UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Quantitative Management Science

2425-1-F7701M137-F7701M137-2

Learning objectives

By the end of the course, students will be able to analyze, model and solve decision-making problems in business contexts using linear programming, integer linear programming and decision theory techniques. Specifically, students will be able to:

- understand the basic principles of linear programming, integer linear programming and decision theory in a business context;
- apply modeling techniques and solution algorithms for decision problems, using specific software and tools;
- identify the type of a real-world decision problem that arises in the business environment and apply the most appropriate modeling and resolution techniques to solve it.

Contents

Optimization problems and their modelling.
Linear programming.
Integer linear programming.
Decision trees: Value of information and value of perfect information.

Detailed program

1. Optimization problems and models:

- Problems of production, investment, facility location, assignment, transportation, flow, project planning
- Models based on continuous, integer or binary variables, formulation of objectives and constraints using

linear functions
- AMPL software

2. Linear Programming:
   * Fundamental theorem of linear programming
   * Duality and complementary slackness theorem
   * Bases: complementarity, degeneracy and optimality
   * Simplex algorithm
   * Sensitivity analysis
   * Hints of multi-objective linear programming
3. Integer Linear Programming:
   * Geometry of integer linear programming
   * Branch & Bound method
4. Decision trees:

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

Prerequisites

Linear algebra: sum and product between matrices, determinant and trace of a matrix, eigenvalues and eigenvectors of a matrix, solving linear systems. Basic notions of probability.

Teaching methods

The module will provide a teaching activity of 35 hours divided as follows:

- 25 hours of face-to-face lectures conducted in in-person delivery mode;
- 10 hours of exercises conducted in interactive in-presence mode.

Assessment methods

The exam consists of a compulsory written test (exercises as a check on disciplinary problem solving skills) and an optional oral test (interview on topics covered in class). The written test is designed to test knowledge of modeling and decision problem solving techniques introduced during the course and the ability to implement optimization models using AMPL software.

Two in-progress tests are conducted during the course in written form (exercises as a check of disciplinary problem solving skills) that can replace the conduct of the written test. The first test is given about halfway through the course and covers modeling optimization problems and Linear Programming; the second test is given at the end of the course and covers Integer Linear Programming and decision trees. In order to participate in the second test, the student must obtain a grade of 18 or higher in the first test.

Textbooks and Reading Materials

Reference books:

- F.S. Hillier, G.J. Lieberman, Ricerca Operativa - Fondamenti, McGraw-Hill, 2010.
- C. Vercellis, Ottimizzazione. Teoria, metodi, applicazioni, McGraw Hill, 2008.
- F. Schoen, Modelli di ottimizzazione per le decisioni, Esculapio, 2006.
- M. Pappalardo, M. Passacantando, Ricerca Operativa, Pisa University Press, 2012.

Additional material will be provided during the course in the form of slides and solved exercises.

Semester

First semester.

Teaching language

Italian.

Sustainable Development Goals

QUALITY EDUCATION