theory.

Examples in Markov Decision Processes A. B. Piunovskiy 2012 This invaluable book provides approximately eighty examples illustrating the theory of controlled discrete-time Markov processes. Except for applications of the theory to real-life problems like stock exchange, queues, gambling, optimal search etc, the main attention is paid to counter-intuitive, unexpected properties of optimization problems. Such examples illustrate the importance of conditions imposed in the theorems on Markov Decision Processes. Many of the examples are based upon examples published earlier in journal articles or textbooks while several other examples are new. The aim was to collect them together in one reference book which should be considered as a complement to existing monographs on Markov decision processes. The book is self-contained and unified in presentation. The main theoretical statements and constructions are provided, and particular examples can be read independently of others. *Examples in Markov Decision Processes* is an essential source of reference for mathematicians and all those who apply the optimal control theory to practical purposes. When studying or using mathematical methods, the researcher must understand what can happen if some of the conditions imposed in rigorous theorems are not satisfied. Many examples confirming the importance of such conditions were published in different journal articles which are often difficult to find. This book brings together examples based upon such sources, along with several new ones. In addition, it indicates the areas where Markov decision processes can be used. Active researchers can refer to this book on applicability of mathematical methods and theorems. It is also suitable reading for graduate and research students where they will better understand the theory.

Continuous-Time Markov Decision Processes Alexey Piunovskiy 2020-12-11 This book offers a systematic and rigorous treatment of continuous-time Markov decision processes, covering both theory and possible applications to queueing systems, epidemiology, finance, and other fields. Unlike most books on the subject, much attention is paid to problems with functional constraints and the realizability of strategies. Three major methods of investigations are presented, based on dynamic programming, linear programming, and reduction to discrete-time problems. Although the main focus is on models with total (discounted or undiscounted) cost criteria, models with average cost criteria and with impulsive controls are also discussed in depth. The book is self-contained. A separate chapter is devoted to Markov pure jump processes and the appendices collect the requisite background on real analysis and applied probability. All the statements in the main text are proved in detail. Researchers and graduate students in applied probability,

operational research, statistics and engineering will find this monograph interesting, useful and valuable.

Discrete-Time Markov Chains G. George Yin 2006-03-30 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.

Applications of Stochastic Models in Finance Reza Habibi 2014-08-14 This note contains some applications of stochastic models in finance. For example, we survey Markov Decision Processes, Bayesian Networks, Adaptive Control, Black-Scholes Pricing methods. This note involves the change point analysis in some financial models, risk management, portfolio selection and credit scoring in financial institutions. Some papers are too short, however, we have studied an observation.

Decision Theory Models for Applications in Artificial Intelligence: Concepts and Solutions Sucar, L. Enrique 2011-10-31 One of the goals of artificial intelligence (AI) is creating autonomous agents that must make decisions based on uncertain and incomplete information. The goal is to design rational agents that must take the best action given the information available and their goals. *Decision Theory Models for Applications in Artificial Intelligence: Concepts and Solutions* provides an introduction to different types of decision theory techniques, including MDPs, POMDPs, Influence Diagrams, and Reinforcement Learning, and illustrates their application in artificial intelligence. This book provides insights into the advantages and challenges of using decision theory models for developing intelligent systems.

Distributed Sensing and Intelligent Systems Mohamed Elhoseny
Markov Decision Processes in Artificial Intelligence Olivier Sigaud 2013-03-04 Markov Decision Processes (MDPs) are a mathematical framework for modeling sequential decision problems under uncertainty as well as Reinforcement Learning problems. Written by experts in the field, this book provides a global view of current research using MDPs in Artificial Intelligence. It starts with an introductory presentation of the fundamental aspects of MDPs (planning in MDPs, Reinforcement Learning, Partially Observable MDPs, Markov games and the use of non-classical criteria). Then it presents more advanced research trends in the domain and gives some concrete examples using illustrative applications.

Hidden Markov Models in Finance Rogemar S. Mamon 2014-05-14 Since the groundbreaking research of Harry Markowitz into the application of operations research to the optimization of investment portfolios, finance has been one of the most important areas of application of operations research. The use of hidden Markov models (HMMs) has become one of the hottest areas of research for such applications to finance. This handbook offers systemic applications of

different methodologies that have been used for decision making solutions to the financial problems of global markets. As the follow-up to the authors' *Hidden Markov Models in Finance* (2007), this offers the latest research developments and applications of HMMs to finance and other related fields. Amongst the fields of quantitative finance and actuarial science that will be covered are: interest rate theory, fixed-income instruments, currency market, annuity and insurance policies with option-embedded features, investment strategies, commodity markets, energy, high-frequency trading, credit risk, numerical algorithms, financial econometrics and operational risk. *Hidden Markov Models in Finance: Further Developments and Applications, Volume II* presents recent applications and case studies in finance and showcases the formulation of emerging potential applications of new research over the book's 11 chapters. This will benefit not only researchers in financial modeling, but also others in fields such as engineering, the physical sciences and social sciences. Ultimately the handbook should prove to be a valuable resource to dynamic researchers interested in taking full advantage of the power and versatility of HMMs in accurately and efficiently capturing many of the processes in the financial market.

Markov Decision Processes Martin L. Puterman 2014-08-28 The Wiley-Interscience Paperback Series consists of selected books that have been made more accessible to consumers in an effort to increase global appeal and general circulation. With these new unabridged softcover volumes, Wiley hopes to extend the lives of these works by making them available to future generations of statisticians, mathematicians, and scientists. "This text is unique in bringing together so many results hitherto found only in part in other texts and papers. . . . The text is fairly self-contained, inclusive of some basic mathematical results needed, and provides a rich diet of examples, applications, and exercises. The bibliographical material at the end of each chapter is excellent, not only from a historical perspective, but because it is valuable for researchers in acquiring a good perspective of the MDP research potential." —Zentralblatt für Mathematik ". . . it is of great value to advanced-level students, researchers, and professional practitioners of this field to have now a complete volume (with more than 600 pages) devoted to this topic. . . . *Markov Decision Processes: Discrete Stochastic Dynamic Programming* represents an up-to-date, unified, and rigorous treatment of theoretical and computational aspects of discrete-time Markov decision processes." —Journal of the American Statistical Association

Markov Decision Processes with Applications to Finance Nicole Bäuerle 2011-06-08 The theory of Markov decision processes focuses on controlled Markov chains in discrete time. The authors establish the theory for general state and action spaces and at the same time show its application by means of numerous examples, mostly taken from the fields of finance and operations research. By using a structural approach many technicalities (concerning measure theory) are avoided. They cover problems with finite and infinite horizons, as well as partially observable Markov decision processes, piecewise deterministic Markov decision processes and stopping problems. The book presents Markov decision processes in action and includes various state-of-the-art applications with a particular view towards finance. It is useful for upper-level undergraduates, Master's students and researchers in both applied probability and finance, and provides exercises (without solutions).

Markov Decision Processes with Applications to Finance Nicole Bäuerle 2011-06-06 The theory of Markov decision processes focuses on controlled Markov chains in discrete time. The authors establish the theory for general state and action spaces and at the same time show its application by means of numerous examples, mostly taken from the fields of finance and operations research. By using a structural approach many technicalities (concerning measure theory) are avoided. They cover problems with finite and infinite horizons, as well as partially observable Markov decision processes, piecewise deterministic Markov decision processes and stopping problems. The book presents Markov decision processes in action and includes various state-of-the-art applications with a particular view towards finance. It is useful for upper-level undergraduates, Master's students and researchers in both applied probability and finance, and

provides exercises (without solutions).

Secondary Analysis of Electronic Health Records MIT Critical Data 2016-09-09 This book trains the next generation of scientists representing different disciplines to leverage the data generated during routine patient care. It formulates a more complete lexicon of evidence-based recommendations and support shared, ethical decision making by doctors with their patients. Diagnostic and therapeutic technologies continue to evolve rapidly, and both individual practitioners and clinical teams face increasingly complex ethical decisions. Unfortunately, the current state of medical knowledge does not provide the guidance to make the majority of clinical decisions on the basis of evidence. The present research infrastructure is inefficient and frequently produces unreliable results that cannot be replicated. Even randomized controlled trials (RCTs), the traditional gold standards of the research reliability hierarchy, are not without limitations. They can be costly, labor intensive, and slow, and can return results that are seldom generalizable to every patient population. Furthermore, many pertinent but unresolved clinical and medical systems issues do not seem to have attracted the interest of the research enterprise, which has come to focus instead on cellular and molecular investigations and single-agent (e.g., a drug or device) effects. For clinicians, the end result is a bit of a "data desert" when it comes to making decisions. The new research infrastructure proposed in this book will help the medical profession to make ethically sound and well informed decisions for their patients.

Continuous-Time Markov Chains and Applications G. George Yin 2012-11-14 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.

Using the Weibull Distribution John I. McCool 2012-08-06 Understand and utilize the latest developments in Weibull inferential methods While the Weibull distribution is widely used in science and engineering, most engineers do not have the necessary statistical training to implement the methodology effectively. *Using the Weibull Distribution: Reliability, Modeling, and Inference* fills a gap in the current literature on the topic, introducing a self-contained presentation of the probabilistic basis for the methodology while providing powerful techniques for extracting information from data. The author explains the use of the Weibull distribution and its statistical and probabilistic basis, providing a wealth of material that is not available in the current literature. The book begins by outlining the fundamental probability and statistical concepts that serve as a foundation for subsequent topics of coverage, including: • Optimum burn-in, age and block replacement, warranties and renewal theory • Exact inference in Weibull regression • Goodness of fit testing and distinguishing the Weibull from the lognormal • Inference for the Three Parameter Weibull Throughout the book, a wealth of real-world examples showcases the discussed topics and each chapter concludes with a set of exercises, allowing readers to test their understanding of the presented material. In addition, a related website features the author's own software for implementing the discussed analyses along with a set of modules written in Mathcad®, and additional graphical interface software for performing

simulations. With its numerous hands-on examples, exercises, and software applications, Using the Weibull Distribution is an excellent book for courses on quality control and reliability engineering at the upper-undergraduate and graduate levels. The book also serves as a valuable reference for engineers, scientists, and business analysts who gather and interpret data that follows the Weibull distribution

Handbook of Markov Decision Processes Eugene A. Feinberg 2012-12-06 Eugene A. Feinberg Adam Shwartz This volume deals with the theory of Markov Decision Processes (MDPs) and their applications. Each chapter was written by a leading expert in the respective area. The papers cover major research areas and methodologies, and discuss open questions and future research directions. The papers can be read independently, with the basic notation and concepts of Section 1.2. Most chapters should be accessible by graduate or advanced undergraduate students in fields of operations research, electrical engineering, and computer science. 1.1 AN OVERVIEW OF MARKOV DECISION PROCESSES The theory of Markov Decision Processes—also known under several other names including sequential stochastic optimization, discrete-time stochastic control, and stochastic dynamic programming—studies sequential optimization of discrete-time stochastic systems. The basic object is a discrete-time stochastic system whose transition mechanism can be controlled over time. Each control policy defines the stochastic process and values of objective functions associated with this process. The goal is to select a "good" control policy. In real life, decisions that humans and computers make on all levels usually have two types of impacts: (i) they cost or save time, money, or other resources, or they bring revenues, as well as (ii) they have an impact on the future, by influencing the dynamics. In many situations, decisions with the largest immediate profit may not be good in view of future events. MDPs model this paradigm and provide results on the structure and existence of good policies and on methods for their calculation.

Continuous-Time Markov Decision Processes Xianping Guo 2009-09-18 Continuous-time Markov decision processes (MDPs), also known as controlled Markov chains, are used for modeling decision-making problems that arise in operations research (for instance, inventory, manufacturing, and queueing systems), computer science, communications engineering, control of populations (such as fisheries and epidemics), and management science, among many other fields. This volume provides a unified, systematic, self-contained presentation of recent developments on the theory and applications of continuous-time MDPs. The MDPs in this volume include most of the cases that arise in applications, because they allow unbounded transition and reward/cost rates. Much of the material appears for the first time in book form.

Analytic Perturbation Theory and Its Applications Konstantin E. Avrachenkov 2013-12-11 Mathematical models are often used to describe complex phenomena such as climate change dynamics, stock market fluctuations, and the Internet. These models typically depend on estimated values of key parameters that determine system behavior. Hence it is important to know what happens when these values are changed. The study of single-parameter deviations

provides a natural starting point for this analysis in many special settings in the sciences, engineering, and economics. The difference between the actual and nominal values of the perturbation parameter is small but unknown, and it is important to understand the asymptotic behavior of the system as the perturbation tends to zero. This is particularly true in applications with an apparent discontinuity in the limiting behavior—the so-called singularly perturbed problems. *Analytic Perturbation Theory and Its Applications* includes a comprehensive treatment of analytic perturbations of matrices, linear operators, and polynomial systems, particularly the singular perturbation of inverses and generalized inverses. It also offers original applications in Markov chains, Markov decision processes, optimization, and applications to Google PageRank? and the Hamiltonian cycle problem as well as input retrieval in linear control systems and a problem section in every chapter to aid in course preparation.

Stochastic Modeling and Optimization David D. Yao 2012-12-06 This book covers the broad range of research in stochastic models and optimization. Applications presented include networks, financial engineering, production planning, and supply chain management. Each contribution is aimed at graduate students working in operations research, probability, and statistics.

Statistical Machine Learning with Applications Gordon Ritter 2021-07-30 This unique compendium develops a general approach to building models of economic and financial processes, with a focus on statistical learning techniques that scale to large data sets. It introduces the key elements of a parametric statistical model: likelihood, prior, and posterior, and show how to use them to make predictions. The book covers classical techniques such as multiple regression and the Kalman filter in a clear, accessible style that has been popular with students, but also includes detailed treatments of state-of-the-art models, highlighting tree-based methods, support vector machines and kernel methods, deep learning, and reinforcement learning. Theories are supplemented by real-world examples. This reference text is useful for undergraduate, graduate and even PhD students in quantitative finance, and also to practitioners who are facing the reality that data science and machine learning are disrupting the industry.

Modelling Under Risk and Uncertainty Etienne de Rocquigny 2012-04-30 "This volume addresses a concern of very high relevance and growing interest for large industries or environmentalists: risk and uncertainty in complex systems. It gives new insight on the peculiar mathematical challenges generated by recent industrial safety or environmental control analysis, focusing on implementing decision theory choices related to risk and uncertainty analysis through statistical estimation and computation, in the presence of physical modeling and risk analysis. The result will lead statisticians and associated professionals to formulate and solve new challenges at the frontier between statistical modeling, physics, scientific computing, and risk analysis"--