Programme of “Matematica per le Applicazioni Economiche e Finanziarie” “Mathematical methods for economics and finance”		
Number of ECTS credits: 6 (workload is 150 hours; 1 credit = 25 hours)		
Optional **LM-77: 2nd Cycle degree in Management, Economics and Finance - 1st year, 1st semester** Teacher: **Marco Castellani**		
1	**Course objectives and Learning outcomes**	The core topic covered will be the optimization of quantities which depend on several variables which may have to satisfy certain constraints. We will try to understand the concepts and results in geometric terms as far as possible, though learning to handle the relevant algebra correctly and confidently at the same time. On successful completion of this module the student will be able to • understand the most fruitful methods of optimization, and apply some of these methods in microeconomics; • understand, from an algebraic and geometric point of view, vector calculus, convex sets and functions, numerical methods, the Lagrange and Kuhn-Tucker theorem.
2	**Dublin descriptors**	Topics of the module include • Linear algebra, vector spaces, scalar product, norm, distance, eigenvalues and eigenvectors of square matrices, definite positive/negative, semidefinite positive/negative, indefinite symmetric matrices • Topology, continuity and Weierstrass Theorem, partial derivative, directional derivative and differentiability of functions of several variables, gradient, C^1 functions, tangent hyperplane, homogeneous functions and Euler Thorem, Hessian matrix and Taylor’s formula, convex sets and their properties, separability of convex sets, convex functions and their characterizations, properties of the convex functions, quasiconvex functions. • Cardinality of a set, Bernstein-Schröder Theorem, Cantor-Bernstein Theorem, countable sets and their properties, Cantor diagonal argument and the cardinality of the continuum of **R**, the continuum hypothesis • Preferences and utility functions, existence of a utility when the choice set is countable, Debreu’s Theorem • First and second order optimality conditions for unconstrained problems • Optimization with equality constraints: Dini’s Theorem, Lagrange multiplier Theorem, the Lagrangean function multipliers method, sensitivity, necessary and sufficient second order conditions • Optimization with inequality constraints: Karush-Kuhn-Tucker Theorem and constraint qualifications (linearity CQ, linear independence CQ, Mangasarian-Fromovitz CQ, Slater CQ) • Pareto efficiency and Markowitz portfolio theory On successful completion of this module students should • be familiar with commonly used concepts of linear algebra • have profound knowledge of basic theory of differential calculus for functions with several variables • know and understand the basic concepts of preferences and utilities in choice theory • be able to develop strategies for solving optimization problems, and to identify the most appropriate method in each situation; • demonstrate skill in mathematical reasoning and ability to conceive a proof • demonstrate capacity for reading and understand other texts on related topics

3	**Prerequisites and learning activities**	The student must own the notions of linear algebra (vectors, matrices, linear systems) and single variable calculus (function, limit, derivative and related theory) as provide in “Matematica Generale”
4	**Teaching methods and language**	Lectures and exercises. Teaching language: Italian Text book: C. Simon, L. Blume, Matematica per le scienze economiche, Egea Some didactic material will be distributed among the students during the course in order to facilitate the understanding of the lectures.
5	**Assessment methods**	**Pre-Assessment.** There is no formal pre-assessment, but the abovementioned pre-requisites are fundamental. **Formative assessment.** The students are involved in discussions and comments in short Q&A sessions. The active participation is supported also by many exercises and practice problems in classroom. **Summative assessment.** Two midterms written exams, a written(*) final examination. The written test (2 hours) consists in solving 4 exercises (the first one is a theoretical exercise: it is the proof of a Theorem which has been developed in classroom) (*) The midterm written exams might substitute (subjected to a positive teacher’s evaluation) the final written exam.