UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Decision Models

2324-1-FDS01Q002-FDS01Q003M

Aims

This module will emphasizes the relevance of data in decision making. The general aim is to develop skills in mathematical modeling, algorithms and computational methods to solve and analyze decision problems. The course will illustrates how to formulate real world problems using case studies and examples; how to use efficient algorithms – both old and new – for solving these models; and how to evaluate, draw useful conclusions and derive useful planning information from the output of these algorithms.

Specific aims of the course module are:

1. To give students the basic concepts of decision theory, modeling and solution methods of decision making problems with applications
2. Guide students in using different models and methods of operations research
3. Teach students different methods that are used for numerical decision making
4. Make students gain skills in finding optimal solutions to problems
5. Use programming languages as AMPL or Python

Contents

1. Types of decisions
2. Types of decision models
3. Decision trees: Value of information and value of perfect information
4. Basic mathematical programming models: linear programming, linear integer programming, nonlinear programming
5. Network optimization models

Detailed program

1. Types of decisions:

- Structured and programmed decision
- Unstructured and non-programmed decision
- Descriptive, predictive and prescriptive analytics
- Decision making conditions: certainty, uncertainty

2. Types of decision models: Model-driven and Data-driven
3. Decision trees:

- Basic definitions and examples
- Value of information: value of sampled information and value of perfect information

4. Basic mathematical programming models:

- linear programming examples and their formulation
- solution of linear programming problems
- sensitivity analysis for linear programming problems
- integer linear programming examples and their formulation
- Branch and Bound method for integer linear programming problems
- nonlinear programming examples and their formulation
- optimality conditions, duality theory and algorithms for nonlinear programming problems
- applications of nonlinear duality theory to Support Vector Machines and epsilon-Support Vector regression

5. Network optimization models:

- transportation problems
- the shortest path problem
- the maximum flow problem

Prerequisites

Linear Algebra.

Teaching form

The course will be held in english.

The course is hands-on. In particular, we use different case studies to show how to formulate and solve different types of problems.

Case studies will be the starting point to illustrate how the decision problem can be formulated and solved.
Practical exercises using software AMPL.

Assignments will be given periodically to access the student critical thinking skills.

Textbook and teaching resource

Textbook:
Cliff Ragsdale, Spreadsheed modeling and decision analysis, any edition.

Instructors make available slides, in-class exercises data and models, additional reading papers.

Semester

II semester

Assessment method

Assignments +Written Exam+ oral (optional)

- Along the course there will be proposed four assignments to be resolved individually. We only allow ”Type 1 collaboration”. This means that collaboration is allowed, but the final product must be individual. You are allowed to discuss the assignment with other team members and work through the problems together. What you turn in, however, must be your own product, written in your own handwriting, or in a computer file of which you are the sole author. Copying another’s work or electronic file is not acceptable.
- Assignment must to be delivered on the established date. No assignment will be considered after deadline. **Assignments are valid until July 2024.**
- A written exam with closed and open questions about the topics presented during thee course to assess: Knowledge of Fundamental Concepts, Overall Understanding, Knowledge of specific models and methods.
- Finally, in order to improve the grade, students can take an oral exam (optional) to assess also the students' Argumentation ability

For more detail about the assessment methods refer to the related document in the introductory part of the course.

Office hours

By appointment.

Sustainable Development Goals