



COMILLAS

UNIVERSIDAD PONTIFICIA

ICAI

ICADE

CIHS

Syllabus
2025 - 2026

FICHA TÉCNICA DE LA ASIGNATURA

Datos de la asignatura	
Subject name	Algebra
Subject code	E000012781
Mainprogram	Grado en Análisis de Negocios / Business Analytics por la Universidad Pontificia Comillas
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.

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Teacher	
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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

General Competencies

- CG02 Ability to analyze massive data from different sources: text, audio, numerical and image.
 - RA1 Being able to analyze and synthesize information received in mathematical language.
- CG03 Problem-solving and decision-making in an environment of massive quantitative and qualitative data.
 - RA1 To know the basic mathematical tools that enable them to pose and solve real problems in the business world.
 - RA2 Acquire the ability to make decisions with knowledge, initiative and critical spirit.
- CG09 Ethical commitment in the information society.
 - RA1 Pursue excellence in professional actions.
- CG11 Ability to learn and work autonomously in the information society.
 - RA1 Be able to apply the knowledge obtained in new contexts.
 - RA2 Be able to learn new methods and theories autonomously in their professional life.

Specific Competencies

- CE17 To acquire the ability to solve problems posed in the business environment using mathematical tools.
 - RA1 To know the basic tools of linear algebra



Resultados de Aprendizaje

Included in the previous section, being associated with the competencies.

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



COMILLAS

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ICAI

ICADE

CIHS

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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

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

Expository sessions always combine theory and solving exercises as an application of the theory.

Laboratories. There is only one preset session initially. As the classes develop, laboratories and computer practices will be incorporated into the classroom. Therefore, students will be asked to bring their computers to class

Metodología Presencial: Actividades

Expository sessions always combine theory and solving exercises as an application of that theory.

Laboratories. There is only one preset session initially. As the classes develop, laboratories and computer practices will be incorporated into the classroom. Therefore, students will be asked to bring their computers to class.

Metodología No presencial: Actividades

Tutorial sessions

Group activity

Completion of proposed exercises for personal study



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ICAI

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CIHS

Syllabus
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RESUMEN HORAS DE TRABAJO DEL ALUMNO

Lessons:

- Lectures: 58 h
- Practical Seminars: 2h

Individual Work:

- Individual and/or group study and organized reading: 90 h

ECTS CREDITS: 6 (150 hours)

EVALUACIÓN Y CRITERIOS DE CALIFICACIÓN

Midterm Tests

- Three midterm tests throughout the course to motivate the student in his/her study and allow him/her to be aware of their performance.

Unjustified absence from any of the tests will result in a score of zero

Final Exam

It will contain questions of different types:

1. Theory exercises
2. Exercises to be solved using MATLAB

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:

The grade of a student who obtains at least 4.25 on the extraordinary exam will be the higher score of the following two options:



COMILLAS

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Syllabus
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- Option a: Extraordinary exam (100%)
- Option b: 65% extraordinary exam and 35 % continuous evaluation.

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

Course Regulations

Failure to attend more than 25% [CLC1] of the total class hours of the course throughout the semester (9 absences) may result in the student losing the right to take the exam for the course in the ordinary session of that academic year (cf. Article 93. Attendance, General Regulations of the University).

Any student who commits an irregularity during the completion of any evaluable test will receive a Fail grade (0) in that test and will be subject to a disciplinary process in accordance with Article 168. Offenses and sanctions for students, General Regulations of the University.

Use of Artificial Intelligence

Professors will encourage the responsible and critical use of artificial intelligence tools, such as generative prompts, to support autonomous study and the understanding of concepts.

However, **the use of such tools (including AI assistants in Matlab) during exams and continuous assessment activities is strictly prohibited**. Their use in these cases will be considered a serious violation of 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	



COMILLAS

UNIVERSIDAD PONTIFICIA

ICAI

ICADE

CIHS

Syllabus 2025 - 2026

Unit 2: Vector Spaces II	Week 6	
Unit 2: Vector Spaces III	Week 7	
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)*.