



TECHNICAL SHEET OF THE SUBJECT

Data of the subject	
Subject name	Investigación Operativa/ Operations Research
Subject code	E000013565
Main program	Grado en Análisis de Negocios / Business Analytics por la Universidad Pontificia Comillas
Involved programs	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
<p>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.</p> <p>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:</p> <ul style="list-style-type: none">• 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)

Topic 1. Introduction to Operations Research (6 hours)

- 1.1. Stages of an Operations Research study.
- 1.2. Definition of an optimization problem.



1.3. Components of optimization models.

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.

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

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

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.



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Syllabus
2024 - 2025

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**