functions and departments and to consequently capture potential performance improvements. For those who deal with the topics from one side of the fence, Chakravarty and Eliashberg provide a solid bridge that will help them to comprehend the other side.

The book contains 11 invited chapters organized into four parts:

In the first part, Franza and Gaimon analyze a manufacturer's investment in flexible technology that allows rapid changeover of its short-cycle products in a competitive environment. Such rapid changeovers are crucial because they allow early entrance into the market. Chong, Ho, and Tang, alarmed by the increasing expansion rate of stock keeping units, search for an appropriate strategy for trimming the product line while incorporating product substitution.

In the second part, Yano and Gilbert discuss the coordination of pricing (which affects external demand) and production and procurement decisions. Iyer and Padmanabhan review the literature on marketing, operations, and industrial organization that deals with the role of contracts in order to better understand the implications of strategic interactions among institutions in distribution channels. Choi, Lei, and Wang explore various models that employ quantity discounts as a tool to encourage coordination among independent members of distribution channels. They also present a model that combines both marketing and operations approaches.

In the third part, Steinberg considers how Internet service should be priced, viewing pricing as a crucial factor in competition and as a way to control congestion. Bashyam and Karmarkar discuss three business-information-service offerings for searching and accessing information, and determine the conditions under which two may coexist based on their having different usage volumes and value segmentation of users. Chakravarty evaluates the preferred collaboration mode among partners in an e-business value chain, paying attention to the impact of technology and strategy.

In the fourth and final part, Bajaj, Kekre, and Srinivasan identify what factors affect the time consumed and financial performance in the design and manufacturing phases of new product development. Kumar and Hadjinicola capture the impact of platform products on an international enterprise while considering product design, marketing, and manufacturing issues. Karmarkar and Lele illustrate the need for firms to coordinate marketing and manufacturing and discuss strategies for promoting such integration and diminishing the conventional separation between the two functions.

The authors provide an excellent review of past work in the area, discuss current developments, and propose directions for future research. In light of the wide spectrum of issues they cover, the typical reader will likely be interested in only some of the chapters. Nonetheless, the value to be gained is substantial and precious.

Amit Eynan
Robins School of Business, University of Richmond, Richmond, Virginia 23173

DIWEKAR, URMILA. 2003. *Introduction to Applied Optimization*. Kluwer Academic Publishers, Dordrecht, The Netherlands. 335 pp. $154.00.

Urmila Diwekar's book on applied optimization is one of the few books on the subject that combines impressive breadth of coverage with delightful readability. In her exposition of concepts and algorithms in the major areas of optimization, she always goes to the heart of the matter and illustrates her explanations with simple diagrams and numerical examples. Graduate and undergraduate students, who constitute part of the target audience, should find this a very useful book.

The author has devoted a chapter to each of the following topics: linear programming, nonlinear programming, discrete optimization, stochastic optimization, multiobjective optimization, and optimal control. Every chapter includes a summary of the key points of the chapter, a set of references, and a number of numerical exercises set in a practical environment. There are several references in the book to an "enclosed CD" (for example, on p. 42), but the copy of the book I received had no CD enclosed.

Very commendably, Diwekar has used a single application to illustrate all the different optimization techniques: the hazardous waste blending problem encountered at the US Department of Energy's Hanford nuclear plant in southeastern Washington. This facility produces a lot of hazardous radioactive waste (as by-products), and the problem is how to

process the waste optimally. Diwekar introduces the problem in the chapter on linear programming, formulating it as a linear programming problem; then she continues it in the chapter on nonlinear programming, where she adds a little more complexity and formulates it as a nonlinear programming problem, and so on right through the chapter on multiobjective optimization.

To describe the problem briefly, the Hanford facility has 177 huge tanks of anywhere from 50,000 to 1,000,000 gallons containing radioactive waste coming from a number of processes in the plant. The waste is separated into high-level and low-level waste, both of which must be processed further for disposal. The high-level waste has to be converted into a glass form. To do this, the plant first blends waste from the different tanks into different blends according to various operating constraints and then vitrifies these blends in a melter with the addition of *frit*, which contains a number of different components needed to form the glass. The objective is to minimize the masses of these components subject to a number of constraints on the components themselves, and on the glass crystallinity, and solubility.

In the chapter on linear programming, the author ignores certain constraints related to durability, viscosity, and electrical conductivity and can therefore combine various wastes into a single blend. She formulates the problem as a linear programming problem. In the chapter on nonlinear programming, she introduces those durability, viscosity, and electrical-conductivity constraints, which are nonlinear, making the problem a nonlinear programming problem. In the chapter on discrete optimization, she changes the objective to one of selecting the combination of blends that minimizes the total amount of frit used. In the chapter on stochastic optimization, she considers the same problem with uncertainties in the waste compositions (which hitherto had been considered as known and constant), and so on.

In this way, Diwekar provides a very good learning experience for students in the realities of modeling as a skill in its own right, apart from learning the use of the optimization techniques themselves.

I am impressed with the large number of topics and techniques she covers; yet she explains each topic so well that readers can get a good understanding of the basic concepts. For example, she begins the chapter on discrete optimization by explaining the tree and network representations of discrete optimization problems, and the strengths and shortcomings of each. She illustrates the ideas by solving a small mixture-component-separation problem through both approaches. In the process, she explains the main ideas of the branch-and-bound technique and the depth-first and breadth-first methods of pruning the tree. Through this initial graphical representation, she leads the reader to the algebraic representation, which is required for larger, practical problems, and how each node in a tree representation is represented by binary variables in the algebraic representation. From there, she goes on to explain the concept behind cutting planes and LP relaxations.

Under mixed-integer nonlinear programming, she explains the generalized-bender's-decomposition, and the outer-approximation algorithms, illustrating both with an example worked out in detail.

She explains how these methods encounter difficulties when functions do not satisfy convexity conditions or when the number of combinatorial possibilities is very large or when the solution space is discontinuous. This leads her naturally into the concepts of simulated annealing and genetic algorithms. She explains both of these thoroughly, first in the context of their original, physical settings and then in the context of discrete optimization.

She covers the subjects of two other chapters, optimization under uncertainty and multiobjective optimization, in similar fashion.

Some readers may also appreciate, as I did, the few historical notes and remarks scattered throughout the book. In bulk, they are as miniscule as spices in a meal. But like spices, they add a delightful flavor that makes the whole book that much more enjoyable. I particularly liked the "Announcement" of Bernoulli dated 1 January 1697, that Diwekar quotes on p. 257. The announcement is a mathematical challenge thrown by Bernoulli to "...the finest mathematicians of our time...." I made a couple of feeble attempts to find out the source from which Dr. Diwekar reproduced this ancient challenge, but I could not find it.

All in all, the book is an extremely commendable exposition of a large number of tough topics, and

it will be a valuable addition to any collection of books on applied optimization.

Jamshed A. Modi
S. P. Jain Institute of Management and Research, Andheri (W), Bombay 400 058, India

PINEDO, MICHAEL L. 2005. *Planning and Scheduling in Manufacturing and Services*. Springer, New York. 506 pp. $69.95.

Planning and scheduling activities are pervasive but complex. People dealing with them have many different views and perspectives. In many cases, planners and schedulers see their jobs as vainly trying to satisfy requirements in an environment that constantly changes. Managers want to keep resources busy and customers happy, while foremen view these demands as impossible. Mathematicians see opportunities to develop new algorithms. Pinedo sees problems to be solved and software to be developed.

This substantial and comprehensive text is a revision of Pinedo and Chao (1999). Like the previous version, the revised book is intended for a senior-level or master's-level course on planning and scheduling, and its focus is formulating and solving scheduling problems.

Pinedo covers planning and scheduling in a wide range of industries, including manufacturing, transportation, and sports and entertainment. He discusses in detail topics related to problem formulation, solution approaches, and scheduling software. The variety of models and methods are useful for answering such questions as, "If I find myself with a scheduling problem, how can I formulate it? How should I solve it? How can I build software that will collect the necessary data, solve the problem, and present the solution?" Although Pinedo deliberately omits the traditional material on the basic single-machine, parallel-machine, and shop-scheduling problems, he proceeds from the perspective that formulating and solving the correct sequencing problem is the key to improving performance.

In this revision, he has added new chapters and includes a CD-ROM. He has added sections describing specific applications to each chapter. For example, the chapter on scheduling in sports and entertainment includes a section on creating a schedule for the men's basketball teams from the schools in the Atlantic Coast Conference. The new chapters cover models for service settings, scheduling in supply chains, scheduling in sports and entertainment, scheduling in transportation, and a look at the newest ideas in planning and scheduling. The book's appendices cover the fundamentals of optimization and provide some information about LEKIN, the scheduling system included on the book's CD-ROM.

The CD-ROM includes multiple sets of slides contributed by faculty members of five different universities who used the first version of the text. Each set covers most of the material in the new book, and it is interesting to see how different instructors organized and presented the same material. All follow a familiar style (most in PowerPoint), with more or less use of color and graphics. I thought that the most attractive slides were those created by Cees Duin and Erik van der Sluis at the University of Amsterdam. The CD-ROM also contains supplemental materials that are well organized but vary in significance, from examples that directly address material in the book to brief descriptions of scheduling applications done by consulting firms. The most effective, by far, is a 15-minute movie about a scheduling system the Paris airports use.

The LEKIN scheduling system software is a very useful tool for learning about the basic machine-scheduling problems. Andrew Feldman was responsible for system development. The software was easy to install, and the software help screens made it easy to learn the fundamentals: create a scheduling problem, use a heuristic to generate a schedule, and modify the schedule. After some practice, generating and comparing multiple schedules was a straightforward task. The educational version can handle deterministic, static scheduling problems for the following environments: single machine, parallel machine, flow shop, job shop, flexible flow shop, and flexible job shop. The software includes the ability to use external scheduling algorithms for generating schedules. Because it is the educational version, the software is limited to problems with at most 20 work centers and 50 jobs.

The book has a companion Web site, http://www.stern.nyu.edu/om/faculty/pinedo/book3/, with additional supplementary information, including suggestions for cases, readings, and videotapes that