COURSE DATA

Data Subject	
Code	36498
Name	Basic Operations Research Models
Cycle	Grade
ECTS Credits	6.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
1332 - Degree in Business Intelligence and Analytics	Faculty of Economics	1	Second term

Subject-matter

Degree	Subject-matter	Character
1332 - Degree in Business Intelligence and Analytics	2 - Matemáticas	Basic Training

Coordination

Name	Department
BALLESTIN GONZALEZ, FRANCISCO FELIPE	257 - Business Mathematics

SUMMARY

“Basic Models in Operations Research” is a six-month basic subject that is taught in the first year, second semester, of the Degree in Business Intelligence and Analytics.
In this subject the basic concepts and techniques of mathematical optimization are developed with the objective of providing the student with the appropriate mathematical tools in order to deal with the problem of assigning scarce resources to different alternative uses. Mathematical optimization techniques are needed to approach the theory of the firm, consumer theory, growth models, etc. Thus, the first topic of this subject introduces terminology and basic concepts of optimization. In the following topics, this knowledge is expanded and resolution techniques are developed so that, when faced with a practical real situation, the student knows how to formulate it, solve it, and interpret the obtained results.
Once the basic concepts have been introduced, non-linear programming is approached as the most general optimization problem, where interesting particular cases are addressed, such as unconstrained problems, problems with equality constraints (classical programming), and problems with non-negative variables, as well as the general case with constraints defined by inequalities. From topic 3, linear programming is addressed, where the fact that all the functions are linear allows the use of efficient methods different from those presented for the general case. The linearity also allows us to analyse the solution of the

problem in a more complete way, by means of sensitivity analysis. The special case where the problem variables can take only integer values is studied in the penultimate topic. The last topic handles structured problems of Combinatorial Optimisation.

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 "Mathematical models for management" is taken for granted. This knowledge includes: basic concepts of analysis (among them, partial derivatives calculation, gradient vector and Hessian matrix), graphical representation of scalar functions with one variable, and calculation of an inverse matrix and multiplication of matrices.

OUTCOMES

1332 - Degree in Business Intelligence and Analytics

- 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 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 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.
- Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.
- Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.
- 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 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 produce models, calculations and reports, and to plan tasks in the specific field of business intelligence and analytics.
- Be able to access and manage information in different formats for subsequent analysis in order to obtain knowledge through data.
- Be able to make autonomous decisions in digital environments characterised by the abundance and dynamism of data.
- Know and know how to properly use the appropriate quantitative and qualitative methods to reason analytically, evaluate results and predict economic and financial magnitudes.
- Be able to apply analytical and mathematical methods for the analysis of economic and business problems.
- Demonstrate skills for analysis and synthesis.
- Be able to analyse and search for information from diverse sources.
- Be able to learn autonomously.
- Be able to use ICT, both in academia and in professional practice.
- Be able to define, solve and present complex problems systemically.
- Be able to work in a team demonstrating commitment to quality, ethics, equality and social responsibility.
- Apply methods and techniques of analysis, synthesis and graphical representation by means of software tools.

LEARNING OUTCOMES

• Ability to recognize an economic problem from observing economic reality.
• Using basic quantitative tools and their application in the economic environment.
• Ability to select a theoretical framework for the development of the analysis.

• Being able to apply different methods and analysis techniques using computer programs.

DESCRIPTION OF CONTENTS

1. Introduction to Optimisation

Introduction: the problem and its parts. Basic concepts: feasible solution, classes of optimum and classification of problems. Convexity. Basic theorems. The modeling process. Syntax of the computer program.

2. Non-linear Programming

Introduction to convexity. Kuhn-Tucker conditions. Basic theorems of non-linear programming. Interpretation of Kuhn-Tucker multipliers. Modeling, interpretation and computer resolution of non-linear programming models: existence and globality of the solution and interpretation of the multipliers.

3. Linear programming

Basic feasible solutions. Fundamental theorems of Linear Programming. The Simplex algorithm. Sensitivity and post-optimization analysis. Modeling, computer resolution and interpretation of linear programming models. Advanced syntax of the computer program. Applications to the business environment.

4. Integer Linear Programming

Introduction. General formulation of linear integer problems. Method of branch and bound. Modeling, computer resolution and interpretation of linear integer programming models.

5. Structured problems in combinatorial optimisation

Problem of the shortest path. Problem of the spanning tree with minimum cost. Other problems.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	30,00	100
Computer classroom practice	30,00	100
Study and independent work	30,00	0
Preparation of evaluation activities	30,00	0
Preparing lectures	15,00	0
Preparation of practical classes and problem	15,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

The classes will be given in English.

Lectures:

The teacher will highlight the main aspects and those more difficult to understand, perform exercises and the study guide students through the materials available in the virtual classroom and reference manuals. After the class, the materials needed for the next class will be indicated, so that students can prepare for the session.
Practical classes:
Practical classes primarily will address issues related to modeling, computer resolution and interpretation, applying all relevant theory, of the results obtained. In each class, students should be able to defend the adequacy of its own model and to take decisions in the light of the results.
Theoretical and practical classes are completed with the proposed individual and/or group exercises.

EVALUATION

a) Continuous Assessment (4 points)

It is divided into two parts:

1) Group work (0.5 points)

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

2) Individual work (3.5 points)

The study of theoretical-practical exercises will be evaluated, the mathematical modeling of practical cases, where appropriate with summations, the modeling with indexed sitaxis of the computer program, its resolution with a computer and the interpretation and discussion of the results obtained.

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

b) Final Exam (6 points)

The synthesis test will consist of solving theoretical-practical problems and, where appropriate, mathematical modelling.

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 subject it will be necessary to meet three conditions: 1) pass the synthesis test, 2) obtain at least a 1.3 out of 3.5 in the individual work or in the recovery test, 3) the final grade must be at least 5 points out of 10.

If the 3 conditions are not met, the final grade may not exceed 4.5 points.

REFERENCES

Basic

- Font, B (2009): Programación matemática para la economía y la empresa. 2ª Edición. Laboratori de Materials, 1. Valencia, PUV.
- Ivorra, C. (2009): Programación matemática. (http://www.uv.es/~ivorra).
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- Meneu, R. (2013): Apunts de teoria de Matemàtiques II (http://roderic.uv.es/handle/10550/25760).
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- Mocholí, M. y Sala, R. (1999): Decisiones de optimización (2ª Edición). Valencia, Tirant lo Blanch.
- Vídeos docents de Matemàtiques II (2018). Projecte dInnovació Docent Preferències en l'aprenentatge de l'assignatura Matemàtiques II: Docència inversa i presencial amb aprenentatge cooperatiu.

Additional

- Arévalo, M. T., Camacho, E., Mármol, A. y Monroy, L. (2004): Programación matemática para la economía. Madrid, Delta Publicaciones.
- Barbolla, R., Cerdá, E. y Sanz, P. (2001): Optimización: Cuestiones, ejercicios y aplicaciones a la economía. Madrid, Pearson Education, Prentice Hall.
- Hillier, F. S. y Lieberman, G. J. (2002): Investigación de operaciones (7ª Edición). México, McGraw-Hill.
- Mocholí, M y Sala R (1993): Programación Lineal: Metodología y problemas. Madrid, Tebar Flores
- Taha, H. A. (2004): Investigación de operaciones (7ª Edición). México, Pearson Education, Prentice Hall.