



INTERMEDIATE MICROECONOMICS

NINTH EDITION

HAL R. VARIAN

Intermediate Microeconomics

A Modern Approach

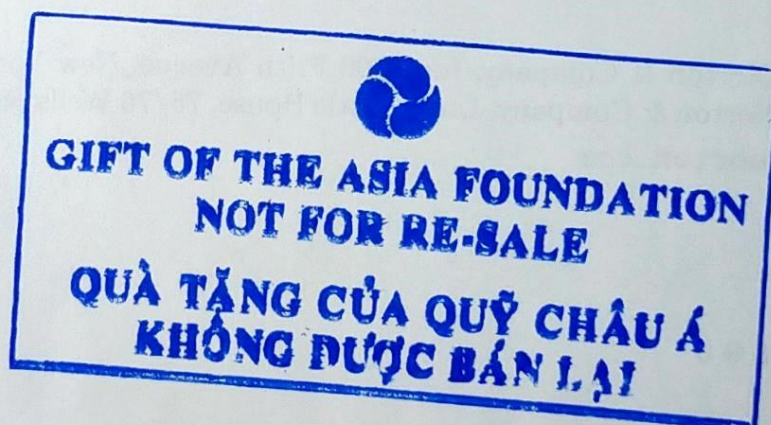
Ninth Edition

Hal R. Varian

University of California at Berkeley



W. W. Norton & Company • New York • London



W. W. Norton & Company has been independent since its founding in 1923, when William Warder Norton and Mary D. Herter Norton first published lectures delivered at the People's Institute, the adult education division of New York City's Cooper Union. The firm soon expanded its program beyond the Institute, publishing books by celebrated academics from America and abroad. By mid-century, the two major pillars of Norton's publishing program—trade books and college texts—were firmly established. In the 1950s, the Norton family transferred control of the company to its employees, and today—with a staff of four hundred and a comparable number of trade, college, and professional titles published each year—W. W. Norton & Company stands as the largest and oldest publishing house owned wholly by its employees.

Copyright © 2014, 2010, 2006, 2003, 1999, 1996, 1993, 1990, 1987 by Hal R. Varian

All rights reserved

Printed in the United States of America

NINTH EDITION

Editor: Jack Repcheck

Senior project editor: Thom Foley

Production manager: Andy Ensor

Editorial assistant: Theresia Kowara

TeXnician: Hal Varian

ISBN 978-0-393-12396-8

W. W. Norton & Company, Inc., 500 Fifth Avenue, New York, N.Y. 10110

W. W. Norton & Company, Ltd., Castle House, 75/76 Wells Street, London W1T 3QT

www.wwnorton.com

4 5 6 7 8 9 0

W. W. Norton & Company has been independent since its founding in 1923, when William Warder Norton and Mary D. Herter Norton first published lectures delivered at the People's Institute, the adult education division of New York City's Cooper Union. The firm soon expanded its program beyond the Institute, publishing books by celebrated academics from America and abroad. By mid-century, the two major pillars of Norton's publishing program—trade books and college texts—were firmly established. In the 1950s, the Norton family transferred control of the company to its employees, and today—with a staff of four hundred and a comparable number of trade, college, and professional titles published each year—W. W. Norton & Company stands as the largest and oldest publishing house owned wholly by its employees.

Copyright © 2014, 2010, 2006, 2003, 1999, 1996, 1993, 1990, 1987 by Hal R. Varian

All rights reserved

Printed in the United States of America

NINTH EDITION

Editor: Jack Repcheck

Senior project editor: Thom Foley

Production manager: Andy Ensor

Editorial assistant: Theresia Kowara

TeXnician: Hal Varian

ISBN 978-0-393-12396-8

W. W. Norton & Company, Inc., 500 Fifth Avenue, New York, N.Y. 10110

W. W. Norton & Company, Ltd., Castle House, 75/76 Wells Street, London W1T 3QT

www.wwnorton.com

4 5 6 7 8 9 0

W. W. Norton & Company has been independent since its founding in 1923, when William Warder Norton and Mary D. Herter Norton first published lectures delivered at the People's Institute, the adult education division of New York City's Cooper Union. The firm soon expanded its program beyond the Institute, publishing books by celebrated academics from America and abroad. By mid-century, the two major pillars of Norton's publishing program—trade books and college texts—were firmly established. In the 1950s, the Norton family transferred control of the company to its employees, and today—with a staff of four hundred and a comparable number of trade, college, and professional titles published each year—W. W. Norton & Company stands as the largest and oldest publishing house owned wholly by its employees.

Copyright © 2014, 2010, 2006, 2003, 1999, 1996, 1993, 1990, 1987 by Hal R. Varian

All rights reserved

Printed in the United States of America

NINTH EDITION

Editor: Jack Repcheck

Senior project editor: Thom Foley

Production manager: Andy Ensor

Editorial assistant: Theresia Kowara

TeXnician: Hal Varian

ISBN 978-0-393-12396-8

W. W. Norton & Company, Inc., 500 Fifth Avenue, New York, N.Y. 10110

W. W. Norton & Company, Ltd., Castle House, 75/76 Wells Street, London W1T 3QT

www.wwnorton.com

4 5 6 7 8 9 0

CONTENTS

Preface

xix

1 The Market

Constructing a Model 1 Optimization and Equilibrium 3 The Demand Curve 3 The Supply Curve 5 Market Equilibrium 7 Comparative Statics 9 Other Ways to Allocate Apartments 11 *The Discriminating Monopolist* • *The Ordinary Monopolist* • *Rent Control* • Which Way Is Best? 14 Pareto Efficiency 15 Comparing Ways to Allocate Apartments 16 Equilibrium in the Long Run 17 Summary 18 Review Questions 19

2 Budget Constraint

The Budget Constraint 20 Two Goods Are Often Enough 21 Properties of the Budget Set 22 How the Budget Line Changes 24 The Numeraire 26 Taxes, Subsidies, and Rationing 26 *Example: The Food Stamp Program* Budget Line Changes 31 Summary 31 Review Questions 32

3 Preferences

Consumer Preferences 34 Assumptions about Preferences 35 Indifference Curves 36 Examples of Preferences 37 *Perfect Substitutes* • *Perfect Complements* • *Bads* • *Neutrals* • *Satiation* • *Discrete Goods* • Well-Behaved Preferences 44 The Marginal Rate of Substitution 48 Other Interpretations of the MRS 50 Behavior of the MRS 51 Summary 52 Review Questions 52

4 Utility

Cardinal Utility 57 Constructing a Utility Function 58 Some Examples of Utility Functions 59 *Example: Indifference Curves from Utility* *Perfect Substitutes* • *Perfect Complements* • *Quasilinear Preferences* • *Cobb-Douglas Preferences* • Marginal Utility 65 Marginal Utility and MRS 66 Utility for Commuting 67 Summary 69 Review Questions 70 Appendix 70 *Example: Cobb-Douglas Preferences*

5 Choice

Optimal Choice 73 Consumer Demand 78 Some Examples 78 *Perfect Substitutes* • *Perfect Complements* • *Neutrals and Bads* • *Discrete Goods* • *Concave Preferences* • *Cobb-Douglas Preferences* • Estimating Utility Functions 83 Implications of the MRS Condition 85 Choosing Taxes 87 Summary 89 Review Questions 89 Appendix 90 *Example: Cobb-Douglas Demand Functions*

6 Demand

Normal and Inferior Goods 96 Income Offer Curves and Engel Curves 97 Some Examples 99 *Perfect Substitutes* • *Perfect Complements* • *Cobb-Douglas Preferences* • *Homothetic Preferences* • *Quasilinear Preferences* • Ordinary Goods and Giffen Goods 104 The Price Offer Curve and the Demand Curve 106 Some Examples 107 *Perfect Substitutes* • *Perfect Complements* • *A Discrete Good* • Substitutes and Complements 111 The Inverse Demand Function 112 Summary 114 Review Questions 115 Appendix 115

7 Revealed Preference

The Idea of Revealed Preference 119 From Revealed Preference to Preference 120 Recovering Preferences 122 The Weak Axiom of Revealed Preference 124 Checking WARP 125 The Strong Axiom of Revealed Preference 128 How to Check SARP 129 Index Numbers 130 Price Indices 132 *Example: Indexing Social Security Payments* Summary 135 Review Questions 135

8 Slutsky Equation

The Substitution Effect 137 *Example: Calculating the Substitution Effect* The Income Effect 141 *Example: Calculating the Income Effect* Sign of the Substitution Effect 142 The Total Change in Demand 143 Rates of Change 144 The Law of Demand 147 Examples of Income and Substitution Effects 147 *Example: Rebating a Tax* *Example: Voluntary Real Time Pricing* Another Substitution Effect 153 Compensated Demand Curves 155 Summary 156 Review Questions 157 Appendix 157 *Example: Rebating a Small Tax*

9 Buying and Selling

Net and Gross Demands 160 The Budget Constraint 161 Changing the Endowment 163 Price Changes 164 Offer Curves and Demand Curves 167 The Slutsky Equation Revisited 168 Use of the Slutsky Equation 172 *Example: Calculating the Endowment Income Effect* Labor Supply 173 *The Budget Constraint* • Comparative Statics of Labor Supply 174 *Example: Overtime and the Supply of Labor* Summary 178 Review Questions 179 Appendix 179

10 Intertemporal Choice

The Budget Constraint 182 Preferences for Consumption 185 Comparative Statics 186 The Slutsky Equation and Intertemporal Choice 187 Inflation 189 Present Value: A Closer Look 191 Analyzing Present Value for Several Periods 193 Use of Present Value 194
Example: Valuing a Stream of Payments *Example: The True Cost of a Credit Card* *Example: Extending Copyright* Bonds 198 *Example: Installment Loans* Taxes 200 *Example: Scholarships and Savings* Choice of the Interest Rate 201 Summary 202 Review Questions 202

11 Asset Markets

Rates of Return 203 Arbitrage and Present Value 205 Adjustments for Differences among Assets 205 Assets with Consumption Returns 206 Taxation of Asset Returns 207 Market Bubbles 208 Applications 209 *Depletable Resources* • *When to Cut a Forest* • *Example: Gasoline Prices during the Gulf War* Financial Institutions 213 Summary 214 Review Questions 215 Appendix 215

12 Uncertainty

Contingent Consumption 217 *Example: Catastrophe Bonds* Utility Functions and Probabilities 222 *Example: Some Examples of Utility Functions* Expected Utility 223 Why Expected Utility Is Reasonable 224 Risk Aversion 226 *Example: The Demand for Insurance* Diversification 230 Risk Spreading 230 Role of the Stock Market 231 Summary 232 Review Questions 232 Appendix 233 *Example: The Effect of Taxation on Investment in Risky Assets*

13 Risky Assets

Mean-Variance Utility 236 Measuring Risk 241 Counterparty Risk 243 Equilibrium in a Market for Risky Assets 243 How Returns Adjust 245 *Example: Value at Risk* *Example: Ranking Mutual Funds* Summary 249 Review Questions 250

14 Consumer's Surplus

Demand for a Discrete Good 252 Constructing Utility from Demand 253 Other Interpretations of Consumer's Surplus 254 From Consumer's Surplus to Consumers' Surplus 255 Approximating a Continuous Demand 255 Quasilinear Utility 255 Interpreting the Change in Consumer's Surplus 256 *Example: The Change in Consumer's Surplus* Compensating and Equivalent Variation 258 *Example: Compensating and Equivalent Variations* *Example: Compensating and Equivalent Variation for Quasilinear Preferences* Producer's Surplus 262 Benefit-Cost Analysis 264 *Rationing* • Calculating Gains and Losses 266 Summary 267 Review Questions 267 Appendix 268 *Example: A Few Demand Functions* *Example: CV, EV, and Consumer's Surplus*

15 Market Demand

From Individual to Market Demand 270 The Inverse Demand Function 272 *Example: Adding Up "Linear" Demand Curves* Discrete Goods 273 The Extensive and the Intensive Margin 273 Elasticity 274 *Example: The Elasticity of a Linear Demand Curve* Elasticity and Demand 276 Elasticity and Revenue 277 *Example: Strikes and Profits* Constant Elasticity Demands 280 Elasticity and Marginal Revenue 281 *Example: Setting a Price* Marginal Revenue Curves 283 Income Elasticity 284 Summary 285 Review Questions 286 Appendix 287 *Example: The Laffer Curve* *Example: Another Expression for Elasticity*

16 Equilibrium

Supply 293 Market Equilibrium 293 Two Special Cases 294 Inverse Demand and Supply Curves 295 *Example: Equilibrium with Linear Curves* Comparative Statics 297 *Example: Shifting Both Curves* Taxes 298 *Example: Taxation with Linear Demand and Supply* Passing Along a Tax 302 The Deadweight Loss of a Tax 304 *Example: The Market for Loans* *Example: Food Subsidies* *Example: Subsidies in Iraq* Pareto Efficiency 310 *Example: Waiting in Line* Summary 313 Review Questions 313

17 Measurement

Summarize data **316** *Example: Simpson's paradox* Test **320** Estimating demand using experimental data **320** Effect of treatment **321**
 Estimating demand using observational data **322** *Functional form* •
Statistical model • *Estimation* • Identification **324** What can go
 wrong? **326** Policy evaluation **327** *Example: Crime and police*
 Summary **328** Review Questions **329**

18 Auctions

Classification of Auctions **331** *Bidding Rules* • Auction Design **332**
Example: Goethe's auction Other Auction Forms **336** *Example: Late*
Bidding on eBay Position Auctions **338** *Two Bidders* • *More Than*
Two Bidders • *Quality Scores* • Should you advertise on your brand?
341 Auction revenue and number of bidders **342** Problems with Auc-
 tions **343** *Example: Taking Bids Off the Wall* The Winner's Curse
344 Stable Marriage Problem **345** Mechanism Design **346** Sum-
 mary **348** Review Questions **349**

19 Technology

Inputs and Outputs **350** Describing Technological Constraints **351**
 Examples of Technology **352** *Fixed Proportions* • *Perfect Substi-*
tutes • *Cobb-Douglas* • Properties of Technology **354** The Marginal
 Product **356** The Technical Rate of Substitution **356** Diminishing
 Marginal Product **357** Diminishing Technical Rate of Substitution **357**
 The Long Run and the Short Run **358** Returns to Scale **358** *Ex-*
ample: Datacenters *Example: Copy Exactly!* Summary **361** Review
 Questions **362**

20 Profit Maximization

Profits 363 The Organization of Firms 365 Profits and Stock Market Value 365 The Boundaries of the Firm 367 Fixed and Variable Factors 368 Short-Run Profit Maximization 368 Comparative Statics 370 Profit Maximization in the Long Run 371 Inverse Factor Demand Curves 372 Profit Maximization and Returns to Scale 373 Revealed Profitability 374 *Example: How Do Farmers React to Price Supports?* Cost Minimization 378 Summary 378 Review Questions 379 Appendix 380

21 Cost Minimization

Cost Minimization 382 *Example: Minimizing Costs for Specific Technologies* Revealed Cost Minimization 386 Returns to Scale and the Cost Function 387 Long-Run and Short-Run Costs 389 Fixed and Quasi-Fixed Costs 391 Sunk Costs 391 Summary 392 Review Questions 392 Appendix 393

22 Cost Curves

Average Costs 396 Marginal Costs 398 Marginal Costs and Variable Costs 400 *Example: Specific Cost Curves* *Example: Marginal Cost Curves for Two Plants* Cost Curves for Online Auctions 404 Long-Run Costs 405 Discrete Levels of Plant Size 407 Long-Run Marginal Costs 408 Summary 409 Review Questions 410 Appendix 411

23 Firm Supply

Market Environments 413 Pure Competition 414 The Supply Decision of a Competitive Firm 416 An Exception 418 Another Exception 419 *Example: Pricing Operating Systems* The Inverse Supply Function 421 Profits and Producer's Surplus 421 *Example: The Supply Curve for a Specific Cost Function* The Long-Run Supply Curve of a Firm 425 Long-Run Constant Average Costs 427 Summary 428 Review Questions 429 Appendix 429

24 Industry Supply

Short-Run Industry Supply **431** Industry Equilibrium in the Short Run **432** Industry Equilibrium in the Long Run **433** The Long-Run Supply Curve **435** *Example: Taxation in the Long Run and in the Short Run* The Meaning of Zero Profits **439** Fixed Factors and Economic Rent **440** *Example: Taxi Licenses in New York City* Economic Rent **442** Rental Rates and Prices **444** *Example: Liquor Licenses* The Politics of Rent **445** *Example: Farming the Government* Energy Policy **447** Two-Tiered Oil Pricing • Price Controls • The Entitlement Program • Carbon Tax Versus Cap and Trade **451** *Optimal Production of Emissions* • A Carbon Tax • Cap and Trade • Summary **455** Review Questions **455**

25 Monopoly

Maximizing Profits **458** Linear Demand Curve and Monopoly **459** Markup Pricing **461** *Example: The Impact of Taxes on a Monopolist* Inefficiency of Monopoly **463** Deadweight Loss of Monopoly **465** *Example: The Optimal Life of a Patent* *Example: Patent Thickets* *Example: Managing the Supply of Potatoes* Natural Monopoly **469** What Causes Monopolies? **472** *Example: Diamonds Are Forever* *Example: Pooling in Auction Markets* *Example: Price Fixing in Computer Memory Markets* Summary **476** Review Questions **476** Appendix **477**

26 Monopoly Behavior

Price Discrimination **480** First-Degree Price Discrimination **480** *Example: First-degree Price Discrimination in Practice* Second-Degree Price Discrimination **483** *Example: Price Discrimination in Airfares* *Example: Prescription Drug Prices* Third-Degree Price Discrimination **487** *Example: Linear Demand Curves* *Example: Calculating Optimal Price Discrimination* *Example: Price Discrimination in Academic Journals* Bundling **492** *Example: Software Suites* Two-Part Tariffs **493** Monopolistic Competition **494** A Location Model of Product Differentiation **498** Product Differentiation **500** More Vendors **501** Summary **502** Review Questions **502**

27 Factor Markets

Monopoly in the Output Market 503 Monopsony 506 *Example: The Minimum Wage* Upstream and Downstream Monopolies 510 Summary 512 Review Questions 513 Appendix 513

28 Oligopoly

Choosing a Strategy 516 *Example: Pricing Matching* Quantity Leadership 517 *The Follower's Problem • The Leader's Problem • Price Leadership* 522 Comparing Price Leadership and Quantity Leadership 525 Simultaneous Quantity Setting 525 An Example of Cournot Equilibrium 527 Adjustment to Equilibrium 528 Many Firms in Cournot Equilibrium 529 Simultaneous Price Setting 530 Collusion 531 Punishment Strategies 533 *Example: Price Matching and Competition Example: Voluntary Export Restraints* Comparison of the Solutions 537 Summary 537 Review Questions 538

29 Game Theory

The Payoff Matrix of a Game 540 Nash Equilibrium 542 Mixed Strategies 543 *Example: Rock Paper Scissors* The Prisoner's Dilemma 545 Repeated Games 547 Enforcing a Cartel 548 *Example: Tit for Tat in Airline Pricing* Sequential Games 550 A Game of Entry Deterrence 552 Summary 554 Review Questions 555

30 Game Applications

Best Response Curves 556 Mixed Strategies 558 Games of Coordination 560 *Battle of the Sexes • Prisoner's Dilemma • Assurance Games • Chicken • How to Coordinate • Games of Competition* 564 Games of Coexistence 569 Games of Commitment 571 *The Frog and the Scorpion • The Kindly Kidnapper • When Strength Is Weakness • Savings and Social Security • Example: Dynamic inefficiency of price discrimination* Hold Up • Bargaining 580 *The Ultimatum Game • Summary* 583 Review Questions 583

31 Behavioral Economics

Framing Effects in Consumer Choice **586** *The Disease Dilemma* •
Anchoring Effects • *Bracketing* • *Too Much Choice* • *Constructed*
Preferences • Uncertainty **590** *Law of Small Numbers* • *Asset In-*
tegration and Loss Aversion • Time **593** *Discounting* • *Self-control*
 • *Example: Overconfidence* Strategic Interaction and Social Norms **595**
Ultimatum Game • *Fairness* • Assessment of Behavioral Economics
597 Summary **599** Review Questions **599**

32 Exchange

The Edgeworth Box **602** Trade **604** Pareto Efficient Allocations
605 Market Trade **607** The Algebra of Equilibrium **609** Walras'
 Law **611** Relative Prices **612** *Example: An Algebraic Example of*
Equilibrium The Existence of Equilibrium **614** Equilibrium and Effi-
 ciency **615** The Algebra of Efficiency **616** *Example: Monopoly in*
the Edgeworth Box Efficiency and Equilibrium **619** Implications of the
 First Welfare Theorem **621** Implications of the Second Welfare Theorem
623 Summary **625** Review Questions **626** Appendix **626**

33 Production

The Robinson Crusoe Economy **628** Crusoe, Inc. **630** The Firm **631**
 Robinson's Problem **632** Putting Them Together **632** Different Tech-
 nologies **634** Production and the First Welfare Theorem **636** Produc-
 tion and the Second Welfare Theorem **637** Production Possibilities **637**
 Comparative Advantage **639** Pareto Efficiency **641** Castaways, Inc.
643 Robinson and Friday as Consumers **645** Decentralized Resource
 Allocation **646** Summary **647** Review Questions **647** Appen-
 dix **648**

34 Welfare

Aggregation of Preferences **651** Social Welfare Functions **653** Welfare Maximization **655** Individualistic Social Welfare Functions **657** Fair Allocations **658** Envy and Equity **659** Summary **661** Review Questions **661** Appendix **662**

35 Externalities

Smokers and Nonsmokers **664** Quasilinear Preferences and the Coase Theorem **667** Production Externalities **669** *Example: Pollution Vouchers* Interpretation of the Conditions **674** Market Signals **677** *Example: Bees and Almonds* The Tragedy of the Commons **678** *Example: Overfishing* *Example: New England Lobsters* Automobile Pollution **682** Summary **684** Review Questions **684**

36 Information Technology

Systems Competition **687** The Problem of Complements **687** *Relationships among Complementors* • *Example: Apple's iPod and iTunes* *Example: Who Makes an iPod?* *Example: AdWords and AdSense* Lock-In **693** *A Model of Competition with Switching Costs* • *Example: Online Bill Payment* *Example: Number Portability on Cell Phones* Network Externalities **697** Markets with Network Externalities **697** Market Dynamics **699** *Example: Network Externalities in Computer Software* Implications of Network Externalities **703** *Example: The Yellow Pages* *Example: Radio Ads* Two-sided Markets **705** *A Model of Two-sided Markets* • Rights Management **706** *Example: Video Rental* Sharing Intellectual Property **708** *Example: Online Two-sided Markets* Summary **711** Review Questions **712**

37 Public Goods

When to Provide a Public Good? 714 Private Provision of the Public Good 718 Free Riding 718 Different Levels of the Public Good 720 Quasilinear Preferences and Public Goods 722 *Example: Pollution Revisited* The Free Rider Problem 724 Comparison to Private Goods 726 Voting 727 *Example: Agenda Manipulation* The Vickrey-Clarke-Groves Mechanism 730 *Groves Mechanism* • *The VCG Mechanism* • Examples of VCG 732 *Vickrey Auction* • *Clarke-Groves Mechanism* • Problems with the VCG 733 Summary 734 Review Questions 735 Appendix 735

38 Asymmetric Information

The Market for Lemons 738 Quality Choice 739 *Choosing the Quality* • Adverse Selection 741 Moral Hazard 743 Moral Hazard and Adverse Selection 744 Signaling 745 *Example: The Sheepskin Effect* Incentives 749 *Example: Voting Rights in the Corporation* *Example: Chinese Economic Reforms* Asymmetric Information 754 *Example: Monitoring Costs* *Example: The Grameen Bank* Summary 757 Review Questions 758

Mathematical Appendix

Functions A1 Graphs A2 Properties of Functions A2 Inverse Functions A3 Equations and Identities A3 Linear Functions A4 Changes and Rates of Change A4 Slopes and Intercepts A5 Absolute Values and Logarithms A6 Derivatives A6 Second Derivatives A7 The Product Rule and the Chain Rule A8 Partial Derivatives A8 Optimization A9 Constrained Optimization A10

Answers

A11

Index

A31