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管理系列

管理科学

Practical Management Science

(英文版)

Wayne L. Winston

S. Christian Albright

世界财经与管理教材大系



东北财经大学出版社

世界财经与管理教材大系
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管 理 科 学

Practical Management Science

威尼·L. 温斯顿 合 著
S. 克利斯第安·阿布莱特
马克·布鲁迪耶 提供案例

Wayne L. Winston
S. Christian Albright
with case studies by
Mark Broadie

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出版者的话

但凡成事，均缘于势。得势则事成，失势则事不顺。顺势而行，如顺水行舟；借势而动，如假梯登高；造势而为，如太空揽月。治学、从政、经商、置业，均不可一日失势。势者，长处、趋势也。

今日中国，是开放的中国；当今世界，是开放的世界。改革开放，大势所趋，势不可挡。经济开放、文化开放、政治开放，世界需要一个开放的中国，中国更要融入开放的世界。借鉴国际惯例，学习他人之长，已经到了不可不为之时。

借鉴国际惯例，学习他人之长，已属老生常谈，但学什么、如何学、以何为蓝本为众多志士仁人所关注。可喜的是，由赤诚图文信息有限公司精心策划，ITP、McGraw-Hill 及 Simon & Schuster 等国际出版公司特别授权，东北财经大学出版社荣誉出版的“世界财经与管理教材大系”现已隆重面世！她以“紧扣三个面向，精选五大系列，奉献百部名著，造就亿万英才”的博大胸襟和恢弘气势，囊括经济学、管理学、财务与会计学、市场营销学、商务与法律等财经、管理类主干学科，并根据大学教育、研究生教育、工商管理硕士（MBA）和经理人员培训项目（ETP）等不同层次的需要，相应遴选了具有针对性的教材，可谓体系完整，蔚为大观。所选图书多为哈佛、斯坦福、麻省理工、伦敦商学院、埃维商学院等世界一流名校的顶尖教授、权威学者的经典之作，在西方发达国家备受推崇，被广为采用，经久不衰，大有“洛阳纸贵”之势。

借鉴国际惯例，毕竟只是因势而动；推出国粹精品，才是造势而为。在借鉴与学习的同时，更重要的是弘扬民族精神，创建民族文化。“民族的，才是国际的”。我们提倡学他人之长，但更希望立自己之势。

势缘何物，势乃人为。识人、用人、育人、成人，乃人本之真谛。育人才、成能人，则可造大势。育人、成人之根本在教育，教育之要件在教材，教材之基础在出版。换言之，人本之基础在书本。

凡事均需讲效益，所谓成事，亦即有效。高效可造宏基，无效难以为继，此乃事物发展之规律。基于此，我们崇尚出好书、出人才、出效益！

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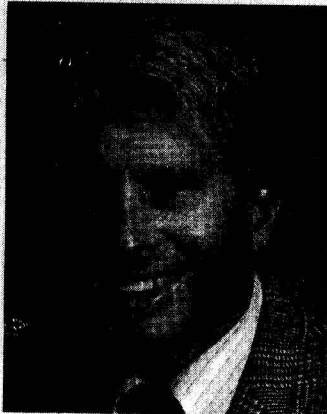
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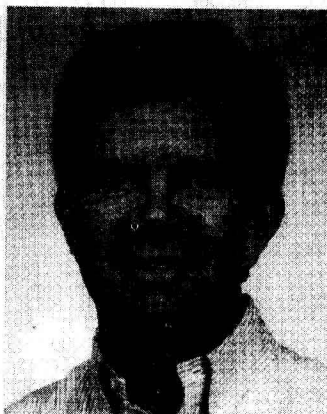
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Wayne is professor of decision sciences in the School of Business at Indiana University, where he has taught since 1975. He received the S.B. degree in mathematics from MIT and his Ph.D. in operations research from Yale University. He has written three successful textbooks—*Operations Research: Applications and Algorithms*, *Introduction to Mathematical Programming: Applications and Algorithms*, and *Simulation Modeling Using @RISK*—all published by Duxbury Press. In addition, he has published more than 20 articles in leading journals and has won many teaching awards, including the Indiana University schoolwide MBA award four times.

Wayne enjoys swimming and basketball, and he appeared on the television series *Jeopardy!* (winning two games). He is married to the lovely and talented Vivian, and they have two children, Gregory and Jennifer.



S. CHRISTIAN ALBRIGHT

Chris received his B.S. degree in mathematics from Stanford University in 1968 and his Ph.D. in operations research from Stanford in 1972. Since then he has been teaching in the decision sciences area of the Business School at Indiana University in Bloomington. His research interests are in the area of applied probability models. Recently he also did research on a favorite topic: streakiness in baseball hitting. He has taught courses in management science, computer simulation, and statistics to all levels of business students: undergraduates, MBAs, and doctoral students. He has authored a book entitled *Statistics for Business and Economics* and a user manual for the Execustat statistical software package.

On the personal side, Chris has been married to his wife, Mary, for 25 years and has one son, Sam, who is now in his third year at Indiana University. Chris has many interests outside the academic area, including activities with his family, playing the piano (classical music), attending cultural events at the university, playing golf and tennis, running, and reading.



MARK BROADIE

The case studies appearing at the ends of chapters were created by Mark Broadie and his colleagues at the Columbia Business School. These cases are outgrowths of real-world applications, including several based on work done by Columbia Business School graduates.

Mark applies management science and operations research techniques to problems arising in managerial decision making. His current research focuses on issues of computational finance, including option pricing, portfolio management, and risk management. Mark worked for Shearson Lehman Brothers to develop pricing and hedging models for government and mortgage-backed securities. He has done extensive consulting work for various investment banks and brokerage firms and has also lectured worldwide. Mark holds a B.S. from Cornell University and a Ph.D. from Stanford University. He joined the faculty of the Graduate School of Business at Columbia University in 1983.

Mark is happily married to Nancy Morgan and they have one son, Christopher. Mark enjoys sports, especially golf (he is lucky enough to have had two holes-in-one).

TO OUR WONDERFUL FAMILIES

Vivian

Mary

Sam

Gregory

Jennifer

Preface

We believe management science has a great deal to offer students—in fact, now more than ever before—and we hope this book will help reverse negative attitudes toward quantitative methods in business. We wrote this book to provide instructors and students with a new yet highly successful approach to teaching and learning management science. We teach by example and adopt a practical spreadsheet-based approach to the modeling of a wide variety of business problems from finance, marketing, and operations. This spreadsheet approach is not brand new, but we believe we have developed the application of management science concepts more than any competing textbook. Based on our own experience with this material in the classroom, both at the undergraduate and MBA levels, we know that the impact can be enormous. Our students are thoroughly interested because they learn skills they will remember and use in their eventual jobs.

A New Paradigm

The relevance of management science for students has been discussed for several years. Many people have suggested that the way to obtain relevance is to include more examples of real-world implementations of MS. We agree, and have adapted many real applications in this book. However, upon reading about large-scale success stories such as American Airlines or Hewlett Packard, a student might argue that MS is an important discipline but that you don't really need to know MS concepts—just someone who does. We have tried to write a book that gives valuable skills and insight to common problems to the “masses,” not just to large problems and the elite few.

The ability to think through complex problems and relate quantities in a spreadsheet is valuable for all business students. This skill provides real competitive advantages in finance, operations, and marketing. The essence of our approach provides skills that are fourfold:

Problem Solving

The modeling process stressed in this book forces students to think through complex problems, identify variables under a decision-maker's control, identify constraints on these decision variables, quantify the effects of uncertainty, and develop structural relationships between all important quantities. This is nothing new—it is the essence of MS—but the spreadsheet approach puts the entire procedure within the capability of virtually all business students, regardless of their mathematical background.

Interdisciplinary Approach

Students see how MS pertains to a variety of business disciplines. Traditionally, MS textbooks have emphasized problems in the operations area. We have also included many examples and problems from finance and marketing, among others. For example, we have included discussions of portfolio selection, options pricing, cash management, currency transactions, and other important finance topics that can be formulated easily as MS models and solved with spreadsheets. Our MBA students, predominantly finance and marketing, love this feature.

Insights

It is not easy to read the statement of a problem and “guess” the answer; there are usually too many relationships and constraints involved. However, it is instructive to look at a spreadsheet solution and see whether this solution looks reasonable or whether it's useful to change input parameters and see whether the effects of these changes on the solution can be anticipated. This what-if analysis, which we attempt to do with many examples in the book, provides valuable insights and helps develop mathematical intuition.

Spreadsheet Skills

Finally, students gain spreadsheet facility by working through many of our examples. Students enter our courses with a wide variety of spreadsheet skills—some have excellent skills, others have few or no skills—but all students leave our courses as very competent spreadsheet users. The particular spreadsheet package we use, Microsoft Excel, is the premier spreadsheet package in today's business world, and students who know Excel have a definite edge in the job market.

New Content and Methods

Most adopters of our approach will need to change the way they teach MS. For some instructors, the change may be great; for others it will be a natural step in a process that has already begun. In terms of content, **we have given up teaching algorithms to the mass MS audiences.** Software packages make algorithms unnecessary for all but MS/OR specialists. In this book **we have also eliminated all but a few traditional algebraic formulations in favor of spreadsheet formulations.** We agree, at least in principle, with some of our reviewers who argue that something is lost by not going through the algebra. However, we are convinced that the benefits of spreadsheet modeling outweigh any potential loss.

Our approach is to teach modeling rather than a collection of well-known models. Admittedly, many of the examples in this book fall into traditional categories, but our emphasis is different. For example, when we discuss the transportation model in Chapter 4, our intent is not to teach every detail about this type of model (and have students memorize these details). Instead, our intent is to introduce a type of model that is very flexible for modeling a variety of problems.

Regarding the teaching method itself, we have found that **the more hands-on we can make the classes, the more students enjoy them and the more they learn.** At the very least, instructors should be equipped with computer projection equipment so that they can develop spreadsheet solutions (or manipulate our files) in real time.

Although many instructors probably agree in principle that a spreadsheet approach is a good idea, they might not be aware of the difficulties this approach can entail. We do not want to ignore these difficulties, but we believe that with proper planning

they can be managed. We have found that grading is the biggest challenge. Grading 50 spreadsheet files (on 50 floppy disks) can definitely take more time than grading 50 algebraic formulations on paper. Similarly, giving an exam in a computer lab, where each student must create one or more spreadsheet files on a PC, can be a real headache unless the details are carefully planned.

One way to avoid some of these problems is to employ spreadsheet “shells,” where the structure of the spreadsheet is given and the students then “fill in the blanks” with appropriate formulas. We discuss these below. Another problem can be the distribution of computerized materials to the students. However, by setting up a Web page or placing files on a network, an instructor can easily distribute files, even with daily updates if desired. This way, for instance, if an example spreadsheet is nearly completed during class, the completed file can be distributed right after class—for immediate reinforcement. Various methods for dealing with these issues are discussed in the Instructor's Resource and Media Manual.

Using This Book

This book teaches by example. Students learn the subjects by working through the examples. There is not much “up front” discussion of basic content in most of the chapters; students can usually dive right into the examples. We believe this is the way students learn the modeling process best, and we believe it is most likely to hold their interest. Of course, some concepts must be discussed generally before specific examples can be given. A good illustration is Chapter 11, on queueing models, where we believe it is necessary to discuss such key concepts as the exponential distribution, Little's formula, and steady state before students can really understand queueing models.

Organization

Largely because of this example-based approach, **the book is very modular**, which allows instructors to cover only those topics and examples that are of most interest to them. For example, in the mathematical programming chapters (2 through 6), students need to read through Section 2.4 of Chapter 2, particularly Section 2.3, which explains the basic concepts of spreadsheet LP models and Excel's Solver. If instructors plan to cover nonlinear models, students

should also read Section 6.2 of Chapter 6, which covers some basic concepts of nonlinear optimization. However, beyond these introductory discussions, instructors can move freely from example to example and chapter to chapter, choosing only those that interest them. This modular approach is discussed more thoroughly in the Instructor's Resource and Media Manual, which outlines several possible study plans.

Problems and Cases

The book contains a greater variety and number of problems than any competing text. These range from very straightforward to challenging. The difficulty level is indicated by the headings "Skill-Building Problems" and "Skill-Extending Problems," the latter being more challenging. There are also a number of "Modeling Problems." These are less structured than the other problems and may require students to discuss the nature of the data that would be necessary to solve a particular problem. Finally, most chapters include one or two cases (written by Mark Broadie of Columbia University). These cases, which are often challenging, should be appreciated particularly by MBA students because of the way they integrate with other business disciplines.

Accompanying Materials

The package of materials that accompanies this book is much more than a set of "ancillaries"; it is an integrated package and is essential to the successful teaching of the course.

■ **Instructor's Resource and Media Manual.** Contains suggestions for teaching the course, including discussions of classroom presentation, homework assignments, team projects, and testing approaches; course syllabi; optional uses of the book for different objectives and audiences—for instance, for undergraduates or MBA students, or for a finance or marketing emphasis; plus instructions for the two 3½ - inch disks that come with the IRMM: the Excel Solutions Disk and the Presentation Disk. Available to all adopting instructors.

■ **Excel Solutions Disk.** Contains complete "live" Excel worksheet solutions for every example, problem, and case study in the book. Also contains shell, or template, worksheets for the problems that provide the structure for the worksheet solution with the numbers and formulas stripped out. Instructors may use these shells as is, strip them further, or add a few

hints. We find these shells are helpful for larger classes or for undergraduates who might need extra help formulating spreadsheet models, plus they force students to enter pertinent information in particular cells and thus make grading easier. For further assistance, grading macros have been included for selected problems. These automatically check whether certain cells contain correct information. In some cases they also enter new inputs and check whether a student's formulas react correctly to the new inputs. A list of solution and shell filenames is included in the IRMM.

■ **Presentation Disk.** Contains PowerPoint slides and accompanying Excel worksheets corresponding to the examples, concepts, and chapter outlines.

■ **Student Excel Disk.** Included with every new copy of the book; contains Excel worksheets for all in-text examples, data sets for problems, and Excel add-ins, described below.

■ **Web Page.** Provides an open communication line for instructors and students to discuss our approach to teaching MS, plus updates on software and spreadsheet information and additional information about the book (www.indiana.edu/~mgtsci).

■ **Videotape.** This video introduction to the book and course highlights our approach with in-class sequences and an interview with the authors.

Software

Several options are available. One is to order the book with the following Excel add-ins, which are available at no additional cost when ordered with the book:

■ **EXCEL SOLVER UPGRADE** from Frontline Systems, the developers of Excel Solver, improves the performance and robustness of your Excel 5.0 or 7.0 Solver. For more information on the Solver and Frontline Systems, go to: <http://www.frontsys.com>

■ **TREEPLAN** by Michael Middleton is an add-in that will generate decision trees for the material in Chapter 8. This shareware version is compatible with Excel 5.0 and later.

■ **MONTE CARLO/DISCRETE EVENT SIMULATION MODULES** from Sam Savage's *Insight: Business Analysis Tools for Microsoft Excel* (Duxbury, 1998), is an add-in for the Monte Carlo and queueing problems in Chapters 11 and 13.

■ **RETAILER** is software for the case study in Chapter 10.

If you favor more powerful software for decision analysis and simulation, the following programs are available at extra cost from the publisher:

■ **DPL** by Applied Decision Analysis is Windows-based professional software for both decision trees and influence diagrams. The student version is identical to the professional version in capability but runs slower. DPL is compatible with Excel.

■ **@RISK** by Palisade Corporation is a professional add-in for Excel and Lotus for Windows for Monte Carlo simulation. Many examples in Chapter 13 use @RISK. If you want more finance examples like those in Chapter 13, order this software and the accompanying book, *Simulation Modeling Using @RISK*, by Wayne Winston. This student version is identical to the professional version in capability and contains many more financial, marketing, and operations applications.

■ **WHAT'S BEST!** by Lindo Systems, an add-in for optimization, is highly recommended for Lotus 1-2-3 users. An introduction to What's Best! can be found in the appendix to Chapter 2.

Acknowledgments

This book has gone through more than its fair share of reviews, and it is a much better product because of them. The majority of the reviewers' suggestions were very good ones, and we have attempted to incorporate them. Thanks to: Mark Broadie, Columbia University; Susan Cohen, University of Illinois, Urbana/Champaign; Abe Feinberg, California State University, Northridge; Paul Fishbeck, Carnegie Mellon University; James Flynn, Cleveland State University; Gregory Frazier, University of Oregon; Robert M. Freund, Massachusetts Institute of Technology; Phil Fry, Boise State University; Daniel Fylstra, Frontline Systems, Inc.; Mark Gershon, Temple University; Anjani Jain, University of Pennsylvania; Thomas R. Jefferson, University of California, Los Angeles; L.

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We would also like to thank Jerry May (University of Pittsburgh) for class testing the manuscript; Daniel Fylstra (Frontline Systems) for checking the accuracy of the Microsoft Solver operations; Abe Feinberg for accuracy checking the pageproofs. And finally, thanks to over 300 faculty members involved in the Duxbury/INFORMS MS/OR teaching survey conducted in the spring of 1995. We have tried to address many of the teaching issues and problems the survey brought to our attention. Finally, we thank our students for their candid comments and suggestions on early drafts of this manuscript.

We would also enjoy hearing from you—we can be reached via e-mail.

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*Bloomington, Indiana
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