Course: Mathematics  
Code: 10BBA50000  
Type: Required  
Year: 1  
Semester: 1  
ECTS credits: 6  
Language: Spanish  
Coordination:
Xari Rovira Llobera

Prerequisites:
Basic knowledge of the functions of a variable.

Prior knowledge:

Workload distribution:
Lectures  46 hours  
Participatory sessions  22.5 hours  
Independent work  105.5 hours  
Tutorials / feedback  6 hours

Course contribution to the programme:
Mathematics is an essential tool in quantitative information analysis, the creation and interpretation of models explaining business economic and financial reality, and the development of structured reasoning processes. In all these areas, this course will help future graduates to attain the educational goals of the qualification in general:
- Have a basic language with which to be able to further explore and use management tools and
- Develop a rigorous and reflexive learning process and, ultimately, professional career.

Course learning objectives:
Upon completing this course, students will be able to:

- Be fluent in and use mathematical reasoning and language in concrete situations.

- Understand, relate and use the basic concepts of matrix algebra and one and two-variable calculus throughout their academic and professional careers.

- Use mathematical reasoning and carry out demonstrations of basic propositions.

- Apply rigorous deductive processes.

Skills developed:
- Ability to acquire, understand and structure knowledge critically.
- Ability to apply knowledge to attain results.
- Capacity for permanent learning.

Contents and methodology:
ALGEBRA
Block 1: Matrices and simultaneous equations

- Objectives:

Upon completing this block, students will be able to:

- Use the matrix calculus language.
- Easily work with symbolic matrices.
- Know how to resolve problems and develop simple equations involving matrices and linear equations.

- Contents:

Definitions and types of matrices. Vectors and Euclidean space ($\mathbb{R}^n$)
Operations with matrices.
Determinants.
Linear combination and linear independence. Matrix rank.
Linear systems. Classification and resolution.

- Activities:
7 hours of lectures
3 hours of participatory classes

Block 2: Matrix diagonalisation

- Objectives:

Upon completing this block, students will be able to:

- Dominate matrix calculus language and use symbolic notations.
- Calculate square matrix eigenvalues and eigenvectors.
- Understand square matrix and symmetrical matrix diagonalisation processes.

- Contents:

Square matrix eigenvalues and eigenvectors.
Square matrix diagonalisation and that of symmetrical matrices.

- Activities:
3.5 hours of lectures
1.5 hours of participatory sessions

Block 3: Quadratic forms

- Objectives:

Upon completing this block, students will be able to:

- Dominate matrix calculus language and use symbolic notations.
- Be familiar with quadratic form concepts and their applications.
- Classify quadratic forms.
- Fully understand the dot product, norm and distance on $\mathbb{R}^n$ concepts.

- Contents:

Definition and classification of quadratic forms.
Quadratic form signs.
Dot product, norm and distance.

- Activities:
  3.5 hours of lectures
  3 hours of participatory sessions

CALCULUS:

Block 4: Real numbers and elemental functions

- Objectives:

Upon completing this block, students will be able to:

- Use one-variable calculus language.
- Use different number sets, functional elements and related elements.

- Contents:

Real numbers. Operations. 
Elemental functions: Expression, domain, range and graphs. Inverse operation.

- Activities:
  3.5 hours of lectures
  1.5 hours of participatory sessions

Block 5: Study of one-variable functions

- Objectives:

Upon completing this block, students will be able to:

- Use one-variable calculus language.
- Understand and use the concepts of limits, continuity and function derivatives. Interpret simple-function graphs.
- Develop simple reasoning using these concepts in concrete applications.

- Contents:

  Functional limit. Indeterminate forms. 
  Continuity and types of function discontinuity. 
  Derivable function properties. Derivative applications. 
  Function graph interpretation. 
  Applications.

- Activities:
  7 hours of lectures
  3 hours of participatory sessions

Block 6: Study of two-variable functions

- Objectives:
Upon completing this block, students will be able to:

- Use two-variable calculus language.
- Understand and use concepts related to two-variable functions.
- Represent and interpret level curves and use them in specific applications.

- Contents:
  
  Basic geometric concepts.
  Level curves: Representing two-variable functions.
  Differentiable functions: Partial and directional derivatives.
  Critical points. Necessary condition of extremality.
  Conditions for second-order determination of extremes.
  Constrained optimisation of functions. Resolving graphs.

- Activities:
  9 hours of lectures
  4.5 hours of participatory sessions

Block 7: Simple and double integrals

- Objectives:

Upon completing this block, students will be able to:

- Use integral calculus language.
- Understand and use the integral concept and resolve simple integrals.
- Represent areas on a plane and resolve some double integrals.

- Content:

  The defined integral of a real function.
  Indefinite integral: Antiderivatives.
  Double integral concept. Properties.
  Double integral calculus. Fubini’s Theorem.
  Simple and double improper integrals.

- Activities:
  7 hours of lectures
  3 hours of participatory sessions

Block 8: Sequences and numeric series

- Objectives:

Upon completing this block, students will be able to:

- Use and interpret sequence and real number series language.
- Apply some of the concepts studied in previous blocks (limits, integrals, etc.) to study sequences and numeric series.
- Develop simple reasoning using these concepts in specific applications.

- Contents:
Real number sequence. Sequence limits.
Numeric series.
Convergence of geometric series and P-series.
Applications.

- Activities:
5.5 hours of lectures
3 hours of participatory sessions

Activities in lectures and participatory sessions:

Lectures (1.5 hours on Mondays and 2 hours on Thursdays): The faculty will combine lectures explaining the theories and exercises. A short test lasting approximately 15 minutes will be held each Thursday.

Participatory session: Work groups will be formed during the first class to discuss the exercises. Prior to each participatory class, students will be informed of the exercises to be carried out and those whose resolution will be discussed in class. Students will have to reflect on how to resolve these exercises and, in some cases, their solutions will have to be turned in prior to class. Participatory sessions are divided into 3 parts:
- Class discussion on the abovementioned exercises solved by students prior to this class.
- Problem-solving in groups of 3 (or 4, maximum) of a new problem presented by the faculty.
- Answering questions and doubts about the exercise or, if needed, about the exercises in general for the subject block in question.

Obligatory tutorials: After the participatory class each Thursday, some students will have to attend their obligatory tutorial to comment on the process used to resolve exercises in groups.

Voluntary tutorials (in-person or virtual) are available for students who need help to resolve exercises or in the use of the different tools.

To foment students’ continuous learning, they will have to periodically fill in a questionnaire aimed at helping them manage their own learning process while, at the same time, adapting learning strategies as needed to meet the course’s objectives.

Evaluation:
The assessment procedure for objectives/competences involves a number of different aspects: Weekly tests, exams, set exercises, active participation in class, etc.

For each objective/competence assessed, the formative activities and the corresponding assessment methods and criteria are fixed, as is the weight (in percent) of this aspect within the course as a whole.

Frames of reference, concepts and tools are presented in lectures. The correct use of concepts and theoretical models and control over symbolic language is achieved through exercises done both individually at home and in groups during the participatory classes. The ability to reason and carry out simple demonstrations will be evaluated by means of in-class discussions and problem-solving during participatory sessions as well as through questions and answers during tutorials. Weekly exams will be held (ongoing evaluation) along with a partial and final exam.

Consolidating what students learn about concepts, tools and their use involves individual thought and study. This is evaluated through the exams.

For the purposes of student self-assessment, students will receive feedback from faculty throughout the course in various ways, depending on the time and the evaluation method.
(weekly tests, feedback during participatory classes and in tutorials, voluntary tutorials, etc.). The questionnaires mentioned above are also of use for students to evaluate their own learning.

The final course mark will be determined as follows:
25% based on weekly tests
10% class participation and exercises
20% the partial exam spanning the first 3 subject blocks (Algebra). If students score less than a 5 (out of 10) on this exam, they will have to prepare this material again for the final exam.
45% final exam in January for the remaining 5 blocks (Calculus).

Students must score a minimum average mark of 4 (out of 10) on the Algebra and Calculus exams (representing 65% of the final course mark) to be able to average these with the marks for the weekly tests and class participation. If students receive less than a 4 (out of 10) on these exams, said mark will be the final course mark.

If the final mark is under 5, students may sit a single final exam for the whole course corresponding to 100% of the mark.

The acquisition of competencies foreseen for this course will be evaluated based on the resolution of problems during participatory classes and discussions of said resolutions during the tutorials. This evaluation may be considered in the 0 to 10 mark, and will also be reflected from A to D in an independent indicator. This indicator will be incorporated into all courses and will be used to follow up on each student’s progress throughout the programme.

**Core bibliography:**


