

Course size (nominal values; actual values may depend on programme)

Credits	7.0	Study time	210 h	Contact hrs	75.0 h
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Course offerings and teaching methods in academic year 2018-2019

A (semester 1)	English	seminar: coached	30.0 h
		exercises	
		lecture	45.0 h

Lecturers in academic year 2018-2019

Maenhout, Broos	EB24	lecturer-in-charge
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Offered in the following programmes in 2018-2019

	crdts	offering
Bachelor of Science in Business Engineering	7	A
Exchange programme in Economics and Business Administration	7	A
Preparatory Course Master of Science in Business Engineering	7	A
Preparatory Course Master of Science in Business Engineering	7	A

Teaching languages

English

Keywords

Optimization, Modeling, Decision theory

Position of the course

The course 'Operations Research' aims to let students acquire insights in mathematical modelling and solution methods for different operational, financial and marketing optimisation problems.

- The course aims to teach insights in the concepts of optimisation.
- The objective of this course is to provide students with various quantitative methods for the solution and analysis of diverse decision problems.
- Based on examples and case studies, we discuss the various application possibilities of operations research within a business environment.

Contents

- 1 Introduction to operations research and mathematical modelling
- 2 Linear programming
 - Modelling, special cases and problem types
 - Solution methods: The graphical solution method, the simplex method and the two-phase simplex method
 - Duality and sensitivity analysis in linear programming
 - Linear programming with multiple objectives
- 3 Network optimisation problems: Problem types and solution methods
 - Transport- and assignment problems
 - Shortest path problem
 - Minimum spanning tree problem
 - Maximum flow and Minimum cut problem
 - General min cost max flow problems
- 4 Binary and integer linear programming
 - Modelling, special cases and problem types
 - Solution methods: Branch-and-bound and Branch-and-Cut
 - Generating cuts: Preprocessing techniques, Minimum cover cuts and Gomory cuts

- 5 Dynamic programming: Concept, solution method and problem types
- 6 Constraint Programming
- 7 Introduction to Heuristics
 - Single-pass vs multi-pass heuristics: Definition and problem types
 - Introduction to meta-heuristics
- 8 Non-linear programming
 - Modeling, concepts and problem types
 - Unconstrained optimisation with a single and multiple variables
 - Constrained optimisation
 - Special cases: Quadratic programming and Separable programming
- 9 Decision trees
 - Concept
 - Decisions without experimentation
 - Decisions with experimentation
 - Introduction to the utility theory
- 10 Introduction to Game Theory
 - Two person zero-sum games
 - Two person nonconstant sum games
- 11 Introduction to Markov chains
 - Concepts and modelling
 - Chapman Kolmogorov equations
 - Irreducible ergodic Markov Chains
 - Absorbing Markov Chains
- 12 Decision problems with multiple criteria: Scoring Models, Goal Programming, Analytic Hierarchy Process

Initial competences

The student should have **a strong quantitative background**.

Algebra, Probability calculation, Statistics

Corresponds to the acquired competences of Mathematics I (A), Mathematics I (B), Mathematics II (A) and Applied Statistics I.

Final competences

- 1 The student is able to think logically and methodically. He is able to analyse, synthesize and model problems.
- 2 The student has insight in the concepts of modelling, optimisation, duality, shadow prices, reduced cost, algorithms, linear and non-linear optimisation, heuristics, decision trees, deterministic and stochastic processes, etc. (cf. Course content)
- 3 The student has insight in optimisation problems, solution methods and sensitivity analyses.
- 4 The student is able to understand and relate the assumptions of decision methods.
- 5 The student is able to use modelling techniques for different kind of problems. He/she is able to determine appropriate solution methods for various types of decision problems, is able to solve the optimization problems in a quantitative and/or graphical manner and evaluate possible decision alternatives, is able to analyze and interpret the results.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Lecture, seminar: coached exercises

Extra information on the teaching methods

Theory and exercise sessions where optimisation methods are applied to simple practical problems

Learning materials and price

- Lecture notes will be provided using the ICT-platform Minerva:
 - Slides (in English) (theory and exercise sessions)
 - Additional exercises and example exam questions
 - Additional course notes and papers
 - **Optional:** Course book - F.S. Hillier and G.J. Lieberman, "Introduction to Operations Research" 10th Ed, McGraw-Hill. ISBN 978-0-07-352345-3 (Cost: 60 EUR).

References

- F.S. Hillier and G.J. Lieberman, Introduction to Operations Research, McGraw Hill.
- H.A. Taha, Operations Research: An Introduction, Prentice Hall.
- W. Winston, Operations Research, Duxbury Press.

Course content-related study coaching

The student can contact the teacher before, during and after each class. They can contact the teacher using email and the ICT-platform Minerva. There is a weekly consultation hour for additional contact. Further support is available via the ICT-platform Minerva:

- The course slides
- The course schedule
- There is a forum to discuss about the course topics
- Additional exercises and example exam questions
- Additional course notes and papers
- Online learning platform by McGraw-Hill Education (for those who buy the book).

Evaluation methods

end-of-term evaluation

Examination methods in case of periodic evaluation during the first examination period

Written examination

Examination methods in case of periodic evaluation during the second examination period

Written examination

Examination methods in case of permanent evaluation

Possibilities of retake in case of permanent evaluation

not applicable

Extra information on the examination methods

Written exam (closed book) with the following focus:

- Theory: The exam evaluates insight in (the assumptions of) optimisation concepts and the relationship between different concepts.
- Exercises: Students should be able to formulate a mathematical model for an economic problem, to identify the correct optimisation method, to carry out the optimisation method, to analyse the results and to perform a sensitivity analysis.

Several exam questions are solved during class.

During examination only the use of a pocket calculator is allowed.

Calculation of the examination mark

End-of-Term evaluation (100%).