



PRESENTACIÓN

Breve descripción: The objective of this course is to provide advanced elements of linear algebra, necessary for other courses in advanced mathematics and data analytics.

- **Titulación:** ADE/ECO + Data Analytics; ECO + International Economics & Finance
- **Módulo/Materia:**
- **ECTS:** 3
- **Curso, semestre:** 2º course, 1st semester
- **Carácter:** Mandatory
- **Profesora:** Stella Salvatierra Galiano (ssalvat@unav.es)
- **Idioma:** English
- **Aula, Horario:** 15:30-17:30, Room 6, Floor 1, Ed.. Arquitectura

COMPETENCIAS

Basic competences (Module 3. Quantitative Methods):

BC3: Students must have the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant social, scientific and ethical topics.

Specific competences (Module 3. Quantitative Methods):

SC8: To analyse quantitative information on economic and business phenomena and variables using mathematical and/or software tools.

SC15: To analyse data using software tools on specific areas of economics and/or business.

Specific competences (Diploma in Data Analytics):

SSOP1: Accessing and managing massive data

SSOP2: Understanding programming languages potentially used to solve economic and/or business problems

SSOP3: Working with visual elements that provide insights and an understanding into complex concepts and components of economic and/or business problems

SSOP4: Identify patterns and trends and gather useful information from massive data in economics and/or business.

SSOP5: Effective communication of results to a professional audience in economics and/or business

PROGRAMA

Unit 1: Vectors and Matrices



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1.1 Vectors and vector operations. Geometric interpretation in the Cartesian plane.

1.2 Linear combinations of vectors.

1.3 Basics in matrix algebra.

1.4 Matrix algebra in \mathbb{R} .

Unit 2: Linear Transformations

2.1 The vector space \mathbb{R}^n . Vector subspaces. Linearly independent/dependent vectors.

2.2 Basis and dimension. Change of basis.

2.3 Linear transformation between vector spaces.

2.4 Matrix representation of a linear transformation. Matrix multiplication as two consecutive linear transformations.

2.5 The inverse of a linear transformation.

Unit 3: Eigenvalues and Eigenvectors

3.1 Eigenvalues and eigenvectors. The characteristic equation.

3.2 Eigenbasis.

3.3 The diagonal matrix.

3.4 Matrix diagonalization.

3.5 Computing eigenvalues and eigenvectors in \mathbb{R} .

Unit 4: Further Applications in Data Processing and Analysis

4.1 Orthogonality, orthogonal/orthonormal matrices.

4.2 Collinearity and data redundancy.

4.3 The variance-covariance matrix and the correlation matrix.

4.4 Singular value decomposition. Singular value decomposition in \mathbb{R} .

4.5 Principal component analysis. Principal component analysis in \mathbb{R} .

ACTIVIDADES FORMATIVAS

The course includes different face-to-face and non face-to-face activities.



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Classes of the Quantitative Methods III course will include theoretical and practical sessions (problems sets and R lab assignments), where particular applications to Economics and Business will be discussed.

In addition to a midterm and a final exam, there will be at least two quizzes.

Face-to-face activities:

1. Theoretical/practical classes: 12 hours.
2. Problem-solving classes. Problems sets and Rlab assignments will be discussed in class: 8 hours.
3. Exams. Midterm and final exams: 4 hours.
4. Tutorials: 6 hours.

Non face-to-face activities:

1. Personal solving problems and Rlab assignments: 22 hours.
2. Online tutorial sessions: 4 hours.
3. Personal study: 19 hours.

Total face-to-face activities: 30 hours.

Total non face-to-face activities: 45 hours.

EVALUACIÓN

The final grade in this course will be a weighted average of different exams, with the weights being as follows:

CONVOCATORIA ORDINARIA

- Quizzes: 30%
- Midterm exam: 30%
- Final exam: 40%

CONVOCATORIA EXTRAORDINARIA

- Final exam: 100%

HORARIOS DE ATENCIÓN

Dña Stella Salvatierra (ssalvat@unav.es)

Office 4060, "Edificio Amigos". Floor 4

Office hours:

- Tuesday, 10:00-11:30hs.



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- Thursday: 12:30-14:00hs.

BIBLIOGRAFÍA

Basic bibliography:

- Larson, R. (2013). *Elementary Linear Algebra*. Ed. 7th Australia: Brooks/Cole Cengage Learning. (ISBN: 9781133111344). [Find it in the library](#)
- Abadir, K. M. and Magnus, J. R. (2005). *Matrix algebra*. Cambridge University Press (ISBN: 9780521822893) [Find it in the library](#)
- Aleskerov, T and Ersel, H and Piontkovski, D. (2011). *Linear algebra for economists*. 1st edition. Springer (ISBN: 9783642205705). [Find it in the library \(ebook\)](#)

To practice using R:

- Dayal, V (2020). *Quantitative Economics with R*. Springer (ISBN: 978-981-15-2035-8). [Library catalog link](#).

To practice more exercises:

- Bronson, R and Costa, G. B. (2009). *Matrix methods*. 3rd edition. Elsevier (ISBN: 978-0-12-374427-2). [Library catalog link](#).

Complementary bibliography:

- Theil, H. (2007) Chapter 1: *LINEAR ALGEBRA AND MATRIX METHODS IN ECONOMETRICS*. *Handbook of econometrics*, edited by James J. Heckman and Edward Leamer. 1st edition. North Holland (ISBN: 9780444532008). [Library catalog link](#).
- Magnus J. R. and Neudecke H. (2019). *Matrix differential calculus with applications in statistics and econometrics*. 3rd edition. John Wiley & Sons (ISBN: 9781119541202). [Library catalog link](#)