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 Al-Equilibrium in the Long Run 17 locate Apartments 16 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 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

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

9 Buying and Selling

The Budget Constraint 161 Changing Net and Gross Demands 160 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 The Budget Constraint • Comparative Statics of Labor Supply 173 Example: Overtime and the Supply of Labor Sum-Labor Supply 174 Review Questions 179 Appendix 179 mary 178

10 Intertemporal Choice

The Budget Constraint 182 Preferences for Consumption 185 parative Statics 186 The Slutsky Equation and Intertemporal Choice Inflation 189 Present Value: A Closer Look 191 ing 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 ple: 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 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 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 Example: The Change in Consumer's Surplus Consumer's Surplus 256 Compensating and Equivalent Variation 258 Example: Compensating and Equivalent Variations Example: Compensating and Equivalent Variation for Quasilinear Preferences Producer's Surplus 262 Rationing • Calculating Gains and Losses 266 Analysis 264 Review Questions 267 Appendix 268 Example: Amary 267 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

Market Equilibrium 293 Two Special Cases 294 Supply 293 Example: Equilibrium with Linverse Demand and Supply Curves 295 Example: Shifting Both Curves ear Curves Comparative Statics 297 Example: Taxation with Linear Demand and Supply Pass-Taxes 298 ing Along a Tax 302 The Deadweight Loss of a Tax 304 Example: Example: Subsidies in The Market for Loans Example: Food Subsidies Example: Waiting in Line Summary 313 Iraq Pareto Efficiency 310 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? Auction revenue and number of bidders 342 Problems with Auc-341 Example: Taking Bids Off the Wall The Winner's Curse tions **343** 344 Stable Marriage Problem 345 Mechanism Design 346 mary 348 Review Questions 349

19 Technology

Inputs and Outputs 350 Describing Technological Constraints Examples of Technology 352 Fixed Proportions • Perfect Substitutes • 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 Example: Datacenters Example: Copy Exactly! Summary 361 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 Profit Maximization and Returns to Scale 373 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 Industry Equilibrium in the Long Run 433 The Long-Run Supply Example: Taxation in the Long Run and in the Short Run Fixed Factors and Economic Rent The Meaning of Zero Profits 439 Example: Taxi Licenses in New York City Economic Rent 442 Example: Liquor Licenses The Politics Rental Rates and Prices 444 Example: Farming the Government Energy Policy 447 of Rent. 445 Two-Tiered Oil Pricing • Price Controls • The Entitlement Program • Carbon Tax Versus Cap and Trade 451 Ontimal Production of Emissions • A Carbon Tax • Cap and Trade • Summary 455 Questions 455

25 Monopoly

Maximizing Profits 458 Linear Demand Curve and Monopoly Example: The Impact of Taxes on a Monopo-Markup Pricing 461 list 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 Example: Diamonds Are Forever Causes Monopolies? 472 Example: Price Fixing in Computer Memory Pooling in Auction Markets Markets Summary 476 Review Questions 476 Appendix 477

26 Monopoly Behavior

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

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

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 Integration 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 Pareto Efficient Allocations Trade **604** 605 Market Trade 607 The Algebra of Equilibrium 609 Relative Prices 612 Example: An Algebraic Example of Equilibrium The Existence of Equilibrium 614 Equilibrium and Efficiency 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 Summary 625 Review Questions 626 623 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-Production and the First Welfare Theorem 636 Production and the Second Welfare Theorem 637 Production Possibilities 637 Comparative Advantage 639 Pareto Efficiency 641 Castaways, Inc. Robinson and Friday as Consumers 645 Decentralized Resource Allocation 646 Summary 647 Review Questions 647 Appendix 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-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 ket Dynamics 699 Example: Network Externalities in Computer Software Implications of Network Externalities 703 Example: The Yellow 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 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 Example: Agenda Manipulation The Vickrev-Voting 727 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