UAB
Universitat Autònoma de Barcelona

Linear Algebra

Code: 104843
ECTS Credits: 6

2024/2025

Degree	Type	Year
2503852 Applied Statistics	FB	1

Contact

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Teachers

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Teaching groups languages

You can view this information at the end of this document.

Prerequisites

None.

Objectives and Contextualisation

(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, ... will be worked on.

Learning Outcomes

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

Content

(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 R ^ n and Linear Applications. Definition of vector space and examples. Vector structure of 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 orthonormatization method. Screenings. Orthogonal complement. Orthogonal matrices. Orthogonal diagonalization of symmetric matrices, spectral theorem. Data adjustment. Singular values and decomposition into singular values.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Lesson	26	1.04	KM02, SM03, KM02
Practical lessons with SageMath	26	1.04	
Type: Supervised			
Solving exercises	40	1.6	SM03, SM03
Type: Autonomous			
Learn theoretical concepts	24	0.96	
Prepare avaluations	26	1.04	

(from Google translate)

Dedication

Given that this subject is assigned 6 credits, the total number of hours (theory classes, problems, seminars, personal work and exams) that an average student should devote during the semester is 150 hours, appropriately spread over time. It is therefore advisable to devote an average of 5 hours of personal work each week to assimilating the theory, problem solving and writing a paper.

It is clear that according to the abilities of work, assimilation, abstraction, mechanisms, etc. some students may need more dedication and others with fewer hours of work will have enough.

Description of the practices.

Throughout the semester there will be 13 practice sessions or problems, some of which will be held in the computer lab or virtually.

Classroom practices

Classroom practices will consist of the approach and resolution of exercises on the subject already explained atheism. In some of the sessions the students will have to solve and deliver in writing a problem (typology "Quiz"). The score for solving these problems will be scored for continuous assessment. Some of these "Quiz" can also be done during theory hours.

Computer practices

Some practice sessions will consist of working on the subjects already explained in theory using an algebraic manipulator (SageMath). Part of the continuous assessment will consist of the delivery of some of the practices, in which the acquisition of the ability to use algebraic manipulators for problem solving will be scored.

Methodology

The subject has 2 hours a week of theory class and 2 hours a week of problem and practice classes. Attendance at all sessions is recommended. The theory taught is quite contained in the texts recommended in the bibliography, although in each of them its presentation has slightly different characteristics. The student should become accustomed to learning from textbooks, which are well-structured and written tools and where both mathematical language and logical reasoning are clearly reflected. Books, at least one, are a very important complement to classes.

Periodically the student will receive lists of problems that he must try to solve individually or in groups and which will be worked on in the problem classes.
Every 3 or 4 weeks approximately there will be an evaluation test (type "Quiz") that the student will have to answer in class or at a specific time before starting the usual class.
The methodology of the practice sessions is described in detail in the section "Description of the practices".
There will be two partial tests specially designed as a test for the student, and for teachers, which will measure the progress of the student and will have value in the continuous assessment note.

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

Continous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Solving exercises	15	1	0.04	KM02
Work with Sage Math	15	1	0.04	SM03
Writting exams	70	6	0.24	KM02

(from Google Translate)

Continued avaluation

The evaluation of the subject will consist of:
a) Problem solving, "Quiz" tests (every three or four weeks, starting with
b) The use of computer tools, computer exam: 1.5 points.
c) A partial exam: 1.5 points
d) A final exam: 5 points
During the exam period, a joint recovery test for sections (c) and (d) will b
To pass the subject you must obtain a grade above 5, and have obtainec
A student will be considered to have attended the subject if they have ca
In case of making use of the recovery test, the final mark of the subject c

Unique assessment

- Attendance at practical classes with a computer is mandatory, as well a
- At the end of the course there will be a single exam with a weight of 8.5
- The same recovery system will be applied as for the continuous assess
- The review of the final qualification follows the same procedure as for th

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:

Enric Nart, Xavier Xarles: Apunts d'àlgebra lineal, Material UAB, 237 (2016), 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.

Language list

Name	Group	Language	Semester	Turn
(PLAB) Practical laboratories	1	Catalan	first semester	afternoon
(PLAB) Practical laboratories	2	Catalan	first semester	afternoon
(SEM) Seminars	1	Catalan	first semester	afternoon

(SEM) Seminars	2	Catalan	first semester	afternoon
(TE) Theory	1	Catalan	first semester	afternoon