

INTRODUCTION TO MATHEMATICAL ECONOMICS

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Course Objective

This course introduces some basic mathematical tools needed for graduate study in economics. Topics include the following. Functions and economic models. Logarithms and exponential growth. (E.g., how to calculate growth rates, the properties of exponential growth, present value computations.) Linear models and basic matrix algebra. (E.g., how to solve a linear IS-LM or supply-demand system.) Review of univariate differential calculus. (Understanding derivatives as a representation of marginalist thinking.) Univariate optimization. (E.g., choosing output level to maximize profits). Introduction to multivariate calculus. (How to apply marginalist thinking at more than one margin.) Comparative statics of nonlinear systems. (E.g., how to find how a nonlinear IS-LM or supply-demand system responds to exogenous shocks.) Introduction to multivariate optimization. (E.g., how to pick two input quantities to minimize costs.) Constrained optimization. (E.g., how to pick two goods to maximize utility.) Some computer applications of these mathematical methods.

Course Organization

Every class is different in background preparation. I will depend on your feedback to set the class pace and the depth of coverage of certain topics, so be sure to speak up.

We will use the [Python](#) programming language in this course. Python is free and open source software; please download and install it. (Most of you will want Python 2.5.1 Windows installer.) After you have installed Python, you should test your installation and learn how to use the Python interpreter. (Suggested resources: [Simple Introduction](#), [Non-Programmer's Tutorial](#), and [Python Tutorial](#) sections 3, 4, 5.) Once you have Python up and running please install the following: [NumPy](#) (most of you will want numpy-1.0.4.win32-py2.5.msi), and [Matplotlib](#) (most of you will want matplotlib-0.91.2.win32-py2.5.exe). You can get installation help in the Social Science Research Lab (Hurst Bldg).

Discussion and exams will reward those who prepare in advance. The exams will draw heavily on the homework assignments given throughout the semester. Homework is not always "required" in the sense of being collected and graded; even so, it is preparatory for subsequent classes and exams. In addition, homework will occasionally cover new material or extensions not treated in class, and mastery of this material will be assumed in all classes

subsequent to its assignment. Ongoing study groups to work on the *uncollected* homework problems are therefore highly recommended. (However collected homework assignments must be written up individually, without help from other students.)

This class will use the [Blackboard CourseInfo](#) software. Look there for the syllabus, lecture notes, and homework. We will also use a listserv mailing list. You must [subscribe](#): send an email to listserv@listserv.american.edu containing the single line of text in the message body:

subscribe econ-505-L Your Name

(Use your AU account to subscribe: if you use a commercial account that appends ads to your email, you may end up with an advertisement as part of your subscribed name! You can always set your AU account to forward mail to your commercial account.) All students are expected to monitor their course email, which may contain homework problems, reading assignments, and grade reports. All students are expected to adhere to [basic email etiquette](#): be respectful, quote appropriately, and do not use HTML. (To repeat: please [turn off HTML formatting of your email](#). I filter HTML messages a spam and may not receive them.)

Course Prerequisites

Prerequisite: One semester of calculus or applied calculus. Concurrent enrollment in Econ-522 is recommended but not required.

I also consider a commitment to upholding the [Academic Integrity Code for American University](#) to be prerequisite to participation in this course.

Grading

Grading will be based on the total points earned on homework and classroom preparedness (20 percent of points possible), a midterm exam (40 percent of points possible), and a cumulative final exam (40 percent of points possible). Exams presume a thorough knowledge of the graded and ungraded homework assignments given throughout the semester. Exams are taken without the aid of textbooks or of notes of any kind, and no collaboration will be allowed on exams. I offer no extra credit, and there will be no makeup exams. (Exams may be missed with a doctor's excuse; the grade will then be calculated from the remaining exams.)

MIDTERM EXAMINATION: 4 March 2008

FINAL EXAMINATION: you will find the date of our final examination on the [final exam schedule](#). (The AU schedule of classes *always* determines the date and time of the final, so please check your schedule of classes.)

Exams presume a thorough knowledge of the (collected and uncollected) homework assignments given throughout the semester. Homework will occasionally cover new material or extensions not covered in class, and mastery of this material will be assumed in all classes subsequent to its assignment. All homework should be typed and submitted to my teaching assistant by email. (I will post my TA's email address to the class email list.) Always copy me on any email to my teaching assistant, including these assignment submissions. Be sure to include your last name, the assignment number, and the course number in the *subject line* of your email. (For example: LastName HW#1, Econ 505.) For programming assignments, you should submit a working program file.

(Run it right before sending it: programs that do not run *as submitted* will not be graded.) Analytic and algebraic exercises must be submitted as Scientific Notebook files. (I have arranged for SN to be available free on campus as an EagleNet application; it is also available at an attractive [student price](#). I also accept **LaTeX format** if you know what you're doing.) Scientific Notebook includes a tutorial, which you should complete during the first week of class.

My TA grades the homework. You may request supplementary comments from the TA, but do not request grade changes. If you wish to contest a homework grade, you may submit your homework to me for regrading of the entire assignment. It is only fair to note that although I instruct my TA to be quite generous in grading, I do not feel so constrained.

Ongoing study groups are highly recommended. Study groups are an excellent means of mastering the course material. They are also a core part of the experience of graduate education. Besides, they are fun. I encourage you to discuss the homework problem sets with others, but there are strict terms for such collaboration. In accord with the canons of academic honesty, you must cite all of your collaborators at the front of your submitted solutions (in writing, on the assignment). Also, you must write up solutions on your own. **To repeat: your write-up of any problem solution must be entirely your own.** The use of pre-packaged sources of solutions to the assigned problems is not permitted. You may neither copy solutions nor provide solutions to be copied. Plagiarism, cheating, and other anti-intellectual behavior will be dealt with severely and can lead to dismissal from the university.

Required Texts

We will use only parts of the following text, which will be available on reserve. Nevertheless, I only require texts that I strongly feel you should add to your professional library.

Klein, Michael, *Mathematical Methods for Economics*, 2/e (Addison-Wesley 2002) ISBN-13: 9780201726268

Recommended Texts

You will probably find the following very useful:

Oliphant, Travis, 2006, [Guide to NumPy](#)

I have requested that some additional texts be put on reserve in the University Library. Consider purchasing any that you find useful. Please note that I consider any marking, underlining, or writing in pencil, pen, or highlighter on any library materials to be defacement of university property, a violation of academic integrity, and grounds for a reduction in your final grade. Please treat all library materials as precious intergenerational resources that you are privileged to share.

Simon, Carl P. and Lawrence Blume, 1994, *Mathematics for Economists* (NY: W.W. Norton and Company) isbn 0393957330

Hefferon, Jim, [Linear Algebra](#) (A free online text.)

Hoy, Michael et al., 2001, *Mathematics for Economists* (Cambridge, MA: MIT Press) isbn: 0-262-08294-2

Topics and Readings

New articles may be added to the readings during the course. The suggested timing of topics and extent coverage is very tentative and will be revised as the semester progresses.

Week 1 (Background) Why Use Math in Economics?

Required: Klein ch.1;

Recommended: Simon and Blume ch.1; Hoy ch. 1;

Week 2-3 Nonlinear Comparative Statics (preview)

Required: Matrix Intro notes

Recommended: Klein ch.4,5; Simon and Blume 8.1

Week 4-5 Functions: with Differential Calculus Basics

Required: Klein ch. 2, ch. 3, ch. 6;

Recommended: Simon and Blume ch.2-4; [e-Calculus](#); [Newton's Method](#)

Week 6-7 Functions: Exponents, Logarithms, and Polynomials

Required: Klein ch.3;

Recommended: Simon and Blume ch.2,5; Appendix A2, A3; Carter 2.2; Klein ch.7; Chiang ch. 10.1-10.4;

Week 8-9 Multivariate Functions

Required: Klein ch.2; Simon and Blume 10;

Recommended: Carter 2.1; Velleman ch.5; Chiang 2,3; de la Fuente 1;

Week 10 An Introduction to Matrix Algebra

Required: Klein ch.4,5;

Recommended: Simon and Blume ch. 6,8,9,26; Dhrymes ch. 1; Simon and Blume ch. 11,27,28; Carter 3.1, 3.5; Chiang ch. 4;

Week 11 The Comparative Statics of Linear Models (redux)

Required: Klein ch.4,5;

Recommended: Simon and Blume 6,7; Chiang ch. 5;

Week 12 (redux)
The Comparative Statics of Non-Linear Models

Required: Klein ch. 6,7,8;

Recommended: Simon and Blume 15; Chiang ch. 6,7,8; Carter 4.5;

Week 13-14
Multivariate Optimization

Required: Klein ch.9,10,11;

Recommended: Simon and Blume 17, 18, 19; Chiang ch. 9,11,12,21; Carter 5.1, 5.2, 5.3;

If Time Remains

Polynomials

Required:

Recommended: *Bezier Curves*

Difference Equations

Required: handout

Recommended: Klein ch.13; Chiang ch. 12,14;

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