Doctoral Program in Economics

UNIVERSITÀ DEGLI STUDI FIRENZE | UNIVERSITÀ DI SIENA | UNIVERSITÀ DI PISA

Academic year 2020/21

MATHEMATICS

Period:

First term: from November 2nd to January 29th

Course hours:

28

Teachers:

Alessio Muscillo (8 hours), Michele Gori (8 hours), Paolo Pin (12 hours; course coordinator)

Exam methods:

Written exam.

Prerequisites:

None.

Part 1 (Muscillo)

Program

Basics of logic: conditional statements, quantifiers, binary operations and truth tables. Proofs by contradiction. Proofs by induction. Topics in Linear Algebra. Determinant and its geometric interpretation. Partitioned matrices and their inverses. Linear independence. Rank of matrices. Basic notions on abstract spaces. Main results on linear systems. Eigenvalues and eigenvectors. Diagonalization. Gershgorin's circle theorems. Quadratic forms and quadratic forms with linear constraints.

Educational objectives

Basics of mathematical logic and linear algebra.

Bibliographical references

Chapter 1 - Sydsæter, K., Hammond, P., Seierstad, A., & Strom, A. (2008). "Further mathematics for economic analysis". Pearson education.

Further references:

- Appendix M in A. Mas-Colell, M. Whinston and J. Green, "Microeconomic Theory."
- Appendix A in W.H. Greene, "Econometric Analysis". Pearson.

Part 2 (Gori)

Program

Balls, open sets, closed sets, bounded sets and compact sets in euclidean spaces. Generalities on functions of several variables. Continuity. Partial derivatives and gradient. Stationary points. Second partial derivatives. Schwartz theorem. Hessian matrix. Convex sets. Concave and convex functions. Strictly concave and strictly convex functions. Necessary and sufficient conditions for concavity (convexity). Sufficient conditions for strict concavity (strict convexity). Quasi-concave and quasi-convex functions. Differentiable functions. Implicit function theorem. Maximum points of a function on a set. General formulation of a maximization problem. Extreme value theorem. Unconstrained maximization problems: necessary first-order conditions for optimality; necessary second-order conditions for optimality; sufficient first-order conditions for optimality. Maximization problems with equality constraints and maximization problems with inequality constraints: Lagrange function; necessary first-order conditions for optimality; sufficient first-order conditions for optimality.

Educational objectives

Basics of multivariate calculus and static optimization.

Bibliographical references

Chapter 2 and 3 - Sydsæter, K., Hammond, P., Seierstad, A., & Strom, A. (2008). “Further mathematics for economic analysis”. Pearson education.

Part 3 (Pin)

Program

One-variable integration. Leibniz’s Formula. The Gamma function. Multiple integrals. Change of variables. Introduction to differential equations. Applications of integrals to economic problems. First order linear equations. Exact equations and integrating factors. Qualitative theory and stability. Existence and uniqueness. Applications of differential equations to economic problems.

Educational objectives

Topics in integration and introduction to differential equations.

Bibliographical references

Chapter 4 and 5 - Sydsæter, K., Hammond, P., Seierstad, A., & Strom, A. (2008). “Further mathematics for economic analysis”. Pearson education.