



## **Allievi Program and Master in Economics**

### **Optimization for Economics**

Instructors: Claudio Mattalia and Luca Regis

#### **Contact Information**

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#### **Objective of the course**

The goal of this course is to provide students with mathematical tools that are necessary for understanding modern economics, doing research or practical work. The object of study in this course is the problem of finding an optimal course of actions subject to feasibility constraints. Such a problem appears in almost every field of economics (consumption/investment choices, theory of the firm, macroeconomics, industrial organization, labor economics, etc.). The art of solving it, however, is usually “too applied” to find space in a purely mathematical curriculum. In this course, the emphasis will be put on the theory of constrained optimization, keeping a balance between mathematical rigour and a focus on economic applications.

#### **Structure of the course**

During the lectures, the theory and mathematical background will be presented and typical problems will be solved. We will assign a problem set each week, and provide the solutions the week after. Problem sets are not evaluated.

Formal course requirements include attendance to the lectures, a midterm exam and a final exam. Both the midterm exam and the final exam will have a maximum grade of 15/30 each, and the final grade will be the sum of the grades of the two partial exams.

## Outline of the course

A good command of single variable calculus and linear algebra is required. The topics presented during the course are the following:

### Part I (15 hours – Claudio Mattalia)

- *Functions of several variables*: notions of topology in  $\mathbb{R}^n$ , elements of calculus in several variables.
- *Unconstrained optimization*: first-order necessary conditions, quadratic forms and their sign, second-order sufficient conditions, concave and convex objective functions.
- *Constrained optimization with equality constraints*: implicit functions, the constrained problem in 2 variables, substitution method and Lagrange method.

### Part II (15 hours – Luca Regis)

- *Constrained optimization with equality constraints*: the constrained problem in  $n$  variables, Lagrange method.
- *Constrained optimization with inequality constraints*: Kuhn-Tucker points and the Kuhn-Tucker method.
- *Economic applications*: monotonicity and concavity for functions of several variables, the problem of the consumer, the problem of the firm, value function and Lagrange multipliers.

## Textbook

The main reference is represented by lecture notes of the teachers that will be available each week.

A useful reference is also:

Simon C. P. - Blume L., *“Mathematics for Economists”*, W. W. Norton & Company, 1994 (Chapters from 13 to 19).