
Interfaces

Publication details, including instructions for authors and subscription information:
http://pubsonline.informs.org

# Book Reviews

Graham K. Rand,

To cite this article:
Graham K. Rand, (2012) Book Reviews. Interfaces 42(3):320-325. http://dx.doi.org/10.1287/inte.1120.0625

Interfaces
Vol. 42, No. 3, May–June 2012, pp. 320–325
ISSN 0092-2102 (print) | ISSN 1526-551X (online)

informs

http://dx.doi.org/10.1287/inte.1120.0625


# Book Reviews

Graham K. Rand
Department of Management Science, Management School, Lancaster University, Lancaster LA1 4YX, United Kingdom,
g.rand@lancaster.ac.uk

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. The editor will be pleased to receive an e-mail from those willing to review a book, with an indication of specific areas of interest. If you are aware of a specific book that you would like to review, or that you think should be reviewed, please contact the editor.

The following books are reviewed in this issue of *Interfaces*, 42(3), May–June 2012: *Introduction to Discrete Event Simulation and Agent-based Modeling: Voting Systems, Health Care, Military, and Manufacturing*, Theodore T. Allen; *Benchmarking with DEA, SFA, and R*, Peter Bogetoft and Lars Otto; *Linear Programming and Generalizations: A Problem-based Introduction with Spreadsheets*, Eric V. Denardo; *The Linear Ordering Problem: Exact and Heuristic Methods in Combinatorial Optimization*, Rafael Marti and Gerhard Reinelt.

---

Allen, Theodore T. 2011. *Introduction to Discrete Event Simulation and Agent-based Modeling: Voting Systems, Health Care, Military, and Manufacturing*. Springer, New York. 215 pp. $79.95.

The unique feature of *Introduction to Discrete Event Simulation and Agent-based Modeling: Voting Systems, Health Care, Military, and Manufacturing* is its use of a consistent case study (i.e., voting system) in all chapters, an approach that should help students learn how to conduct a full simulation modelling project. The book also provides examples using Microsoft Excel to explain some difficult concepts. I find this approach useful because many students are familiar with the Excel software. The book's content can be broadly classified into four sections: main simulation concepts, theories related to simulation modelling, simulation software, and an introduction to agent-based simulation.

In the first section, Chapter 1 starts with a clear discussion about the book's focus: discrete event simulation and agent-based simulation. However, the chapter makes readers aware of other simulation paradigms that may share similar modelling methodologies. Onggo (2009) has a similar view. This chapter also explains the voting system that will be used as a case study in subsequent chapters. In common with other researchers (e.g., Robinson et al. 2010), this chapter highlights the importance of a charter that defines a simulation project. Chapters 2 and 3 provide a good explanation of probability theory and statistical analysis, respectively, for input modelling. The explanation is designed for those who have no background on the topics; hence, prior knowledge of statistics and probability is not required. Chapter 4 explains how the discrete event simulation controller works. It also gives a brief introduction to model verification and validation. Chapter 5 presents a good explanation of output analysis, including topics such as Bonferroni inequality and sample-size estimates. It also discusses advanced topics such as statistical selection and ranking methods, design experiments, and simulation optimization.

The second section starts with a brief overview of queuing theory (Chapter 6), emphasizing its use in the validation of simulation models, its computational efficiency, and the insights it can provide. Chapter 7 discusses two case studies that explain how the concepts and theories from the previous chapters can be applied. Chapter 8 provides an overview of variance reduction techniques and quasi-Monte Carlo sampling. It also discusses the warm-up period in simulation; this differs from most simulation books, which explain this warm-up period in the context of output analysis (e.g., Law 2007, Pidd 2005).

The third section, Chapter 9, which explains the basic programming constructs in Visual Basic, would

be useful for students who have no programming experience. However, some students might find it difficult to follow the long codes at the end of the chapter. The last two chapters provide an introduction to ARENA.

The last section, Chapters 10 through 12, explains agent-based simulation and how it relates to discrete event simulation and other simulation paradigms. It discusses the similarities and differences between discrete event simulation and agent-based simulation, including a brief introduction to NetLogo. This section also provides links to various paradigms, except for system dynamics.

Since reading this book, I have recommended it to students of an undergraduate- and a graduate-level introductory course in computer simulation. It would also be useful as a supporting book in a more advanced simulation course to provide a brief overview of the main simulation concepts. In summary, this text will be suitable for anybody who is seeking a concise introduction to computer simulation.

### References

Law AM (2007) *Simulation Modeling and Analysis.* 4th ed. (McGraw-Hill, New York).

Onggo BSS (2009) Towards a unified conceptual model representation: A case study in health care. *J. Simulation* 3(1):40–49.

Pidd M (2005) *Computer Simulation in Management Science*, 5th ed. (John Wiley & Sons. Chichester, UK).

Robinson S, Brooks R, Kotiadis K, Van Der Zee D-J ( 2010) *Conceptual Modelling for Discrete-Event Simulation* (Taylor and Francis, Boca Raton, FL).

*Stephan Onggo*
*Department of Management Science, Lancaster University Management School, Lancaster, United Kingdom, s.onggo@lancaster.ac.uk*

BOGETOFT, PETER, LARS OTTO. 2011. *Benchmarking with DEA, SFA, and R.* Springer Science + Business Media, Dordrecht, The Netherlands. 367 pp. €139.95

*Benchmarking with DEA, SFA, and R* covers data envelopment analysis (DEA) and stochastic frontier analysis (SFA), arguably the two most prominent and well-researched quantitative methods for efficiency and productivity analysis. The authors state that their intended audience includes graduate students and advanced consultants. Although more advanced readers with keener interests in DEA and SFA will gain more from reading this book, it contains something for all who are interested in the principles underlying DEA and SFA and who want to know how to use these methods, whatever their level of their prior knowledge in this area. The book also includes the bonus of a multitude of real-life applications summarized at appropriate places in the text to illustrate key concepts as they are introduced.

After a brief introduction to initial concepts in efficiency analysis such as the notion of inputs and outputs and of production technology and its frontier in Chapter 1, the book introduces efficiency measures in Chapter 2. This chapter begins with classical radial measures of efficiency and moves on to distance functions and measures of efficiency when prices (e.g., profit, cost, revenue, and allocative efficiency) are available. Although measures of efficiency are too numerous to cover exhaustively, the authors could have mentioned some additional measures that also have some currency (e.g., range or slack adjusted measures), as Thanassoulis et al. (2008) discuss. It is perhaps unfortunate that the well-known Malmquist index of productivity change, which most readers will know as one of productivity change, is covered under the term dynamic efficiency. However, the chapter explains well the pros and cons of each measure and illustrates them using numerical and real-life examples. Chapter 3 discusses some of the best illustrated concepts around the notion of technology or production possibility set underpinning efficiency and productivity analysis. The concepts are explained well for the reader not familiar with the field.

Chapters 4, 5, and 6 cover DEA. Chapter 4 begins with a clear description of some of the most prevalent technologies used in DEA, including the constant and variable returns-to-scale technologies; it then moves on to cover free disposal and free repricability hull, and nonincreasing and nondecreasing returns-to-scale technologies. The relationships between the technologies are illustrated and the impact of the restrictions on the size of each technology, and therefore on the resulting measures of efficiency, is explained. The chapter covers other key by-products of efficiency analysis by DEA such as efficient peer units, targets, and scale efficiency. Chapter 5 goes beyond the basic DEA models and introduces further measures of efficiency, illustrating their uses in practice. These

include the notion of super-efficiency, directional efficiency measures, graph efficiency, and several others. The chapter also introduces the dual to the envelopment DEA model and thus makes contact with a value-based measure of efficiency, which is defined as the ratio of the sum of weighted outputs to the sum of weighted inputs. This in turn introduces the notion of weights restrictions used to convey partial information about the user's preferences or knowledge of the marginal rates of substitution between the factors of production. In all cases, the relevant linear programming models are specified; in most cases, the efficiency measure is illustrated with reference to an example, computing the measure using the software package R. Finally, Chapter 6 introduces statistical tests within DEA. One of the key drawbacks that critics of DEA put forth is its deterministic nature. DEA assumes that the distance of a unit from the technology frontier is entirely attributable to the unit's inefficiency. However, the data might have noise, and part of the distance might be attributable to chance events. The chapter covers the significant progress made in recent years in introducing statistical tests around DEA results to answer these criticisms. The main approach to such tests is through bootstrapping, which is complex by nature. Although the book conveys bootstrapping in a most approachable manner, the uninitiated reader will still struggle in places. However, the chapter, as in the rest of the book, does illustrate concepts through real-life examples using the software R; the section on bootstrapping is no exception to this.

Chapters 7 and 8 cover the SFA approach to efficiency and productivity analysis. Unlike DEA, which is nonparametric in the sense that no prior assumptions are made about the functional form transforming inputs to outputs, the functional form is assumed to be known in SFA and the data are used to estimate its parameters. The authors explain clearly the disadvantage this represents in terms of assuming the form of a function that is unknown, but they also highlight the advantages the approach offers. First and foremost among these is the ability to decompose the distance of a unit from the technology frontier into a component attributable to random noise and one attributable to inefficiency. Chapter 7 gives a very readable explanation of the principles underlying SFA, how the parameters of the SFA function are estimated, and how efficiency at a unit level can be estimated. All explanations are accompanied with code from the software R, thus helping consolidate the reader's understanding of the concepts. The chapter ends with an interesting comparison of the results obtained on a set of data using alternative efficiency assessments methods based on DEA, SFA, and corrected ordinary least squares (COLS) regression. Chapter 8 extends the coverage of SFA in two major ways. It looks at distance functions when SFA is to be used in multiple-input multiple-output contexts. It also looks at a number of functional forms traditionally deployed in SFA such as Cobb-Douglas, homogeneous, and translog functions. The chapter ends with an excellent coverage of a variety of tests for statistical inference with special reference to SFA reliance on maximum-likelihood estimations of the parameters of the hypothesized function. All tests are illustrated using the software R.

Chapter 9 switches the focus from the unit to the collection of units that might jointly constitute a whole in some sense, such as representing a whole industry or perhaps the industry or service in a geographical region (e.g., the hospitals in some region of a country). The collection of units is referred to as a sector and its efficiency as structural efficiency. The authors present methods for optimizing performance at a sector level. They cover measures of the potential gain through mergers of units or alternatively keeping them as separate entities. The measure of gains from a merger is termed adjusted overall gains. This is decomposed into gains through learning, harmony, and scale-size adjustment. An R routine is presented for computing these measures, and details are given of the use of these concepts in an application of mergers to Dutch hospitals. The concept of exogenously fixed variables within the context of assessing potential gains from mergers is also addressed.

One area in which comparative efficiency methods have had extensive application is that of regulation. Regulation regimes have typically been legislated into place, most notably in Europe, as a consequence of the privatization of previously publicly owned utilities such as water, electricity, gas, and telecommunications. Such utilities retain extensive monopoly powers

because they control the network needed to deliver to customers the services concerned. The regulator is empowered to intervene, inter alia, in the price a company can charge its customers for its services. To make an objective assessment of the scope for efficiency savings at a company, a regulator typically uses one or more of the methods that this book covers. Chapter 10 gives a very good introduction to alternative regulation regimes such as cost-recovery, price-cap, and revenue cap. The chapter explores the advantages and disadvantages of each regulatory system and the potential for perverse incentives or gaming by those being regulated. It also contains an extensive description of the German electricity and gas regulatory regime, which the authors had some involvement in developing.

The style of the book is appropriate for readers who have a fairly good foundation in the methods of DEA and SFA and wish to raise their level of understanding. However, much of the book is also suitable for the reader who is a beginner in this area. It offers a good bridge between the basic foundations of the concepts covered and a deeper understanding of the theoretical principles underpinning the methods covered, including their extensions. The more technical material is delegated to appendices, thus improving the access to the basic concepts in the main body. The use of extensive routines in the code of the free software R gives additional opportunity for readers to demonstrate concepts for themselves using their own data.

### Reference

Thanassoulis E, Portela MCS, Despić. 2008. Data envelopment analysis: The mathematical programming approach to efficiency analysis. Fried HO, Knox Lovell CA, Schmidt SS, eds. *The Measurement of Productive Efficiency and Productivity Growth* (Oxford University Press, Oxford, UK), 251–420.

*Emmanuel Thanassoulis*
*Aston Business School, Aston University, Birmingham, United Kingdom, e.thanassoulis@aston.ac.uk*

DENARDO, ERIC V. 2011. *Linear Programming and Generalizations: A Problem-based Introduction with Spreadsheets.* Springer, New York. 673 pp. $99.00

Linear programming (LP) is one of the fundamental tools that operations research (OR) practitioners use. A wealth of books has been written on the topic; these range from the highly theoretical (Dantzig and Thapa 2003) to more modest texts directed toward undergraduate students (Pannell 1996). The renowned Yale professor, Eric V. Denardo, launches the latest contribution into this seemingly saturated foray of texts.

In addition to being an indisputable expert in the field of optimization, Professor Denardo is an expert in OR education. He has served as a member of the Yale faculty for more than three decades, during which his work in dynamic programming and Markov chains has been widely published. His focus on education is clearly on the application rather than the mechanics of optimization techniques. He advocates introducing students to optimization through numerous applied examples inspired by decision making in practice rather than using purely academic problems (Denardo 2001). Furthermore, he empowers students by encouraging them to leverage the various software tools at their disposal (e.g., Microsoft Excel), as a practicing analyst would.

This philosophy first became apparent in an earlier text (Denardo 2002), which includes a much broader overview of OR tools than *Linear Programming and Generalizations, A Problem-based Introduction with Spreadsheets*. However, this text includes a more in-depth review of LP, lending the student thorough knowledge of the art and science of problem solving using LP. Students reading this text will become more than intelligent consumers of LP results; they will become competent analysts who are knowledgeable enough to solve a breadth of problems in constrained optimization. The first four parts of the text (444 pages) cover LP. The concluding chapters provide more cursory-level knowledge of game theory (pp. 445–507) and nonlinear optimization (pp. 545–617).

The text introduces concepts in a manner that an undergraduate student could be expected to understand easily The narrative assumes only an elementary knowledge of linear algebra and calculus. The text is well organized and progresses gently through the material, focusing as much on solving the problem using Excel 2007 or Excel 2010 as on ensuring that students understand the mathematical operations that Excel Solver is executing. That is not to say that

Denardo avoids discussing the mathematical principles of the simplex method; he does an admirable job of providing the essential information throughout the text in a continuous narrative but leaves in-depth elaboration of the mathematics to Part IV, in which he discusses LP theory. Each chapter concludes with a short review (of approximately half a page) and provides 10–20 homework problems.

Finding an appropriate audience for this book is a challenge. Undergraduate students in applied commerce or business programs are clearly part of the audience. It is also suitable for a course that introduces LP, its application, and its integration with widely used software (i.e., Excel and Solver Premium). In cases in which courses in both deterministic and stochastic solution strategies are required, I expect that faculty will prefer a text that spans both families of methodologies; for example, although Anderson et al. (2010) is more costly, it could be used for both courses. However, I am convinced that any LP course that uses Denardo's text will be received well by most students and the book will serve their education well. In addition, faculty members teaching LP will appreciate having this text as a secondary reference to support their courses.

This text also has a well-deserved place outside the classroom. Practitioners with an interest in refreshing their knowledge in LP or expanding their knowledge to include LP will be equally satisfied by this book.

### References

Anderson DR, Sweeney DJ, Williams TA, Camm JD (2010) *An Introduction to Management Science*, 13th ed. (South-Western Cengage Learning, Mason, OH).

Dantzig G, Thapa MN (2003) *Linear Programming: Theory and Extensions* (Springer, New York).

Denardo EV (2001) The science of decision making: A problem-based approach using Excel. *OR/MS Today* 28(4):30–32.

Denardo EV (2002) *The Science of Decision-Making: A Problem-Based Approach using Excel* (Wiley, New York).

Pannell DJ (1996) *Introduction to Practical Linear Programming* (Wiley-Interscience, Hoboken, NJ).

*Geoffrey T. Pond*
*St. Lawrence College, Kingston, Ontario, Canada,*
*gpond@sl.on.ca*

Martí, Rafael, Gerhard Reinelt. 2011. *The Linear Ordering Problem: Exact and Heuristic Methods in Combinatorial Optimization.* Springer, Heidelberg, Germany. 183 pp. $99.00.

The field of combinatorial optimization has grown to such an extent that it is now common practice to devote entire edited volumes or monographs to specific problems or classes of problems. Typically, such works attempt not only to give a comprehensive survey of the literature on the problem, covering theory, applications, algorithms, and software, but also to summarize the state of the art at the time of writing. Prominent recent examples include Toth and Vigo (2002) on vehicle routing problems, Kellerer et al. (2004) on knapsack problems, Burkard et al. (2009) on assignment problems, and both Gutin and Punnen (2002) and Applegate et al. (2007) on the traveling salesman problem (TSP).

Martí and Reinelt attempt to do the same for another combinatorial optimization problem, the linear ordering problem (LOP). In graph-theoretic terms, we can succinctly define the LOP as the problem of finding an acyclic tournament of maximum weight in a complete digraph. The following is a less technical explanation. A set of entities needs to be ranked or ordered from first to last (or from best to worst). For each ordered pair of entities, for example, $(i, j)$, one is given a weight (typically a nonnegative integer) that expresses the desirability of placing entity $i$ before entity $j$ in the ordering. The goal is to maximise the sum of the weights over all ordered pairs that actually appear in that order in the solution.

As the title of the book suggests, and as the authors state explicitly in the preface, the authors had two main goals when writing the text. The first was simply to survey the literature on the LOP. However, the second was to use the LOP as a vehicle for introducing key concepts of combinatorial optimization to the reader. In this sense, the book echoes the classic text by Lawler et al. (1985), which used the TSP as a vehicle in a similar way. There are two important differences. First, the literature on combinatorial optimization is far more extensive now than it was in 1985, meaning that the authors can only scratch the surface. Second, the LOP is much less well known than the TSP, which perhaps makes it a somewhat odd choice when introducing combinatorial optimization to the uninitiated. This leads me to suspect that the book will be attractive only to established researchers who need or want to learn about the LOP, rather than

to students or junior researchers who want a general introduction to combinatorial optimization.

Chapter 1 introduces the problem and surveys some of its (many) applications. Chapters 2 and 3 deal with heuristics (i.e., classical local search and constructive heuristics) and modern metaheuristics, respectively. Chapters 4 and 5 address exact methods, covering branch-and-bound and branch-and-cut, respectively. Chapter 6 is deeper and more technical mathematically, showing how a study of the convex hull of feasible solutions, the so-called linear ordering polytope, can be used to derive cutting planes that are provably strong in various senses. Finally, Chapter 7 covers miscellaneous topics, including approximation algorithms, semidefinite relaxations, and dual ascent.

The book is written in a very readable style and, as one might expect given the topic (!), the material is ordered in a logical way. I did not find any mathematical errors; however, I found a number of minor spelling errors (e.g., odering on p. 2, ramdomized on p. 82, and expontially on p. 99).

I confess that I found one aspect of the book disappointing. The authors frequently mention concepts without giving either a formal definition or a reference. Examples include the linear arrangement and cut-width problems on p. 10, the dynamic programming and quadratic assignment approaches on p. 85, the bundle method on p. 92, and the ellipsoid method on p. 100. An experienced researcher who is already familiar with such terms will have no problem understanding the material; however, the lack of definitions or references may well put off others.

## References

Applegate Dl, Bixby RE, Chvátal V, Cook WJ (2007) *The Traveling Salesman Problem: A Computational Study* (Princeton Series in Applied Mathematics, Princeton University Press, Princeton, NJ).

Burkard R, Dell'Amico M, Martello S. 2009. *Assignment Problems* (SIAM, Philadelphia).

Gutin G, Punnen A, eds. (2002) *The Traveling Salesman Problem and Its Variations* (Kluwer, Dordrecht, NL).

Kellerer H, Pferschy U, Pisinger D (2004) *Knapsack Problems* (Springer, Berlin).

Lawler EL, Lenstra JK, Rinnooy Kan AHG, Shmoys DB, eds. (1985) *The Traveling Salesman Problem: A Guided Tour of Combinatorial Optimization* (John Wiley & Sons, New York).

Toth P, Vigo D, eds. (2002) *The Vehicle Routing Problem* (SIAM Monographs on Discrete Mathematics and Its Applications. SIAM, Philadelphia).

*Adam Letchford*

*Department of Management Science, Lancaster University Management School, Lancaster University, Lancaster, United Kingdom, a.n.letchford@lancaster.ac.uk*