Universidad Zaragoza

Academic Year/course: 2024/25

27608 - Mathematics II

Syllabus Information

Academic year: 2024/25
Subject: 27608 - Mathematics II
Faculty / School: 109 - Facultad de Economía y Empresa
Degree: 450 - Degree in Marketing and Market Research
ECTS: 6.0
Year: 1
Semester: Second semester
Subject type: Basic Education
Module:

1. General information

Mathematics instruction in this year has two main goals: to train students in mathematics and to train them for use in their future profession. In addition to the goals covered in Mathematics I, the aim is to develop a rigorous approach , abstraction capacity and the scientific method characteristic of Mathematics. Modeling techniques related to classical optimization, linear programming and dynamic analysiswill be introduced at.

These approaches are aligned with the Sustainable Development Goals (SDGs) of the UN's 2030 Agenda, as the mathematical modeling can be applied to all 17 goals.

It is recommended to have acquired the necessary knowledge to pass the subject Mathematics I.

2. Learning results

In order to pass this subject, the student should demonstrate the following results:

- Has acquired proficiency in the use of mathematical language, both in its comprehension and writing.
- Identifies the fundamental elements of an optimization problem: variables, objective function and constraints.
- It poses static optimization problems without constraints and with equality and inequality constraints.
- Solve graphically, where possible, an optimization problem.
- Assesses whether a mathematical program meets the conditions to be solved using the techniques studied.
- Distinguish between critical and extreme or optimal points.
- Distinguishes between local optima and global optima
- Distinguishes between necessary conditions and sufficient conditions of local optimality
- Calculate the critical points by solving the system of equations obtained by posing the first order conditions of local optimality, both in the unconstrained case and in the case of equality constraints.
- Study the critical points obtained using the second order conditions, both in the case of unconstrained optimization problems and in the case of problems with equality constraints.
- It applies the conditions that ensure the globality of the optimums.
- Interpret the economic significance of Lagrange multipliers obtained in an optimization problem with equality constraints.
- Evaluates whether a mathematical program is linear and solves it graphically, if possible, and by means of the simplex algorithm.
- Analyze the variation in the solution of a linear optimization problem in the presence of a modification in some data of the problem without the need to solve a new problem.
- Solve, using appropriate computer programs, an optimization problem and interpret the results obtained.
- Identify a dynamic process in an economic phenomenon and represent it if possible by means of an ordinary differential equation.
- Understands the concept of solution of an ordinary differential equation and distinguishes between a general solution and a particular solution.
- Distinguish between first order differential equation and linear differential equation of order n.
- Solve some first order differential equations using the appropriate method.

- Distinguish in a linear differential equation of constant coefficients, the associated homogeneous equation and calculate its general solution.
- Calculate a particular solution of a linear differential equation of constant coefficients.
- Calculate the general solution of a linear differential equation of constant coefficients.
- Calculate the solution of a linear differential equation of constant coefficients of order n with n initial conditions.
- Is able to relate the different topics covered in the course.

3. Syllabus

UNIT 1: Mathematical programs

1.1. General formulation of a mathematical program. Classification.

1.2. Definitions and properties. Weierstrass theorem.

1.3. Graphic resolution.

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.

UNIT 2: Unrestricted programming

2.1- Problem formulation.

2.2- Optimal premises:

2.2.1. First-order conditions for the existence of local optimality.

2.2.2. Second-order conditions for the existence of local optimality.

2.3- Global optimums: Convex programs.

UNIT 3: Programming with equality constraints

3.1- Problem formulation.

3.2- Optimal premises:

3.2.1. First-order conditions for the existence of local optimality.

3.2.2. Second-order conditions for the existence of local optimality.

3.3- Global optimums: Convex programs and Weierstrass Theorem.

3.4- Economic interpretation of Lagrange multipliers.

UNIT 4: Linear programming

4.1- Formulation of a linear programming problem.

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.

UNIT 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. Equations in separate variables.

5.3.2. First order linear equations.

5.4- Linear differential equations of order n with constant coefficients.

5.5- Qualitative analysis: break-even points and stability.

4. Academic activities

To facilitate the students' achievement of the planned learning outcomes, it is proposed:

Master classes: 30 hours, in which the presentation of concepts and results will be combined with the participatory resolution of exercises, in which the theoretical aspects explained will be immediately applied. These classes will be in person and will be taught to the entire group.

Practical classes: 30 hours, in which the students will solve, with the help of the teacher, more complete exercises and economic problems. These classes will be in person and will be taught to half of the group.

Other activities (Tutorials, Personal Study,

Assignments, Seminars, Evaluation tests,...): 90 hours.

6 ECTS = 150 hours

In principle, the methodology for teaching teaching and its evaluation is planned to revolve around face-to-face classes. However, if circumstances require it, they can be done online.

5. Assessment system

The evaluation will be global, both in first and second call, and will consist of a final exam to be taken on the dates established by the Center. This exam will be written and will evaluate the proposed learning results by means of theoretical, practical and/or theoretical-practical questions that will be adjusted to the subject matter. Scoring out of 10 points.

In addition, in the first call, there is the possibility of taking a voluntary intermediate test valued at 5 points.

This test will evaluate the knowledge on the subject corresponding to topics 1, 2 and 3 of the program, and will be carried out on the date and place that the professor, with sufficient notice, will indicate in the classroom and/or teaching platforms of the teaching staff. The students who obtain in this test a grade higher or equal to 50% of the grade (2.5 points out of 5) may choose to eliminate this subject from the global exam of the first call and only examine the remaining contents (valued at 5 points); in which case the grade corresponding to the eliminated subject will be transferred to the grade of the global exam . To pass the subject the student must obtain a minimum of 5 points out of 10. In order to be eligible for this form of assessment, it is compulsory to actively participate and solve the questions, exercises and tests that will be proposed in the classes according to the indications that the lecturer responsible for each group of the subject will give on the day of the presentation of the subject. In this case it is necessary to participate in at least 75% of the proposed activities.

Assessment Criteria:

It will be assessed whether the student has acquired the learning results outlined above. In particular, the following will be valued following aspects:

- The correct use of writing mathematical language.
- Logical reasoning in the approach and resolution of problems.
- The reference to the theoretical content used is noteworthy.
- The choice of the appropriate method for solving the problem.
- Clarity in the application of mathematical concepts and procedures.
- The correct expression in the results obtained when solving problems.
- Interpretation of the results in the context of the problem posed, if applicable.

6. Sustainable Development Goals

4 - Quality Education
8 - Decent Work and Economic Growth
9 - Industry, Innovation and Infrastructure