Optimization

Code: 101742
ECTS Credits: 6

2025/2026

Degree	Type	Year
Aeronautical Management	OB	3

Contact

Name: Enric Nart Viñals

Email: enric.nart@uab.cat

Teaching groups languages

You can view this information at the end of this document.

Prerequisites

Calculus-103815, and Linear Algebra-103814 .

Objectives and Contextualisation

Operations Research (or Operational Research) consists in applying mathematical, statistical and algorithmical models to help decision-making. Problems involving making decisions arise in fields as diverse as business administration, industrial engineering, or economics and they all share the common goal of resource efficiency.

This course aims to provide basic knowledge of optimization models required to pose and solve common operational problems in Aeronautical Management, such as scheduling, fleet management, routing, etc... In addition, the student will become capable of dealing with a wider range of distribution, logistics, and transportation problems(air, marine or rail cargo, urban freight, supply chain management, etc...).

Competences

- Allocate and manage aircraft turnaround resources efficiently.
- Apply specific software for solving problems in the aeronautical sector.
- Communication.
- Personal attitude.
- Personal work habits.
- Supervise the management of resources in an airport.
- Thinking skills.
- Use knowledge of the fundamental principles of mathematics, economics, information technologies and psychology of organisations and work to understand, develop and evaluate the management processes of the different systems in the aeronautical sector.
- Work in teams.

Learning Outcomes

1. Adapt to unexpected circumstances.

2. Apply the optimisation criteria efficiently.
3. Critically assess the work done.
4. Describe the fundamental principles of the use of optimisation and simulation environments.
5. Develop critical thought and reasoning.
6. Develop curiosity and creativity.
7. Develop independent learning strategies.
8. Develop scientific thinking skills.
9. Develop systemic thinking.
10. Develop the ability to analyse, synthesise and plan ahead.
11. Establish optimisation models for strategic-decision making.
12. Evaluate resource requirements to ensure quality in air transport operations.
13. Formulate and solve problems in aeronautical management.
14. Identify, manage and resolve conflicts.
15. Make decisions.
16. Make efficient use of ICT in communicating ideas and results.
17. Manage time and available resources. Work in an organised manner.
18. Plan activities in order to cope with the workload.
19. Prevent and solve problems.
20. Schedule aircraft turnaround operations.
21. Select optimisation tools suited to the types of problems to be solved.
22. Work cooperatively.
23. Work independently.
24. Working in complex or uncertain environments and with limited resources.

Content

Linear Programming.

Examples. Definitions.

The Simplex Method. Introduction.

The Simplex Method. Algorithm and tableau.

Duality and intro to Sensitivity Analysis.

Integer Programming.

Introduction.

The Branch and Bound Method.

Binary variables.

Linear Network Optimization.

Introduction and basic concepts.

The minimum-cost flow problem. The Network Simplex Algorithm.

The maximum flow problem. Ford-Fulkerson Algorithm.

Programming language for solving optimization problems.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Computer Lab	12	0.48	12, 11, 14, 21, 22
Lectures	26	1.04	12, 11, 14, 21, 22
Problem Sets	13	0.52	12, 11, 14, 21, 22
Type: Autonomous			
Out-of-class/online activities	89	3.56	12, 11, 14, 21, 22

Classroom hours, within the context of guided learning activities, consist of:

Lectures:

The instructor explains the basic concepts of the subject, providing examples and applications, and tailored to the mathematical background of the class. Attendance and participation in the classroom are taken into account. Also, students are expected to devote some out-of-class time to homework and readings in order to complement lectures.

Problem Sets:

Through exercices, students will improve their understanding of the lecture material and practice some problem-solving techniques.

Computer Labs :

Students learn a programming language, and how to use it to formulate and solve course exercices with the help of a computer.

Transversal Skills

Peer collaboration in Problem-Set as well as in Computer-Lab meetings, where joint discussion of course exercises takes place, helps to improve cooperative learning and teamwork skills(T03). The instructor provides the class with tools for both analysis and synthesis, which contribute to the enhancing of thinking habits (T01), communication, and individual creativity(T04,T06). The grading of the computer-lab and problem-set assignments should thus reflect the student's ability to communicate and engage in teamwork, in addition to personal attitude and study habits.

Teaching will be offered on campus or in an on-campus and remote hybrid format depending on the number of students per group and the size of the rooms at 50% capacity.

AI

En aquesta assignatura, es permet l'ús de tecnologies d'Intel·ligència Artificial (IA) com
a part integrant del desenvolupament del treball, sempre que el resultat final reflecteixi una contribució significativa de l'estudiant en l'anàlisi i la reflexió personal. L'estudiant haurà d'identificar clarament quines parts han estat generades amb aquesta tecnologia, especificar les eines emprades i incloure una reflexió crítica
sobre com aquestes han influït en el procés i el resultat final de l'activitat. La no transparència de l'ús de la IA es considerarà falta d'honestedat acadèmica i pot comportar una penalització en la nota de l'activitat, o sancions majors en casos de gravetat

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Computer-Lab assignments	20%	6	0.24	1, 2, 3, 12, 4, 8, 9, 10, 6, 5, 11, 16, 13, 17, 14, 18, 15, 21, 24
Graded Tasks	80%	4	0.16	1, 2, 3, 12, 4, 8, 9, 7, 10, 6, 5, 11, 16, 13, 17, 14, 18, 15, 19, 20, 21, 22, 23, 24

This subject does not offer a unique evaluation option

Course grade will be calculated as the weighted average of the scores obtained in the graded tasks. The percentage breakdown is the following:

Computer-Lab Assignments: 20% (3 assignments)

Midterm Exam: 30% (1 exam)

Final Exam: 50% (1 exam)

Exam Retake Option: There is only one possible retake for the two exams (80%). To be eligible to retake the final exam, you should have participated in graded tasks adding up to a minimum percentage of 70%.

If you fail the course, your grade will be the lowest value between 4.5 and the weighted average of all graded-task scores.

Graded-task schedule:

Graded-task dates(assingments and midterm exams) will be announced on Virtual Campus UAB and may be subject to change. Always log into Virtual Campus to check for schedule changes. Virtual Campus is the standard information sharing environment among students and teaching staff.

School policy on cheating :

Any dishonest behavior in order to get a grade higher than your own work merits will be considered cheating and will receive a zero score on the assignment or exam on which you cheated. Therefore, copying anothers's test, or allowing others to copy your work will result in failing the task with a zero score. Neither a make-up assignment nor a retake exam will be granted, and this will lead to failing the whole course.

Bibliography

Course material

Alabert, Aureli; Curs d'investigació Operativa. Apunts.
(http://mat.uab.cat/alabert/Docs/teaching/Optimisation.pdf)

Fourer, R., Gay, D.M. & Kernighan, B.W.; AMPL. A Modeling Language for Mathematical Programming. Pacific Grove: Thomson/Brooks/Cole, cop. 2003. (https://ampl.com/resources/the-ampl-book)

Suggested textbooks

Basart, Josep M.; Programació Lineal. Materials UAB 58, 2000.

Taha, Hamdy A.; Operations Research. Pearson Education, 8th. ed., 2007.

Additional readings

Bazargan, Massoud; Airline Operations and Scheduling. Ashgate, 2004.

Pujolar, David; Fundamentos de programación lineal y optimización de redes. Materials UAB 146, 2004.

Software

LibreOffice

AMPL

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	11	Catalan	first semester	afternoon
(PAUL) Classroom practices	12	Catalan	first semester	afternoon
(PLAB) Practical laboratories	21	Catalan	first semester	afternoon
(PLAB) Practical laboratories	22	Catalan	first semester	afternoon
(PLAB) Practical laboratories	23	Catalan	first semester	afternoon
(TE) Theory	11	Catalan	first semester	afternoon