COURSE DATA

Data Subject	
Code	36416
Name	Optimisation
Cycle	Grade
ECTS Credits	6.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
1406 - Degree in Data Science	School of Engineering	1	Second term

Subject-matter

Degree	Subject-matter	Character
1406 - Degree in Data Science	5 - Optimisation	Obligatory

Coordination

Name	Department
ALVAREZ-VALDES OLAGUIBEL, RAMON	130 - Statistics and Operational Research

SUMMARY

36416 Optimisation is a compulsory subject of the second term of the first year of the Degree in Data Science. From the mathematical foundations developed in the subjects 36408 Algebra and 36407 Mathematical Analysis, taught in the first term, the aim of the subject is to provide students with a practical knowledge of the basic methods of optimisation that appear in the advanced procedures of data analysis that will be developed throughout the Degree.

Theory lessons will be taught in Spanish and practical and laboratory lessons as according to the information sheet available on the web page of the degree

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

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

Other requirements

Basic knowledge of Linear Algebra and Differential Calculus is needed.

OUTCOMES

1406 - Degree in Data Science

- (CG01) Knowledge of basic subjects and technologies that enable students to learn new methods and technologies, and to provide them with versatility to adapt to new situations.
- (CG03) Capability to elaborate models, calculations, reports, to plan tasks and other works analogous to the specific field of data science.
- (CT01) To be able to access (bibliographical) information tools and appropriately use them in the development of their daily tasks.
- (CT03) Ability to defend your own work with rigor and arguments and to expose it in an adequate and accurate way with the use of the necessary means.
- (CE01) Ability to solve the mathematical problems that can be posed in data science and be able to apply knowledge on: linear algebra, differential and integral calculus and numerical methods and optimisation.
- (CE13) To know how to design, apply and evaluate data science algorithms for the resolution of complex problems.
- (CB2) 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.
- (CB5) Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.

LEARNING OUTCOMES

1.- To know how to build Optimisation models from the description of the problem to be solved, using the variables and appropriate restrictions in each case (competences B02, B05, T03).
2.- To be able to use the basic optimisation algorithms with and without constraints (competences B03, G01, T01, CE01, CE13).
3.- To know how to use the basic tools for solving the models of Linear Programming and Integer Linear Programming (competencies G01, T01, CE01, CE13).
4.- To know how to identify the complexity of a problem (competences B05, T03).
5.- To design and implement appropriate metaheuristic algorithms for each problem (competencies G03, T01, T03, CE01, CE13).

DESCRIPTION OF CONTENTS

1. Introduction to Optimisation

1.1. Basic optimisation problems
1.2. Construction of models
1.3. Cost functions

2. Unconstrained Optimisation

2.1. Optimality conditions
2.2. Search methods
2.3. Gradient method.
2.4. Newtons method

3. Constrained Optimisation

3.1. Method of penalties
3.2. Lagrange multipliers
3.3. Conditions of Karush-Kuhn_Tucker

4. Linear and Integer Programming

4.1. Linear Programming Models
4.2. Simplex Method
4.3. Integer Programming Models
4.4. Branch and Bound algorithms

5. Metaheuristic algorithms

5.1. Local search
5.2. Path-based algorithms
5.3 Population-based algorithms: Genetic algorithms

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	32,00	100
Laboratory practices	20,00	100
Classroom practices	8,00	100
Development of group work	35,00	0
Study and independent work	20,00	0
Preparation of evaluation activities	10,00	0
Preparing lectures	15,00	0
Preparation of practical classes and problem	10,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

MD1 - Theoretical activities. Expositive development of the subject (CG01) with the participation of students in the resolution of specific questions (CB02, CT03).

In those lessons, the topics of the course will be developed, encouraging the participation of students (CT03).

MD2 - Practical activities. Learning by solving problems, exercises and case studies through which competences are acquired on the different aspects of the course (CB02, CG03, CE01). Theoretical explanations are complemented by practical activities in order to apply the basic concepts and acquire an operational knowledge of the optimisation methods.

MD4 - Work in computer classroom. Learning by performing activities developed in small groups and carried out in computer classrooms (CB02, CB05, CG03, CT01, CT03, CE01, CE13).

In addition to classroom activities, students must perform work on their own, related to classroom practices, as well as preparing classes and exams (CG01). Some of these tasks will be carried out individually, in order to enhance autonomous work, but there will also be tasks that will require the participation of small groups of students (2-3) to promote the capacity for integration in work groups (CG03, CT03).

The Virtual Classroom of the Universitat de València will be used as a communication support with students. Through it they will have access to the didactic material used in class, as well as the problems and exercises to solve.

EVALUATION

The subject will be evaluated according to 3 types of aspects:
SE1 - Objective test, consisting of one or several exams that consist of both theoretical and practical issues and problems.
SE2 - Evaluation of practical activities based on the preparation of papers / reports and / or oral presentations.
SE3 - Continuous evaluation of each student, based on the participation and degree of involvement of the student in the teaching-learning process, taking into account the regular attendance at the planned classroom activities and the resolution of questions and problems proposed periodically.

In each of these aspects the following considerations will be taken into account:
SE-1: There will be an exam at the end of the term that will consist of both theoretical and practical questions and problems (assessment of competencies CB02, CB05, CG01, CG05, CT03, CE01, CE13).
SE-2: Evaluation of the tasks related to the computer practice (evaluation of competencies CB02, CB05, CG01, CG03, CT03, CE01, CE13).
SE-3: Continuous evaluation of each student considering two aspects:
SE-3-1 (50%): Regular attendance at the scheduled classroom activities (evaluation of competencies CB02, CG01).
SE-3-2 (50%): Resolution of questions and problems proposed in class (competences evaluation CB02, CG01, CT01).

The final grade of the course will be calculated as the weighted average of the 3 previous sections, according to the following criteria: SE-1 (50%), SE-2 (40%), SE-3 (10%)

Particular considerations on the evaluation:
- Non-recoverable sections: The criteria that evaluate the follow-up of the course during the school term are not recoverable later. These are: SE-3-1 and SE-3-2. The SE-2 criterion will be recoverable, only in the 2nd call, through an individual practical examination carried out in conditions equivalent to those of a practice, but with a time limitation and access to support materials.
- Sections that require a minimum grade: It is required to obtain a minimum grade of 4 (out of 10) in each of the following evaluation sections in order to pass the subject: SE-1 and SE-2.

In any case, the evaluation system will be governed by what is established in the Evaluation and Qualification Regulations of the University of Valencia for Degrees and Masters:

https://webges.uv.es/uvTaeWeb/MuestraInformacionEdictoPublicoFrontAction.do?accion=inicio&idEdictoSeleccionado=5639

REFERENCES

Basic

- Chong, E.K.P y Zak, S.H. An Introduction to Optimization, Wiley 4ª ed., 2013

- Pedregal, P. Introduction to Optimization, Springer, 2004.
- Bazaraa, M.S, Jarvis, J.J. y Sherali, H.D. Linear Programming and Network Flows, Wiley, 4ª ed., 2010
- Dhaenens, C. y Jourdan, L. Metaheuristics for Bid Data, Wiley, 2016.