Economics 4113
Introduction to Mathematical Economics
Fall 2004

Course Description

Economics is a quantitative discipline, and in recent decades the discourse of the profession has become substantially more precise, in the sense of utilizing formal mathematical models. This has many benefits: assumptions and lines of reasoning become completely explicit; exactly understood results can be used with confidence as a basis for more sophisticated reasoning; novel insights can be derived from the application of sophisticated mathematical methods.

The purpose of this course is to acquaint the students with the central mathematical methods utilized in the mathematical approach to economic analysis, and to show how these methods are applied in the central theories of economics. Specifically, the focus will be on optimization in the presence of constraints, emphasizing the approach derived from multivariate calculus.

Time and Location:
12:45-2:00 TuTh, CSOM 1-127.

Prerequisites:
Economics 3101, 3102, or equiv., and Math 1271-1272, 2243, or equiv.

Website:
http://www.econ.umn.edu/~mclennan/Classes/classes.shtml
Texts:

  
  This is the main text for the course: our central focus will the mastery of the ideas and models it describes.

- **Mathematics for Economists**, by Carl Simon and Lawrence Blume.
  
  The readings from this book are assigned in the hope that they will be helpful in understanding related material in Dixit. In addition, this will be used as a source of problems.

- **Lecture notes (LN) from earlier versions of this course.**
  
  These give a concise and systematic account of the mathematical underpinnings of the analysis. The attitude is more oriented toward proofs and foundations, with less focus on “how-to-do-it” than this course, so they not really “required” reading, but are offered in the hope that they will be useful.

You will do much better if you prepare for each class by doing related reading.

Assignments and Grading:

There will be problem sets each week, except that no problem sets will be due on weeks when there are midterms (25%), two midterms exam (15% each), a final exam (40%), and consideration of class participation (5%).

A bonus point worth 0.5% of the grade base will be awarded for each problem set answer prepared using \LaTeX. Specifically, at the end of the course the grades will be drawn up without these bonus points. Then the bonus points will be added to your score, and your grade will be the grade corresponding, under the original grading, to the sum of your original score and your bonus points.

To prepare documents using \LaTeX you will need one of the following:

- \texttt{MiKTEX} and WinEdt on Windows.
- \texttt{OzTeX} on Macintosh.
- \texttt{Linux} or some other version of Unix.

For an introduction to \LaTeX, and for easy reference,

\texttt{http://abel.math.harvard.edu/computing/latex/manual/.texman.html}

is very good.
Course Calendar

Week 1: September 7 and 9
Review of fundamental mathematical concepts, differentiation of univariate functions, necessary and sufficient conditions for maximization, optimal choice subject to a budget constraint with two goods.

- Dixit: Chapter 1.
- Simon and Blume: Chapter 2 and 3 (Review).
- LN-2, LN-3, LN-6.

Week 2: September 14 and 16
Lagrangean analysis of optimization of a function of two variables subject to an equality constraint. Partial derivatives.

- Dixit: Chapter 2.
- Simon and Blume: Chapter 14, Section 15.2, Chapter 18.
- LN-7.

Week 3: September 21 and 23
Generalizations of Lagrangean analysis: n variables; inequality constraints; nonnegativity constraints; complementary slackness. Differentiation of multivariate functions

- Dixit: Chapter 3.
- Simon and Blume: Chapters 18 and 19.
- LN-4, LN-12.

Week 4: September 28 and 30
Shadow prices, with both equality and inequality constraints, and numerous examples. Comparative statics. The implicit function theorem.

- Dixit: Chapter 4.
- Simon and Blume: Chapter 19.
- LN-11.

Week 5: October 5 and 7
The maximum function, and the envelope theorem. Total differentiation.

- Dixit: Chapter 5.
- Simon and Blume: Chapter 19
Week 6: October 12 and 14

October 12: First Midterm

Introduction to convex sets, and convex and concave functions.

(*) Dixit: Chapter 6.
(*) Simon and Blume: Chapter 21.
(*) LN-10.

Week 7: October 19 and 21

Convexity continued: separating hyperplanes. The Second Welfare Theorem of Economics.

(*) Dixit: Chapter 6.
(*) Simon and Blume: Sections 22.3 and 22.4.
(*) LN-9.

Week 8: October 26 and 28

Concave programming. Quasiconcave programming.

(*) Dixit: Chapter 7, Appendix.
(*) Simon and Blume: Chapter 21.
(*) LN-14.

Week 9: November 2 and 4

Second derivatives. Second order necessary and sufficient conditions for unconstrained maximization.

(*) Dixit: Chapter 8.
(*) Simon and Blume: Chapter 17.
(*) LN-8.

Week 10: November 9 and 11

Review, further examples, supplementary topics.

Week 11: November 16 and 18

November 16: Second Midterm

Choice under uncertainty, expected utility, risk aversion, portfolio choice.

(*) Dixit: Chapter 9.
(*) Simon and Blume: Appendix A5, Section 28.2.
**Week 12:** November 23 (Thanksgiving week)
Continuation of uncertainty, and introduction to optimization over time.
(●) Dixit: Chapter 10.

**Week 13:** November 30 and December 2
Continuation of optimization over time.
(●) Dixit: Chapter 10.

**Week 14:** December 7 and 9
Dynamic programming.
(●) Dixit: Chapter 11.

**Week 15:** December 14
Review, further examples, supplementary topics.
Grading Standards and Academic Dishonesty

The Faculty Senate recommends that the following (or an equivalent) statement of grading standards be incorporated into every syllabus:

*University Grading Standards*

A - achievement that is outstanding relative to the level necessary to meet course requirements.

B - achievement that is significantly above the level necessary to meet course requirements.

C - achievement that meets the course requirements in every respect.

D - achievement that is worthy of credit even though it fails to meet fully the course requirements.

S - achievement that is satisfactory, which is equivalent to a C- or better (achievement required for an S is at the discretion of the instructor but may be no lower than a C-).

F - (or N) Represents failure (or no credit) and signifies that the work was either (1) completed but at a level of achievement that is not worthy of credit or (2) was not completed and there was no agreement between the instructor and the student that the student would be awarded an I.

I - (Incomplete) Assigned at the discretion of the instructor when, due to extraordinary circumstances, e.g., hospitalization, a student is prevented from completing the work of the course on time. Requires a written agreement between instructor and student.

*Academic Dishonesty*

Academic dishonesty in any portion of the academic work for a course shall be grounds for awarding a grade of F or N for the entire course.

*Credits and Workload Expectations*

For undergraduate courses, one credit is defined as equivalent to an average of three hours of learning effort per week (over a full semester) necessary for an average student to achieve an average grade in the course. For example, a student taking a three credit course that meets for three hours a week should expect to spend an additional six hours a week on coursework outside the classroom.