ECON 8030: Mathematics for Economists

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It should be noted that this course syllabus provides a general plan for the course and deviations may be necessary.

Important Notice: Please be advised that after the midpoint of the course, you will be given a WF if you are on the roll, but no longer taking the class.

Statement on Academic Honesty: Students are expected to abide by GSU's policy on academic honesty, 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"

If you have questions about academic honesty, please see me.

Location: Room 323, General Classroom Building

Time: Mondays and Wednesdays, 3:00pm-4:15pm

Office Hours: Wednesdays, 10:00am-12:00pm, and by appointment

Evaluation: Three tests (30%, 30% and 40%). **No make-up exams will be given.** One of the following letter grades, A, A-, B+, B, B-, C+, C, C-, D, F, will be assigned to a student based on the student's cumulative score.

Homework Assignments: Homework assignments will be distributed regularly; I will either distribute answer keys or discuss them in class; they will not, however, be graded and will not be counted for the final grade.

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

Other Recommended Books:

A. Dixit, *Optimization in Economic Theory*, Oxford University Press, 1990, 2nd edition, 1992.

E. Silberberg and W. Suen, *The Structure of Economics*, McGraw-Hill, 2001.

A. Chiang, *Fundamental Methods of Mathematical Economics*, McGraw-Hill, 1984.

A. Chiang, *Elements of Dynamic Optimization*, Waveland Press, 1992/2000.

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

K. Sydsaeter, A. Strom and P. Berck, *Economists' Mathematical Manual*, 3rd edition, Springer, 1999.

K. Arrow and M. Intriligator (eds.), *Handbook of Mathematical Economics*, Vol. 1, 1981.

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

Prerequisite: 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.

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 Cramers 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 multivariable 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.

Topics and Reading Assignments:

0. Preview

    0.1 Simple Logic

    0.2 Proofs

    0.3 Real Numbers and Sets

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 Differentation Rules: Handout

    2.3 Convex and Concave Functions, Maxima and Minima: Handout

3. **Test # 1**

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**

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**