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Book Reviews

Benjamin Lev
School of Management, FCS, The University of Michigan-Dearborn, 19000 Hubbard Drive, Dearborn, Michigan 48126, blev@umich.edu

In *Book Reviews*, we review an extensive and diverse range of books. They cover theory and applications in operations research, statistics, management science, econometrics, mathematics, computers, and information systems. In addition, we include books in other fields that emphasize technical applications. However, we do not review software. To submit a book for review, please send it to me at the above address. Although we cannot review all books because of space limitations, we do list all books that we receive. We commission all book reviews and do not accept unsolicited reviews. To become a reviewer, please send me your name, address, and specific areas of expertise. We encourage readers to suggest books for review or to ask publishers to send copies of such books.

The authors or editors of books we review in this issue are Frada Burstein, Clyde W. Holsapple, John W. Chinneck, Michael C. Ferris, Olvi L. Mangasarian, and Stephen J. Wright.

Burstein, Frada, Clyde W. Holsapple, eds. 2008. *Handbook on Decision Support Systems 1: Basic Themes*. Springer, New York. 854 pp. $249.00; *Handbook on Decision Support Systems 2: Variations*. Springer, New York. 800 pp. $239.00.

The combined volumes of *Handbook on Decision Support Systems* are like the "Rosetta Stone" for decision-support systems (DSS). They are comprehensive and inclusive as a decision-support guide for business organizations. Volume I includes sections on multi-participant, intelligent DSS, and on the foundations, system fundamentals, and effects of computer-based DSS. Volume II includes chapters on time and space issues, DSS scopes, dashboards, development and management, cases and applications, and horizons.

The authors of the chapters are the "who's who" of the DSS researchers. Each chapter is crisp and insightful. The handbooks present DSS topics with much detail and vigor. The books are organized well. Each chapter includes an introduction and a summary section, and is integrated with the literature; thus, the reader can see the richness and detailed development of the topics. The editors, Burstein and Holsapple, deserve credit for such care.

The authors have done an excellent job in bringing theory and practice together for researchers, students, and business professionals. They present the material in a very logical and systematic order. Professors teaching DSS should require that their respective libraries place this book on reserve in their university libraries.

The exceptional strength of these books comes from their organization into well-integrated themes. For example, "Foundations of Decision Support Systems," in Part I of Volume 1, comprises eight chapters that discuss the role of DSS in decision making and knowledge-management support. The authors of each individual chapter link the appropriate management literature with the DSS and information systems literature. All chapters are fresh and up-to-date. Part II, "Decision Support System Fundamentals," discusses DSS architecture, data warehousing, online analytical processing (OLAP), spreadsheet DSS, multicriteria DSS, and Web-based DSS. These topics are all current and important; OLAP and Web-based systems are changing how businesses are making decisions (Jukic 2006).

Part III discusses multiparticipant DSS. It includes chapters on collaboration technology, group-support systems, organizational DSS, and negotiation-support systems. Part IV focuses on intelligent DSS and data mining. The OLAP section (in Part II) and the data mining section, in particular, will enable business organizations to be more agile and thus to anticipate and adapt to future DSS-related issues (Patten et al. 2005).

Part V concludes Volume 1 and discusses the effects of computer-based DSS. In essence, this is the social and organizational networking section. It highlights the benefits of DSS and also includes an interesting and novel chapter on DSS failures; in this chapter, David Arnott and Gemma Dodson emphasize that defining both success and failure is not easy to do. They present a basic model and several case studies.

Volume 2 introduces the reader to variations on DSS. Part VI leads the reader through chapters that address turbulent and high-velocity environments, real-time enterprises, emergence situations, geographical information and analysis, decision making in mobile financial applications, and DSS in road safety. These chapters, which are current and interesting, show, as the editors suggest, the variations in DSS applications.

Part VII continues on the Volume 2 variation theme by presenting DSS scopes. Its chapters focus on the use of models, business intelligence, process, and frameworks for applying DSS in business contexts. Each chapter provides the benefits and implementation characteristics of the applications.

Part VIII is a cleverly designed section on developing and managing decision-support systems. The authors investigate features of, evaluation of, evolution of, and portfolios of DSS; it also includes a chapter on the role of analysts as change agents; in this chapter, Kenneth E. Kendal and Julie E. Kendal expand Sprague's (1980) model that enables the change agent to take on multiple roles (e.g., intermediary, toolsmith, builder, and technical support).

Part IX discusses decision-support cases and applications, including operations management, marketing, finance, business intelligence, security, health care, forest management, enterprise, and case studies from South America and Egypt.

The last part, Part X, investigates decision-support horizons. The authors look into their "crystal" DSS spheres and very insightfully point to where DSS technology will make its next mark. They discuss applications, such as Web-based enterprise modeling, models based on Churchman's (1971) inquiring systems, Web-based voting and argumentation, real-time data capture and analysis, visualization, creativity, and strategic learning.

Overall, the book is extremely useful for DSS students, researchers, and practitioners. In addition, students and researchers of engineering, the sciences, and medical health care will also find it very useful. The volumes of *Handbook on Decision Support Systems* are very academic in their design but very practical in their delivery. Their primary value is their overall approach to delineating the topic of decision-support systems.

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Jerry Fjermestad
New Jersey Institute of Technology, Newark, New Jersey 07102, fjermestad@adm.njit.edu

Chinneck, John. W. 2008. *Feasibility and Infeasibility in Optimization: Algorithms and Computational Methods*. Springer, New York. 270 pp. $99.00.

Optimization models consist of two parts: an objective function and a feasible region. Either could make finding the solution to an optimization problem difficult. This book addresses the difficulties caused by constraints that define a supposedly feasible region.

It is widely agreed that global optimization, in which objective functions are multimodal, is the most complicated part of optimization theory. Finding a global minimum of a multimodal problem is difficult even in the case of a simple (e.g., defined by interval constraints) feasible region. While the complexity of optimization problems with opposite characteristics might not be starry, a problem with a very simple (e.g., linear) objective function and an intricately defined feasible region could be extremely difficult. There exists some convertibility between difficulties caused by properties of the objective function and those caused by properties of the feasible region; for example, in some cases, constraints can be transferred into the objective function by means of the penalty method and thus excluded from the constraints. Therefore, duality theory is especially important for investigating feasibility; it enables us to analyze summarily properties of the objective function and of the constraints. As the title makes clear, infeasibility of an optimization problem is a property related to the emptiness of the feasible region; therefore, constraint programming (methods for analysis compatibility and inconsistence of constraints) is a natural tool for feasibility and infeasibility analyses. Both duality theory and constraint programming constitute the theoretical basis for most methods for feasibility and infeasibility analyses. Although this book focuses on practical aspects rather than on theory, it does include some fragments of duality theory and constraint programming.

Properties of different classes of optimization differ; correspondingly, there are different methods for their analysis and solution. For example, compare linear programming and global optimization methods. Because solution methods of indisputable feasible problems differ so greatly, we could hardly expect a unified theory of feasibility and infeasibility in optimization. Although this book's author does not explicitly conclude that the differences of methods for different classes of optimization problems with respect to feasibility and infeasibility analysis are too great to be embedded into a unifying framework, the structure of the book implicitly corroborates this conclusion: the two main parts of the book ("Part I: Seeking Feasibility," and "Part II: Analysis of Infeasibility") are subdivided into chapters on methods for linear programming, mixed-linear programming, and nonlinear programming.

The first part of the book is devoted to methods for quickly finding a feasible solution. This problem is obviously important: some optimization methods can begin only from a feasible point, and the efficiency of most methods would be enhanced by providing a feasible starting point. The aim of finding a good feasible point at a preprocessing stage is well justified by a joke: the best starting point for minimization is a minimum point. The theme of feasibility of linear programming (LP) problems is as old as LP itself because the first and most frequently used method for solving LP problems, i.e., the simplex algorithm, cannot be started without knowing a feasible basis solution. Therefore, even elementary LP textbooks consider pivoting methods (i.e., simplex algorithm-like methods) for finding feasible basis solutions (or proving the infeasibility of the problem). A short chapter in the first part of the book introduces this classical material, as well as relatively new methods that exploit the idea of projection of an infeasible point on a set defined by constraints. As mentioned above, elementary textbooks include descriptions of pivoting methods. However, more recent interior-point methods, which seek feasibility and optimality in parallel, are presented only in research papers or narrowly oriented monographs. The inclusion of interior-point methods would improve this book; the size of the volume was not a limiting factor: the book is definitely not too large. I can only guess that the author did not include interior-point methods because the presentation of these methods in the brief style of the book seemed insufficient for the supposedly broad audience of the book to understand. Indeed, pivoting methods are still more widely studied than interior-point methods; therefore, the ideas of the latter are not familiar to the broad community of potential users of optimization methods. Mixed-integer linear programming (MILP) problems are much harder to solve than LP problems. Most methods of solving these problems are implemented as versions of a general branch-and-bound approach, in which LP relaxations should be repeatedly solved for updating bounds for a minimum of the original problem. The efficiency of branch-and-bound-type methods depends significantly on tightness of bounds; therefore, availability of a feasible solution at early iterations is important to enhance the efficiency of MILP methods. The book proposes various modifications of branching procedures in optimization algorithms to achieve integer feasibility as early as possible. It presents these methods and feasibility pump methods (i.e., combining LP relaxation and integer rounding) primarily by using pseudocodes; it also briefly reports the results of the comparative efficiency analysis of various methods. The chapter on seeking feasibility in nonlinear programming (NLP) problems has more pages than the chapters on seeking feasibility in LP and in MILP together. This illustrates the complexity of the problem. The book also discusses different heuristics for seeking feasibility in NLP. However, it does not provide many reasons for optimistic conclusions: of course, a feasible point in a convex problem can be found by means of penalty methods; however, without the convexity assumption, the problem is reduced to a global optimization of a multimodal function. Therefore, it is natural that familiar global optimization random search methods (including hit-and-run and multistart) appear here in the context of seeking feasibility in NLP. To complement these chapters, we refer to Zilinskas (2004) and Zilinskas et al. (2006), which propose hybrid methods that combine ideas of continuation, evolutionary search, and visualization for the black box problems with very small implicitly defined feasible regions. In addition to the chapters on seeking feasibility in LP, MILP, and NLP, the first part of the book includes a short six-page chapter, "Brief Tour of Constraint Programming," which introduces ideas on this subject and illustrates them by their application to the classical SAT (satisfiability of Boolean formula) problem. The community of optimization experts expects that the merge of mathematical programming with constraint programming could be very fruitful (Hooker 2007); therefore, including a chapter on constraint programming in this book is reasonable. However, in comparison to the other chapters, its presentation seems too brief and weak. In addition, it seems misplaced between the chapters on seeking feasibility in MILP and in NLP.

The second part of the book is devoted to the analysis of infeasibility; its objective is to revise constraints and redefine an infeasible optimization problem as feasible. The introductory section of the chapter "Isolating Infeasibility" briefly presents ideas on detecting the smallest possible subset of constraints that imply infeasibility. The author states that this problem is NP-hard. Although a reader will not have reasons to doubt this, an immediate reference for the proof would be desirable, especially because the statement justifies a heuristic approach to implementation of the methods reviewed in the subsequent sections; the introduction to the next chapter, which is devoted to linear constraints, provides some discussion on complexity of the problem. The subsequent sections of the first chapter (of the second part of the book) are devoted to methods specific to LP, MILP, NLP, and constraint programming. Because of the heuristic nature of these methods, the conditions of their rational application cannot be briefly and precisely defined. Nevertheless, we feel that a reader concerned with infeasibility will find useful advice on coping with it. Subsequent chapters, which deal with linear and adjustable constraints, include more detailed recommendations. The latter means primarily the inequality constraints whose right side can be altered.

The third part of the book addresses applications. Normally, there are several ways to mathematically formulate an applied problem; in addition, including an experienced optimization expert in the construction of the mathematical model might prevent problems. However, such participation is the exception rather than the rule. Most applied problems are difficult partly because, in the process of building mathematical models, experts of applied fields do not focus on the properties that are important from an optimization perspective. For example, overloading a mathematical model with details generally causes excessive complexity of an objective function or of a feasible region. Of course, this also occurs in real-world problems because sophisticated model building cannot prevent infeasibility difficulties. Although it might seem to be a paradox, enhanced computer power and algorithm efficiency implies the growth of many problems that are unsolvable using contemporary software packages. One reason is the persistent increase of the dimensionality of considered mathematical models and of the number of constraints, which sometimes reach millions. Naturally, it is not easy to make such models consistent. Nevertheless, they must be optimized, and the methods that the book discusses could help. It presents a list of examples of real-world problems whose solutions were facilitated by methods for feasibility seeking and infeasibility analysis, thus showing the high application potential of these methods. It should be noted also that hybrid methods that combine rapidly finding a good feasible starting point with a subsequent optimum search could be essentially more efficient than an optimum search that starts from an arbitrary point. In some cases, methods of feasibility analysis have been proven competitive with other well-established methods, e.g., with support vector machines in classification problems.

My next two remarks address a wider phenomenon than the considered book. My first remark concerns the list of references: Russian publications are completely ignored. However, problems of infeasibility were indeed important to the mathematical programming experts of the former USSR because of the application of linear programming to the planning of economics. Infeasibility of such problems was usual because of the permanent incompatibility of available recourses and desirable goals. Whether the experts in optimization could really improve (or not improve) Soviet economics is a rhetorical question; however, they have achieved important mathematical results in the considered subject, as Eremin (1986) and Eremin et al. (1983) discuss. The second remark applies to the book's subtitle, *Algorithms and Computational Methods*. This subtitle seemingly says that the book is not about theory, but about practical aspects. However, what else, if not the properties of methods and algorithms, could be objects of the theoretical research in which the existence of solutions is obvious? What was the reason to contradistinguish two terms in the title when the book uses them as synonyms?

The remarks above do not spoil my general evaluation that this book is excellent. In my opinion it is well-timed, presents urgent material, and is written by a well-recognized expert. It will be very useful for many researchers and practitioners in solving difficult optimization problems.

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Antanas Zilinskas

Department of Mathematics and Informatics, Vilnius University, Vilnius, Lithuania, antanasz@ktl.mii.lt

Ferris, Michael C., Olvi L. Mangasarian, Stephen J. Wright. 2007. *Linear Programming with MATLAB.* Society for Industrial and Applied Mathematics, Philadelphia, PA. 266 pp. $45.00.

Linear Programming with MATLAB is the seventh in a series of books on optimization published by the Society for Industrial and Applied Mathematics. This series includes research monographs, books on applications, textbooks, and tutorials. In this volume, the authors deal with concepts of practical optimization techniques, thus making it a classic textbook. However, it also provides the required commands to demonstrate the computational aspects of those concepts using MATLAB software. The authors assume that the reader has a basic familiarity with MATLAB. Thus, this book is not the classic MATLAB tutorial that is devoted to the discussion of computational tools that are of interest in linear programming.

It includes a self-contained introduction to linear programming to clarify the development of algorithms and theory. In each chapter, it interweaves examples and exercises with theory. The reader requires only a basic knowledge of linear algebra and calculus to understand the material. Moreover, two appendices provide additional information.

The authors present the topics in a precise but understandable way. Their style and methods of exposition are excellent; thus, it is not difficult to comprehend and to extract valuable information from the book. Although they present the concepts in a conventional way, they do it with prowess, and exhibit order, simplicity, precision, and clarity in explaining difficult topics. Moreover, the notation used is an excellent compromise between conciseness and clarity.

The book, which is organized into nine chapters, could be divided into two main parts. Early chapters cover basic linear algebra, the simplex method, duality, solving large linear problems, sensitivity analysis, and parametric linear programming. In the later chapters, the authors discuss quadratic programming, linear complementarity, interior-point methods, and selected applications of linear programming to approximation and classification problems. The first of the pair of appendices chapters provides additional information on linear algebra, convexity, and nonlinear functions.

The first chapter is an introduction to the topic of linear programming. It shows how practical problems can be formulated as a particular type of optimization problem known as a linear program. In Chapter 2, the authors describe the basics of an algebraic interpretation that allows linear programming methods be implemented on a computer. They mainly focus on the development of the Jordan exchange and its implementation in MATLAB. Chapter 3 is dedicated to the simplex method, while Chapter 4 focuses on duality. Chapter 5 describes the revised simplex method, which is used to solve large linear programs. Chapter 6 has four subsections; two examine sensitivity analysis, and two discuss parametric linear programming.

Chapter 7 analyses some extensions of linear programming to other mathematical programming problems. Because it covers nonlinear problems, readers should review the material in Appendix A (linear algebra, convexity, and nonlinear functions) prior to reading this chapter. It also focuses on quadratic programming, which it explains in depth. Chapter 8 is devoted to the interior-point methods; this chapter concludes with some recommendations for further reading. In Chapter 9, which discusses both approximation and classification, the authors examine the use of linear and quadratic programming techniques to solve applications in approximation/regression and for classification problems of machine learning.

Finally, two short appendices address a mathematical review, and a summary of available MATLAB commands, respectively. However, a linear algebra introductory book, such as Bronson (1995), would complement Appendix A. Additionally, because the authors assume that the reader has a basic familiarity with MATLAB, they recommend the MATLAB Primer by Sigmon and Davis (2004) for those who are unfamiliar with MATLAB. A bibliography and a short index conclude the book.

This book is intended for those who want to delve deeply into optimization techniques. Therefore, Fletcher (2000) would be a good companion book, as would Vadja (1975). While Vadja's book includes solutions to each problem presented, it is only essential to those who have difficulty understanding *Linear Programming with MATLAB*, which does not provide solutions to each exercise. However, note that this book has an associated website (http://www.cs.wisc.edu/math-prog/lpbook/) that contains supplementary material, MATLAB codes, typo corrections, and purchasing information.

Linear Programming with MATLAB started as a set of class notes from a linear programming course and has grown over many years. Therefore, this motivating book about applied optimization techniques would be appropriate for undergraduate or first-year graduate level courses, or for self-study by researchers who are unfamiliar with linear programming.

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Sergio Ubeda

Department of Statistics and Operations Research, Public University of Navarre, 31006 Pamplona, Spain, sergio.ubeda@unavarra.es

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