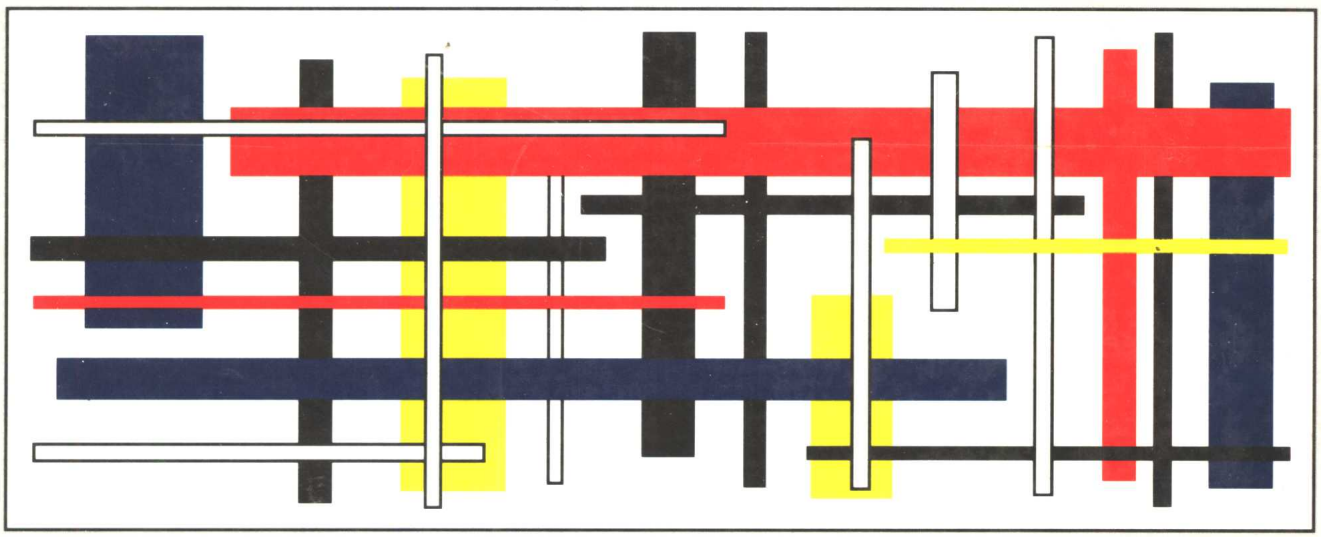
Fundamentals of

MANAGEMENT SCIENCE

Fifth Edition



Turban ▪ Meredith

FUNDAMENTALS OF MANAGEMENT SCIENCE

Fifth Edition

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IRWIN
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Boston, MA 02116

TO THE MEMORY OF OUR PARENTS

Devora and Itzak
E. T.

Blanche and Joyce Harvey
J. M.

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PREFACE

Today, the techniques of management science are known to business leaders, urban planners, farmers, military strategists, space scientists, and public administrators in a host of fields. Words such as *systems*, *models*, *optimization*, *simulation*, and *cost-benefit* are now common in the public vocabulary. The need is thus great for an introductory text that explains, with a minimum of mathematics, how to *formulate* decision problems, how to *solve* them using management science concepts, and how to *apply* the solutions obtained.

THE FIFTH EDITION

This fifth edition provides the first step in a modernization of the teaching of management science. We all are aware of recent developments in information technology that are having a major impact on how management science is being practiced. Some interesting papers have been published during the last two years discussing these developments and suggesting changes in the manner in which management science is being taught. In the previous editions of our book we started to incorporate some of these suggestions. In this edition we are incorporating much more. Yet, we are preserving the basic philosophy that a management science book must cover all the tools of the trade (similarly, a statistics text must cover all the tools of statistics). What we have changed is the *approach* and the *emphasis*.

The following are some of the unique features of this edition.

1. We believe that management science is strongly related to managerial decision making. Therefore, a detailed understanding of the decision making process is provided (Chapter 2).
2. Similarly, we believe that the *process* of *modeling* needs to be emphasized (e.g., see Marks and McLure [6]). This is done in Chapter 2 and throughout the text.
3. Our text emphasizes *problem formulation*, *applications*, and *understanding of what practitioners do*, as suggested by a special task force of the Institute of Management Sciences (see Borsting et al. [2]).

4. We recognize that Management Science, Decision Support Systems and Artificial Intelligence/Expert Systems are all interrelated (Adams and Song [1], Geoffrion [2], Fordyce et al. [3]). This philosophy is presented in Section 1.2 and in the special chapters on Decision Support Systems (Chapter 18) and Expert Systems (Chapter 19).
5. We recognize the end-user computing movement and the possibility that managers are starting to build their own MS/OR models. This could change the notion that an introductory course should be aimed at management science consumers (Borsting et al. [2]) to the philosophy that the course should also be aimed at management science *producers*, or "self-starters," as suggested by Lee et al. [5]. Chapters 18 and 20 address this issue.
6. Software support is essential for any management science course. Unique support is provided by this text (see instructional support).
7. A "problem first" approach, as suggested by Samson [7], is incorporated in two ways. First, we present several problems at the end of Chapter 2 for the purpose of illustrating many aspects of modeling. These problems range from simple to complex. Some of them require a *sequence* of several models, some require the use of statistics, and some require the application of a DSS. In addition, we start each "tool" chapter with an illustrative problem.
8. Relevance to the real world (as suggested by Borsting et al. [2]) is illustrated by examples of many real world applications (throughout the text).
9. The use of heuristics is becoming important both as a computational tool for complex numerical problems and as a search mechanism in expert systems. This neglected topic (per Tingley [8]) is presented in a separate, new chapter (Chapter 17).
10. Implementation of MS/OR models is treated, as in the previous editions, with respect. Namely, we devote a special chapter (Chapter 20) to the topic and review of much of the relevant research.
11. We recognize the importance of globalization and internationalization. We added more cases and problems with international aspects in this edition.
12. We preserved most of the content of the fourth edition, including all the cases (we added more).

The book is organized in three parts: Foundations, The Tools, and Applications.

In Part I of the book, the foundations of the field are outlined. The reader is introduced to the topic of management science in Chapter 1. Its characteristics and processes are then outlined in Chapter 2, which focuses on the relation of management science to decision making.

Part II, The Tools, is concerned with formulating managerial problems

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from many different fields and finding solutions to them using management science models. The chapters are intentionally written to be independent of each other so the instructor may cover only the topics desired for the course. Chapters in this part of the book are typically divided into two segments: "Basics" and "Extensions." The book was written with the express aim of allowing coverage in a course ranging from one quarter (if only the "Basics" are covered) to two quarters (if the entire text is to be covered). The essence of each topic is presented in the former at a minimal level of mathematical sophistication—typically, only algebra or elementary statistics is needed. The segments in the "Extensions" elaborate on some of the basic models at a somewhat higher level of sophistication. These segments are typically also independent of each other and may thus be selected at will by the instructor for further class study. The mathematical and statistical background needed for the book, as well as a few additional topics (such as "present value"), are included in Appendix A, Mathematics, and in Appendix B, Statistics. Appendix C includes requisite tables for the text and, lastly, the *answers* (not solutions) to most of the even-numbered problems are given in Appendix D.

Each chapter in Part II typically begins with a brief episode showing the student how a particular decision problem arises. When possible, this example is carried throughout the chapter to illustrate the concepts being developed. We have attempted to present a variety of decision situations from a number of fields to emphasize the flexibility of the management science approach. Chapter 7 in particular presents a wide array of applications of linear programming, thus departing from the standard format of the chapters in Part II. In lieu of presenting the mathematical theorems and proofs that form the basis of many of the models, we appeal to intuitive reasoning and logic. These chapters each include a case to help the student apply the tools and techniques learned in the chapter to a realistic situation. The chapters then conclude with a glossary of chapter terms.

The sequence of the chapters progresses from general decision models (Chapter 3 and 4) through forecasting (Chapter 5), mathematical programming (Chapters 6–10), networks (Chapter 11), dynamic programming (Chapter 12), Markov analysis (Chapter 13), inventory models (Chapter 14), and the stochastic models of queuing (Chapter 15) and simulation (Chapter 16). Finally, heuristic programming is presented as a viable approach to decision making (Chapter 17). Each chapter is as independent of the others as possible to provide the instructor with the flexibility of using selected chapters at will.

Part III, Applications, begins with an examination of the new tools of decision support systems (Chapter 18) and expert systems (Chapter 19). From there, the difficulty and process of implementation is addressed in Chapter 20. A detailed case study and answers to the complex cases of Chapter 2 are given in Chapter 21 to illustrate how to integrate the MS tools and techniques in a more realistic framework than the problems of

Part II alone allow. The book concludes with an assessment of the future directions and areas of the application of management science in Chapter 22.

INSTRUCTIONAL SUPPORT

This edition is supported by:

1. *Instructor's Manual.* This manual includes solutions to all the problems and cases. In addition, you will find extensive suggestions for organizing the course and many transparency masters.
2. *Test Bank.* The test bank is divided into two parts: conceptual questions and problems. Multiple choice format is used in both cases and problems. The test bank is available both in hard cover and on a disk (with Computest).
3. *Software support.* This edition is supported by the following software:
   a. Lotus spreadsheet templates (by Scott Shafer) for most of the models in this book.
   b. Preprogrammed management science software (DSS, by Vahid Lotfi and Carl Pegels or MSS, by Norman Nelson) for most of the models in this book.
   c. IFPS/PC, student version, from Execucom Systems Corporation which will be provided free for all adopters of the book.

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Efraim Turban
Jack Meredith

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PART I
FOUNDATIONS

In Part I of the text, our aim is to provide a foundation on which to develop the topics in the rest of the book. We do this in two stages.

- Chapter 1 introduces the topic of management science and its wide applicability to decision making. The chapter concludes with an overview of the plan of the text.
- Chapter 2 is directed toward the management science process itself. The use of models to solve managerial problems is the essence of this approach and thus the focus of the chapter. The chapter then relates the management science tools to prototypal managerial problems and discusses their applicability. Finally, we present several challenging managerial problems that introduce many interesting points.

1
INTRODUCTION

1.1 What's it all about?
1.2 Managerial decision making.
1.3 Definitions of management science (MS).
1.4 The characteristics of management science.
1.5 The tools of management science.
1.6 Cutler-Hammer's patent decision.
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