ECO 205: QUANTITATIVE METHODS I
(Winter 2004)

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COURSE DESCRIPTION:

This is the first of a two-course sequence designed to give economics majors the quantitative skills necessary for upper-level courses in the department. The principal topics covered are: i) linear equations, systems of linear equations, and exponential and logarithmic functions as they applied to economics and business problems, ii) basic mathematics of finance, and iii) applied 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:

Rosser, Mike, *Basic Mathematics for Economists,* Routledge Publishing, 2nd edition, 2003.

PART I: BASIC CONCEPTS OF FUNCTIONS AND ALGEBRAIC RELATIONSHIPS

1. LINEAR RELATIONSHIPS

Section A: Functions and Linear Equations (Chapter 4, pp. 61-86)

a) The basic concept functions
b) Linear functions
c) Equation of a line: the slope-intercept form
d) Applications: linear demand and supply functions, break-even analysis and a straight-line depreciation of a capital asset.

Section B: Systems of Linear Equations (Chapter 5, pp. 109- 147)

a) Basic notions
b) Operations on linear systems
c) Simultaneous equations
d) Applications: budget equation, production problems, simultaneous equilibrium in related markets, price discrimination, and aggregate consumption function

Section C: Fitting a Linear Function – an overview

(a) Scattered diagram
(b) The least square estimators

Section D: Linear Programming (Chapter 5, pp. 148-167)

(a) The general model of Linear Programming
(b) Constrained maximization
(c) Constrained minimization

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

a) The general form of the quadratic function
b) Quadratic equations
c) Economic applications

3. **EXPONENTIAL AND LOGARITHMIC FUNCTIONS (Chapter 14, pp. 440-446)**

a) Exponential functions and their properties
b) Graphs of exponential functions
c) The function e
d) Logarithms and logarithm rules
e) Common and natural logarithms
f) Economic applications: growth functions, log-linear demand and production functions

PART II: MATHEMATICS OF FINANCE (Chapter 7, pp. 189-218)

a) Compound interest and the future value
b) Compound discount: present value
c) Continuous compounding
d) Doubling time
e) Applied problems in business and economics

PART III: APPLIED DIFFERENTIAL AND INTEGRAL CALCULUS (Six Weeks)

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) Derivatives of exponential and logarithmic functions
e) Economic applications: marginal concepts and analysis, relationships among total, average and marginal concepts, tax yield, point elasticity of demand, 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 applications: maximization of revenue and profit functions and minimization of cost functions, inventory control, comparative static effects of taxes

3. **MULTIVARIATE CALCULUS (Chapter 10, pp. 291-328; Chapter 11, pp. 334-363)**

a) The partial derivative
b) Maxima and minima: two independent variables
c) Total differentials and total derivatives
d) Constrained optimization
e) the method of the Lagrange multiplier
f) Applications: production, revenue, cost and profit functions.

4. **MORE ON DIFFERENTIAL CALCULUS (Chapter 12, pp. 364-377)**

a) The chain rule
b) Implicit differentiation
c) Economic applications: elasticity of demand and total revenue and the multiplier

5. **SIMPLE INTEGRATION (Chapter 12, pp. 384-394)**

a) Antiderivatives: the indefinite integral
b) Rules of integration
c) The definite integral
d) The fundamental theorem of calculus
g) Area and the definite integral
h) Applications: consumers' and producers' surplus; the Lorenz coefficient,

and depreciation