Universidad Zaragoza

**Academic Year/course: 2023/24**

# 27502 - Mathematics I

## Syllabus Information

**Academic year:** 2023/24
**Subject:** 27502 - Mathematics I
**Faculty / School:** 109 - Facultad de Economía y Empresa
**Degree:** 449 - Degree in Finance and Accounting
**ECTS:** 6.0
**Year:** 1
**Semester:** First semester
**Subject type:** Basic Education
**Module:**

## 1. General information

Mathematics subjects are, for future graduates in Finance and Accounting, a methodological work instrument that should serve as a support for other subjects, such as Microeconomics, Macroeconomics, Econometrics, etc.

The general goal of these subjects is to study economic problems from a formal point of view, i.e. to model 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, the goal of Mathematics I is to broaden mathematical knowledge of calculus matricial calculus and functions of one variable and to introduce the study of functions of several variables, thus preparing students to assimilate in Mathematics II, taught in the second four-month period of this course, the mathematical tools most used in economic analysis, fundamentally in the field of Economic Theory and Econometrics. This first subject of Mathematics helps students to take off from their fundamentally calculistic knowledge, typical of Mathematics in secondary education, towards the rigor and abstraction of the scientific field of Mathematics, whichwill allow them to face other subjects of the degree that use mathematical apparatus and future challenges within their profession.

At the end of the subject, students will know with certain precision the mathematical language, which will allow them to understand economic concepts and interpret results with certain rigour, and will know a set of instruments and methods of calculation that will allow them to solve simple economic problems.

{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 1-17, as mathematical modelling can be applied to all of them.

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

## 2. Learning results

**At the end of the course the students will be able to:**

1: Use mathematical language, both in its comprehension and writing.

2: Distinguish when the relationships between the variables of a problem are linear or nonlinear and use for their representationthe appropriate mathematical instrument in each case.

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: To apply the diagonalization of square matrices in the economic context, for example in the study of a long-run dynamic process.

11: Recognize the chain dependence of different variables and calculate the variation of the final variables with respect to any of the initial ones.

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, particularly in the context of production functions.

14: Recognize the mathematical tool that allows to determine a total magnitude from the corresponding partial 15: To understand the concepts of primitive of a function and indefinite integral.

16: Recognize if the indefinite integral of a function is immediate and solve it with the application of the table of immediate integrals . Identify the most appropriate method to calculate the indefinite integral of a function.

17: To understand the geometric meaning of the definite integral: Riemann integral.

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

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

8: To differentiate between endogenous and exogenous variables in an economic phenomenon and to represent the relationships between them by means of functions.

9: To understand the meaning of the mathematical concepts of continuity and differentiability in the economic context.

10: To be proficient in the calculation of partial derivatives and their interpretation in the economic field.

## 3. Syllabus

Unit 1. Matrices

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

1.2. Rn: 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 RninRm

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

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 (Topics 1 to 3) 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 demand will be similar to that of the material seen in class.
- W ritten 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 Topics 1 to 3. 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 resolution and the

interpretation/comparison of the results obtained will be evaluated. The level of demand 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.

The computer part may be passed by students by means of two partial computer tests, PI1 (Topics 1 to 2) and PI2 (Topic 3) to be taken during the class period or by means of a single global computer test (PI) to be taken on the dates of the official call.

In order to be eligible for the partial computer-based tests (PI1 and PI2), it is compulsory to actively participate and solve the questions, exercises and tests that will be carried out in the on-site classes (minimum 75%), according to the indications that the lecturer responsible for each group of the subject will present on the day of the presentation of the same.

The written test will only take place on the dates of the official calls.

In order to be eligible to eliminate the computer part of the global exam of the first call through the partial computer tests the student must obtain at least 3 points in each of the partial tests PI1 and PI2. Students who, even having obtained these minimum scores in the partial computer tests, wish to improve their grade in the computer part for the first call may take the global computer test (PIG), keeping the better of the two grades.

Additionally, students who have not passed the subject in the first call may take the second call, whose evaluation will be similar to the overall evaluation of the first call, a Computer Test (PI) + Written Test (PE) maintaining the weights in the final grade. Both the written test and the PI computer test (or either the overall test or PI1+PI2) with a minimum of 4 points, of the first call, are kept for the second call.

**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.