Economics 7808  
Quantitative Analysis  
Fall 1998

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Location: Econ 205  
Meeting Times: T/TH, 2:00-3:15  
Office Hours: T/Th 3:30-4:30

Required Textbooks:  
*Optimization in Economic Theory* by A.K. Dixit  
*Analysis with an Introduction to Proof* by S.R. Lay

Course Purpose

Economics is highly mathematical. A glance at one of the top journals such as the *American Economic Review* or *Econometrica* and you will find that most articles use quite sophisticated mathematics. In order for you to succeed as a scholar, it is imperative that you become comfortable when you read and apply mathematics in the context of economic problems. This course will serve as an applied mathematics primer by (1) equipping you with basic skills necessary for completing the Ph.D.; and (2) to providing you additional tools that will help you later apply mathematical reasoning to your own research.

Teaching Philosophy

To most beginning economic Ph.D. students, the biggest shock upon entering the program is the mathematical focus. My pledge to you is that I will make every effort to make the material accessible to you and to be available for help during difficult times.

Your Philosophy *(ideally)*

Do not get hung up on how much more or less knowledgeable others are relative to you. Approach the course in a mature manner. Participate in class by asking questions and providing your own insights. Help fellow students and allow yourself to be helped by other students. Your fellow students will turn out to be one of your greatest assets throughout graduate school. Start developing ties today. Do all required and suggested assignments. DO NOT PANIC! Rather than fall into despair, come see me when in doubt. Be nice to your fellow students as well as the professor.

Course Description

The course will be taught in five sections.

Section 1 - Logic and Proof (Lay, chap. 1)  
This section will provide the basis for doing mathematical proofs. Note that it is not listed in the University's course description. While most economists are very familiar with optimization, many are ignorant of what it means to prove a mathematical statement. This ignorance often leads to behavior such as avoiding problems that require formal proof. Learning the basics of proof will give you the confidence to formally tackle problems. Topics will include establishing logical equivalences through truth tables, proof by induction, proof by contradiction, proof by contraposition, and direct methods of proof.
Section 2 - Static Optimization (Dixit chaps. 1-8)
Static optimization provides the bread and butter for most economists. Therefore it is a must that you thoroughly understand the basic class of static optimization problems typically applied in economics. Special emphasis will be placed on the Kuhn-Tucker theorem and the conditions provided therein.

Section 3 - Dynamic Optimization (Dixit chaps. 10, 11, and supplemental readings)
Problems in macro and natural resource economics require modeling choices that occur over time. The temporal dimension of such problems requires the adoption of a dynamic modeling framework. While dynamic problems are more complicated than static problems, several key theorems provide the basis for examining dynamic problems using our static intuition (you'll see when we get there). This section will cover basic dynamic optimization techniques and provide you the opportunity to practice these techniques. Topics to be covered include the maximum principal, the Hamiltonian in discrete and continuous time, and dynamic programming under certainty and uncertainty.

Section 4 - Topics in Probability and Statistics
Basic econometric techniques rely on optimization for estimating models. In estimation problems we typically want to find the "best" model from a given model class. The trick is defining what we mean by best in a precise manner and then using this criterion to select from the model class. This section will provide an introduction to maximum likelihood estimation. You will be introduced to the philosophy of maximum likelihood and the general large-sample properties of maximum likelihood estimators.

Section 5 - Real Analysis (Lay, chaps. 4-6)
Most economic models rely on differentiable techniques. Without differentiability, we would have no marginal economic intuition. Real analysis lies at the heart of differentiability and therefore some basic knowledge of this topic is extremely helpful. It will also provide you the opportunity to apply the proof techniques and logic from section 4. Topics will include real-valued functions, sequences, limits, continuity, differentiation, and theorems relevant to optimization.

Evaluative Criteria

- Midterm I: 25%
- Midterm II: 25%
- Homework: 10%
- Subjective Evaluation: 5%
- Final Exam: 35%

The midterm examinations and final will be in-class examinations. Make-up exams will be allowed only under exceptional circumstances. Homeworks will be graded and on many occasions, you will be called upon (randomly) to present homework results on the board. There will also be group exercises that will be done in and out of class. The subjective evaluation will be based on class participation and your demonstration of dedication to the class.

Important Dates
October 1 - Midterm I
November 5 - Midterm II
November 26-31 - Thanksgiving Holiday
December 8 - Last Day of Class
Final Exam - December 12, 7:30 - 10:30 p.m.