

Handbook Of Markov Decision Processes Methods And Applications International Series In Operations Research Management Science

Handbook of Educational Data Mining (EDM) provides a thorough overview of the current state of knowledge in this area. The first part of the book includes nine surveys and tutorials on the principal data mining techniques that have been applied in education. The second part presents a set of 25 case studies that give a rich overview of the problems that EDM has addressed. Researchers at the Forefront of the Field Discuss Essential Topics and the Latest Advances With contributions by well-known researchers from a variety of fields, the book reflects the multidisciplinary nature of the EDM community. It brings the educational and data mining communities together, helping education experts understand what types of questions EDM can address and helping data miners understand what types of questions are important to educational design and educational decision making. Encouraging readers to integrate EDM into their research and practice, this timely handbook offers a broad, accessible treatment of essential EDM techniques and applications. It provides an excellent first step for newcomers to the EDM community and for active researchers to keep abreast of recent developments in the field.

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.

With rapidly rising healthcare costs directly impacting the economy and quality of life, resolving improvement challenges in areas such as safety, effectiveness, patient-centeredness, timeliness, efficiency, and equity has become paramount. Using a system engineering perspective, Handbook of Healthcare Delivery Systems offers theoretical foundations, methodologies, and case studies in each main sector of the system. It explores how system engineering methodologies and their applications in designing, evaluating, and optimizing the operations of the healthcare system could improve patient outcomes and cost effectiveness. The book presents an overview of current challenges in the healthcare system and the potential impact of system engineering. It describes an integrated framework for the delivery system and the tools and methodologies used for performance assessment and process improvement with examples of lean concept,

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evidence-based practice and risk assessment. The book then reviews system engineering methodologies and technologies and their applications in healthcare. Moving on to coverage of the design, planning, control and management of healthcare systems, the book contains chapters on 12 services sectors: preventive care, telemedicine, transplant, pharmacy, ED/ICU, OR, decontamination, laboratory, emergency response, mental health, food and supplies, and information technology. It presents the state-of-the-art operations and examines the challenges in each service unit. While system engineering concepts have been broadly applied in healthcare systems, most improvements have focused on a specific segment or unit of the delivery system. Each unit has strong interactions with others and any significant improvement is more likely to be sustained over time by integrating the process and re-evaluating the system design from a holistic viewpoint. By providing an overview of individual operational sectors in the extremely complex healthcare system and introducing a wide array of engineering methods and tools, this handbook establishes the foundation to facilitate integrated system thinking to redesign the next generation healthcare system.

In both rich and poor nations, public resources for health care are inadequate to meet demand. Policy makers and health care providers must determine how to provide the most effective health care to citizens using the limited resources that are available. This chapter describes current and future challenges in the delivery of health care, and outlines the role that operations research (OR) models can play in helping to solve those problems. The chapter concludes with an overview of this book – its intended audience, the areas covered, and a description of the subsequent chapters. **KEY WORDS** Health care delivery, Health care planning **HEALTH CARE DELIVERY: PROBLEMS AND CHALLENGES** 3 1.1 **WORLDWIDE HEALTH: THE PAST 50 YEARS** Human health has improved significantly in the last 50 years. In 1950, global life expectancy was 46 years [1]. That figure rose to 61 years by 1980 and to 67 years by 1998 [2]. Much of these gains occurred in low- and middle-income countries, and were due in large part to improved nutrition and sanitation, medical innovations, and improvements in public health infrastructure.

The scope of this book is Operations Research methods in Agriculture and a thorough discussion of derived applications in the Agri-food industry. The book summarizes current research and practice in this area and illustrates the development of useful approaches to deal with actual problems arising in the agriculture sector and the agri-food industry. This book is intended to collect in one volume high quality chapters on Methods and Applications in Agriculture and Agri-food industry considering both theoretical issues and application results. Methods applied to problems in agriculture and the agri-food industry include, but are not restricted to, the following themes: Dynamic programming Multi-criteria decision methods Markov decision processes Linear programming Stochastic programming Parameter estimation and knowledge acquisition Learning from data Simulation Descriptive and normative decision tree techniques, including: agent modelling and simulation, and state of the art surveys Each chapter includes some standard and traditional methodology but also some recent research advances. All the applications presented in the chapters have been inspired and motivated by the demands from the agriculture and food production areas.

This book introduces multiagent planning under uncertainty as formalized by decentralized partially observable Markov decision processes (Dec-POMDPs). The intended audience is researchers and graduate students working in the fields of artificial intelligence related to sequential decision making: reinforcement learning, decision-theoretic planning for single agents, classical multiagent planning, decentralized control, and operations research.

The Wiley-Interscience Paperback Series consists of selected books that have been made more accessible to consumers in an effort

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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

This book covers formulation, algorithms, and structural results of partially observed Markov decision processes, whilst linking theory to real-world applications in controlled sensing. Computations are kept to a minimum, enabling students and researchers in engineering, operations research, and economics to understand the methods and determine the structure of their optimal solution.

Handbook of Probabilistic Models carefully examines the application of advanced probabilistic models in conventional engineering fields. In this comprehensive handbook, practitioners, researchers and scientists will find detailed explanations of technical concepts, applications of the proposed methods, and the respective scientific approaches needed to solve the problem. This book provides an interdisciplinary approach that creates advanced probabilistic models for engineering fields, ranging from conventional fields of mechanical engineering and civil engineering, to electronics, electrical, earth sciences, climate, agriculture, water resource, mathematical sciences and computer sciences. Specific topics covered include minimax probability machine regression, stochastic finite element method, relevance vector machine, logistic regression, Monte Carlo simulations, random matrix, Gaussian process regression, Kalman filter, stochastic optimization, maximum likelihood, Bayesian inference, Bayesian update, kriging, copula-statistical models, and more. Explains the application of advanced probabilistic models encompassing multidisciplinary research Applies probabilistic modeling to emerging areas in engineering Provides an interdisciplinary approach to probabilistic models and their applications, thus solving a wide range of practical problems

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

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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.

This book is intended as a text covering the central concepts and techniques of Competitive Markov Decision Processes. It is an attempt to present a rigorous treatment that combines two significant research topics: Stochastic Games and Markov Decision Processes, which have been studied extensively, and at times quite independently, by mathematicians, operations researchers, engineers, and economists. Since Markov decision processes can be viewed as a special noncompetitive case of stochastic games, we introduce the new terminology Competitive Markov Decision Processes that emphasizes the importance of the link between these two topics and of the properties of the underlying Markov processes. The book is designed to be used either in a classroom or for self-study by a mathematically mature reader. In the Introduction (Chapter 1) we outline a number of advanced undergraduate and graduate courses for which this book could usefully serve as a text. A characteristic feature of competitive Markov decision processes - and one that inspired our long-standing interest - is that they can serve as an "orchestra" containing the "instruments" of much of modern applied (and at times even pure) mathematics. They constitute a topic where the instruments of linear algebra, applied probability, mathematical programming, analysis, and even algebraic geometry can be "played" sometimes solo and sometimes in harmony to produce either beautifully simple or equally beautiful, but baroque, melodies, that is, theorems. 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

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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.

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. Fundamentally, this is a methodology that examines and analyzes 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. Its objective 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. Markov Decision Processes (MDPs) model this paradigm and provide results on the structure and existence of good policies and on methods for their calculations. MDPs are attractive to many researchers because they are important both from the practical and the intellectual points of view. MDPs provide tools for the solution of important real-life problems. In particular, many business and engineering applications use MDP models. Analysis of various problems arising in MDPs leads to a large variety of interesting mathematical and computational problems. Accordingly, the Handbook of Markov Decision Processes is split into three parts: Part I deals with models with finite state and action spaces and Part II deals with infinite state problems, and Part III examines specific applications. Individual chapters are written by leading experts on the subject.

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

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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.

"This book focuses on methods widely used in modeling gene networks including structure discovery, learning, and optimization"--Provided by publisher.

Artificial intelligence (AI) describes machines/computers that mimic cognitive functions that humans associate with other human minds, such as learning and problem solving. As businesses have evolved to include more automation of processes, it has become more vital to understand AI and its various applications. Additionally, it is important for workers in the marketing industry to understand how to coincide with and utilize these techniques to enhance and make their work more efficient. The Handbook of Research on Applied AI for International Business and Marketing Applications is a critical scholarly publication that provides comprehensive research on artificial intelligence applications within the context of international business. Highlighting a wide range of topics such as diversification, risk management, and artificial intelligence, this book is ideal for marketers, business professionals, academicians, practitioners, researchers, and students.

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.

The Handbook of Simulation Optimization presents an overview of the state of the art of simulation optimization, providing a survey of the most well-established approaches for optimizing stochastic simulation models and a sampling of recent research advances in theory and methodology. Leading contributors cover such topics as discrete optimization via simulation, ranking and selection, efficient simulation budget allocation, random search methods, response surface methodology, stochastic gradient

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estimation, stochastic approximation, sample average approximation, stochastic constraints, variance reduction techniques, model-based stochastic search methods and Markov decision processes. This single volume should serve as a reference for those already in the field and as a means for those new to the field for understanding and applying the main approaches. The intended audience includes researchers, practitioners and graduate students in the business/engineering fields of operations research, management science, operations management and stochastic control, as well as in economics/finance and computer science. 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.

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.

This book provides the reader with a comprehensive set of instructions and examples of how to perform an economic evaluation of a health intervention, focusing solely on cost-effectiveness analysis in healthcare.

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.

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A guide for constructing and using composite indicators for policy makers, academics, the media and other interested parties. In particular, this handbook is concerned with indicators which compare and rank country performance.

In financially constrained health systems across the world, increasing emphasis is being placed on the ability to demonstrate that health care interventions are not only effective, but also cost-effective. This book deals with decision modelling techniques that can be used to estimate the value for money of various interventions including medical devices, surgical procedures, diagnostic technologies, and pharmaceuticals. Particular emphasis is placed on the importance of the appropriate representation of uncertainty in the evaluative process and the implication this uncertainty has for decision making and the need for future research. This highly practical guide takes the reader through the key principles and approaches of modelling techniques. It begins with the basics of constructing different forms of the model, the population of the model with input parameter estimates, analysis of the results, and progression to the holistic view of models as a valuable tool for informing future research exercises. Case studies and exercises are supported with online templates and solutions. This book will help analysts understand the contribution of decision-analytic modelling to the evaluation of health care programmes. ABOUT THE SERIES: Economic evaluation of health interventions is a growing specialist field, and this series of practical handbooks will tackle, in-depth, topics superficially addressed in more general health economics books. Each volume will include illustrative material, case histories and worked examples to encourage the reader to apply the methods discussed, with supporting material provided online. This series is aimed at health economists in academia, the pharmaceutical industry and the health sector, those on advanced health economics courses, and health researchers in associated fields.

Praise for the First Edition ". . . an excellent textbook . . . well organized and neatly written." —Mathematical Reviews ". . . amazingly interesting . . ." —Technometrics Thoroughly updated to showcase the interrelationships between probability, statistics, and stochastic processes, *Probability, Statistics, and Stochastic Processes, Second Edition* prepares readers to collect, analyze, and characterize data in their chosen fields. Beginning with three chapters that develop probability theory and introduce the axioms of probability, random variables, and joint distributions, the book goes on to present limit theorems and simulation. The authors combine a rigorous, calculus-based development of theory with an intuitive approach that appeals to readers' sense of reason and logic. Including more than 400 examples that help illustrate concepts and theory, the Second Edition features new material on statistical inference and a wealth of newly added topics, including: Consistency of point estimators Large sample theory Bootstrap simulation Multiple hypothesis testing Fisher's exact test and Kolmogorov-Smirnov test Martingales, renewal processes, and Brownian motion One-way analysis of variance and the general linear model Extensively class-tested to ensure an accessible presentation, *Probability, Statistics, and Stochastic Processes, Second Edition* is an excellent book for courses on probability and statistics at the upper-undergraduate level. The book is also an ideal resource for scientists and engineers in the fields of statistics, mathematics, industrial management, and engineering.

Markov Decision Processes (MDPs) are widely popular in Artificial Intelligence for modeling sequential decision-making scenarios

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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

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

Handbook of Decision Support Systems for Neurological Disorders provides readers with complete coverage of advanced computer-aided diagnosis systems for neurological disorders. While computer-aided decision support systems for different medical imaging modalities are available, this is the first book to solely concentrate on decision support systems for neurological disorders. Due to the increase in the prevalence of diseases such as Alzheimer, Parkinson's and Dementia, this book will have significant importance in the medical field. Topics discussed include recent computational approaches, different types of neurological disorders, deep convolution neural networks, generative adversarial networks, auto encoders, recurrent neural networks, and modified/hybrid artificial neural networks. Includes applications of computer intelligence and decision support systems for the diagnosis and analysis of a variety of neurological disorders Presents in-depth, technical coverage of computer-aided systems for tumor image classification, Alzheimer's disease detection, dementia detection using deep belief neural networks, and morphological approaches for stroke detection Covers disease diagnosis for cerebral palsy using auto-encoder approaches, contrast enhancement for performance enhanced diagnosis systems, autism detection using fuzzy logic systems, and autism detection using generative adversarial networks Written by engineers to help engineers, computer scientists, researchers and clinicians understand the technology and applications of decision support systems for neurological disorders

The Second Edition of this book presents the state of the art in this important field. Marketing decision models constitute a core

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component of the marketing discipline and the area is changing rapidly, not only due to fundamental advances in methodology and model building, but also because of the recent developments in information technology, the Internet and social media. This Handbook contains eighteen chapters that cover the most recent developments of marketing decision models in different domains of marketing. Compared to the previous edition, thirteen chapters are entirely new, while the remaining chapters represent complete updates and extensions of the previous edition. This new edition of the Handbook has chapters on models for substantive marketing problems, such as customer relationship management, customer loyalty management, website design, Internet advertising, social media, and social networks. In addition, it contains chapters on recent methodological developments that are gaining popularity in the area of marketing decision models, such as structural modeling, learning dynamics, choice modeling, eye-tracking and measurement. The introductory chapter discusses the main developments of the last decade and discusses perspectives for future developments.

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.

From the Preface: Collectively, the chapters in this book address application domains including inpatient and outpatient services, public health networks, supply chain management, and resource constrained settings in developing countries. Many of the chapters provide specific examples or case studies illustrating the applications of operations research methods across the globe, including Africa, Australia, Belgium, Canada, the United Kingdom, and the United States. Chapters 1-4 review operations research methods that are most commonly applied to health care operations management including: queuing, simulation, and mathematical programming. Chapters 5-7 address challenges related to inpatient services in hospitals such as surgery, intensive care units, and hospital wards. Chapters 8-10 cover outpatient services, the fastest growing part of many health systems, and describe operations research models for primary and specialty care services, and how to plan for patient no-shows. Chapters 12 – 16 cover topics related to the broader integration of health services in the context of public health, including optimizing the location of emergency vehicles, planning for mass vaccination events, and the coordination among different parts of a health system. Chapters 17-18 address supply chain management within hospitals, with a focus on pharmaceutical supply management, and the challenges of managing inventory for nursing units. Finally, Chapters 19-20 provide examples of important and emerging research in the realm of humanitarian logistics.

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,

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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).

Reinforcement learning (RL) will deliver one of the biggest breakthroughs in AI over the next decade, enabling algorithms to learn from their environment to achieve arbitrary goals. This exciting development avoids constraints found in traditional machine learning (ML) algorithms. This practical book shows data science and AI professionals how to learn by reinforcement and enable a machine to learn by itself. Author Phil Winder of Winder Research covers everything from basic building blocks to state-of-the-art practices. You'll explore the current state of RL, focus on industrial applications, learn numerous algorithms, and benefit from dedicated chapters on deploying RL solutions to production. This is no cookbook; doesn't shy away from math and expects familiarity with ML. Learn what RL is and how the algorithms help solve problems Become grounded in RL fundamentals including Markov decision processes, dynamic programming, and temporal difference learning Dive deep into a range of value and policy gradient methods Apply advanced RL solutions such as meta learning, hierarchical learning, multi-agent, and imitation learning Understand cutting-edge deep RL algorithms including Rainbow, PPO, TD3, SAC, and more Get practical examples through the accompanying website

Eugene A. Feinberg Adam Schwartz 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.

How can analytics scholars and healthcare professionals access the most exciting and important healthcare topics and tools for the 21st century? Editors Tinglong Dai and Sridhar Tayur, aided by a team of internationally acclaimed experts, have curated this

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timely volume to help newcomers and seasoned researchers alike to rapidly comprehend a diverse set of thrusts and tools in this rapidly growing cross-disciplinary field. The Handbook covers a wide range of macro-, meso- and micro-level thrusts—such as market design, competing interests, global health, personalized medicine, residential care and concierge medicine, among others—and structures what has been a highly fragmented research area into a coherent scientific discipline. The handbook also provides an easy-to-comprehend introduction to five essential research tools—Markov decision process, game theory and information economics, queueing games, econometric methods, and data science—by illustrating their uses and applicability on examples from diverse healthcare settings, thus connecting tools with thrusts. The primary audience of the Handbook includes analytics scholars interested in healthcare and healthcare practitioners interested in analytics. This Handbook: Instills analytics scholars with a way of thinking that incorporates behavioral, incentive, and policy considerations in various healthcare settings. This change in perspective—a shift in gaze away from narrow, local and one-off operational improvement efforts that do not replicate, scale or remain sustainable—can lead to new knowledge and innovative solutions that healthcare has been seeking so desperately. Facilitates collaboration between healthcare experts and analytics scholar to frame and tackle their pressing concerns through appropriate modern mathematical tools designed for this very purpose. The handbook is designed to be accessible to the independent reader, and it may be used in a variety of settings, from a short lecture series on specific topics to a semester-long course.

Performance optimization is vital in the design and operation of modern engineering systems, including communications, manufacturing, robotics, and logistics. Most engineering systems are too complicated to model, or the system parameters cannot be easily identified, so learning techniques have to be applied. This book provides a unified framework based on a sensitivity point of view. It also introduces new approaches and proposes new research topics within this sensitivity-based framework. This new perspective on a popular topic is presented by a well respected expert in the field.

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