



COMILLAS

UNIVERSIDAD PONTIFICIA

ICAI

ICADE

CIHS

Syllabus
2026 - 2027

FICHA TÉCNICA DE LA ASIGNATURA

Datos de la asignatura	
Subject name	Algebra
Subject code	E000012781
Main program	Bachelor's Degree in Business Analytics
Involved programs	Grado en Análisis de Negocios/Bachelor in Business Analytics y Grado en Relaciones Internacionales [First year] Grado en Análisis de Negocios/Bachelor in Business Analytics y Grado en Derecho [First year] Grado en Análisis de Negocios/Bachelor in Business Analytics [First year] Grado en Admin. y Dirección de Emp. y Grado en Análisis de Negocios/Bachelor in Business Analytics [First year]
Level	Reglada Grado Europeo
Quarter	Semestral
Credits	6,0 ECTS
Type	Básico
Department	Departamento de Métodos Cuantitativos
Coordinator	Luis Ángel Calvo Pascual
Office hours	Students will be informed on the first day of class.

Datos del profesorado	
Teacher	
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Name	Raquel Galazo García
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DATOS ESPECÍFICOS DE LA ASIGNATURA

Contextualización de la asignatura

Aportación al perfil profesional de la titulación

A graduate in Business Analytics must deal with complex data and apply advanced analytical techniques to improve business decision-making. To achieve this, it is not enough to simply know how to use tools: it is essential to understand the foundations behind models and data structures.

The Algebra course provides a solid foundation for many of these skills. It not only fosters abstraction and structured thinking but also prepares students to successfully tackle subjects such as Calculus, Quantitative Models, Operations Research, and Machine Learning.

Prerrequisitos

Students are expected to have a basic understanding of the following concepts: matrices, determinants, rank, and systems of linear equations.

If they are not yet confident with these topics, the online course [E-LEARNING COMILLAS PREU-MAT](#) is available on Moodle.

Competencias - Objetivos

Competencias

- **CN6.** Understands the mathematical tools required to formulate and solve real-world problems arising in business environments.
- **HA6.** Selects and uses the mathematical tools and techniques best suited to each problem, implements them, appropriately interprets the results and their limitations, and communicates them to a non-technical audience.
- **CM7.** Uses mathematical tools and techniques to solve problems and support decision-making in big-data environments involving both quantitative and qualitative data, and is able to learn and work independently in the information society.

Resultados de Aprendizaje

- **RA.1.** Be able to analyse and synthesise information presented in mathematical language.
- **RA.2.** Understand the basic tools of linear algebra.

BLOQUES TEMÁTICOS Y CONTENIDOS

Contenidos – Bloques Temáticos

Unit 0: Matrices

1. Introductory example
2. Matrices. Basic types



3. Operations with matrices

4. Square matrices

5. Rank of a matrix

Unit 1: Systems of Linear Equations

1. Introductory example

2. Systems of linear equations

3. Types of systems according to their solution

4. Rouché-Frobenius Theorem

5. Solving systems of linear equations

Unit 2: Vector Spaces

1. Introductory example

2. Definition of (Real) Vector Space (VS)

3. Linear combination of vectors. Linear Span.

4. Generating system of a vector space.

5. Linearly dependent/independent vectors

6. Basis of a VS. Dimension of a VS. Change of basis in a VS

7. Vector subspace (VSS)

Unit 3: Linear Maps

1. Definition of a linear map

2. Matrix expression of a linear map

3. Change of basis in a linear map

Unit 4: Endomorphisms and Diagonalization

1. Eigenvalues and eigenvectors. Determination and important theorems

2. Diagonalization of an endomorphism

3. Applications of diagonalization of endomorphisms.

4. Diagonalization of symmetric matrices



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Unit 5: Quadratic Forms

1. Definition of quadratic form. Matrix expression.
2. Sign of a quadratic form.
3. Study of the sign of a quadratic form through eigenvalues.
4. Study of the sign of a quadratic form through principal minors.
5. Restricted quadratic forms

METODOLOGÍA DOCENTE

Aspectos metodológicos generales de la asignatura

Metodología Presencial: Actividades

Expository Lessons: The professor will explain the fundamental concepts of each topic, either on the board or using the slides and teaching materials available on Moodle, with particular emphasis on the most relevant aspects.

Problem-Solving in Class: Different types of problems will be solved, explained, and analyzed in class, ranging from basic examples aimed at helping students understand the theory to problems of medium and high complexity. The materials used will be Problem Sets A and B available on Moodle. Expository lessons and problem-solving sessions will be naturally integrated throughout the course.

Computer Practices: Practical computer sessions will be conducted in which students will apply the concepts and techniques studied in the course by solving problems using the MATLAB programming language.

Tutoring: Tutoring will be conducted both in groups and individually. Group tutoring sessions will take place at pre-scheduled times and will be used to resolve general questions concerning the topics covered or the problems included in the corresponding Problem Sets A and B. Individual tutoring will take place during the professor's scheduled office hours.

Continuous Assessment Tests: Two continuous assessment tests will be conducted throughout the semester during regular class hours. The first will be held at the end of Topic 1, and the second after the completion of Topics 2, 3, and 4.

Metodología No presencial: Actividades

Independent Study: Students will independently study the concepts presented in the expository lessons, as well as the problems and MATLAB practical exercises.

As an additional learning resource, students will have access to **short audiovisual learning modules** of approximately 10 minutes each. A total of eight videos will be provided, covering the main concepts and representative examples from each topic.

RESUMEN HORAS DE TRABAJO DEL ALUMNO

Lessons:

- Lectures: **56 h**
- Practical Seminars: **4h**

Individual Work:



- Organized study and reading: **40 h**
- Exercises, case studies, and problem solving: **50 h**

ECTS CREDITS: 6 (**150 hours**)

EVALUACIÓN Y CRITERIOS DE CALIFICACIÓN

Assessment Activities	Assessment Criteria	Weight
Final Exam	- Understanding of concepts. - Application of concepts, techniques, and procedures to the solution of practical problems. - Analysis and interpretation of the results obtained in problem solving. - Written presentation and communication.	65%
Three continuous assessment tests will be conducted throughout the semester	- Understanding of concepts. - Application of concepts, techniques, and procedures to the solution of practical problems. - Analysis and interpretation of the results obtained in problem solving. - Written presentation and communication.	5% + 10% + 20% = 35%

Calificaciones

Ordinary Examination:

The continuous evaluation will be 35% of the final grade (of which 5% corresponds to the first test, 10% to the second, and 20% to the third).

The final exam will form 65% of the final grade.

The final grade will be calculated as follows:

The final grade of a student who obtains at least 4.25 in the final exam will be calculated based on the continuous evaluation and the final, with the percentages as given above (that is, 65% of the final and 35% of the continuous evaluation).

The final grade of a student who obtains below 4.25 on the final exam will be the grade obtained on the final exam.

Extraordinary Examination Session:

- If the student obtains a grade of **4.25 or higher** in the extraordinary examination, the final course grade will be the higher of the following two options:
 - **Option A:** Extraordinary examination (100%).
 - **Option B:** Extraordinary examination (65%) and continuous assessment grades (35%).
- If the student obtains a grade **below 4.25** in the extraordinary examination, the final course grade will be the grade obtained in that examination.

Course Regulations



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Failure to attend classes, under the conditions established in the academic regulations of each Faculty, may result in the student not being allowed to sit the examination in the ordinary examination session.

If a student is unable to take a continuous assessment test, a make-up test will only be offered if the absence is duly justified on the grounds of illness or another serious circumstance. Otherwise, the student will receive a grade of 0 for that test. Students with a justified absence must accept the date proposed by the professor for a special examination prepared for such cases.

If a student repeatedly behaves inappropriately in class, this may result in penalties to their final grade, disciplinary proceedings being initiated by the Academic Affairs Office, or other measures as appropriate.

Use of Artificial Intelligence

Professors will encourage the responsible and critical use of artificial intelligence tools, including generative AI tools and prompting techniques, to support independent study and the understanding of concepts.

However, the use of such tools, including **AI assistants in MATLAB**, is **strictly prohibited during examinations and continuous assessment activities**. Any use of these tools in such circumstances will be considered a serious breach of the academic regulations.

PLAN DE TRABAJO Y CRONOGRAMA

Activities	Date of realization	Delivery date
Unit 0: Matrices MatLab Introduction and Installation	Week 1	
Unit 0: Matrices Unit 1: Linear systems of equations	Week 2	
Unit 1: Linear systems of equations Unit 2: Vector spaces I	Week 3	
Unit 2: Vector Spaces I	Week 4	
Unit 2: Vector Spaces II	Week 5	
Unit 2: Vector Spaces II	Week 6	
Unit 2: Vector Spaces III	Week 7	



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Unit 3: Linear Maps	Week 8	
Unit 3: Linear Maps	Week 9	
Unit 4: Diagonalization	Week 10	
Unit 4: Diagonalization	Week 11	
Unit 4: Diagonalization	Week 12	
Unit 5: Quadratic forms	Week 13	
Unit 5: Quadratic forms	Week 14	

BIBLIOGRAFÍA Y RECURSOS

Bibliografía Básica

1. Giménez Abad, M.^a J., Martín Antón, G., & Serrano Rey, A. (2014). *Matemáticas para ADE: Teoría y ejercicios*. Pearson Educación.
2. De la Villa, A. (2010). *Problemas de álgebra*. CLAGSA.

Bibliografía Complementaria

1. Lay, D. C. (2003). *Linear Algebra and Its Applications* (3rd ed.). Pearson Education India.
2. Anthony, M., & Biggs, N. (1996). *Mathematics for Economics and Finance: Methods and Modelling*. Cambridge University Press.
3. Blanco, S., García, P., & Del Pozo, E. (2004). *Matemáticas Empresariales I: Enfoque Teórico-Práctico*. Thomson.
4. Wolfram Alpha. (n.d.). *Computational Knowledge Engine*. Retrieved from <http://www.wolframalpha.com/>
5. *E-Learning Comillas PREU-MAT (Moodle)*.