Universitat Autònoma de Barcelona

2017/2018

Operational Research

Code: 102150
ECTS Credits: 6

Degree	Type	Year	Semester
2501232 Business and Information Technology	OB	2	2

Contact

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Use of languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Teachers

Daniel Blabia Girau
Sergio Espluga Campabadal

Prerequisites

Basic knowledge of mathematics and quantitative techniques (equivalent to Mathematics II) would be advisable. Furthermore, a basic awareness of algorithmic techniques is equally convenient. Finally, the analysis of business and organizational situations in which the course focuses on requires a basic understanding of Business Economics.

Objectives and Contextualisation

This course constitutes, together with Introduction to Problem Solving and Algorithm Design, the "Quantitative Methods in Management" module.

The basic aims of the Operations Research (OR) course are:

- To introduce students to the methodological approach developed by OR professionals to help effective decision-making using quantitative methods;
- Study the key basic tools and techniques for solving optimization problems, including its main theoretical results and algorithms;
- Apply the studied methodologies to real life projects and problems arising in business and organizations, also making use of both generic and specific software tools (Excel, LINGO).

At the end of the course, students should be able to model real-world problems arising in businesses and organizations in which OR and optimization methods can be useful. In particular, they should be competent to decide on a significant set of items to include in the model, choose an appropiate type of mathematical model and use a computer to solve it and interpret the results, including sensitive analysis. They should also be able to present appropriate recommendations, both to OR professionals and to business managers. Moreover, they should be able to critically evaluate the use of OR models in the situations studied, considering the complexity and uncertainty of decision making in today's world.

Content

The course is organized around five units. The first one (unit 0) will be developed across the entire length of the course while the remaining four will be introduced in a more linear way.

Unit 0. Operational Research methodology
We will discuss the role of models in the decision-making process, together with the broad lines of the methodological process used in OR to help such process. It will involve the conceptual analysis of a project or problem, the use of various design tools to model it; as well as the process of definition, validation and planning the implementation of the recommended solution. Preparation and presentation of results, both in oral and written form, is also an important part of this process.

Unit 1. Multiple constraints on decision making: linear programming

The topic aims to the detailed study of linear programming, probably the most popular and widely used mathematical programming model. We will first study the basic features of linear problems and their solutions. Graphic resolution of two variable models will lead to the study of general algorithmic methods to compute optimal solutions (simplex method), and to the use of software. Sensitivity analysis is also considered, together with the review of several standard applications of linear programming.

Unit 2. Between the complexity for solving and the accuracy of the solution: Integer programming

The topic motivates the use of integer and binary programming models, as well as the difficulties inherent to different solving strategies. Basic branch and bound methods are presented and discussed.

Unit 3. Capturing significant non-linear features: Nonlinear programming

The unit presents some economic situations requiring relatively simple nonlinear models. We will review the theoretical conditions for finding the optimal solution (based on the Lagrange function and the Karush-Kuhn-Tucker conditions), and introduce the basic numerical methods for solving nonlinear problems in an algorithmic way.

Unit 4. Network models: a dissimilar decision-making tool

This last unit presents some of the key classical problems that can be modeled through the use of graphs (networks), as well as the main algorithms for solving them.