FIN-414 **Optimization methods**

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Cursus	Sem.	Type
Financial engineering	MA1, MA3	Obl.

Language of teaching	English
Credits	2
Session	Winter
Semester	Fall
Exam	During the semester
Workload	60h
Weeks	14
Hours	**2 weekly**
Courses	1 weekly
Exercises	1 weekly
Number of positions	

Remark

For sem. MA1. Special schedule: see the IF website http://sfi.epfl.ch/mfe/study-plan

Summary

This course presents the problem of static optimization, with and without (equality and inequality) constraints, both from the theoretical (optimality conditions) and methodological (algorithms) point of view. Economics and financial applications are provided. Dynamic optimization is also introduced

Content

Static optimization:

- Univariate and multivariate unconstrained optimization: existence and uniqueness of solutions. Algorithms:Newton's method, golden-section search, steepest descent.
- Constrained optimization with equality constraints: Lagrange multipliers and their interpretation.
- Constrained optimization with inequality constraints: Kuhn-Tucker method and duality theory.
- Several examples from economics and finance

Dynamic optimization

- Bellman equation and optimal control problems
- Applications to finance: dynamic portfolio optimization
- Applications to economics: dynamic consumption/saving choice.

Keywords

Optimization program, equality and inequality constraints, Lagrange and Kuhn-Tucker theorems, algorithms, Bellman equation, optimal control.

Learning Prerequisites

Important concepts to start the course

Basic concepts of linear algebra, mathematical analysis and probability.

Learning Outcomes

By the end of the course, the student must be able to:

- Describe optimization programs with and without equality or inequality constraints
- Solve optimization programs with and without equality or inequality constraints
- Describe algorithms adopted to solve such a univariate and multivariate optimization problems.
- Apply different algorithm to financial applications such as portfolio optimization and parameter estimation.
- Solve simple optimal control problems.

Transversal skills

- Use a work methodology appropriate to the task.
- Set objectives and design an action plan to reach those objectives.
- Demonstrate the capacity for critical thinking
- Use both general and domain specific IT resources and tools

Teaching methods

Slides.

Assessment methods

The grading will be based on exercises (30%), and (70%) final exam. The final exam is closed-books and closed-notes.

Resources

Virtual desktop infrastructure (VDI)

No

Bibliography

- Brandimarte P., “ Numerical Methods in Finance”, Wiley Series in Economics and Statistics
- Dixit, A. K., "Optimization in economic theory", Oxford University Press, second edition.

- C. P. Simon and L.E. Blume, "Mathematics for Economists", W. W. Norton and Company
- R. K. Sundaram, "A First Course in Optimization Theory", Cambridge University Press.

Ressources en bibliothèque

- A First Course in Optimization Theory / Sundaram
- Mathematics for Economists / Simon
- Optimization in Economic Theory / Dixit
- Numerical Methods in Finance / Brandimarte

Notes/Handbook

Slides for each lectures will be provided.