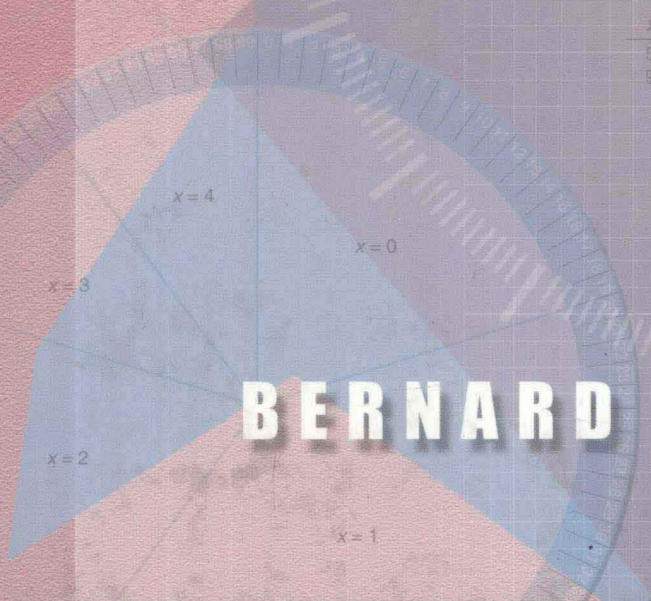
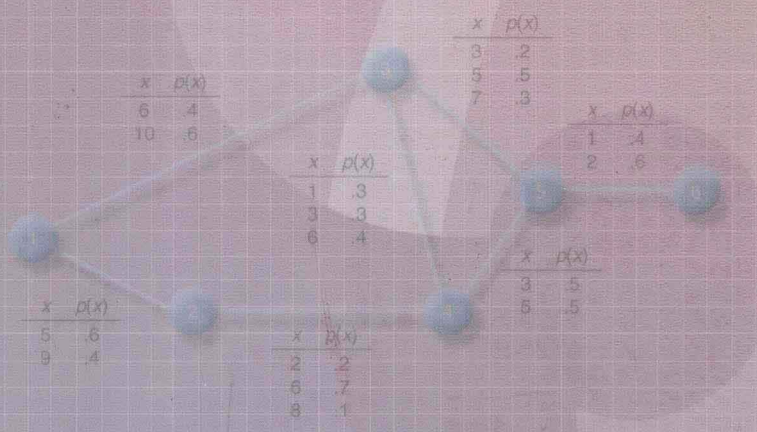


INTRODUCTION

Management Science

SEVENTH EDITION

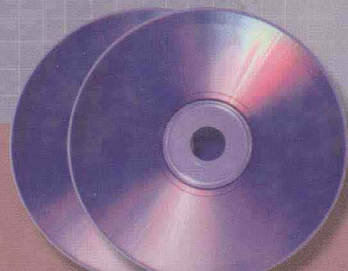


BERNARD W. TAYLOR III

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Introduction to Management Science

Seventh Edition

Bernard W. Taylor III

Virginia Polytechnic Institute and State University



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To Diane, Kathleen, and Lindsey

*To the memory of my grandfather,
Bernard W. Taylor Sr.*

Preface

The objective of management science is to solve the decision-making problems that confront and confound managers in both the public and the private sector by developing mathematical models of those problems. These models have traditionally been solved with various mathematical techniques, all of which lend themselves to specific types of problems. Thus, management science as a field of study has always been inherently mathematical in nature, and as a result sometimes complex and rigorous. When I began writing the first edition of this book in 1979, my main goal was to make these mathematical topics seem less complex and thus more palatable to undergraduate business students. To achieve this goal I started out by trying to provide simple, straightforward explanations of often difficult mathematical topics. I tried to use lots of examples that demonstrated in detail the fundamental mathematical steps of the modeling and solution techniques. Although in the last two decades the emphasis in management science has shifted away from strictly mathematical to mostly computer solutions, my objective has not changed. I have provided clear, concise explanations of the techniques used in management science to model problems, and provided lots of examples of how to solve these models on the computer, while still including some of the fundamental mathematics of the techniques.

The stuff of management science can seem abstract, and students sometimes have trouble perceiving the usefulness of quantitative courses in general. I remember when I was a student I could not foresee how I would use such mathematical topics (in addition to a lot of the other things I learned in college) in any job after graduation. Part of the problem is that the examples used in books often do not seem realistic. Unfortunately, examples must be made simple to facilitate the learning process. Larger, more complex examples reflecting actual applications would be too complex to help the student learn the modeling technique. The modeling techniques presented in this text are, in fact, used extensively in the business world and their use is increasing rapidly because of computer and information technology. Therefore, the chances of students using the modeling techniques that they learn from this text in a future job are very great indeed.

Even if these techniques are not used on the job, the logical approach to problem solving embodied in management science is valuable for all types of jobs in all types of organizations. Management science consists of more than just a collection of mathematical modeling techniques; it embodies a philosophy of approaching a problem in a logical manner, as does any science. Thus, this text not only teaches specific techniques but also provides a very useful method for approaching problems.

My primary objective throughout all revisions of this text is readability. The modeling techniques presented in each chapter are explained with straightforward examples that avoid lengthy written explanations. These examples are organized in a logical step-by-step fashion that the student can subsequently apply to the Problems at the end of each chapter. I have tried to avoid complex mathematical notation and formulas wherever possible. These various factors will, I hope, help make the material more interesting and less intimidating to students.

Learning Features

This seventh edition of *Introduction to Management Science* includes many features that are designed to help sustain and accelerate the student's learning of the material. Some of these features remain from the previous editions while others are new to this edition. The most significant change in this edition has been to move several of the strictly mathematical topics—like the simplex and transportation solution methods—out of the text and onto the accompanying CD-ROM. This has freed up text space for additional modeling examples in several of the chapters, allowed more emphasis on computer solutions with Excel spreadsheets, and added additional homework problems. In the following sections, we will summarize these and other learning features that appear in the text.

Revised Text Organization An important objective is to have a well-organized text that flows smoothly and follows a logical progression of topics, placing the different

management science modeling techniques in their proper perspective. To achieve this, the new edition has been substantially reorganized. The first 10 chapters group together those chapters related to mathematical programming that can be solved using Excel spreadsheets, including linear, integer, nonlinear, and goal programming as well as network techniques.

Within these mathematical programming chapters the traditional simplex procedure for solving linear programming problems mathematically is now located on the CD-ROM that accompanies this text. It can still be covered by the student on the computer as part of linear programming or it can be excluded, without leaving a “hole” in the presentation of this topic. Moving this chapter, as well as some mathematical topics in other chapters, to the accompanying CD-ROM has provided space in the text to add several new sections with various modeling examples. The integer programming chapter has been moved up in the text to follow chapter 4 on modeling examples, and the mathematical branch and bound solution method has been moved to the CD-ROM. In chapter 6, on the transportation and assignment problems, the strictly mathematical solution approaches, including the northwest corner, VAM, and stepping-stone methods, have also been moved out of the text and onto the accompanying CD-ROM. Since transportation and assignment problems are specific types of network problems, the two chapters that cover network flow models and project networks that can be solved with linear programming, as well as traditional model-specific solution techniques and software, have been moved up to follow chapter 6 on transportation and assignment problems. In addition, in chapter 10, on nonlinear programming, the traditional mathematical solution techniques, including the substitution method and the method of Lagrange multipliers, have been moved to the CD-ROM.

Chapters 11 through 14 include topics generally thought of as being probabilistic, including probability and statistics, decision analysis, queuing, and simulation. The chapter on Markov analysis has been moved to the accompanying CD-ROM. Also, the section on game theory, included in previous editions in the chapter on decision analysis, has been moved to the CD-ROM. Forecasting in chapter 15 and inventory in chapter 16 are both unique topics related to operations management. Overall, the text has been reduced from 19 to 16 chapters.

New Topics and Sections in This Edition In an effort to keep the book current and abreast of contemporary trends in management science, and especially the increased emphasis on model development and solution with Excel spreadsheets, several chapters have been

altered to include new sections. In chapter 4, on modeling examples, a section on the data envelopment analysis (DEA) model with Excel solution has been added. In chapter 5, on integer programming, a new section has been added with 0–1 integer programming modeling examples, including a capital budgeting example, a fixed charge and facility location example, and a set covering example, all with Excel solutions. In chapter 6, on transportation and assignment problems, a new section on the transshipment model with Excel solution has been added. In chapter 10, on nonlinear programming, a new section on modeling examples, including a facility location example and a portfolio selection example with Excel solutions, has been added. Chapter 9, on multicriteria decision making, has been expanded to include a section on scoring models.

Excel Spreadsheets This new edition continues to emphasize Excel spreadsheet solutions of problems. Spreadsheet solutions are demonstrated in all the chapters in the text (except for chapter 2, on linear programming modeling and graphical solution), for virtually every management science modeling technique presented. These spreadsheet solutions are presented in optional subsections, allowing the instructor to decide whether to cover them. The text includes over 175 Excel spreadsheet screens, most of which include reference callout boxes that describe the solution steps within the spreadsheet. Files that include all the Excel spreadsheet model solutions for the examples in the text are included on the accompanying CD-ROM, and can be easily downloaded by the student to determine how the spreadsheet was set up and the solution derived, and to use as templates to work homework problems. In addition, appendix B at the end of the text provides a tutorial on how to set up and edit spreadsheets for problem solution.

Free Spreadsheet “Add-Ins” Several spreadsheet add-in packages are provided on the CD-ROM that is packaged with every copy of this text.

Excel QM For some management science topics, the Excel formulas that are required for solution are lengthy and complex and, thus, are very tedious and time-consuming to type into a spreadsheet. In several of these instances in the book, including chapter 6 on transportation and assignment problems, chapter 12 on decision analysis, chapter 13 on queuing, chapter 15 on forecasting, and chapter 16 on inventory control, a spreadsheet “add-in” called Excel QM is demonstrated. These add-ins provide a generic spreadsheet set-up with easy-to-use dialog boxes and all of the formulas already typed in for

specific problem types. Unlike other “black box” software, these add-ins allow users to see the formulas used in each cell. The input, results, and the graphics are easily seen and can be easily changed, making this software ideal for classroom demonstrations and student explorations. This software is provided free on the accompanying CD-ROM.

TreePlan Another spreadsheet add-in program that is demonstrated in the text is *TreePlan*, a program that will set up a generic spreadsheet for the solution of decision-tree problems in chapter 12 on decision analysis. This too is provided free on the accompanying CD-ROM.

Crystal Ball Still another spreadsheet add-in program that is included on the accompanying CD-ROM and demonstrated in the book is *Crystal Ball*. *Crystal Ball* is demonstrated in chapter 14 on simulation and shows how to perform simulation analysis for certain types of risk analysis and forecasting problems.

OPTIONAL Software Package: QM FOR WINDOWS The computer package that many students and instructors will prefer to use with this text is *QM for Windows*. This software is very user-friendly, requiring virtually no preliminary instruction except for the “help” screens that can be accessed directly from the program. It is demonstrated throughout the text in conjunction with virtually every management science modeling technique, except simulation. Thus, for most topics problem solution is demonstrated via both Excel spreadsheets and *QM for Windows*. *QM for Windows* can be packaged with this text for a reasonable additional price. To order this software packaged with the text, please use ISBN 0-13-071756-8.

New Problems and Cases Previous editions of the text always provided a substantial number of homework questions, problems, and cases to offer students practice. This edition includes over 675 homework problems, 90 of which are new, and over 40 end-of-chapter cases, 7 of which are new. In addition, four additional spreadsheet modeling cases are provided on this text’s Web page, which can be accessed at <http://www.prenhall.com/taylor>.

Management Science Applications Boxes These boxes are located in every chapter in the text. They describe how a company, organization, or agency uses the particular management science technique being presented and demonstrated in the chapter to compete in a global environment. There are more than 60 of these boxes throughout the text and they encompass a broad range of service and manufacturing operations, both foreign and domestic.

Marginal Notes Notes are included in the margins that serve the same basic function as notes that students themselves might write in the margin. They highlight certain topics to make it easier for the student to locate them, they summarize topics and important points, and they provide brief definitions of key terms and concepts.

Examples The primary means of teaching the various quantitative modeling techniques presented in this text is through examples. Thus, examples are liberally inserted throughout the text, primarily to demonstrate how problems are solved with the different quantitative techniques and to make them easier to understand. These examples are organized in a logical step-by-step solution approach that the student can subsequently apply to the homework problems.

Solved Example Problems At the end of each chapter, just prior to the homework questions and problems, there is a section with solved examples to serve as a guide for doing the homework problems. These examples are solved in a detailed, step-by-step fashion.

Instructors’ and Students’ Supplements

For the Instructor:

- PowerPoint Presentations—PowerPoint presentations are available for every chapter to enhance lectures. Features figures, tables, Excel work, and main points from the text. Available on the text Web site or on the Instructor’s CD-ROM.
- Instructor’s Solutions Manual—detailed solutions for all end-of-chapter exercises and cases. In addition to a printed solutions manual, these solutions are provided electronically on the text’s Web site and on a separate Instructor’s CD-ROM, allowing instructors to electronically post individual solutions on their own course Web site.
- Test Item File—available on both hard copy and on disk, with Prentice Hall’s Custom Test.
- Instructor’s CD-ROM—this separate CD-ROM, for instructors only, contains all of the above supplements, as well as the author’s Excel, *Crystal Ball*, and *TreePlan* files (with solutions) used in the examples in the text. The only item not included on the CD-ROM is the Prentice Hall Custom Test. The individual test questions, however, are included.
- Text Web Page (<http://www.prenhall.com/taylor>)—the Web site for this text has a password-accessed Web site to protect the instructors’ material. Included are the Excel *QM*, instructor’s solutions, the electronic transparencies,

test questions, and four extra spreadsheet modeling cases with their Excel workbooks. Please contact your local Prentice Hall sales representative for the password.

For the Student:

- *FREE CD-ROM*—A CD-ROM is packaged with every copy of this book. This CD-ROM contains free software (Excel QM, a student version of Crystal Ball, and TreePlan), and Excel, Crystal Ball, and TreePlan files for the examples in the text.
- *Text Web Page* (<http://www.prenhall.com/taylor>)—the Web site for this text contains the Excel, Crystal Ball, and TreePlan files used in the text's examples, as well as four extra cases.

Acknowledgments

As with any large project, the revision of a textbook is not accomplished without the help of many people. The seventh edition of this book is no exception, and I would like to take this opportunity to thank those who have contributed to its preparation. First, I would like to thank my friend and colleague, Larry Moore, for his help in developing the organization and approach of the original edition of this book and for his many suggestions during its revisions. We spent many hours discussing what an introductory text in management science should con-

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Management Science

The Management Science Approach to Problem Solving

Observation • Definition of the Problem • Model Construction • Model Solution • Implementation

TIME OUT for Pioneers in Management Science

Management Science Application: Management Science at Taco Bell

Model Building: Break-Even Analysis

Components of Break-Even Analysis • Computing the Break-Even Point • Graphical Solution • Sensitivity Analysis

Computer Solution

Excel Spreadsheets • The Excel QM Macro for Spreadsheets • QM for Windows

Management Science Modeling Techniques

Linear Mathematical Programming Techniques • Probabilistic Techniques • Network Techniques • Other Techniques • Forecasting and Inventory Techniques

Management Science Application: Management Science at Federal Express

Business Usage of Management Science Techniques

Summary • References • Problems • Case Problems

