

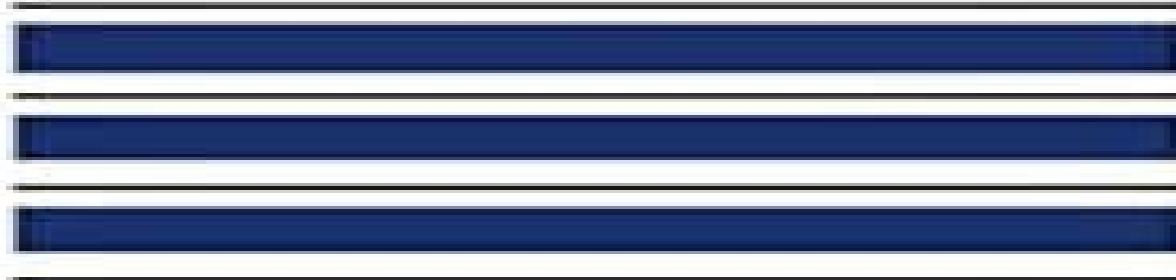
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# CONDITIONAL MONTE CARLO

Gradient Estimation and  
Optimization Applications

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Michael FU  
Jian-Qiang HU



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# Conditional Monte Carlo Gradient Estimation And Optimization Applications The Springer International Series

**Michael C. Fu, Jian-Qiang Hu**



### **Conditional Monte Carlo Gradient Estimation And Optimization Applications The Springer International Series:**

*Conditional Monte Carlo* Michael C. Fu, Jian-Qiang Hu, 2012-10-08 Conditional Monte Carlo Gradient Estimation and Optimization Applications deals with various gradient estimation techniques of perturbation analysis based on the use of conditional expectation The primary setting is discrete event stochastic simulation This book presents applications to queueing and inventory and to other diverse areas such as financial derivatives pricing and statistical quality control To researchers already in the area this book offers a unified perspective and adequately summarizes the state of the art To researchers new to the area this book offers a more systematic and accessible means of understanding the techniques without having to scour through the immense literature and learn a new set of notation with each paper To practitioners this book provides a number of diverse application areas that makes the intuition accessible without having to fully commit to understanding all the theoretical niceties In sum the objectives of this monograph are two fold to bring together many of the interesting developments in perturbation analysis based on conditioning under a more unified framework and to illustrate the diversity of applications to which these techniques can be applied Conditional Monte Carlo Gradient Estimation and Optimization Applications is suitable as a secondary text for graduate level courses on stochastic simulations and as a reference for researchers and practitioners in industry

### **Supervision of Petri Nets** Geert Stremersch, 2012-12-06

Supervision of Petri Nets presents supervisory control theory for Petri nets with a legal set as the control goal Petri nets model discrete event systems dynamic systems whose evolution is completely determined by the occurrence of discrete events Control laws which guarantee that the system meets a set of specifications in the presence of uncontrollable and unobservable events are studied and constructed using application areas such as automated manufacturing and transportation systems Supervision of Petri Nets introduces a new and mathematically sound approach to the subject Existing results are unified by proposing a general mathematical language that makes extensive use of order theoretical ideas and numerous new results are described including ready to use algorithms that construct supervisory control laws for Petri nets Supervision of Petri Nets is an excellent reference for researchers and may also be used as a supplementary text for advanced courses on control theory

### **Handbook of Simulation Optimization** Michael C Fu, 2014-11-13

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 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

*Monte Carlo and Quasi-Monte Carlo Methods* Alexander Keller, 2022-05-20 This volume presents the revised papers of the 14th International Conference in Monte Carlo and Quasi Monte Carlo Methods in Scientific Computing MCQMC 2020 which took place online during August 10 14 2020 This book is an excellent reference resource for theoreticians and practitioners interested in solving high dimensional computational problems arising in particular in statistics machine learning finance and computer graphics offering information on the latest developments in Monte Carlo and quasi Monte Carlo methods and their randomized versions

*Body of Knowledge for Modeling and Simulation* Tuncer Ören, Bernard P. Zeigler, Andreas Tolk, 2023-01-27 Commissioned by the Society for Modeling and Simulation International SCS this needed useful new Body of Knowledge BoK collects and organizes the common understanding of a wide collection of professionals and professional associations Modeling and simulation M S is a ubiquitous discipline that lays the computational foundation for real and virtual experimentation clearly stating boundaries and interactions of systems data and representations The field is well known too for its training support via simulations and simulators Indeed with computers increasingly influencing the activities of today's world M S is the third pillar of scientific understanding taking its place along with theory building and empirical observation This valuable new handbook provides intellectual support for all disciplines in analysis design and optimization It contributes increasingly to the growing number of computational disciplines addressing the broad variety of contributing as well as supported disciplines and application domains Further each of its sections provide numerous references for further information Highly comprehensive the BoK represents many viewpoints and facets captured under such topics as Mathematical and Systems Theory Foundations Simulation Formalisms and Paradigms Synergies with Systems Engineering and Artificial Intelligence Multidisciplinary Challenges Ethics and Philosophy Historical Perspectives Examining theoretical as well as practical challenges this unique volume addresses the many facets of M S for scholars students and practitioners As such it affords readers from all science engineering and arts disciplines a comprehensive and concise representation of concepts terms and activities needed to explain the M S discipline Tuncer Ören is Professor Emeritus at the University of Ottawa Bernard Zeigler is Professor Emeritus at the University of Arizona Andreas Tolk is Chief Scientist at The MITRE Corporation All three editors are long time members and Fellows of the Society for Modeling and Simulation International Under the leadership of three SCS Fellows Dr Ören University of Ottawa Dr Zeigler The University of Arizona and Dr Tolk The MITRE Corporation more than 50 international scholars from 15 countries provided insights and experience to compile this initial M S Body of Knowledge

**Stochastic Simulation Optimization For Discrete Event Systems: Perturbation Analysis, Ordinal Optimization And Beyond** Chun-hung Chen, Qing-shan Jia, Loo Hay Lee, 2013-07-03 Discrete event systems DES have become pervasive in

our daily lives Examples include but are not restricted to manufacturing and supply chains transportation healthcare call centers and financial engineering However due to their complexities that often involve millions or even billions of events with many variables and constraints modeling these stochastic simulations has long been a hard nut to crack The advance in available computer technology especially of cluster and cloud computing has paved the way for the realization of a number of stochastic simulation optimization for complex discrete event systems This book will introduce two important techniques initially proposed and developed by Professor Y C Ho and his team namely perturbation analysis and ordinal optimization for stochastic simulation optimization and present the state of the art technology and their future research directions

**Conditional Monte Carlo** Michael C. Fu, Jian-Qiang Hu, 2012-12-06 Conditional Monte Carlo Gradient Estimation and Optimization Applications deals with various gradient estimation techniques of perturbation analysis based on the use of conditional expectation The primary setting is discrete event stochastic simulation This book presents applications to queueing and inventory and to other diverse areas such as financial derivatives pricing and statistical quality control To researchers already in the area this book offers a unified perspective and adequately summarizes the state of the art To researchers new to the area this book offers a more systematic and accessible means of understanding the techniques without having to scour through the immense literature and learn a new set of notation with each paper To practitioners this book provides a number of diverse application areas that makes the intuition accessible without having to fully commit to understanding all the theoretical niceties In sum the objectives of this monograph are two fold to bring together many of the interesting developments in perturbation analysis based on conditioning under a more unified framework and to illustrate the diversity of applications to which these techniques can be applied Conditional Monte Carlo Gradient Estimation and Optimization Applications is suitable as a secondary text for graduate level courses on stochastic simulations and as a reference for researchers and practitioners in industry

*Max-Plus Linear Stochastic Systems and Perturbation Analysis* Bernd F. Heidergott, 2006-12-26 During the last decade the area of stochastic max plus linear systems has witnessed a rapid development which created a growing interest in this area This book provides a thorough treatment of the theory of stochastic max plus linear systems Max plus algebra is an algebraic approach to discrete event systems DES like queueing networks that are prone to synchronization Perturbation analysis studies the sensitivity of the performance of DES with respect to changes in a particular system parameter The first part of the book addresses modeling issues and stability theory for stochastic max plus systems The second part of the book treats perturbation analysis of max plus systems a calculus for differentiation of max plus systems is developed This calculus leads to numerical evaluations of performance indices of max plus linear stochastic systems such as the Lyapunov exponent or waiting times

**Foundations of Average-Cost Nonhomogeneous Controlled Markov Chains** Xi-Ren Cao, 2020-09-09 This Springer brief addresses the challenges encountered in the study of the optimization of time nonhomogeneous Markov chains It develops new insights and new

methodologies for systems in which concepts such as stationarity ergodicity periodicity and connectivity do not apply This brief introduces the novel concept of confluency and applies a relative optimization approach It develops a comprehensive theory for optimization of the long run average of time nonhomogeneous Markov chains The book shows that confluency is the most fundamental concept in optimization and that relative optimization is more suitable for treating the systems under consideration than standard ideas of dynamic programming Using confluency and relative optimization the author classifies states as confluent or branching and shows how the under selectivity issue of the long run average can be easily addressed multi class optimization implemented and Nth biases and Blackwell optimality conditions derived These results are presented in a book for the first time and so may enhance the understanding of optimization and motivate new research ideas in the area

*Encyclopedia of Operations Research and Management Science* Saul I. Gass, Carl M. Harris, 2001 Audience Anyone concerned with the science techniques and ideas of how decisions are made BOOK JACKET **Advances in Modeling and Simulation** Zdravko Botev, Alexander Keller, Christiane Lemieux, Bruno Tuffin, 2022-11-30 This book celebrates the career of Pierre L Ecuyer on the occasion of his 70th birthday Pierre has made significant contributions to the fields of simulation modeling and operations research over the last 40 years This book contains 20 chapters written by collaborators and experts in the field who by sharing their latest results want to recognize the lasting impact of Pierre s work in their research area The breadth of the topics covered reflects the remarkable versatility of Pierre s contributions from deep theoretical results to practical and industry ready applications The Festschrift features article from the domains of Monte Carlo and quasi Monte Carlo methods Markov chains sampling and low discrepancy sequences simulation rare events graphics finance machine learning stochastic processes and tractability

**Object-Oriented Computer Simulation of Discrete-Event Systems** Jerzy Tyszer, 2012-12-06 Object Oriented Computer Simulation of Discrete Event Systems offers a comprehensive presentation of a wide repertoire of computer simulation techniques available to the modelers of dynamic systems Unlike other books on simulation this book includes a complete and balanced description of all essential issues relevant to computer simulation of discrete event systems and it teaches simulation users how to design program and exploit their own computer simulation models In addition it uses the object oriented methodology throughout the book as its main programming platform The reader is expected to have some background in the theory of probability and statistics and only a little programming experience in C as the book is not tied down to any particular simulation language The book also provides 50 complete simulation problems to assist with writing such simulation programs Object Oriented Computer Simulation of Discrete Event Systems demonstrates the basic and generic concepts used in computer simulation of discrete event systems in a comprehensive uniform and self contained manner

Timed Petri Nets Jiacun Wang, 2012-12-06 Driven by the request for increased productivity flexibility and competitiveness modern civilization increasingly has created high performance discrete event dynamic systems DEDSs These systems exhibit concurrent sequential competitive activities among their components

They are often complex and large in scale and necessarily flexible and thus highly capital intensive. Examples of systems are manufacturing systems, communication networks, traffic and logistic systems, and military command and control systems. Modeling and performance evaluation play a vital role in the design and operation of such high performance DEDSs and thus have received widespread attention from researchers over the past two decades. One methodology resulting from this effort is based on timed Petri nets and related graphical and mathematical tools. The popularity that Petri nets have been gaining in modeling of DEDSs is due to their powerful representational ability of concurrency and synchronization; however, these properties of DEDSs cannot be expressed easily in traditional formalisms developed for analysis of classical systems with sequential behaviors. This book introduces the theories and applications of timed Petri nets systematically. Moreover, it also presents many practical applications in addition to theoretical developments, together with the latest research results and industrial applications of timed Petri nets. **Timed Petri Nets: Theory and Application** is intended for use by researchers and practitioners in the area of Discrete Event Dynamic Systems.

**Supervisory Control of Discrete Event Systems Using Petri Nets** John O. Moody, Panos J. Antsaklis, 2012-12-06. **Supervisory Control of Discrete Event Systems Using Petri Nets** presents a novel approach to its subject. The concepts of supervisory control and discrete event systems are explained, and the background material on general Petri net theory necessary for using the book's control techniques is provided. A large number of examples is used to illustrate the concepts and techniques presented in the text, and there are plenty of references for those interested in additional study or more information on a particular topic. **Supervisory Control of Discrete Event Systems Using Petri Nets** is intended for graduate students, advanced undergraduates, and practicing engineers who are interested in the control problems of manufacturing, communication, and computer networks, chemical process plants, and other high level control applications. The text is written from an engineering perspective, but it is also appropriate for students of computer science, applied mathematics, or economics. The book contains enough background material to stand alone as an introduction to supervisory control with Petri nets, but it may also be used as a supplemental text in a course on discrete event systems or intelligent autonomous control.

**Analysis of Manufacturing Enterprises** N. Viswanadham, 2012-12-06. **Analysis of Manufacturing Enterprises** presents a unified and systematic treatment of manufacturing enterprises. These enterprises are networks of companies working in partnership. Such networks are a common occurrence in auto, grocery, apparel, computer, and other industries, and competition is among enterprises rather than between individual companies. Thus, for these enterprises, global or local to succeed, there is a need for systematically designing the enterprise-wide value delivery processes, such as the order-to-delivery process, supply chain process, and new product development process. This calls for developing systematic analysis methodologies for evaluating the performance of value delivering processes. **Analysis of Manufacturing Enterprises** fills this vital need. The first part of the book focuses on foundations of manufacturing enterprises: the generic value delivery process, their performance measures, and redesign to

meet specifications on lead time and defect levels The second part provides a clear and comprehensive discussion on new product development order to delivery and supply chain processes which are core processes of a manufacturing enterprise Analysis of Manufacturing Enterprises is an excellent resource for researchers and professionals in the field of manufacturing engineering Tutorials in Operations Research Institute for Operations Research and the Management Sciences. National Meeting, 2008 **Modeling and Optimization: Theory and Applications** Boris Defourny, Tamás Terlaky, 2015-11-05 This volume contains a selection of contributions that were presented at the Modeling and Optimization Theory and Applications Conference MOPTA held at Lehigh University in Bethlehem Pennsylvania USA on August 13 15 2014 The conference brought together a diverse group of researchers and practitioners working on both theoretical and practical aspects of continuous or discrete optimization Topics presented included algorithms for solving convex network mixed integer nonlinear and global optimization problems and addressed the application of deterministic and stochastic optimization techniques in energy finance logistics analytics healthcare and other important fields The contributions contained in this volume represent a sample of these topics and applications and illustrate the broad diversity of ideas discussed at the meeting *2008 Tutorials in Operations Research: State-of-the-Art Decision-Making Tools in the Information-Intensive Age*, **Proceedings**, 2005 **Seismic Inversion** Gerard T. Schuster, 2017-07-01 This book describes the theory and practice of inverting seismic data for the subsurface rock properties of the earth The primary application is for inverting reflection and or transmission data from engineering or exploration surveys but the methods described also can be used for earthquake studies Seismic Inversion will be of benefit to scientists and advanced students in engineering earth sciences and physics It is desirable that the reader has some familiarity with certain aspects of numerical computation such as finite difference solutions to partial differential equations numerical linear algebra and the basic physics of wave propagation For those not familiar with the terminology and methods of seismic exploration a brief introduction is provided To truly understand the nuances of seismic inversion we have to actively practice what we preach or teach Therefore computational labs are provided for most of the chapters and some field data labs are given as well



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