

Mathematics for Economics

Objectives

This course is designed to give students a systematic grounding in a significant part of the mathematical theory that is most important for and widely used in economics. It will cover a range of topics in the calculus of several variables, real analysis, and optimization theory. Unlike traditional courses in mathematics, this set of lectures will motivate the theory by means of applications in economic problems. There will be extensive readings, which will be used in class to introduce the mathematical concepts and tools and to illustrate how they are used in economics. The course is open to all students at the Collegio but it would not be appropriate for those without solid foundations in the single variable calculus, linear algebra, and basic set theory but also some economic sophistication.

Outline

1. *Main Concepts of Set Theory and the Space \mathbb{R}^n* : set operations, relations and functions, level sets and curves, metric in n -dimensional space, triangle inequality, Euclidean spaces, neighborhoods and open sets, sequences and limits, closed sets, closures and boundaries of sets.
2. *Functions of Several Variables*: limits and continuity of functions, partial and total derivative, marginal products and elasticities, chain rule, geometric interpretation of partial derivatives and the total differential, linear approximation, differentiability, smooth functions, directional derivatives and gradient.
3. *Higher-order Derivatives*: Young's theorem, Hessian matrix, economic applications. *Vector-valued Functions*: Jacobian. *Implicit Function Theorem*: applications in comparative statics problems.
4. *Unconstrained Optimization*: multi-dimensional objective functions, stationary points and first-order conditions, second-order conditions for extrema,

quadratic forms and the associated matrices, definiteness and semi-definiteness of quadratic forms, Sylvester criterion.

5. *Constrained Optimization*: Lagrangean function and multiplier, Kuhn-Tucker theorem, bordered Hessian and second-order conditions for constrained extrema under linear constraints, economic meaning of the multiplier, smooth dependence on the parameters, envelope theorem.

Requirements

Formal requirements include regular attendance and participation in lectures, weekly problem sets, a midterm, and a final examination. 50%, 30%, and 20% of the course grade will be determined by the final and midterm examinations and the problem sets, respectively. The problem sets are mandatory and an essential part of the course. They will be graded according to excellent, good, adequate, and not adequate. The grading is intended to give students a guide as to how well they are grasping the material on a “real time” basis. In determining the final grade for the course, the distinction between “excellent” and “good” problem sets will have no effect but a student who has a consistent record of good or excellent problem sets will get extra credit towards the course grade. This is due to the fact that the problems sets will be demanding and doing very well will be quite difficult. Moreover, and perhaps more importantly, I want to encourage you to work in groups discussing the material in the problem sets and lectures with other students. Needless to say, it is expected that the answers you turn in will reflect your own work.

Textbooks

The main texts for the course are *Mathematics for Economists* by C.P. Simon and L. Blume (W. Norton & Company, 1994) and *Mathematical Methods and Models for Economists* by A. de la Fuente (Cambridge University Press, 2000). Alternative textbooks useful to consult are *Optimization in Economic Theory* by A. Dixit (Oxford University Press, 1990) and *Real Analysis with Economic Applications* by E. A. Ok (Princeton University Press, 2007).