

Effect of Seven Steps Approach on Simplex Method to Optimize the Mathematical Manipulation

Mohammad Rashid Hussain, Mohammed Qayyum, Mohammad Equebal Hussain

Abstract: the Simplex method is the most popular and successful method for solving linear programs. The objective function of linear programming problem (LPP) involves in the maximization and minimization problem with the set of linear equalities and inequalities constraints. There are different methods to solve LPP, such as simplex, dual-simplex, Big-M and two phase method. In this paper, an approach is presented to solve LPP with new seven steps process by choosing "key element rule" which is still widely used and remains important in practice. We propose a new technique i.e. seven step process in LPP for the simplex, dual-simplex, Big-M and two phase methods to get the solution with complexity reduction. The complexity reduction is done by eliminating the number of elementary row transformation operation in simplex tableaux of identity matrix. By the proposed technique elementary transformation of operation has completely avoided and we can achieve the results in considerable duration.

Index Terms: Linear programming problem (LPP), Key element (KE), Key column (KC), Key row (KR), Profit per unit (PPU), Random variables (RV), Linear Gaussian Random variables (LGRV), standard deviation (SD), Probability Density Function (PDF)

I. INTRODUCTION

To solve a LPP, simplex method is the popular and widely used method. Simplex model in Simulink for ease in visualization and simulation in Systems Generator are used to achieve a fast implementation. It is efficient tableaux based representation and the clock frequency achieved by such design is compared with that in general purpose software [26]. There are some certain steps are needed to solve LPP using Simplex method to implement in Standard form and it is necessary to linear programs before solving the optimal solution. There are some important requirements for the solving of LPP and to optimize: (1) If the objective function is in minimization form, it has to change to maximization (2) All linear constraints must be \leq inequality. (3) All variables must be non-negative. The above three requirements must be satisfied by converting given linear program by using basic algebra and substitution then determine slack variables i.e. To change inequality constraints to equality constraints there are some additional variables have been introduced into the

linear constraints of linear program. The slack variables always have a +1 coefficient when the model is in standard form. For optimality the slack variables are introduced. By using the slack variables concept, the coefficient of objective function can be modified. According to the nature of problem it can be easily implemented on computer and these methods overcome the limitations of graphical method and the unnecessary iterations in the search can be skipped. We proposed an approach of seven steps process which resolved certain complication encountered in the application of the simplex method and feasible solution is obtained in iteration first and optimal solution can be obtained. For the efficient solution of large scale LPP some techniques and computational results have been introduced to predict permanent basic and non-random basic variables to implement in linear programming codes to save the computation time by eliminating the number of elementary row transformation operation. In implementation part(V), our proposed approach have introduced in detail with our seven steps process, by using last two steps in simplex tableaux, the elementary row transformation operation are completely eliminated.

The general form of a linear program is $\text{Max } (Z) = C^T X$
Subject to $AX \leq b, X \geq 0$

Where A is a $m \times n$ matrix, C is a n -vector and b is an m -vector.

$(A)_{m \times n}, X \leq b_{m \times 1}, X_i, i=1,2,\dots,n$

$$\begin{pmatrix} 2 & 1 \\ 2 & 3 \end{pmatrix}_{m \times n} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}_{n \times 1} + s_m = \begin{pmatrix} 8 \\ 12 \end{pmatrix}_{m \times 1}$$

We get linear system with 5 variables and 3 equations.
Initial simplex tableau:

| | x_1 | x_2 | s_1 | s_2 | P | |
|-------|-------|-------|-------|-------|---|----|
| KR | 2 | 1 | 1 | 0 | 0 | 8 |
| | | | | | | |
| s_2 | -3 | 3 | 0 | 1 | 0 | 12 |
| P | | -1 | 0 | 0 | 1 | |
| KC | | | | | | |

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Research Journals On Simplex Method In Mathematics

Stephen Smale, Roderick Wong



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technology underlying standardization *Complex Scheduling* Peter Brucker, Sigrid Knust, 2006-04-26 Scheduling problems have been investigated since the late fties Two types of applications have mainly motivated research in this area project planning and machine scheduling While in machine scheduling a large number of speci c scheduling situations depending on the machine environment and the job c racteristicshavebeenconsidered theearlyworkingprojectplanninginvestigated scheduling situations with precedence constraints between activities assuming that su cient resources are available to perform the activities More recently in project scheduling scarce resources have been taken into account leading to so called resource constrained project scheduling problems On the other hand also in machine scheduling more general and complex problems have been vestigated Due to these developments today both areas are much closer to each other Furthermore applications like timetabling rostering or industrial scheduling are connected to both areas This book deals with such complex scheduling problems and methods to solve them It consists of three parts The rst part Chapters 1 and 2 contains a description of basic scheduling models with applications and an introduction into discrete optimization covering complexity shortest path algorithms linear programming network ow algorithms and general optimization methods In the second part Chapter 3 resource constrained project scheduling problems are considered Especially methods like constraint propagation branch a bound algorithms and heuristic procedures are described Furthermore lower bounds and general objective functions are discussed **Linear Programming and Network Flows** Mokhtar S. Bazaraa, John J. Jarvis, Hanif D. Sherali, 2011-09-28 The authoritative guide to modeling and solving complex problems with linear programming extensively revised expanded and updated The only book to treat both linear programming techniques and network flows under one cover Linear Programming and Network Flows Fourth Edition has been completely updated with the latest developments on the topic This new edition continues to successfully emphasize modeling concepts the design and analysis of algorithms and implementation strategies for problems in a variety of fields including industrial engineering management science operations research computer science and mathematics The book begins with basic results on linear algebra and convex analysis and a geometrically motivated study of the structure of polyhedral sets is provided Subsequent chapters include coverage of cycling in the simplex method interior point methods and sensitivity and parametric analysis Newly added topics in the Fourth Edition include The cycling phenomenon in linear programming and the geometry of cycling Duality relationships with cycling Elaboration on stable factorizations and implementation strategies Stabilized column generation and acceleration of Benders and Dantzig Wolfe decomposition methods Line search and dual ascent ideas for the out of kilter algorithm Heap implementation comments negative cost circuit insights and additional convergence analyses for shortest path problems The authors present concepts and techniques that are illustrated by numerical examples along with insights complete with detailed mathematical analysis and justification An emphasis is placed on providing geometric viewpoints and economic interpretations as well as strengthening the understanding of the fundamental ideas Each chapter is accompanied

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Parallel Scientific Computing and Optimization Raimondas Ciegis, David Henty, Bo Kågström, Julius Žilinskas, 2008-10-08 Parallel Scientific Computing and Optimization introduces new developments in the construction analysis and implementation of parallel computing algorithms This book presents 23 self contained chapters including survey chapters and surveys written by distinguished researchers in the field of parallel computing Each chapter is devoted to some aspects of the subject parallel algorithms for matrix computations parallel optimization management of parallel programming models and data with the largest focus on parallel scientific computing in industrial applications This volume is intended for scientists and graduate students specializing in computer science and applied mathematics who are engaged in parallel scientific computing

Integer and Combinatorial Optimization Laurence A. Wolsey, George L. Nemhauser, 2014-08-28 Rave reviews for INTEGER AND COMBINATORIAL OPTIMIZATION This book provides an excellent introduction and survey of traditional fields of combinatorial optimization It is indeed one of the best and most complete texts on combinatorial optimization available And with more than 700 entries it has quite an exhaustive reference list Optima A unifying approach to optimization problems is to formulate them like linear programming problems while restricting some or all of the variables to the integers This book is an encyclopedic resource for such formulations as well as for understanding the structure of and solving the resulting integer programming problems Computing Reviews This book can serve as a basis for various graduate courses on discrete optimization as well as a reference book for researchers and practitioners Mathematical Reviews This comprehensive and wide ranging book will undoubtedly become a standard reference book for all those in the field of combinatorial optimization Bulletin of the London Mathematical Society This text should be required reading for anybody who intends to do research in this area or even just to keep abreast of developments Times Higher Education Supplement London Also of interest INTEGER PROGRAMMING Laurence A Wolsey Comprehensive and self contained this intermediate level guide to integer programming provides readers with clear up to date explanations on why some problems are difficult to solve how techniques can be reformulated to give better results and how mixed integer programming systems can be used more effectively 1998 0 471 28366 5 260 pp

Linear Optimization and Extensions Manfred Padberg, 2013-04-17 I was pleasantly surprised when I was asked by Springer Verlag to prepare a second edition of this volume on Linear Optimization and Extensions which not exactly contrary to my personal expectations has apparently been accepted reasonably well by the global optimization community My objective in putting this book together was originally and still is to detail the major

algorithmic ideas in linear optimization that have evolved in the past fifty years or so and that have changed the historical optimization landscape in substantial ways both theoretically and computationally While I may have overlooked the importance of some very recent developments the work by Farid Alizadeh which generalizes linear programming to semidefinite programming is perhaps a candidate for one of my omissions I think that major new breakthroughs on those two fronts that interest me theory and computation have not occurred since this book was published originally As a consequence I have restricted myself to a thorough reworking of the original manuscript with the goal of making it more readable Of course I have taken this opportunity to correct a few Sch neitsfehler of the first edition and to add some illustrations The index to this volume has been extended substantially to permit a hurried reader a quicker glance at the wealth of topics that were covered nevertheless already in the first edition As was the case with the first edition Dr Parallel Processing and Applied Mathematics Roman Wyrzykowski, Jack Dongarra, Konrad Karczewski, Jerzy Wasniewski, 2012-07-03 This two volume set LNCS 7203 and 7204 constitutes the refereed proceedings of the 9th International Conference on Parallel Processing and Applied Mathematics PPAM 2011 held in Torun Poland in September 2011 The 130 revised full papers presented in both volumes were carefully reviewed and selected from numerous submissions The papers address issues such as parallel distributed architectures and mobile computing numerical algorithms and parallel numerics parallel non numerical algorithms tools and environments for parallel distributed grid computing applications of parallel distributed computing applied mathematics neural networks and evolutionary computing history of computing *The Collected Papers of Stephen Smale* Stephen Smale, Roderick Wong, 2000 This invaluable book contains the collected papers of Stephen Smale These are divided into eight groups topology calculus of variations dynamics mechanics economics biology electric circuits and mathematical programming theory of computation miscellaneous In addition each group contains one or two articles by world leaders on its subject which comment on the influence of Smale's work and another article by Smale with his own retrospective views *Combinatorial Optimization* Bernhard Korte, Jens Vygen, 2006-01-27 This well written textbook on combinatorial optimization puts special emphasis on theoretical results and algorithms with provably good performance in contrast to heuristics The book contains complete but concise proofs as well as many deep results some of which have not appeared in any previous books **Integer Programming and Combinatorial Optimization** Jon Lee, Jens Vygen, 2014-05-17 This book constitutes the refereed proceedings of the 17th International Conference on Integer Programming and Combinatorial Optimization IPCO 2014 held in Bonn Germany in June 2014 The 34 full papers presented were carefully reviewed and selected from 143 submissions The conference is a forum for researchers and practitioners working on various aspects of integer programming and combinatorial optimization The aim is to present recent developments in theory computation and applications in these areas The scope of IPCO is viewed in a broad sense to include algorithmic and structural results in integer programming and combinatorial optimization as well as revealing computational

studies and novel applications of discrete optimization to practical problems Collected Papers Of Stephen Smale, The (In 3 Volumes) - Volume 2 Roderick S C Wong, Felipe Cucker, 2000-06-30 This invaluable book contains the collected papers of Stephen Smale These are divided into eight groups topology calculus of variations dynamics mechanics economics biology electric circuits and mathematical programming theory of computation miscellaneous In addition each group contains one or two articles by world leaders on its subject which comment on the influence of Smale's work and another article by Smale with his own retrospective views Linear Programming Robert J Vanderbei, 2007-10-23 This Third Edition introduces the latest theory and applications in optimization It emphasizes constrained optimization beginning with linear programming and then proceeding to convex analysis network flows integer programming quadratic programming and convex optimization You'll discover a host of practical business applications as well as non business applications With its focus on solving practical problems the book features free C programs to implement the major algorithms covered The book's accompanying website includes the C programs JAVA tools and new online instructional tools and exercises High Performance Networking, Computing, and Communication Systems Yanwen Wu, 2011-10-22 This book constitutes the refereed post proceedings of the Second International Conference on High Performance Networking Computing and Communication systems ICHCC 2011 held in Singapore in May 2011 The conference was held together with the Second International Conference on Theoretical and Mathematical Foundations of Computer Science ICTMF 2011 which proceedings are published in CCIS 164 The 84 revised selected papers presented were carefully reviewed and selected for inclusion in the book The topics covered range from computational science engineering and technology to digital signal processing and computational biology to game theory and other related topics *The Simplex Method* Karl Heinz Borgwardt, 2012-12-06 For more than 35 years now George B Dantzig's Simplex Method has been the most efficient mathematical tool for solving linear programming problems It is probably that mathematical algorithm for which the most computation time on computers is spent This fact explains the great interest of experts and of the public to understand the method and its efficiency But there are linear programming problems which will not be solved by a given variant of the Simplex Method in an acceptable time The discrepancy between this negative theoretical result and the good practical behaviour of the method has caused a great fascination for many years While the worst case analysis of some variants of the method shows that this is not a good algorithm in the usual sense of complexity theory it seems to be useful to apply other criteria for a judgement concerning the quality of the algorithm One of these criteria is the average computation time which amounts to an analysis of the average number of elementary arithmetic computations and of the number of pivot steps A rigid analysis of the average behaviour may be very helpful for the decision which algorithm and which variant shall be used in practical applications The subject and purpose of this book is to explain the great efficiency in practice by assuming certain distributions on the real world problems Other stochastic models are realistic as well and so this analysis should be considered as one of many possibilities **Optimization for Machine**

Learning Suvrit Sra, Sebastian Nowozin, Stephen J. Wright, 2011-09-30 An up to date account of the interplay between optimization and machine learning accessible to students and researchers in both communities The interplay between optimization and machine learning is one of the most important developments in modern computational science Optimization formulations and methods are proving to be vital in designing algorithms to extract essential knowledge from huge volumes of data Machine learning however is not simply a consumer of optimization technology but a rapidly evolving field that is itself generating new optimization ideas This book captures the state of the art of the interaction between optimization and machine learning in a way that is accessible to researchers in both fields Optimization approaches have enjoyed prominence in machine learning because of their wide applicability and attractive theoretical properties The increasing complexity size and variety of today's machine learning models call for the reassessment of existing assumptions This book starts the process of reassessment It describes the resurgence in novel contexts of established frameworks such as first order methods stochastic approximations convex relaxations interior point methods and proximal methods It also devotes attention to newer themes such as regularized optimization robust optimization gradient and subgradient methods splitting techniques and second order methods Many of these techniques draw inspiration from other fields including operations research theoretical computer science and subfields of optimization The book will enrich the ongoing cross fertilization between the machine learning community and these other fields and within the broader optimization community [Handbook of Defeasible Reasoning and Uncertainty Management Systems](#) Dov M. Gabbay, Philippe Smets, 2013-04-17 Reasoning under uncertainty is always based on a specified language or formalism including its particular syntax and semantics but also on its associated inference mechanism In the present volume of the handbook the last aspect the algorithmic aspects of uncertainty calculi are presented Theory has sufficiently advanced to unfold some generally applicable fundamental structures and methods On the other hand particular features of specific formalisms and approaches to uncertainty of course still influence strongly the computational methods to be used Both general as well as specific methods are included in this volume Broadly speaking symbolic or logical approaches to uncertainty and numerical approaches are often distinguished Although this distinction is somewhat misleading it is used as a means to structure the present volume This is even to some degree reflected in the two first chapters which treat fundamental general methods of computation in systems designed to represent uncertainty It has been noted early by Shenoy and Shafer that computations in different domains have an underlying common structure Essentially pieces of knowledge or information are to be combined together and then focused on some particular question or domain This can be captured in an algebraic structure called valuation algebra which is described in the first chapter Here the basic operations of combination and focusing marginalization of knowledge and information is modeled abstractly subject to simple axioms [Mathematical Methods of Operations Research](#) Thomas L. Saaty, 2004-01-01 The first graduate level text devoted to the subject this classic offers a concise history and overview of methods as well as an excellent

exposition of the mathematical foundations underlying classical operations research procedures It begins with a review of historical scientific and mathematical aspects examples and ideas related to classical methods of forming models introduce discussions of optimization game theory applications of probability and queuing theory Carefully selected exercises illustrate important and useful ideas This text is an ideal introduction for students to the basic mathematics of operations research as well as a valuable source of references to early literature on operations research 1959 edition **Advances in**

Optimization and Numerical Analysis S. Gomez,J.P. Hennart,2013-03-09 In January 1992 the Sixth Workshop on Optimization and Numerical Analysis was held in the heart of the Mixteco Zapoteca region in the city of Oaxaca Mexico a beautiful and culturally rich site in ancient colonial and modern Mexican civilization The Workshop was organized by the Numerical Analysis Department at the Institute of Research in Applied Mathematics of the National University of Mexico in collaboration with the Mathematical Sciences Department at Rice University as were the previous ones in 1978 1979 1981 1984 and 1989 As were the third fourth and fifth workshops this one was supported by a grant from the Mexican National Council for Science and Technology and the US National Science Foundation as part of the joint Scientific and Technical Cooperation Program existing between these two countries The participation of many of the leading figures in the field resulted in a good representation of the state of the art in Continuous Optimization and in an over view of several topics including Numerical Methods for Diffusion Advection PDE problems as well as some Numerical Linear Algebraic Methods to solve related problems This book collects some of the papers given at this Workshop

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