YOU KNOW WHAT I THINK YOU HAVE, SIR? YOU HAVE "MATH ANXIETY."

IF I ASKED YOU HOW MANY WAYS THAT NINE BOOKS COULD BE ARRANGED ON A SHELF WHAT WOULD BE YOUR FIRST REACTION?

AAUGHH!

SEE? YOU HAVE "MATH ANXIETY!"
INTRODUCTION TO MATHEMATICAL ECONOMICS

Econ 4808/5808
Edward Morey
Fall 1992

Course Description
Econ 4808/5808 is a course that will improve your understanding of economic theory, make your other economics courses much easier and improve your basic math skills. It might even be fun. Math should be viewed as a language. Like the other languages we use in economics (e.g., English and graphical analysis), math is a way of representing and conveying information. In principles of economics courses, ideas are presented verbally and graphically. My first reaction, when I took principles, was that I liked the words but not the graphs. However, after a while I came to realize that graphs have their place. Graphs often make difficult concepts clear by allowing us to visualize what is going on. Words are often vague and open to misinterpretation; the English language can be quite imprecise. Graphs tend to convey information more precisely than words. A graph is worth a thousand words. Many econ majors come to love them.

Now I am asking you to learn and love a new language, math. Math allows us to understand much more complicated phenomenon than would be possible if we restricted ourselves to words and graphs. This is due to its precision and compactness. The preciseness of math forces us to understand what we are doing and forces us to be logically consistent. Economic concepts and models can often be easily and precisely described in terms of mathematical notation when words and graphs would fail or mislead us. Since paper and blackboards only have two dimensions, graphs are restricted to at most three dimensions. Graphs can be very enlightening, but if the phenomenon being studied involves more than three variables, the graph provides an incomplete, and sometimes misleading, picture. In this case, mathematical functions and our ability to manipulate them become very powerful tools of economic analysis. The intent of this course is to teach you the language of mathematics and how to use it to better understand economics. The ability to describe an economic model verbally, graphically, and mathematically will make your economic life a lot easier.

Prerequisites
Principles of Economics and either Math 1070 and 1080 or Math 1300. It is very important that you fulfill the prerequisites before you take this course. To be successful in mathematical economics, you need to first be comfortable with algebra and derivatives.

Gory Details
There will be two exams; a midterm and a comprehensive final. The midterm will constitute 25% of your course grade and the final 50%, unless you do better on the final, in which case, the midterm will not count and the grade on the final will constitute 75% of your course grade.
There will be \( n \) quizzes during the term and your best \((n-1)\) quiz scores will constitute 25% of your grade. (This means your lowest quiz grade will not count.) There will be a quiz approximately every other week. There will be announced a class or two in advance. The packet at Kinko's (ask for CU-70) includes the quizzes and exams given in Fall 1987, Spring 1988, Fall 1988, Spring 1989, Spring 1990 and Fall 1991. Use these to study. To provide you with feedback and reinforcement, I have included answer keys for one of the midterms and two of the finals. However, try not to look at an answer until you are either convinced that you have the correct answer, or have tried, on at least two separate occasions, to answer the question. The objective is to learn how to answer question on you own, not to convince yourself that my answer is correct.

Some of the quizzes will be group quizzes. I will tell you in advance if a quiz is a group quiz. Groups will consist of three people (you choose your own group). The group will work together and just turn in one quiz. Everyone in the group will get the same grade for that quiz. Group quizzes are one of my ways of giving you an incentive to work and study together.

Reviewing your quiz and midterm answers is an integral part of the learning process. Therefore, if you are in class when I hand back a quiz and I discuss the students' answers, I will add one point (out of 10) to your quiz score. If you are in class when I hand back the midterm and discuss the answers, I will add five points (out of 100) to your score.

In class I will ask many questions. I also expect you to ask questions. In addition to these question, I will often give you the opportunity to earn, or lose, points by verbally answering specific questions. Participation in this latter activity is completely voluntary.

**Office Hours**

My office hours will be from 4:45 to 6:15 on Tuesdays, from 10:45 to 12:15 on Thursdays and by appointment. My office is Econ 122. Please feel free to call my office (492-6898), to make an appointment. If I am not there, please leave a message and I will call you back as soon as I can (this might take a day or two).

**Correct Class Behavior**
Readings:

(1) The Book You Purchase

A note about Fundamentals of Mathematical Economics. This book text is designed to teach you the mathematical tools that you will need to solve economic problems. In addition it applies these tools to solve basic economic problems. The author's intent was not to teach economic theory. To do well in this course, you will need to understand and use the mathematical tools presented in the text. In this sense, an understanding of the material in the text is necessary for you to do well in the course. However, it is not sufficient. You will also need to understand and use economic theory, and, most importantly, you will need to be able to integrate the economic theory and the math to solve economic problems. You can only achieve this integration by solving economic problems. You will have ample opportunity to do this both in and out of class. In this sense, understanding of the material in the text is necessary but not sufficient for one to do well in the course.

(2) Other Readings:
To review economic concepts and theories, you will often want to reread section of your principles text, and sections of your intermediate micro and macro texts. If you no longer have your texts from these courses, I can suggest texts you can obtain from the bookstore or library.
Homework (four types):
The homework will not be collected but is an essential part of learning mathematical economics.

(1) Homework problems from Chiang
Chapter 1: None
Chapter 2: (2.3) 1-5; (2.4) 4-6; and (2.5) 1,2,5,6.
Chapter 3: (3.2) 1-5; (3.3) 2, 3ad, 5a; (3.5) 1,2.
Chapter 6: (6.2) 1b, 2b (use the definition of a derivative that I gave you in class); (6.4) 1, 2; (6.6) 1, 2a, 3a.
Chapter 7: (7.1) 1cd, 2be, 3cd; (7.2) 1, 3af, 7, 8; (7.3) 1, 4-6; (7.4) 1ac, 2cd, 3, 4; (7.5) 1, 2
Chapter 8: (8.1) 1, 3, 4; (8.2) 1b, 2b, 3, 4; (8.3) 1b, 2b, 3; (8.5) 2a.
Chapter 9: (9.2) lad, 2ab, 3, 4ab; (9.3) lad, 5; (9.4) 1a, 2, 3, 6b.
Chapter 11: (11.2) 1-3; (11.6) 1, 2.
Chapter 12: (12.2) 1ac, 3a, 4; (12.5) 1ab, 2ab.
Chapter 4: (4.1) 1,2; (4.2) 1-7; (4.3) 1-3, 5-8, 9a; (4.4) 1a, 3; (4.5) 1, 2; (4.6) 1, 2, 4.
Chapter 5: (5.1) laefg; (5.2) laced, 3, 4ab; (5.3) 4ac; (5.4) 2a, 4acd, 5; (5.5) 1-3; (5.6) 1
Doing these question will teach basic mathematical skills. The answers to these questions from Chaing are available in the packet at Kinko’s (Packet CU-70), but try not to look at an answer until you have really tried to do the problem.

(2) Homework: the old quizzes and exams
Before each quiz or exam you should work out the answers to all relevant questions from old quizzes and exams. This should be done enough in advance so that if you get stuck you will have time to work out the answer(s) either with me or with one of your classmates. I greatly encourage you to work with your classmates. Some of the questions will require a couple of tries.

(3) Homework: I will often assign problems in class

(4) Homework: Reviewing economics concepts and theories by rereading sections of your principles text, and intermediate micro and macro texts.
Course Outline

Readings for I: Chapters 1 and 2

I. Introduction: Models (Theories) and Tools
   Brief review of economics models, mathematical models vs. econometrics, sets, relations, functions, scalars and vectors.

EQUILIBRIUM ANALYSIS
   This part of the course examines equilibrium models: the nature of equilibrium and its displacement (comparative statics).

Readings for II: Chapter 3

II. Economic Models and Static Analysis
   A. Equilibrium defined
      1. definition
      2. the continuum from partial to general equilibrium (G.E.) models
   B. Simple partial equilibrium models
      1. a simple linear model of supply and demand
      2. a simple nonlinear model of supply and demand
      3. a simple Keynesian macro model
   C. Moving toward General Equilibrium (G.E.)
      1. general market equilibrium
      2. a simple two-good example
      3. N goods
      4. existence in G.E.

Readings for III: Chapters 6, 7 (skip "input output" pp. 182-4 and skip 7.6) and 8 (skip "Another Variation on the Theme" pp. 201-3; skip 8.4 (pp. 198-204); skip the Simultaneous Equation case, pp. 210-14; and skip 8.6).

III. Comparative Static Analysis: Differential Calculus
   A. The nature of comparative static analysis and the concept of a derivative
      1. slopes, continuity, limits and derivatives.
   B. Rules of Differentiation
      1. Functions of single variables: Derivatives
      2. Economic examples of derivatives: marginal revenues and marginal costs
      3. Functions of multiple variables: Partial Derivatives
      4. Economic examples of partial derivatives: marginal products, elasticities, Shepard's Lemma and the conditional demand functions for inputs, macro
C. The Total Differential
   1. Total differentials
   2. Economic applications of total differentials: isoquants, indifference curves, isocosts lines and budget lines
   3. Implicit functions and total differentials
   4. Economic applications of implicit functions: multiple output production processes

OPTIMIZATION
This part of the course considers problems where there are goals and constraints.

Readings for IV: Chapters 9 (skip 9.5 and 9.6) and 11 (skip three variable quadratic forms pp. 323-30, skip 11.4, skip "checking concavity" pp. 340-53 and skip 11.7). Also read the page in your Kinko's packet entitled "One method for solving pairs of linear equations like those that need to be solved in chapter 11."

IV. Unconstrained Optimization From A Mathematical Perspective
   A. With one variable
      1. necessary and sufficient conditions for a max and min in terms of the first and second derivatives
      2. economic examples
      3. necessary and sufficient conditions for a max and min in terms of the first and second-order differential

   B. With multiple variables
      1. necessary and sufficient conditions for a max and min in terms of the first and second-order total differentials
      2. necessary and sufficient conditions for a max and min in terms of the first and second-order partial derivatives
      3. eliminating constraints by substitution into the objective function
      4. economic applications

Readings for V: Chapter 12 (skip 12.3 and 12.4, skip "second order conditions" pp. 402-9, skip 12.5 and 12.7).

V. Constrained Optimization with Equality Constraints
   A. Theory

   B. Applications
1. Utility max
2. Cost min

MATRIX ALGEBRA
Matrix algebra greatly simplifies the notation for systems of linear equations. This makes it much easier to solve systems of linear equations.

Readings for VI: Chapters 4 and 5 (skip 5.7)

VI. Linear Models and Matrix Algebra
A. Theory
1. vectors and matrices, matrix operations, determinants, Cramer's Rule.

B. Economic applications
1. market equilibrium and macro models

Potential Dangers From Course

"Notice all the computations, theoretical scribblings and lab equipment, Norm. ... Yes, curiosity killed these cats."

"Hal Webster's blown his cerebral cortex."
How Undergraduates Can Succeed: Study Together, and in Small Classes

By ANTHONY DEPALMA

College students who study together, meet frequently with advisers and enroll in at least one small class every semester are most likely to excel, according to a report being made public today by Harvard University.

The report, which is expected to influence the way many courses are taught at other colleges and universities, also found that contrary to popular notions about college top students prefer courses that require substantial amounts of writing. They also consider foreign language courses, where classes are small and there is frequent interaction between teacher and students, close to being an academic ideal, the report found.

After five years of study the Harvard researchers concluded that the most effective strategy for an undergraduate to pursue is to make alliances with fellow students, faculty members and advisers, and not try to brave college alone.

"The thing for a student to avoid," said Richard J. Light, a professor of education at Harvard who was director of the assessment project, "is signing up for all large classes, drifting in and out anonymously, sitting in the eighth row working quietly and then going back to the library or a dorm room and applying the seat of the pants to the seat of the chair."

A Five-Year Assessment

The report is the second of two parts of a five-year assessment of what constitutes effective teaching and learning at Harvard and, by extension, at all universities. The first part of the assessment, published last year, found that students learned better in courses where professors were more effective in courses where progress could be tracked through frequent tests, quizzes and one-minute exams at the end of a lesson. Some of its findings and recommendations have been widely copied.

"What the Harvard assessment report identified is important for learning in all kinds of settings," said Claire L. Gaudiani, president of Connecticut College, a private liberal arts college in New London. Dr. Gaudiani said that in 1990 she encouraged all faculty members at her college to examine the first report and consider following some of its suggestions, and would do the same with the second report.

The report being made public today contains some recommendations that are simple and easy to adopt. Among them are these:

- When students are unwilling or unable to organize into study groups that meet outside the classroom, professors ought to set up such groups and require that readings be completed before the groups meet.
- In courses with several writing assignments, professors should ask a few students each week to prepare their papers early so they can be photocopied and distributed for class discussion. Research has found this encourages students to work harder on their papers and enhances the level of class discussions.
- Students should not try to get all their required classes out of the way as soon as possible, but each semester should mix in at least one small group or seminar class.
- Professors in science and mathematics should encourage cooperative learning and study groups rather than place too much importance on competitive grades, which drives interested nonmajors from the field.

Faculty Accessibility

The researchers also found that while students were generally satisfied with their professors' availability during office hours, they did not feel comfortable trying to talk informally to faculty members about personal matters, a failing that has contributed to a sense of dissatisfaction with the academic environment.

Harvard officials concede the shortcoming, "It is clearly the case that some faculty could do a better job of making themselves more accessible," said David Pilbeam, associate dean for undergraduate education at Harvard. But he said it was up to the students to buttonhole busy professors.

"We don't have Mr. Chips here," he said. "If students want that, they should go somewhere else, to a small liberal arts college."

Among the institutions that studied the first report was the State University of New York at Plattsburgh. Henry C. Morlock, a professor of psychology there, said he has incorporated the one-minute exam into his introductory course, calling it "one of those nice little tricks, effortless and cheap, that tells me what's not getting across to the students."

Group Study Teams

This is one of the hardest things in teaching to know, especially in large classes, he said, adding, "In small classes you can see the puzzled looks on their faces and ask what's wrong, but you can't do that in a big lecture."

Even in small liberal arts colleges, where large classes are not an issue, Bonne Allison, a professor of child development at Connecticut College, said that after reading the report she was especially impressed with the projected effectiveness of group study teams, which are common in law school settings but not in undergraduate courses.

For her 'Children and Society' class, she said, she organizes the 14 students into four groups. Each group is assigned a different Supreme Court case involving children's issues. After reading the decision and determining its most important points, the students present it to the class.

"I read the case more carefully and took very clear notes because I knew I would have to give a presentation about it," said Kristina L. Putalik, a child development major from Armonk, N.Y., who studied a 1988 case on high school students' First Amendment rights. She and the three other members of her group met in the college library to go over the case, and then spent 45 minutes discussing what it meant. In a recent class Ms. Putalik gave the background of the case and the others presented the legal implications, and the class then fielded questions from their classmates. Then the next study group presented a different case, which the class later discussed.

Ms. Putalik said she came away with a deeper understanding of the issues and a firmer grasp of the cases. "I just find that I learn better from discussions and talking to other people about the same material," she said.