

Degree programme	Type	Course
Applied Statistics	FB	1

Contact lecturer

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Group languages

You can consult this information at the [end](#) of the document.

Prerequisites

Elementary knowledge of Mathematics corresponding to secondary education and high school.

Objectives

(from Google Translate)

This subject is a presentation of matrix algebra, with emphasis on solving systems of equations and diagonalization of matrices, in particular symmetric matrices.

The main goal is for the student to reach maturity in matrix manipulation and acquire the theoretical knowledge that should allow him to use matrices in statistical treatments. In particular, the decompositions of matrices such as PAQ-reduction, decomposition into singular values (SVD), diagonalization, ...

Learning outcomes

- KM02 (Recognise the language and basic tools of linear algebra.) Recognise the language and basic tools of linear algebra.
- SM03 (Solve, using numerical methods, optimisation problems, linear algebra and analysis in general that appear in science and, especially, in statistics.) Solve, using numerical methods, optimisation problems, linear algebra and analysis in general that appear in science and, especially, in statistics.

Contents

(from Google Translate)

1. Systems of linear equations and matrices. Operations with matrices. Invertible matrices. Elementary transformations of matrices. Normal form of Gauss - Jordan. Range of an array. Inversibility criteria. Matrix of a system of linear equations. Solving systems of linear equations. Determinant of a square matrix. PAQ-reduction and generalized inverse.

2. Vector Spaces and Linear Applications: Vectors in $\mathbb{R}^n$ and Linear Applications. Definition of vector space and examples. Vector structure of $\mathbb{R}^n$ and subspaces. Definition of linear application and examples. Core and image of a linear application. Dependence and linear independence of vectors. Generator systems, bases of vector spaces. Dimension and range. Coordination, base change matrices, matrix associated with a linear application with respect to bases fixed to the departure and arrival spaces.

3. Diagonalization of endomorphisms: Eigenvectors and eigenvalues of an endomorphism. Characteristic polynomial and minimum polynomial. Diagonalization criterion.

4. Vector spaces with scalar product. Bilinear product, definition and properties. Orthogonality. Orthonormal bases. Gram-Schmidt orthonormalization method. Screenings. Orthogonal complement. Orthogonal matrices. Orthogonal diagonalization of symmetric matrices, spectral theorem. Data adjustment. Singular values and decomposition into singular values.

Learning activities and methodology

Title	Hours	ECTS	Learning outcomes
Learn theoretical concepts	27	1.08	KM02, SM03
Problem solving and practical lessons	24	0.96	KM02, SM03
Prepare evaluations	26	1.04	KM02, SM03
Solving exercises	40	1.6	SM03
Lesson	25	1	KM02, SM03

Time commitment Considering that this subject is worth 6 credits, the total number of hours (theory classes, problems, seminars, personal work and exams) that an average student should dedicate to it during the semester is 150 hours, adequately distributed over time. It is therefore advisable to allocate an average of 5 hours of personal work each week to assimilating the theory and solving problems.

Methodology During the semester, the subject has 2 hours of theory classes per week and 2 hours of problem or practical classes per week. In the theory classes, the contents of the subject will be presented, giving special emphasis to the meaning, motivations and reasoning that lead us to each of the concepts that will be worked on. During the problem classes, lists of exercises will be worked on that the student will receive in advance in which the most practical aspect of the concepts worked on will be emphasized. Finally, in the practical classes, you will learn to use a certain computer program to assist us in solving the problems. As a complement to all this, it is advisable for the student to get used to consulting textbooks, which are well-structured tools where both the mathematical language used in the classroom and the logical reasoning to demonstrate the concepts are clearly reflected. Within the computer practice sessions, evaluative tests will also be done with the corresponding software.

Annotation: within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continuous assessment activities

Title	Weight	Hours	ECTS	Learning outcomes
Writing exams	80	6	0.24	KM02, SM03
Work with Sage Math	10	1	0.04	SM03
Solving exercises	10	1	0.04	KM02, SM03

(from Google Translate)

Continuous assessment

The assessment of the subject will consist of the following activities:

Exams:

- First part (November) P1 (30%)
- Second part (January) P2 (50%)

Practical:

- SageMath tests (various) S (20%)

These activities, scored out of 10, will receive the weight indicated in the final grade. That is, the final grade of the subject will be:

$$\text{Final grade} = 0.2S + 0.3P1 + 0.5P2$$

In the event of not achieving a pass, the student may opt for a single retake exam, R, which will allow them to recover the grade of the two parts (P1 and P2).

The student will be considered "Not assessable" if they have carried out assessment activities that represent a weight below 50% of the final grade of the course.

Single assessment

If the student opts for the single assessment, he/she will take a single exam coinciding with the date of the second part. The exam will consist of the content of the entire subject including the practical part of SageMath.

As in the case of continuous assessment, the grade of this exam can be recovered in a retake exam.

Bibliography

Basic:

M. Masdeu, A. Ruiz, Apunts d'Àlgebra lineal (<https://mmasdeu.github.io/algebralineal/>)

Otto Bretscher: *Linear Algebra with Applications*. Pearson Prentice Hall, 3rd edition.

Complementary:

Ferran Cedó i Agustí Reventós: *Geometria plana i àlgebra lineal*, Manuals UAB, (2004), UAB.

Stanley I. Grossman, *Álgebra lineal*, Grupo Editorial Iberoamérica, 1983.

Shayle R. Searle, *Matrix Algebra Useful for Statistics*, Wiley-Interscience

David A. Harville, *Matrix Algebra from a Statistician's Perspective*, Springer

Software

We use Sage Math (www.sagemath.org) software during some lessons.

Course groups and languages

The information provided is provisional until November 30. After this date, you will be able to consult the language of each group through this [link](#). To access the information, you will need to enter the course CODE

Type of teaching	Group	Language	Semester	Shift
(TE) Theory	1	Catalan	first semester	afternoon
(PLAB) Practical laboratories	1	Catalan	first semester	afternoon
(SEM) Seminars	1	Catalan	first semester	afternoon
(PLAB) Practical laboratories	2	Catalan	first semester	afternoon
(SEM) Seminars	2	Catalan	first semester	afternoon