ECO 205: QUANTITATIVE METHODS I  
(Winter 2009)

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COURSE DESCRIPTION:

This is the first of a two-course sequence designed to give economics and business majors the quantitative skills necessary for upper-level courses in the department. The principal topics covered are: i) linear equations, systems of linear equations, linear programming, polynomial and exponential functions—as they applied to economics and business, ii) the foundation of mathematics of finance (compounding, discounting, and investment appraisal using the net present value criterion), and iii) applied differential and integral calculus—differentiation, optimization and simple integration. In this course, mathematics is viewed as a means rather than an end in itself. Thus, applications of the relevant mathematical concepts and theories to economics and business related problems are strongly emphasized. Prerequisite: at least two years of high school algebra.

TEXTBOOK:


PART I: BASIC CONCEPTS OF FUNCTIONS AND FUNCTIONAL RELATIONSHIPS:  
Linear, Polynomial and Exponential Functions and their Applications in Economics 
& Business

1. LINEAR RELATIONSHIPS

Section A: Functions and Linear Equations (Chapter 4, pp. 63-86)

a) The basic concept of functions  
b) Linear functions  
c) Equation of a line: the slope-intercept form  
d) Inverse functions  
e) Applications: demand and supply functions, budget equation, cost functions, aggregate consumption function, break-even analysis, and a straight-line depreciation of capital asset.

Section B: Systems of Linear Equations (Chapter 5, pp. 109-126)

a) Basic notions  
b) Solution for system of linear equations: The Gauss-Jordan Method/Row Operations  
c) Applications: product or input mixture problems, simultaneous equilibrium in related markets, a Keynesian macroeconomic model of an economy, comparative static and the reduced form of an economic models, and effects of per unit versus proportionate sales tax.
Section C: Linear Programming: A Case of Constrained Optimization  
(Chapter 5, pp. 148-167)

(a) The general properties of Linear Programming as a mathematical model  
(b) Graphic method for finding the solution for L-P problem  
(a) **Economics and business applications**: input mix that would minimize cost, output mix that would maximize profit, and the opportunity cost of unused resources or production capacity (the shadow prices of slack variables)

2. QUADRATIC FUNCTIONS AND THEIR APPLICATIONS IN ECONOMICS  
(Chapter 6, pp. 168-184)

a) The general form of a polynomial function  
b) Quadratic equations and their salient properties  
c) **Economic applications**: firms’ production and cost functions

3. EXPONENTIAL AND LOGARITHMIC FUNCTIONS WITH APPLICATIONS IN THE MATHEMATICS OF FINANCE  (Chapter 7, pp. 189-218; pp.240-245)

A. **BASIC NOTION OF EXPONENTIAL AND LOG FUNCTIONS**

a) Exponential functions and their properties  
b) Graphs of exponential functions  
c) The function ‘e’ and its broad applications  
d) Logarithmic transformation of exponential function

B. **BASICS IN MATHEMATICS OF FINANCE**

a) Compound interest and the future value  
b) Compound discount: present value  
c) Continuous compounding  
d) Doubling time: the tyranny of compounding  
e) **Applications**: Interest rates on Treasury Bills, non-linear depreciation of capital assets, investment appraisal using the net present value criterion, and several other economic applications of growth and decline (for example, how long will it take to exhaust a known reserve of natural resource given the current level of consumption and an assumed fixed annual rate of growth in future consumption).
PART II: DIFFERENTIAL AND INTEGRAL CALCULUS AND THEIR APPLICATIONS IN ECONOMICS AND BUSINESS

1. INTRODUCTION TO DIFFERENTIAL CALCULUS: Single Variable Functions
   (Chapter 8, pp. 247-271; Chapter 12, pp. 372-379)
   a) The concept of limits and basic limit theorems
   b) The concept of continuity and the basic notion of continuous functions
   c) The average rate of change: the difference quotient
   d) The derivative
   e) Basic differentiation rules
   f) Economic and business applications: marginal concepts and analysis, relationships among total, average and marginal concepts, tax yield, point elasticity of demand and supply, the Keynesian multiplier, etc.

2. UNCONSTRAINED OPTIMIZATION: Functions of Single Variable
   (Chapter 9, pp. 272-290)
   a) The basic notion of optimization
   b) Maxima and minima of functions: the first derivative test
   c) The second derivative test
   d) Economic and business applications: maximization of revenue and profit functions and minimization of cost functions, inventory control, and comparative static effects of taxes

3. MULTIVARIATE CALCULUS AND CONSTRAINED OPTIMIZATION (Chapter 10, pp. 291-328; Chapter 11, pp. 334-363)
   a) The partial derivative
   b) Maxima and minima: two independent variables
   c) The mathematical formulation of constrained optimization: the LaGrange method
   d) The concept of shadow price
   e) Applications: production, revenue, cost and profit functions

4. SIMPLE INTEGRATION (Chapter 12, pp. 384-394)
   a) Anti-derivatives: the indefinite integral
   b) Rules of integration
   c) The definite integral
   d) The fundamental theorem of calculus
   h) Applications: consumers' and producers' surplus; the Lorenz coefficient, and asset depreciation.
GRADING:

- Two mid-term exams 50%
- Final exams 25%
- Homework Assignments 25%

IMPORTANT REMINDER:

Exams must be taken at the times designed except in the case of illness with a physician's excuse. No late assignment will be accepted. The final exam will be comprehensive. Violation of an academic regulation could have a very serious consequence ranging from a reduction of grade on a specific project to failure in a course. In this class, in no time and under no circumstance is academic dishonesty tolerated.