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**: Grado en Economía
- **Módulo/Materia**: Módulo 3: Métodos Cuantitativos / Materia: 3.1: Métodos Cuantitativos
- **ECTS**: 3
- **Curso, semestre**: 2º course, 1st semester
- **Carácter**: Mandatory
- **Profesor:** Luis Alberiko
- **Idioma**: English

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

GC4: Reason autonomously and critically on issues relevant to economics and business.

SC5: Apply mathematical reasoning and/or quantitative tools to the analysis of economic reality.

SC6: Use software tools in the quantitative and/or qualitative analysis of economic and/or business issues with sound judgment.

SC8: Apply economic logic and/or econometric techniques to specific areas of Economics.

PROGRAMA

Unit 1: Vectors and Matrices

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

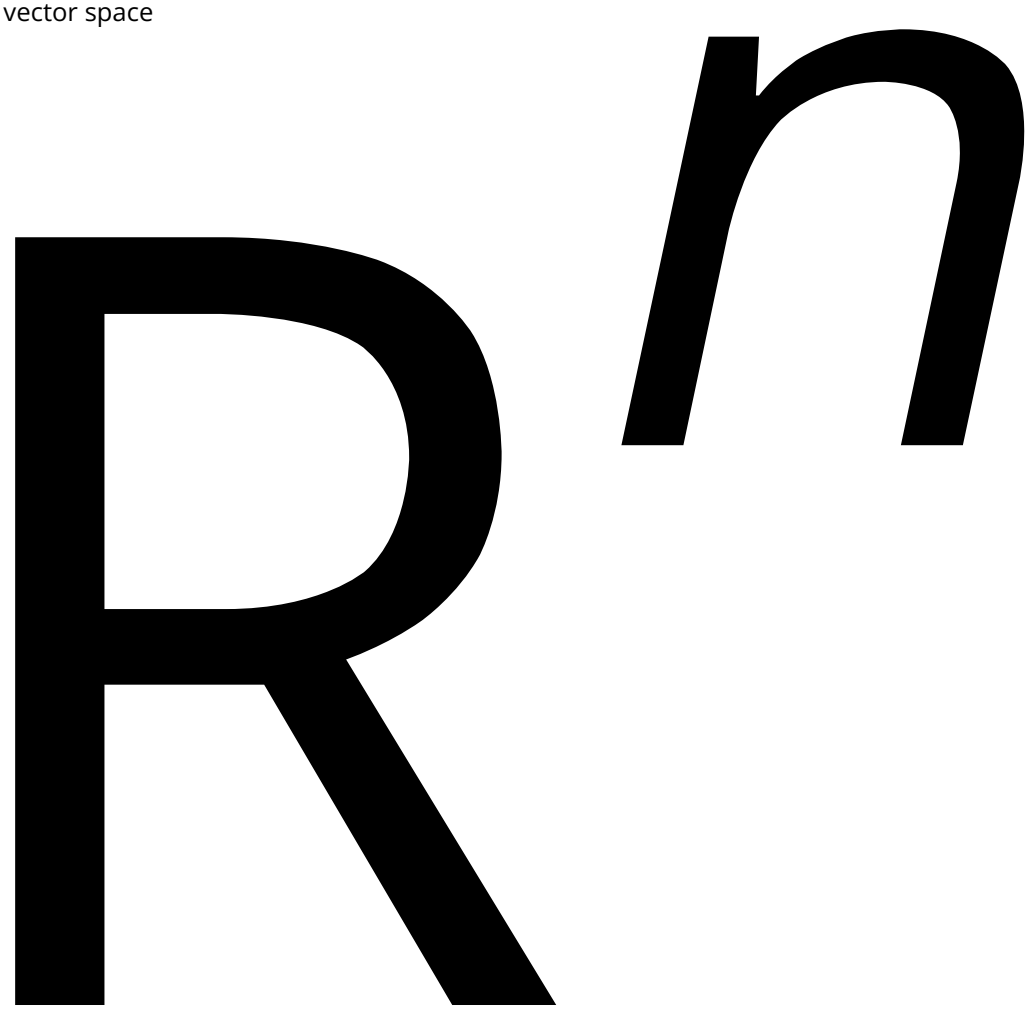
1.2 Linear combinations of vectors.

1.3 Basics in matrix algebra.

1.4 Matrix algebra in R.

Unit 2: Linear Transformations

2.1 The vector space



. 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

Within the formation activities the students will have to attend one econometric/statistical seminar per month. They may also participate in all the other seminars and congresses organized by the Faculty of Economics.

Clases teoricas y / o practicas: 24 horas teotricas + 6 horas practicas

Trabajos individuales y / o grupos: 50 horas

Estudio personal: 200 horas

Tutorias: 10 horas

EVALUACIÓN

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

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CONVOCATORIA ORDINARIA

- Class participation and exercises: 15%
- Final exam: 85%

CONVOCATORIA EXTRAORDINARIA

- Final exam: 100%

There will be a continuous evaluation that will be related to class participation and exercises during the course. It will take 15% of the final score.

HORARIOS DE ATENCIÓN

Fridays, from 12.00 to 5.00pm

Onliine at any time

Prof. Luis Alberiko (alana@unav.es)

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