ECON 8030: Mathematics for Economists
Fall 2009

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Location: Room 326, Sparks Hall
Time: Mondays and Wednesdays, 3:00pm-4:15pm
Office Hours: Mondays and Wednesdays, 4:30am-5:30pm, and by appointment

Prerequisites: Calculus I and II, and linear algebra.

Course Objectives: This course covers the elements of mathematical analysis, classical optimization techniques (Lagrange technique), and linear and nonlinear programming, with applications to economics, particularly comparative statistics.

Text:

K. Sydsaeter, P. Hammond, A. Seierstad and A. Strom, *Further Mathematics for Economic Analysis*, 2005, Pearson Education.

Other Recommended Books:

K. Sydsaeter and P. J. Hammond, *Mathematics for Economic Analysis*, Prentice Hall, 1995.

C. Simon and L. Blume, *Mathematics for Economists*, W. W. Norton and Company, 1994.

Method of Instruction: Lectures, class discussions, homework assignments, examinations.

Grading Policy: There will be two midterm exams and a comprehensive final exam. Your grade for the course will be based on two midterm exams (30% each) and the final exam (40%). NO make-up exams will be given**.** If you miss a midterm exam then 75% of your final exam score will count as the missed exam score. You may NOT miss the final exam. Please be advised that after the midpoint of the course (October 15, 2009), you will be given a WF if you are on the roll, but no longer taking the class.

Learning Outcomes: Students should be able: (1) to define and explain concepts of a relation, a function, an open set, a closed set, a compact set, a convex set and to graph simple functions such as linear functions, quadratic functions, polynomial functions, rational functions, exponential functions, and logarithmic functions, and to draw levels curves for some commonly used functions in economics; (2) to identify some basic properties of a function such as monotonicity, continuity, and differentiability, concavity, convexity, quasi-concavity, quasi-convexity, homogeneity and homotheticity; (3) to perform matrix operations such as matrix addition and subtraction, matrix multiplication, and to compute determinants and inverses of matrices; (4) to analyze solutions to systems of linear equations and to solve systems of linear equations using the matrix inverse method and Cramer's rule; (5) to do differentiations for both one-variable and multi-variable functions using various differentiation rules (sum, difference, product, quotient, and chain rule); (6) to do comparative statics using implicit function theorems; (7) to identify and characterize extreme values of one-variable and multi-variable functions; (8) to solve optimization problems with equality constraints using Lagrangian functions; (9) to solve optimization problems with inequality constraints through Kuhn-Tucker method; (10) to

solve simple differential equations and systems of differential equations and to analyze stability of equilibrium using phase diagrams.

Course Outline

0. Review

    0.1 Sets: Handout

    0.2 Numbers: Handout

    0.3 Proofs: Handout

1. Linear Algebra

    1.1 Matrices, Determinants and Cramer's Rule: 1.1, 1.2

    1.2 Vectors and Linear Independence: 1.3

    1.3 The Rank of a Matrix and Solutions to Linear Systems: 1.4, 1.5

    1.4 Eigenvalues, Eigenvectors and Diagonalization: 1.6, 1.7

    1.5 Quadratic Forms with or without Linear Constraints: 1.8, 1.9

2. Calculus I: One Variable Functions

    2.1 Continuity, Derivatives and Differentiability: Handout

    2.2 Differentiation Rules: Handout

    2.3 Convex and Concave Functions, Maxima and Minima: Handout

3. **Test # 1** (September 16)

4. Calculus II: Functions of Many Variables

    4.1 Some Topology: 13.1, 13.2

    4.2 Convex Sets: 2.2, 13.5

    4.3 Partial Derivatives and Total Derivative: 2.1

    4.4 Concave, Convex, Quasi-concave and Quasi-convex Functions: 2.3, 2.4, 2.5

    4.5 Homogeneous and Homothetic Functions: Handout

    4.6 Mean Value Theorem, Taylor's Formula: 2.1, 2.6

    4.7 Implicit Functions and Their Derivatives: 2.8

5. Unconstrained Optimization

    5.1 Necessary and Sufficient Conditions for Extreme Points: 3.1, 3.2

    5.2 Envelope Theorems: 3.1

    5.3 Maximum Theorems: 13.4

6. **Test # 2** (October 21)

7. Constrained Optimization

    7.1 Equality Constraints and the Lagrangean Method: 3.3

    7.2 Envelope Theorems: 3.3

7.3 Second Order Conditions: 3.4

7.4 Inequality Constraints and the Kuhn-Tucker conditions: 3.5, 3.8

7.5 Constraint Qualifications: 3.6

7.6 Nonnegativity Constraints: 3.7

8. Dynamic Economics

8.1 Integration: 4.1-4.8

8.2 First-Order Differential Equations: 5.1-5.8

8.3 Second-Order and Higher-Order Differential Equations: 6, 7

9. Discrete Time Optimization: 12

10. **Test # 3** (December 9)

The course syllabus provides a general plan for the course; deviations may be necessary.

Academic Honesty: Students are expected to abide by GSU's Policy on Academic Honesty (Section 409), which is published in the student handbook. A portion of this policy follows:

"...As members of the academic community, students are expected to recognize and uphold standards of intellectual and academic integrity. The University assumes as a basic and minimum standard of conduct in academic matters that students be honest and that they submit for credit only products of their own efforts... The student is responsible for understanding the legitimate use of resources; the appropriate ways of acknowledging academic, scholarly, or creative indebtedness; and the consequences of violating this responsibility"

Course Assessment: Your constructive assessment of this course plays an indispensable role in shaping education at Georgia State. Upon completing the course, please take time to fill out the online course evaluation.

Disabilities: Students who wish to request accommodation for a disability may do so by registering with the Office of Disability Services. Students may only be accommodated upon issuance by the Office of Disability Services of a signed Accommodation Plan and are responsible for providing a copy of that plan to instructors of all classes in which an accommodation is sought."