Logic and Economics (Econ 4999)

Course Syllabus – Spring 2002

"I asked you a question, buddy... What's the square root of 5,248?"
Econ 4999 Logic and Mathematics
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Course Description: Econ 4999 is a course that will improve your understanding of economic theory, make your other economics courses much easier and improve your 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.

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. Compact means a lot of stuff (equations, variables, etc.) can be expressed with a small amount of notation. Consider, for example, matrix notation. 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 more about mathematics and logic and how to use them to better understand economics. The ability to describe an economic model verbally, graphically, and mathematically will make your economic life a lot easier.
In terms of set theory, think of the course as the intersection of economics, math, and logic.

The course is designed for all Majors who would like more than the basic courses in economic theory and mathematical economics (4808). In particular, individuals who are considering graduate studies in Economics are advised to take this course.

Mathematical economics (4808) “should” be required of all Econ majors. Econ 4808 teaches basic mathematical tools and how these basic tools can be used to solve economic problems. Econ 4999 will provide the student with more opportunities to address economic problems from a mathematical perspective. Both additional applications and additional tools will be studied. 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.

The course considers the mathematics of, and economic applications of, constrained optimization, curvature properties, duality theory, integration, game theory, and equilibrium analysis. Applications include problems in consumer and producer theory, general equilibrium, welfare economics, growth and discounting, oligopoly behavior, game theory, statistics, and econometrics.

**Prerequisites:** I expect that you are comfortable with algebra and derivatives and know something about integration. You did well and enjoyed math econ (4808) and intermediate micro theory.

This course is very similar to my Econ 6808 course, which is the math econ course for M.A. students, except that we have more flexibility as to which topics we will cover and in what depth. We will use many of the same readings and notes. The web page for 6808 is located at [http://www.colorado.edu/Economics/morey/6808/6808home.html](http://www.colorado.edu/Economics/morey/6808/6808home.html).

**Web page:** My web site is located at [http://www.colorado.edu/Economics/morey/index.html](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/4999/4999home.html](http://www.colorado.edu/Economics/morey/4999/4999home.html).

Past and current assignments, review questions, and additional readings will be made available at this site on an as-need basis.

You are responsible for knowing what you will be expected of you. Know what you are getting into.

**Class format:** Lecture/problem solving/discussion/project

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.

View the 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 is material that is not explicitly in the readings.

You will complete some sort of project for this class, and some of you will likely present what you have done to the class.

Details: There will be problem sets, small projects and short exams hereafter the short assignments) Your best (N-1) grades on these activities will constitute 25% of your course grade, the midterm 20%, your “major” project 25%, and the final 30% of your course grade unless you do better on the final than you did on the midterm and short assignments. If you do better on the final than the other activities (excluding the major project), the project will be 25%, the final 45%, and the short assignments and midterm together will be 30%. The final will be cumulative.

Review questions: Review questions and homework problems will be handed out for each section of the course. 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 your classmates. You will want to form study groups. Also make sure you understand and can do all the problems on the relevant old exams. Old sets of these review questions can be found on the web page.

In class I will ask many questions. I also expect you to ask questions. In addition to these questions, I will sometimes 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. 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 one 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 math skills.

**The Project:** The purpose of the project will be to show how the mathematical techniques and theory can be used to address an economic problem or issue that you find of interest. You will be encouraged to do one of the following: build a simple mathematical model of economic behavior; critique a journal article that utilizes a mathematical model to analyze economic behavior; write a survey article for the class that expands on one of the topics we discussed in class, write a survey article for the class on a topic in mathematical economics or mathematics that is of interest to you (and relevant to economics), but that we did not have time to cover in class. Your project could be a web project and or a *Mathematica project*. Please discuss your paper topic with me before you write your paper. The final copy of your paper will be due in my office around at the time of the final. If you get you get a “final” draft of your project to me 10 days or more before that date, I will give you comments that, hopefully, you can use to improve the paper. Some of your short assignments will have to do with your project. I will consider group projects, but they better be good.

**Office Hours:** My office hours will be Mondays from 3:00 to 4:00, Wednesdays from 5:15 to 6:00 and by appointment. My office is Econ 122. To make an appointment, catch me after class or contact me by email ([Edward.Morey@Colorado.edu](mailto:Edward.Morey@Colorado.edu)) - suggest some times. It might take me a day or two to return your email.
Correct Class Behavior:

Peanuts

Daydreaming?

No, ma'am, I wasn't daydreaming...

I was just conceptualizing!
Readings

*Mathematics for Economic Analysis* (Knut Sydsaeter and Peter Hammond). It is clear, rigorous, and modern. Remember it is book on math for economists, not mathematical economics.

A note about *Mathematics for Economic Analysis*. 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 authors’ 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 some mathematics 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. (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 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.

*Intermediate Microeconomics* (Hal Varian). An intermediate micro book that is both elegant and rigorous. It will provide you with the theory that you need. If you still have the text from your Intermediated Micro Course, it will likely suffice.

Other readings (book chapters, journal articles, etc.) will supplement the above books on an as-need basis. I will make them available either online or bring copies to class.

**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 on the C.U. computer system. One can also buy a student version of it at either bookstore. 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.) If you would like to learn more about *Mathematica*, please visit the web site for either this class of my Econ 6808 course.

**Logic and Mathematics** (Preliminary Outline):
I do not anticipate covering the complete outline. Which sections we cover will depend on class interests and in how much depth we consider topics. The topics we don't get to are a good source for paper material. The intent is give you new tools and perspectives for analyzing and modeling economic behavior, not to learn some specific bundle of facts and theories, so we have latitude as to how best approach the task at hand. In addition to learning specific math tool, you need to learn how to identify and learn the tools you need to do your work.

1. Game theory and economics
2. Economic applications of constrained optimization
3. Economic curvature
4. Economic applications of duality theory
5. Integration: an introduction and some simple economic and statistical examples
6. General equilibrium: interactions among economic agents
ECONOMIC OPTIMIZATION

Searching
for the max

On the next pass, however, Helen failed
to clear the mountains.
Mathematics and Religion:

CALVIN AND HOBBES

YOU KNOW, I DON'T THINK MATH IS A SCIENCE. I THINK IT'S A RELIGION.

YEAH, ALL THESE EQUATIONS ARE LIKE MIRACLES. YOU TAKE TWO NUMBERS AND WHEN YOU ADD THEM, THEY MAGICALLY BECOME ONE NUMBER! NO ONE CAN SAY HOW IT HAPPENS, YOU EITHER BELIEVE IT OR YOU DON'T.

THIS WHOLE BOOK IS FULL OF THINGS THAT HAVE TO BE ACCEPTED ON FAITH! IT'S A RELIGION.

AND IN THE PUBLIC SCHOOLS, NO USE. CALVIN SHOULD BE EXPELLED FROM THIS.

AS A MATH ATHEIST, I SAY NO USE. CALVIN SHOULD BE EXPELLED FROM THIS.
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."
1. What to look for in "proofs"
How Undergraduates Can Succeed: Study Together, and in Small Classes

BY ANTHONY DEPALMA

College students who study together, meet frequently with advisors 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 finds that contrary to popular notions about college top students prefer courses that require a substantial amount 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, Harvard researchers concluded that the most effective strategy for an undergraduate to pursue is to make alliances with fellow students, faculty members and advisors, 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 studies, one was published last year, that found 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 lecture. 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.

On courses with writing assignments professors should ask a few students each week to prepare their papers early so they can be photocopied and distributed in class discussion.

In the classroom, students should try to work harder on their group projects and enhance the level of course discussions.

Students should try not to try to get all their required classes out of the way as soon as possible, but each semester should pick in at least one small group or seminar class.

Professors in science and mathematics should encourage cooperative learning in study groups rather than place too much importance on competitive grades, which drives interested nongraduates 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 shortcomings. "It's clearly the case that some faculty could do a better job of making themselves more accessible," said Dr. vid Pircher, an associate dean for undergraduate education at Harvard. "But he said it was up to the students to buttomle 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."

Institutions that studied the first report were the State University of New York at Plattsburgh; Henry C. Murlock, 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, especially in large classes, he said, adding, "In small classes you can see where the kids look 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. Afterwards the team presents its findings 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. Putak, a child development major from Armenk, 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 they meant.

In a recent class Ms. Putak gave the background of the case and the other members presented their ideas, and all our field questions from their classmate. Then the next study group pre-eminent case, which the class later discussed.

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