27018 - Operations Research

Información del Plan Docente

Academic Year	2018/19
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

1.1.Aims of the course

To provide students with an introduction to optimization models, methods, and their applications. Students will develop the ability to conceptualize from real-world situations appropriate mathematical programming models. The students will model, analyze, solve, and interpret results of decision-making problems.

1.2.Context and importance of this course in the degree

1.3.Recommendations to take this course

It is recommended that students attend all classes. Students are expected to prepare the topics throughout the course and to do regular homework assignments to become familiar with the different concepts, some with economic implications, which are the core of the course.

2.Learning goals

2.1.Competences

2.2.Learning goals

At the end of the course, the student will be able to:

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.

Apply optimality conditions to get a local/global optimal solution of a nonlinear (continuous) optimization problem.

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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 of a linear optimization problem and understand the relationship between a linear program and its dual.

Perform sensitivity analysis.

Solve specialized linear programming problems like the transportation, thansshipment and assignment problems.

Formulate some basic models in integer programming.

Use specialized software to solve optimization problems.

2.3.Importance of learning goals

3.Assessment (1st and 2nd call)

3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

Laboratories and active participation during the classes (5%)

Midterm exam (15%).

Final exam (80%)

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as lectures, problem-solving sessions and laboratory sessions.

4.2.Learning tasks

This course is organized as follows:

- **Lectures**. (50% sessions) Lecture slides and other important materials will be posted in Moodle. Please check the platform regularly.
- **Problem-solving sessions**. (30% classes) Computer practice sessions in small groups
- **Laboratory sessions**. (20% sessions)

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- **Assessment tasks**. A midterm exam will take place as well as a final exam. Exams are closed book and closed notes.

4.3.Syllabus

This course will address the following topics:

- **Topic 1: Introduction to Operations Research.**
- **Topic 2: Convex Analysis.**
  - Convex sets.
  - Polyhedra.
  - Extreme points and extreme directions of a polyhedron.
- **Topic 3: Linear Optimization.**
  - Problem formulation.
  - Basic concepts and fundamental theorems.
  - The simplex algorithm.
- **Topic 4: Duality and Sensitivity Analysis.**
  - Formulation of the dual problem.
  - Primal-dual relationships.
  - The dual-simplex algorithm.
  - Sensitivity analysis.
- **Topic 5: Special Models in Linear Optimization.**
  - Transportation, transshipment and assignment problems.
- **Topic 6: Integer Programming.**
  - Problem formulation.
  - Branch and bound algorithm.
- **Topic 7: Introduction to Nonlinear Optimization.**
  - Unconstrained and constrained minimization.
  - Optimization of convex functions.
  - Karush-Kuhn-Tucker optimality conditions.

4.4.Course planning and calendar

The midterm exam will take place in November.

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course will be provided on the first day of class or please refer to the Faculty of Sciences website and Moodle.

4.5.Bibliography and recommended resources

Bazaraa, Mokhtar S.. Linear programming and network flows / Mokhtar S. Bazaraa, John J. Jarvis, Hanif D. Sherali . - 2nd. ed. New York [etc.] : Wiley & Sons, cop. 1990

Bazaraa, Mokhtar S.. Nonlinear programming : theory and algorithms / Mokhtar S. Bazaraa, Hanif D. Sherali, C. M. Shetty . - 3rd ed. Hoboken (New Jersey) : John Wiley & Sons, cop. 2006

Calvete Fernández, Herminia Inmaculada. Programación lineal, entera y meta : problemas y aplicaciones / Herminia I. Calvete Fernández, Pedro M. Mateo Collazos Zaragoza : Prensas Universitarias de Zaragoza, 1994

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Winston, Wayne L.. Operations research : applications and algorithms / Wayne L. Winston . - 4th ed. Belmont, California : Thomson/Brooks/Cole, cop. 2004