



Third Edition

MANAGERIAL ECONOMICS

MAURICE / SMITHSON

MANAGERIAL ECONOMICS

Applied Microeconomics for Decision Making

S. Charles Maurice
Professor of Economics Texas A&M University

Charles W. Smithson
Managing Director The Continental Bank

Third Edition 1988

IRWIN

Homewood, Illinois 60430

Cover photo: © H. Mark Weidman

© RICHARD D. IRWIN, INC., 1981, 1985, and 1988

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the publisher.

This book was set in Times Roman by Carlisle Communications Limited.
The editors were Gary L. Nelson, Ethel Shiell, and Merrily D. Mazza.
The production manager was Irene H. Sotiroff.
The designer was Michael Warrell.
The drawings were done by Jay Bensen, The Artforce.
R. R. Donnelley & Sons Company was the printer and binder.

ISBN 0-256-05914-4

Library of Congress Catalog Card No. 87-81579

Printed in the United States of America

5 6 7 8 9 0 DO 5 4 3 2 1

MANAGERIAL ECONOMICS

IRWIN PUBLICATIONS IN ECONOMICS

Advisory Editor: Martin S. Feldstein, *Harvard University*

Atkinson
ECONOMICS: THE SCIENCE OF
CHOICE, *First Edition*

Baldwin
MARKET POWER, COMPETITION,
AND ANTITRUST POLICY, *First
Edition*

Blair and Kaserman
ANTITRUST ECONOMICS, *First
Edition*

Bornstein
COMPARATIVE ECONOMIC
SYSTEMS: MODELS AND CASES,
Fifth Edition

Brown
READINGS, ISSUES, AND
QUESTIONS IN PUBLIC FINANCE,
First Edition

Buchanan and Flowers
THE PUBLIC FINANCES, *Sixth Edition*

Colberg and Forbush
BUSINESS ECONOMICS, *Seventh
Edition*

Daly
MANAGERIAL MACROECONOMICS:
A CANADIAN PERSPECTIVE, *First
Edition*

Gould and Lazear
MICROECONOMIC THEORY, *Sixth
Edition*

Hagen
THE ECONOMICS OF
DEVELOPMENT, *Fourth Edition*

Herber
MODERN PUBLIC FINANCE, *Fifth
Edition*

Lindert
INTERNATIONAL ECONOMICS,
Eighth Edition

Marshall, Briggs, and King
LABOR ECONOMICS, *Fifth Edition*

Maurice and Phillips
ECONOMIC ANALYSIS, *Fifth Edition*

Maurice and Smithson
MANAGERIAL ECONOMICS, *Third
Edition*

Meyer
MONEY, FINANCIAL INSTITUTIONS,
AND THE ECONOMY, *First Edition*

Peterson
PRINCIPLES OF ECONOMICS:
MACRO, *Sixth Edition*

Peterson
PRINCIPLES OF ECONOMICS:
MICRO, *Sixth Edition*

Reynolds
ECONOMICS: A GENERAL
INTRODUCTION, *Fifth Edition*

Reynolds
MACROECONOMICS, *Sixth Edition*

Reynolds
MICROECONOMICS, *Sixth Edition*

Rima
DEVELOPMENT OF ECONOMIC
ANALYSIS, *Fourth Edition*

Rosen
PUBLIC FINANCE, *Second Edition*

Rowan
READINGS IN LABOR ECONOMICS
AND LABOR RELATIONS, *Fifth
Edition*

Seo
MANAGERIAL ECONOMICS, *Sixth
Edition*

Shepherd
PUBLIC POLICIES TOWARD
BUSINESS, *Seventh Edition*

Steltzer and Kitt
SELECTED ANTITRUST CASES,
Seventh Edition

Stigum
PROBLEMS IN MICROECONOMICS,
First Edition

Tullock and McKenzie
THE NEW WORLD OF ECONOMICS,
Fourth Edition

Walton and Wykoff
UNDERSTANDING ECONOMICS
TODAY, *First Edition*

PREFACE

In the preface to our second edition, we admitted, "When we began this revision, we fully expected that our changes would be rather minor. But, as we read the comments of users, we eventually came to the opinion that a major revision was needed."

When we began this, our third edition, we again expected that our changes would be rather minor. And yet again we came to the opinion that a major revision was necessary.

In the case of this revision, two factors led us to revise our expectations and opt for a major revision. First, as with the previous revision, we listened to the people who used the text. Our users had asked for some reorganization, for still more business-oriented applications, and for the discussion of linear programming that had been dropped in the second edition to be included once again. Second, in the interim since the second edition was written, Charles Smithson spent two years teaching managerial economics and corporate finance to officers of Chase Manhattan Bank throughout the world. As is always the case, the person in the class who learns the most is the teacher; and this was definitely the case with Charles' experience with Chase. Most significantly, he got a much fuller appreciation of the way managerial economics and managerial finance fit together, and he wanted to try to incorporate that appreciation in this text.

Hence, to the two fundamental objectives described in the preface to our second edition:

1. To present the core of microeconomic theory.
2. To show how the theoretical concepts can actually be implemented.

we add a third objective in this edition:

3. To demonstrate the relation of managerial economics to finance and to the other courses in a business school curriculum.

Indeed, these three objectives illuminate the primary distinguishing characteristics of our approach to managerial economics.

First, this text can “stand alone” in the sense that it contains all of the principles of microeconomic theory needed to understand specific managerial economics concepts; no supplemental text is necessary. By presenting the basic theory and the specific managerial economics constructs together, we demonstrate that managerial economics is simply an application of microeconomics.

Second, we stress that the theoretical principles of microeconomics are *useful* in the real world. We use a “three-pronged attack” to make this crucial point. (1) We show that the principles of microeconomic theory will invariably lead the manager to decisions that will increase the value of the firm. (2) Using some simple numerical examples, we show that the implementation of the principles using real-world data and some basic empirical models and techniques is not all that hard. (3) Drawing on recent articles in publications like *The Wall Street Journal*, we show that real-world managers are actually using the theoretical principles to make decisions on a day-to-day basis.

Third, we demonstrate how managerial economics—applied microeconomic theory—is related to the other disciplines the student will encounter in a business school curriculum. We point out how managerial economics relies on material from other disciplines (e.g., the importance of the theory of efficient markets to the issue of forecasting future sales) and how economics provides a theoretical framework for questions asked in other disciplines (e.g., the use of the indifference curves to evaluate the effect of advertising programs).

The reorganization of material reflected in this edition resulted solely from requests from our users. There are three major areas in which the reorganization appears.

As has been the case since its inception, the body of the text contains no calculus; only algebra and basic geometry are required for complete understanding of the material presented. In the past, the calculus was presented in footnotes. In this edition, we have moved those mathematical discussions, as well as any difficult material that could be bypassed without a loss of continuity, to appendices to the relevant chapters.

For the reasons given in the preface to our second edition, we still believe that it is easier to teach production and cost first and then teach demand. This belief notwithstanding, our current role as textbook writers requires us to listen to our users about the topic order they think is easier to teach. We have listened. Consequently, we have in this edition returned to the traditional topic organization of demand first (Part 2, following the methodological preliminaries in Part 1) and then production and cost (Part 3).

As noted earlier, a number of users asked that we reinstate the topic of linear programming. While we do not use linear programming directly in any of our applications, we have added this topic in an appendix to this text.

The response of instructors and students to the applications in our previous editions has been gratifying. And, if you liked those, you should love the new ones. In this revision, we gave particular attention to the applications.

We searched *The Wall Street Journal* and other publications to find stories that illustrate the theoretical principles. In particular, our goal was to find timely and amusing stories. We think that, with applications like “‘People Watching’ to Estimate Demand” (Chapter 7), “Insurance and Litigation Expenses: A Different Type of Production Cost” (Chapter 12), “An Advertiser’s Dilemma: Baby Food and Burger Wars” (Chapter 15), and “Selling off the Crown Jewels” (Chapter 18), we succeeded.

For more complicated topics and/or those that required numerical solutions, we were sometimes forced to make up stylized applications. We developed these stylized applications to correspond to real-world events as much as possible. For example, our applications for hostile takeovers—“What Happened to the Golden Boys at EasTex Oil?” and “Goodbye to the Golden Boys at EasTex Oil” (Chapter 18)—are simply stylized versions of stories that were repeated many times in the 1980s.

In addition to the revised applications, we have made extensive revisions and, we believe, improvements to the text. For example, the chapters on production and cost have been expanded to make the material more accessible. Moreover, much of the material on market structures, particularly oligopoly, has been reordered and expanded. Indeed, we have added new text material to every chapter—as we continue to learn new material, we pass it on to the users of this text.

The effect on our thinking of Charles’ experiences at Chase appear throughout the text. Examples include estimation of the market model (Chapter 4), the discussion of efficient markets as they relate to demand forecasting (Chapter 8), and price forecasts obtained from the futures markets and random walk price forecasts (Chapter 13).

However, the most significant changes are reflected in Part 6 of the text, all of which is new material. In Parts 1 through 5 of the text, we implicitly consider a firm that is owned and managed by a single entrepreneur, has only a single-period time horizon, and faces no uncertainty. In Part 6, we explicitly consider the shareholder-owned firm. Chapter 18 examines the effects of a multiperiod time horizon, considering the concept of present value, the net present value rule for maximizing the value of a firm, the relation between single-period profit maximization and maximizing the value of the firm, the way maximizing the value of the firm eliminates potential conflicts among shareholders, and how the net present value rule can explain much of the recent merger and acquisition activity in the United States. Chapter 19 examines the effects of uncertainty. After looking at some basic features of probability distributions and showing how the variance of a distribution can be used as a measure of risk, we concentrate on the valuation of a stream of risky cash flows, with particular emphasis on the appropriate discount rate for a risky project. In the process, we consider risk-adjusted discount rates, the weighted average cost of capital, and the capital asset pricing model. Chapter 20 brings together Chapters 18 and 19 by considering the investment decision. We compare the net present value rule with other competing investment criteria—payback, return to investment, and internal rate of return—and then briefly examine the capital rationing problem.

The material in Part 6 is an integral part of managerial economics. In Parts 1 through 5, we look at three questions a manager must answer when maximizing single-period profit:

How much output do I produce?

What price do I charge?

What levels of input usage is optimal?

In Part 6, we look at the fourth question a manager must answer:

What investment projects will I undertake?

Moreover, as is apparent from the topics covered and the order of presentation, the material in Part 6 will lead into or reinforce the material learned in the student's finance courses. Hence, it provides an integration of managerial economics with finance, which is part of our third objective for this text.

Chuck Maurice
Charles Smithson

ACKNOWLEDGMENTS

We are indebted to a number of people for their help and support in this revision. In particular, we want to acknowledge the significant contribution made by Niccie McKay at Texas A&M University. She has been involved with every part of this revision, suggesting changes, commenting on the entire draft manuscript, and providing new end-of-chapter questions.

We are also indebted to the persons we met through Richard D. Irwin, Inc., who helped us with this text. Daryl Winn (University of Colorado) has been particularly helpful, making suggestions about the design of the revision and commenting on the draft manuscript for the third edition. We also were helped by the comments and suggestions of Daniel Blakey (University of San Francisco), Charles Brumfield (California State University, Hayward), James Overdahl (University of Texas, Dallas), and Pat Sanderson (Mississippi State University).

We want to thank the people Charles Smithson met and learned from through his affiliation with Chase. Clifford W. Smith, Jr. (University of Rochester) deserves particular thanks for teaching Charles the principles of modern corporate finance that could subsequently be added to this text. Roberto Wessels (Erasmus University) convinced us that Part 6 had to be revised and helped us to revise it. J. Nicholas Robinson (Chase), Dylan Thomas (London Polytechnic), and D. Sykes Wilford (then of Chase, now of Drexel, Burnham, Lambert) read and provided useful comments on much of the manuscript. But most of all, we want to thank officers of Chase Manhattan Bank who came as students but ended up teaching us that managerial economics is a real-world discipline with real-world answers to real-world problems.

S. C. M.

C. W. S.

CONTENTS

1 Scope of Managerial Economics	1
1.1 Why Firms Exist	3
1.2 Roles of Managers	4
1.3 Managerial Economics as Part of a Business Curriculum	5
1.4 Purpose of Economic Theory	6
1.5 Purpose of Empirical Analyses	7
1.6 A Preview	7
Application: Hours of Operation for a Store	7
Application: Breakage in the Factory—Should It Be Eliminated?	8
Application: The Optimal Mix of Advertising Media	10
Application: Do I Acquire a New Machine?	11
1.7 Structure of the Text	12
 PART I THE PRELIMINARIES	 15
2 Demand and Supply	17
2.1 Demand	18
<i>The Wall Street Journal</i> Application: Gasoline Prices and the Demand for Burgers	20
The Demand Function	22
Shifts in Demand	24
<i>The Wall Street Journal</i> Application: Demand for Remodeling: Why Does Demand Increase?	27
2.2 Supply	28
The Supply Function	30
Shifts in Supply	31

<i>The Wall Street Journal</i> Application: Supply in the Oil Industry	33
2.3 Market Equilibrium	35
<i>The Wall Street Journal</i> Application: Do Buyers Really Bid Up Prices?	37
2.4 Changes in Market Equilibrium	38
Application: World Economic Conditions and the Price of Platinum	42
2.5 Summary	44
3 Theory of Optimizing Behavior	51
3.1 Unconstrained Optimization	52
Application: Upscale Migrant Workers	54
<i>The Wall Street Journal</i> Application: Optimal Product Quality	57
3.2 Constrained Optimization	59
Application: The Optimal Allocation of Advertising Expenditures—A Hypothetical Example	61
<i>The Wall Street Journal</i> Application: The Optimal Allocation of Advertising Expenditures—An Actual Example	63
Application: The Optimal Combination of Inputs	66
Application: The Optimal Allocation of Study Time	67
3.3 Summary	68
Appendix: The Mathematics of Optimization	74
4 Basic Estimation Techniques	77
4.1 Fitting a Regression Line	77
4.2 Tests for Significance	80
4.3 Evaluation of the Regression Equation	83
Application: The Market Model	85
4.4 Multiple Regression	87
Linear Equations	87
Application: A Simple Consumption Function	88
Nonlinear Equations	89
Application: A Log-Linear Regression	91
4.5 Regression in Managerial Decision Making	92
Appendix: Some Additional Problems	95
 PART 2 DEMAND	 97
5 Theory of Consumer Behavior: Individual Demand Curves	99
5.1 The Utility Function	100
Complete Information	100
Preference Ordering	100
5.2 Indifference Curves and Maps	101
Marginal Rate of Substitution	103
Indifference Maps	104
Application: Indifference Curves in Investments	105
Marginal Utility Approach	107
5.3 The Consumer's Budget Constraint	107
Budget Lines	108
Shifting the Budget Line	109

5.4	Utility Maximization	111	
	Maximizing Utility Subject to a Limited Money Income	111	
	Application: The Optimal Portfolio of Investments	113	
	Marginal Utility Interpretation	114	
	Application: The Allocation of Retail Display Space	116	
5.5	An Individual Consumer's Demand Curve	117	
5.6	Substitution and Income Effects	119	
	Substitution Effect	120	
	Income Effect	121	
	Why Demand Slopes Downward	124	
5.7	Advertising and Indifference Curves	124	
	Informative Advertising	125	
	Application: Informative Advertising	127	
	Image Advertising	129	
	Application: Ads to Reduce Substitutability	131	
	Application: Ads to Increase Demand	133	
5.8	Summary	135	
	Appendix: Utility Maximization Subject to an Income Constraint	140	
6	Market Demand and Elasticity		141
6.1	Aggregating Individual Demands	141	
6.2	Demand Elasticity—Own-Price Elasticity	143	
	Computation of Elasticity	145	
	Application: Texas Calculates Elasticity	148	
	Factors Affecting Elasticity	149	
	Application: Time and the Demand for Petroleum	151	
6.3	Other Elasticities	153	
6.4	Marginal Revenue and Elasticity	154	
6.5	Summary	159	
	Appendix	163	
7	Empirical Demand Functions		165
7.1	Direct Methods of Demand Estimation	166	
	Consumer Interviews	166	
	<i>The Wall Street Journal</i> Application: Problems with Consumer Interviews	167	
	Market Studies and Experiments	168	
	<i>The Wall Street Journal</i> Application: "People Watching" to Estimate Demand	169	
	<i>The Wall Street Journal</i> Application: Why 42 Oreo Cookies to a Package?	170	
	Application: The Residential Demand for Electricity	171	
	Application: High-Tech Market Experiments	172	
7.2	Estimation of Demand Using Regression Analysis	173	
	A Linear Demand Function	174	
	A Nonlinear Demand Function	175	
	The Identification Problem	175	
	Estimation of the Demand Function	179	
	Application: The World Demand for Copper	180	
	Appendix: Derivation of Elasticity Estimates	188	

8 Demand Forecasting 190

- 8.1 Sales Forecasts versus Price Forecasts 191
 - Application: Making \$1 Million Trading Wheat Futures 193
- 8.2 Qualitative Techniques 194
 - The Wall Street Journal* Application: A Sluggish Economy 197
- 8.3 Time-Series Models 199
 - Linear Trend Forecasting 201
 - Cyclical Variation 202
 - Application: Use of Dummy Variables 205
- 8.4 Econometric Models 209
 - Simultaneous Equations Forecasts 210
 - Application: A Forecast for World Copper Consumption 213
 - A Note on Simulations 214
- 8.5 Some Final Warnings 215
 - Application: The Dismal Science 217

PART 3 PRODUCTION AND COST 223

9 Theory of Production 225

- 9.1 Production Functions 226
 - Economic Efficiency 227
 - Short Run and Long Run 227
 - Fixed or Variable Proportions 228
 - Application: Can the West Do without South Africa's Minerals? 229
- 9.2 Production in the Short Run 230
 - Total, Average, and Marginal Products 231
 - Law of Diminishing Marginal Product 235
 - Shifts in Total, Average, and Marginal Products 235
 - Total, Average, and Marginal Products of Capital 237
 - Summary of Short-Run Production 237
- 9.3 Production in the Long Run 239
 - Marginal Rate of Technical Substitution 242
 - Relation of *MRTS* to Marginal Products 243
- 9.4 The Optimal Combination of Inputs 244
 - Input Prices and Isocost Curves 245
 - Production of a Given Output at Minimum Cost 247
 - Production of Maximum Output with a Given Level of Cost 249
 - The Expansion Path 250
- 9.5 Returns to Scale 252
- 9.6 Changes in Input Prices and Technological Change 254
 - Changes in Relative Prices 254
 - The Wall Street Journal* Application: Firms Adapt to Higher Wage Rates 256
 - Technological Change 258
 - Input Price Changes and Technological Change 260
 - The Wall Street Journal* Application: Is a Change in Technology Always Good? 261
- 9.7 Summary 263
- Appendix 268

10 Theory of Cost	270
10.1 Some Basic Concepts	270
Fixed and Variable Costs	270
Explicit and Implicit Costs	271
10.2 Cost in the Short Run	272
Short-Run Total Cost	272
Average and Marginal Cost	275
Relations between Average Variable and Marginal Costs and Average and Marginal Products	278
<i>The Wall Street Journal</i> Application: Are Costs and Productivity Related?	280
General Short-Run Cost Curves	280
Application: Irrelevance of Fixed Cost	282
10.3 Long-run costs: The Planning Horizon	284
Derivation of Cost Schedules from a Production Function	284
Economies and Diseconomies of Scale	288
<i>The Wall Street Journal</i> Application: An Airline Runs into Trouble	292
10.4 Relations between Short-Run and Long-Run Costs	295
<i>The Wall Street Journal</i> Application: Oil Drillers Cut Costs	298
10.5 Summary	300
Appendix	305
11 Empirical Production and Cost Functions	306
11.1 Estimation of Production Functions	307
Application: Production in U.S. Electric Utility Firms	311
11.2 Regression Analyses of Cost—Some General Considerations	316
Short-Run versus Long-Run Estimation	316
Data Problems	318
11.3 Estimation of a Short-Run Cost Function	319
Application: A Short-Run Cost Function	323
11.4 Estimation of a Long-Run Cost Function	326
Application: Costs in the U.S. Electric Utility Industry	328
11.5 An Alternative Approach—The Engineering Technique	332
Application: An Engineering Cost Function in Petroleum Refining	332
Appendix A: The Cobb-Douglas Production Function	340
Appendix B: The Efficiency Criterion	342
Application: Input Efficiency in the U.S. Electric Utility Industry	344
 PART 4 PERFECT COMPETITION	 347
12 Theory of Perfectly Competitive Firms and Industries	349
12.1 Some Principles	350
12.2 Characteristics of Perfect Competition	352
Application: Financial Markets as (Super) Competitive Markets	353
12.3 The Demand Curve Facing an Individual Firm	354
12.4 Profit Maximization in the Short Run	355
<i>The Wall Street Journal</i> Application: Insurance and Litigation Expenses: A Different Type of Production Cost	361
12.5 Profit Maximization in the Long Run	363
Profit-Maximizing Equilibrium	364
Long-Run Competitive Equilibrium	364

The Wall Street Journal Application: How Profits Get Competed Away: The Miniwarehouse Industry 367

12.6 Profit-Maximizing Input Usage 369

Value of Marginal Product 369

VMP and the Hiring Decision 370

Input Demand by a Competitive Industry 373

Application: Supply and Demand in High-Wage Labor Markets 374

12.7 Summary 376

Appendix 381

13 Profit Maximization in Competitive Markets— Implementation of the Theory

383

13.1 Profit-Maximizing Output 383

Price Forecasts 384

The Wall Street Journal Application: Futures Prices as Price Forecasts 384

Application: A Random Walk Forecast 386

Application: An Econometric Price Forecast 388

Estimation of Average Variable Cost 390

Application: An Average Variable Cost Function 390

Derivation of the Marginal Cost Function 390

Application: A Marginal Cost Function 391

The Shutdown Decision 391

Application: Should I Produce? 391

The Output Decision 392

Application: How Much Should I Produce? 392

Total Profit or Loss 393

Application: What's the Bottom Line? 394

13.2 Profit-maximizing Levels of Input Usage 395

Application: How Many Workers Should I Hire? 396

Appendix: The Profit-Maximizing Levels of Input Usage when Several Inputs Are Variable 401

Application: A More Complicated Employment Decision 402

PART 5 FIRMS WITH MARKET POWER

405

14 The Theory of Monopoly

407

14.1 Characteristics of Monopoly 408

Application: Is the National Football League a Monopoly? 410

14.2 Barriers to Entry 412

Economies of Scale 412

Barriers Created by Government 413

Input Barriers 414

Brand Loyalties 414

The Wall Street Journal Application: Advantages of Established Firms and Strategic Behavior 415

14.3 Profit Maximization under Monopoly—The Output and Price Decisions 419

Demand and Marginal Revenue 420

A Numerical Example 420

Short-Run Equilibrium: Profit Maximization	422
Short-Run Equilibrium: Loss Minimization	424
Long-Run Equilibrium	427
<i>The Wall Street Journal</i> Application: What Can a Giant Do when It's Losing Money?	428
14.4 Input Demand for a Monopolist	431
Input Prices Given	431
Upward-Sloping Input Supply	434
Application: Monopoly Power of Another Sort	434
14.5 Summary	437
Appendix	442
15 Imperfect Competition	444
15.1 Monopolistic Competition	446
Short-Run Equilibrium	446
Long-Run Equilibrium	448
<i>The Wall Street Journal</i> Application: How Quickly Are Profits Competed Away?	450
15.2 Characteristics of Oligopoly	452
Similar Characteristics	453
Differing Characteristics	454
Application: Oligopoly Interdependence in the Airplane Market	455
15.3 Noncooperative Oligopoly Behavior	456
Price Rigidity under Oligopoly	457
<i>The Wall Street Journal</i> Application: Oligopolists Do Use Price Competition—But They Don't Like It	459
Nonprice Competition in Oligopoly Markets: Advertising	460
<i>The Wall Street Journal</i> Application: An Advertiser's Dilemma: Baby Food and Burger Wars	463
Nonprice Competition in Oligopoly Markets: Product Quality	465
Application: Who Cares about a Little Bit of Sugar?	467
15.4 Cooperative Oligopoly Behavior	469
Cartel Profit Maximization	469
The Problem of Cheating	473
Application: Is Cheating a Problem for Cartels?	475
Tacit Collusion	476
Application: Tacit Collusion and Market Sharing	477
Price Leadership	478
15.5 Summary	479
Appendix	485
16 Profit Maximization for Firms with Market Power—Implementation of the Theory	486
16.1 Monopoly Output and Price	487
Application: Estimation of a Marginal Revenue Function	488
Application: How Much Do I Produce?	489
Application: What Price Do I Charge?	490
Application: The Shutdown Decision	490
Application: Marginal Revenue for a Log-linear Demand Function	492