
SECOND EDITION

Managerial Economics

Eugene F. Brigham
University of Florida

James L. Pappas
University of Wisconsin

SECOND EDITION

Managerial Economics

Eugene F. Brigham
University of Florida

James L. Pappas
University of Wisconsin



The Dryden Press
Hinsdale, Illinois

Editorial - Production Services provided
by COBB/DUNLOP, Inc.

Copyright © 1976 by The Dryden Press
A Division of Holt, Rinehart and Winston
All rights reserved

Library of Congress Catalog Card Number: 75-21324
ISBN: 0-03-089696-7

Printed in the United States of America
8 9 032 9 8 7 6 5 4 3

PREFACE

The economic environment has undergone many significant changes in recent years. Strong inflationary pressures are having dramatic effects on both individuals and business firms. Energy shortages and rising energy costs are forcing drastic changes in production processes and techniques. The recession of 1975 has shown all too clearly that our economy is still subject to business cycles, and that neither individuals nor business firms can neglect this factor when planning for the future. In such a setting, economic analysis is assuming a growing importance in business decision making—firms are hiring professional economists, setting up economics departments, and using economic data and methods of analysis in all phases of their operations.

With this background in mind, we designed this second edition of *Managerial Economics* to present those aspects of economic theory and analysis that are most relevant for students of business administration. The book provides a rigorous development of the elements of microeconomics that are most useful for managerial decisions, then illustrates with problems and cases the usefulness of the theory. Throughout, emphasis is placed on the actual decision process and on the role that economic analysis plays in this process.

Although virtually every aspect of both micro- and macroeconomic theory has important implications for managerial decisions, a number of microeconomic topics are of paramount importance. These include demand theory and estimation, production theory and cost estimation, analysis of market structures and their effects on pricing practices, antitrust policy, and capital expenditure decisions. *Managerial Economics* examines each of these topics.

Managers attempt to optimize under conditions of uncertainty. Accordingly, optimization techniques and methods of risk analysis are taken up early in the text, then used throughout the book. Although many students will have been introduced to these subjects in other courses, we have found that most either do not recall them or else never really had a grasp of how the techniques are applied in practice. Thus, in *Managerial Economics*, we presuppose no prior exposure to these basic tools and techniques.

An important feature of *Managerial Economics* is its attempt to show the firm as a cohesive, unified organization. Students of business administration take courses in marketing, finance, production, and so on, but they often fail to see the integration of these subjects. In *Managerial Economics*, we use a basic valuation model, show that value is determined as the present value of expected future profits, and then relate each topic in the text to an element of the valuation model. In the process, management is seen to involve an integration of the marketing, production, and finance functions. This integrating process is reinforced in the final chapter, which examines a long, integrated case that is particularly valuable, both for consolidating the materials and for demonstrating that important business decisions are interdisciplinary in the truest sense of the word. According to our students, setting forth the interrelationships within a business firm—or a business administration curriculum—as a unified whole rather than as a series of discrete, unrelated topics is one of the most valuable aspects of managerial economics.

The revisions made in this second edition include updating the descriptive materials, expanding the number and types of illustrations employed, smoothing out some of the more difficult presentations, and both modifications and additions to the end-of-chapter questions and problems. A *Study Guide* has also been developed, which outlines the major points in the text and provides a comprehensive set of solved problems. The basic framework for *Managerial Economics*, however, remains unchanged.

ACKNOWLEDGMENTS

We are grateful to the many individuals who aided in the preparations of both editions of *Managerial Economics*. Many helpful suggestions and valuable comments have been received from instructors (and students) using the first edition of the book, and numerous reviewers provided insightful assistance in clarifying difficult presentations. Among those who were

especially helpful are B. Allen, R. Auerbach, C. Chittle, J. Elterich, R. Haas, E. Hale, T. Hogarty, R. Knapp, B. Mabry, G. Mellish, P. Nelson, T. Shin, K. Smith, J. Song, R. Thornton, D. Vrooman and D. Weigel. The Universities of California, Wisconsin, and Florida, and our students and colleagues on these campuses, also provided us with a stimulating environment and general intellectual support. Finally, we are indebted to the Dryden Press staff, particularly Jere Calmes and Sandy Nykerk, for their special efforts in helping us convert a manuscript into a bound book.

The field of managerial economics continues to undergo significant changes, and it is stimulating to participate in these exciting developments. We sincerely hope that *Managerial Economics* will contribute to a better understanding of the application of economic theory and methodology to managerial practices, and thus help lead to a more efficient economic system.

Eugene F. Brigham
James L. Pappas

Gainesville, Florida
Madison, Wisconsin
September, 1975

CONTENTS

Preface ix

1	Uses and Applications of Managerial Economics	1
	What is Managerial Economics?	1
	The Basic Valuation Model	7
	Nature of Profits	11
	Structure of This Text	13
	Summary	14
	Questions	14
	Selected References	15
2	Optimizing Techniques	17
	Optimization: Maximizing the Value of the Firm	17
	Methods of Expressing Economic Relationships	19
	Total, Average, and Marginal Relationships	21
	Differential Calculus	29
	Rules for Differentiating a Function	32
	Use of Derivatives to Maximize or Minimize Functions	38

IV CONTENTS

Partial Derivatives	45
Maximizing Multivariable Functions	47
Constrained Optimization	48
Summary	53
Questions	53
Problems	54
Case—Kantell Engineering Corporation: Optimization in Product Reliability Design	59
Selected References	60
3 Risk Analysis	61
Risk in Economic Analysis	61
Utility Theory and Risk Aversion	68
Adjusting the Valuation Model for Risk	71
Techniques for Decision Making under Uncertainty	76
Summary	83
Questions	84
Problems	84
Selected References	89
Appendix: Alternative Decision Rules	89
4 Demand Theory	97
The Demand Function	98
Industry Demand versus Firm Demand	100
The Demand Curve	100
Relationship between Demand Function and Demand Curve	102
Demand Relationships and Managerial Decisions	103
Price Elasticity of Demand	106
Some Uses of Price Elasticity	113
Income Elasticity of Demand	114
Cross-Elasticity of Demand	116
Other Kinds of Elasticities	117
Direct versus Derived Demand	118
Time Characteristics of Demand	121
Summary	123
Questions	124
Problems	125
Selected References	127
5 Techniques of Demand Estimation	129
The Identification Problem	130
Consumer Interviews	133
Market Studies and Experimentation	135
Regression Analysis	137

Regression Statistics	145
Frozen Fruit Pie Demand: An Illustrative Regression Analysis	
Problem	155
Summary	157
Questions	158
Problems	159
Selected References	162
6 Production Theory	163
Production Function	163
Production Isoquants	166
Marginal Rate of Substitution	170
The Law of Diminishing Returns to a Factor	174
The Three Stages of Production	174
The Role of Revenue and Cost in Production	177
Returns to Scale	184
Empirical Production Functions	189
Summary	190
Questions	191
Problems	192
Selected References	196
Appendix: A Constrained Optimization Approach to Developing the Optimal Input Combination Relationships	197
7 Linear Programming	201
Applications of Linear Programming	201
Relationship of Linear Programming to the Lagrangian Technique	202
Assumption of Linearity	203
Linear Programming and Production Planning: One Product	204
Linear Programming and Production Planning: Multiple Products	212
Graphic Specification and Solution of the Linear Programming Problem	214
Algebraic Specification and Solution of a Linear-Programming Problem	220
The Dual in Linear Programming	226
Constrained Cost Minimization: An Additional Linear-Programming Problem Example	233
Summary	239
Questions	240
Problems	240
Selected References	244

vi CONTENTS

8	Cost Theory	245
	Relevant Cost Concept	246
	Cost Functions	249
	Short-Run and Long-Run Costs	252
	Fixed Costs	253
	Variable Costs	253
	Short-Run Cost Curves	253
	Long-Run Cost Curves	256
	Firm Size and Plant Size	259
	Plant Size and Flexibility	261
	Breakeven Analysis	262
	Profit Contribution Analysis	268
	Limitations of Breakeven Analysis	269
	Summary	270
	Questions	271
	Problems	272
	Selected References	275
9	Empirical Cost Analysis	277
	Short-Run Cost Estimation	278
	Long-Run Statistical Cost Estimation	285
	Summary	292
	Questions	293
	Hunter Textiles: A Case on Cost Estimation	293
	Selected References	295
10	Market Structure and the Theory of Prices	297
	Classification of Market Structures	297
	Factors Determining Market Structure	298
	Pure Competition	299
	The Firm's Price/Output Decision	304
	Monopoly	308
	Monopolistic Competition	312
	Oligopoly	315
	Nonprice Competition	326
	Summary	327
	Questions	328
	Problems	330
	Selected References	334
11	Pricing Practices	335
	Cost-Plus Pricing	336
	Incremental Analysis in Pricing	339
	Price Discrimination	341

Multiple-Product Pricing	349
Summary	358
Questions	359
Problems	359
Selected References	363
Appendix: Transfer Pricing	364
12 Regulation and Antitrust	377
Operating Controls	378 •
Monopoly Control: Utility Regulation	383
Price Regulation	384
Antitrust Policy	389
Summary	394
Questions	395
Problems	396
Sterling Drug Company versus Federal Trade Commission: A New Look at Market Structure for Antitrust Action	399
Selected References	401
Appendix: Selected Supreme Court Antitrust Cases	402
13 Long-term Investment Decisions: Capital Budgeting	445
A Simplified View of Capital Budgeting	446
Application of the Concept	447
Mechanics of Capital Budgeting	449
Mathematical Programming Approaches to Capital Budgeting	454
Steps in the Capital Budgeting Process	458
Summary	463
Questions	465
Problems	465
Selected References	467
14 The Westfall Company: An Integrated Case in Managerial Decision Making	469
Background	469
Capital Budgeting Process	471
Demand Estimates	475
Demand for the Southern Plant's Output	481
Statistical Cost Analysis	483
Engineering Cost Estimates	488
Estimating Net Present Values for Alternative Plants and Products	491
Final Decision	498
Questions	498

viii CONTENTS

Appendix A: Compound Interest	505
Compound Interest	505
Compound Value of an Annuity	508
Present Value of an Annuity	510
Annual Payments for Accumulation of a Future Sum	511
Annual Receipts from an Annuity	512
Determining Interest Rates	512
Present Value of an Uneven Series of Receipts	513
Semiannual and Other Compounding Periods	515
Compound Interest Tables	517
Problems	524
 Appendix B: Forecasting	 525
Forecasting Methodologies	526
Trend Projection, or Extrapolation	527
Barometric Methods	533
Econometric Models	536
Input-Output Analysis	539
Survey Techniques	548
Problems	550
 Appendix C: Check Figures for Selected	
End-of-Chapter Problems	553
 Index	 561

CHAPTER 1

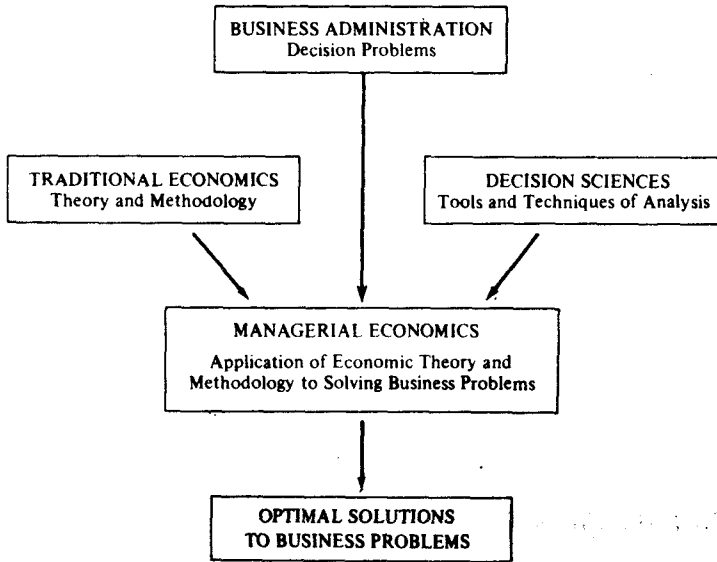
Uses and Applications of Managerial Economics

WHAT IS MANAGERIAL ECONOMICS?

Although one finds the term *managerial economics* defined in a variety of ways, the differences are typically more semantic than real. To some, managerial economics is applied microeconomics. Others define the field in terms of management science and operations research concepts. There are also those who see managerial economics as primarily providing an integrative framework for analyzing business decision problems. In actuality, all of those views are correct, for each tells a part of the truth.

Managerial economics is the application of economic theory and methodology to business administration practice. More specifically, managerial economics uses the tools and techniques of economic analysis to analyze and solve business problems. In a sense, managerial economics provides the link between traditional economics and the decision sciences in managerial decision making, as is illustrated in Figure 1-1.

While we relate managerial economics to business administration decision problems in Figure 1-1, and while our focus is primarily on business applications throughout the text, it is important to recognize that the concepts of managerial economics are equally applicable to other types of or-

Figure 1-1 The Role of Managerial Economics in Business Decision Making

ganizations. That is, the principles of managerial economics are also relevant to the management of nonbusiness, nonprofit organizations—such as government agencies, schools, hospitals, museums, and similar institutions. We shall emphasize this point repeatedly through the use of examples from the not-for-profit sector at appropriate points in the chapters that follow.

Relationship of Managerial Economics to Traditional Economics

A clearer understanding of the generality of the concepts of managerial economics, as well as the complexities involved, can be gained by examining the relationship of managerial economics to traditional economics and the decision sciences. Understanding the relationship between managerial economics and traditional economics is facilitated by a consideration of the structure of traditional economics. Although this structure may be presented in several different ways, one common breakdown is given in Table 1-1.

The various aspects of traditional economics presented in Table 1-1 overlap to some extent. Not only are micro and macro theory interrelated but there are also micro and macro aspects to each area listed. Moreover, the areas themselves overlap to some extent; for example, econometric techniques provide a common set of tools of analysis applicable to each other area. Similarly, economic systems as studied in positive, or descriptive, economics must be understood before meaningful normative rules can be formulated. Never-

Table 1-1 Classifications of Traditional Economic Studies

Theory:	<p><i>Microeconomics</i> focuses on individual consumers and firms.</p> <p><i>Macroeconomics</i> focuses on aggregations of economic units, especially national economies.</p>
Specific Areas:	<p>Agricultural Economics</p> <p>Comparative Economics</p> <p>Econometrics</p> <p>Economic Development</p> <p>Foreign Trade</p> <p>Industrial Organization</p> <p>Labor Economics</p> <p>Money and Banking</p> <p>Public Finance</p> <p>Stabilization Policy</p> <p>Urban and Regional Economics</p> <p>Welfare Economics</p>
Emphasis:	<p><i>Normative</i> focuses on prescriptive statements; that is, establishes rules to help attain specified goals.</p> <p><i>Positive</i> focuses on description; that is, describes the manner in which economic systems operate without attempting to state how they should operate.</p>

theless, the focus of each item in the table is sufficiently well defined to warrant the breakdown.

Since each area of traditional economics has some bearing on business firms, managerial economics draws from all the areas. In practice some are more relevant to the business firm than others, and hence to managerial economics. To illustrate, although both microeconomics and macroeconomics are important in managerial economics, the micro theory of the firm is especially significant. It may be said that the theory of the firm is the single most important element in managerial economics. However, because the individual firm is very much influenced by the general economy, which is the domain of macroeconomics, managerial economics does involve macro theory.

The emphasis of managerial economics is certainly on normative theory. We want to establish decision rules that will help business firms attain their goals; this is the essence of the word "normative." If firms are to establish valid decision rules, however, they must thoroughly understand their environment; for this reason descriptive economics cannot be ignored.

Relationship of Managerial Economics to the Decision Sciences

Just as economics provides the theoretical framework for analyzing business decision problems, the tools and techniques of analysis derived from the decision sciences provide the means for actually constructing decision mod-

els, analyzing the impact of alternative courses of action, and evaluating the results obtained from the model. Managerial economics draws heavily from the area of *optimization techniques*, including differential calculus and mathematical programming, for developing decision rules aimed at assisting management in achieving the firm's established goals. *Statistical tools* are used to estimate relationships between important variables in decision problems. Because most business decision problems involve activities and events which will occur in the future, *forecasting techniques* also play an important role in managerial decision making and, therefore, in the study of managerial economics.

As in the economics area, the dichotomy used here to classify the decision sciences is not absolute. Optimization procedures are inherent in statistical relationships, and both optimization techniques and statistical relationships play important parts in developing forecasting methodologies.

In addition to the overlaps within the economics and decision science classifications, there is substantial overlap between them. For example, many of the basic corollaries of economics—including the well-known microeconomic axiom that profit maximization requires that marginal revenue equal marginal cost—are derived from the optimization procedures of differential calculus. It is because of these substantial interrelationships that we stated earlier that the definitional differences for managerial economics are largely semantic in nature.

Relationship of Managerial Economics to Business Administration

Now that we have established the role of economics and the decision sciences in managerial economics, it should prove useful to attempt to place managerial economics in perspective as a part of the study of business administration. In general, business administration is organized into four major categories, as is illustrated in Table 1-2. The functional areas are reasonably well situated because both businesses and business schools are generally structured to include these departments. The "special" areas are also fairly well defined, and their place in the business administration curriculum is relatively clearcut; the "tool" areas and integrating courses are not so easily categorized. Principles of management, for example, could be included as a tool or as an integrating course. It is not in the list of functional areas because no business firm has a management department. Yet management, in the sense of coordinating various aspects of the firm, is certainly a function, so there would be some justification for listing management within the functional areas. Accounting presents a similar problem—it is a function within the firm, but it is also a tool used throughout the firm. Accordingly, accounting is listed both as a functional area and as a tool.

The real question is this: Where does managerial economics fit into the picture? Again, the answer is not clearcut. Although many firms have economics departments, these departments are usually small, and "economics"

Table 1-2 Classifications of Business Administration Studies

Functional Areas:	Accounting Finance Marketing Personnel Production
"Tool" Areas:	Accounting Behavioral Science Computer Science Management Managerial Economics Quantitative Analysis, Including Operations Research
"Special" Areas:	Banking Insurance International Business Real Estate Transportation
Integrating Courses:	Management Managerial Economics

per se is not an important function within the firm. One possibility is to include managerial economics as a special area, but in our judgment it would be somewhat out of character there.

As we see it, managerial economics fits into the classification of business administration studies in two places. First, it serves as a tool course, wherein certain economic theories, methods, and techniques of analysis are covered in preparation for their later use in the functional areas. Second, it serves as an integrating course, combining the various functional areas and showing not only how they interact with one another as the firm attempts to achieve its goals, but also how the firm interacts with the environment in which it operates.

Role of Business in Society

One very important inquiry in managerial economics concerns the interrelationship between the firm and society. Managerial economics can help to clarify the vital role business firms play in our society and to point out ways of improving their operations for society's benefit. A business enterprise is a combination of people, physical assets, and information (technical, sales, coordinative, and so on). The people directly involved include stockholders, management, labor, suppliers, and customers. In addition to these direct participants, all society is indirectly involved in the firm's operations, be-