Economics 700: Math Camp
Summer, 2021

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BASIC QUANTITATIVE TECHNIQUES

Class Description

This course is the so called "math camp" for the PhD program in economics. The purpose of this course is twofold. First, it provides the necessary mathematical preparation for the Ph.D core sequences in economics. Second, it helps students to develop and to improve their ability to read and write formal proofs. The course titled *Analytical Methods for Mathematical Economics* (Econ 701) is the continuation of the current course.

Class Requirements

There will be 3 problem sets. It is strongly recommended that you attempt the problem sets yourself before the solution is posted. You are also encouraged to work in groups., but you need to hand in individual copy of your answer. You may discuss difficulties with your group members in your daily group meeting (in zoom or in person), and the TA (**in that order**) if you are stuck. Further, there will be two midterm and one final exam (all are closed book). The 2nd midterm will only cover material since the first midterm. The final exam is cumulative. Grades for the class will be based on:

- Midterm (10% each)
- Problem sets (30%)
- Final Exam (50%)

Readings

The class covers calculous, linear algebra, optimization theory and real analysis. There is no required textbook, each of the following books almost cover all the topics in the class.

- De la Fuente, Angel. *Mathematical methods and models for economists*. Cambridge University Press, 2000.
- Simon, Carl P., and Lawrence Blume. *Mathematics for economists*. Vol. 7. New York: Norton, 1994.
- Osborne, Martin. *Mathematical methods for economic theory*. online textbook.

In the first two weeks, we focus on real analysis (math 521 and 522) and linear algebra (math 347 and 577). Here is a list of some references.

- Pugh, Charles Chapman. *Real mathematical analysis*. Springer, 2002. (Full text available via the UNC-Chapel Hill Libraries)
- Rudin, Walter. *Principles of mathematical analysis*. McGraw-hill, 1964.
- Strang, Gilbert. *Introduction to linear algebra*. Wellesley-Cambridge Press, 2016.

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In the third week, we study convex analysis and optimization theory. A short (and sufficient for this course) summary in optimization theory is contained in the appendix of Mas-Colell, Whinston, Green (MWG): *Microeconomic Theory.* It is the required textbook of Econ 710 and 711. The following books provide not only more rigorous theoretical treatment but also many applications.

- Sundaram, Rangarajan K. *A first course in optimization theory*. Cambridge university press, 1996.
- Vohra, Rakesh V. *Advanced mathematical economics*. Routledge, 2004.

We will use the first recitation to go over some basic techniques of proofs. A reader-friendly treatment of proof methods can be found in the following books.

- Hammack, Richard H. *Book of proof*. Richard Hammack, 2013., Free online copy.

Class Logistics

The class meets on Monday-Friday 9:00-10:15am and 10:45-12:00pm (Eastern Time). There will be recitations almost every afternoon 1:30-2:20pm. You are encouraged to attend all classes and recitations.

Contacting Us

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Your TA for this course is Martin Braun. His email is mjbraun@live.unc.edu.

Tentative Agenda

1. Set Theory (1.5 lectures)
2. Real Number (2 lectures)
3. Function and Cardinality (1.5 lectures)
4. Sequence and Limit (2.5 lectures)
5. Basic Topology (2 lectures)
6. Midterm I (July 30)
7. Continuity (2 lectures)
8. Linear Algebra (4 lectures)
9. Differentiation and Implicit Function Theorem (3 lectures)
10. Midterm II (August 6)
11. Convex Analysis and Separation Theorem (2 lectures)
12. Concave, Convex and Quasi-Concave Function (1.5 lectures)
13. Constrained Optimization and Envelop Theorem (4 lectures)
14. Correspondence and Maximum Theorem (1.5 lectures)
15. Riemann Integration (1.5 lectures)
16. Final (TBA)