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Economics 210B: Mathematical Methods in Economics

August-September 2006
University of California at Santa Cruz

This course is intended to refresh and extend entering graduate students' understanding of the major mathematical tools used in economic analysis. The main topics to be covered are linear algebra, differential and integral calculus, static and dynamic optimization, and difference and differential equations.

Main textbooks:

Carl Simon and Lawrence Blume, *Mathematics for Economists*, 1994 (SB)

Avinash Dixit, *Optimization in Economic Theory*, 2nd ed., 1990 (D)

Jérome Adda and Russell Cooper, *Dynamic Economics: Quantitative Methods and Applications*, 2004 (AC)

Other helpful references:

Alpha Chiang, *Fundamental Methods of Mathematical Economics*, 1984

Alpha Chiang, *Elements of Dynamic Optimization*, 1992

Morton Kamien and Nancy Schwartz, *Dynamic Optimization*, 1991

Nancy Stokey and Robert Lucas, *Recursive Methods in Economic Dynamics*, 1989

Avinash Dixit and Robert Pindyck, *Investment under Uncertainty*, 1994

Lars Ljungqvist and Thomas Sargent, *Recursive Macroeconomic Theory*, 2nd ed., 2004

Lecture Schedule

Readings from the textbooks are listed at the right-hand side of the page.

Lecture 1: Mon. Aug. 28
- (1A) Linear equations and vector spaces. SB (10), 11
- (1B) Matrix algebra. SB 8

Lecture 2: Tues. Aug. 29
- (2A) Linear equations and determinants. SB 9, 26
- (2B) Differentiation. SB (2), (4), 14

Lecture 3: Weds. Aug. 30
- (3A) Differentiation and approximation. SB 14, 30
- (3B) The implicit function theorem and comparative statics. SB 15
- (3C) Introduction to MATLAB.

Lecture 4: Thurs. Aug. 31
- (4A) Introduction to optimization. SB (3), 17
- (4B) Constrained optimization: Lagrangians. SB 18, (16), (19); D 2

Lecture 5: Fri. Sept. 1
- (5A) Optimization with inequality constraints. SB 18, (19); D 3
- (5B) Integral calculus. SB App. A

Lecture 6: Tues. Sept. 5
- (6A) Integral calculus, continued. SB App. A
- (6B) Introducing dynamics: first-order difference equations. SB 23

Lecture 7: Weds. Sept. 6
- (7A) The eigenvalue problem. SB 23
- (7B) Systems of difference equations. SB 23

Lecture 8: Thurs. Sept. 7
- (8A) First-order ordinary differential equations. SB 24
- (8B) Higher-order differential equations: characteristic equation. SB 24

Lecture 9: Fri. Sept. 8
- (9A) Systems of ordinary differential equations. SB 25
- (9B) Introduction to dynamic optimization: Lagrangian approach. AC 2.3.1; D 10

Lecture 10: Mon. Sept. 11
- (10A) Dynamic programming: Bellman's equation. AC 2; see also: D11, Stokey & Lucas Ch. 2
- (10B) Solving Bellman's equation: guess and verify, backwards induction. AC 2.3.2

Lecture 11: Tues. Sept. 12
- (11A) Solving Bellman's equation: Euler equation approaches.
- (11B) States, costates, and saddle path stability.

Lecture 12: Weds. Sept. 13
- (12) Numerical dynamic programming. AC 3

Final Exam: Fri. Sept. 15