Introduction to Mathematical Economics 4808
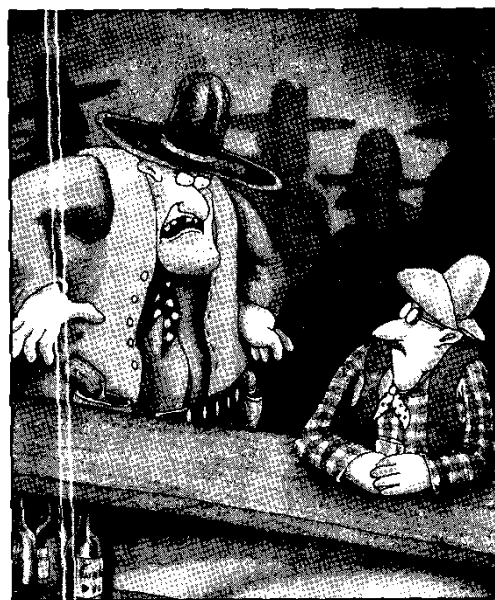
Course Syllabus - Spring 2012

"I asked you a question, buddy. . . . What's the square root of 5,248?"

Econ 4808 Introduction to Mathematical Economics

Edward Morey
Spring 2012 (January 15, 2012)

Course Description: Econ 4808 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.

Since 4808 is designed to make your other econ courses easier, you hopefully have more econ courses to take. (That is, you did foolishly not wait until your last semester to take this course.)

Math should be viewed as a language. Like the other languages we use in economics (English, French, Chinese, 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; we will use them in 4808. Words are often vague and open to misinterpretation; the English language can be quite imprecise.1 Graphs tend to convey information more precisely than words. A graph is worth a thousand words. Many economics majors come to love them.

That said, the point on a graph where two lines cross can be the answer to most questions in economics, assuming you are vague about what is on each axis.

Now I am asking you to learn and appreciate a different language, math. Mathematics allows us to understand more complicated phenomenon than would be possible if we restricted ourselves to words and graphs. This is due to its *precision*, *compactness*, and that it has a lot of useful theorems. Compact means that a lot of stuff (equations, variables, etc.) can be expressed with a small amount of notation. Consider, for example, algebra where a letter can represent a whole matrix.

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1 When after three shots of tequila, George gently kisses you in the neck and says, "I love you." he might love you or he might be saying …

Compare the preciseness of the following two statements:

There is a positive relationship between x and y.

And

y=a+bx, where a,b>0

This second statement states that there is a positive relationship between x and y, and restricts the positive relationship to a specific type. Arguably, the second statement is less easy to misinterpret than is the first statement.

The preciseness of math compels us to understand what we are doing and forces us to be logically consistent. When expressing things mathematically, we can't hide behind vagueness, or at least not easily hide.

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 goal of economics is often to develop a model and then derive predictions from that model. It turns out that many of our model's predictions are special cases of existing mathematical theorems, so rather than having to prove something from scratch, we, for example, just have to show that our result is a special case of the famous Hans Guber Theorem of Crossing Lines. (I just made up that name for a theorem.)

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 life as an econ. major a lot easier.

The course considers the mathematics of, and economic applications of equilibrium, slopes and derivatives, differentials, optimization (maximizing and minimizing stuff like profit, cost and utility), and constrained optimization (e.g., maximizing utility subject to the budget constraint) and integration (consumer's surplus). Applications include problems in consumer and producer theory, general equilibrium, welfare economics, growth and discounting, oligopoly behavior, game theory, statistics, and econometrics.

Surf the course web page. You are responsible for knowing what you will be expected of you. Know what you are getting into.

Prerequisites: Principles of Economics (Econ 2010 and Econ 2020, or Econ 1000) are prerequisites, so are Econ 1078 (Mathematical Tools for Economists 1) and Econ 1088 Mathematical Tools for Economists 2), or the equivalent. One or more semesters of Calculus would more than suffice for Econ 1078 and 1088. This course and Intermediate Micro Theory are definite compliments. It is **very** important that you fulfill the prerequisites **before** you take this course, and **still** understand the materials in the prerequisites. To be successful in mathematical economics, you need to first be comfortable with algebra and derivatives. If you have any uncertainty as whether you are under or over qualified to take the course, please talk to me ASAP (talk to me after class or email me).

If you took 1078 12 semesters ago and earned a C, you probably do not want to be here.

Who should take this course? I would recommend the course to: anyone who likes math and likes economics, and to anyone who wants to understand the important role mathematics and models play in modern economics.

One does not really understand what economics is until one has studied its different components, and mathematical tools are a primary component in the toolbox of the economist.

This course is essential for anyone considering graduate work in economics. In general, mathematics is a much more integral part of economics than most undergraduate economics majors imagine.

[Click here for some additional comments and thoughts to help you decide whether to take the course](#).

Web page: My web site is located at http://www.colorado.edu/Economics/morey/index.html . From it you can link to the web page for Econ 4808, or you can go directly to web page for the

course at http://www.colorado.edu/Economics/morey /4808/4808home.html . If you forget my web addresses, just Google "Edward Morey".

Review questions, and additional readings are available on the web page. These will be revised and updated on an ongoing basis.

I taught a similar course, but more advanced, for M.A. students (the M.A. program is now extinct). Its web page is located at http://www.colorado.edu/Economics/morey /6808/6808home.html. That course covered many of the same topics we will cover, but at a more advanced level. It is place to start if you ever want more advanced material.

Class format: Lecture/problem solving/discussion

Economic theory, critical thinking and problem solving will be stressed. Class format will include both individual and group problem solving. After completing the course, you will be better able to critically evaluate economic theories.

You will spend a considerable amount of class time interactively formulating and solving problems and building models. Small groups will often be utilized – I love small groups.

View readings and my lectures as complements rather than substitutes. A lot of the basic material that you will be responsible for will be presented in lecture and not in any assigned readings.

Details: There will be problem sets, projects and short exams. Your best (N-2) grades on these activities will constitute 40% of your course grade, the midterm 25%, and the final 35% of your course grade <u>unless</u> you do better on the final than on the other activities, in which case, all activities before the final will constitute 50% (30% short activities, 20% midterm) of your course grade and your final 50% of your course grade. The final will be cumulative.

Review questions: Review questions and homework problems are posted for each section of the course. Each set of questions will be revised and updated as we start on the topic(s) covered by that set of questions. Knowledge of these review questions will be will be **very helpful** when taking the exams. **I strongly encourage you to write out answers to these questions and discuss them with you classmates.** If I examine you on a question that was a review question, I will grade it assuming that you had, prior to the exam, worked on and answered the question.

You will want to form study groups.

The review questions will be updated numerous times throughout the semester.

I expect a lot.

In class I will ask many questions. I also expect you to ask questions. In addition to these questions, 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.

Group Assignments: Some of the assignments will be done in groups. I will tell you in advance if an assignment is a group endeavor. You choose your own group. The group will work together and turn in only one assignment. Everyone in the group will get the same grade for that assignment. Group activities are one of my ways of giving you an incentive to work and study together. **See the article** about group studying appended to the end of the syllabus. **Note that if your group gets a grade of x on a group quiz, this does not imply that every member of the group knows the material at a x level.**

Reviewing your answers to the problem sets and short exams is an integral part of the learning process. Therefore, if you are in class when I hand back and discuss the answers, **I will add one point** (out of 10) to your quiz score. **Note that adding a point to your score does not, by itself, increase your skills or level of understanding.**

Office Hours: My office hours are posted on the home page for the course. Feel free to email me but note that it might take a day or more for me to respond. My office is Econ 122. To make an appointment, catch me after class or contact me by email (Edward.Morey@Colorado.edu) - suggest some times in your email. Even if you are coming doing office hours, let me know ahead of time, if you can.

Correct Class Behavior:

Readings:

I will likely not assign specific readings from any book.

But, that said, you need access to a good text or texts on algebra and calculus.

Essential Mathematics for Economic Analysis (Knut Sydsaeter and Peter Hammond)

Is the official math text for undergraduate econ majors here at C.U. You are expected to own a copy and understand much of the material in this book (it is official for all of your economics courses, not just 4808)

Essential Mathematics for Economic Analysis is the required text for Econ 1078 and Econ 1088 and students in those courses are told to keep and use the book until they finish their undergraduate major in economics. If you don't have a copy you should be able to easily find one online. ISBN 0 273 68180 X (don't buy one at the bookstore intended for a student in 1078)

> A note about *Essential Mathematics for Economic Analysis*. This book 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 authors' intent was **not** to teach economic theory.

To do well in this course, you will need to **understand and use mathematical tools.** In this sense, an understanding of some mathematics is *necessary* for you to do well in the course. However, *it is not sufficient.*2 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. (Being a math wiz will not guarantee you a good grade) You can only achieve this integration of mathematics and economics by solving economic problems. You cannot achieve this integration by watching me solve problems. You will have ample opportunity solve problems both in and out of class. In this sense, understanding of the material in *Essential Mathematics for Economic Analysis* is *necessary but not sufficient* for one to do well in the course.

You should also have handy an intermediate micro theory text; e.g. the one you used in Econ 3070.

> I like *Intermediate Microeconomics* (Hal Varian). It is an intermediate micro book that is both elegant and rigorous, but its old. It, or the book you used in 3070, will provide you with the theory that you need.

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2 Note that necessary and sufficient are two of my favorite words.

An Aside: There is lots of software out there that can do algebra and calculus. One good example is called *Mathematica.* It can differentiate, integrate, solve systems of equations and create great graphics. *Mathematica* is available from the CU Office of Information Technology. Go to http://oit.colorado.edu/software-hardware/site-licenses/mathematica
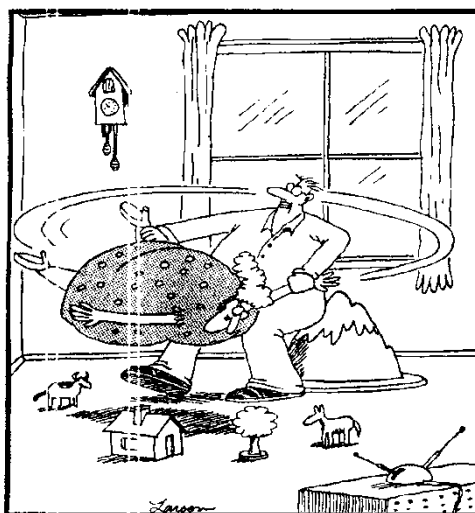It is cool stuff. While *Mathematica* will play no formal role in the course, it could help you to learn and solve problems. Of course, **you** would never use it a substitute for learning how to take a derivative. (Even if you have it on your computer, you won't have it available for in-class exams.) **Electronic devices will not be needed or used during quizzes and exams.** If you would like to learn more about *Mathematica*, please see the readings about Mathematica on the course web page. I personally use the mathematical software, *Mudpad*; it is integrated into my word processing software, *Scientific Word*.

Tentative Course Outline: A tentative outline for the course and some lecture notes can be found at http://www.colorado.edu/Economics/morey/4808/4808read.html .
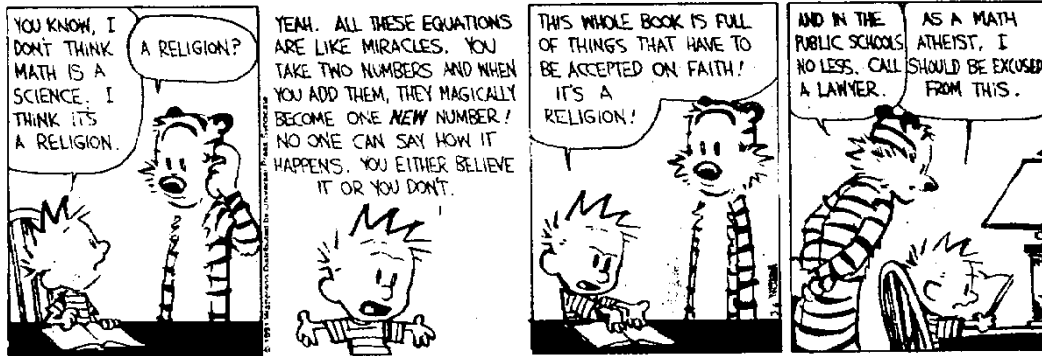
ECONOMIC OPTIMIZATION

Searching
for the max
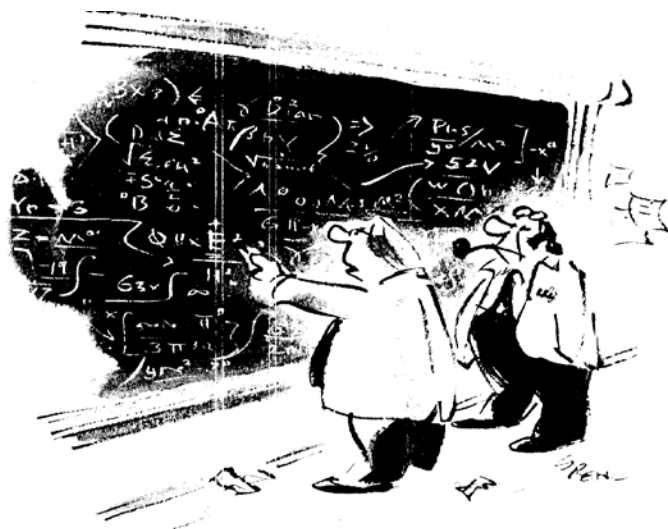
who is tallest in the room?

On the next pass, however, Helen failed
to clear the mountains.

Mathematics and Religion:

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."

I. **What to look for in "proofs"**

"Here's your problem—you forgot the sleaze factor."

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 and 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 learn-

Joe Wrinn for The New York Times
Richard J. Light, a Harvard professor and director of the assessment project, recommends avoiding anonymity in large classes.

A new report at Harvard offers tips for students and professors.

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ing 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. Researchers 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 often 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

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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,

the first report prompted change. Bonnie 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 1986 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 all of them 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.