Universidad Zaragoza

Academic Year/course: 2023/24

27402 - Mathematics I

Syllabus Information

Academic year: 2023/24
Subject: 27402 - Mathematics I
Faculty / School: 109 - Facultad de Economía y Empresa
Degree: 417 - Degree in Economics
ECTS: 6.0
Year: 1
Semester: First semester
Subject type: Basic Education
Module:

1. General information

Mathematics subjects are, for future economics graduates, a methodological working tool that should support other subjects that form the distinctive core of their training, such as microeconomics, macroeconomics, econometrics, etc,

The general objective of this subject is to study economic problems from a formal point of view, i.e., to model the economic reality in order to understand it and give a scientific explanation of what has happened, as well as to try to predict what is going to happen.

Specifically, Mathematics I aims to broaden mathematical knowledge of matrix calculus and functions of one variable and to introduce the study of functions of several variables, thus preparing the student to assimilate in Mathematics II (taught in the second semester of the same year) the mathematical tools more used in economic analysis, mainly in the field of Economic Theory and Econometrics. This first mathematics subject helps the student to move from the fundamentally calculative knowledge of mathematics in secondary education to the rigor and abstraction of the scientific field of mathematics, which will allow them to face other subjects of the degree that use mathematical apparatus and future challenges in their profession. At the end of the subject, the student will know with certain precision the mathematical language, which will allow them to understand economic concepts and interpret results with certain rigor, and will know a set of instruments and calculation methods that will allow them to solve simple economic problems.

These approaches and goals are aligned with the Sustainable Development Goals (SDGs) of the 2030 Agenda of the United Nations () Agenda (https://www.un.org/sustainabledevelopment/es/), in particular, the activities planned in the subject will contribute to the achievement of Goals 1-17, as mathematical modelling can be applied in all of them

It is advisable that at the beginning of this subject the students have skills in the handling of arithmetic operations, matrices and real functions of a real variable, at the level of the knowledge acquired in the subject of Baccalaureate Mathematics Applied to Social Sciences II.

2. Learning results

At the end of the subject the students will be able to:

1. Use mathematical language with some proficiency, both in understanding and writing.

2. Distinguish when the relationships between the variables of a problem are linear or nonlinear and use the appropriate mathematical tool for their representation.

3. Use matrix notation and calculus to represent and solve an economic problem in which the relationships between variables are linear.

4. Solve a system of compatible linear equations using the most appropriate method and interpret its solutions in the context from which it comes if it is the case.

5. Determine if a square matrix is diagonalizable and diagonalize it if necessary.

6. Apply the diagonalization of square matrices in the economic context, for example, in the study of a long-run dynamic process.

7. Identify a quadratic form and determine its sign with the most appropriate procedure.

8. Differentiate between endogenous and exogenous variables in an economic phenomenon and represent the relationships between them by means of functions.

9. Understand the meaning of the mathematical concepts of continuity and differentiability in the economic context.

10. Calculate partial derivatives and interpret them in the economic field.

11. Recognize the chain dependency of different variables and calculate the variation of the final variables with respect to any of the initials.

12. Recognize whether a function is given in explicit or implicit form and obtain the partial derivatives, in either case.

13. Recognize when a function is homogeneous and the implications of this property, in particular in the context of production functions.

14. Recognize the mathematical tool that allows to determine a total magnitude from the corresponding partial one.

15. Understand the concepts of primitive of a function and indefinite integral.

16. Identify and apply the most appropriate method to calculate the indefinite integral of a function.

17. Understand the geometric meaning of the definite integral: Riemann integral.

18. Apply Barrow's rule for the calculation of the definite integral.

19. Identify the fundamental elements in a problem of an economic nature, formalize if possible such phenomenon in a mathematical problem, solve such mathematical problem with the most appropriate method or tool and interpret the result in the original economic context.

3. Syllabus

Unit 1. Matrices

1.1. Determinants. Applications: calculating the rank of a matrix, calculating the inverse matrix and Cramer's Rule.

1.2. R*n*: Generator systems. Basis.

1.3. Diagonalization of square matrices:

1.3.1. Eigenvalues and eigenvectors of a square matrix: definition and calculation.

1.3.2. Diagonalization of a square matrix.

1.3.3. Application to the calculation of matrix powers.

Unit 2. Real quadratic forms

2.1. Quadratic forms: definition. Matrix expression and polynomial expression.

2.2. Diagonal expression of a quadratic form.

2.3. Classification of a quadratic form according to its sign.

2.4. Restricted quadratic forms.

Unit 3. Functions of R*n* in R*m*

3.1. Preliminaries: topological concepts.

3.2. Functions: domain, range and graph. Level sets of scalar functions.

3.3. Continuity of a function.

3.4. Derivation of a function. Partial derivatives. Gradient vector. Jacobian matrix.

3.5. Differentiable function. Directional derivative of differentiable functions.

3.6. Derivation of composite functions: Chain rule. Tree diagrams.

3.7. Higher order derivatives. Schwartz theorem. Hessian matrix. Taylor's Theorem.

3.8. Implicit function theorem. Derivation of implicit functions.

3.9. Homogeneous functions. Euler's Theorem.

3.10. Basic methods of integration of a function of one variable. Barrow's rule.

4. Academic activities

To facilitate student achievement of the intended learning results the following 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 will be applied immediately. These classes will be face-to-face and will be taught to the whole group.

Practical classes: 30 hours, in which the students will solve, with the help of the teacher, more complete exercises and problems of an economic nature. These exercises can be found on the URL. These classes will be face-to-face and will be taught to half of the group .

Personal work:

- **Teaching assignments: u**p to 24 hours, in which various activities directed and reviewed by the faculty may be carried out
- **Study**: from 60 hours.

Assessment tests. 6 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**, and will consist of a final exam to be taken in the period 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. Grading is out of 10 points.

In addition, in the **first call**, there is the possibility of **taking a voluntary midterm test** valued at 5 points. This test will evaluate the knowledge on the subject corresponding to topics 1 and 2 of the program, and will take place on the date and place that the teacher, with sufficient notice, will indicate in the classroom and/or teaching platforms of the faculty.

The students who obtain in this test a grade higher than or equal to 50% of the grade (2.5 points out of 5) may choose to eliminate these topics from the global exam of the first call and only take an exam on the remaining contents (valued at 5 points). In this case, the grade corresponding to the eliminated topics 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 carried out 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 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. The correct expression in the results obtained when solving problems.
7. Interpretation of the results in the context of the problem posed, if applicable.