Applied Mathematical Concepts for Agricultural Economics - Fall 373: 211:01

Instructor: Dr. Isaac Vellangany PhD., MBA

Email: Vellangany@aesop.rutgers.edu
Office: COB: 112
Phone: 732-932-9171
Office Hours: MH: 2.30 – 3.30PM

Reading Materials

Required Text Book

Michael W. Klein (2002), *Mathematical Methods for Economics (2nd ed).* Addison-Wesley. ISBN: 0-201-72626-2.

Complementary material:
Alpha Chiang (1990), *Fundamental Methods of Mathematical Economics*. McGraw Hill. ISBN: 0-07-010813-7.

Carter Michael (2001*), Foundations of Mathematical Economics.* MIT Press. ISBN: 0-2262-53192-5

Carl P. Simon and Lawrence Blume (1994), *Mathematics for economists*. N.W. Norton & Company, Inc. ISBN: 0-3993-95733-0.

Calculator Note: It is strongly recommended that you own a calculator that can do basic mathematical functions. These include exponentials, logarithms, radicals, and factorials. Any basic scientific calculator will perform these functions. While a graphic calculator may be useful in doing some of the homework problems, you may not be allowed to use it on the exam. ***You own a calculator. You are not allowed to borrow from your neighbor during the exam!***

Course Goals

Mathematics is increasingly important in terms of the expression and communication of ideas in economics and business. A basic knowledge of mathematics is indispensable for understanding almost all fields of economics. Yes, it is a math course and some of you may struggle to master the material. This should not, however, dissuade you from taking up the challenge. In order to facilitate your understanding of the subject matter, we will have recitation sessions and you are expected to make full use of this opportunity.

At the end of the course students should be able to:

1. Understand laws of indices, roots and perform algebraic manipulation of polynomials, including expanding brackets and collecting like terms and factorization.

2. Explain information presented in mathematical forms (e.g., equations, graphs, diagrams, tables, and words).
3. Use exponential and logarithmic functions to analyze growth, interest compounding and investment appraisal.
4. Demonstrate understanding of and ability to explain the economic applications of differentiation, and use it to formulate economic problems, including elasticities, marginal cost/ benefit, marginal product of labor/capital, marginal utilities.
5. Find unconstrained optima of functions with one or more choice variables
6. Find constrained optima using the Lagrange multiplier and substitution methods
7. Understand and use these techniques to solve problems in economics, such as profit maximization, cost minimization or utility optimization
8. Use matrix algebra to find the unknowns: Cramer's rule, Inverse Methods and Gauss-Markov elimination procedure: use graphic calculator.
9. Apply linear programming principles and applications to solve real world problems: use solver in excel spreadsheet.

Course Requirements

There will be three assignments and two-in class exams; one midterm and one final examination. The grade weights of these requirements are the following: Please note: all homework assignments are to be turn in within the dead-line. No late submission will be accepted.

Homework 1:	5%	Homework 5:	10%
Homework 2:	5%	Homework 6:	10%
Homework 3:	10%	Homework 7:	10%
Homework 4:	10%	Attendance	10%
Final exam:	30%		

Please Note: Any homework submitted after the due date will not be accepted. If you miss a quiz, you will receive a grade of zero for that quiz. Out of four quizzes, only the best three will be considered towards your final grade, the lowest one will be dropped. Attendance is mandatory for this course.

Email: It is the University policy that no grade should be transmitted via email. I will post all your grades on sakai.

Grade Points	90 - 100	85-89	80-84	75-79	70-74	65-69	< 64
Grade Letter	A	B+	B	C+	C	D	F

Tentative schedule:

I. Introductory Mathematical Concepts
   a. Notation
   b. Variables, Constants & Parameters
   c. Number Systems
   d. Set Algebra
   e. Necessary & Sufficient Conditions
   f. Relations & Functions
      i. Basic Properties
      ii. Limits
      iii. Continuity.

Application: General application to economics and business: Consumer behavior, producer's behavior, sellers' behavior and the tax implications on individual and social well-being. What is a tangent and the shape of the curve at the tangent and its implications for maximization and minimization problems?

II. Functions
   a. Monotonicity
   b. Inverse
   c. Composite
   d. Extreme Values
   e. Secant Lines & Average Rate of Change
   f. Concavity & Convexity
   g. Frequently Used Functions
      i. Polynomials
      ii. Exponentials
      iii. Logs

Applications to growth: Indifference curve, demand curve, supply and isoquants. Exponential function applied to models of exponential growth and decay and Solow growth model.

III. Equilibrium Analysis
   a. Solving Systems of Equations
      i. Repeated Substitution
      ii. Adding and Subtracting Equations
      iii. Gaussian Elimination
   b. Comparative Statics.

Application: Demand and supply and the market clearing quantity and price, price ceiling and price floor.

IV. Matrix Algebra
   a. Definitions
   b. Basic Operations
   c. Determinants
   d. Linear Dependence and Singularity
   e. Inverting a Matrix
   f. Cramer's Rule

Application: Multi-production facilities and the optimal output from each facility that maximizes corporate profit.

V. Univariate Differential Calculus
   a. Difference Quotient
   b. Differentiability & the Derivative
   c. Differentials
   d. Rules for Differentiation
   e. Higher-order Derivatives
   f. Taylor Series Approximation:

Application: Marginal analysis: Utility function, cost function and profit function and Cobb-Douglas production function.

VI. Multivariate Differential Calculus
   a. Partial Derivatives and the Gradient
   b. Higher-Order Partial Derivatives
   c. Cross Partial Derivatives, Young's Theorem & the Hessian
   d. Multivariate Chain Rule
   e. Homogeneity
   f. Euler's Theorem
   g. Homotheticity
   h. Differentials
   i. Implicit Function Theorem.

Application: Economic interpretation, price elasticity of demand, price elasticity of supply, income elasticity of demand, marginal products, elasticity and total revenue.

VII. Unconstrained Optimization of Univariate Functions
   a. First-Order Condition & Stationary Points
   b. Second-Order Conditions

VIII. Unconstrained Optimization of Multivariate Functions
   a. First-Order Conditions
   b. Positive & Negative Definite Matrices
   c. Positive & Negative Semi-definite Matrices
   d. Second Order-Conditions

Application: relative maxima and minima.

IX. Constrained Optimization
   a. Solving with Substitution
   b. Solving with a Lagrangian function
   c. The Envelope Theorem
   d. The Bordered Hessian
   e. Second-Order Conditions

Application: Utility maximization and a budget constraint. (Slutsky equation), Iso-cost and the output maximization.

X. Integral Calculus
   a. Fundamental Theorem of Calculus
   b. Economics & Finance Applications

Application: average value, present value.