Universidad Zaragoza

Academic Year/course: 2024/25

27508 - Mathematics II

Syllabus Information

Academic year: 2024/25
Subject: 27508 - Mathematics II
Faculty / School: 109 - Facultad de Economía y Empresa
Degree: 449 - Degree in Finance and Accounting
ECTS: 6.0
Year: 1
Semester: Second semester
Subject type: Basic Education
Module:

1. General information

Mathematics instruction in this course has two main objectives: 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 analysis will be introduced.

These approaches and goals are aligned with the Sustainable Development Goals (SDGs) of the United Nations Agenda 2030 (https://www.un.org/sustainabledevelopment/es/), in particular, the activities planned in the subject will contribute to the achievement of goals 4, 8 and 9.

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

2. Learning results

The student, in order to pass this subject, must demonstrate the following results:

1. Has acquired proficiency in the use of mathematical language, both in its comprehension and writing.

2. Identifies the fundamental elements of an optimization problem: variables, objective function and constraints.

3. It poses static optimization problems without constraints and with equality and inequality constraints.

4. Solve graphically, where possible, an optimization problem.

5. Assesses whether a mathematical program meets the conditions to be solved using the techniques studied.

6. Distinguish between critical and extreme or optimal points.

7. Distinguishes between local optima and global optima

8. Distinguishes between necessary conditions and sufficient conditions of local optimality

9. 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.

10. It studies the critical points obtained using the second-order conditions, both in the case of problems of unconstrained optimization as in the case of problems with equality constraints.

11. It applies the conditions that ensure the globality of the optima.

12. Interpret the economic significance of the Lagrange multipliers obtained in an optimization problem with equality constrains.

13- Evaluates if a mathematical program is linear and solves it graphically, if possible, and by means of the algorithm of the simplex.

14- Analyzes the variation in the solution of a linear optimization problem in the face of a change in some data of the problem without the need to solve a new problem.

15- Solves, using appropriate computer programs, an optimization problem and interprets the results obtained.

16- Identify a dynamic process in an economic phenomenon and represent it if possible by means of an ordinary differential equation.

17- Understands the concept of solution of an ordinary differential equation and distinguishes between general solution and particular solution.

18- Distinguish between first order differential equation and linear differential equation of order n.

19- Solve some first order differential equations using the appropriate method.

20- Distinguish in a linear differential equation of constant coefficients, the associated homogeneous equation and calculate its general solution.

21- Calculate a particular solution of a linear differential equation of constant coefficients.

22- Calculate the general solution of a linear differential equation of constant coefficients.

23- Calculate the solution of a linear differential equation of constant coefficients of order n with n initial conditions.

24- 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:

c1 Convex sets. Definition and properties.

c1 Convex and concave functions. Definitions and properties.

c2 Convex programs.

Unit 2: Unrestricted programming

2.1. Problem formulation.

2.2. Optimal points:

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

c3 Second-order conditions for the existence of local optimality.

2.3. Global optima: Convex programs.

Unit 3: Programming with equality constraints

3.1. Problem formulation.

3.2. Optimal points:

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

c.4. Second-order conditions for the existence of local optimality.

3.3. Global optima: 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:

c1 Equations in separate variables.

c1 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

Master classes: 30 hours

Practical classes: 30 hours

Other Activities (Tutorials, Personal Study, Papers, Seminars, Evaluation Tests, ...): 90 hours

6 ECTS= 150 hours

In principle, the teaching methodology and its evaluation is planned to be based on face-to-face classes . However, if circumstances so require, they may be carried out online

5. Assessment system

The evaluation will be **GLOBAL**, both in first and second call.

Two types of evaluation activities are foreseen:

- Computer test (PI) to be carried out in the computer classroom, in which students must apply the computer tools to the mathematical concepts developed in the course (Chapters 1 to 5) with the Free Software wxMaxima, GeoGebra or other legally licensed software. In the computer tests, the use of the functions of these programs related to the mathematics of the subject, the numerical and/or symbolic results obtained, as well as and their interpretation and conclusions will be assessed. The level of exigence will be similar to that of the material seen in class.
- Written test (PE) in which the students will have to solve several theoretical, theoretical-practical and practical questions and problems related to the application of the mathematical techniques presented in Chapters 1 to 5. In each problem there will be several sections in the resolution of which the mathematical approach to the problem, the use of mathematical notation and terminology, the correct numerical and/or symbolic solving and the interpretation/comparison of the results obtained will be evaluated. The level of exigence will be similar to that of the material seen in class.

Each test will be graded on a scale of 0 to 10 points.

The part of the subject evaluated by means of computer tests (PI) will have a weight of 60% in the overall grade, while the part evaluated by means of a written test (PE) will have the remaining 40%. In order to pass the course a minimum of 3 points in each of the parts (PI and PE) and a score of 5 points or more out of 10 in the final grade will be required. The final grade will be obtained as follows: FINAL_GRADE = 0.6*PI + 0.4*PE.

In addition, in the FIRST CALL there is the possibility of taking a voluntary intermediate test valued 5 points, which includes both the computer and written parts. This test will evaluate the knowledge on the subject corresponding to the chapters 1 to 3 of the program of the subject and will take place during class time. If a grade higher or equal to 50% of the grade is obtained in this test (2.5 points out of 5 in total, weighting 60% the computer part and 40% the written part), the student may choose to eliminate this material from the global exam of the first call and examine only the remaining contents (valued 5 points); in this case the grade corresponding to the eliminated subject will be transferred to the grade of the global exam. If the student obtains a grade higher or equal to 50% of the grade (2.5 points out of 5) and wants to take the whole of the global test, the better of the two grades in the first part will be considered to calculate the total maximum.

In order to be eligible for the intermediate voluntary test, it is mandatory to actively participate and solve the questions, exercises and tests that will be proposed in the face-to-face classes (minimum 75%), according to the indications that the professor responsible for each group of the subject will tell the day of the presentation of the subject.

It should be taken into account that academic years close the evaluation processes, which means that merits from one year cannot be claimed for evaluations in subsequent academic years.

Valuation Criteria:

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

1. The correct use of writing mathematical language.
2. Logical reasoning in the approach and resolution of problems.
3. The reference to the theoretical content used is noteworthy.
4. The choice of the appropriate method for solving the problem
5. Clarity in the application of mathematical concepts and procedures.
6. Calculations carried out with care.
7. The correct expression in the results obtained when solving problems.

6. Sustainable Development Goals

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