UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Mathematical Methods for Economic Analysis - Optimization and Convex Analysis

2425-1-F4001Q095

Aims

In line with the educational objectives of the Master Degree in Mathematics, the course aims at providing the *knowledge* about the fundamental concepts and statements of the theory of optimization and convex analysis in the Euclidean setting. It will also build the *skills* needed to understand and use the most important proving arguments and techniques in the theory and the *ability* to solve exercises and deal with problems exploiting them. Particular emphasis will be put on the theory of nonlinear programming and its relationship with convexity, as well as some results of duality.
At the end of the corse the students are supposed:

1. to have absorbed the pricipal topics of the course and to be able to apply methods and mathematical techniques to solve problems and exercises;
2. to be able to translate problems arising from real situations into models that can be analysed via the mathematical theory developed in the course;
3. to have acquired a proper use of language that enables them to communicate in a clear and rigorous way what they have learnt.

Contents

Finite-dimensional optimization, elements of convex analysis, duality theory, multiobjective optimization.

Detailed program

Introduction to optimization problems. Basic calculus tools in Rn.

Unconstrained optimization.

Ekeland variational principle.

Transposition theorems.

Convex analysis for sets and functions.

Nonlinear programming.

Duality theory and convex programming.

Introduction to vector optimization.

Partially ordered vector spaces.

Solution of a vector optimization problem.

Scalarization and optimality conditions.

Prerequisites

Basic concepts and results of linear algebra and analysis in finite-dimensional spaces.

Teaching form

All lessons are conducted in person in a classroom setting.

Textbook and teaching resource

Referenze:
O. Guler, Foundations of Optimization, Springer, 2010 (available as e-book)
S. Boyd and L. Vandenberghe, Convex Optimization, Cambridge University Press, 2009
M. Ehrgott, Multicriteria Optimization, Springer 2005

Ulteriori referenze:
M. S. Bazaraa, H. D. Sherali, C. M. Shetty, Nonlinear Programming, John Wiley & Sons, 1993
L. Berkovitz, Convexity and Optimization in R?, John Wiley & Sons, 2002
J. Jahn, Vector Optimization, Springer, 2011

Semester

I

Assessment method

Examination type:

1. there are no intermediate exams.
2. in both written and, if applicable, oral part of the exam are judged: the knowledge of the techniques shown during the course, the accuracy of the line of thinking, the ability to illustrate the results of the course
3. the evaluation of both written and oral exams will take into account mainly of the knowledge of the subjects and the accuracy of the line of thinking.

Written and oral examination

Written Exam: It consists of open-ended questions, specifically:

a) exercises that allow the instructor to assess the student's ability to apply theory in solving problems or in verifying simple theoretical results
b) a theoretical question, in which the student is asked to provide a proof from those proposed, or to fully present some definitions, statements of theorems, and give a few examples.

Oral Exam: The oral exam covers theorems and proofs, for which a detailed list will be provided at the end of the course, as well as theoretical exercises. It is preceded by a discussion of the written exam. All students who have obtained a score of at least 18 in the written exam are eligible to take the oral exam. Students who have achieved a score of at least 18 and choose not to take the oral exam may record their grade.
Each exam evaluates the correctness of reasoning, clarity, and rigor of presentation.

A student who receives a passing grade on the written exam may decline the grade (of the written exam, or the possible oral exam) no more than twice.

Office hours

By appointment.

Sustainable Development Goals