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Stochastic Optimization Methods

Gerard Cornuejols, Reha Tütüncü

Stochastic Optimization Methods:

Stochastic Optimization Methods Kurt Marti, 2005-12-05 Optimization problems arising in practice involve random parameters For the computation of robust optimal solutions i e optimal solutions being insensitive with respect to random parameter variations deterministic substitute problems are needed Based on the distribution of the random data and using decision theoretical concepts optimization problems under stochastic uncertainty are converted into deterministic substitute problems Due to the occurring probabilities and expectations approximative solution techniques must be applied

Deterministic and stochastic approximation methods and their analytical properties are provided Taylor expansion regression and response surface methods probability inequalities First Order Reliability Methods convex approximation deterministic descent directions efficient points stochastic approximation methods differentiation of probability and mean value functions

Convergence results of the resulting iterative solution procedures are given **Stochastic Optimization** Stanislav Uryasev, Panos M. Pardalos, 2013-03-09 Stochastic programming is the study of procedures for decision making under the presence of uncertainties and risks Stochastic programming approaches have been successfully used in a number of areas such as energy and production planning telecommunications and transportation Recently the practical experience gained in stochastic programming has been expanded to a much larger spectrum of applications including financial modeling risk management and probabilistic risk analysis Major topics in this volume include 1 advances in theory and implementation of stochastic programming algorithms 2 sensitivity analysis of stochastic systems 3 stochastic programming applications and other related topics Audience Researchers and academics working in optimization computer modeling operations research and financial engineering The book is appropriate as supplementary reading in courses on optimization and financial engineering

First-order and Stochastic Optimization Methods for Machine Learning Guanghui Lan, 2020-05-15 This book covers not only foundational materials but also the most recent progresses made during the past few years on the area of machine learning algorithms In spite of the intensive research and development in this area there does not exist a systematic treatment to introduce the fundamental concepts and recent progresses on machine learning algorithms especially on those based on stochastic optimization methods randomized algorithms nonconvex optimization distributed and online learning and projection free methods This book will benefit the broad audience in the area of machine learning artificial intelligence and mathematical programming community by presenting these recent developments in a tutorial style starting from the basic building blocks to the most carefully designed and complicated algorithms for machine learning

Stochastic Optimization Kurt Marti, 2012-12-06 This volume includes a selection of refereed papers presented at the GAMM IFIP Workshop on Stochastic Optimization Numerical Methods and Technical Applications held at the Federal Armed Forces University Munich May 29 31 1990 The objective of this meeting was to bring together scientists from Stochastic Programming and from those Engineering areas where Mathematical Programming models are common tools as e g Optimal Structural Design Power

Dispatch Acid Rain Management etc The first theoretical part includes the papers by S D Flam H Niederreiter E Poechinger and R Schultz The second part on methods and applications contains the articles by N Baba N Grwe and W Roemisch J Mayer E A Mc Bean and A Vasarhelyi ***Stochastic Optimization Methods*** Kurt Marti,2015-02-21 This book examines optimization problems that in practice involve random model parameters It details the computation of robust optimal solutions i e optimal solutions that are insensitive with respect to random parameter variations where appropriate deterministic substitute problems are needed Based on the probability distribution of the random data and using decision theoretical concepts optimization problems under stochastic uncertainty are converted into appropriate deterministic substitute problems Due to the probabilities and expectations involved the book also shows how to apply approximative solution techniques Several deterministic and stochastic approximation methods are provided Taylor expansion methods regression and response surface methods RSM probability inequalities multiple linearization of survival failure domains discretization methods convex approximation deterministic descent directions efficient points stochastic approximation and gradient procedures and differentiation formulas for probabilities and expectations In the third edition this book further develops stochastic optimization methods In particular it now shows how to apply stochastic optimization methods to the approximate solution of important concrete problems arising in engineering economics and operations research

Stochastic Optimization

Ioannis Dritsas,2011-02-28 Stochastic Optimization Algorithms have become essential tools in solving a wide range of difficult and critical optimization problems Such methods are able to find the optimum solution of a problem with uncertain elements or to algorithmically incorporate uncertainty to solve a deterministic problem They even succeed in fighting uncertainty with uncertainty This book discusses theoretical aspects of many such algorithms and covers their application in various scientific fields ***Stochastic Optimization Methods*** Kurt Marti,2024 This book examines optimization problems that in practice involve random model parameters It outlines the computation of robust optimal solutions i e optimal solutions that are insensitive to random parameter variations where appropriate deterministic substitute problems are needed Based on the probability distribution of the random data and using decision theoretical concepts optimization problems under stochastic uncertainty are converted into corresponding deterministic problems Due to the probabilities and expectations involved the book also shows how to apply approximative solution techniques Several deterministic and stochastic approximation methods are provided Taylor expansion methods regression and response surface methods RSM probability inequalities multiple linearization of survival failure domains discretization methods convex approximation deterministic descent directions efficient points stochastic approximation and gradient procedures and differentiation formulas for probabilities and expectations The fourth edition of this classic text has been carefully and thoroughly revised It includes new chapters on the solution of stochastic linear programs by discretization of the underlying probability distribution and on solving deterministic optimization problems by means of controlled random search methods and multiple random search

procedures It also presents a new application of stochastic optimization methods to machine learning problems with different loss functions For the computation of optimal feedback controls under stochastic uncertainty besides the open loop feedback procedures a new method based on Taylor expansions with respect to the gain parameters is presented The book is intended for researchers and graduate students who are interested in stochastics stochastic optimization and control It will also benefit professionals and practitioners whose work involves technical economic and or operations research problems under stochastic uncertainty

Optimization Methods Marco Cavazzuti,2012-09-14 This book is about optimization techniques and is subdivided into two parts In the first part a wide overview on optimization theory is presented Optimization is presented as being composed of five topics namely design of experiment response surface modeling deterministic optimization stochastic optimization and robust engineering design Each chapter after presenting the main techniques for each part draws application oriented conclusions including didactic examples In the second part some applications are presented to guide the reader through the process of setting up a few optimization exercises analyzing critically the choices which are made step by step and showing how the different topics that constitute the optimization theory can be used jointly in an optimization process The applications which are presented are mainly in the field of thermodynamics and fluid dynamics due to the author s background

Designing Engineering Structures using Stochastic Optimization Methods

Levent Aydin,H. Seçil Artem,Selda Oterkus,2020-04-27 Among all aspects of engineering design is the most important step in developing a new product A systematic approach to managing design issues can only be accomplished by applying mathematical optimization methods Furthermore due to the practical issues in engineering problems there are limitations in using traditional methods As such stochastic optimization methods such as differential evolution simulated annealing and genetic algorithms are preferable in finding solutions in design optimization problems This book reviews mechanical engineering design optimization using stochastic methods It introduces students and design engineers to practical aspects of complicated mathematical optimization procedures and outlines steps for wide range of selected engineering design problems It shows how engineering structures are systematically designed Many new engineering design applications based on stochastic optimization techniques in automotive energy military naval manufacturing process and fluids heat transfer are described in the book For each design optimization problem described background is provided for understanding the solutions There are very few books on optimization that include engineering applications They cover limited applications and that too of well known design problems of advanced and niche nature Common problems are hardly addressed Thus the subject has remained fairly theoretical To overcome this each chapter in this book is contributed by at least one academic and one industrial expert researcher

Stochastic Optimization Methods for Modern Machine Learning Problems

Yuejiao Sun,2021 Optimization has been the workhorse of solving machine learning problems However the efficiency of these methods remains far from satisfaction to meet the ever growing demand that arises in modern applications In this context

the present dissertation will focus on two fundamental classes of machine learning problems 1 stochastic nested problems where one subproblem builds upon the solution of others and 2 stochastic distributed problems where the subproblems are coupled through sharing the common variables One key difficulty of solving stochastic nested problems is that the hierarchically coupled structure makes the computation of stochastic gradients the basic element in first order optimization machinery prohibitively expensive or even impossible We will develop the first stochastic optimization method which runs in a single loop manner and achieves the same sample complexity as the stochastic gradient descent method for non nested problems One key difficulty of solving stochastic distributed problems is the resource intensity especially when algorithms are running at resource limited devices In this context we will introduce a class of communication adaptive stochastic gradient descent SGD methods which adaptively reuse the stale gradients thus saving communication We will show that the new algorithms have convergence rates comparable to original SGD and Adam algorithms but enjoy impressive empirical performance in terms of total communication round reduction

Optimization Methods in Finance

Gerard Cornuejols, Reha Tütüncü, 2006-12-21 Optimization models play an increasingly important role in financial decisions This is the first textbook devoted to explaining how recent advances in optimization models methods and software can be applied to solve problems in computational finance more efficiently and accurately Chapters discussing the theory and efficient solution methods for all major classes of optimization problems alternate with chapters illustrating their use in modeling problems of mathematical finance The reader is guided through topics such as volatility estimation portfolio optimization problems and constructing an index fund using techniques such as nonlinear optimization models quadratic programming formulations and integer programming models respectively The book is based on Master's courses in financial engineering and comes with worked examples exercises and case studies It will be welcomed by applied mathematicians operational researchers and others who work in mathematical and computational finance and who are seeking a text for self learning or for use with courses

Optimization Methods and Applications

Sergiy Butenko, Panos M. Pardalos, Volodymyr Shylo, 2018-02-20 Researchers and practitioners in computer science optimization operations research and mathematics will find this book useful as it illustrates optimization models and solution methods in discrete non differentiable stochastic and nonlinear optimization Contributions from experts in optimization are showcased in this book showcase a broad range of applications and topics detailed in this volume including pattern and image recognition computer vision robust network design and process control in nonlinear distributed systems This book is dedicated to the 80th birthday of Ivan V Sergienko who is a member of the National Academy of Sciences NAS of Ukraine and the director of the V M Glushkov Institute of Cybernetics His work has had a significant impact on several theoretical and applied aspects of discrete optimization computational mathematics systems analysis and mathematical modeling

Stochastic Optimization Methods in Finance and Energy

Marida Bertocchi, Giorgio Consigli, Michael A. H. Dempster, 2011-09-15 This volume presents a collection of contributions

dedicated to applied problems in the financial and energy sectors that have been formulated and solved in a stochastic optimization framework. The invited authors represent a group of scientists and practitioners who cooperated in recent years to facilitate the growing penetration of stochastic programming techniques in real world applications inducing a significant advance over a large spectrum of complex decision problems. After the recent widespread liberalization of the energy sector in Europe and the unprecedented growth of energy prices in international commodity markets we have witnessed a significant convergence of strategic decision problems in the energy and financial sectors. This has often resulted in common open issues and has induced a remarkable effort by the industrial and scientific communities to facilitate the adoption of advanced analytical and decision tools. The main concerns of the financial community over the last decade have suddenly penetrated the energy sector inducing a remarkable scientific and practical effort to address previously unforeseeable management problems. Stochastic Optimization Methods in Finance and Energy: New Financial Products and Energy Markets Strategies aims to include in a unified framework for the first time an extensive set of contributions related to real world applied problems in finance and energy leading to a common methodological approach and in many cases having similar underlying economic and financial implications. Part 1 of the book presents 6 chapters related to financial applications. Part 2 presents 7 chapters on energy applications and Part 3 presents 5 chapters devoted to specific theoretical and computational issues.

Stochastic Global Optimization: Techniques And Applications In Chemical Engineering (With Cd-rom)

Gade Pandu Rangaiah, 2010-06-04 Optimization has played a key role in the design, planning and operation of chemical and related processes for several decades. Global optimization has been receiving considerable attention in the past two decades. Of the two types of techniques for global optimization stochastic global optimization is applicable to any type of problems having non-differentiable functions, discrete variables and/or continuous variables. It thus shows significant promise and potential for process optimization. So far there are no books focusing on stochastic global optimization and its applications in chemical engineering. Stochastic Global Optimization: a monograph with contributions by leading researchers in the area bridges the gap in this subject with the aim of highlighting and popularizing stochastic global optimization techniques for chemical engineering applications. The book with 19 chapters in all is broadly categorized into two sections that extensively cover the techniques and the chemical engineering applications.

Stochastic Process Optimization using Aspen Plus®

Juan Gabriel Segovia-Hernández, Fernando Israel Gómez-Castro, 2017-11-01 Stochastic Process Optimization using Aspen Plus Bookshop Category Chemical Engineering Optimization can be simply defined as choosing the best alternative among a set of feasible options. In all the engineering areas optimization has a wide range of applications due to the high number of decisions involved in an engineering environment. Chemical engineering and particularly process engineering is not an exception thus stochastic methods are a good option to solve optimization problems for the complex process engineering models. In this book the combined use of the modular simulator Aspen Plus and stochastic optimization methods codified in

MATLAB is presented. Some basic concepts of optimization are first presented then strategies to use the simulator linked with the optimization algorithm are shown. Finally examples of application for process engineering are discussed. The reader will learn how to link the process simulator Aspen Plus and stochastic optimization algorithms to solve process design problems. They will gain ability to perform multi objective optimization in several case studies. Key Features: The book links simulation and optimization through numerical analyses and stochastic optimization techniques. Includes use of examples to illustrate the application of the concepts and specific guidance on the use of software Aspen Plus, Excel, MATLAB to set up and solve models representing complex problems. Illustrates several examples of applications for the linking of simulation and optimization software with other packages for optimization purposes. Provides specific information on how to implement stochastic optimization with process simulators. Enable readers to identify practical and economic solutions to problems of industrial relevance enhancing the safety, operation, environmental and economic performance of chemical processes.

Stochastic Optimization Johannes Schneider, Scott Kirkpatrick, 2006-11-07 This book addresses stochastic optimization procedures in a broad manner. The first part offers an overview of relevant optimization philosophies the second deals with benchmark problems in depth by applying a selection of optimization procedures. Written primarily with scientists and students from the physical and engineering sciences in mind this book addresses a larger community of all who wish to learn about stochastic optimization techniques and how to use them. **Stochastic Modeling and Optimization**, 2025 Most processes in life are prone to randomness which can be both a challenge and an aid in mathematical modeling and optimization. In this dissertation this randomness is studied through various modeling methods and stochastic optimization algorithms. It is shown how these can be developed for and applied to diverse problems in the domains of healthcare, manufacturing and search engine optimization. The key modeling methods are Markov chains and discrete event models and the key optimization algorithms are stochastic approximation algorithms and evolutionary algorithms. The following is addressed: A three step framework for capacity planning in nursing homes is developed that includes a shift scheduling algorithm and a genetic algorithm that assigns nurses to daily tasks. A neural network metamodeler is developed that integrates biased analytical queuing features to estimate the throughput of a tandem line. This metamodeler is applied to a variety of optimization problems such as the buffer allocation problem. An algorithm based on pseudo gradient methods is developed to optimize a function over the stationary distribution of a Markov chain. The emergency response process of electric ambulances is modeled to determine the influence of transitioning from a diesel to an electric fleet on the response times. **Modern Optimization Methods for Decision Making Under Risk and Uncertainty** Alexei A. Gaivoronski, Pavlo S. Knopov, Volodymyr A. Zaslavskyi, 2023-10-06 The book comprises original articles on topical issues of risk theory, rational decision making, statistical decisions and control of stochastic systems. The articles are the outcome of a series of international projects involving the leading scholars in the field of modern stochastic optimization and decision making. The structure of

stochastic optimization solvers is described. The solvers in general implement stochastic quasi gradient methods for optimization and identification of complex nonlinear models. These models constitute an important methodology for finding optimal decisions under risk and uncertainty. While a large part of current approaches towards optimization under uncertainty stems from linear programming LP and often results in large LPs of special structure stochastic quasi gradient methods confront nonlinearities directly without need of linearization. This makes them an appropriate tool for solving complex nonlinear problems concurrent optimization and simulation models and equilibrium situations of different types for instance Nash or Stackelberg equilibrium situations. The solver finds the equilibrium solution when the optimization model describes the system with several actors. The solver is parallelizable performing several simulation threads in parallel. It is capable of solving stochastic optimization problems finding stochastic Nash equilibria and of composite stochastic bilevel problems where each level may require the solution of stochastic optimization problem or finding Nash equilibrium. Several complex examples with applications to water resources management energy markets pricing of services on social networks are provided. In the case of power system regulator makes decision on the final expansion plan considering the strategic behavior of regulated companies and coordinating the interests of different economic entities. Such a plan can be an equilibrium a planned decision where a company cannot increase its expected gain unilaterally.

Stochastic Optimization Methods in Finance and Energy, 2011-09-11 *Numerical Techniques for Stochastic Optimization* I^UU^{ri}
Mikhailovich Ermol'ev, Roger J.-B. Wets, 1988

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