University of Pennsylvania – Department of Economics
Economics 897 – Summer 2008

July 14 – August 22

Course Objective

Economics 897 covers the basic principles of mathematical analysis. It is the first course of a two-course sequence; the second part, Economics 898, is offered in the Fall. The primary objective of the sequence is to provide incoming graduate students with the mathematical foundations necessary for the first-year sequence of theory and econometric courses.

Prior Preparation

It is highly recommended that the incoming student have a very strong background in calculus. The textbook by Simon & Blume (Mathematics for Economists, Norton, 1994) covers most of the material in Economics 897, but at a more basic level than the course aims at. If your only background in formal analysis is one or two years of college level calculus, we strongly recommend that you review Simon & Blume thoroughly before you come. The course moves very quickly and this prior preparation will help you keep up with the classes. Any other reviews you are able to do of material relevant to the course will only be to your advantage. We have included a syllabus and some past exams to help you with your preparation. Please note that, as the syllabus has changed from previous years, the past exams may cover different material from this year's exam.

Who should take this course?

Math camp has two very important functions. The first is to introduce the necessary mathematical tools for the first year courses. The second, almost equally important, function of math camp is to introduce you to Philadelphia and to the other students with whom you will be working for the next year. First year study groups are typically formed during math camp.

If you are really comfortable with the material described in the overview and in the lecture notes available on the web site, then you might consider taking the waiver exam offered at the end of August. However, you should also consider the non-academic benefits to taking the course. All others should and must (we strongly urge you to) take the course.

Course Schedule

The course begins on Monday, July 14 and ends on Friday, August 22 Steinberg Hall Dietrich Hall 1206**.** It meets daily from 10:00 -- 12:00 and from 1:30 -- 3:30. New material will be covered during the sessions on Monday through Thursday. The morning session and part of the afternoon session on Friday serve as a review, questioning, and clarification opportunity.

There will be a short quiz every Friday, evaluating you on material taught during the previous four days. The final exam for the course is on Wednesday, August 27 (9:00am to 12:00pm in 1206 SH-DH). It is the same exam as the waiver for the course. It will be comprehensive, and will examine material taught throughout the course.

General Aspects

This course is designed on the presumption that the students have been exposed to most of the material in their previous studies and therefore covers a fairly ambitious schedule in a relatively short period of time. Students will be regularly assigned problem sets. **Passing this course, or its waiver exam, is a requirement for the doctoral program.**

Instructors

KyungMin Kim (Teddy)	kim37@sas.upenn.edu
Matthew Hoelle	mhoelle@sas.upenn.edu
Fatih Karahan	karahan@sas.upenn.edu

Text Books:

In addition to lecture notes, instructors will be using the following texts. Copies of these texts will be placed on reserve.

Casella, G. and Berger, R., *Statistical Inference.* Duxbury Press, 2001.
Rudin, W., *Principles of Mathematical Analysis*. McGraw-Hill, 1976.
Strang, G., *Linear Algebra and It's Applications.* Brooks Cole, 2005.

Additional References:

Apostol, T. *Mathematical Analysis*. Addison Wesley, 1976, covers almost all the material that Rudin does, and is less concise. Some of you may find it easier to read the first time around, when you are newly introduced to this material. We plan to put this book on reserve in the library so that those of you who want to consult it, can do so. At the same time, we believe you would benefit from becoming familiar with Rudin. In addition to being a required text for Economics 897, Rudin is also a required text for Economics 701, one of the two core Microeconomics courses you will take in the fall, and a great reference book during later years of research.

Sundaram, *A First Course in Optimization Theory*. Cambridge. In previous years, this text was required for the optimization section of the course. It may be a useful reference, but many past students never opened the cover.

Comment:

Apart from Rudin's and Apostol's book, for the first part we will be also using parts of "Analysis, with an Introduction to Proof" by S. Lay (Prentice Hall). This book contains nice explanations and examples for the entire first part of the course and will be the source material for the first classes on logic and the structure of proofs. The level is very accessible but the scope is limited to the first third of the course. If you feel comfortable enough with Rudin, you can skip it. Anyway, the lecture notes will contain the necessary material from this book.

Economics 897
Summer 2008
July 14 – August 22

Course Outline

More details and lecture notes will be posted on the web.

Module I

Section 1: Metric Spaces, Sequences

1. Preliminaries
   I. Logic
   II. Elementary Set Theory
   III. The Structure of Proofs
   IV. Relations and Functions
2. The Real Number System
3. Metric Spaces.
4. Properties of Metric Spaces
5. Sequences and Series
6. Convergence and Limits

Section 2: One-Variable Calculus

1. Continuity
2. Differentiation
3. Properties of Continuous Functions
4. Properties of Differentiable Functions
5. Linear Approximation, Taylor's Theorem
6. Optimization in R
7. Concave functions

Section 3: Probability Theory I

1. Random variables
2. Conditional probability and independence
3. Distribution functions
4. Transformations of random variables
5. Expected values
6. Moments and moment generating functions

Module II

Section 1: Topology of R^n

1. Balls and bounded sets
2. Sequences in R^n
3. Continuous maps
4. Limits
5. Open and closed sets
6. Compactness
7. Connectedness

Section 2: Linear Algebra (Review)

1. Vector spaces; subspaces
2. Linear maps
3. Kernel and image
4. Direct sum and projection

Section 3:Differentiable Functions

1. Partial derivates; directional derivatives
2. Differentiability
3. Inverse Function Theorem
4. Local structure of immersions and submersions
5. Implicit Function Theorem

Section 4: Riemann Integral

1. Definition and properties
2. Measure zero sets
3. Jordan measurable sets
4. Lebesgue Theorem
5. Iterated integrals
6. Change of Variables

Section 3: Probability Theory II

1. Joint and marginal distributions
2. Conditional distributions and independence
3. Multivariate distributions
4. Convergence concepts

Module III

Section 1: Linear Algebra

1. Matrices and Gaussian elimination
2. Vector spaces and linear equations
3. Orthogonality
4. Determinants
5. Eigenvalues and Eigenvectors
6. Positive definite matrices

Section 2: Optimization

1. Convexity and Separation Theorems
2. Concave Functions
3. Existence of Solutions
4. Unconstrained Optimization
5. Equality Constraints: The Theorem of Lagrange
6. Inequality Constraints: The Theorem of Kuhn – Tucker