Programme of "Ricerca Operativa" "Operations research"		
LM-77 (2nd Cycle degree in Administration Economics and Finance) 1st year, 1st semester		
Number of ECTS credits: 6 (workload is 42 hours; 1 credit = 7 hours)		
Teacher: Marco Castellani		
1	**Course objectives**	Aim of this course is to introduce the student to the formulation of basic optimization problems, particularly linear optimization problems, and train him/her to the related solution algorithms. Learn algorithmic techniques for some combinatorial optimization problems. Being able to formulate and solve combinatorial optimization problems using suitable methods
2	**Course content and Learning outcomes (Dublin descriptors)**	Topics of this course include: • Optimization problems: decision variables, objectives and constraints; modeling techniques and model classification • Geometry of linear programming and the simplex method • Duality theory in linear programming, the dual interpretation of the simplex method and the dual simplex method • Integer linear programming. Unimodular and totally unimodular matrices. Branch and bound method • Problems on network and solution methods o The minimum spanning tree problem and the Kruskal's algorithm o The shortest path problem and the Dijkstra's algorithm o The Hitchcock-Koopmans transportation problem and the primal-dual algorithm o The assignment problem and the Hungarian method o The maximum-flow problem and the Ford-Fulkerson method On successful completion of this module, the student should: • Acquire the knowledge of optimization problems and of the mathematical modeling techniques for complex decisions • Be able to recognize optimization problems and develop mathematical models of decision-making problems • Acquire the ability of computing solutions of linear programming problems. • Be able to hold a conversation and to read texts on topics related to the modeling of decision problems and Linear Programming. • Acquire the ability of upgrading flexible knowledge and skills in the field of optimization and related problems that arise in various areas, such as mathematics, computer science and management science.
3	**Prerequisites and learning activities**	Prerequisities • vector space • scalar product • matrix product • inverse matrix • determinant and rank of a matrix • solvability of a linear system • Gauss-Jordan method • Rouché-Capelli Theorem
4	**Teaching methods and language**	Lectures and exercises Language: Italian Text books • M.L. De Cesare, M.R. Maddalena, Introduzione alla programmazione lineare, Giappichelli Editore, Torino, 2001 • S. Martello, M.G. Speranza, Ricerca operativa per l'economia e l'impresa, Esculapio, Bologna, 2012 • R.J. Vanderbei, Linear programming: Foundations and extensions, Kluwer Academic Publishers, 1998 (English Book)
	Assessment methods and criteria	**Pre-Assessment**. There is no formal pre-assessment, but the abovementioned pre-requisites are fundamental and additional lectures are provided in order to keep the presentation self-consistent.

		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. Some homeworks are requested to specific topics. **Summative assessment**. It consists of a written test followed by an optional oral exam. An optional mid-term written test is also foreseen and is meant to assess the first part of the course, in order to help the students to split the workload. The mid-term test only concerns the written part of the exam, not the oral assessment. The written test (2 hours) consists in 8 exercises concerning with different topics: • The primal/dual simplex method • The geometrical primal simplex method • The branch and bound method for a discrete linear problem • The Kruskal's algorithm • The Dijkstra's algorithm • The primal/dual method for a transportation problem • The Hungarian method for the assignment problem • The Ford-Fulkerson method for the maximum flow It is designed to verify the ability of the students in the application of methods and algorithms presented during the Course. Criteria of evaluation will be the level of knowledge and practical ability; the property of use of the technical/mathematical language; the completeness of the presentation. Each exercise is assigned with a number of points contributing to the final mark.