Economics 4113
Introduction to Mathematical Economics
Spring 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:
8:15-9:30 TuTh, Blegen 105.

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

Website:
Texts:

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

- Fundamental Methods of Mathematical Economics, by Alpha C. Chiang.
  The readings from this book are assigned in the hope that they will be helpful in understanding related material in Dixit.

- 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 are 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:

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

For an introduction to LaTeX, and for easy reference,


is very good.
Course Calendar

Week 1: January 20 and 22

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.
(●) Chiang: Chapter 2 (Review), Sections 6.2, 6.3, 6.4, 7.1, 7.2, 7.3.
(●) LN-2, LN-3, LN-6.

Week 2: January 27 and 29

Lagrangean analysis of optimization of a function of two variables subject to an equality constraint. Partial derivatives.

(●) Dixit: Chapter 2.
(●) Chiang: Section 7.4, 12.1, 12.2.
(●) LN-7.

Week 3: February 3 and 5

Generalizations of Lagrangean analysis: \( n \) variables; inequality constraints; nonnegativity constraints; complementary slackness. Differentiation of multivariate functions

(●) Dixit: Chapter 3.
(●) LN-4, LN-12.

Week 4: February 10 and 12

Shadow prices, with both equality and inequality constraints, and numerous examples. Comparative statics. The implicit function theorem.

(●) Dixit: Chapter 4.
(●) Chiang: Sections 8.5, 8.6, 8.7.
(●) LN-11.

Week 5: February 17 and 19

The maximum function, and the envelope theorem. Total differentiation.

(●) Dixit: Chapter 5.
(●) Chiang: Sections 8.1, 8.2, 8.3, 8.4.
(●) LN-13.
Week 6: February 24 and 26

February 24: First Midterm

Introduction to convex sets, and convex and concave functions.

(*) Dixit: Chapter 6.
(*) Chiang: Sections 11.5.
(*) LN-10.

Week 7: March 2 and 4

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

(*) Dixit: Chapter 6.
(*) Chiang: Sections 12.4.
(*) LN-9.

Week 8: March 9 and 11

Concave programming. Quasiconcave programming.

(*) Dixit: Chapter 7, Appendix.
(*) Chiang: Chapter 21.
(*) LN-14.

Spring Break

Week 9: March 23 and 25

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

(*) Dixit: Chapter 8.
(*) LN-8.

Week 10: March 30 and April 1

Review, further examples, supplementary topics.

Week 11: April 6 and 8

April 6: Second Midterm

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

(*) Dixit: Chapter 9.
Week 12: April 13 and 15
Continuation of uncertainty, and introduction to optimization over time.

(●) Dixit: Chapter 10.
(●) Chiang: Chapter 13.

Week 13: April 20 and 22
Continuation of optimization over time.

(●) Dixit: Chapter 10.
(●) Chiang: Chapter 13.

Week 14: April 27 and 29
Dynamic programming.

(●) Dixit: Chapter 11.
(●) Chiang: Chapter 14.

Week 15: May 4 and 6
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.