

Economics 519: Mathematics for Economists

August 2006

Class meetings	401kk McClelland Hall Monday-Saturday, 9:30-11:30am, and 5:00-6:00pm
Instructor	David Reiley reiley@eller.arizona.edu Office hours: 2:00-2:30pm, or by appointment 401cc McClelland Hall
Teaching Assistant	Natalia Lazzati nlazzati@email.arizona.edu
Course home page	http://www.u.arizona.edu/~dreiley/econ519/syllabus.html

Course Description

This is an intensive course in the mathematics one should know when beginning a doctoral program in economics. The textbook by Simon & Blume is excellent. The course objective is simply that you achieve an understanding of the concepts we will cover in the textbook *and the ability to apply them*. As you can see from the tentative schedule below, it will be a very fast-moving, very intensive course - a sort of mathematical boot camp. You'll have little time for other things during these three weeks, but the course will prepare you for the doctoral program in economics.

Teaching Philosophy

As an economist, I believe in efficient allocation of resources. Because I try to practice what I preach, you may find that my teaching style differs from what you are used to, or from what you will see from other faculty in the economics department.

Here's the plan. I want to reserve our class time (a precious resource) for two-way communication: questions, discussions, and cooperative problem-solving. Most of the one-way communication in this course will happen through assigned readings rather than through lectures.

In order for the interactive class format to work, you should do two things: (1) **Make sure to complete each day's assigned reading before coming to class**, so that we can discuss it and you can ask questions about anything you didn't understand. When doing the readings, try a few problems out of the book to check your understanding. (2) **Be ready to think and talk when you come to class**. In order to make sure that everyone has the chance to participate in class, I will call on each student from time to time.

Whenever you don't understand something, either from the readings or from class, please ask a question. Often other students are having the same difficulty as you are and all can benefit from the exchange. I need your feedback so that I can make the course meet your needs. Furthermore, if you're scared of the idea that I might cold-call you during class, a great defensive move is to come prepared to ask me something, so that I know you're actively participating.

I believe that the deepest learning occurs when students teach themselves. Therefore, I expect you to do most of your learning through the readings and assignments, both on your own and in cooperation with

your classmates. I do not intend to "cover" everything in class lectures. Rather, my job in this course is to guide the learning by choosing readings and exercises for you, and to coach you through this learning process in a way that maximizes understanding with as little frustration as possible.

For example, when you get stuck on a page of reading you don't understand; don't waste hours on it, but instead note that you want to ask me about it, and then move on. Similarly, when you get stuck on a math problem you can't solve, you should plan to struggle for about 15-30 minutes to make sure you understand the problem and where you're stuck, but don't ever spend more than 30 minutes stuck on a single problem in this class. Instead, find a classmate and see if you can work it out together. If that doesn't work after 15 minutes, email me for a hint, or ask me or the teaching assistant in class. The book can't interact with you, but we can, and that's what we're here for. But in order to take full advantage of this learning opportunity, you're going to have to put in your own effort, early and often.

Readings

Reading assignments will come mainly from the required text: [*Mathematics for Economists*](#), by Carl P. Simon and Lawrence Blume (Norton 1994; ISBN 0-393-95733-0).

As noted above, please make sure to do each day's reading assignment **before** that morning's class. So, for example, by the time you arrive for the first day's class, you should have read Chapters 10, 11, and 27 from the textbook, and made notes about anything you didn't fully understand.

Something else I'd like everyone to learn is the value of consulting alternative references. When you don't understand something in your assigned text, it can be a really good idea to consult other sources about the same topic, to see if one of them makes more sense to you. You can find additional references in the library and on the World Wide Web. I'd like to recommend three examples in particular:

- The book [*Fundamental Methods of Mathematical Economics*](#), by Chiang and Wainwright, will probably seem much more readable to you if you're having trouble with our textbook. It has some really good explanations of concepts, but omits some of the more advanced material in our textbook. I've provided a couple of links below to sections I particularly want you to read.
- Martin Osborne's [Mathematical Methods for Economic Theory](#) web tutorial also has some terrific explanations of key concepts. I particularly like the one about [quasiconcavity](#).
- Paul Madden's [Concavity and Optimization in Economics](#) is an entire book about constrained optimization (Chapters 18-19). It contains some very good examples on that topic. Below I give you a link to an optional reading of Chapters 5-6.

Preparation

There will be a problem set due in class each morning of the course, **including the first day of class**. During the summer, I expect you to obtain a copy of the textbook and work all the problems in my assigned [summer problem set](#) on differentiation, integration, basic probability, and basic linear algebra. (These topics can be found in Chapters 1-9, and appendices A4 and A5 in the text.) Plan to turn in this problem set on the first day. I'm hoping these problems will all be review for you. I'm assigning them just to make sure that everyone remembers these basic concepts, because it may have been a few years since you last computed an integral, or you may have missed learning Gaussian elimination or determinants in a linear-algebra course. If you're rusty or missing one of these topics, I believe the book is excellent and will help you get up to speed.

If, during the summer, you run into difficulty with one of the problems, you are welcome to email me for help. Since I will be traveling a lot this summer, I may not always reply immediately, I promise to get back

to you as soon as I can. **Please put "Econ 519" in the subject line of your email**, so that the message will come to my attention promptly.

If you are worried about the pace of this mathematical "boot camp" and want to work ahead even beyond the first assigned problem set, you are welcome to read ahead in the book and try the exercises. See the course schedule below.

Suggestions for Surviving the Course

Once the course starts, it will be extremely fast-paced. Therefore, here are some suggestions to help you make the most efficient use of your time.

- Remember to read the assigned chapters **before** coming to class. I suggest that you read in several stages.
 - First, read the introduction and skim over the topics to get an overview of what's contained in the chapter.
 - Second, read each section in more detail, paying particular attention to the examples, but skipping the proofs of the theorems the first time through. As you read each section, look at the assigned problems on the problem set for that section, and see if you know how to do them. If you have no idea, make a note of that fact, so that you can ask questions in class.
 - Third, assuming you still have time after that, try to read and digest the proofs of the theorems, so that you understand why they are true, and so that you can complete the exercises requiring you to do your own proofs.
 - Finally, review the topics in the chapter to make sure you remember the broad outline of the topics and their relationships to each other.
- On the problem sets, it is crucial that you spend some time struggling alone with unfamiliar concepts. The struggle will help you learn and internalize the concepts at a fundamental level that will be useful to you in the future (for example, when you want to pass the final exam). However, because this course is so fast-paced, it is also crucial that you not spend *too* much time struggling on a given problem. Many times I have devoted 3-4 hours to struggling over math problems I didn't understand, but you cannot afford to do this in our course. My suggested compromise is that you spend no more than 15 minutes struggling with a given problem. If you can't see how to solve it by then, skip it and move on to the next one. Once you've made a first pass at the problem set, you have several good options for how to proceed. I suggest you meet regularly with a small group of classmates to see if anyone else has a good idea they can explain to you. You may also choose to visit me, visit the TA, or send one of us an email asking for help.
- In the Internet age, there are some nice online resources for understanding mathematics. For example, this [page of math applets](#) has tools to help you plot functions in three dimensions, visualize the continuity of functions, plot tangent planes, and so on. You are welcome to use any such tools to help you make sense of your homework for the course.
- It's also crucial that you get sufficient rest every night. If you find that it's midnight and for some reason you have still only completed two-thirds of the problem set due tomorrow, I suggest that you go to sleep. You're much better off turning in a partial problem set and getting a good night's sleep so that you can pay attention in class, than staying up all night and finishing it. Since the course meets nearly every day, you don't have the luxury of crashing for a day and catching up on your sleep. Do your best to keep up, but don't ruin yourself by being a perfectionist.
- Here's a suggested daily schedule. You'll have to figure out what works best for you, but this gives you an idea of my work expectations:
 - 8-9:30am: Read the assigned reading for today's class. As you read, note the related problem-set questions assigned for tomorrow, and come to class prepared to ask questions about them.
 - 9:30-11:30am: Attend class.
 - 12:30-5pm: Attempt homework problems on your own.

- 5-6pm: Attend the TA's group problem-solving session.
- 7-10pm: Meet with a study group to iron out problems you're still uncertain about. Then send me emails on problems still stumping you, so that I have time to reply before class in the morning.
- 11pm-7am: SLEEP!
- You may also find some of the above study tips useful for getting the most out of your subsequent PhD courses. At least, I certainly wish someone had given *me* the above advice about how to do my readings, and how to attempt my problem sets, when I started my PhD program... I could have saved myself a lot of wasted time and effort!

Grading

Your grade in this course will be based on your graded problem sets (50%) and your final exam (50%). I will give an open-book exam, where you may use any books or notes you like. The point of the course is not to memorize formulas and theorems, but to make sure you know how to use the concepts to solve problems. [Here is a page where you can find past exams for the course.](#)

Schedule

This schedule is subject to change. Any changes will be announced in advance.

Date	Reading	Topic	Homework due
31 July	Ch 10, Sec 11.1	Vectors, linear independence	Summer problem set
1 Aug	Ch 11, Ch 27	Vector spaces	PS #1
2 Aug	App A1, Ch 12	Proofs, set theory, limits	PS #2
3 Aug	Ch 13, Sec 14.1-14.5	Functions, differentiation	PS #3
4 Aug	Sec 14.6-14.9, Sec 15.1-15.4	More differentiation, implicit functions Note: Sections 14.7, 15.2, and 15.3 are relatively abstract and hard to read. Master the other sections first. In these more abstract sections, remember to focus on the examples. Here is a guide to reading Section 15.4 .	PS #4
5 Aug	Ch 16-17	Quadratic forms, unconstrained optimization	PS #5
7 Aug	Ch 18, plus Chiang/Wainwright 13.2 on constraint qualifications	Constrained optimization I Note: Some of the theorems can be hard to follow, so make sure to focus on understanding the examples in the	PS #6

		<p>text.</p> <p>In Section 18.7, make sure to study the first application and the "One More Worked Example," but please skip "The Averch-Johnson Effect" for now, as it's complicated and potentially confusing.</p> <p>If you find some of the reading in Chapters 18-19 tough to follow, I recommend Chapters 5-6 of Madden as an optional, alternative treatment.</p>	
8 Aug	Ch 19	Constrained optimization II	PS #7
9 Aug	NO MEETING	International student orientation	
10 Aug	NO MEETING	International student orientation	
11 Aug	Ch 20, Sec 21.1-21.3, Chiang/Wainwright 12.4,13.4	Useful categories of functions: homogenous, homothetic, concave, quasiconcave	PS #8
12 Aug	Ch 29	Cauchy sequences, compactness, connectedness, alternative norms	PS #9
14 Aug	Ch 30	Advanced calculus theorems, Taylor approximations	PS #10
15 Aug	Sec 23.1, 23.3, 23.7, 23.8	Eigenvalues and eigenvectors; Review	PS #11
16 Aug	NO MEETING	Graduate College orientation	
17 Aug	NO MEETING	Graduate Teaching orientation	
18 Aug		Final exam	