Syllabus
2026 - 2027

TECHNICAL SHEET OF THE SUBJECT

Data of the subject	
Subject name	Operations Research
Subject code	E000013565
Mainprogram	Bachelor's Degree in Business Analytics
Involved programs	Grado en Análisis de Negocios/Bachelor in Business Analytics y Grado en Relaciones Internacionales [Third year] Grado en Análisis de Negocios/Bachelor in Business Analytics y Grado en Derecho [Fourth year] Grado en Análisis de Negocios/Bachelor in Business Analytics [Second year] Grado en Admin. y Dirección de Emp. y Grado en Análisis de Negocios/Bachelor in Business Analytics [Second year] Grado en Admin. y Dirección de Emp. y Grado en Análisis de Negocios/Bachelor in Business Analytics [Second year]
Level	Reglada Grado Europeo
Quarter	Semestral
Credits	6,0 ECTS
Type	Obligatoria (Grado)
Department	Departamento de Métodos Cuantitativos

Teacher Information	
Teacher	
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SPECIFIC DATA OF THE SUBJECT

Contextualization of the subject

Contribution to the professional profile of the degree

In the professional profile of a graduate in Business Analytics, this course aims to deepen and expand knowledge of mathematical techniques that support decision-making.

Upon completing the course, students will master the formulation and modeling of optimization and decision problems, understand the different modeling alternatives, and the existing techniques to solve operations research models. Specifically, the course aims for the student to be able to:

- Recognize the various fields in which operations management techniques are applied.
- Model systems characteristic of different business sectors using quantitative techniques.
- Understand and apply techniques used in decision-making that affect system behavior.
- Analyze and interpret the solutions obtained from the different applied techniques.
- Formulate and solve specific system models using an algebraic modeling language.
- Analyze and synthesize the information received and appropriately convey, both in written and verbal form, the content of the modeling practice performed.
- Learn to work in teams when conducting practical exercises.

Prerequisites

Basic knowledge of algebra, statistics, and calculus.

Competencies - Objectives

Competences

Learning outcomes

CN6	Resultados del proceso de Formación y de Aprendizaje: CN6. Conoce las herramientas matemáticas necesarias que les capacite para plantear y resolver los problemas reales planteados derivados del entorno empresarial.
HA6	Resultados del proceso de Formación y de Aprendizaje: HA6. Utiliza las herramientas y técnicas matemáticas más adecuadas a cada problema, implementarlas, interpretar adecuadamente los resultados y sus limitaciones, y comunicarlos a un público no técnico.
CM7	Resultados del proceso de Formación y de Aprendizaje: CM7. Usa herramientas y técnicas matemáticas para dar solución a problemas y toma de decisiones en un entorno de datos masivos tanto cuantitativos como cualitativos, así como es capaz de aprender y trabajar autónomamente en la sociedad de la información.
RA1	ÁLGEBRA RA.1. Ser capaz de analizar y sintetizar la información recibida en lenguaje matemático.
RA2	ÁLGEBRA. RA. 2. Conocer las herramientas básicas de algebra lineal.
RA1	CÁLCULO. RA.1 Ser capaz de analizar y sintetizar la información recibida en lenguaje matemático.
RA2	CÁLCULO. RA.2 Modelizar en términos del cálculo diferencial e integral en situaciones dependientes de varias variables.
RA1	INVESTIGACIÓN OPERATIVA RA. 1 Reconocer los campos en los que se aplican las técnicas de investigación operativa.
RA2	INVESTIGACIÓN OPERATIVA RA. 2 Comprender y aplicar los modelos matemáticos adecuados para la toma de decisiones cuando se posee gran cantidad de información.
RA3	INVESTIGACIÓN OPERATIVA. RA. 3 Analizar e interpretar las soluciones obtenidas.

RA1	MATEMATICAS FINANCIERAS. RA.1 Ser capaz de obtener información de operaciones financieras y, a partir de ella, identificar su estructura.
RA2	MATEMATICAS FINANCIERAS. RA.2 Conocer los modelos matemáticos que permiten analizar y comparar operaciones financieras ciertas

THEMATIC BLOCKS AND CONTENTS

Contents - Thematic Blocks
Topic 1. Introduction to Operations Research (6 hours)
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1.1. Stages of an Operations Research study. 1.2. Definition of an optimization problem. 1.3. Components of optimization models. 1.4. Critical use of generative artificial intelligence to support mathematical modelling: opportunities, limitations, and verification of results.
Topic 2. Linear, Integer, Mixed, and Nonlinear Models (20 hours)
2.1 Assumptions of linear models. 2.2 Linear models. Characterization of linear models. Types of linear models. Modeling and solving using a computer system. 2.3 Integer and mixed models. Characterization of integer and mixed models. Types of integer and mixed models. Branch and Bound solution method. Modeling and solving using a computer system. 2.4 Nonlinear models. Characterization of nonlinear models. Types of nonlinear models. Modeling and solving using a computer system.
Topic 3. Multicriteria Models (10 hours)
3.1 Characterization of multicriteria models. 3.2 Typology of multicriteria problems. Application of multicriteria models to sustainable resource allocation problems, jointly considering economic, environmental, and social criteria. 3.3 Solution methods. Epsilon method, Weighted method, Lexicographic method. 3.4 Modeling and solving using a computer system.
Topic 4. Project Planning and Resource Optimization (8 hours)
4.1 Basic definitions of project planning theory. Construction of networks to describe projects. 4.2 CPM (Critical Path Method) for project planning.

4.3 Application of linear programming to project planning. Modeling and solving using a computer system.

4.4 Project acceleration.

Topic 5. Decision-Making Criteria (8 hours)

5.1 Characterization of decision-making processes. Construction of decision matrices.

5.2 Deterministic criteria for decision-making using decision matrices.

5.3 Probabilistic criteria for decision-making under uncertainty.

5.4 Decision trees for decision-making under uncertainty.

Topic 6. Queueing Theory (8 hours)

6.1 Characterization of waiting phenomena.

6.2 Poisson model with a single server. M/M/1.

6.3 Poisson model with multiple servers. M/M/S.

TEACHING METHODOLOGY

General methodological aspects of the subject

Use of Generative Artificial Intelligence

Generative AI may be used as a learning support tool, particularly to explore and compare modelling ideas. Under no circumstances may it replace the student's mathematical reasoning, formal verification, or the implementation and validation of models using the GAMS software system.

When using AI tools, students must:

- Declare their use.
- Verify the results by implementing and running the models in GAMS, following the modelling procedures and structures covered in class, including tests and sensitivity analyses where appropriate.
- Justify the modelling decisions made and demonstrate an understanding of the solutions obtained.

AI tools may not be used to generate and submit solutions without the student's own analysis and validation. Nor may protected data or unauthorised teaching materials, including copyrighted materials, be uploaded to external tools. Students must use these tools critically, responsibly, and ethically, independently verifying the results obtained. Any use that contravenes these rules may be considered academic misconduct in accordance with University regulations.

Pedagogical Approach

The course methodology is inspired by the Ignatian Pedagogical Paradigm (Context–Experience–Reflection–Action–Evaluation). Drawing on situations from the professional field of *Business Analytics*, students engage with modelling and optimisation problems applied to real-world business contexts.

Practical activities combine model formulation and solution with critical reflection on the modelling decisions made, interpretation of results, and justification of the proposed solutions. Individual and group work encourages students to apply the knowledge acquired, exchange perspectives, and progressively develop their autonomy.

Assessment considers not only the correctness of the results, but also the student's understanding of the problem, reasoning skills, and ability to provide an appropriate justification of the approach followed, in line with a holistic approach to education.

In-class Methodology: Activities

1. **Lectures:** The instructor will explain the fundamental concepts of each topic, with particular emphasis on the most relevant aspects. This will be followed by a series of representative problems designed to help students identify the key elements involved in formulating and solving problems related to each topic.
2. **In-class problem solving:** In these sessions, problems previously assigned by the instructor and worked on by students will be discussed, corrected, and analysed. These problems will be similar to, or more complex than, those covered in each topic.
3. **Modelling activities:** These activities will be carried out individually and/or in groups and will require students to apply the concepts and techniques covered in the course to the formulation and solution of decision problems. The activities may include problems related to sustainable resource allocation and the consideration of economic, environmental, and social criteria, as well as tasks aimed at critically evaluating formulations proposed using generative artificial intelligence tools. In all cases, students will be required to interpret and justify their modelling decisions and verify the results using the appropriate software system.

Non-Presential Methodology: Activities

1. Individual study of the concepts presented during lectures.
2. Individual solution of practical problems, which will subsequently be reviewed and discussed in class.
3. Group problem-solving activities based on problems proposed by the instructor.
4. Completion of four individual practical assignments, corresponding to Topics 2, 3, 4, and 5. The third practical assignment will also require the preparation of a written report. The main objective of these activities is to develop a thorough understanding of the theoretical concepts covered in the course and the ability to apply this knowledge to solve different types of problems.

The main objective of independent study and non-classroom activities is to understand and consolidate the theoretical concepts covered in the course and to develop the ability to apply this knowledge to the solution of different types of problems.

SUMMARY STUDENT WORKING HOURS

CLASSROOM HOURS
Lecciones de carácter expositivo
56.00
NON-PRESENTIAL HOURS
Ejercicios y resolución de casos y de problemas
4.00
ECTS CREDITS: 6,0 (60,00 hours)

EVALUATION AND CRITERIA

The use of AI to produce full assignments or substantial parts thereof, without proper citation of the source or tool used, or without explicit permission in the assignment instructions, will be considered plagiarism and therefore subject to the

University's General Regulations.

Evaluation activities	Evaluation criteria	Weight
Final Exam	Understanding of concepts. Application of concepts to problem-solving. Analysis and interpretation of the results obtained.	50
Midterm	Two midterm exams will be conducted, accounting for a total of 35% of the final grade.	35
Completion of individual optimization exercises.	As a practical activity, students will carry out the mathematical formulation of the assigned problem, as well as its solution using the corresponding computer system.	15

Ratings

The final grade for the course in the regular assessment will be determined as a weighted average of continuous assessment and the final exam according to the following weights:

50% from continuous assessment, consisting of:

a) 15% based on the grades from assignments submitted throughout the course.

b) 35% based on two midterm exams.

50% from the final exam.

To calculate the final grade, a minimum score of 4.5 on the Final Exam is mandatory. If this minimum score is not achieved, the final grade will correspond to the score obtained on the Final Exam.

If a student has attended less than 80% of the in-person classes, they are not eligible to take the final exam.

For the retake assessment, the final grade will be the higher of the following two options:

The grade obtained by weighting the retake exam score (50%) and the accumulated continuous assessment score (50%).

The grade from the retake exam:

Similar to the final exam, a minimum score of 4.5 is required to consider either of the above options. If this minimum score is not achieved, the final grade will correspond to the score obtained on the retake exam.

BIBLIOGRAPHY AND RESOURCES

Basic Bibliography

F.S. Hillier, G.J. Lieberman Introduction to Operations Research, 9/e. McGraw-Hill Higher Education. 2014.

Betancourt, M.A (2020).Operations Research: Problems in Business Analytics. ISBN-13: **9788479915230**

Complementary Bibliography

1. Taha, H.A. (2017). Investigación de Operaciones, 10ª ed. Pearson. 2. Murty, K. G. (2010).

2.Optimization for Decision Making Linear and Quadratic Models. Springer Science+ Business Media.