Math Camp 2020 Syllabus

Department of Economics, Columbia University

Course Information

Instructor : Vinayak Iyer
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Dates : Monday, August 17th - Thursday, September 3rd
Place and Time : 9:30 AM - 12 PM on Zoom
Office Hours : Thursday 12 - 1 on Zoom
Website : https://github.com/vinayakiyer/Columbia-MA-Math-Camp-2020

Overview

This course provides an overview of the mathematical concepts needed for the first year Master's sequence in economics; its goal is to prepare students for their first-year economics classes. Focus will be put on thinking about and writing proofs as well as problem solving. Problem sets will be assigned weekly and due on Mondays. Although these will be graded, no grade will be given for the class. There will be an exam covering the material from math camp during the first meeting of the Math Methods course.

Lecture notes/ slides will be available on the course website, and the material presented in the course will largely be self-contained. Students are expected to have taken courses in single-variable calculus, and some familiarity with concepts in probability and linear algebra will be assumed, although we will spend some time reviewing these topics.

Classes will meet every weekday from 9:30AM – 12PM, running from Monday, August 17th through Thursday, September 3rd.

Textbooks

The material from this course will primarily pull from two reference texts:

1. Essential Mathematics for Economic Analysis (5th Edition) by Knut Sydsæter, Peter Hammond, Arne Strøm, and Andrés Carvajal

2. Further Mathematics for Economic Analysis (2nd Edition) by Knut Sydsæter, Peter Hammond, Atle Seierstad and Arne Strøm

I will go over all the relevant material in class and will post slides and/or lecture notes, but these books may be useful for further reading or to clarify points I make in class. A few copies are also available through the library. Many other textbooks cover material related to the topics we will cover here. For those interested in pursuing particular topics more fully, a partial list of references is given below :

1. Linear Algebra, by Serge Lang

2. Principles of Mathematical Analysis, by Walter Rudin

3. Real Analysis with Economic Applications, by Efe Ok

4. A First Course in Optimization Theory, by Rangarajan Sundaram

5. Recursive Methods in Economic Dynamics, by Nancy Stokey and Robert Lucas

6. Probability Theory with Economic Applications by Efe Ok

Tentative Course Outline

Introduction (2 Lectures)

- Proof Writing Techniques

- Basics of Set Theory

- Functions and Relations

Real Analysis (4 Lectures)

- Metric Spaces, Open sets and closed sets, Euclidean distance

- Sequences, Limits and convergence

- Compactness, Completeness

- Continuity, Weierstrass' Theorem

Linear Algebra (3 Lectures)

- Vectors, Matrices, Determinants, Inner Products

- Linear spaces, Linear Independence, Span, Basis, Dimension and Rank

- Systems of Equations, Cramer's rule

- Eigen Values, Diagonalization and Quadratic Forms

Convexity (1 Lecture)

- Convex sets

- Convex and concave functions

- Quasiconvex and quasiconcave functions

Multivariable Calculus and Optimization (4 Lectures)

- Derivatives, partial derivatives, Taylor expansions, implicit function theorem

- Log linearization and Taylor approximation

- Static Optimization, convexity, neccesary and sufficient conditions for extrema

- Static Optimization with Equality constraints

- Static Optimization with Inequality Constraints (Time permitting)

- Integration, Fundamental Theorem of Calculus, Leibniz Rule