Universidad Zaragoza

Academic Year/course: 2024/25

27302 - Mathematics I

Syllabus Information

Academic year: 2024/25
Subject: 27302 - Mathematics I
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: First semester
Subject type: Basic Education
Module:

1. General information

Mathematics subjects are, for future graduates in Business Administration and Management, a methodological work instrument that should serve as support to other subjects, such as Microeconomics, Macroeconomics, Econometrics, etc.
The general aim of these subjects is to study the economic problems from a formal point of view, that is to say, to model the economic reality in order to understand it, and to provide a scientific explanation of what happened and also to try to predict what is going to happen.

In particular, the course Mathematics I is intended to extend mathematical knowledge of the matrix calculation and functions of one variable and introducing the study of functions of several variables, thus preparing the student to assimilate in Mathematics II, taught in the second semester of this year, mathematical tools used in economic analysis, mainly in the field of economic theory and Econometrics. This first course helps the students to take off their knowledge of mainly operational tools of mathematics in high school, to the rigor and abstraction of the scientific field of mathematics, allowing them to deal with other subjects of the degree that use mathematical apparatus and future challenges within their profession. At the end of the course the student will know with some precision the mathematical language, which will allow the students to understand economic concepts and interpret results with some rigor, and meet a set of instruments and methods that will allow them the resolution of simple economic problems.

These objectives are aligned with the Sustainable Development Objectives (ODS) of the United Nations 2030 agenda (https://www.un.org/sustainabledevelopment/es/), in particular, the tasks planned in this subject will contribute to the achievement of objectives 1-17 since in all of them mathematical modelizations can be formulated.
Students should have the level of skills required by the subject “Mathematics Applied to Social Sciences II” (Spanish Secondary Education) in arithmetic operations, matrix theory, and calculus of real-valued functions of one real-valued variable.

2. Learning results

At the end of the course, students will be able to:1: use mathematical language, both in comprehension and writing.
2: distinguish whether the relations between variables in a problem are linear or non-linear, and to be able to represent the different cases by means of a suitable mathematical tool.
3: use matrix notation and matrix calculus to represent and solve a problem of an economic nature with linear relations between variables.
4: know how to solve a consistent system of linear equations by the most suitable method and be able to interpret the solutions in accordance with the underlying context.
5: identify a diagonalisable square matrix and diagonalise a square matrix when this is possible.
6: apply matrix diagonalisation to an economic context, such as the study of a dynamical process in the long run.
7: identify a quadratic form and determine its sign by the most suitable method.
8: distinguish the endogenous and exogenous variables of an economic system and to know how to use functions to represent the relations between these variables.
9: understand the concepts of continuous and differentiable function applied to an economic context.
10: be skilled in calculating partial derivatives and in their interpretation in Economics.
11: identify the chained dependency between different variables and to know how to calculate the variation in the final variables with respect to any of the initial ones.
12: distinguish whether a function is written in explicit or implicit form and to know how to obtain the partial derivatives in both cases.
13: identify a homogeneous function and its implications, in particular, in the scenario of production functions.
14: know which mathematical tool allows the recovery of a total magnitude from the corresponding marginal magnitude.
15: understand the concepts of primitive function and indefinite integral.
16: identify whether the indefinite integral of a function can be obtained by basic integration and to be able to work it out by using the table of basic integrals. Identify the most adequate method for computing the indefinite integral of a function.
17: understand the geometrical interpretation of the Riemann definite integral.
18: apply the second fundamental theorem of calculus to obtain the value of a definite integral.

3. Syllabus

Topic 1. Matrices
1.1. Determinants. Applications: calculation of the rank of one matrix, calculation of the inverse matrix and Cramer's Rule.
1.2. Rn: Generating systems. Bases.
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.

Topic 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. Constrained quadratic forms.

Topic 3. Functions from Rn to Rm
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. Differentiation of a function. Partial derivatives. Gradient vector. Jacobian matrix.
3.5. Differentiability. Directional derivative of differentiable functions.
3.6. Differentiation of composed functions: Chain's Rule. Tree diagrams.
3.7. Higher order derivatives. Schwarz's Theorem. Hessian matrix. Taylor's Theorem.
3.8. Implicit function Theorem. Differentiation of implicit functions.
3.9. Homogeneous functions. Euler's Theorem.
3.10. Basic integration methods of function of one variable. Barrow's Rule.

4. Academic activities

To facilitate the students' achievement of the planned learning outcomes, it is proposed:
Lectures: 30 hours, in which will be presented the concepts and results corresponding to the contents. At the same time, some exercises will be solved with the participation of the students to help them comprehend the theoretical concepts presented. These classes are face-to-face and will be given to the full group.
Problem and case solving in the classroom: 30 hours, in which the students will apply the theoretical results in order to solve, with the teacher's help, more complete exercises, and problems of an economic nature. Problem sets will be available for the students (http://dae.unizar.es/grados/ade-administracion-y-direccion-de-empresas). These classes are face-to-face and will be given separately to each subgroup.
Other activities (Answering questions, autonomous work and study, projects, seminars, exams, …): 90 hours.
6 ECTS = 150 hours
The teaching methodology and its evaluation is expected to be face-to-face. However, if for some reason it were necessary, they might take place online.

5. Assessment system

The evaluation will be **GLOBAL in both the first and second sittings**. It will consist of a final exam to be taken on the dates determined by the Faculty. The global exam will be written and will assess the proposed learning outcomes through questions that are theoretical, practical, or of a mixed theoretic-practical character and that will be based on the topics taught. It will be worth 10 points.

In addition, in the **first sitting**, it will be possible for students to take a voluntary intermediate test worth 5 points. This test will assess the student's knowledge of the Chapters 1 and 2 of the subject, and it will take place during the class schedule. The students who obtain a mark of at least 50% of the maximum value in this test (2.5 points out of 5) will be able to eliminate the corresponding topics from the global exam at the first sitting, and to take the exam of only the rest of the contents (worth 5 points out of 10). In this case, the mark corresponding to the eliminated topics will be added to the mark of the global exam. In order to pass the subject the student should obtain a minimum of 5 points out of 10. If the student obtains a mark of at least 2.5 points out of 5 in the intermediate test and wants to do the whole global exam anyway, the best of the two marks in the first part of the subject will be considered to compute the final mark.

To be eligible for this form of assessment students are required to participate actively and resolve issues, exercises and tests that will be presented in the classroom, according to indications that the teacher in charge of each group of the subject will be exhibiting the same day of the presentation. In such a case, it is necessary to attend and participate in at least 75% of the face-to-face sessions or proposed activities. The student that at the end of the semester does not fulfill this requirement will not be able to be eligible to this procedure of assessment.

It has to be taken into account that the evaluation process closes at the end of the academic year, so it is not possible to claim academic merits from one academic year in a later one.

Evaluation criteria

Students will be assessed on whether they have acquired the learning outcomes mentioned above. In particular, they will be assessed on the following aspects:

1. Correct mathematical writing.
2. Logical reasoning in the posing and solving of the problems.
3. Reference to the theoretical results used, when relevant.
4. The choice of the most appropriate method for the solving of problems.
5. Clarity in the application of mathematical concepts and procedures.
6. The correct expression of the results obtained when solving problems.

7. The interpretation of the results, if applicable, in the context of the given problem.

6. Sustainable Development Goals

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