



B.E. International Program

Faculty of Economics, Thammasat University



Syllabus

EE 421 Mathematical Economics I

Semester: 2/2011 (January 9– May 20, 2012)

Instructor: Dr. Thanet Makjamroen

Office Hours: By appointment

Office: Room No. 521 Fifth Floor, Faculty of Economics
thanet@econ.tu.ac.th

Time: Wednesday and Friday, 12.30-14.00 hrs.

Room: 201, Faculty of Economics

Prerequisite:

(Curriculum 2004) EE311 and MA217 (or MA212)

(Curriculum 2009) MA217 (or MA212) and having completed or currently taking EE311

Text: Jeffrey Baldani, et. al., *Mathematical Economics*, 2nd edition, Dryden 2004.

Lecture Notes: Thanet Makjamroen, *Lecture Notes for EE421 Mathematical Economics I*, May 2008.

References:

Gale [1960], *The Theory of Linear Economic Models*, McGraw-Hill.

Jehle [1991], *Advanced Microeconomics Theory*, Prentice-Hall.

Sundaram [1996], *A First Course in Optimization Theory*, Cambridge University Press.

Simon and Blume [1994], *Mathematics for Economics*, Norton.

Sydsaeter and Hammond [1995], *Mathematics for Economic Analysis*, Prentice-Hall.

Evaluation:

Midterm Exam 45% (March 2, 2012, 12.30-14.00)

Final Exam 50% (May 8, 2012, 09.00-12.00)

Topics:

Chapter 1 Introduction

1.1 Mathematical Economic Model

1.2 Use of Economic Model

1.3 An Example of Mathematical Models

Chapter 2 Calculus of Single Variable

2.1 Derivative

- 2.2 Examples of Derivatives in Economics
- 2.3 Derivatives and Increasing Functions
- 2.4 Second- and Higher-Order Derivatives
- 2.5 Optimization: Single Variable
 - 2.5.1 Necessary Conditions
 - 2.5.2 Sufficient Conditions
- 2.6 Concave and Convex Functions
- 2.7 Differentials

Chapter 3 Calculus of Single Variable: Applications

- 3.1 Labor Union
- 3.2 Profit Maximization in Perfect Competition
- 3.3 Profit Maximization of a Monopoly
- 3.4 Taxation on Monopoly
- 3.5 Profit Maximization of Duopoly (Cournot Model)
- 3.6 Balanced-Budget Multiplier

Chapter 4 Multivariate Calculus

- 4.1 Partial Derivatives
- 4.2 Second-Order Partial Derivatives and Cross Partial Derivatives
- 4.3 Total Differentials
- 4.4 Conventions of Matrix Notations for Derivatives of Functions of Several Variables
- 4.5 Chain Rules of Composite Functions of Several Variables
- 4.6 Directional Derivatives
 - 4.6.1 First-order Directional Derivatives
 - 4.6.2 Directional Derivatives and Optimization
 - 4.6.3 Second-order Directional Derivatives
- 4.7 Mean-Value Theorem
- 4.8 Taylor's Polynomials and Taylor's Approximation in $\mathbf{R}^n$
- 4.9 Implicit Functions and Implicit Function Theorem
- 4.10 Level Sets, Tangents and Gradients
- 4.11 Homogeneity

Chapter 5 Multivariate Calculus: Applications

- 5.1 Balanced-Budget Multipliers in Closed Economy
 - 5.1.1 Simple Keynesian Model
 - 5.1.2 IS-LM Model
 - 5.1.3 Aggregate Demand-Aggregate Supply Model
- 5.2 Monetary Policy Effectiveness
 - 5.2.1 IS-LM Model
 - 5.2.2 Mundell-Fleming Model with Flexible Exchange Rate
- 5.3 Tax Incidence in Supply-Demand Model

Chapter 6 Multivariable Optimization without Constraints

- 6.1 Definitions of Extreme Points
- 6.2 2-Variable Optimization
- 6.3 First-Order Necessary Condition
- 6.4 Second-Order Necessary Condition
- 6.5 Sufficient Conditions
- 6.6 Multivariable Optimization without Constraints

- 6.7 First-Order Necessary Condition
- 6.8 Second-Order Necessary Condition
- 6.9 Sufficient Conditions
- 6.10 Test of Definiteness of the Hessian
- 6.11 Concavity, Convexity and Optimization
- 6.12 Comparative Statics Analysis

Chapter 7 Multivariable Unconstrained Optimization: Applications

- 7.1 Competitive Firm Input Choices: Cobb-Douglas Technology
- 7.2 Competitive Firm Input Choices: General Production Technology
- 7.3 Multiplant Firm
- 7.4 Multi-Market Monopoly
- 7.5 Statistical Estimation: Linear Regression

Chapter 8 Constrained Optimization: Equality

- 8.1 The Lagrangian Method
- 8.2 Graphical Interpretation
- 8.3 Optimization with k Equality Constraints
- 8.4 Second-order Sufficient Conditions
 - 8.4.1 Bordered Hessian for Single Equality Constraint
 - 8.4.2 Bordered Hessian for k Equality Constraints
 - 8.4.3 Test of Bordered Matrix
- 8.5 Comparative Static Analysis: Sensitivity Analysis

Chapter 9 Equality Constrained Optimization: Applications

- 9.1 Cost Minimization and Conditional Input Demand
 - 9.1.1 Sufficient Conditions
 - 9.1.2 comparative Static Analysis
- 9.2 Utility Maximization: Log Utility Function
- 9.3 Utility Maximization Subject to Budget and Time Constraints
 - 9.3.1 Sufficient Conditions
 - 9.3.2 Sensitivity analysis
- 9.4 Intertemporal Consumption
 - 9.4.1 2-Period Case
 - 9.4.2 n -Period Case

Chapter 10 Inequality Constraints Optimization

- 10.1 First-Order Sufficient Conditions: One Inequality Constraint
- 10.2 First-Order Sufficient Conditions: Several Inequality Constraints
- 10.3 First-Order Sufficient Conditions: Mixed Constraints
- 10.4 First-Order Sufficient Conditions: Minimization under Mixed Constraints
- 10.5 Second-Order Sufficient Conditions: Mixed Constraints
- 10.6 Second-Order Necessary Conditions
- 10.7 Comparative Static analysis: Sensitivity Analysis
- 10.8 Kuhn-Tucker Formulation

Chapter 11 Inequality Constrained Optimization: Applications

- 11.1 Utility Maximization with Two Goods
- 11.2 Two Goods Diet Problem: Linear Programming and its Duality
- 11.3 Sales Maximization
- 11.4 Intertemporal Consumption with Liquidity Constraint

Chapter 12 Sensitivity Analysis and Envelope Theorems

12.1 The Meaning of the Multipliers

12.2 The Meaning of Lagrange Multiplier: One Equality Constraint Case

12.3 The Meaning of Lagrange Multiplier: Several Equality Constraint Case

12.4 The Meaning of Lagrange Multiplier: Inequality Constraint Case

12.5 Envelope Theorems

12.6 Envelope theorem: Unconstrained Case

12.7 Envelope Theorem: Equality Constraints Case

12.8 Applications: Shephard's Lemma, Roy's Identity and Demand Function

12.9 Envelope Theorem: Inequality Constraints Case
