
Sequential Stochastic Optimization

R. Caroli
Robert C. Dalang



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Sequential Stochastic Optimization

Andrew Gelman, Xiao-Li Meng



Sequential Stochastic Optimization:

Sequential Stochastic Optimization R. Cairoli, Robert C. Dalang, 2011-07-26 Sequential Stochastic Optimization provides mathematicians and applied researchers with a well developed framework in which stochastic optimization problems can be formulated and solved Offering much material that is either new or has never before appeared in book form it lucidly presents a unified theory of optimal stopping and optimal sequential control of stochastic processes This book has been carefully organized so that little prior knowledge of the subject is assumed its only prerequisites are a standard graduate course in probability theory and some familiarity with discrete parameter martingales Major topics covered in Sequential Stochastic Optimization include Fundamental notions such as essential supremum stopping points accessibility martingales and supermartingales indexed by INd Conditions which ensure the integrability of certain suprema of partial sums of arrays of independent random variables The general theory of optimal stopping for processes indexed by INd Structural properties of information flows Sequential sampling and the theory of optimal sequential control Multi armed bandits Markov chains and optimal switching between random walks

Reinforcement Learning and Stochastic Optimization Warren B. Powell, 2022-04-25 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 **Sequential Stochastic Optimization in Water Resources** Thomas Earl Croley,1972

Stochastic Optimization of Linear Sequential Control Systems Don William Hilgendorf,1964 *A Weak Convergence Approach to the Theory of Large Deviations* Paul Dupuis,Richard S. Ellis,2011-09-09 Applies the well developed tools of the theory of weak convergence of probability measures to large deviation analysis a consistent new approach The theory of large deviations one of the most dynamic topics in probability today studies rare events in stochastic systems The nonlinear nature of the theory contributes both to its richness and difficulty This innovative text demonstrates how to employ the well established linear techniques of weak convergence theory to prove large deviation results Beginning with a step by step development of the approach the book skillfully guides reader through models of increasing complexity covering a wide variety of random variable level and process level problems Representation formulas for large deviation type expectations are a key tool and are developed systematically for discrete time problems Accessible to anyone who has a knowledge of measure theory and measure theoretic probability *A Weak Convergence Approach to the Theory of Large Deviations* is important reading for both students and researchers **Geometrical Foundations of Asymptotic Inference** Robert E. Kass,Paul W. Vos,2011-09-09 Differential geometry provides an aesthetically appealing and often revealing view of statistical inference Beginning with an elementary treatment of one parameter statistical models and ending with an overview of recent developments this is the first book to provide an introduction to the subject that is largely accessible to readers not already familiar with differential geometry It also gives a streamlined entry into the field to readers with rich mathematical backgrounds Much space is devoted to curved exponential families which are of interest not only because they may be studied geometrically but also because they are analytically convenient so that results may be derived rigorously In addition several appendices provide useful mathematical material on basic concepts in differential geometry Topics covered include the following Basic properties of curved exponential families Elements of second order asymptotic theory The Fisher Efron Amari theory of information loss and recovery Jeffreys Rao information metric Riemannian geometry Curvature measures of nonlinearity Geometrically motivated diagnostics for exponential family regression Geometrical theory of divergence functions A classification of and introduction to additional work in the field *Applied Bayesian Modeling and Causal Inference from Incomplete-Data Perspectives* Andrew Gelman,Xiao-Li Meng,2004-09-03 This book brings together a collection of articles on statistical methods relating to missing data analysis including multiple imputation propensity scores instrumental variables and Bayesian inference Covering new research topics and real world examples which do not feature in many standard texts The book is dedicated to Professor Don Rubin Harvard Don Rubin has made fundamental contributions to the study of missing data Key features of the book include Comprehensive coverage of an important area for both research

and applications Adopts a pragmatic approach to describing a wide range of intermediate and advanced statistical techniques Covers key topics such as multiple imputation propensity scores instrumental variables and Bayesian inference Includes a number of applications from the social and health sciences Edited and authored by highly respected researchers in the area

Statistical Advances in the Biomedical Sciences Atanu Biswas, Sujay Datta, Jason P. Fine, Mark R. Segal, 2008-01-02 The Most Comprehensive and Cutting Edge Guide to Statistical Applications in Biomedical Research With the increasing use of biotechnology in medical research and the sophisticated advances in computing it has become essential for practitioners in the biomedical sciences to be fully educated on the role statistics plays in ensuring the accurate analysis of research findings Statistical Advances in the Biomedical Sciences explores the growing value of statistical knowledge in the management and comprehension of medical research and more specifically provides an accessible introduction to the contemporary methodologies used to understand complex problems in the four major areas of modern day biomedical science clinical trials epidemiology survival analysis and bioinformatics Composed of contributions from eminent researchers in the field this volume discusses the application of statistical techniques to various aspects of modern medical research and illustrates how these methods ultimately prove to be an indispensable part of proper data collection and analysis A structural uniformity is maintained across all chapters each beginning with an introduction that discusses general concepts and the biomedical problem under focus and is followed by specific details on the associated methods algorithms and applications In addition each chapter provides a summary of the main ideas and offers a concluding remarks section that presents novel ideas approaches and challenges for future research Complete with detailed references and insight on the future directions of biomedical research Statistical Advances in the Biomedical Sciences provides vital statistical guidance to practitioners in the biomedical sciences while also introducing statisticians to new multidisciplinary frontiers of application This text is an excellent reference for graduate and PhD level courses in various areas of biostatistics and the medical sciences and also serves as a valuable tool for medical researchers statisticians public health professionals and biostatisticians

Bayesian Models for Categorical Data Peter Congdon, 2005-12-13 The use of Bayesian methods for the analysis of data has grown substantially in areas as diverse as applied statistics psychology economics and medical science Bayesian Methods for Categorical Data sets out to demystify modern Bayesian methods making them accessible to students and researchers alike Emphasizing the use of statistical computing and applied data analysis this book provides a comprehensive introduction to Bayesian methods of categorical outcomes Reviews recent Bayesian methodology for categorical outcomes binary count and multinomial data Considers missing data models techniques and non standard models ZIP and negative binomial Evaluates time series and spatio temporal models for discrete data Features discussion of univariate and multivariate techniques Provides a set of downloadable worked examples with documented WinBUGS code available from an ftp site The author's previous 2 bestselling titles provided a comprehensive introduction to the theory and application of Bayesian models

Bayesian Models for Categorical Data continues to build upon this foundation by developing their application to categorical or discrete data one of the most common types of data available The author s clear and logical approach makes the book accessible to a wide range of students and practitioners including those dealing with categorical data in medicine sociology psychology and epidemiology *Applied Survival Analysis* David W. Hosmer, Jr., Stanley Lemeshow, Susanne May, 2011-09-23 THE MOST PRACTICAL UP TO DATE GUIDE TO MODELLING AND ANALYZING TIME TO EVENT DATA NOW IN A VALUABLE NEW EDITION Since publication of the first edition nearly a decade ago analyses using time to event methods have increase considerably in all areas of scientific inquiry mainly as a result of model building methods available in modern statistical software packages However there has been minimal coverage in the available literature to9 guide researchers practitioners and students who wish to apply these methods to health related areas of study *Applied Survival Analysis* Second Edition provides a comprehensive and up to date introduction to regression modeling for time to event data in medical epidemiological biostatistical and other health related research This book places a unique emphasis on the practical and contemporary applications of regression modeling rather than the mathematical theory It offers a clear and accessible presentation of modern modeling techniques supplemented with real world examples and case studies Key topics covered include variable selection identification of the scale of continuous covariates the role of interactions in the model assessment of fit and model assumptions regression diagnostics recurrent event models frailty models additive models competing risk models and missing data Features of the Second Edition include Expanded coverage of interactions and the covariate adjusted survival functions The use of the Worcester Heart Attack Study as the main modeling data set for illustrating discussed concepts and techniques New discussion of variable selection with multivariable fractional polynomials Further exploration of time varying covariates complex with examples Additional treatment of the exponential Weibull and log logistic parametric regression models Increased emphasis on interpreting and using results as well as utilizing multiple imputation methods to analyze data with missing values New examples and exercises at the end of each chapter Analyses throughout the text are performed using Stata Version 9 and an accompanying FTP site contains the data sets used in the book *Applied Survival Analysis* Second Edition is an ideal book for graduate level courses in biostatistics statistics and epidemiologic methods It also serves as a valuable reference for practitioners and researchers in any health related field or for professionals in insurance and government **Nonparametric Statistics with Applications to Science and Engineering** Paul H. Kvam, Brani Vidakovic, 2007-08-24 A thorough and definitive book that fully addresses traditional and modern day topics of nonparametric statistics This book presents a practical approach to nonparametric statistical analysis and provides comprehensive coverage of both established and newly developed methods With the use of MATLAB the authors present information on theorems and rank tests in an applied fashion with an emphasis on modern methods in regression and curve fitting bootstrap confidence intervals splines wavelets empirical likelihood and goodness of fit testing

Nonparametric Statistics with Applications to Science and Engineering begins with succinct coverage of basic results for order statistics methods of categorical data analysis nonparametric regression and curve fitting methods The authors then focus on nonparametric procedures that are becoming more relevant to engineering researchers and practitioners The important fundamental materials needed to effectively learn and apply the discussed methods are also provided throughout the book Complete with exercise sets chapter reviews and a related Web site that features downloadable MATLAB applications this book is an essential textbook for graduate courses in engineering and the physical sciences and also serves as a valuable reference for researchers who seek a more comprehensive understanding of modern nonparametric statistical methods

Empirical Model Building James R. Thompson, 2011-11-30 Praise for the First Edition This novel and highly stimulating book which emphasizes solving real problems should be widely read It will have a positive and lasting effect on the teaching of modeling and statistics in general Short Book Reviews This new edition features developments and real world examples that showcase essential empirical modeling techniques Successful empirical model building is founded on the relationship between data and approximate representations of the real systems that generated that data As a result it is essential for researchers who construct these models to possess the special skills and techniques for producing results that are insightful reliable and useful Empirical Model Building Data Models and Reality Second Edition presents a hands on approach to the basic principles of empirical model building through a shrewd mixture of differential equations computer intensive methods and data The book outlines both classical and new approaches and incorporates numerous real world statistical problems that illustrate modeling approaches that are applicable to a broad range of audiences including applied statisticians and practicing engineers and scientists The book continues to review models of growth and decay systems where competition and interaction add to the complexity of the model while discussing both classical and non classical data analysis methods This Second Edition now features further coverage of momentum based investing practices and resampling techniques showcasing their importance and expediency in the real world The author provides applications of empirical modeling such as computer modeling of the AIDS epidemic to explain why North America has most of the AIDS cases in the First World and data based strategies that allow individual investors to build their own investment portfolios Throughout the book computer based analysis is emphasized and newly added and updated exercises allow readers to test their comprehension of the presented material Empirical Model Building Second Edition is a suitable book for modeling courses at the upper undergraduate and graduate levels It is also an excellent reference for applied statisticians and researchers who carry out quantitative modeling in their everyday work

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

Latent Curve Models Kenneth A. Bollen, Patrick J. Curran, 2006-01-03 An effective technique for data analysis in the social sciences The recent explosion in longitudinal data in the social sciences highlights the need for this timely publication Latent Curve Models A Structural Equation Perspective provides an effective technique to analyze latent curve models LCMs This type of data features random intercepts and slopes that permit each case in a sample to have a different trajectory over time Furthermore researchers can include variables to predict the parameters governing these trajectories The authors synthesize a vast amount of research and findings and at the same time provide original results The book analyzes LCMs from the perspective of structural equation models SEMs with latent variables While the authors discuss simple regression based procedures that are useful in the early stages of LCMs most of the presentation uses SEMs as a driving tool This cutting edge work includes some of the authors recent work on the autoregressive latent trajectory model suggests new models for method factors in multiple indicators discusses repeated latent variable models and establishes the identification of a variety of LCMs This text has been thoroughly class tested and makes extensive use of pedagogical tools to aid readers in mastering and applying LCMs quickly and easily to their own data sets Key features include Chapter introductions and summaries that provide a quick overview of highlights Empirical examples provided throughout that allow readers to test their newly found knowledge and discover practical applications Conclusions at the end of each chapter that stress the essential points that readers need to understand for advancement to more sophisticated topics Extensive footnoting that points the way to the primary literature for more information on particular topics With its emphasis on modeling and the use of numerous examples this is an excellent book for graduate courses in latent trajectory models as well as a supplemental text for courses in structural modeling This book is

an excellent aid and reference for researchers in quantitative social and behavioral sciences who need to analyze longitudinal data

Statistical Analysis of Designed Experiments Ajit C. Tamhane, 2012-09-12 A indispensable guide to understanding and designing modern experiments The tools and techniques of Design of Experiments DOE allow researchers to successfully collect analyze and interpret data across a wide array of disciplines Statistical Analysis of Designed Experiments provides a modern and balanced treatment of DOE methodology with thorough coverage of the underlying theory and standard designs of experiments guiding the reader through applications to research in various fields such as engineering medicine business and the social sciences The book supplies a foundation for the subject beginning with basic concepts of DOE and a review of elementary normal theory statistical methods Subsequent chapters present a uniform model based approach to DOE Each design is presented in a comprehensive format and is accompanied by a motivating example discussion of the applicability of the design and a model for its analysis using statistical methods such as graphical plots analysis of variance ANOVA confidence intervals and hypothesis tests Numerous theoretical and applied exercises are provided in each chapter and answers to selected exercises are included at the end of the book An appendix features three case studies that illustrate the challenges often encountered in real world experiments such as randomization unbalanced data and outliers Minitab software is used to perform analyses throughout the book and an accompanying FTP site houses additional exercises and data sets With its breadth of real world examples and accessible treatment of both theory and applications Statistical Analysis of Designed Experiments is a valuable book for experimental design courses at the upper undergraduate and graduate levels It is also an indispensable reference for practicing statisticians engineers and scientists who would like to further their knowledge of DOE

Approximate Dynamic Programming Warren B. Powell, 2011-10-26 Praise for the First Edition Finally a book devoted to dynamic programming and written using the language of operations research OR This beautiful book fills a gap in the libraries of OR specialists and practitioners Computing Reviews This new edition showcases a focus on modeling and computation for complex classes of approximate dynamic programming problems Understanding approximate dynamic programming ADP is vital in order to develop practical and high quality solutions to complex industrial problems particularly when those problems involve making decisions in the presence of uncertainty Approximate Dynamic Programming Second Edition uniquely integrates four distinct disciplines Markov decision processes mathematical programming simulation and statistics to demonstrate how to successfully approach model and solve a wide range of real life problems using ADP The book continues to bridge the gap between computer science simulation and operations research and now adopts the notation and vocabulary of reinforcement learning as well as stochastic search and simulation optimization The author outlines the essential algorithms that serve as a starting point in the design of practical solutions for real problems The three curses of dimensionality that impact complex problems are introduced and detailed coverage of implementation challenges is provided The Second Edition also features A new chapter describing four fundamental classes

of policies for working with diverse stochastic optimization problems myopic policies look ahead policies policy function approximations and policies based on value function approximations A new chapter on policy search that brings together stochastic search and simulation optimization concepts and introduces a new class of optimal learning strategies Updated coverage of the exploration exploitation problem in ADP now including a recently developed method for doing active learning in the presence of a physical state using the concept of the knowledge gradient A new sequence of chapters describing statistical methods for approximating value functions estimating the value of a fixed policy and value function approximation while searching for optimal policies The presented coverage of ADP emphasizes models and algorithms focusing on related applications and computation while also discussing the theoretical side of the topic that explores proofs of convergence and rate of convergence A related website features an ongoing discussion of the evolving fields of approximation dynamic programming and reinforcement learning along with additional readings software and datasets Requiring only a basic understanding of statistics and probability Approximate Dynamic Programming Second Edition is an excellent book for industrial engineering and operations research courses at the upper undergraduate and graduate levels It also serves as a valuable reference for researchers and professionals who utilize dynamic programming stochastic programming and control theory to solve problems in their everyday work

Applied Linear Regression Sanford Weisberg, 2013-06-07 Master linear regression techniques with a new edition of a classic text Reviews of the Second Edition I found it enjoyable reading and so full of interesting material that even the well informed reader will probably find something new a necessity for all of those who do linear regression Technometrics February 1987 Overall I feel that the book is a valuable addition to the now considerable list of texts on applied linear regression It should be a strong contender as the leading text for a first serious course in regression analysis American Scientist May June 1987 Applied Linear Regression Third Edition has been thoroughly updated to help students master the theory and applications of linear regression modeling Focusing on model building assessing fit and reliability and drawing conclusions the text demonstrates how to develop estimation confidence and testing procedures primarily through the use of least squares regression To facilitate quick learning the Third Edition stresses the use of graphical methods in an effort to find appropriate models and to better understand them In that spirit most analyses and homework problems use graphs for the discovery of structure as well as for the summarization of results The Third Edition incorporates new material reflecting the latest advances including Use of smoothers to summarize a scatterplot Box Cox and graphical methods for selecting transformations Use of the delta method for inference about complex combinations of parameters Computationally intensive methods and simulation including the bootstrap method Expanded chapters on nonlinear and logistic regression Completely revised chapters on multiple regression diagnostics and generalizations of regression Readers will also find helpful pedagogical tools and learning aids including More than 100 exercises most based on interesting real world data Web primers demonstrating how to use standard statistical packages

including R S Plus SPSS SAS and JMP to work all the examples and exercises in the text A free online library for R and S Plus that makes the methods discussed in the book easy to use With its focus on graphical methods and analysis coupled with many practical examples and exercises this is an excellent textbook for upper level undergraduates and graduate students who will quickly learn how to use linear regression analysis techniques to solve and gain insight into real life problems

Statistical Rules of Thumb Gerald van Belle, 2011-09-20 Praise for the First Edition For a beginner this book is a treasure trove for an experienced person it can provide new ideas on how better to pursue the subject of applied statistics Journal of Quality Technology Sensibly organized for quick reference Statistical Rules of Thumb Second Edition compiles simple rules that are widely applicable robust and elegant and each captures key statistical concepts This unique guide to the use of statistics for designing conducting and analyzing research studies illustrates real world statistical applications through examples from fields such as public health and environmental studies Along with an insightful discussion of the reasoning behind every technique this easy to use handbook also conveys the various possibilities statisticians must think of when designing and conducting a study or analyzing its data Each chapter presents clearly defined rules related to inference covariation experimental design consultation and data representation and each rule is organized and discussed under five succinct headings introduction statement and illustration of the rule the derivation of the rule a concluding discussion and exploration of the concept s extensions The author also introduces new rules of thumb for topics such as sample size for ratio analysis absolute and relative risk ANCOVA cautions and dichotomization of continuous variables Additional features of the Second Edition include Additional rules on Bayesian topics New chapters on observational studies and Evidence Based Medicine EBM Additional emphasis on variation and causation Updated material with new references examples and sources A related Web site provides a rich learning environment and contains additional rules presentations by the author and a message board where readers can share their own strategies and discoveries Statistical Rules of Thumb Second Edition is an ideal supplementary book for courses in experimental design and survey research methods at the upper undergraduate and graduate levels It also serves as an indispensable reference for statisticians researchers consultants and scientists who would like to develop an understanding of the statistical foundations of their research efforts A related website www.vanbelle.org provides additional rules author presentations and more

An Introduction to Probability and Statistics Vijay K. Rohatgi, A. K. Md. Ehsanes Saleh, 2015-08-06 A well balanced introduction to probability theory and mathematical statistics Featuring updated material An Introduction to Probability and Statistics Third Edition remains a solid overview to probability theory and mathematical statistics Divided into three parts the Third Edition begins by presenting the fundamentals and foundations of probability The second part addresses statistical inference and the remaining chapters focus on special topics An Introduction to Probability and Statistics Third Edition includes A new section on regression analysis to include multiple regression logistic regression and Poisson regression A reorganized chapter on large sample theory to emphasize the

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Fundamentals of Queueing Theory Donald Gross, John F. Shortle, James M. Thompson, Carl M. Harris, 2011-09-23

Praise for the Third Edition This is one of the best books available Its excellent organizational structure allows quick reference to specific models and its clear presentation solidifies the understanding of the concepts being presented IIE Transactions on Operations Engineering Thoroughly revised and expanded to reflect the latest developments in the field Fundamentals of Queueing Theory Fourth Edition continues to present the basic statistical principles that are necessary to analyze the probabilistic nature of queues Rather than presenting a narrow focus on the subject this update illustrates the wide reaching fundamental concepts in queueing theory and its applications to diverse areas such as computer science engineering business and operations research This update takes a numerical approach to understanding and making probable estimations relating to queues with a comprehensive outline of simple and more advanced queueing models Newly featured topics of the Fourth Edition include Retrial queues Approximations for queueing networks Numerical inversion of transforms Determining the appropriate number of servers to balance quality and cost of service Each chapter provides a self contained presentation of key concepts and formulae allowing readers to work with each section independently while a summary table at the end of the book outlines the types of queues that have been discussed and their results In addition two new appendices have been added discussing transforms and generating functions as well as the fundamentals of differential and difference equations New examples are now included along with problems that incorporate QtsPlus software which is freely available via the book s related Web site With its accessible style and wealth of real world examples Fundamentals of Queueing Theory Fourth Edition is an ideal book for courses on queueing theory at the upper undergraduate and graduate levels It is also a valuable resource for researchers and practitioners who analyze congestion in the fields of telecommunications transportation aviation and management science

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Sequential Stochastic Optimization Introduction

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