

Introductory Mathematics for Economists

Keio University (PEARL, Spring 2019)

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Introduction

- Why study maths and stats?
 - Firstly, economics and maths are tied together;
 - Improve your technical and analytical skills;
 - Advantageous on the job market; and
 - An important toolkit to help you understand how the world works.

Introduction

- This course will aim to give you the basic tools required to go onto perform economic analysis at the introductory and intermediate level in undergraduate studies.
- Many of the concepts you will learn in this course will be expanded upon in future studies. For some this may include up to the graduate level (Masters and DPhil).
- Be sure to build a solid foundation now – you will thank yourself later, believe me.

Introduction

- Be warned: some of the content presented in this course will be difficult!
- We all have to start from somewhere. Michael Jordan was once cut from his high school basketball team, Steve Jobs got fired from his own company, and Gordon Ramsay probably couldn't fry an egg.
- Keep practicing, and do not be afraid to fail or make mistakes.

Course Outline

Through this course we will try and cover the following topics:

- 1 Unconstrained Optimisation
- 2 Linear Programming
- 3 The Envelope Theorem
- 4 Neoclassical Theory of the Consumer and Producer
- 5 The Simple Linear Regression Model (if time permits)

Before covering each topic, we will go through some mathematical prerequisites together. It is **STRONGLY** recommended that you practice these mathematical prerequisites before and after class.

Course Outline

The course schedule is as follows:

- Class 1: 2nd period (10:45-12:15, 623) 2 April
- Class 2: 3rd period (13:00-14:30, 623) 2 April
- Class 3: 2nd period (10:45-12:15, D202) 3 April
- Class 4: 3rd period (13:00-14:30, D202) 3 April
- Class 5: 2nd period (10:45-12:15, D203) 4 April
- Class 6: 3rd period (13:00-14:30, D203) 4 April

Recommended Reading

My notes will be based on the following textbooks:

- Banner A (2007), *The Calculus Lifesaver*, Princeton University Press, New Jersey;
- Chiang A.C. & K Wainwright (2005), *Fundamental Methods of Mathematical Economics*, fourth edition, McGraw-Hill, New York; and
- Turkington D.A. (2006), *Mathematical Tools for Economics*, Blackwell Publishing, Oxford.

However, almost any standard math textbook for introductory economics will suffice. If you're resourceful, you can find a tonne of free material online (e.g. YouTube video tutorials, StackExchange forums, public lecture notes, and so on).

The Common Mathematical Programming Problem in Economics

In economics, almost all of the problems you will face will be constrained optimisation mathematical programming problems, which can be generalised to the form:

$$\begin{array}{ll}
 \text{Optimise} & Z = f(x_1, \dots, x_n) \\
 \text{subject to} & g^1(x_1, \dots, x_n) \leq \geq c_1 \\
 & \vdots \\
 & g^m(x_1, \dots, x_n) \leq \geq c_m \\
 & x_1 \geq 0, \dots, x_n \geq 0
 \end{array}$$

The Common Mathematical Programming Problem in Economics

Consider the baseline Real Business Cycle model proposed by Kydland & Prescott (1982) which can be represented as the following programming problem:

$$\begin{aligned} \max \quad & E_t \left[\sum_{i=0}^{\infty} \beta^i (U(C_{t+i}) - V(N_{t+i})) \right] \\ \text{s.t.} \quad & Y_t = C_t + I_t \\ & Y_t = A_t K_{t-1}^{\alpha} N_t^{1-\alpha} \\ & K_t = I_t + (1 - \delta) K_{t-1}. \end{aligned}$$

By the end of this course, I hope you all develop the skills required to solve the above problems! While it may seem impossible now, I assure you all that it isn't as difficult as what you may think.