Syllabus

INTRODUCTION TO MATHEMATICAL ECONOMICS

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Course: Econ 505-001

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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 determine the response of a nonlinear IS-LM or supply-demand system to exogenous shocks.) Introduction to multivariate optimization. (E.g., how to pick two input quantities to maximize profits.) Constrained optimization. (E.g., how to pick two goods to maximize utility subject to a budget constraint.) 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. Discussion and exams will reward those who prepare in advance. The exams will draw heavily on the homework assignments given throughout the semester.

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. For this course, you must subscribe to econ-505-L. (Refer to the subscription instructions.) I recommend that you use your AU account to subscribe: 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

One semester of calculus or applied calculus is prerequisite to this course. A commitment to upholding the Academic Integrity Code for American University is also prerequisite to participation in this course. Concurrent enrollment in Econ-523 is recommended but not required.

Software

Analytic and algebraic homeworks must be submitted as Scientific Notebook (.tex) files. (I also accept LaTeX format, if you know what you're doing.) Programming homeworks must be submitted as Python (.py) 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, including a single semester license. Scientific Notebook includes a tutorial, which you should complete during the first week of class.

Python is free and open source software; please download and install it. (Most of you will want Python 2.5.4 Windows installer. Please do **not** install Python 2.6 or Python 3.0.) After you have installed Python, you should you test your installation and learn how to use the Python interpreter. Once you have Python up and running please install two Python packages: NumPy and Matplotlib. (Get the latest versions for Python 2.5.) A reasonable way to get all this software at one go is to download the Enthought Python Distribution. You can get installation help in the Social Science Research Lab (Hurst Bldg).

Grading

Grading will be based on the total points earned by the end of the semester. Homework contributes 20 percent of points possible, a midterm exam contributes 40 percent of points possible, and a cumulative final exam contributes 40 percent of points possible. There is no "extra credit".

Exams

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 makeup exams. (Exams may missed with a doctor's excuse; the grade will then be calculated from the remaining exams.) Exams presume a thorough knowledge of any (collected or uncollected) homework assignments given throughout the semester.

MIDTERM EXAMINATION: 3 March 2009

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.)

Homework

Homework must be submitted in an approved file format. (See the discussion of course Software.) 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 Heath Henderson at econ50501@gmail.com. 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.)

My TA grades the homework. You may request supplementary comments from the TA, but do not request grade changes. My TA is not authorized to make 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.

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 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.

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.)

Required Texts

Our core text is [klein-2002]. We will use only parts of this text, which will be available on reserve. However, I only require texts that I strongly feel you should add to your professional library.

Be sure to check my page of errata for this book.

Recommended Texts

You will probably find [oliphant-2006-guide] to be very useful. (It is available free, but please make the recommended donation.)

I have requested that some additional texts be put on reserve in the University Library. I will mention in particular [chiang-1984-fmme], [heffron-2000-la], [hoy-2001-me], and [simon.blume-1994-me]. 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.

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.

Why Use Math in Economics?

Week 1 (Background)

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

Nonlinear Comparative Statics (preview)

Week 2-3

Required:
Matrix Intro notes;
Recommended:
Klein ch.4,5; Simon and Blume 8.1

Functions: with Differential Calculus Basics

Week 4-5

Required:
Klein ch. 2, ch. 3, ch. 6;
Recommended:
Simon and Blume ch.2-4; Story's e-Calculus; Newton's Method Tutorial

Functions: Exponents, Logarithms, and Polynomials

Week 6-7

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;

Sequences

Week 8

Required:

Klein ch.13;

Recommended:

Simon and Blume ch.12

Multivariate Functions

Week 9

Required:

Klein ch.2;

Recommended:

Simon and Blume 10; Carter 2.1; Velleman ch.5; Chiang 2,3; de la Fuente 1;

An Introduction to Matrix Algebra

Week 10

Required:

Klein ch.4,5;

Recommended:

Simon and Blume ch. 6,8,9,26<!-- ,27,28 -->; Dhrymes ch. 1; Simon and Blume ch. 11,27,28; Carter 3.1, 3.5; Chiang ch. 4;

The Comparative Statics of Linear Models (redux)

Week 11

Required:

Klein ch.4,5;

Recommended:

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

The Comparative Statics of Non-Linear Models (redux)

Week 12

Required:

Klein ch. 6,7,8;

Recommended:

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

Continuity and Differentiability of Multivariate Functions

Week 12

Required:

Simon and Blume 12,13.4,29; Carter 4.1, 4.2, 4.3;

Recommended:

Klein ch. 6,7,9; Chiang ch. 6;

Quadratic Forms

Week 13

Required:

Simon and Blume 16

Recommended:

Nothing yet.

Multivariate Optimization

Week 13-14

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:

Nothing yet.

Recommended:

Bezier Curves

Difference Equations

Required:

handout

Recommended:

Klein ch.13; [chiang-1984-fmme] 12,14;

Dynamic Programming

Required:

[benveniste.scheinkman-1979-e]

Recommended:

Nothing yet.

References

Benveniste, L M, and J A Scheinkman. 1979. On the Differentiability of the Value Function in Dynamic Models of Economics. *Econometrica* 47, 727--732.

Chiang, Alpha C. (1984) *Fundamental Methods of Mathematical Economics*. New York: McGraw-Hill, Inc..

Hefferon, James S. 2000. Linear Algebra.

Hoy, Michael. (2001) *Mathematics for Economists*. Cambridge, MA: MIT Press.

Klein, Michael W. (2002) *Mathematical Methods for Economics*. Boston, MA: Addison-Wesley.

Oliphant, Travis E. 2006. Guide to NumPy.

Simon, Carl P, and Lawrence Blume. (1994) *Mathematics for Economists*. New York: W.W. Norton & Company, Inc..