ANDERSON SWEENEY WILLIAMS

NINTH EDITION

AN INTRODUCTION TO MANAGEMENT SCIENCE

QUANTITATIVE APPROACHES TO DECISION MAKING

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QUANTITATIVE APPROACHES TO DECISION MAKING

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PREFACE

The purpose of the ninth edition, as with previous editions, is to provide undergraduate and graduate students with a sound conceptual understanding of the role that management science plays in the decision-making process. The text describes many applications in which management science has been used successfully. Former users of this text have told us that the applications we describe have led them to find new ways to use management science in their companies.

An Introduction to Management Science is applications oriented and continues to use the problem scenario approach that has been a hallmark of every edition of the text. Using the problem scenario approach, we describe a problem in conjunction with the management science technique being introduced. The development of the management science technique or model includes applying it to the problem to generate a solution or recommendation. We have found that this approach helps to motivate the student by demonstrating not only how the procedure works, but also how it can contribute to the decision-making process.

From the very first edition we have been committed to the challenge of writing a textbook that would help make the mathematical and technical concepts of management science understandable and useful to students of business and economics. Judging from the responses from our teaching colleagues and thousands of students, we have successfully met the challenge. Indeed, the comments and suggestions of many loyal users have helped to make the text successful.

Throughout the text we have utilized generally accepted notation so that students who pursue study beyond the level of this text might be comfortable reading more advanced material. To assist in further study, a references and bibliography section is included at the back of the book.

CHANGES IN THE NINTH EDITION

In preparing the ninth edition, we have been careful to maintain the overall format and approach of the previous edition. However, based on our classroom experiences and suggestions from users of previous editions, a number of changes have been made to enhance the content, managerial orientation, and readability of the text.

LINEAR PROGRAMMING

Chapter 2 has undergone a major revision that includes a step-by-step discussion of problem formulation or modeling. We emphasize the need for understanding the problem thoroughly, writing a verbal description of the objective and each constraint, defining the decision variables, writing the objective in terms of the decision variables, and writing the constraints in terms of the decision variables. We think this new approach will ease students' transition to modeling more complex problems in Chapters 3 and 4.

In the previous edition, the computer solution of a linear program was not introduced until Chapter 3. In the new edition we have moved this discussion to Chapter 2, immediately following the graphical solution procedure. In this section we show how *The Management Scientist* software package can be used to solve a linear program. Appendix A at the back of the book provides an overview of the features available with *The Management Scientist.* Step-by-step instructions for using the software to solve a linear program are pro-

vided in the appendix to Chapter 2. In addition, a new Appendix G has been added to illustrate the use of LINDO in solving linear programming problems.

In introducing both the maximization and minimization cases we have changed from using x_1 and x_2 notation for the decision variables to more descriptive notation. For example, in the Par, Inc., problem used to introduce linear programming, we now let S denote the number of standard bags and D the number of deluxe bags. However, because we believe it is important for students to be able to write a mathematical model using general linear programming notation, the final section in Chapter 2 shows the use of general notation.

Chapter 3 now focuses on sensitivity analysis and interpretation. It also offers additional practice in formulating, solving, and interpreting the solution for more complex problems.

SIMULATION

Chapter 13 on simulation has undergone a major revision. The new edition provides simulation output for both one-channel and two-channel waiting line systems, and discusses the added service benefits of the two-channel system. The chapter also offers approximately 20 new problems, a revised spreadsheet appendix, and two new Management Science in Action vignettes.

DECISION ANALYSIS

Chapter 14's coverage of decision analysis has been revised in order to provide more emphasis on the decision-making process and less on the technical details of computing revised probabilities. Use of Bayes Theorem and the detailed calculations of revised probabilities are now included in an optional section.

MULTICRITERIA DECISON PROBLEMS

A new section on scoring models has been added to Chapter 15 as a quick and relatively easy way to identify a decision alternative for a multicriteria problem. The section on AHP has been restructured to better match the flow of the decision process for a car selection problem that now involves three alternatives with data for three automobiles: Accord, Saturn, and Cavalier. A Microsoft® Excel appendix showing how to implement the scoring model has also been added.

SPREADSHEET APPENDIXES

Spreadsheet appendixes to show how Excel can be used to implement some of the methods explained in the text were first introduced in the previous edition. Based on our teaching experience using Excel, we have rewritten the previous spreadsheet appendixes and have added four new ones. The new edition offers spreadsheet appendixes for Chapter 1, Introduction; Chapter 2, Introduction to Linear Programming; Chapter 3, Linear Programming: Sensitivity Analysis and Interpretation of Solution; Chapter 7, Transportation, Assignment, and Transshipment Problems; Chapter 8, Integer Linear Programming; Chapter 11, Inventory Models; Chapter 12, Waiting Line Models; Chapter 13, Simulation; Chapter 14, Decision Analysis; Chapter 15, Multicriteria Decision Problems; and Chapter 16, Forecasting. For students and faculty who are comfortable with spreadsheets, these appendixes provide an alternative to the software tools provided by management science software packages.

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NEW PROBLEMS AND CASE PROBLEMS

We have updated approximately 10 percent of the problems in the book and have added new case problems in linear programming, linear programming applications, integer linear programming, and waiting line models.

THE MANAGEMENT SCIENTIST SOFTWARE PACKAGE

The new version 5.0 of *The Management Scientist* is now available for Windows 95, Windows 98, and Windows NT operating systems. We have made a number of improvements in entering and editing data in several modules. For instance, in the forecasting module the user may now add and delete time series observations. The integer programming module has been reworked to provide a more stable and robust solution procedure, and the user interface has been enhanced to improve ease of use.

FEATURES AND PEDAGOGY

We have continued many of the features from previous editions. Some of the important ones are noted here.

Annotations

Annotations that highlight key points and provide additional insights for the student are a continuing feature of this edition. These annotations, which appear in the margins, are designed to provide emphasis and enhance understanding of the terms and concepts being presented in the text.

Notes & Comments

At the end of many sections, we provide Notes & Comments designed to give the student additional insights about the quantitative methodology and its application. Notes & Comments include warnings about or limitations of the methodology, recommendations for application, brief descriptions of additional technical considerations, and other matters.

Self-Test Exercises

Certain exercises are identified as self-test exercises. Completely worked-out solutions for those exercises are provided in an appendix at the end of the text. Students can attempt the self-test exercises and immediately check the solution to evaluate their understanding of the concepts presented in the chapter.

ANCILLARY TEACHING AND LEARNING MATERIALS

As has always been the case, this new edition of *An Introduction to Management Science* has ancillaries that will increase the value of the text to both students and instructors.

- **Study Guide** (ISBN: 0-324-00324-2) Prepared by John Loucks of St. Edward's University, the *Study Guide* will provide the student with significant supplementary study materials. It contains an outline, a review and a list of formulas for each text chapter, sample exercises with step-by-step solutions, exercises with answers, and a series of self-testing questions with answers. The *Study Guide* may be purchased at a special price when bundled with the textbook (Smartpak ISBN: 0-324-07946-X).
- ***The Management Scientist,* version 5.0** (ISBN: 0-324-00890-2) provides 12 computer modules for working through the problems in the course. The software is class tested to run with little or no instructor supervision. Thorough documentation, including examples of how to use the software on actual problems, accompanies the

CD-ROM. *The Management Scientist* software may also be purchased at a value price when bundled with the textbook (Smartpak ISBN: 0-538-50834-5).

- **LINDO® version 6.01** The new Windows version of LINDO has been completely redesigned to make it more intuitive and easier to use. It has the familiar Windows graphical interface with pull-down menus, dialog boxes, and a tool bar for frequently used commands. An educational version of LINDO 6.01 software is sold at a discounted price when it is packaged with the text (Smartpak ISBN: 0-324-07944-3). In Appendix G we describe how to use the Windows version of LINDO by entering and solving the Par, Inc., problem introduced in Chapter 2.

The following support materials are available to adopters from the ITP Academic Resource Center at 800-423-0563 or through **www.swcollege.com:**

- **Solutions Manual** The *Solutions Manual* (ISBN: 0-324-00323-4), prepared by the authors, includes solutions for all problems in the text. At the request of the instructor, the *Solutions Manual* can be packaged with the text for student purchase.
- **Instructor's Manual** The *Instructor's Manual* (ISBN: 0-324-00322-6), also prepared by the authors, contains solutions to all case problems presented in the text. The manual also provides brief annotations for problems in the text. These annotations will help instructor's select homework problems designed to meet their course objectives.
- **Microsoft® PowerPoint™ Presentation Slides** Also prepared by John Loucks, the presentation slides (ISBN: 0-324-00326-9) contain a teaching outline that incorporates graphics to help instructors create even more stimulating lectures. The PowerPoint 97 slides may be adapted using PowerPoint software to facilitate classroom use.
- **Test Bank** Prepared by a new member of the ASW team, Kenneth Lawrence of New Jersey Institute of Technology, the Test Bank (ISBN: 0-324-00325-0) includes true/false, multiple choice, short answer questions, and problems for each chapter. South-Western's computerized testing software (ISBN: 0-324-00327-7) allows instructors to create, edit, store, and print exams.

COURSE OUTLINE FLEXIBILITY

The text has been designed to enhance the instructor's flexibility in selecting topics to meet specific course needs. The single-semester and single-quarter outlines that follow are a sampling of the many options available.

One-Semester Course Emphasis on Linear Programming, Model Development, and Applications

- Introduction (Chapter 1)
- Introduction to Linear Programming and Computer Solutions (Chapters 2 and 3)
- Linear Programming Applications (Chapter 4)
- Transportation, Assignment, and Transshipment Models (Chapter 7)
- Integer Programming (Chapter 8)
- Project Scheduling: Pert/CPM (Chapter 10)
- Inventory Models (Chapter 11)
- Waiting Lines (Chapter 12)
- Simulation (Chapter 13)
- Decision Analysis (Chapter 14)
- Multicriteria Decision Making (Chapter 15)

The instructor in a one-semester course who wants to focus on model development and other applications could either spend more time on the applications in Chapter 4 or cover additional topics.

One-Quarter Course Emphasis on Linear Programming, Model Development, and Applications

- Introduction (Chapter 1)
- Introduction to Linear Programming and Computer Solutions (Chapters 2 and 3)
- Linear Programming Applications (selected portions of Chapters 4 and 7)
- Project Scheduling: Pert/CPM (Chapter 10)
- Waiting Lines (Chapter 12)
- Simulation (Chapter 13)
- Decison Analysis (Chapter 14)

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At the University of Cincinnati, Professor Anderson has taught introductory statistics for business students as well as graduate-level courses in regression analysis, multivariate analysis, and management science. He has also taught statistical courses at the Department of Labor in Washington, D.C. He has been honored with nominations and awards for excellence in teaching and excellence in service to student organizations.

Professor Anderson has coauthored eight textbooks in the areas of statistics, management science, linear programming, and production and operations management. He is an active consultant in the field of sampling and statistical methods.

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Professor Sweeney has published more than 30 articles and monographs in the area of management science and statistics. The National Science Foundation, IBM, Procter & Gamble, Federated Department Stores, Kroger, and Cincinnati Gas & Electric have funded his research, which has been published in *Management Science, Operations Research, Mathematical Programming, Decision Sciences,* and other journals.

Professor Sweeney has coauthored eight textbooks in the areas of statistics, management science, linear programming, and production and operations management.

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Before joining the College of Business at RIT, Professor Williams served for seven years as a faculty member in the College of Business Administration at the University of Cincinnati, where he developed the undergraduate program in Information Systems and then served as its coordinator. At RIT he was the first chairman of the Decision Sciences Department. He teaches courses in management science and statistics, as well as graduate courses in regression and decision analysis.

Professor Williams is the coauthor of nine textbooks in the areas of management science, statistics, production and operations management, and mathematics. He has been a consultant for numerous *Fortune* 500 companies and has worked on projects ranging from the use of data analysis to the development of large-scale regression models.

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