

27018 - Operations Research

Syllabus Information

Academic year: 2023/24

Subject: 27018 - Operations Research

Faculty / School: 100 - Facultad de Ciencias

Degree: 453 - Degree in Mathematics

ECTS: 6.0

Year: 3

Semester: First semester

Subject type: Compulsory

Module:

1. General information

Operations research is the discipline in which advanced analytical methods are applied to help make better decisions. Its objective is to provide future professionals with knowledge in the modeling of systems and in the techniques for solving the associated problems. Specifically, this subject deals with the treatment of problems that can be formulated as the optimization of a certain function that represents the objective to be achieved, subject to a set of constraints that represent the conditions under which the system can operate. These are the so-called deterministic models. The linear optimization model is studied in depth, with some particular cases of interest, and integer optimization is briefly introduced.

The approaches and objectives of this module are aligned with the Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda; the learning activities could contribute to some extent to the achievement of the goals 4 (quality education), 5 (gender equality), 8 (decent work and economic growth), and 10 (reducing inequality).

2. Learning results

- Understand problems from narrative statements and convert narrative statements to mathematical models.
- Identify convex sets and convex functions from their definition or characterizations.
- Determine extreme points and extreme directions of a polyhedron.
- Identify systems which can be modelled as linear problems.
- Formulate and solve linear optimization problems.
- Understand the theoretical workings of the simplex method for linear programming and perform iterations of it by hand.
- Formulate and solve the dual problem of a linear optimization problem and understand the relationship between a linear program and its dual.
- Perform sensitivity analysis.
- Formulate and solve specialized linear programming problems related to the transportation problem.
- Formulate some models of integer programming.
- Use specialized software to solve optimization problems.

3. Syllabus

1. Introduction. The methodology of operations research.
2. Convex analysis.
Convex sets. Polyhedra. Extreme points and extreme directions of a polyhedron characterization. Convex functions. Convex functions optimization.
3. Linear optimization.
Problem formulation. Basic concepts and fundamental theorems. The simplex algorithm.
4. Duality in linear optimization. Sensitivity analysis.
Theorems concerning primal and dual structures. The dual-simplex algorithm. Changes in the parameters of the linear optimization problem.
5. Special models in linear optimization.
Transportation, transshipment and assignment problems.
6. Introduction to integer programming.

Problem formulation. Branch and bound algorithm.

4. Academic activities

Master classes: 30 hours.
Problem solving: 24 hours.
Computer classes: 6 hours.
Study: 84 hours.
Assessment tests: 6 hours.

5. Assessment system

- A written theory test in October/November, on a date to be specified at the beginning of the course. If the student wishes, the score obtained will be saved for the first call of the course. Otherwise, this test can be repeated in the first official exam (20%).
- A final written exam of problems and theoretical-practical questions in the first official exam (80%).
- None of the previous scores are saved for the second official call, which consists of a written exam of theory and problems (100%).

According to the University regulations, the students can refuse the aforementioned system and take only the exams in the official periods as a global test.