MEMORANDUM

TO: Sandra Williams, Director Academic Support Services
THROUGH: Larry Oliver, Associate Dean Liberal Arts
FROM: Yoosoon Chang, Department Head Economics
SUBJECT: Credit Hour Change in Ecmt 669
DATE: December 4, 2007

The Department of Economics requests a change in the number of credit hours for Ecmt 669. This request reflects our wish to reduce the credit hours from three to two. This course will be offered to our incoming first year PhD students and taught in August for two credits. The course description is unchanged.
Texas A&M University
Departmental Request for a Change in Course
Undergraduate • Graduate • Professional
Submit original form and attachments

1. This request is submitted by the Department of Economics

2. Course prefix, number and complete title of course: Ecmt 669 - Fundamental Mathematics for Economists

Attach a brief supporting statement for changes made to items 3a thru 3d, and 5 below.

3. Change requested
   a) Prerequisite(s): From ______________________ To ______________________
   b) Withdrawal (reason) ______________________
   c) Cross-list with ______________________
      Cross-listed courses require the signature of both department heads.
   d) Change in course title and description. Enter complete current course title and current course description; complete proposed course title and proposed course description in items 4 and 5.
   e) Change in credit/contact hours. Complete item 6b. Underscore change(s). Attach a course syllabus.

4. Complete current course title and current course description: Fundamental Mathematics for Economists - Mathematics of nonlinear programming; applications to micro-theoretic models of demand and production; fundamental results from matrix theory and multivariate differential calculus; systems of differential equations and stability analysis and their economic applications.

5. Complete proposed course title and proposed course description (not to exceed 50 words): Fundamental Mathematics for Economists - Mathematics of nonlinear programming; applications to micro-theoretic models of demand and production; fundamental results from matrix theory and multivariate differential calculus; systems of differential equations and stability analysis and their economic applications.

6. a) As currently in course inventory:

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   b) Change to:

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7. Approval recommended by:

   Head of Department: Yuen Wei Cheng 11-6-01
   Chair, College Review Committee: Emily G. Davidson 11-6-01
   Dean of College: 11-24-07
   Dean of College: 11-24-07

   Submitted to Coordinating Board by:

   Director of Academic Support Services: Date
   Effective Date: 11-24-07

Questions regarding this form should be directed to Sandra Williams at 845-8836.
OAR/AS – 04/07

2 of 5 C14
Instructor: Dr. Ted Turocy, turocy@econmail.tamu.edu, 862-8082, BUSH 3065.
Office hours: I will be available in my office most weekdays, when not in lecture.
TA: Diego Escobari, escobari@neo.tamu.edu, BUSH 3055.

Course webpage: This syllabus, copies of handouts and other useful information, and announcements will be posted to the course webpage, which is http://econweb.tamu.edu/turocy/ecmt669
You are responsible for all materials and announcements made on the website; be sure to check it frequently.

Course Description: the official description in the graduate catalog is “Mathematics of nonlinear programming; applications to micro-theoretic models of demand and production; fundamental results from matrix theory and multivariate differential calculus; systems of differential equations and stability analysis and their economic applications.” The outline of topics and the course calendar, following below, will expand on this to highlight the learning objectives and units we will cover this semester.

Goals of the course: This course is an introduction to and tour of many of the main mathematical concepts and techniques used in modern economic analysis. The goal of the course is twofold: first, to give you the background needed to follow articles on current economic research; second, and perhaps more importantly, to give you practice in constructing solid mathematical arguments on your own for your own research.
The diversity of mathematics used in economics is such that it will not be possible to cover all of it in one semester. Even in the cases of the enumerated topics which will be covered, the coverage will not go into much depth, and focus mostly on the aspects which are important for economic analysis. Indeed, each of the high-level topics listed could easily be the topic of a semester-length course on their own. At the end of this semester, you hopefully will feel confident in your ability to make use of mathematical logic in your own work and will have enough background to use as a starting point in exploring the branches of mathematics which will be of most use to you and which you may wish to study in greater depth.

Being prepared: This course assumes a typical undergraduate preparation in mathematics. Nearly half the pages in Simon and Blume cover topics which will be assumed that you have mastered. These include:
- Chapters 2 through 5 and 13 through 14, on the calculus of functions of one and many variables
- Chapters 6 through 11 on linear algebra and its applications
- Appendix A1 on basic mathematical terminology and logic.
If you feel at all uncertain of your preparation in these areas, I also encourage you to have on hand a good undergraduate text on calculus with which you are comfortable, to be available as an extra reference.

Lecture style and the use of proofs: This course is designed to strengthen your abilities in reading and interpreting mathematics, as well as constructing mathematical arguments on your own. Depending on your mathematics background, you will see, and be expected to understand and construct, more proofs than you have been previously accustomed to doing. This is particularly true if your undergraduate math courses had titles similar to “business math” or “mathematics for engineers.” The skill of precise mathematical argument is indispensable for the modern economist. This course will be taught in a way that hopefully will help you develop this skill. Note that the presentation of many concepts and results in lecture will not be in a clean, linear, “cookbook” style. In most lectures, I will try to simulate the process that you might follow when trying to derive a result for the first time. It is this process, as much as the specific results, that it is important for you to master, because it is this process which will serve you in good stead as you try to assimilate the body of knowledge you’ll be exposed to over the year. I can’t teach you all the math you need to know in one semester; I can teach you how to understand the math you’ll need to know when you come across it.

Being successful: There is an old saying: Mathematics is not a spectator sport. The only way to do well in this course is to practice. Each week, keep exercises, and solutions for suggested exercises. This is simply a minimum, however. To “study” in this course means working problems, and understanding their solutions. I have often had students come to me after doing very poorly on an exam, asking how they could improve. I almost always find out that these students had not worked a single problem that was not assigned for homework. You cannot study for this course by reading over your notes, or by memorizing lists of theorems and axioms. You can only study by doing exercises.


Grading: You will be evaluated on the basis of homework problems (20%) and two equally weighted in class exams (40%) and scheduled as follows: Exam One, Thursday, October 11, and Exam Two, Thursday, November 29. In preparing for these exams, in addition to the homeworks, you will find generating a complete set of class notes to be helpful. The grading scale is as follows: 90-100 = A; 80-89 = B; 70-79 = C; 60-69 = D; 59 and below = F.
Other References: The following is a short list of recommended texts, which cover some of the areas upon which we’ll be touching in more detail.

- Logic and proof technique
  - Solow, How to Read and Do Proofs, John Wiley & Sons.
    Highly recommended for learning how to put proofs together; also very useful for learning how to read technical papers.
  - Polya, How to Solve It, Princeton University Press.
    A classic in the discipline of heuristic. Focused more towards problem-solving rather than proof construction, but still a good read.

- Mathematical economics
  - Chiang, Fundamental Methods of Mathematical Economics, McGraw-Hill.
    The other “standard” text for a course such as this. Chiang focuses more explicitly on economic applications, while Simon and Blume (and this course) is more concerned with the technical toolkit of the modern economist.

- Microeconomics
    The resource for modern microeconomics: well-organized, nicely formatted, and well-presented proofs.
    The mathematical appendix is an excellent guidebook for the math you need for microeconomics (in fact, we will cover most or all of it in this course).
  - Varian. Microeconomic Analysis, Norton.
    Another popular text for first-year graduate microeconomics.

- Real analysis
  - Royden. Real Analysis, Prentice-Hall. On the plus side, the organization and proofs are clear; on the down side, some important proofs are left as exercises, and the book does have some typographical errors.
  - Rudin, Real and Complex Analysis, McGraw-Hill. The other “standard” real analysis book. Written at a bit higher level than Royden; which you prefer is a matter of taste.

- Static optimization
    A new favorite of mine, and an excellent reference to have handy for the budding economic theorist.
  - Luenberger. Linear and Nonlinear Programming, Addison-Wesley.

- Dynamic optimization

Additionally, it may be handy to have a reference covering basic differential calculus and linear algebra, if you are rusty on these topics.

Outline of Topics: Here is our projected path through the material, subject to the usual on-the-fly modifications based on time and interest. I will endeavor to keep the lecture listing on the course website up-to-date with topics. (1) Introduction to analysis: sequences, convergence, basic results. (2) Useful classes of functions (3) Static optimization (4) Dynamic optimization (5) Difference equations and differential equations

Course Calendar

Week One: August 28 and 30
  Introduction and motivations, “Foreshadowings” handout, micro problem from producer theory, macro problem from neoclassical growth model.

Week Two: September 4 and 6
  Sequences, limits, continuity.
  KEY theorems: Bolzano-Weierstrass Theorem, Weierstrass Theorem
  ECON applications: profit max, competitive firms, monopoly

Week Three: September 11 and 13
  Differentiability, the claim rule, optimization.
  KEY theorems: First-order Necessity, Mean Value Theorem
  ECON applications: price elasticity, pricing power, mark-ups and the Lerner index

Week Four: September 18 and 20
  Linear approximations, Mean Value Theorem applications, functions of several variables, differentiability, homogeneity, homotheticity.
  KEY theorems: Mean Value Theorem, Euler’s Theorem
  ECON applications: linearly homogeneous production functions, elasticity of substitution

Week Five: September 25 and 27
  Linear and quadratic approximations.
  KEY theorems: Taylor’s theorem, Extended Law of the Mean
ECON applications: homogeneity in demand theory, returns to scale

Week Six: October 2 and 4
Classical optimization, first order necessity, second order sufficiency.
KEY theorems: Weierstrass Theorem, Taylor's Theorem, Mean Value Theorem
ECON applications: Comparative status for short-run profit maximization problem

Week Seven: October 9 and 11
Classifying critical relative extrema, saddlepoints, functions of several variables.
KEY theorems: First and second order differential tests
ECON applications: Profit maximization, derived input demands, supply and indirect profit functions, homogeneity and comparative status

EXAM ONE, Thursday, October 11

Week Eight: October 16 and 18
Quadratic forms, necessary and sufficiency conditions for signing.
KEY theorem: Signing the second differential as a quadratic form
ECON applications: law of supply, IS-LM comparative status, Cournot duopoly with homogeneous products, Cournot-Nash equilibrium

Week Nine: October 23 and 25
Introduction to integration and integration techniques.
KEY theorem: Fundamental Theorem of Calculus
ECON applications: Cournot duopoly with differentiated products, consumer surplus

Week Ten: October 30 and November 1
Further applications of the fundamental theorem, intro to first-order linear differential equations.
KEY theorem: Leibnitz Rule, chainrule for integrals
ECON applications: Producer surplus, economic implications of Hotelling's Lemma

Week Eleven: November 6 and 8
Autonomous differential equations, equilibrium points identified, using phase lines to classify as sink, source or mode.
KEY theorem: First derivative test, sufficiency for sink-source classification
ECON applications: Walrasian price adjustments, logistic growth

Week Twelve: November 13 and 15
Solving first order linear differential equations with constant coefficients, stability analysis and comparative dynamics.
KEY theorem: linearization of autonomous equations
ECON applications: Walrasian and Marshallian stability, neoclassical growth model, golden rule to maximize steady-state per capita consumption

Week Thirteen: November 20 and 22
Classical Constrained optimization, Lagrangian techniques.
KEY theorem: Kuhn-Tucker Theorem
ECON applications: Consumer problem, Marshallian demands and indirect utility function; cost min problem, cost function and conditional demands

Week Fourteen: November 27 and 29
Applying the Envelope theorem to micro models.
KEY theorem: Envelope Theorem
ECON applications: Hotelling's Lemma, Shephard's Lemma, Roy's Identity

EXAM TWO, Thursday, November 29

ADA Policy Statement: The Americans with Disabilities ACT (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. "Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact the Office of Support Services for Students with Disabilities in Room 126 of the Student Services Building. The telephone number is 843-1637."

AGGIE HONOR CODE: "An Aggie does not lie, cheat, or steal or tolerate those who do."
Upon accepting admission to Texas A&M University, a student immediately assumes a commitment to uphold the Honor Code, to accept responsibility for learning, and to follow the philosophy and rules of the Honor System. Students will be required to state their commitment on examinations, research papers, and other academic work. Ignorance of the rule does not exclude any member of the TAMU community from the requirements or the processes of the Honor System. For additional information, please visit www.tamu.edu/aggiehonor/

Final thoughts: This course is designed and intended to be challenging. The modern economist needs to command a wide range of mathematical tools. While this diversity can be overwhelming at first, I encourage you to remember throughout this course that the goal of this course is to make you a better economist. At the end of the day, this is your goal: keep that in mind if you start to feel frustrated by a particularly difficult concept or problem.