COURSE DATA

DATA SUBJECT

Code: 34178
Name: Models in operational research
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
1107 - Degree in Mathematics	Facultat de Ciències Matemàtiques	4	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1107 - Degree in Mathematics	Models of statistics and operations research	ELECTIVES

COORDINATION

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SUMMARY

This course extends the contents of the course on Mathematical Programming for those students interested in Optimization and its application to real problems in Economics, Logistics, Production, etc... in order to do that, this course reviews the basic concepts on modelling and problem solving in Linear Programming and extends them to Integer Linear Programming.

The two main aspects of this course are the modelling of real problems and the development of solution procedures for Integer Linear Programming. Starting from a deep knowledge of modelling techniques and solution methods, it will be possible to introduce some of the most important problems of Operations Research, such as Production, Transportation, and Inventory models.

In the final part of the course, we will introduce the basic concepts of Simulations, as an alternative to the Optimization methods.

According to the contents and objectives of this course, its main component is the student work, individually and in groups, modelling and solving real applications. For solvins the models, the students will

use available software.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

There are no specified enrollment restrictions with other subjects of the curriculum.

OTHER REQUIREMENTS

COMPETENCES / LEARNING OUTCOMES

1107 - Degree in Mathematics

Adapting to new situations.

Apply the knowledge in the professional world.

Argue logically in decision-making.

Capacity of abstraction and modeling.

Expressing mathematically in a rigorous and clear manner.

Knowing the time and the historical context in which occurred the great contributions of women and men in the development of mathematics.

Learn autonomously.

Participate in the implementation of software and learn mathematical software.

Reason logically and identify errors in the procedures.

Visualize and interpret the solutions obtained.

DESCRIPTION OF CONTENTS

1. Mathematical modeling

1.1 Course introduction
1.2 Optimization models
1.3 AMPL.

2. Linear Programming

2.1 Integer and binary variables.
2.2 Logic constraints.
2.3 Branch and bound algorithms.
2.4 Cutting planes algorithms.

3. Heuristic Algorithms

3.1 Introduction to algorithms.
3.2 Metaheuristics.
3.3 Artificial intelligence.

4. Supply Chain

4.1 Production planning
4.2 Transportation and network flows.

5. Extensions

5.1 Goal Programming
5.2 The Multi-Objective model.
5.3 Neural networks

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	37,50
Other activities	7,50
Computer classroom practice	15,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	45,00
Independent study and work	0,00
Preparation of lessons	15,00
Preparation for assessment activities	15,00
Resolution of case studies	15,00
Total hours	**90,00**

TEACHING METHODOLOGY

The classes will combine the theoretical and the practical part, without separating sessions devoted to theory from those devoted to practice. All the classes will be in a computer equipped classroom.

In the theoretical part of the classes, the teacher will introduce the concepts and methods of Integer Linear Programming and the Operations Research models, with examples and exercises to be solved by the students.

In the practical part, synchronized with the theory, the students will use the available software to model and solve real problems and interpret the results.

EVALUATION

The evaluation of the knowledge and skills attained by the students will be done in a continuous way throughout the course. The evaluation will have two components:

1.- Project: Algorithm coding: 30% of the final grade.

2.- Written final exam: 70% of the grade

In order to pass the course, it is necessary to get a minimal mark of 5 over 10 in the final exam.

The activities in part 1 are considered not-recoverable, that is, they cannot be evaluated by an exam. The marks will be kept for the whole academic year.

REFERENCES

- Cliff T. Ragsdale, Spreadsheet Modeling & Decision Analysis, A Practical Introduction to Business Analytics, 8th Edition, 2018. Cengage Learning.
- Winston, W.L. and Albright, W., Practical Management Science. Duxbury Press (2011), 4th edition.
- Duarte, A., M. Laguna, and R. Martí, Metaheuristics in Business Analytics, EURO Advanced Tutorials on Operations Research, Springer (2018).

- Eiselt, H.A., and Sandblom, C.L. Operations Research. A model-based approach. Springer (2012), 2nd edition.

- Sarker, R.A. and Newton, C.S., Optimization Modelling. A Practical Approach, CRC Press (2008)

- Hillier, F.S. y Lieberman, G.J.: Introducción a la Investigación de Operaciones. McGraw-Hill (2010), 9ª edición.

- Williams, H., Model Building in Mathematical Programming. Wiley (2013), 5th edition.

- Taha, H., Investigación de Operaciones. Pearson, Educación (2012), 9ª edición.