Practical Bilevel Optimization

#bilevel optimization #practical applications #hierarchical optimization #optimization algorithms #multi-level decision making

Explore the principles and practical applications of bilevel optimization, a powerful framework for solving hierarchical optimization problems. This area focuses on developing efficient optimization algorithms and strategies for multi-level decision making in real-world scenarios, ensuring robust and implementable solutions.

Each note is structured to summarize important concepts clearly and concisely.

Practical Bilevel Optimization

The use of optimization techniques has become integral to the design and analysis of most industrial and socio-economic systems. Great strides have been made recently in the solution of large-scale problems arising in such areas as production planning, airline scheduling, government regulation, and engineering design, to name a few. Analysts have found, however, that standard mathematical programming models are often inadequate in these situations because more than a single objective function and a single decision maker are involved. Multiple objective programming deals with the extension of optimization techniques to account for several objective functions, while game theory deals with the inter-personal dynamics surrounding conflict. Bilevel programming, the focus of this book, is in a narrow sense the combination of the two. It addresses the problern in which two decision makers, each with their individual objectives, act and react in a noncooperative, sequential manner. The actions of one affect the choices and payoffs available to the other but neither player can completely dominate the other in the traditional sense.

Practical Bilevel Optimization

2019 marked the 85th anniversary of Heinrich Freiherr von Stackelberg’s habilitation thesis “Marktform und Gleichgewicht,” which formed the roots of bilevel optimization. Research on the topic has grown tremendously since its introduction in the field of mathematical optimization. Besides the substantial advances that have been made from the perspective of game theory, many sub-fields of bilevel optimization have emerged concerning optimal control, multiobjective optimization, energy and electricity markets, management science, security and many more. Each chapter of this book covers a specific aspect of bilevel optimization that has grown significantly or holds great potential to grow, and was written by top experts in the corresponding area. In other words, unlike other works on the subject, this book consists of surveys of different topics on bilevel optimization. Hence, it can serve as a point of departure for students and researchers beginning their research journey or pursuing related projects. It also provides a unique opportunity for experienced researchers in the field to learn about the progress

made so far and directions that warrant further investigation. All chapters have been peer-reviewed by experts on mathematical optimization.

Bilevel Optimization

Bilevel programming problems are hierarchical optimization problems where the constraints of one problem (the so-called upper level problem) are defined in part by a second parametric optimization problem (the lower level problem). If the lower level problem has a unique optimal solution for all parameter values, this problem is equivalent to a one-level optimization problem having an implicitly defined objective function. Special emphasize in the book is on problems having non-unique lower level optimal solutions, the optimistic (or weak) and the pessimistic (or strong) approaches are discussed. The book starts with the required results in parametric nonlinear optimization. This is followed by the main theoretical results including necessary and sufficient optimality conditions and solution algorithms for bilevel problems. Stationarity conditions can be applied to the lower level problem to transform the optimistic bilevel programming problem into a one-level problem. Properties of the resulting problem are highlighted and its relation to the bilevel problem is investigated. Stability properties, numerical complexity, and problems having additional integrality conditions on the variables are also discussed. Audience: Applied mathematicians and economists working in optimization, operations research, and economic modelling. Students interested in optimization will also find this book useful.

Foundations of Bilevel Programming

This book provides a complete background on metaheuristics to solve complex bi-level optimization problems (continuous/discrete, mono-objective/multi-objective) in a diverse range of application domains. Readers learn to solve large scale bi-level optimization problems by efficiently combining metaheuristics with complementary metaheuristics and mathematical programming approaches. Numerous real-world examples of problems demonstrate how metaheuristics are applied in such fields as networks, logistics and transportation, engineering design, finance and security.

Metaheuristics for Bi-level Optimization

2019 marked the 85th anniversary of Heinrich Freiherr von Stackelberg’s habilitation thesis “Marktform und Gleichgewicht,” which formed the roots of bilevel optimization. Research on the topic has grown tremendously since its introduction in the field of mathematical optimization. Besides the substantial advances that have been made from the perspective of game theory, many sub-fields of bilevel optimization have emerged concerning optimal control, multiobjective optimization, energy and electricity markets, management science, security and many more. Each chapter of this book covers a specific aspect of bilevel optimization that has grown significantly or holds great potential to grow, and was written by top experts in the corresponding area. In other words, unlike other works on the subject, this book consists of surveys of different topics on bilevel optimization. Hence, it can serve as a point of departure for students and researchers beginning their research journey or pursuing related projects. It also provides a unique opportunity for experienced researchers in the field to learn about the progress made so far and directions that warrant further investigation. All chapters have been peer-reviewed by experts on mathematical optimization.

Bilevel Optimization

Researchers working with nonlinear programming often claim "the word is non linear" indicating that real applications require nonlinear modeling. The same is true for other areas such as multi-objective programming (there are always several goals in a real application), stochastic programming (all data is uncer tain and therefore stochastic models should be used), and so forth. In this spirit we claim: The word is multilevel. In many decision processes there is a hierarchy of decision makers, and decisions are made at different levels in this hierarchy. One way to handle such hierar chies is to focus on one level and include other levels' behaviors as assumptions. Multilevel programming is the research area that focuses on the whole hierar chy structure. In terms of modeling, the constraint domain associated with a multilevel programming problem is implicitly determined by a series of opti mization problems which must be solved in a predetermined sequence. If only two levels are considered, we have one leader (associated with the upper level) and one follower (associated with the lower level).

Multilevel Optimization: Algorithms and Applications

The goal of the Encyclopedia of Optimization is to introduce the reader to a complete set of topics that show the spectrum of research, the richness of ideas, and the breadth of applications that has come from this field. The second edition builds on the success of the former edition with more than 150 completely new entries, designed to ensure that the reference addresses recent areas where optimization theories and techniques have advanced. Particularly heavy attention resulted in health science and transportation, with entries such as "Algorithms for Genomics\

Encyclopedia of Optimization

Robust optimization is still a relatively new approach to optimization problems affected by uncertainty, but it has already proved so useful in real applications that it is difficult to tackle such problems today without considering this powerful methodology. Written by the principal developers of robust optimization, and describing the main achievements of a decade of research, this is the first book to provide a comprehensive and up-to-date account of the subject. Robust optimization is designed to meet some major challenges associated with uncertainty-affected optimization problems: to operate under lack of full information on the nature of uncertainty; to model the problem in a form that can be solved efficiently; and to provide guarantees about the performance of the solution. The book starts with a relatively simple treatment of uncertain linear programming, proceeding with a deep analysis of the interconnections between the construction of appropriate uncertainty sets and the classical chance constraints (probabilistic) approach. It then develops the robust optimization theory for uncertain conic quadratic and semidefinite optimization problems and dynamic (multistage) problems. The theory is supported by numerous examples and computational illustrations. An essential book for anyone working on optimization and decision making under uncertainty, Robust Optimization also makes an ideal graduate textbook on the subject.

Robust Optimization

This book constitutes the proceedings of the 18th International Conference on Mathematical Optimization Theory and Operations Research, MOTOR 2019, held in Ekaterinburg, Russia, in July 2019. The 48 full papers presented in this volume were carefully reviewed and selected from 170 submissions. MOTOR 2019 is a successor of the well-known International and All-Russian conference series, which were organized in Ural, Siberia, and the Far East for a long time. The selected papers are organized in the following topical sections: mathematical programming; bi-level optimization; integer programming; combinatorial optimization; optimal control and approximation; data mining and computational geometry; games and mathematical economics.

Mathematical Optimization Theory and Operations Research

This book describes recent theoretical findings relevant to bilevel programming in general, and in mixed-integer bilevel programming in particular. It describes recent applications in energy problems, such as the stochastic bilevel optimization approaches used in the natural gas industry. New algorithms for solving linear and mixed-integer bilevel programming problems are presented and explained.

Bilevel Programming Problems

This book presents recent research on bioinspired heuristics for optimization. Learning- based and black-box optimization exhibit some properties of intrinsic parallelization, and can be used for various optimizations problems. Featuring the most relevant work presented at the 6th International Conference on Metaheuristics and Nature Inspired Computing, held at Marrakech (Morocco) from 27th to 31st October 2016, the book presents solutions, methods, algorithms, case studies, and software. It is a valuable resource for research academics and industrial practitioners.

Bioinspired Heuristics for Optimization

Semi-infinite optimization is a vivid field of active research. Recently semi infinite optimization in a general form has attracted a lot of attention, not only because of its surprising structural aspects, but also due to the large number of applications which can be formulated as general semi-infinite programs. The aim of this book is to highlight structural aspects of general semi-infinite programming, to formulate optimality conditions which take this structure into account, and to give a conceptually new solution method. In fact, under certain assumptions general semi-infinite programs can be solved efficiently when their bi-level structure is exploited appropriately. After a brief introduction with some historical

background in Chapter 1 we be gin our presentation by a motivation for the appearance of standard and general semi-infinite optimization problems in applications. Chapter 2 lists a number of problems from engineering and economics which give rise to semi-infinite models, including (reverse) Chebyshev approximation, minimax problems, ro bust optimization, design centering, defect minimization problems for operator equations, and disjunctive programming.

Bi-Level Strategies in Semi-Infinite Programming

Mathematical optimization encompasses both a rich and rapidly evolving body of fundamental theory, and a variety of exciting applications in science and engineering. The present book contains a careful selection of articles on recent advances in optimization theory, numerical methods, and their applications in engineering. It features in particular new methods and applications in the fields of optimal control, PDE-constrained optimization, nonlinear optimization, and convex optimization. The authors of this volume took part in the 14th Belgian-French-German Conference on Optimization (BFG09) organized in Leuven, Belgium, on September 14-18, 2009. The volume contains a selection of reviewed articles contributed by the conference speakers as well as three survey articles by plenary speakers and two papers authored by the winners of the best talk and best poster prizes awarded at BFG09. Researchers and graduate students in applied mathematics, computer science, and many branches of engineering will find in this book an interesting and useful collection of recent ideas on the methods and applications of optimization.

Recent Advances in Optimization and its Applications in Engineering

This proceedings set contains 85 selected full papers presented at the 3rd International Conference on Modelling, Computation and Optimization in Information Systems and Management Sciences - MCO 2015, held on May 11–13, 2015 at Lorraine University, France. The present part I of the 2 volume set includes articles devoted to Combinatorial optimization and applications, DC programming and DCA: thirty years of Developments, Dynamic Optimization, Modelling and Optimization in financial engineering, Multiobjective programming, Numerical Optimization, Spline Approximation and Optimization, as well as Variational Principles and Applications.

Modelling, Computation and Optimization in Information Systems and Management Sciences

The book discusses three classes of problems: the generalized Nash equilibrium problems, the bilevel problems and the mathematical programming with equilibrium constraints (MPEC). These problems interact through their mathematical analysis as well as their applications. The primary aim of the book is to present the modern tool of variational analysis and optimization, which are used to analyze these three classes of problems. All contributing authors are respected academicians, scientists and researchers from around the globe. These contributions are based on the lectures delivered by experts at CIMPA School, held at the University of Delhi, India, from 25 November–6 December 2013, and peer-reviewed by international experts. The book contains five chapters. Chapter 1 deals with nonsmooth, nonconvex bilevel optimization problems whose feasible set is described by using the graph of the solution set mapping of a parametric optimization problem. Chapter 2 describes a constraint qualification to MPECs considered as an application of calmness concept of multifunctions and is used to derive M-stationarity conditions for MPEC. Chapter 3 discusses the first- and second-order optimality conditions derived for a special case of a bilevel optimization problem in which the constraint set of the lower level problem is described as a general compact convex set. Chapter 4 concentrates the results of the modelization and analysis of deregulated electricity markets with a focus on auctions and mechanism design. Chapter 5 focuses on optimization approaches called reflection methods for protein conformation determination within the framework of matrix completion. The last chapter (Chap. 6) deals with the single-valuedness of quasimonotone maps by using the concept of single-directionality with a special focus on the case of the normal operator of lower semi-continuous quasiconvex functions.

Generalized Nash Equilibrium Problems, Bilevel Programming and MPEC

Convex optimization problems arise frequently in many different fields. This book provides a comprehensive introduction to the subject, and shows in detail how such problems can be solved numerically with great efficiency. The book begins with the basic elements of convex sets and functions, and then describes various classes of convex optimization problems. Duality and approximation techniques are then covered, as are statistical estimation techniques. Various geometrical problems are then presented, and there is detailed discussion of unconstrained and constrained minimization problems,

and interior-point methods. The focus of the book is on recognizing convex optimization problems and then finding the most appropriate technique for solving them. It contains many worked examples and homework exercises and will appeal to students, researchers and practitioners in fields such as engineering, computer science, mathematics, statistics, finance and economics.

Convex Optimization

Modern optimization approaches have attracted many research scientists, decision makers and practicing researchers in recent years as powerful intelligent computational techniques for solving several complex real-world problems. The Handbook of Research on Modern Optimization Algorithms and Applications in Engineering and Economics highlights the latest research innovations and applications of algorithms designed for optimization applications within the fields of engineering, IT, and economics. Focusing on a variety of methods and systems as well as practical examples, this book is a significant resource for graduate-level students, decision makers, and researchers in both public and private sectors who are seeking research-based methods for modeling uncertain real-world problems. .

Handbook of Research on Modern Optimization Algorithms and Applications in Engineering and Economics

This book presents a structured approach to formulate, model, and solve mathematical optimization problems for a wide range of real world situations. Among the problems covered are production, distribution and supply chain planning, scheduling, vehicle routing, as well as cutting stock, packing, and nesting. The optimization techniques used to solve the problems are primarily linear, mixed-integer linear, nonlinear, and mixed integer nonlinear programming. The book also covers important considerations for solving real-world optimization problems, such as dealing with valid inequalities and symmetry during the modeling phase, but also data interfacing and visualization of results in a more and more digitized world. The broad range of ideas and approaches presented helps the reader to learn how to model a variety of problems from process industry, paper and metals industry, the energy sector, and logistics using mathematical optimization techniques.

Business Optimization Using Mathematical Programming

The articles that comprise this distinguished annual volume for the Advances in Mechanics and Mathematics series have been written in honor of Gilbert Strang, a world renowned mathematician and exceptional person. Written by leading experts in complementarity, duality, global optimization, and quantum computations, this collection reveals the beauty of these mathematical disciplines and investigates recent developments in global optimization, nonconvex and nonsmooth analysis, nonlinear programming, theoretical and engineering mechanics, large scale computation, quantum algorithms and computation, and information theory.

Advances in Applied Mathematics and Global Optimization

This book constitutes the post-conference proceedings of the 5th International Conference on Machine Learning, Optimization, and Data Science, LOD 2019, held in Siena, Italy, in September 2019. The 54 full papers presented were carefully reviewed and selected from 158 submissions. The papers cover topics in the field of machine learning, artificial intelligence, reinforcement learning, computational optimization and data science presenting a substantial array of ideas, technologies, algorithms, methods and applications.

Machine Learning, Optimization, and Data Science

This book presents the XXII Congress of APDIO – IO 2022 which is the 22nd edition of the regular meeting of the Portuguese Association of Operational Research (APDIO). The APDIO regular meetings aim to gather Portuguese and international researchers, scholars and practitioners, as well as M.Sc. and Ph.D. students, working in the field of Operations Research to present and discuss their latest research works. The main theme of the XXII Congress of APDIO is OR in Turbulent Times: Adaptation and Resilience. Readers find interesting results and applications of Operational Research cutting-edge methods and techniques in the wide variety of the addressed problems. Of particular interest are the applications of, among others, linear, nonlinear and mixed-integer programing, multiobjective optimization, metaheuristics and hybrid heuristics, multicriteria decision analysis, data envelopment analysis, simulation, clustering techniques and decision support systems, in different areas such as, supply chain

management, scheduling problems, production management, logistics, energy, telecommunications, finance and health.

Operational Research

This book focuses on the tremendous development that has taken place recently in the field of of nondifferentiable nonconvex optimization. Coverage includes the formulation of optimality conditions using different kinds of generalized derivatives for set-valued mappings (such as, for example, the co-derivative of Mordukhovich), the opening of new applications (the calibration of water supply systems), and the elaboration of new solution algorithms (e.g., smoothing methods).

Optimization with Multivalued Mappings

This proceedings volume addresses advances in global optimization—a multidisciplinary research field that deals with the analysis, characterization and computation of global minima and/or maxima of nonlinear, non-convex and nonsmooth functions in continuous or discrete forms. The volume contains selected papers from the third biannual World Congress on Global Optimization in Engineering & Science (WCGO), held in the Yellow Mountains, Anhui, China on July 8-12, 2013. The papers fall into eight topical sections: mathematical programming; combinatorial optimization; duality theory; topology optimization; variational inequalities and complementarity problems; numerical optimization; stochastic models and simulation and complex simulation and supply chain analysis.

Advances in Global Optimization

This book presents the proceedings of the 8th International Workshop on Soft Computing Applications, SOFA 2018, held on 13–15 September 2018 in Arad, Romania. The workshop was organized by Aurel Vlaicu University of Arad, in conjunction with the Institute of Computer Science, Iasi Branch of the Romanian Academy, IEEE Romanian Section, Romanian Society of Control Engineering and Technical Informatics – Arad Section, General Association of Engineers in Romania – Arad Section and BTM Resources Arad. The papers included in these proceedings, published post-conference, cover the research including Knowledge-Based Technologies for Web Applications, Cloud Computing, Security Algorithms and Computer Networks, Business Process Management, Computational Intelligence in Education and Modelling and Applications in Textiles and many other areas related to the Soft Computing. The book is directed to professors, researchers, and graduate students in area of soft computing techniques and applications.

Soft Computing Applications

This volume constitutes the thoroughly refereed post-conference proceedings of the 5th International Conference on Swarm, Evolutionary, and Memetic Computing, SEMCCO 2014, held in Bhubaneswar, India, in December 2014. The total of 96 papers presented in this volume was carefully reviewed and selected from 250 submissions for inclusion in the proceedings. The papers cover a wide range of topics in swarm, evolutionary, memetic and other intelligent computing algorithms and their real world applications in problems selected from diverse domains of science and engineering.

Swarm, Evolutionary, and Memetic Computing

In the twenty-first century the sustainability of energy and transportation systems is on the top of the political agenda in many countries around the world. Environmental impacts of human economic activity necessitate the consideration of conflicting goals in decision making processes to develop sustainable systems. Any sustainable development has to reconcile conflicting economic and environmental objectives and criteria. The science of multiple criteria decision making has a lot to offer in addressing this need. Decision making with multiple (conflicting) criteria is the topic of research that is at the heart of the International Society of Multiple Criteria Decision Making. This book is based on selected papers presented at the societies 19th International Conference, held at The University of Auckland, New Zealand, from 7th to 12th January 2008 under the theme "MCDM for Sustainable Energy and Transportation Systems".

Multiple Criteria Decision Making for Sustainable Energy and Transportation Systems

This book constitutes the refereed proceedings of the 8th International Conference on Evolutionary Multi-Criterion Optimization, EMO 2015 held in Guimarães, Portugal in March/April 2015. The 68

revised full papers presented together with 4 plenary talks were carefully reviewed and selected from 90 submissions. The EMO 2015 aims to continue these type of developments, being the papers presented focused in: theoretical aspects, algorithms development, many-objectives optimization, robustness and optimization under uncertainty, performance indicators, multiple criteria decision making and real-world applications.

Evolutionary Multi-Criterion Optimization

Nonconvex Optimization is a multi-disciplinary research field that deals with the characterization and computation of local/global minima/maxima of nonlinear, nonconvex, nonsmooth, discrete and continuous functions. Nonconvex optimization problems are frequently encountered in modeling real world systems for a very broad range of applications including engineering, mathematical economics, management science, financial engineering, and social science. This contributed volume consists of selected contributions from the Advanced Training Programme on Nonconvex Optimization and Its Applications held at Banaras Hindu University in March 2009. It aims to bring together new concepts, theoretical developments, and applications from these researchers. Both theoretical and applied articles are contained in this volume which adds to the state of the art research in this field. Topics in Nonconvex Optimization is suitable for advanced graduate students and researchers in this area.

Topics in Nonconvex Optimization

This book constitutes the refereed proceedings of the 7th International Symposium on Integrated Uncertainty in Knowledge Modelling and Decision Making, IUKM 2019, held in Nara, Japan, in March 2019. The 37 revised full papers presented were carefully reviewed and selected from 93 submissions. The papers deal with all aspects of uncertainty modelling and management and are organized in topical sections on uncertainty management and decision support; econometrics; machine learning; machine learning applications; and statistical methods.

Integrated Uncertainty in Knowledge Modelling and Decision Making

Operations Research (OR) is a fast-evolving field, which is having a significant impact on its neighbouring disciplines of Business Analytics and Data Science, and on contemporary business and management practices. This handbook provides a comprehensive and cutting edge collection of studies in the area. Views differ on what should be included within the scope of OR. The editors of this volume have taken the view that an inclusive stance is the most helpful, both for theory and practice. Real-world problems often require consideration from both ‘softer’ and ‘harder’ perspectives and need consideration of both predictive and prescriptive problems. In accordance with this inclusive approach to OR, the book is divided into six parts, covering Discrete Optimization, Continuous Optimization, Heuristic Search Optimization, Forecasting, Simulation and Prediction, Problem Structuring and Behavioural OR, and finally some recent OR Applications. This wide-ranging handbook includes a culturally diverse collection of authors, with different perspectives and backgrounds around Operations Research. It will be of tremendous value to researchers, students and practitioners in the field of OR

The Palgrave Handbook of Operations Research

Among the various multi-level formulations of mathematical models in decision making processes, this book focuses on the bi-level model. Being the most frequently used, the bi-level model addresses conflicts which exist in multi-level decision making processes. From the perspective of bi-level structure and uncertainty, this book takes real-life problems as the background, focuses on the so-called random-like uncertainty, and develops the general framework of random-like bi-level decision making problems. The random-like uncertainty considered in this book includes random phenomenon, random-overlapped random (Ra-Ra) phenomenon and fuzzy-overlapped random (Ra-Fu) phenomenon. Basic theory, models, algorithms and practical applications for different types of random-like bi-level decision making problems are also presented in this book.

Random-Like Bi-level Decision Making

This volume contains the extended versions of papers presented at the 3rd International Conference on Computer Science, Applied Mathematics and Applications (ICCSAMA 2015) held on 11-13 May, 2015 in Metz, France. The book contains 5 parts: 1. Mathematical programming and optimization: theory, methods and software, Operational research and decision making, Machine learning, data security,

and bioinformatics, Knowledge information system, Software engineering. All chapters in the book discuss theoretical and algorithmic as well as practical issues connected with computation methods & optimization methods for knowledge engineering and machine learning techniques.

Advanced Computational Methods for Knowledge Engineering

Global Optimization has emerged as one of the most exciting new areas of mathematical programming. Global optimization has received a wide attraction from many fields in the past few years, due to the success of new algorithms for addressing previously intractable problems from diverse areas such as computational chemistry and biology, biomedicine, structural optimization, computer sciences, operations research, economics, and engineering design and control. This book contains refereed invited papers submitted at the 4th international confer ence on Frontiers in Global Optimization held at Santorini, Greece during June 8-12, 2003. Santorini is one of the few sites of Greece, with wild beauty created by the explosion of a volcano which is in the middle of the gulf of the island. The mystic landscape with its numerous mult-extrema, was an inspiring location particularly for researchers working on global optimization. The three previous conferences on "Recent Advances in Global Opti mization\

Frontiers in Global Optimization

This monograph presents new developments in multi-level decision-making theory, technique and method in both modeling and solution issues. It especially presents how a decision support system can support managers in reaching a solution to a multi-level decision problem in practice. This monograph combines decision theories, methods, algorithms and applications effectively. It discusses in detail the models and solution algorithms of each issue of bi-level and tri-level decision-making, such as multi-leaders, multi-followers, multi-objectives, rule-set-based, and fuzzy parameters. Potential readers include organizational managers and practicing professionals, who can use the methods and software provided to solve their real decision problems; PhD students and researchers in the areas of bi-level and multi-level decision-making and decision support systems; students at an advanced undergraduate, master’s level in information systems, business administration, or the application of computer science.

Multi-Level Decision Making

This two-volume book gathers the proceedings of the Sixth International Conference on Soft Computing for Problem Solving (SocProS 2016), offering a collection of research papers presented during the conference at Thapar University, Patiala, India. Providing a veritable treasure trove for scientists and researchers working in the field of soft computing, it highlights the latest developments in the broad area of “Computational Intelligence” and explores both theoretical and practical aspects using fuzzy logic, artificial neural networks, evolutionary algorithms, swarm intelligence, soft computing, computational intelligence, etc.

Proceedings of Sixth International Conference on Soft Computing for Problem Solving

Graph theory is very much tied to the geometric properties of optimization and combinatorial optimization. Moreover, graph theory's geometric properties are at the core of many research interests in operations research and applied mathematics. Its techniques have been used in solving many classical problems including maximum flow problems, independent set problems, and the traveling salesman problem. Graph Theory and Combinatorial Optimization explores the field's classical foundations and its developing theories, ideas and applications to new problems. The book examines the geometric properties of graph theory and its widening uses in combinatorial optimization theory and application. The field's leading researchers have contributed chapters in their areas of expertise.

Graph Theory and Combinatorial Optimization

This book constitutes the refereed proceedings of the 6th International Conference on Simulated Evolution and Learning, SEAL 2006, held in Hefei, China in October 2006. The 117 revised full papers presented were carefully reviewed and selected from 420 submissions.

Simulated Evolution and Learning

In a rapidly developing field like Operations Research, its easy to get overwhelmed by the variety of topics and analytic techniques. Paul Jensen and Jonathan Bard help you master the expensive

field by focusing on the fundamental models and methodologies underlying the practice of Operations Research. Bridging the gap between theory and practice, the author presents the quantitative tools and models most important to understanding modern operations research. You'll come to appreciate the power of OR techniques in solving real-world problems and applications in your own field. You'll learn how to translate complex situations into mathematical models, solve models and turn models into solutions. This text is designed to bridge the gap between theory and practice by presenting the quantitative tools and models most suited for modern operations research. The principal goal is to give analysts, engineers, and decision makers a larger appreciation of their roles by defining a common terminology and by explaining the interfaces between the underlying methodologies. Features Divides each subject into methods and models, giving you greater flexibility in how you approach the material. Concise and focused presentation highlights central ideas. Many examples throughout the text will help you better understand mathematical material.

Operations Research Models and Methods

This book paves the way for researchers working on the sustainable interdependent networks spread over the fields of computer science, electrical engineering, and smart infrastructures. It provides the readers with a comprehensive insight to understand an in-depth big picture of smart cities as a thorough example of interdependent large-scale networks in both theory and application aspects. The contributors specify the importance and position of the interdependent networks in the context of developing the sustainable smart cities and provide a comprehensive investigation of recently developed optimization methods for large-scale networks. There has been an emerging concern regarding the optimal operation of power and transportation networks. In the second volume of Sustainable Interdependent Networks book, we focus on the interdependencies of these two networks, optimization methods to deal with the computational complexity of them, and their role in future smart cities. We further investigate other networks, such as communication networks, that indirectly affect the operation of power and transportation networks. Our reliance on these networks as global platforms for sustainable development has led to the need for developing novel means to deal with arising issues. The considerable scale of such networks, due to the large number of buses in smart power grids and the increasing number of electric vehicles in transportation networks, brings a large variety of computational complexity and optimization challenges. Although the independent optimization of these networks lead to locally optimum operation points, there is an exigent need to move towards obtaining the globally-optimum operation point of such networks while satisfying the constraints of each network properly. The book is suitable for senior undergraduate students, graduate students interested in research in multidisciplinary areas related to future sustainable networks, and the researchers working in the related areas. It also covers the application of interdependent networks which makes it a perfect source of study for audience out of academia to obtain a general insight of interdependent networks.

Sustainable Interdependent Networks II