Decision Making and Optimization

Master in Data Analytics for Business

Lisbon School
of Economics
& Management
Universidade de Lisboa

2025-2026

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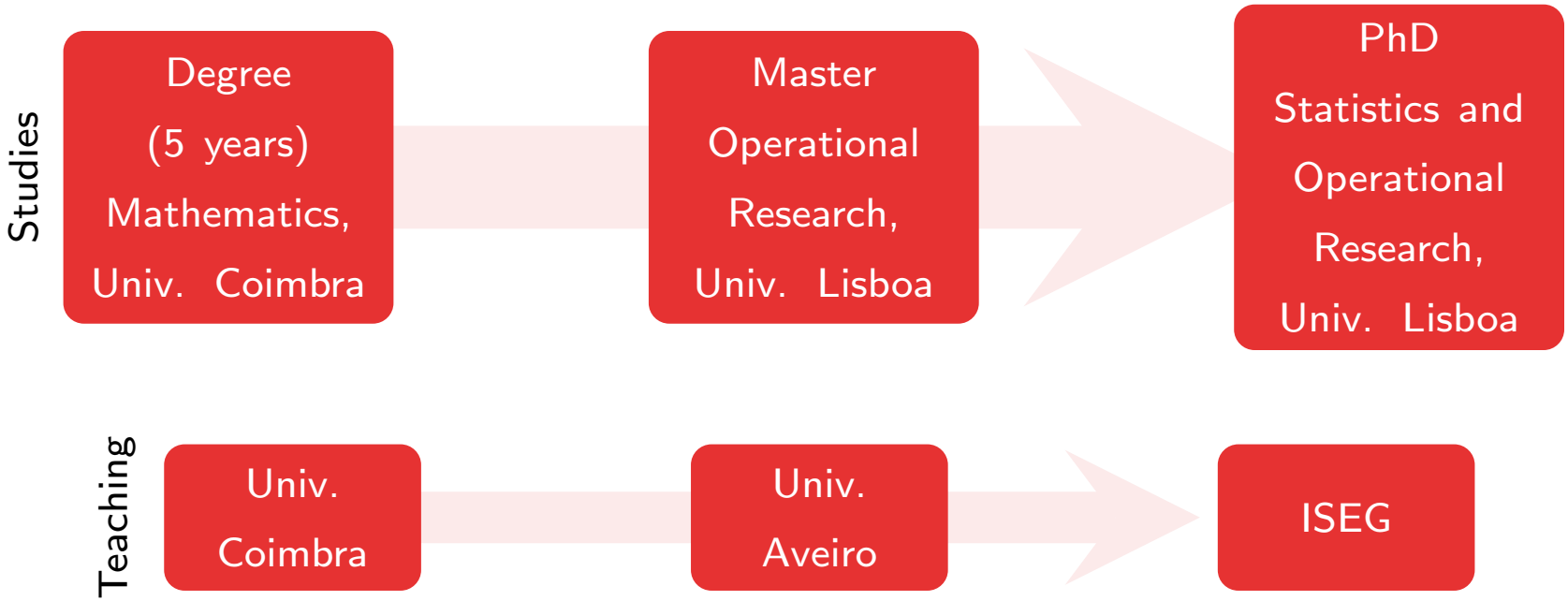

Syllabus

1. Linear Programming
2. Duality and Sensitivity Analysis
3. Transportation Model and Variants
4. Integer Linear Programming
5. Heuristics and Metaheuristics
6. Multi-Objective Programming
7. Decision Analysis

Objectives

1. Study Optimization Approaches to Decision Making.
2. Understand mathematical models to address problems such as production, assignment, scheduling, distribution and routing.
3. Apply theoretical knowledge, practical problem-solving methods, including heuristics, and use analytical tools in the context of business decision making.
4. Understand the type of data needed to support the mathematical models and tools used to analyze the data.
5. Structure and analysis of sequential decision problems.

Bibliography

1. H.A. Taha. *Operations Research: An Introduction.* Pearson Education Limited. 2017.
2. F.S. Hillier & G.J. Lieberman. *Introduction to Operations Research.* McGraw-Hill Education. 2024.
3. P. Goodwin & P.G. Wright. *Decision Analysis for Management Judgement.* John Wiley & Sons, Inc. 2014.
4. R. Martí, P. Pardalos & M. Resende (Eds.). *Handbook of Heuristics.* Springer Nature. 2018.
5. P.A. Jensen & J.F. Bard. *Operations Research: Models and methods.* John Wiley and Sons. 2002.

and many others

Assessment

The assessment comprises two components:

- two group project, which accounts for 60% of the total grade.
- an individual written examination, which accounts for 40% of the total grade.

Final classification: weighted average of all the components.

The grades range from 0 to 20. To obtain approval, the weighted average of all assessment components must be greater than or equal to 9.5, with a minimum grade of 6 for each component.
Students with a final grade of 9 may be required to take an oral examination for approval. In this case, the maximum final grade will be 9.5.

Assessment rules for the group project

- The group size is three students.
- The project 1 accounts for 35% of the total mark and a minimum grade of 6 is required;
- The project 2 accounts for 25% of the total mark and a minimum grade of 6 is required.
- Students who do not achieve a grade of 6 or above in each project will be required to undertake an individual written examination during the Repeat Assessment Period. If they do not obtain a minimum grade of 6 in that exam, the final grade will be, at maximum, of 9.
- The scheduled dates for the submission of the group project are **October 31** for project 1, and **December 5** for project 2.
- A presentation and discussion of the project (either one or both) will be required.
- Following the presentation and discussion of the projects, discrepancies may arise in the grades awarded to individual group members.

Assessment rules for the written examination

- In written examinations, students are permitted to consult
  - one A4 sheet (equivalent to two pages) of material written by themselves, and
  - a scientific calculator (not be graphical, must be silent, not be capable of remote communication, not have Symbolic Algebraic Calculation (SAC) and not be Opensource).
- Students who miss the exam or do not achieve a grade of 6 or above in the individual written examination at the Regular Assessment Period will be required to undertake an individual written examination during the Repeat Assessment Period. If they do not obtain a minimum grade of 6 in that exam, the final grade will be, at maximum, of 9.
- The date of the individual written examination at the Regular Assessment Period is **09 December 2025**, at 12h00, duration 2h.
- The date of the individual written examination at the Repeat Assessment Period is **07 January 2026**, at 15h00, duration 2h.

Assessment rules

Any aspect not covered in the aforementioned provisions shall be subject to the general rules and regulations governing the assessment of master's degrees (see also `https://www.iseg.ulisboa.pt/secretaria/en/legislation-and-documents/`).

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Decision Making and Optimization

- Decision Making and Optimization are part of Operations Research, which seeks to determine how best to plan and operate a system.
- Study programming models for complex organisational systems to aid decision making.
- Use mathematical programming models and programming techniques to obtain values for system variables to help optimise/improve their performance.

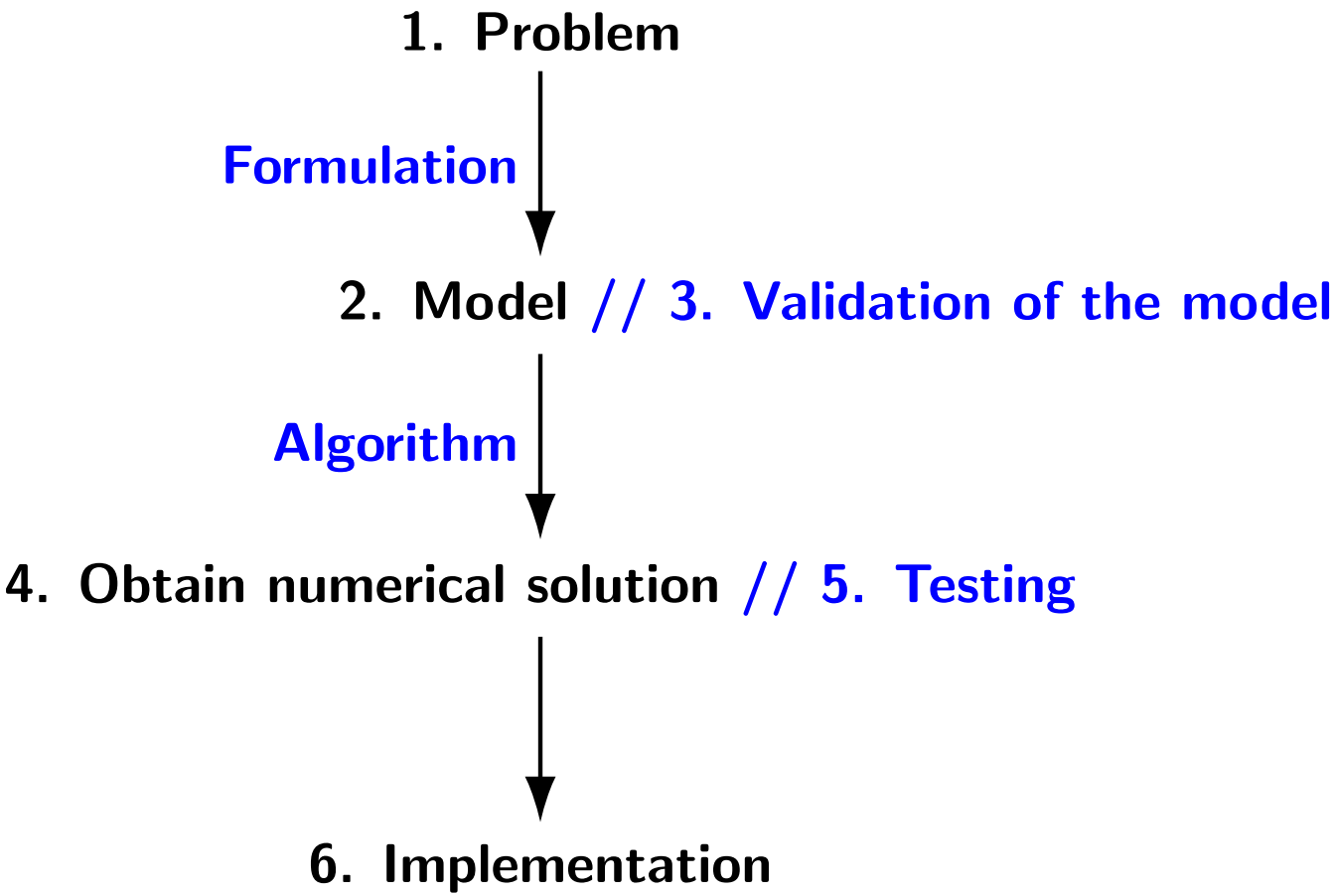
General methodology

Several authors (e.g. W. Winston, Operations Research: Applications and Algorithm, 3rd ed. Duxbury Press, 1994) suggest that the methodology of problem solving must include the following steps

1. Identification and study of the problem;
2. Formulation and construction of a mathematical programming model;
3. Validation of the model;
4. Obtaining the model solution;
5. Testing the solution (and validation of the model);
6. Implementation of the solution.

- models improve the organization of operations

Steps of an OR project



Some Operations Research (OR) models

- Mathematical Programming Models:
  - Linear Programming (LP),
  - Integer Linear Programming (ILP),
  - Non-Linear Programming (NLP),
  - Network Optimization (NO),
  - Multi-criteria Optimization (MCO),
  - Robust Optimization (RO),
  - Stochastic Optimization (SO), etc
- Probabilistic Models:
  - Markov Chains,
  - Queues,
  - Prediction, etc
- Decision models:
  - Comparison Process,
  - Decision Trees,
  - Simulation,
  - Game Theory, etc

Challenge

The organic market *From Orchard to Basket* prepares weekly fruit baskets for its customers. There are two types of baskets:

- **Premium Basket (A)** – designed for juices and fruit salads.
- **Smart Basket (B)** – an economical option for daily snacks.

The warehouse has limited fruit stock:

- **Apples:** 10 units available.
- **Oranges:** 14 units available.

Each basket requires the following resources:

- Premium Basket (A): 1 apple and 2 oranges.
- Smart Basket (B): 1 apple and 1 orange.

The profits are:

- Premium Basket (A): 5 € per unit.
- Smart Basket (B): 3 € per unit.

Decide how many baskets A and B to prepare in order to maximize profit without exceeding the stock of fruit.