

Tony Hürlimann

MATHEMATICAL MODELING AND OPTIMIZATION

**An Essay for the Design
of Computer-Based
Modeling Tools**

Springer-Science+Business Media, B.V.

Mathematical Modeling And Optimization An Essay For The Design Of Computer Based Modeling Tools

Tao Wei



Mathematical Modeling And Optimization An Essay For The Design Of Computer Based Modeling Tools:

Mathematical Modeling and Optimization Tony Hürlimann, 2013-03-14 Computer based mathematical modeling the technique of representing and managing models in machine readable form is still in its infancy despite the many powerful mathematical software packages already available which can solve astonishingly complex and large models On the one hand using mathematical and logical notation we can formulate models which cannot be solved by any computer in reasonable time or which cannot even be solved by any method On the other hand we can solve certain classes of much larger models than we can practically handle and manipulate without heavy programming This is especially true in operations research where it is common to solve models with many thousands of variables Even today there are no general modeling tools that accompany the whole modeling process from start to finish that is to say from model creation to report writing This book proposes a framework for computer based modeling More precisely it puts forward a modeling language as a kernel representation for mathematical models It presents a general specification for modeling tools The book does not expose any solution methods or algorithms which may be useful in solving models neither is it a treatise on how to build them No help is intended here for the modeler by giving practical modeling exercises although several models will be presented in order to illustrate the framework Nevertheless a short introduction to the modeling process is given in order to expound the necessary background for the proposed modeling framework Modeling Languages in Mathematical Optimization Josef Kallrath, 2013-12-01 This volume presents a unique combination of modeling and solving real world optimization problems It is the only book which treats systematically the major modeling languages and systems used to solve mathematical optimization problems and it also provides a useful overview and orientation of today's modeling languages in mathematical optimization It demonstrates the strengths and characteristic features of such languages and provides a bridge for researchers practitioners and students into a new world solving real optimization problems with the most advances modeling systems **Mathematical Modeling in Economics, Ecology and the Environment** N.V. Hritonenko, Yuri P.

Yatsenko, 2013-04-17 The problems of interrelation between human economics and natural environment include scientific technical economic demographic social political and other aspects that are studied by scientists of many specialities One of the important aspects in scientific study of environmental and ecological problems is the development of mathematical and computer tools for rational management of economics and environment This book introduces a wide range of mathematical models in economics ecology and environmental sciences to a general mathematical audience with no in depth experience in this specific area Areas covered are controlled economic growth and technological development world dynamics environmental impact resource extraction air and water pollution propagation ecological population dynamics and exploitation A variety of known models are considered from classical ones Cobb Douglass production function Leontief input output analysis Solow models of economic dynamics Verhulst Pearl and Lotka Volterra models of population dynamics and

others to the models of world dynamics and the models of water contamination propagation used after Chernobyl nuclear catastrophe. Special attention is given to modelling of hierarchical regional economic ecological interaction and technological change in the context of environmental impact.

XIII XIV Construction of Mathematical Models *Modeling for Decision Support in Network-Based Services* Daniel Dolk, Janusz Granat, 2012-01-16 This book originated from several recent workshops and related activities conducted by the IFIP Working Group 7.6 on Optimization Based Computer Aided Modeling and Design. This group has been active for 20 years with the stated objective of developing high performance computer aided systems to support modeling, decision analysis, optimization and multi criteria decision making. Recently the group has turned its attention to the application of modeling and optimization to service science, management and engineering. SSME is still a young research field searching for its theoretical underpinnings and one which offers many opportunities for analytical modeling to not only advance the understanding but also to help form the foundation of a new discipline. This book is the result of the group's introductory foray into the application of quantitative modeling to the nascent field of service science with special emphasis on the network aspects of services. The 11 papers presented are grouped into sections on Network Science, Computational and Analytical Modeling and Knowledge Science. They showcase the value of modeling in a new and timely context and provide many seeds for further exciting research.

Nonlinear Optimization Applications Using the GAMS Technology Neculai Andrei, 2013-06-22 Here is a collection of nonlinear optimization applications from the real world expressed in the General Algebraic Modeling System GAMS. The concepts are presented so that the reader can quickly modify and update them to represent real world situations.

Hierarchical Optimization and Mathematical Physics Vladimir Tsurkov, 2013-11-21 This book should be considered as an introduction to a special class of hierarchical systems of optimal control where subsystems are described by partial differential equations of various types. Optimization is carried out by means of a two level scheme where the center optimizes coordination for the upper level and subsystems find the optimal solutions for independent local problems. The main algorithm is a method of iterative aggregation. The coordinator solves the problem with macrovariables whose number is less than the number of initial variables. This problem is often very simple. On the lower level we have the usual optimal control problems of mathematical physics which are far simpler than the initial statements. Thus the decomposition or reduction to problems of less dimensions is obtained. The algorithm constructs a sequence of so called disaggregated solutions that are feasible for the main problem and converge to its optimal solution under certain assumptions e.g. under strict convexity of the input functions. Thus we bridge the gap between two disciplines: optimization theory of large scale systems and mathematical physics. The first motivation was a special model of branch planning where the final product obeys a preset assortment relation. The ratio coefficient is maximized. Constraints are given in the form of linear inequalities with block diagonal structure of the part of a matrix that corresponds to subsystems. The central coordinator assembles the final production from the components produced by the subsystems.

Cooperative Control and Optimization Robert Murphey, Panos M. Pardalos, 2006-04-18 A cooperative system is defined to be multiple dynamic entities that share information or tasks to accomplish a common though perhaps not singular objective. Examples of cooperative control systems might include robots operating within a manufacturing cell, unmanned aircraft in search and rescue operations or military surveillance and attack missions, arrays of micro satellites that form a distributed large aperture radar, employees operating within an organization and software agents. The term entity is most often associated with vehicles capable of physical motion such as robots, automobiles, ships and aircraft, but the definition extends to any entity concept that exhibits a time dependent behavior. Critical to cooperation is communication which may be accomplished through active message passing or by passive observation. It is assumed that cooperation is being used to accomplish some common purpose that is greater than the purpose of each individual, but we recognize that the individual may have other objectives as well, perhaps due to being a member of other caucuses. This implies that cooperation may assume hierarchical forms as well. The decision making processes, control, are typically thought to be distributed or decentralized to some degree. For if not, a cooperative system could always be modeled as a single entity. The level of cooperation may be indicated by the amount of information exchanged between entities. Cooperative systems may involve task sharing and can consist of heterogeneous entities. Mixed initiative systems are particularly interesting heterogeneous systems since they are composed of humans and machines. Finally, one is often interested in how cooperative systems perform under noisy or adversary conditions. In December 2000, the Air Force Research Laboratory and the University of Florida successfully hosted the first Workshop on Cooperative Control and Optimization in Gainesville, Florida. This book contains selected refereed papers summarizing the participants' research in control and optimization of cooperative systems. Audience: Faculty, graduate students and researchers in optimization and control, computer sciences and engineering.

Mixed-Mode Modelling: Mixing Methodologies For Organisational Intervention M.G. Nicholls, S.A. Clarke, B. Lehaney, 2013-12-01 The 1980s and 1990s have seen a growing interest in research and practice in the use of methodologies within problem contexts characterised by a primary focus on technology, human issues or power. During the last five to ten years, this has given rise to challenges regarding the ability of a single methodology to address all such contexts and the consequent development of approaches which aim to mix methodologies within a single problem situation. This has been particularly so where the situation has called for a mix of technological, the so called hard and human centred, so called soft methods. The approach developed has been termed mixed mode modelling. The area of mixed mode modelling is relatively new, with the phrase being coined approximately four years ago by Brian Lehaney in a keynote paper published at the 1996 Annual Conference of the UK Operational Research Society. Mixed mode modelling, as suggested above, is a new way of considering problem situations faced by organisations. Traditional technological approaches used in management science have suffered criticisms relating to their adequacy in the past few decades and these hard approaches have been replaced by soft methods which consider

process more relevant than outcome However the sole use of human centred approaches to organisational problems has also proved to be inadequate Mixed mode modelling accepts the importance of both process and outcome and provides enabling mechanisms for hard and soft investigation to be undertaken *Building Model Driven Decision Support Systems with Dicodess* Alexandre Gachet,2004 Separable Programming S.M. Stefanov,2013-11-11 In this book the author considers separable programming and in particular one of its important cases convex separable programming Some general results are presented techniques of approximating the separable problem by linear programming and dynamic programming are considered Convex separable programs subject to inequality equality constraint s and bounds on variables are also studied and iterative algorithms of polynomial complexity are proposed As an application these algorithms are used in the implementation of stochastic quasigradient methods to some separable stochastic programs Numerical approximation with respect to l_1 and l_4 norms as a convex separable nonsmooth unconstrained minimization problem is considered as well Audience Advanced undergraduate and graduate students mathematical programming operations research specialists

Aspects of Semidefinite Programming E. de Klerk,2006-04-18 Semidefinite programming has been described as linear programming for the year 2000 It is an exciting new branch of mathematical programming due to important applications in control theory combinatorial optimization and other fields Moreover the successful interior point algorithms for linear programming can be extended to semidefinite programming In this monograph the basic theory of interior point algorithms is explained This includes the latest results on the properties of the central path as well as the analysis of the most important classes of algorithms Several classic applications of semidefinite programming are also described in detail These include the Lov sz theta function and the MAX CUT approximation algorithm by Goemans and Williamson Audience Researchers or graduate students in optimization or related fields who wish to learn more about the theory and applications of semidefinite programming **Transportation Planning** Michael Patriksson,Martine Labbé,2006-04-18 This book collects selected presentations of the Meeting of the EURO Working Group on Transportation which took place at the Department of Mathematics at Chalmers University of Technology G teborg or Gothenburg Sweden September 9 11 1998 The EURO Working Group on Transportation was founded at the end of the 7th EURO Summer Institute on Urban Traffic Management which took place in Cetraro Italy June 21 July 1991 There were around 30 founding members of the Working Group a number which now has grown to around 150 Meetings since then include Paris 1993 Barcelona 1994 and Newcastle 1996 About 100 participants were present enjoying healthy rain and a memorable conference dinner in the Feskek rka The total number of presentations at the conference was about 60 coming from quite diverse areas within the field of operations research in transportation and covering all modes of transport Deterministic traffic equilibrium models 6 papers Stochastic traffic equilibrium models 5 papers Combined traffic models 3 papers Dynamic traffic models 7 papers Simulation models 4 papers Origin destination matrix estimation 2 papers Urban public transport models 8 papers Aircraft scheduling 1 paper Ship routing 2 papers

Railway planning and scheduling 6 papers Vehicle routing 3 papers Traffic management 3 papers Signal control models 3 papers Transportation systems analysis 5 papers ix x TRANSPORTATION PLANNING Among these papers 14 were eventually selected to be included in this volume *Multicriteria Decision Aid Classification Methods* Michael Doumpos, Constantin Zopounidis, 2006-04-18 The book discusses a new approach to the classification problem following the decision support orientation of multicriteria decision aid The book reviews the existing research on the development of classification methods investigating the corresponding model development procedures and providing a thorough analysis of their performance both in experimental situations and real world problems from the field of finance Audience Researchers and professionals working in management science decision analysis operations research financial banking analysis economics statistics computer science as well as graduate students in management science and operations research

Intelligent Control Systems Gábor Szederkényi, R. Lakner, M. Gerzson, 2006-04-18 Intelligent control is a rapidly developing complex and challenging field with great practical importance and potential Because of the rapidly developing and interdisciplinary nature of the subject there are only a few edited volumes consisting of research papers on intelligent control systems but little is known and published about the fundamentals and the general know how in designing implementing and operating intelligent control systems Intelligent control system emerged from artificial intelligence and computer controlled systems as an interdisciplinary field Therefore the book summarizes the fundamentals of knowledge representation reasoning expert systems and real time control systems and then discusses the design implementation verification and operation of real time expert systems using G2 as an example Special tools and techniques applied in intelligent control are also described including qualitative modelling Petri nets and fuzzy controllers The material is illustrated with simple examples taken from the field of intelligent process control *Transportation Systems Engineering* Ennio Cascetta, 2001-02-28 This book provides a rigorous and comprehensive coverage of transportation models and planning methods and is a must have to anyone in the transportation community including students teachers and practitioners Moshe Ben Akiva Massachusetts Institute of Technology **Scheduling: Control-Based Theory and Polynomial-Time**

Algorithms K. Kogan, E. Khmelnitsky, 2013-11-27 This book presents a first attempt to systematically collect classify and solve various continuous time scheduling problems The classes of problems distinguish scheduling by the number of machines and products production constraints and performance measures Although such classes are usually considered to be a prerogative of only combinatorial scheduling literature the scheduling methodology suggested in this book is based on two mathematical tools optimal control and combinatorics Generally considered as belonging to two totally different areas of research and application these seemingly irreconcilable tools can be integrated in a unique solution approach with the advantages of both This new approach provides the possibility of developing effective polynomial time algorithms to solve the generic scheduling problems This book is aimed at a student audience final year undergraduates as well as master and Ph D

students primarily in Operations Research Management Industrial Engineering and Control Systems Indeed some of the material in the book has formed part of the content of undergraduate and graduate courses taught at the Industrial Engineering Department of Tel Aviv University the Logistics Department of Bar Ilan University and the Technology Management Department of Rolon Center for Technological Education Israel The book is also useful for practicing engineers interested in planning scheduling and optimization methods Since the book addresses the theory and design of computer based scheduling algorithms applied mathematicians and computer software specialists engaged in developing scheduling software for industrial engineering and management problems will find that the methods developed here can be embedded very efficiently in large applications

Intelligent Decision Aiding Systems Based on Multiple Criteria for Financial Engineering Constantin Zopounidis, Michael Doumpos, 2013-11-27 This book provides a new point of view on the field of financial engineering through the application of multicriteria intelligent decision aiding systems The aim of the book is to provide a review of the research in the area and to explore the adequacy of the tools and systems developed according to this innovative approach in addressing complex financial decision problems encountered within the field of financial engineering Audience Researchers and professionals such as financial managers financial engineers investors operations research specialists computer scientists management scientists and economists

Filter Design With Time Domain Mask Constraints: Theory and Applications Ba-Ngu Vo, Antonio Cantoni, Kok Lay Teo, 2001-10-31 Optimum envelope constrained filter design is concerned with time domain synthesis of a filter such that its response to a specific input signal stays within prescribed upper and lower bounds while minimizing the impact of input noise on the filter output or the impact of the shaped signal on other systems depending on the application In many practical applications such as in TV channel equalization digital transmission and pulse compression applied to radar sonar and detection the soft least square approach which attempts to match the output waveform with a specific desired pulse is not the most suitable one Instead it becomes necessary to ensure that the response stays within the hard envelope constraints defined by a set of continuous inequality constraints The main advantage of using the hard envelope constrained filter formulation is that it admits a whole set of allowable outputs From this set one can then choose the one which results in the minimization of a cost function appropriate to the application at hand The signal shaping problems so formulated are semi infinite optimization problems This monograph presents in a unified manner results that have been generated over the past several years and are scattered in the research literature The material covered in the monograph includes problem formulation numerical optimization algorithms filter robustness issues and practical examples of the application of envelope constrained filter design Audience Postgraduate students researchers in optimization and telecommunications engineering and applied mathematicians

Large-scale Optimization Vladimir Tsurkov, 2013-03-09 Decomposition methods aim to reduce large scale problems to simpler problems This monograph presents selected aspects of the dimension reduction problem Exact and approximate

aggregations of multidimensional systems are developed and from a known model of input output balance aggregation methods are categorized The issues of loss of accuracy recovery of original variables disaggregation and compatibility conditions are analyzed in detail The method of iterative aggregation in large scale problems is studied For fixed weights successively simpler aggregated problems are solved and the convergence of their solution to that of the original problem is analyzed An introduction to block integer programming is considered Duality theory which is widely used in continuous block programming does not work for the integer problem A survey of alternative methods is presented and special attention is given to combined methods of decomposition Block problems in which the coupling variables do not enter the binding constraints are studied These models are worthwhile because they permit a decomposition with respect to primal and dual variables by two level algorithms instead of three level algorithms Audience This book is addressed to specialists in operations research optimization and optimal control

Progress in Optimization Xiao-qi Yang, Alistair I. Mees, Mike Fisher, Les Jennings, 2013-12-01 Optimization Day OD has been a series of annual mini conferences in Australia since 1994 The purpose of this series of events is to gather researchers in optimization and its related areas from Australia and their collaborators in order to exchange new developments of optimization theories methods and their applications The first four OD mini conferences were held in The University of Ballarat 1994 The University of New South Wales 1995 The University of Melbourne 1996 and Royal Melbourne Institute of Technology 1997 respectively They were all on the eastern coast of Australia The fifth mini conference Optimization Days was held at the Centre for Applied Dynamics and Optimization CADO Department of Mathematics and Statistics The University of Western Australia Perth from 29 to 30 June 1998 This is the first time the OD mini conference has been held at the western coast of Australia This fifth OD preceded the International Conference on Optimization Techniques and Applications ICOTA held at Curtin University of Technology Many participants attended both events There were 28 participants in this year's mini conference and 22 presentations in the mini conference The presentations in this volume are refereed contributions based on papers presented at the fifth Optimization Days mini conference The volume is divided into the following parts Global Optimization Nonsmooth Optimization Optimization Methods and Applications

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Introduction

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