School of
Economics and Management

Optimization Techniques

A.Y. 2018/2019

Prof. Paolo Crespi

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Learning Objectives

At the end of the course **the student will be able:**

a) to apply basic optimization techniques if required during research activities;
b) to understand and implement research results involving more advanced tools of mathematical programming.

Course Content

The wide branches of optimization theory are commonly accepted as a basic tool to study several topics in both economics and management. Resource allocation, portfolio optimization, Inventory management are few but significative examples of decision making issues that have been addressed by modeling them as optimization problems. To copy with the increasing number of research papers in management science and economic literature that involves advanced mathematical tools, Ph.D. candidates should master the basic arguments of optimization theory.

All Ph.D. students, regardless to the specific major chosen, are welcome to attend the classes on Optimization Technique. The aim of the course is to present some big issues of Optimization theory in order to make the student familiar with the topics of applied research and the main assumptions used in the model studied in management science, economics and decision science. A background on standard real analysis, topology, linear algebra and uni variate and mutivariate differential calculus and integral calculus may be necessary, although the level of skills needed can be mastered with short self study.

The outline of the course will be:

1. Introduction
    a. Definition of an optimization problem and motivating examples
    b. Short presentation of background topics
2. Static Optimization
    a. Unconstrained optimization
    b. Constrained optimization
        i. Equality constraints; Lagrange multipliers
        ii. Inequality constraints; KKT conditions

3. Calculus of Variations.
4. Optimal control theory.

Course Delivery

Individual study is mandatory to master the topics of the course. Lectures will be led by the instructor, presenting main ideas of the topics. However students will be responsible for reviewing the arguments presented in class and practicing the subject.

A set of homework will be provided during the classes to help student reviewing the topics discussed and eventually deepen the study.

Students are also encouraged to actively interact with the instructor, not only during classes, to discuss the studying material.

Course Etiquette

In your own interest and of your colleagues, please strictly observe the following courtesy rules:

1. Arrive in class on time; do not leave early without prior explicit instructor's approval;
2. Keep your mobiles and laptops off; do not chat with your classmates;
3. Do not wandering in and out of the classroom;
4. Hand in assignments (if any) on time. No late submissions are allowed

Required Readings

An exhaustive presentation of the topics of the course, as well as the background arguments, can be found in

1. Hoy et al. Mathematics for Economics, third edition, The MIT Press; Cambridge, USA, 2011.
2. S. J. G. Gift, Contributions to the calculus of variations, *Journal of Optimization Theory and Applications*, January 1987, Volume 52, Issue 1, pp 25-51
3. Further readings may be suggested by the instructor during classes.

Interested students can also refer to the following books:

4. A.C. Chiang, Fundamental methods of Mathematical Economics, McGraw Hill, 1974
5. A.C. Chiang, Elements of Dynamic optimization, McGraw Hill, 1992

Course Evaluation

Grade is based on class assignment (50%) and a final oral exam, based on a 15 minutes presentation.

Instructor

Paolo Crespi (Ph.D. 2001, Università di Trieste, B. Sc., Università Bocconi, 1998) is Full Professor of Applied Mathematics at Università degli Studi dell'Insubria, Department of Economics. He was previously Associate Professor of Applied Mathematics at Università della Valle d'Aosta (until march 2015) and then at Università degli Studi dell'Insubria. He has previously held teaching positions at Università Statale di Milano (Faculty of Politics) and at University of Insubria (Faculty of Economics). He is currently teaching Mathematics and Applied Mathematics at LIUC and Università Bocconi. His main research interests are in the fields of Optimization, Variational inequalities, Generalized Convexity, Set-valued analysis, Robust Optimization and

related applications to economics and finance. He is expert in “Previdenza e Credito” at Tribunale di Busto Arsizio.

How to get in touch:

P. Crespi: Friday 05.30 pm, ground floor, small building in front of Tower Building.
By phone: +39-0331-572.418 by e-mail: pcrespi@liuc.it

Syllabus

Session 1 November 23, 2018 Time: 14:30 – 17:30	**Topics** • Introduction. • Review of some background topics and setting of the problem. • Mathematical Programming: Unconstrained optimization
Session 2 November 30, 2018 Time: 14:30 – 17:30	**Topics** • Constrained optimization. • Lagrange multipliers • KKT conditions
Session 3 December 06, 2017 Time: 14:30 – 17:30	**Topics** • Dynamic optimization: Calculus of variations. ***First partial: Static optimization***
Session 4 December 14, 2017 Time: 14:30 – 17:30	**Topics** • Dynamic Optimization: Optimal control 1.
Session 5 December 21, 2017 Time: 14:30 – 17:30	**Topics** • Dynamic Optimization: Optimal control 2. ***Second partial: Dynamic optimization***

Topics of each session are subject to changes according to teaching needs.