Haverford College - Department of Economics

ECON/MATH 360 - MATHEMATICAL ECONOMICS

Spring Term, 2020

SYLLABUS

Course Description

This course introduces students to advanced mathematical tools that are commonly used in economic analysis. The first half develops these tools, whilst the second half whilst the second half explores their applications. Topics include advanced linear algebra (spectral decomposition and quadratic forms), optimization (convex programming), and dynamic programming. Applications include producer theory, statistics and econometrics, and dynamic models of growth, search and learning.

Instructor
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Texts

- Simon, C. P., & Blume, L. (1994). *Mathematics for economists* (Vol. 7). New York: Norton.
- Turkington, D. A. (2007). *Mathematical tools for economics*. Blackwell.
- de la Fuente, A. (2000). *Mathematical Methods and Models for Economists*, Cambridge UP

Prerequisites

MATH 215 and either MATH 121 or MATH 216.

A prior course in statistics (e.g. ECON 203/4, MATH 203, MATH 218 or MATH 286) is strongly recommended. Students will benefit from having taken Analysis I (MATH 317). This course is intended as part of the Mathematical Economics concentration.

Assessment

Student evaluation will be based on twelve problem sets (40%), a midterm exam (30%) and a final exam (30%).

Problem sets shall submitted via Moodle, typically on a Thursday. Late problem sets will incur a penalty of 10% if submitted within 2 days of deadline, and 20% if submitted any later. Problem sets should be typeset in Latex. Solutions will be posted on Moodle the following week. There will be a take-home midterm exam during the week beginning Monday March 16.

Course Outline

1. Eigenvalues and Quadratic Forms
    a. Eigenvalues
    b. Diagonalization
    c. Quadratic Forms

2. Application to Statistics and Econometrics
    a. Review of Probability and Statistics
    b. Multivariate Normal Distribution and Derived Distributions
    c. Asymptotic Properties of Estimators
    d. Linear Regression
    e. Generalized Method of Moments
    f. Maximum Likelihood Estimation

3. Convex Programming
    a. Taylor's Theorem, Implicit Function Theorem
    b. Convex Sets, Convex/Concave Functions
    c. Quasi-convex/concave & Pseduo-convex/concave functions
    d. Optimisation — Lagrange & Kuhn-Tucker Conditions
    e. Theorem of the Maximum, Envelope Theorem

4. Application to Consumer Theory
    a. Utility Maximization, Expenditure Minimization, Slutsky Equation

5. Dynamic Programming & Optimal Control
    a. Dynamic Programming: Solving Bellman Equations
    b. Contraction Mapping Theorem, Blackwell's sufficient conditions.
    c. Optimal Control: Hamilton-Jacobi-Bellman equation & the Hamiltonian.
    d. Applications to models of growth, search and learning