

Contents

PREFACES

<i>PART 1 ANALYTIC TOOLS OF OPTIMIZATION</i>	1
1 Optimization and an Example from Inventory Analysis	3
1. Optimization—a Basic Viewpoint. 2. Optimality Analysis in Operations Research. 3. The Role of Optimality in Economic Analysis. 4. Illustration: A Simple Inventory Problem. 5. Determination of the Cost Relationship. 6. The Optimality Calculation.	
2 Some Elementary Mathematics	12
1. Functions. 2. Slope. 3. Linear and Other Simple Equations. 4. Exponents: Definitions and Elementary Rules of Manipulation. 5. Logarithms. 6. Σ Notation.	
3 Marginal Analysis	21
1. Marginal Reasoning and the Logic of Decision-Making. 2. Theorems on Resource Allocation. 3. Totals, Averages, and Marginals: Their Arithmetic Relationships. 4. Geometry of Marginal Analysis: Total x Curves. 5. Marginal and Average x Curves. 6. Marginal Analysis and Fixed Costs. 7. Average vs. Marginal Figures in Business Practice. 8. Averages as Approximations to Marginal Figures. 9. First- and Second-Order Optimality Conditions. 10. Global, Local, and Corner Maxima. 11. The Second-Order Conditions and Stability.	

4	<i>Maximization, Minimization, and Elementary Differential Calculus</i>	42
<p>1. Differential Calculus and Marginal Analysis. 2. Rules of Differentiation. 3. Geometric Interpretation: The First-Order Maximum Condition. 4. Nondifferentiability and Limited Variable Range Problems. 5. Second-Order Conditions of Maximization and Minimization. 6. Maximization in Many-Variable Relationships: Partial Differentiation. 7. Total Differentiation. 8. Constrained Maxima: Lagrange Multipliers. 9. Some Economic Applications of the Differential Calculus.</p>		
5	<i>Linear Programming</i>	72
<p>1. Some Standard Programming Problems. 2. Characteristics of Programming. 3. Algebra and Geometry. 4. Slack Variables, Feasible Solutions, and Basic Solutions. 5. The Basic Theorem and the Simplex Method. 6. The Initial Basic Solution, Feasibility, and Optimality Criteria. 7. The Next Basic Solution: The Pivoting Process. 8. Special Pivoting Rules. 9. Choosing the Pivot. 10. Illustration: Another Pivot Step. 11. Cases Where the Origin is not a Feasible Solution.</p>		
6	<i>Duality</i>	105
<p>1. The Dual Problem. 2. Economic Interpretation of the Dual Problem. 3. Some Duality Theorems. 4. Duality and Decentralized Decision-Making. 5. Solution of the Primal and Dual Programs. 6. Another Look at the Simplex Method. Appendix A: On the Derivation of the Duality Theorems. Appendix B: The Initial Basic Solution and the "Feasibility Program."</p>		
7	<i>Nonlinear Programming</i>	140
<p>1. Algebraic Notation and Example. 2. Geometric Representation: Nonlinear Constraints. 3. Geometry of Nonlinear Objective Functions. 4. Convex and Nonconvex Regions. 5. Concave and Convex (Objective) Functions. 6. Nonlinearities and the Basic Theorem of Linear Programming. 7. Methods of Nonlinear Computation.</p>		
8	<i>Kuhn-Tucker Methods</i>	156
<p>1. The Kuhn-Tucker Analysis. 2. The Form of the Lagrangian Expression. 3. The Kuhn-Tucker Conditions. 4. Rationale of the Kuhn-Tucker Conditions. 5. Interpretation of the Kuhn-Tucker Conditions. 6. Why It Works. 7. Theoretical Applications of the Kuhn-Tucker Conditions.</p>		

PART 2 DEMAND AND PRODUCTION THEORY	177
9 Demand Curves, Utility Surfaces and Indifference Maps	179
1. Demand Curves. 2. Shifting Demand Curves: Demand Functions. 3. Elasticity: A Measure of Responsiveness. 4. Properties of the Elasticity Measure. 5. Utility Analysis of Demand. 6. Indifference Maps: Ordinal and Cardinal Utility. 7. Properties of Indifference Curves. 8. Violation of the Premises about Indifference Curves. Satiation and Lexicographical Orderings. 9. Price Lines: Consumer Income and Prices. 10. Equilibrium of the Consumer. 11. Responses to Price and Income Changes. 12. Income and Substitution Effects: The Slutsky Theorem. 13. The Role of the Income Effect. 14. Complements and Substitutes. 15. Compensated Demand Curves. 16. Ordinal Utility Functions: Monotonic Transformations. 17. Interior Points on a Line Segment. 18. Concave and Strictly Concave Functions. 19. Quasi-Concave Utility Functions. 20. Elementary Mathematics of Demand Analysis.	
10 On Empirical Determination of Demand Relationships	227
1. Why Demand Functions? 2. Interview Approaches to Demand Determination. 3. Direct Market Experiments. 4. Standard Statistical Approaches. 5. Omission of Important Variables. 6. Inclusion of Mutually Correlated Variables. 7. Simultaneous Relationship Problems. 8. The Identification Problem. 9. Least Squares Bias in Simultaneous Systems. 10. Concluding Comments. Appendix: Notes on Identification and Simultaneous Equation Estimation. 1. <i>Some Identification Theorems.</i> 2. <i>Criteria for Evaluating Simultaneous Equation Estimation Methods.</i> 3. <i>Maximum Likelihood Method: General Description.</i> 4. <i>Advantages and Disadvantages of the Full-Information Maximum-Likelihood Method.</i> 5. <i>Structural Equations and Reduced-Form Equations: Definitions.</i> 6. <i>The Reduced-Form Method.</i> 7. <i>The Limited-Information Method.</i> 8. <i>The Method of Instrumental Variables.</i> 9. <i>The Method of Two-Stage Least Squares.</i>	
11 Production and Cost	267
1. Production, Inputs and Outputs. 2. The Production Function. 3. Relative Input Levels and Production. 4. Properties of Production Functions: Diminishing Returns. 5. Properties of Production Functions: Returns to Scale. 6. Notation for Production Functions and Production Sets: Multi-Product Firms. 7. Iso-Product Curves and Production Frontiers. 8. Price Line and Expansion Path. 9. Homogeneous and Homothetic Production Functions. 10. Some Properties of Homogeneous (Homothetic) Functions. 11. Cobb-Douglas Production Functions. 12. Elasticity of Substitution: Response to Relative Input Prices. 13. Derivation of Cost Curves. 14. Long Run and Short Run: Definitions. 15. Long-Run and Short-Run Average Costs. 16. Some Elementary Mathematics of Production Theory.	

12	<i>Linear Programming and the Theory of Production</i>	297
	1. Why a Programming Reexamination of Production Theory? 2. An Alternative Linear Programming Diagram. 3. Illustrative Example. 4. The Feasible Region. 5. Representation of a Process. 6. Production Indifference Curves: Construction. 7. Some Properties of the Indifference Curves. 8. Profit Indifference Curves. 9. Graphic Solution of the Programming Problem. 10. Alternative Types of Solutions. 11. Marginal, Total, and Average Input Products. 12. Conclusion.	
13	<i>Comparative Statics and Maximization: Consumers and Firms</i>	319
	1. Comparative Statics: Parameters and Endogenous Variables. 2. Comparative Statics Without Maximization. 3. Comparative Statics and Maximization: The Simplest Cournot Case. 4. Dissection of the Process: The Crucial Step of Total Differentiation. 5. Digression on Second-Order Conditions in Multi-Variable Models. 6. Example II: The Slutsky Theorem in a Two-Input Firm. 7. Second-Order Conditions, Constrained n -Variable Problems: Bordered Hessians. 8. Illustration III: The Slutsky Theorem for the Consumer. 9. Illustration IV: The Linder Theorem.	
14	<i>Towards Observability: Revealed Preference and Expenditure and Cost Functions</i>	343
	1. The Revealed Preference Model. 2. Revealed Preference and the Slutsky Theorem in n Variables. 3. Revealed Preference and the Indifference Map. 4. Revealed Preference and Index Numbers of Real Income. 5. Duality and the Theory of the Producer and Consumer. 6. The Expenditure Function as a Substitute for Utility Analysis. 7. Three Properties of the Expenditure-Utility Relationships. 8. Dual Properties of Utility and Expenditure Functions. 9. The Compensated Demand Function. Shephard's Lemma. 10. The Slutsky Theorem and Other Results in Comparative Statics. 11. Cost, Revenue and Profit Functions. 12. On Cost and Production Functions. 13. Revenue and Profit Functions: Definitions. 14. Illustration I: Deducing the Cost and Profit Functions from the Production Function. 15. Illustration II: Useful Cost Functions Derived Independently of Production Functions.	
PART 3	<i>FIRMS, GAMES AND DECISIONS</i>	375
15	<i>The Firm and Its Objectives</i>	377
	1. Alternative Objectives of the Firm. 2. The Profit-Maximizing Firm. 3. Application: Pricing and Cost Changes. 4. Extension: Multiple Products and Inputs. 5. Price-Output Determination: Sales Maximization. 6. Advertising. 7. Choice of Input and Output Combinations. 8. Pricing and Changes in Fixed Costs and Taxes. 9. Satisficing and Behavior Analysis. 10. Profit and Sales Maximization: Sample Calculations.	

16 Market Structure, Pricing, and Output 393

1. Classification of Market Structures. 2. The Profit-Maximizing Competitive Firm. 3. Equilibrium in the Competitive Industry. 4. Supply Curves: Some Comments. 5. Pure Monopoly. 6. Monopolistic Competition (Product Differentiation). 7. Monopsony. 8. Remarks on Discriminating Monopoly. 9. Bilateral Monopoly. 10. Oligopolistic Interdependence. 11. Stability of Oligopoly Arrangements: Kinked Demand Curves. 12. Reaction Curves and Oligopolistic Pricing. 13. Monopoly, Duopoly, and Discrimination: Elementary Mathematical Analysis.

17 Neumann-Morgenstern Utility Theory 420

1. Utility, Risk, and Game Theory. 2. Classes of Measures and Their Strength. 3. Construction of an N-M Index. 4. Expected Utility vs. Expected Payoff. 5. Psychological Premises Behind the Prediction. 6. N-M vs. Neoclassical Cardinal Utility. Appendix: The Psychological Premises and the Index.

18 Game Theory 437

1. Taking Account of Competitive Decisions. 2. The Zero-Sum, Two-Person Game. 3. Maximin and Minimax Strategies. 4. Equilibrium (Saddle) Points. 5. Geometry of Equilibrium Points: Saddle Points. 6. Payoff Matrices Without Equilibrium Points. 7. Mixed Strategies. 8. Optimal Mixed Strategies and the Saddle-Point Theorem. 9. Strategy; the Extensive and Normal Form of a Game. 10. Two-Person, Nonconstant-Sum Games. 11. n -Person Games: Some Concepts.

19 Decision Theory 458

1. The Subject Matter of Decision Theory. 2. Some Proposed Decision Rules. 3. Geometric Interpretation of the Decision Rules. 4. Axiomatization. 5. Neumann-Morgenstern Utility and the Bayes Criterion. 6. Decision Theory and the Foundations of Statistics.

PART 4 GENERAL EQUILIBRIUM, WELFARE AND DISTRIBUTION 477

20 General Equilibrium and the Theory of Money 479

1. Interdependence in the Economy: Substitutes and Complements. 2. Equations of General Equilibrium. 3. The Redundant Equation: Walras' Law. 4. Pitfalls in Determination of the Price Level. 5. The Real Balance Effect. 6. Comparative Statics: General Equilibrium Analysis. 7. Optimal Cash Balances.

21 General Equilibrium and Welfare Economics 496

1. Resource Allocation and General Equilibrium. 2. The Maximands: Consumers' and Producers' Surplus. 3. Pareto Optimality and Productive Efficiency. 4. Optimal Distribution of Products Among Consumers. 5. Optimal Use of Resources in Producing Given Outputs. 6. Marginal Rule for Pareto-Optimal Output Levels. 7. An Optimal Price System. 8. Pure Competition and Monopoly. 9. Centralized Planning Without Centralized Direction. 10. Breakeven Constraints and Optimal Deviations Between Prices and Marginal Costs. 11. Beneficial and Detrimental Externalities of Production and Consumption. 12. "Market Failure" and Public Goods. 13. Some Additional Results of Welfare Theory. 14. Criteria for Welfare Judgments. 15. A Theorem on Democratic Group Decisions. 16. Concluding Remarks.

22 Input-Output Analysis 537

1. The Economic Problem and the Assumptions. 2. The Mathematics. 3. A Dynamized Input-Output Model. 4. Some Theorems of Input-Output Analysis.

23 Activity Analysis and General Equilibrium 549

1. The Existence and Uniqueness Problems. 2. Solution of the Existence Problem. 3. Solution of the Uniqueness Problem. 4. The Von Neumann Model of an Expanding Economy. 5. Activity Analysis and Welfare Economics. 6. Dual Prices and Decentralized Decision Making. 7. Integer Programming and Welfare Economics.

24 Theory of Distribution 570

1. Controversies in the Theory of Distribution. 2. On the Marginal Productivity Theory. 3. Marginal Productivity, Cobb-Douglas Functions and the Constancy of Labor's Share. 4. Euler's Theorem and the Adding-Up Controversy. 5. Alternative Distribution Theories, I: The Ricardian Model. 6. Alternative Distribution Theories, II: The Kaldor Model. 7. Backward-Rising Input Supply Curves: Labor and Saving. 8. Unions as Monopolies: Alternative Union Goals. 9. Inputs in Fixed Supply: Land. 10. Economic Rent as Surplus. Heterogeneous Inputs and Increasing Costs.

25 Capital and Investment Decisions 597

1. Discounting and Present Value: Valuation of Capital Assets. 2. Discount Rate and Opportunity Cost; Real vs. Nominal Rates. 3. Payout Period. 4. Marginal Efficiency of Investment. 5. Discounted Present Value vs. Marginal Efficiency. 6. Illustration: Use of the Discounted Present-Value Criterion. 7. Indivisibility, Interdependence, and Capital Rationing Problems. 8. Risk and the Investment Decision. 9. Financing Investments: Alternative Methods. 10. On Optimal Financial Policy. 11. The Cost of Capital. 12. Concluding Comment. Appendix: Continuous Compounding and Discounting.

26 Capital and Distribution Theory 639

1. Time as a Requisite of Production Processes. 2. Heterogeneity and Homogeneity of Capital: Putty vs. Clay. 3. On Measures of Quantity of Capital: Preliminary. 4. Capital Measurement: Dated Inputs and the Stationary State. 5. Determination of Interest Rate in the General Equilibrium Model. 6. The Interest Rate and Producers' Demand for Investment. 7. Interest Rate and the Supply of Saving: Lending and Borrowing. 8. Digression on Monetary Interest Theory. 9. Diminishing Returns and the Neoclassical Savings-Investment Parable. 10. Institutional and Sociological Determinants of Saving. 11. On Some Simple Technologies and Neoclassical Investment Models. 12. Reswitching of Techniques and Contradiction of the Parables. 13. Current Neoclassical Theory: The Factor Price Frontier and Labor's Share. 14. Some Last Comments on the Debate. Appendix: Comments on the Mathematics of Reswitching.

Answers to Problems 673**Index** 679