

# ECON 200A: MICROECONOMICS (“DECISIONS”)

Fall 2007

T, Th 12:00 - 1:50pm

102 Social Sciences Bldg.

Prof. Mark Machina

Office: ECON 217

Office Hours: Wed. 8am-noon

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ECON 127

Mon. 3-5pm

The topics of this course are the economic theories of consumer and producer behavior.

The texts for the 200A/B/C sequence are:

Kreps, D., *A Course in Microeconomic Theory*. Princeton: Princeton Univ. Press, 1990.

Mas-Colell, A., M. Whinston and J. Green (“MWG”), *Microeconomic Theory*, Oxford: Oxford Univ. Press, 1995.

Varian, H., *Microeconomic Analysis*, 3rd ed. New York: W.W. Norton & Co., 1992.

There will also be a Mathematical Handout for this course, and additional in-class handouts.

An extremely useful book of problems, designed to hone your analytical ability is:

Dixon, P., S. Bowles and D. Kendrick, *Notes and Problems in Microeconomic Theory*, 1985, (Amsterdam: North-Holland)

Other useful readings include the relevant chapters of:

Debreu, G., *Theory of Value*, 1959, (New York: Wiley).

Henderson, J. and R. Quandt, *Microeconomic Theory: A Mathematical Approach*, 3rd ed., 1980 (New York: McGraw-Hill)

Malinvaud, E., *Lectures on Microeconomic Theory*, 1972 (Amsterdam: North-Holland)

Russell, R. and M. Wilkinson, *Microeconomics: A Synthesis of Modern and Neoclassical Theory*, 1979, (New York: Wiley)

**EXAMS:** Your grade in the course will be determined on the basis of two midterms (dates to be determined) and the final exam (Friday, December 14, 11:30am – 2:30pm).

**OPTIONAL QUESTIONS:** For those who would like prior practice working with the material at a more basic level, or whose microeconomics background is not strong, there is an Econ 100A package available at Soft Reserve. This package contains approximately  $\infty$  practice questions, which sometimes accidentally find their way onto Econ 200A midterms and final exams. Even onto Micro Qualifiers ...

[www.econ.ucsd.edu/~mmachina/courses/ECON\\_200A/ECON\\_200A.html](http://www.econ.ucsd.edu/~mmachina/courses/ECON_200A/ECON_200A.html)

# ECONOMICS 200A COURSE OUTLINE

Fall 2007

Mark Machina

## I. INTRODUCTION AND BASIC MATHEMATICAL IDEAS

### a. Some Introductory Ideas

- Domain of Microeconomic Analysis
- Role of Models in Economics
- The Circular Flow Diagram
- Stocks versus Flows and the Dimensions of Economic Variables

### b. Elasticity

### c. Level Curves of Functions

### d. Possible Properties of Functions

- Cardinal vs. Ordinal Properties of Functions
- Scale Invariance and Constant Returns to Scale
- Homogeneous Functions and Euler's Theorem
- Homotheticity
- Concavity and Convexity
- Quasiconcavity and Quasiconvexity
- Additive and Multiplicative Separability

### e. Systems of Linear Equations and Cramer's Rule

## II. MATHEMATICS OF OPTIMIZATION

### a. The General Structure of Optimization Problems

- Objective Functions, Control Variables, Parameters, Constraints
- Solution Functions and Optimal Value Functions

### b. Unconstrained Optimization

- First Order Conditions
- Second Order Conditions

### c. Constrained Optimization

- First Order Conditions
  - Lagrangians
  - Corner Solutions
- Second Order Conditions

### d. Comparative Statics of Solution Functions – Implicit Differentiation

- Differentiation of First Order Conditions
- A Related Application: Comparative Statics of Equilibria

### e. Comparative Statics of Optimal Value Functions – The Envelope Theorem

- Unconstrained Case: Differentiation of the Objective Function
- Constrained Case: Differentiation of the Lagrangian

### III. CONSUMER PREFERENCES AND THE UTILITY FUNCTION

#### a. The Choice Space

- The Objects of Choice
- The Relevant Time Period
- The Issue of Divisibility

#### b. The Consumer's Preference Ranking

- Weak Preference, Strict Preference and Indifference
- Preferences are Defined over Commodity Bundles, *not* Individual Commodities
- General Properties of the Preference Ranking:
  - Completeness, Reflexivity and Transitivity
  - Continuity
    - Alternative Definitions of Continuity
  - Example of Non-Continuous Preferences: Lexicographic Preferences
- Possible Additional Properties of the Preference Ranking
  - Weak Monotonicity/Strong Monotonicity
  - Local Nonsatiation
  - Weak Convexity/Convexity/Strong Convexity

#### c. Indifference Curves and the Marginal Rate of Substitution

- Better-Than Sets, Worse-Than Sets and Indifference Sets
- Typical Properties of Indifference Curves
  - One Through Each Point
  - Downward Sloping and "Thin"
  - Can't Cross
- Marginal Rate of Substitution (MRS)
  - Definition of MRS
  - Graphical Interpretation: Slope of the Indifference Curve
  - Convexity of Preferences and Hypothesis of Diminishing MRS

#### d. Utility Functions

- Representation of a Preference Ranking by a Utility Function
- Monotonic Invariance of Utility Functions
- Possible Properties of a Utility Function:
  - Weak/Strong Monotonicity
  - Weak/Strong Quasiconcavity
  - Homotheticity
  - Additive/Multiplicative Separability
- Expressing the MRS in Terms of Marginal Utilities
- Monotonic Invariance of the MRS
- Hypothesis of Diminishing MRS
  - Algebraic Condition for Hypothesis of Diminishing MRS
- Important Examples of Utility Functions
  - Linear
  - Cobb-Douglas
  - Leontief
  - Constant Elasticity of Substitution (CES)

## IV. UTILITY MAXIMIZATION AND DEMAND FUNCTIONS

### a. Utility Maximization Subject to a Budget Constraint

Graphical Illustration

First Order Conditions for Utility Maximization

Two Interpretations of the First Order Conditions

Monotonic Invariance of the First Order Conditions

“Marginal Utility of Income”

Second Order Conditions (Hypothesis of Diminishing MRS)

Algebraic Examples: Cobb-Douglas, Leontief, Linear

Corner Solutions

### b. Regular or “Marshallian” Demand Functions

Definition of Regular Demand Functions

Examples: Cobb-Douglas, Leontief, Linear

General Properties of Demand Functions:

*Not* Necessarily Nonincreasing in “Own Price”

Walras’ Law

Scale Invariant in Prices and Income

Relationship between Price Elasticities & Income Elasticity for a Good

Market Demand Functions

### c. The Indirect Utility Function

Properties:

Increasing in Income, Nonincreasing in Prices

Scale Invariant in Prices and Income

Quasiconvex in Prices and Income

Utility-Income Curves

Price Indifference Curves

Effect of Monotonic Transformation of Utility

Examples: Cobb-Douglas, Leontief, Linear

### d. Compensated Demand Functions and the Expenditure Function

The Expenditure Minimization Problem

First Order Conditions for Expenditure Minimization

Compensated or “Hicksian” Demand Functions

Properties:

Scale Invariant in Prices

Nonincreasing in “Own Price”

Identities Linking the Marshallian and Hicksian Demand Functions

Examples: Cobb-Douglas, Leontief, Linear

The Expenditure Function

Properties:

Increasing in Utility, Nondecreasing in Prices

Homogeneous of Degree One in Prices

Concave in Prices

Identities Linking the Expenditure and Indirect Utility Functions

## **V. COMPARATIVE STATICS OF DEMAND**

### **a. Changes in Income**

- Income-Consumption Loci
- Engel Curves: Definition and Graphical Derivation
- Income Elasticity
  - Superior, Normal and Inferior Goods
  - Income Elasticity and Budget Shares
  - Relationship Between Income Elasticities of All Goods
- Algebraic Derivation of the Effect of an Income Change
- Relationship Between Income Elasticities for All Goods

### **b. Changes in Prices**

- Price-Consumption Loci
- Graphical Derivation of Marshallian Demand Curves
- Own Price Elasticity
  - Price Elasticity and Budget Shares
- Cross Price Elasticity
  - Gross Substitutes and Gross Complements
- Algebraic Derivation of the Effect of a Price Change
- Relationship Between All Price and Income Elasticities for a Good

### **c. Compensated Price Changes**

- Graphical Illustration of a Compensated Price Change
- Graphical Illustration of a Compensated Demand Curves
- Algebraic Derivation of the Effect of a Compensated Price Change
- Nonpositivity of Own Compensated Price Effect
- Compensated Cross Price Elasticity
  - Net Substitutes and Net Complements

### **d. The Slutsky Equation**

- Expressing Each of the Three Basic Changes in Terms of the Other Two
- Graphical Illustration
- Algebraic Formulation
- Giffen Goods

### **e. Some Important Results**

- Economic Interpretation of the Lagrangian Multiplier
- Roy's Identity (Linking the Indirect Utility and Demand Functions)
- Relationship Between the Expenditure and Compensated Demand Functions
- A One-Line Proof of the Slutsky Equation
- Justification of the Two-Good Approach: The Composite Commodity Theorem

## **VI. PRODUCTION, COST AND DUALITY**

### **a. Factors of Production**

The Stock-Flow Distinction  
Types of Factors and Their Income

### **b. Production Functions and Production Sets**

Definition and Important Examples of Production Functions  
Marginal Products and the Law of Diminishing Marginal Returns  
Average Products and the Average-Marginal Relationship  
Returns to Scale  
Technical Progress  
Three Implications of Technical Progress  
Hicks-Neutral, Harrod-Neutral and Solow-Neutral Technical Progress  
Continuous Technical Progress  
Production Sets and Input Requirement Sets

### **c. Isoquants and the Marginal Rate of Technical Substitution (MRTS)**

Definition and General Properties of Isoquants  
Definition of MRTS  
Expressing MRTS in Terms of Marginal Products  
Hypothesis of Diminishing MRTS  
Elasticity of Substitution

### **d. The Nature of Cost**

Definition of Cost  
Accounting Cost vs. Opportunity Cost of Owned Factors  
Cost of Entrepreneurial Ability and Definition of “Normal Profits”  
Short Run versus Long Run Planning Horizons

### **e. Long Run Minimization and Long Run Cost Functions**

Isocost Lines  
Long Run Cost Minimization  
First Order Conditions and Output-Constrained Factor Demands  
Two Interpretations of the First Order Conditions  
Second Order Conditions and the Hypothesis of Diminishing MRTS  
Equivalence to Constrained Output Maximization  
The Long Run Expansion Path  
Long Run Total Cost Function (LTC)  
Properties of LTC:  
Increasing in Output, Nondecreasing in Factor Prices  
Homogeneous of Degree One in Factor Prices  
Concave in Factor Prices  
Deriving Output-Constrained Factor Demands from LTC  
Long Run Marginal Cost Function (LMC)  
Relation of LMC to Marginal Products and Factor Prices  
Long Run Average Cost Function (LAC)  
Returns to Scale and Long Run Average Cost  
Average-Marginal Relationship  
Relation Between Long Run and Short Run Total, Average and Marginal Cost Curves

**f. Short Run Cost Functions**

- Expansion Path in the Short Run
- Graphical Derivation of the Short Run Total Cost Curve
- Algebraic Derivation of Short Run Total Cost Function (STC)
  - Examples: Linear, Leontief, Cobb-Douglas
- Short Run Variable Cost Function (SVC)
- Short Run Fixed Cost Function (SFC)
- Short Run Marginal Cost Function (SMC)
  - Relation of SMC to Marginal Product of Labor and Wage Rate
- Short Run Average Total Cost Function (SATC)
- Short Run Average Variable Cost Function (SAVC)
- Short Run Average Fixed Cost Function (SAFC)
- Average-Marginal Relationships
- Effects and Interpretation of “Changes in Fixed Capital  $K$ ”

**g. Duality Between Production and Cost**

- Equivalence of Cost Minimization and Constrained Output Maximization
- Convexification of Input Requirement Sets and Competitive Production
- Recovery of Production Function and Cost Functions from Each Other
- Characterization of Cost Functions:
  - Positive
  - Nondecreasing in Output and Factor Prices
  - Homogeneous Degree One in Factor Prices
  - Concave in Factor Prices
- Relationship Between Isocost Curves (in the Factor Price Plane) and Isoquants

**VII. PROFIT MAXIMIZATION AND SUPPLY**

**a. Long Run Profit Maximization and Supply**

- Long Run Profit Maximization (Graphical Illustration and Algebraic Formulation)
  - First Order Conditions and Interpretation
  - Second Order Condition (Increasing Marginal Cost)
- The Long Run Supply Function of the Firm
  - Properties:
    - Increasing in Price, Nonincreasing in Factor Prices
    - Scale Invariant in Output and Factor Prices
    - Long Run Elasticity of Supply
  - Cobb-Douglas Example
- The Long Run Profit Function
  - Properties:
    - Increasing in Price, Nonincreasing in Factor Prices
    - Homogeneous of Degree One in All (Output and Factor) Prices
    - Convex in Output and Factor Prices
  - Cobb-Douglas Example
- Identity Linking the Long Run Profit and Supply Functions

## **b. Short Run Profit Maximization and Supply**

The Three Relevant Regions and the Shut Down Decision

Illustration in Terms of STC and SVC Curves

Illustration in Terms of SATC and SAVC Curves

The Short Run Supply Curve of the Firm

The Short Run Supply Function of the Firm

Properties:

Increasing in  $p$ , Nonincreasing in  $(w, r)$

Scale Invariant in  $(p, w)$

Effects of Changes in  $K$

Short Run Elasticity of Supply

Cobb-Douglas Example

The Short Run Profit Function

Properties

Increasing in  $p$ , Nonincreasing in  $(w, r)$

Homogeneous Degree One in  $(p, w, r)$

Convex in  $(p, w, r)$

Effects of Changes in  $K$

Cobb-Douglas Example

Identity Linking the Short Run Profit and Supply Functions

Comparison of Short Run and Long Run Profit Functions

Comparison of Short Run and Long Run Supply Elasticities

## **c. Factor Demand Functions**

Maximizing Profits by Choosing Optimal Input Levels

Marginal Value Product of a Factor of Production

Short Run Factor Demand

First Order Condition for Short Run Profit Maximization

Short Run Factor Demand Functions

Nonincreasing in Own Factor Price

Scale Invariant in Output Price and Prices of Variable Factors

Relation to Short Run Supply Function

Long Run Factor Demand

First Order Conditions for Long Run Profit Maximization

Long Run Factor Demand Functions

Nonincreasing in Own Factor Price

Scale Invariant in Output Price and Factor Prices

Relation to Long Run Supply Function

Relation to the Profit Function

Properties:

Nonincreasing in Own Price

Scale Invariant in  $(p, w, r)$

Symmetric Cross Factor Price Effects



## **VIII. CHOICE UNDER UNCERTAINTY**

### **a. Objective Uncertainty**

- Objects of Choice and Preference Functionals
- Structure of Expected Utility Preferences
  - Axiomatic Characterization of Expected Utility
- Arrow-Pratt Characterization of Comparative Risk Aversion
  - Risk Aversion and Wealth
- Rothschild-Stiglitz Characterization of Comparative Risk
- Demand for Insurance

### **b. Subjective Uncertainty**

- States, Events, Outcomes and Acts
- Probabilistic Sophistication
- Expected Utility Preferences over Subjective Acts
  - State-Dependent Utility

### **c. Evidence and Alternative Models**

- Evidence on the Independence Axiom
- Non-Expected Utility Preference Functionals
  - Generalized Expected Utility Analysis
- Evidence on Probabilistic Sophistication and the Stability of Preferences

## **IX. INTERTEMPORAL CHOICE & PRODUCTION: SUPPLY AND DEMAND FOR CAPITAL**

### **a. Supply of Labor: The Labor-Leisure Decision**

- Income-Leisure Space and the Labor-Leisure Decision
- First Order Conditions for Optimal Supply of Labor
- Comparative Statics: Income and Substitution Effects
- Backward Bending Supply of Labor Curves
- Kinked Budget Lines and the Overtime Decision

### **b. Supply of Capital: The Consumption-Savings Decision**

- Intertemporal Income and Consumption Streams
- Interest Rates and Discounted Present Value of a Stream
- Intertemporal Utility Maximization
  - First Order Conditions and Interpretation
- Comparative Statics: Income and Substitution Effects

### **c. Intertemporal Production: The Demand for Capital**

- Two-Period Illustration
- Finite-Period Production and Investment
- Continuous Time Production: When to Cut a Tree

### **d. Relationship between Rental Market and Sales Market for Capital**

## **X. SPECIFICATION AND ESTIMATION OF DEMAND, COST AND SUPPLY**

### **a. Parametric Estimation of Demand Systems**

### **b. Parametric Estimation of Production and Cost Systems**

### **c. Nonparametric Testing of the Maximization Hypothesis**

# ECONOMICS 200A READINGS BY TOPIC

Fall 2007

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## **I. Introduction and Basic Mathematical Ideas**

*Required:* Math Handout, Sections A through F; Kreps Ch.1

*Also suggested:* MWG App.A-E; Varian Ch.26

## **II. Mathematics of Optimization**

*Required:* Mathematical Handout, Sections G through I

*Also suggested:* Kreps App.1; MWG App. J-L; Varian Ch.27

## **III. Consumer Preferences and the Utility Function**

*Required:* Kreps Sect.2.1; MWG Ch.1, Sects.2A -2C,3A - 3C; Varian Sect. 7.1

*Also suggested:* Suggested readings will be provided in an in-class handout

## **IV. Utility Maximization and Demand Functions**

*Required:* Kreps Ch.2; MWG Sects.2D,3D; Varian Sects.7.2-7.5

*Also suggested:* Henderson & Quandt, Sects.2.1-2.3

## **V. Comparative Statics of Demand**

*Required:* MWG Sects.2E-2F, 3E-3J; Varian Chs. 8, 9

*Also suggested:* MWG Ch.4; Varian Ch.10, Henderson & Quandt, Sects.2.5-2.7

## **VI. Production, Cost and Duality**

*Required:* Kreps Sect. 7.1 ; MWG Ch.5; Varian Chs.1,4,5,6

*Also suggested:* Henderson & Quandt, Chs.4,5

## **VII. Profit Maximization and Supply**

*Required:* Kreps Ch.7; MWG Ch.5; Varian Chs.2,3

*Required:* Viner, J. (1931). "Cost Curves and Supply Curves," *Zeitschrift für Nationalökonomie* III. 23-46.

*Also suggested:* Kreps Chs.19,20

## **VIII. Choice Under Uncertainty**

*Required:* Kreps Ch.3; MWG Ch.6; Varian Ch.11;

*Required:* Pratt J. (1964). "Risk Aversion in the Small and in the Large," *Econometrica* 32, 122-136.

*Also suggested:* Rothschild, M. & J. Stiglitz (1970). "Increasing Risk: I. A Definition," *Journal of Economic Theory* 2, 225-243;

Machina, M. (1987). "Choice Under Uncertainty: Problems Solved and Unsolved," *Journal of Economic Perspectives*, Summer 1987.

## **IX. Intertemporal Choice and Production**

*Required:* MWG Sects.20A-20D; Varian Ch.19

*Also suggested:* Kreps Ch.4, Sect.6.5; MWG Sects.19A-19B

## **X. Specification and Estimation of Demand, Cost and Supply**

*Required:* Varian Ch.12

*Required:* Ch. 3 of Deaton & Muellbauer (1980), *Economics and Consumer Behavior*.

## ECON 200A: FAMOUS OPTIMIZATION PROBLEMS

Optimization Problem	Objective Function	Constraint	Control Variables	Parameters	Solution Functions	Optimal Value Function
<b>Consumer's Problem</b>	$U(x_1, \dots, x_n)$ utility function	$p_1 \cdot x_1 + \dots + p_n \cdot x_n = I$ budget constraint	$x_1, \dots, x_n$ commodity levels	$p_1, \dots, p_n, I$ prices and income	$x_i(p_1, \dots, p_n, I)$ regular demand functions	$V(p_1, \dots, p_n, I)$ indirect utility function
<b>Expenditure Minimization Problem</b>	$p_1 \cdot x_1 + \dots + p_n \cdot x_n$ expenditure level	$U(x_1, \dots, x_n) = \bar{u}$ desired utility level	$x_1, \dots, x_n$ commodity levels	$p_1, \dots, p_n, \bar{u}$ prices and utility level	$h_i(p_1, \dots, p_n, \bar{u})$ compensated demand functions	$e(p_1, \dots, p_n, \bar{u})$ expenditure function
<b>Labor/Leisure Decision</b>	$U(H, I)$ utility function	$I = I_0 + w \cdot (168 - H)$ budget constraint	$H, I$ leisure time, disposable inc.	$w, I_0$ wage rate and nonwage income	$L(w, I_0) \equiv 168 - H(w, I_0)$ labor supply function	$V(w, I_0)$ indirect utility function
<b>Intertemporal Optimization</b>	$U(c_1, \dots, c_n)$ utility function	$\sum_{t=1}^n (1+i)^t \cdot (I_t - c_t) = 0$ budget constraint	$c_1, \dots, c_n$ consumption levels	$I_1, \dots, I_n, i$ income stream and interest rate	$c_i(I_1, \dots, I_n, i)$ consumption functions	$V(I_1, \dots, I_n, i)$ indirect utility function
<b>Long Run Cost Minimization</b>	$w \cdot L + r \cdot K$ total cost	$F(L, K) = Q$ desired output	$L, K$ factor levels	$Q, w, r$ desired output and factor prices	$L(Q, w, r), K(Q, w, r)$ output-constrained factor demands	$LTC(Q, w, r)$ long run total cost function
<b>Long Run Profit Maximization</b> (in terms of $Q$ )	$P \cdot Q - LTC(Q, w, r)$ total profit	none	$Q$ output level	$P, w, r$ output price and factor prices	$Q(P, w, r)$ long run supply function	$\pi(P, w, r)$ long run profit function
<b>Long Run Profit Maximization</b> (in terms of $L, K$ )	$P \cdot F(L, K) - w \cdot L - r \cdot K$ total profit	none	$L, K$ factor levels	$P, w, r$ output price and factor prices	$L(P, w, r), K(P, w, r)$ factor demand functions	$\pi(P, w, r)$ long run profit function
<b>Long Run Profit Maximization</b> (in terms of $Q, L, K$ )	$P \cdot Q - w \cdot L - r \cdot K$ total profit	$F(L, K) = Q$ production function	$Q, L, K$ output and factor levels	$P, w, r$ output price and factor prices	$Q(P, w, r), L(P, w, r), K(P, w, r)$ output supply & factor demand functions	$\pi(P, w, r)$ long run profit function