Book Reviews

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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 David L. Applegate, Robert E. Bixby, Vašek Chvátal, William J. Cook, Paolo Brandimarte, Chetan S. Sankar, and Karl-Heinz Rau.

APPLEGATE, DAVID L., ROBERT E. BIXBY, VAŠEK CHVÁTAL, WILLIAM J. COOK. 2007. *The Traveling Salesman Problem: A Computational Study*. Princeton University Press, Princeton, NJ. 606 pp. $45.00.

The symmetric travelling salesman problem (TSP) is one of the most familiar problems of combinatorial optimization—very easy to explain and visualize, yet with a semblance of real-world applicability. Given a set of cities and the cost of travel between each pair of them, the TSP must find the cheapest way of visiting each city (i.e., the order in which the cities are visited) and returning to the point of departure. This book provides an excellent survey of methods that kick-started this "engine of discovery in applied mathematics" (pp. 40–43, 56, 59, 489, and 531).

In more than 600 pages, the authors present a survey of methods used in their TSP solver, Concorde, almost to the exclusion of any other content. Chapters 1–4 describe the TSP. Chapters 5 and 6 provide a brief introduction to solving the TSP by using the branch-and-cut method. Chapters 7–11 are the heart of the book; they survey various classes of cuts, some of which the authors have proposed. Chapter 7 surveys cuts from blossoms and blocks; Chapter 8 presents cuts from combs and consecutive ones; and Chapter 9 introduces cuts from dominoes. Chapters 11 and 12 describe separation and metamorphoses of strong valid inequalities in yet more detail. The book mentions other variants of the problem only in passing;

these include the asymmetric TSP and other solution approaches, such as metaheuristics and approximation algorithms. However, other books (Gutin and Punnen 2002) cover these variants well. Consequently, the seemingly narrow focus enables the authors to provide an in-depth treatment.

The treatment clearly benefits from the authors' extensive experience in implementing solvers for problems of combinatorial optimization. While many textbooks on combinatorial optimization mention primal heuristics only in passing and present cuts in the very mathematical style of definition (i.e., proof of validity and proof of dimensionality), this book does not. Chapters 6–11 suggest separation routines, exact or heuristic, together with the description of strong valid inequalities. Chapter 12 is devoted to the management of cuts and instances of linear programming; Chapter 13 describes pricing routines for column generation. Finally, Chapter 15 is devoted to primal (tour-finding) heuristics. "Implementation details," such as the choice of suitable data structures and trade-offs between heuristic and exact separation, are thoroughly discussed. This emphasis on computational aspects of combinatorial optimization should certainly be commended and recommended.

It is surprising that a book subtitled "*A Computational Study*" devotes a large part (Chapters 1–4 and parts of Chapters 13–17) to the history of exact methods in combinatorial optimization in general and in

solving the TSP in particular. These parts also provide an excellent commentary to the bibliography of 561 items. Although the excitement that is clearly visible in these parts of the book is also manifested in many other accounts of "research by competition," this histoire ranks among the best in the "motivational history of mathematics."

Finally, the editorial attitudes that the book reflects are laudable. The text is based on experiences that the authors gained while developing Concorde, which is available at http://www.tsp.gatech.edu. Thus, all observations and conclusions are easily verifiable and readers can look up any details in the source code. Regrettably, such a level of integrity is rare, although there are exceptions; these include *Solving Constraint Integer Programs* (SCIP), the integer programming solver by Tobias Achterberg (Achterberg 2007), and SAT solvers, such as Chaff (Moskewicz et al. 2001) and PicoSAT. While the book provides little comparison with other approaches, the unrivalled performance of Concorde explains this. The text is written well and is accompanied by many illustrations and illustrative examples, as one would expect from Vašek Chvátal (Avis et al. 2007) and Bill Cook. In addition, the typesetting (Chapter 11 is an exception), bookbinding, and reasonable pricing are laudable. These often overlooked technical aspects of writing and producing a book contribute to the pleasure one derives from reading such a great book.

Although this book is narrow in scope, we recommend it to a wide audience; its most likely audience is any researcher who works in combinatorial optimization. Advanced undergraduate students and anyone with a keen interest in combinatorial optimization and advanced algorithm design may also enjoy reading it.

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BRANDIMARTE, PAOLO. 2006. *Numerical Methods in Finance and Economics: A MATLAB-Based Introduction*, 2nd edition. John Wiley & Sons, Hoboken, NJ. 669 pp. $105.00.

This book is a revised edition of *Numerical Methods in Finance: A MATLAB-Based Introduction* (Brandimarte 2002). The previous edition incorporated material organized around a core in which the author addressed problems, such as portfolio optimization and option pricing, using key selected methodologies (e.g., Monte Carlo, finite difference, and programming). He augmented the revised edition substantially to enhance the value of the book both as a textbook and a reference for self-study. The slightly modified title reflects the book's financial and economics content accurately. The new edition has 669 pages; the previous edition had 403. Major changes include: (1) substantial additions to the first section, which includes some preparatory material (131 pages in the revised edition, 72 pages in the previous edition); (2) a new chapter on lattice models for derivatives; and (3) substantial rearrangement of material to provide a more logical presentation. My comments from this point on will refer to the new edition.

Numerical Methods in Finance and Economics: *A MATLAB-Based Introduction* (NMFE) has four sections comprising 12 chapters. Two chapters in the first section consist of a well-designed preparation for the more advanced material that follows; topics addressed include fixed income, portfolio analysis, and options. The second section has four chapters and provides numerical-based methods for more conventional optimization methods (e.g., basics of numerical analysis, integration and deterministic Monte Carlo methods, finite difference methods for partial differential equations, and convex optimization). The third section focuses on options and includes three chapters: binomial and trinomial lattices (a new chapter), pricing with Monte Carlo methods, and pricing with finite differences, respectively. The fourth and last section studies advanced optimization methods that are applied to selected problems: dynamic programming (American options pricing), linear stochastic

programming (portfolio optimization), and nonconvex optimization (portfolio optimization). The chapter on nonconvex optimization covers mixed-integer programming methods, branch-and-bound methods, and a brief introduction to heuristic methods. There are also three appendices: a brief introduction to MATLAB programming, a "refresher" on probability theory and statistics, and an introduction to AMPL, a modeling language for mathematical programming.

Brandimarte's NMFE is a product of the complexity and specialization in modern financial decision-making, especially in areas such as portfolio construction and complex derivatives trading (e.g., options, futures). There is a corresponding need for modern textbooks to help students learn these topics effectively. Developing such textbooks is difficult because it requires coverage of several overlapping areas, such as financial and economic theory and mathematics (i.e., calculus, linear algebra and matrix analysis, optimization, probability theory). In addition, learning these topics requires a command of specialized tools. Other respected textbooks that instructors may consider are Benninga (2001) and Jackson and Staunton (2001). There are differences between these textbooks and Brandimarte's work as follows:

(1) Brandimarte's book originates from teaching a course on numerical methods in a Ph.D. program in economics. As the author states: "This is essentially a book for students and practitioners working in Finance. Nevertheless, it can be useful to Ph.D. students in Economics as well, as a complement to more specific and advanced books" (p. xvii). Both the approach and the content indicate the author's intention to reach a wide range of readers. For example, the term "practitioners" is likely to include institutional portfolio managers and those who specialize in financial engineering.

(2) Brandimarte's selected problems require full integration of tools and financial analysis, while the aforementioned texts use a modular organization because they include many and more generic problems.

(3) Brandimarte's tool of choice is MATLAB; both Benninga (2001) and Jackson and Staunton (2001) use EXCEL. EXCEL and its Visual Basic for Applications (VBA) programming offer very impressive capabilities; nevertheless, they are insufficient for the problems that Brandimarte studies, which in some cases

even exceed MATLAB's current capabilities including its specialized toolboxes.

When Brandimarte's first edition was published, his choices of problems and tools (MATLAB instead of EXCEL) represented gutsy choices. Time seems to have favored his approach, especially for those students, educators, and practitioners who deal with the problems and sophistication levels that he targets. However, educators and students in graduate programs in economics and finance may still welcome EXCEL-based methods because of their availability. Note that Microsoft®Visual Studio®Tools for Applications (VSTA) and its supporting Microsoft®Visual Studio®Tools for Office (VSTO) is replacing VBA.

I offer four suggestions. First, in his revised edition, the author has partially addressed one suggestion that readers of the previous edition may have had: enhancing the transition from basic (i.e., static, classical optimization) to advanced material (i.e., Ito's stochastic calculus). Still, it may be useful to include some intermediate problems as illustrations of intermediate techniques or to refer the reader to intermediate material during those transitions.

My second suggestion concerns the use of MATLAB toolboxes. Readers may expect the author to address less sophisticated material with the MATLAB core (i.e., MATLAB built-in or ready-to-use functions) and to reserve specialized toolboxes for more sophisticated material. However, he does exactly the opposite: he uses the financial, optimization, and statistical toolboxes in preparatory material, and the MATLAB core in some of the more sophisticated problems. There is a reason: the author and the problems themselves push the capabilities of the toolboxes, and the toolboxes speed up the coverage of introductory topics. I believe that many readers may like to use the standard MATLAB package. Not using the MATLAB core functions in introductory material is likely to prevent readers with limited experience from practicing and developing MATLAB programming skills safely. Placing toolbox material in appendices to each chapter would make the material clearer.

My third suggestion concerns an intriguing possibility: using MATLAB symbolic tools to illustrate some material, such as optimization, analytical and numerical derivatives, approximation errors, portfolio optimization, and option analysis (Tarrazo 2006).

MATLAB uses MAPPLE's symbolic engine in both its standard package and in MATLAB's own symbolic toolbox.

My fourth suggestion is to balance the presentation of numerical "wizardry" with alternatives. For example, even individual small investors may use simple cash to hedge risky stock positions (Russell and Smith 1966). The literature on value-at-risk seems to ignore this fact; instead, it feasts freely on complicated methods as if there was no tomorrow. In the same manner, NMFE readers may wonder about the actual power of additional dosages of conventional methods (no doubt "tried and true" for others) to enhance practical decisionmaking, especially now that refreshing methodological winds are highlighting the potential of hybrid (words + numbers, qualitative + quantitative) methodologies.

However, the overall balance of Brandimarte's NMFE is enormously positive. The changes made in this revised edition were all appropriate; they provide additional value for different sets of potential users—educators, researchers, students, and practitioners. This book provides a state-of-the-art treatment of its subject (numerical methods in finance and economics). It also includes insights and implications for further theoretical development. The author's presentation of sophisticated numerical methods is also tempered with common sense. For example, in describing "arbitrage," he notes how the emphasis is a "much less ambitious attitude" simply trying to "avoid obvious inconsistencies [among prices]" (p. 39). His presentation of risk for fixed-income securities stresses that risk is also related to "the intended use of the security" (p. 54); he stresses practical uses of the material and presents them in a way that is absent in most of the corresponding literature.

In summary, this book is a "must have" for professionals and researchers who employ numerical methods in economic and financial modeling. The amount and quality of the material that the author offers is so generous that readers are likely to benefit from it even if they are not interested in some of the specific applications presented.

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Sankar, Chetan S., Karl-Heinz Rau. 2006. *Implementation Strategies for SAP R/3 in a Multinational Organization: Lessons from a Real-World Case Study.* Cybertech Publishing, Hershey, PA. 345 pp. $79.95.

This book is essentially an extended case study that involves a global company and provides instructive insight into the complex process of enterprise resource planning (ERP) implementation and various strategies for SAP R/3. ERP is an information system designed to integrate internal and external parts of the supply chain. Core processes include production planning and control, inventory management, purchasing, and distribution. It makes sense that a case study on this topic would encompass an entire book because an ERP implementation is extremely complicated. In addition, no two implementations are the same; therefore, a single strategy would not be practical for use by professionals or business people who are looking for guidance. The main example that the book uses is Robert Bosch GmbH's implementation of SAP R/3. The authors studied Bosch before, during, and after the implementation to analyze what the company did, why it did it, and what its expectations were versus the results achieved. In addition to examples from Bosch and other companies, the book provides an overview of the nature of multinational companies, ERP systems, and the concepts of change management.

Originally, only very large companies implemented ERP systems. Because the costs involved are great, the benefits outweigh the costs in very large-scale implementations only. In recent years, scaled-down versions of several ERP systems have been implemented; however, big firms still primarily use the larger versions such as SAP R/3.

Chapter I includes a brief introduction to the book and explains the pedagogical approach. This book focuses on multinational companies. Chapter II begins with an overview of the structure of multinational companies. It shows that because it is difficult to coordinate and standardize business units around the globe, an integrated IT structure, which provides from which local operations can work, is beneficial.

In Chapter III, the book discusses the concepts of ERP systems, beginning with the predecessors of ERP—MRP and MRP II. It explains that ERP systems consist of many modules that are integrated to reduce time lags and information gaps from various areas of the business. The three main groups are financials, logistics, and human resources. Each of these groups is then broken out into its various modules, such as general ledger, sales and distribution, and compensation. Finally, the book discusses an overview of the main ERP vendors with an emphasis on SAP because it is the book's focus.

Chapter IV is dedicated to the topic of change management. Implementing an ERP system introduces many changes to a business; therefore, it is essential to the success of the implementation that both employees and management are prepared. Employees need to understand that their actions directly affect other areas of the business both in function and location. Data are shared throughout functional areas such as finance and production as well as in different countries. Management must support the new systems and business processes to ensure that appropriate resources are dedicated to the implementation and to keep the project on track.

Chapter V illustrates the basic concepts of database management systems and defines many relevant terms. In Chapters VI–IX, the book moves into the Bosch case study. The first part of the case study reviews the development of the SAP R/3 implementation strategy from 1992–1999. It describes how Bosch was structured and why it needed a global IT division to support its various global business units. The book goes on to describe how Bosch's US division began to deviate from the rest of the company's implementation strategy. This raised concerns from the central IT division, which eventually intervened to ensure that the US implementation would be fully effective in the global context.

The next period discussed is 2000–2004—the period in which Bosch business units began to implement SAP R/3. Several major changes were made to Bosch's management team and some changes were made to the implementation strategy even after these first business units began their implementation. The most important effect was the harmonization of the business processes and standardization of data elements across the different business units. Without this, the implementation might have failed.

Chapter X addresses some future directions and trends of ERP solutions. It presents the enterprise service architecture (ESA), a new concept based on a general understanding of service-oriented architecture (SOA). Actually, NetWeaver, the product portfolio of SAP that enables flexible integrated solutions, supports this ESA concept.

Chapter XI offers a shorter case study of an SAP R/3 implementation at Sidler GmbH. Sidler is a smaller company than Bosch, but it operates globally and needed a central IT solution. It opted for an SAP R/3 system and primarily used consultants to develop its implementation strategy. Many ERP providers, including SAP, are now offering solutions for small and mid-sized companies because these companies cannot afford to implement the older, more complex systems in their entirety. SAP now offers its NetWeaver platform, which gives a company more flexibility to customize its system by using only the modules it really needs, while still accruing the benefits of a larger ERP system.

Chapter XII provides conclusions. It analyzes the change-management processes that Bosch adopted by using the change-management life-cycle theory. In summary, it identifies key management issues in designing and implementing ERP systems.

Overall, I found this book to be very informative about SAP R/3 implementation strategies. The beginning sections are useful because they provide a thorough background on multinational companies, ERP systems, and change management. As the authors suggest, the lessons learned at Bosch are valuable to business people and graduate students who wish to implement an ERP system. In addition, the Sidler case study provides insights into an implementation at a smaller company. However, a reader should certainly

be aware that each company will have its own unique problems to address and overcome.

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