EE320 (1/2015)

INTRODUCTORY MATHEMATICAL ECONOMICS

INTRODUCTION

About the Instructor

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- Education:
  - B.A. (Economics), McGill University, Canada
  - M.A. (Economics), University of British Columbia, Canada
  - Ph.D. (Applied Economics), University of Minnesota, USA
- Fields of interest:
  - Health economics
  - Development economics
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About the Students

- Name & Nickname
- Which year of the program are you in?
- Have you taken both EE211 & EE212?
- Please tell me anything that will make me remember you!

Course Contents

- Mathematics and economic relations (1)
- Static and equilibrium analysis in economics (3)
- Basic matrix algebra and applications (3)
- Nonlinear model and differential calculus (3)
- Optimization without constraints: 1-independent-variable case (3)
- Derivatives of multiple independent variable function (5)
- Optimization without constraints: Multiple-independent-variable case (4)
- Optimization under equality constraint (4)
- Integration and its application (3)

Textbooks & Class Materials

Main text:

- Chiang, A. C. and Wainwright, K. (2005). *Fundamental Methods of Mathematical Economics*, 4th edition, McGraw-Hill, Inc., Singapore. (CW)

Other recommended books:

- Sydsaeter K. and P. Hammond. (2006). *Essential Mathematics for Economic Analysis*, 2nd edition, Prentice Hall.
- Dowling, E. T. (2001). *Schaum's Outline of Theory and Problem of Introduction to Mathematical Economics*, 3rd edition, The McGraw-Hill Companies, Inc.
- Holden, K. and Pearson, A.W. (1992). *Introductory Mathematics for Economics and Business* Second edition, The Macmillan Press Ltd.

Lecture notes, practice problems (and solutions) for each topic, and other materials can be found on BE-moodle (enrollment key: **2109).**

Course Organization

- Meet every Tuesday and Thursday, 11am-12:30pm.
- There are two sections, all quizzes and exams are identical.
- Lectures-based style, with regular quizzes and practice problems
  - Class participation and own practices are highly encouraged.
  - Homework assignments will be posted on the moodle.
- Classroom *etiquette*:
  - Please turn off ALL electronic devices! There will be a quiz anytime that a cellphone rings or there's a message-notification sound.
  - Dress code: no shorts, sandals, tank-tops, or other informal wear

Assessment

- Homework assignments (10 %)
- Quizzes (10 %)
- Midterm Exam (30%) – October 6, 2015 (11am – 12:30pm)
- Final Exam (50%) – December 14, 2015 (9am – 12pm)

Today's Topics

- What is mathematical economics?
- Mathematical vs. nonmathematical economics
- Why do we study mathematical economics?
- Mathematical economics vs. econometrics
- Economic models

What is Mathematical Economics?

- Mathematical economics is an *approach* (or tool) to economic analysis.
- We use mathematics as a *language* to state problems and to derive a set of conclusions or theorems from a given set of assumptions.
- What are examples of mathematics have you seen in your economic courses so far?
  - Demand and supply functions: Q = f(P)
  - National income function: Y = C + I + G + (X-M)
  - Etc.

Mathematical vs. Nonmathematical Economics

- Both mathematical and nonmathematical approaches to economic analysis are *not* fundamentally different from each other.
- Mathematical economics
  - Assumptions and conclusions are stated in mathematical symbols and equations.
  - Use mathematical theorems in the reasoning process.
- Nonmathematical (or literary) economics
  - Assumptions and conclusions are stated in words and sentences.
  - Use literary logic in the reasoning process.

Why Study Mathematical Economics?

- Using mathematical approach in analyzing economic problems has the following advantages:
  1. The *language* used is more concise and precise.
  2. There exists a wealth of mathematical theorem that can be used to aid our reasoning.
  3. It prevent us from unintentionally using unwanted implicit assumptions, by forcing us to explicitly state all the assumptions.
  4. It allows us to treat general *n*-variable cases.
- Thus, this course should equip you with fundamental mathematical concepts and tools needed in studying other economics courses.

Mathematical Economics vs. Econometrics

- Mathematical economics:
  - Applies mathematics to the purely *theoretical* aspects of economic analysis.
  - Uses deductive reasoning
- Econometrics:
  - Deals with the study of *empirical* observations using statistical methods of estimation and hypothesis.
  - Uses inductive reasoning
- Empirical studies and theoretical analyses are often complementary and mutually reinforcing.

Example: Demand Analysis

- Demand equation can be written as:

$$Q^D = a - b*P$$

- From the above demand equation, econometricians can estimate the price elasticity from the following specification:

$$\ln(Q^D) = \ln(a) + b*\ln(P)$$

➔ Price elasticity: $E^d = (\%\Delta Q^D)/(\%\Delta P) = b$

In this class, we will show that $E^d = b$ (where $b < 0$).

- Thus, theories must be tested against empirical data for validity, whereas econometric models need economic theories as a guide for the research direction.

Economic Models

- What is an economic model?
  - An economic model is a deliberately simplified analytical framework, used as a rough presentation or a skeletal of the actual economy.
  - Economic models are usually written as mathematical models, involving a set of equations and a number of variables.
- Ingredients of a mathematical model:
  - Variables – $x, y, z, \ldots$
  - Equations – $y = f(x), z = f(x, y), \ldots$

Variables, Constants, and Parameters

- A **variable** is something that can take on different values, and must be represented by a symbol.
  - Endogenous (dependent) variables are solution values of a certain set of variables that can be solved from an economic model.
  - Exogenous (independent) variables are variables which are assumed to be determined by forces external to the model and whose magnitudes are accepted as given data.
  - A constant is a magnitude that does not change and is the opposite of a variable.
  - A parameter is a constant in an equation that varies in other equations of the same general form.
- Example: 1. $Q^D = 50 - 0.6P$

  2. $Q^D = \alpha - \beta P$

Examples

- Which variable is the exogenous (independent) variable, and which is endogenous (dependent)?
  - $y = f(x) = \ln(2x^2)$
  - $Q_d = a - bP$
  - $Q_d = 8 - 3P_1 + P_2 - 4P_3$
  - $AE = C + I + G + X - M$
  - $C = C_0 + cY$
  - $Q = f(K, L)$
  - $Q = 36KL - 2K^2 - 3L^2$

Equations and Identities

- A definitional equation sets up an identity between two alternative expressions that have exactly the same meaning. The symbol ≡ (identical-equality sign) is used to between the two expressions.
  - Ex: $\pi \equiv R - C$
- A behavioral equation specifies the manner in which a variable behaves in response to changes in other variables.
  - Ex: $TC = 80 + 20Q$
  - Ex: $C = a + bY$
- A conditional equation states a requirement to be satisfied.
  - Ex: An equilibrium conditions: $Q_d = Q_s$
  - Ex: Break-even condition: $\pi = TR - TC = 0$