COURSE DATA

DATA SUBJECT

Code: 36507
Name: Advanced Operations Research Models
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2025-26

STUDY (S)

Degree	Center	Acad. year	Period
1332 - Degree in Business Intelligence and Analytics	Facultat d'Economia	2	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1332 - Degree in Business Intelligence and Analytics	Matemáticas Avanzadas	COMPULSORY

COORDINATION

BALLESTIN GONZALEZ FRANCISCO FELIPE

SUMMARY

The subject of "Advanced Operations Research Models" is a compulsory semester subject taught in the second year, first semester, of the Degree in Business Intelligence and Analytics / BIA.

This course delves into mathematical optimization concepts studied in the subject "Basic Models of Operations Research" and develops concepts and basic techniques of several important areas within Operational Research that are not covered in the first-year course. The subject is divided into three large blocks. The first introduces the design of heuristic and metaheuristic algorithms, necessary to solve many operational research problems and in particular some of the problems considered in the rest of the subject. In the second block, concepts and methods for multi-objective programming are developed. In this type of optimization one works with several criteria at the same time, something very present in practice. The block begins by studying necessary basic concepts, such as the efficient solution or the Pareto set. Next, some of the existing methods to solve these type of problems are studied.

In the last block, programming with uncertainty is studied, with the aim of providing the student with the appropriate mathematical and algorithmic instruments to tackle problems where some of the data is not deterministic, but contains significant variability.

The relevance of these problems and their frequent appearance in the economics and business world makes the capacities for abstraction, synthesis, and analysis for the right evaluation of the situation and the problem statement, as well as the knowledge of the resolution and analysis methods, fundamental skills that a good graduate of Business Intelligence and Analytics must possess.

PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

The knowledge corresponding to the subject " Basic Models of Operations Research " is taken for granted. This knowledge includes: the basic concepts of optimisation and modelling, as well as the use of Lingo / Gams and indexed syntax of Lingo / Gams.

COMPETENCES / LEARNING OUTCOMES

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Acquire basic training that can be used to learn new methods and technologies and to adapt to new situations in academic and professional areas.

Be able to access and manage information in different formats for subsequent analysis in order to obtain knowledge through data.

Be able to analyse and search for information from diverse sources.

Be able to apply analytical and mathematical methods for the analysis of economic and business problems.

Be able to define, solve and present complex problems systemically.

Be able to learn autonomously.

Be able to make autonomous decisions in digital environments characterised by the abundance and dynamism of data.

Be able to produce models, calculations and reports, and to plan tasks in the specific field of business intelligence and analytics.

Be able to solve problems and to communicate and spread knowledge, skills and abilities, taking account of the ethical, egalitarian and professional responsibility of the activity of business intelligence and analytics.

Be able to use ICT, both in academia and in professional practice.

Be able to work in a team demonstrating commitment to quality, ethics, equality and social responsibility.

Demonstrate skills for analysis and synthesis.

Express situations of uncertainty and randomness using mathematical, synthetic and graphic languages.

Know and know how to properly use the appropriate quantitative and qualitative methods to reason analytically, evaluate results and predict economic and financial magnitudes.

Know the basic concepts of logic, algorithmics, computational complexity and their application to business intelligence.

Make decisions under certainty and uncertainty.

Reach strategic diagnoses in complex and uncertain environments using appropriate methodologies.

Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.

Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.

Students must have acquired knowledge and understanding in a specific field of study, on the basis of general secondary education and at a level that includes mainly knowledge drawn from advanced textbooks, but also some cutting-edge knowledge in their field of study.

Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.

Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration.

DESCRIPTION OF CONTENTS

1. Design of algorithms: heuristic algorithms.

Coding. Constructive algorithms: intelligent, random, intelligent randomized. Local search.

2. Design of algorithms: metaheuristic algorithms.

Classification. Grasp, Genetic Algorithms. Other examples.

3. Multiobjective programming.

Basic concepts. Efficient solutions and Pareto points. Techniques for generating the efficient set: weighted sum method and epsilon-constraint method. A priori information techniques: goal programming. Other techniques. Use of computer software to solve problems.

4. Programming with uncertainty.

Introduction and basic concepts. Resolution methods. Practical applications. Introduction to fuzzy programming. Use of a computer program to solve problems.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	30,00
Computer classroom practice	30,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	15,00
Independent study and work	15,00
Preparation of lessons	30,00
Preparation for assessment activities	30,00
Resolution of case studies	0,00
Total hours	**90,00**

TEACHING METHODOLOGY

Theoretical classes:

The teacher will explain the different concepts, delving into those that are more difficult to understand. Examples will be provided, and students will be guided in their study through the materials available on the

virtual classroom and the reference manuals. Students will have the necessary materials to prepare for the next class.

Practical classes:

The practical classes will fundamentally address the aspects related to the different models and procedures studied in the theory, algorithm design, computer resolution and interpretation, applying all the relevant theory, of the results obtained. In each class the student must be able to defend the suitability of their own model and the decisions to be made in view of the results.

The theoretical and practical classes are completed with the proposal of individual and / or team exercises.

EVALUATION

a) Continuous Assessment (4 points)

It is divided into two parts:

1) Group work (1 point)

May require defense of developed positions. It is not recoverable.

2) Individual work (3 points)

The study of theoretical-practical exercises, the mathematical modeling of problems, their theoretical or computer resolution, including Lingo/Gams indexed syntax, and the interpretation and discussion of the results obtained will be assessed. Algorithm design and programming can also be assessed.

It is recoverable.Negative behavior can reduce the continuous evaluation mark.

b) Summary Test (6 points)

The proof of synthesis may contain theoretical-practical problems, modeling, algorithm design, and problems that require Lingo/Gams indexed syntax. In some cases, the help of the computer may be required for its resolution.

The final grade (out of 10) will be obtained as the sum of the synthesis test grade plus the group work grade plus the individual work grade.

The individual work part is recoverable. Whoever so wishes may ¿both in the first and second call¿ take an extra test to recover that part, the same day of the syntax test. Students who wish to recover that part must

notify at least five days in advance of their desire to recover it. For those people, that extra test will replace the grade of the individual work in the calculation of the final grade.

To pass the course, it will be necessary to meet two conditions: 1) pass the synthesis test, 2) the final grade must be at least 5 points out of 10.

If the 2 conditions are not met, the final grade may not exceed 4.5 points.

REFERENCES

- Hillier, F. S. y Lieberman, G. J. (2010): Introducción a la Investigación de Operaciones (9ª Edición). México, McGraw-Hill.
- Alonso-Ayuso, A., Cerdá, E., Escudero, L.F., Sala, R. (eds.) (2004) Optimización bajo incertidumbre Tirant lo Blanch. Valencia, España.
- Hillier, F. S. y Lieberman, G. J. (2002): Investigación de operaciones (7ª Edición). México, McGraw-Hill.
- Taha, H. A. (2004): Investigación de operaciones (7ª Edición). México, Pearson Education, Prentice Hall.
- Lai, Y. J., Hwang, C. L. (1992): Fuzzy Mathematical Programming: Theory and applications,. Springer, Berlin