Universidad de Navarra

Quantitative Methods III

Guía docente 2025-26

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

RESULTADOS DE APRENDIZAJE (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

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 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 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 R.

4.5 Principal component analysis. Principal component analysis in 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 assignmets: 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