IB352-15 Applied Optimization Methods

24/25

Department
Warwick Business School
Level
Undergraduate Level 3
Module leader
Juergen Branke
Credit value
15
Module duration
10 weeks
Assessment
Multiple
Study location
University of Warwick main campus, Coventry

Description

Introductory description

This is a module for MORSE students in particular.
To introduce general algorithms for convex and non-convex optimization problems arising in various application areas such as financial portfolio optimization, energy system planning, and engineering design optimization, and their computational aspects using a numerical software tool such as Matlab.

Module web page

Module aims

To introduce general algorithms for convex and non-convex optimization problems arising in various application areas such as financial portfolio optimization, energy system planning, and engineering design optimization, and their computational aspects using a numerical software tool such as Matlab.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

Module introduction with examples of several optimization problems in various application areas such as financial portfolio optimization, energy system planning, and engineering design optimization, and review of mathematical background materials (linear algebra, calculus-derivatives, etc.).
Introduction to a software for modelling and solving optimization problems.
Optimality conditions.
Unconstrained optimization.
Quadratic programming.
Constrained optimization.
Discrete optimization and exact methods.
Heuristics.
Global optimization.
Multi-objective optimization.

We plan to cover various applications such as financial portfolio optimization, energy system planning, and engineering design optimization, and several solution algorithms.

Learning outcomes

By the end of the module, students should be able to:

- Derive general optimality conditions for convex optimization problems.
- Apply numerical algorithms for unconstrained and constrained convex optimization problems.
- Apply exact methods for discrete optimization problems with general non-linear convex objective as well heuristics methods.
- Understand global optimization methods.

Indicative reading list

- G. Calafiore and L. El Ghaoui, Optimization Models, Cambridge Publications, 2014
- P. Venkataraman, Applied Optimization with Matlab Programming, Wiley, 2nd Edition, 2009
- J. Nocendal and S. Wright, Numerical Optimization, Springer, 2nd Edition, 2000
- C. Papadimitriou and K. Steiglitz, Combinatorial Optimization: Algorithms and Complexity, Dover Publications, 1998
- A. E. Eiben and J. E. Smith, Introduction to Evolutionary Computing, Springer 2015

Subject specific skills

Use Matlab or similar numerical software to solve optimization problems using numerical algorithms and builtin/add-on optimization solver.

Transferable skills

Distinguish between convex and non-convex optimization problems and different solution techniques.

Study

Study time

Type	Required
Lectures	10 sessions of 1 hour (7%)
Tutorials	10 sessions of 1 hour (7%)
Online learning (independent)	10 sessions of 1 hour (7%)
Private study	48 hours (33%)
Assessment	69 hours (47%)
Total	147 hours

Private study description

Private Study.

Costs

No further costs have been identified for this module.

Assessment

You do not need to pass all assessment components to pass the module.

Assessment group D5

	Weighting	Study time	Eligible for self-certification
Group Work Numerical problem solving.	20%	15 hours	No
Weekly Online Multiple Choice Questions	5%	4 hours	No
In-person Examination Exam	75%	50 hours	No

- Answerbook Pink (12 page)
- Students may use a calculator

- Graph paper

Assessment group R1

	Weighting	Study time	Eligible for self-certification
Individual Assignment	25%		Yes (extension)
In-person Examination	75%		No

- Answerbook Pink (12 page)
- Students may use a calculator
- Graph paper

Feedback on assessment

For the assignment, students will receive individual feedback. For the exam, general feedback will be provided about typical errors made.

Past exam papers for IB352

Availability

Pre-requisites

To take this module, you must have passed:

- Any of
  - IB104-12 Mathematical Programming I
  - IB207-12 Mathematical Programming II

Courses

This module is Core for:

- USTA-G301 Undergraduate Master of Mathematics,Operational Research,Statistics and Economics (with Intercalated
  - Year 3 of G30G Master of Maths, Op.Res, Stats & Economics (Operational Research and Statistics Stream) Int
  - Year 4 of G30G Master of Maths, Op.Res, Stats & Economics (Operational Research and Statistics Stream) Int

This module is Optional for:

- UECA-4 Undergraduate Economics 4 Year Variants
    - Year 4 of LV16 Economics & Economic History with Study Abroad
    - Year 4 of L114 Industrial Economics with Study in Europe
- Year 3 of USTA-G300 Undergraduate Master of Mathematics,Operational Research,Statistics and Economics
- Year 3 of UMAA-G1NC Undergraduate Mathematics and Business Studies
- Year 4 of UECA-GL12 Undergraduate Mathematics and Economics (with Intercalated Year)
- Year 4 of USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)
- USTA-G1G4 Undergraduate Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)
    - Year 4 of G1G4 Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)
    - Year 5 of G1G4 Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)

This module is Unusual option for:

- UPHA-L1CA Undergraduate Economics, Psychology and Philosophy
    - Year 2 of L1CA Economics, Psychology and Philosophy
    - Year 3 of L1CA Economics, Psychology and Philosophy
- Year 3 of UPHA-V7ML Undergraduate Philosophy, Politics and Economics

This module is Option list A for:

- USTA-G301 Undergraduate Master of Mathematics,Operational Research,Statistics and Economics (with Intercalated
    - Year 3 of G30E Master of Maths, Op.Res, Stats & Economics (Actuarial and Financial Mathematics Stream) Int
    - Year 4 of G30E Master of Maths, Op.Res, Stats & Economics (Actuarial and Financial Mathematics Stream) Int
- Year 3 of USTA-Y602 Undergraduate Mathematics,Operational Research,Statistics and Economics
- Year 4 of USTA-Y603 Undergraduate Mathematics,Operational Research,Statistics,Economics (with Intercalated Year)

This module is Option list B for:

- Year 4 of UCSA-G504 MEng Computer Science (with intercalated year)
- Year 3 of UCSA-G500 Undergraduate Computer Science
- Year 4 of UCSA-G502 Undergraduate Computer Science (with Intercalated Year)
- UCSA-G503 Undergraduate Computer Science MEng
    - Year 3 of G500 Computer Science
    - Year 3 of G503 Computer Science MEng
- Year 3 of USTA-GG14 Undergraduate Mathematics and Statistics (BSc)
- Year 4 of USTA-GG17 Undergraduate Mathematics and Statistics (with Intercalated Year)

This module is Option list C for:

- Year 4 of UCSA-G504 MEng Computer Science (with intercalated year)
- Year 3 of UCSA-G500 Undergraduate Computer Science

- Year 4 of UCSA-G502 Undergraduate Computer Science (with Intercalated Year)
- UCSA-G503 Undergraduate Computer Science MEng
    - Year 3 of G500 Computer Science
    - Year 3 of G503 Computer Science MEng

This module is Option list D for:

- Year 3 of USTA-G300 Undergraduate Master of Mathematics,Operational Research,Statistics and Economics
- Year 3 of USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)

This module is Option list G for:

- Year 2 of UPHA-V7ML Undergraduate Philosophy, Politics and Economics