



## Book Selection

Edited by JM Wilson

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### Modern Digital Simulation Methodology II

EJ Dudewicz (Ed)

*American Sciences Press, Syracuse, New York, 1997.*  
231 pp. \$135.00. ISBN 0 935950 42 7

The title of this book suggests that it will be of interest to many in OR, but I suspect they will be disappointed. The book consists of four long papers of a technical nature and would only interest a few specialists. The first paper, by Dudewicz and Karian, provides many pages of tables of the extended generalised lambda distribution. The second paper, again by Dudewicz and a co-author, provides numerous pictures of the bivariate generalised lambda distribution. The third paper, by Wright and Bates, investigates Monte Carlo methods on mass enumeration studies. The final paper, by Sun and Müller-Schwarze, provides a case study on beaver dispersal patterns and includes a listing of a bootstrap/jackknife program.

The book is a special issue of the American Journal of Mathematical and Management Studies, so the intention of the volume may always have been different from that conveyed by the title.

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### Robust Discrete Optimization and its Applications

P Kouvelis and G Yu

*Kluwer Academic Publishers, London, 1997.* xvi + 356 pp.  
£119.00. ISBN 0 7923 4291 7

This book collates research carried out by the two authors and colleagues over the past few years. Its aim is to introduce the concept of *Robust Discrete Optimization* (RDO) to a readership spanning from the graduate student to the OR/MS practitioner.

Unlike deterministic optimisation models which rely on the assumption that the most likely scenario will certainly occur, RDO acknowledges that real-life problems involve considerable uncertainty. However, rather than assigning probabilities to different scenarios with a view to generating a decision which is optimal in the long run (as in stochastic optimisation approaches), RDO considers a set of potentially realisable scenarios. Use of *min–max* criteria is then made to select a decision that has the best worst-case performance over the scenario set. As the authors point out, the approach is particularly suitable for decisions of a non-repetitive nature where the decision-makers are risk-averse and/or where decisions are evaluated against the realised scenario.

The material in the book is organised as follows. Chapter 1 introduces the robustness approach to decision-making under uncertainty, mainly by comparing it against its traditional counterparts; that is, deterministic and stochastic optimisation. The merit of the approach is illustrated clearly using a simple example from production scheduling. After introducing the three criteria used in robust optimisation, the authors further motivate the use of the technique through international sourcing applications. Chapter 2 starts with a general formulation of robust optimisation problems as mathematical programs and then discusses sixteen application areas. The last section of the chapter highlights an interesting link between robustness and multi-objective optimisation. For technical reasons, in the remainder of the book, the authors restrict their attention to a class of problems in which all scenarios are associated with feasible solutions. In Chapter 3 complexity results are presented for a variety of such robust discrete optimisation problems. Unsurprisingly, when a known optimisation problem is examined in the robust optimisation framework, its complexity increases considerably. As an illustration, the well known deterministic problem of sequencing  $n$  jobs on a simple machine to minimise the sum of the job completion times is solvable in  $O(n \log n)$  time by indexing the jobs according to the *shortest processing time* (SPT) rule. By

contrast, the corresponding robust optimisation problem is shown to be NP-hard in the ordinary sense even for only two distinct scenarios regarding each job processing time. Similar results are given for various other robust optimisation problems. Chapter 4 contains some slightly more encouraging results. Specifically, six robust optimisation problems are shown to be solvable in polynomial time. However the problems in question are the exception rather than the rule; in the authors' words: 'We believe that the number of polynomially solvable discrete robust optimisation problems is very limited.' The chapter is nevertheless interesting from a theoretical point of view. Chapter 5, however, is of interest to both the practitioner and the academic researcher as it contains a detailed exposition of a branch-and-bound algorithm that can be used for various robust optimisation problems. The solution method proposed by the authors relies on upper and lower bounds obtained through surrogate relaxation—directly and via a heuristic procedure, respectively. The approach requires that the corresponding single scenario (deterministic) problem be solvable in polynomial or pseudo-polynomial time. The branch-and-bound algorithm is illustrated in detail for four different applications and extensive computational results are given to demonstrate the efficiency of the approach. The next three chapters deal with applications of robust optimisation. Chapter 6 discusses several variants of the 1-median location problem whereas two basic production scheduling problems are studied in Chapter 7. The closely interrelated problems of network design and international sourcing are examined in Chapter 8. For the former, the authors present an extension of the Benders decomposition methodology that is often used to tackle the corresponding deterministic problem; for the latter they give a purpose-built algorithm that exploits the problem's special structure. The last chapter starts with a summary of the main results in the book. Particularly useful to the practitioner of the robust optimisation approach is a section on implementation issues where the authors provide guidelines for obtaining good problem formulations and consequently more efficient solutions. The closing section contains numerous suggestions for further research that will be of particular interest to academic researchers.

Depending on their background and interests, readers will favour different parts of this book but they will invariably gain a sound understanding of the topic. Practitioners will appreciate the clarity of presentation and the absence of unnecessary notation where what matters is the overview and not the mathematical detail.

Every chapter is followed by a comprehensive list of references. Whenever an algorithm is proposed, pseudo-code—and in some cases PASCAL code—is provided. Finally, an abundance of examples and insightful remarks throughout the book enhance the clarity of presentation and make it a pleasure to read.

It is a shame that the high price is likely to prevent the book from reaching the wide readership it deserves.

University of Southampton

A Gerodimos

### Steiner Minimal Trees

D Cieslik

*Kluwer Academic Publishers, London, 1998. xi + 319 pp. £89.00. ISBN 0 7923 4983 0*

Take  $n$  points in the Euclidean Plane and try and connect them all together using as little ink as possible—this is the classic and historic *Steiner problem*. The result will be a tree—the *Steiner minimal tree*. The leaves of the tree will all be your original points and interior nodes of the tree will either be original points or newly created points—so called *Steiner points*. Constructing this Steiner minimal tree is known to be NP-hard but the problem and variants thereof have so many practical applications that it has attracted many person-years of research effort. In fact, along with such favourites as the Travelling Salesperson Problem and Job Shop Scheduling, it has become a 'classic' problem for OR research.

In this book, Cieslik considers not just the construction of the tree in a Euclidean space but rather addresses the more general problem of constructing it in a finite-dimensional Banach space (that is, a Banach-Minkowski space). By adopting this approach and largely concentrating on the two-dimensional case, his results have wide applicability. For example, they encompass both the traditional Euclidean problem and also the well-studied rectilinear variant.

This book is essentially a geometer's view of the problem and the author includes a considerable amount of material on associated geometric problems. For example, the whole of Chapter 3 is devoted to Fermat's problem in Banach-Minkowski spaces. Most practical applications will either be related to the Euclidean or rectilinear case or to the construction of a minimal Steiner tree in a graph.

By taking a very general and abstract approach, the author is in danger of making his results inaccessible to the majority of OR researchers. Fortunately though, the book contains a gentle introduction to Banach spaces and is well written throughout. It contains a wealth of good material and a reasonable bibliography. The chapter on the Steiner ratio, that is the infimum of the ratio between the length of the Steiner minimal tree and that of the minimum spanning tree, is particularly good. I also enjoyed the material on the important  $k$ -SMT problem, where the number of Steiner points is restricted to be  $k$  or less.

The Steiner minimal tree problem and its many generalisations have many practical applications not only in location analysis and topological network design but also in more diverse areas such as data mining and phylogeny.

Although some of these are mentioned in the book, there is only scant attention paid to the applications of the theory. Similarly, the practical solution of many of these problems relies on pre-processing to simplify a given instance as much as possible and then the application of one or more of a number of heuristics. Once again, Cieslik covers this material but it does not lie at the core of the book as many OR practitioners might have wished. A more OR oriented approach to Steiner tree problems should be available soon in *Advances in Steiner Trees*.<sup>1</sup>

In summary, this is a well written book on an interesting and challenging range of problems but from a mathematician's viewpoint. As such it can be strongly recommended.

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VJ Rayward-Smith

### Reference

- 1 Du D-Z, Rubinstein JH and MacGregor Smith J (1998). *Advances in Steiner Trees*, Kluwer Academic Press: London (to appear).

### System Development Methods for the Next Century

WG Wojtkowski, W Wojtkowski, S Wrycza and J Zupancic (Eds)

*Plenum Press, New York, 1997. xii + 569 pp. \$135.00. ISBN 0 306 45693 1*

The book contains selected papers from the Sixth International Conference on Information Systems Development Methods and Tools. The purpose of the meeting was to address the challenges to industry, governments, and academia when specifying, developing, managing, and improving

software systems. In my opinion, a lukewarm achievement of the lofty title of the book was attained. There were too few papers discussing the Web, distributed processing and the ramifications thereof. Moreover the articles were uneven in content as well as pertaining to the future. Most were written about present day technologies as if they held the future in the palm of their hands. The future has always been difficult and dangerous to predict notwithstanding. The book might have been more appropriately entitled current technologies and methods for systems development, but it was not. This led to my disappointment.

Concerning the book itself, it was organised as best as I could tell into six sections with overlap and miscellaneous topics being tossed in. The six sections were: object-oriented technologies (Chapters 1–4), group support technologies (5–8), future development methodologies (9–20), use of intelligent/knowledge based systems (21–29), some miscellaneous examples (30–38), and theoretical concepts (39–45). Some of the papers which I found interesting were: Objects through Relations: The ADOORE approach; Object-Oriented Information Technologies; and Virtual Reality Prototyping in Development and Web-Based Marketing of the Future. One which I really did not care for was: A Comparison of the Ability of Neural Networks and Logit Regression Models to Predict Levels of Financial Distress. Some which I found might have theoretical interest were: An Application of a Matrix Idea in Management Systems Analysis, and A Dynamic Approach to Information Systems Development.

In summary, one might find the book useful in a seminar on systems development. However, I would suggest that the instructor review the book prior to assigning it as a text.

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C Leake