Universidad Zaragoza

Academic Year/course: 2023/24

27308 - Mathematics II

Syllabus Information

Academic year: 2023/24
Subject: 27308 - Mathematics II
Faculty / School: 109 - Facultad de Economía y Empresa
228 - Facultad de Empresa y Gestión Pública
301 - Facultad de Ciencias Sociales y Humanas
Degree: 448 - Degree in Business Administration and Management
454 - Degree in Business Administration and Management
458 - Degree in Business Administration and Management
ECTS: 6.0
Year: 1
Semester: Second semester
Subject type: Basic Education
Module:

1. General information

Mathematics is a course in the degree of Business Management and Administration. This subject will support other key subjects such as Microeconomics, Macroeconomics and Econometrics.
The Mathematics course has two main objectives: to train students in mathematics and to train them for its use in their future profession. In addition to the objectives covered in Mathematics I, it seeks to develop a rigorous approach, the capacity for abstraction and the scientific method typical of Mathematics. Modeling techniques related to classical optimization, linear programming and dynamic analysis will be introduced.
These approaches are aligned with the Sustainable Development Goals (SDGs) of the UN Agenda 2030, since mathematical modeling can be applied to all 17 goals.
It is recommended to have coursed Mathematics I.

2. Learning results

At the end of the subject the students will be able to:
1.- Acquire skills in the use of mathematical language, both in comprehension and writing.
2.- Identify the fundamental elements of an optimization problem: variables, objective function and restrictions.
3.- Formulate static optimization problems with and without equality and inequality restrictions.
4.- Solve optimization problems graphically, when possible.
5.- Evaluate whether a mathematical program meets the conditions to be solved using the techniques studied.
6.- Distinguish between critical points and extreme or optimal points.
7.- Distinguish between local optima and global optima.
8.- Distinguish between necessary and sufficient conditions of local optimality.
9.- Calculate the critical points by solving the system of equations obtained by stating the first-order conditions of local optimality, both in problems without restrictions and with equality restrictions.
10.- Study critical points using second-order conditions, in problems without restrictions and with equality restrictions.
11.- Apply conditions that ensure the globality of the optima.
12.- Interpret the economic meaning of Lagrange multipliers in optimization problems with equality constraints.
13.- Evaluate whether a mathematical program is linear and solve it graphically, if possible, and using the simplex algorithm.
14.- Analyze the variation in the solution of a linear optimization problem in the face of changes in the data, without solving a new problem.
15.- Identify a dynamic process in an economic phenomenon and represent it using an ordinary differential equation, if possible.
16.- Understand the concept of solution of an ordinary differential equation and distinguish between general solution and particular solution.
17.- Distinguish between first order differential equation and linear differential equation of order n.
18.- Solve some first-order differential equations using the appropriate method.
19.- Distinguish the associated homogeneous equation in a linear differential equation with constant coefficients and calculate its general solution.
20.- Calculate a particular solution of a linear differential equation of constant coefficients.
21.- Calculate the general solution of a linear differential equation of constant coefficients.
22.- Calculate the solution of a linear differential equation of constant coefficients of order n with n initial conditions.
23.- Use qualitative analysis in simple dynamic models in an economic context to identify equilibrium and its long-term scope.
24.- Identify the fundamental elements in an economic problem, formalize it as a mathematical problem, solve it with the most appropriate tool and interpret the results in the original economic context.

3. Syllabus

Topic 1: Mathematical programs
1.1. General formulation of a mathematical program. Classification.
1.2. Definitions and properties. Weierstrass theorem.
1.3. Graphic solving.
1.4. Introduction to convexity:

1.4.1. Convex sets. Definition and properties.
1.4.2. Convex and concave functions. Definitions and properties.
1.4.3. Convex programs.
Topic 2: Programming without constraints
2.1. Problem's formulation.
2.2. Optimal locations:
2.2.1. First order conditions for the existence of local optimum.
2.2.2. Second order conditions for the existence of local optima.
23. Global optima: Convex programs.
Topic 3: Programming with equality constraints
3.1. Problem formulation.
3.2. Optimal locations:
3.2.1. First order conditions for the existence of local optimum.
3.2.2. Second order conditions for the existence of local optima.
3.3. Global optima: Convex programs and Weierstrass' Theorem.
3.4. Economic interpretation of Lagrange's multipliers.
Topic 4: Linear programming
4.1. Formulation of a problem of linear programming.
4.2. Solutions of a linear program. Basic feasible solutions.
4.3. Characterization of the optimal basic solutions. Simplex' algorithm.
4.4. Introduction to sensitivity analysis.
4.5. Introduction to the dual program.
Topic 5: Introduction to ordinary differential equations
5.1. Introduction to dynamic analysis.
5.2. Concept of differential equation, solution and types of solutions.
5.3. First order ordinary differential equations:
5.3.1. Separable equations.
5.3.2. Linear first order equations.
5.4. Linear differential equations of order n with constant coefficients.
5.5. Qualitative analysis: equilibrium points and stability.

4. Academic activities

They are proposed:

Lectures: 30 hours. The presentation of concepts, results and participatory resolution of exercises will be combined, in which the theoretical aspects will be immediately applied. Classes will be in person and will be taught to the entire group.
Practical classes: 30 hours, solving exercises and economic problems with the help of teachers. The exercises will be available in the url. Classes will be face-to-face and will be taught to half of the group.

Autonomous work: 84 hours
• Teaching works: up to 24 hours, in which various activities directed and reviewed by the teaching staff can be carried out.
• Study: from 60 hours.
Assesment: 6 hours
6 ECTS = 150 hours
In principle, the methodology for teaching assignment and its evaluation is planned to be face-to-face classes. However, if circumstances require it, they can be done online.

5. Assessment system

The evaluation will be GLOBAL, both in the first and second call, and will consist of a final exam to be taken in the period established by the Center. This exam will be carried out in writing and will evaluate the proposed learning results through theoretical, practical and/or theoretical-practical questions that will adjust to the subject taught. It will be scored out of 10 points. Furthermore, in the first call, there is the possibility of taking an intermediate voluntary test valued at 5 points. This test will evaluate knowledge of the subject corresponding to topics 1, 2 and 3 of the program, and will be carried out on the date and place that the teacher, with sufficient advance notice, indicates in the classroom and/or teaching platforms of the teaching staff. Students who obtain a grade greater than or equal to 50% of the grade (2.5 points out of 5) in said test may choose to eliminate said subject from the global exam of the first call and take the exam only on the remaining contents (valued at 5). points); in which case the grade corresponding to the eliminated subject will be transferred to the global exam grade. To pass the subject the student must obtain a minimum of 5 points out of 10. To be eligible for this form of evaluation, it is mandatory to actively participate and solve the questions, exercises and tests that will be carried out in the face-to-face classes according to the instructions that the teacher responsible for each group of the subject will present on the day of its presentation. In this case it is necessary to participate in at least 75% of the proposed activities.
Evaluation criteria
It will be evaluated whether the student has acquired the learning results set out above. In particular, the following aspects will be assessed:
1. The correct use of mathematical language writing.
2. Logical reasoning in the approach and resolution of problems.
3. The reference to the theoretical content that is used, if notable.
4. Choosing the appropriate method to solve the problem.
5. Clarity in the application of mathematical concepts and procedures.
6. The correct expression in the results obtained when solving problems.
7. The interpretation of the results in the context of the problem posed, if applicable.