

**Mathematical Economics (ECON 600)**  
Fall 2009

**Instructor:** Yusufcan Masatlioglu

**Office:** Lorch Hall 335B

**Email:** yusufcan@umich.edu

**GSI:** Paul Greiner (psg@umich.edu)

**Summer class meetings:** Mon-Thu, Aug 20 - Sep 03, 10-12 AM and 2-4 PM 1372 EH

Exam on Thursday, September 3, 2-4 PM

**Fall class meetings:** Wed, 1-3 PM, 513 DENN

**Suggested Textbook:**

- Simon and Blume, Mathematics for Economists, 1994. (S & B)
- Leonard and van Long, Optimal Control Theory and Static Optimization in Economics, 1992. (L & vL)

**Other Texts Useful but NOT Required for this Course:**

- Takayama, Mathematical Economics, Cambridge University Press: Cambridge, UK, 1985.
- Rudin, Principles of Mathematical Analysis, McGraw-Hill: New York, 1976.
- Stokey, Lucas, and Prescott, Recursive Methods In Economic Dynamics, HU Press, 1989.
- Ok, Real Analysis with Economic Applications, Princeton University Press, 2007.
- Sundaram, A First Course in Optimization Theory, 1996.

**Course website:**

You may access the course website at: <https://ctools.umich.edu/> On the web site you can find updates to the syllabus, supplementary notes, problem sets, and other material related to the course. Lecture notes will also be provided as the course progresses. Please check the web site regularly to remain up to date.

**Brief Description and Aim:**

This course is concerned with developing the basic mathematical tools needed for advanced study in economics. It will also improve your understanding of economic theory; make your other economics courses much easier.

Do we have to study math in order to do economics? Yeah. You got to have a quantitative mind. It might even be fun. We should consider “math” as a language which is a way of representing and conveying information. You might not like to learn another language but you have to if you want to communicate with others. Now I am guiding you to learn and love (if possible) a different language, math. Math helps us to understand much more complicated material.

In this course, we will not only solve problems but also prove things, and that is a significant conceptual part of this course. This will require you to take a more formal approach to mathematics. Not only will you need to know these, but you will have to understand them, and be able (through the use of them) to demonstrate that you understand them. Simply learning the definitions without understanding what they mean is not going to be adequate.

I highly recommend you to study for this course on a daily basis to produce the best outcome. Doing assigned exercises is essential for your success. Since each topic is built on preceding topics, make sure that you understand the core of the material before we move to the next topic. Do not hesitate to contact me and/or your GSI for your questions.

### **Organization and Grading:**

The course has two elements: a summer session and a fall session. The summer session will represent the bulk of our course hours. During the summer session there will be three graded problem sets, one ungraded problem set, and one test. The summer session will cover all of the material up to and including Static Optimization (Part III). During the fall session, there will be regular problem sets, a mid-term exam and a final exam. All exams are closed book. The problem sets can, and should, be worked on in groups, though each student is required to turn in his or her own problem set. Problem sets are due at the beginning of class. Late problem sets will not be accepted.

The grading weights are as follows:

- Problem sets 20
- Summer test 35
- Midterm exam 15
- Final exam 30

The following schedule will guide us. In the course, we will undoubtedly skip over some of this material, and cover additional material that is not in the texts but will be in the lecture notes.

#### Part 0: Introduction and Basics

- Elements of Set Theory and Logic
- How to do “proofs”?

#### Part I: Linear Algebra

- Systems of Linear Equations, and Linear Transformations (S&B Ch. 7 & 13.3)
- Matrices and Matrix Algebra (S& B Ch. 8)
- Determinants (S&B Ch. 9)

- Euclidean Spaces (S&B Ch. 10)
- Linear Independence (S&B Ch. 11)

Part II: Multivariate Analysis

- Sequences, Limits, and Open Sets (S&B Ch. 12)
- Functions of Several Variables (S&B Ch. 13.1-5)
- Quadratic Forms and Definite Matrices (S&B Ch. 16)
- Calculus of Several Variables (S&B Ch. 14)
- The Implicit Function Theorem (S&B Ch. 15)

Part III: Static Optimization with Calculus Techniques

- Convex Sets and Separation Theorems (Lecture Notes)
- Concave, Quasi-concave and Pseudo Concave Functions (S&B Ch. 21)
- Existence and Uniqueness of Optimal Solutions (S&B Ch. 30)
- Unconstrained Optimization (S&B Ch. 17)
- Constrained Optimization and the Envelope Theorem (S&B Ch. 18 and 19)
- Concave Programming (S&B Ch. 21.5)
- Parametric Continuity and the Maximum Theorem (Lecture Notes)
- Fixed Point Theorems (Lecture Notes)

Part IV: Preliminaries on Dynamics

- Difference Equations (S&B Ch. 23)
- Ordinary Differential Equations (S&B Chs. 24 and 25)

Part V: Dynamic Optimization

- Dynamic Programming (Lecture notes)
- Maximum Principle (L&vL Chs. 3 and 4)
- Constrained Optimal Control (L&vL Ch. 6)
- Transversality Conditions (L&vL Ch.