MRM 1st Term 2019 1 - Basic Mathematics

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Introduction

This course covers the basics of vector and matrix algebra, with a focus on the application of linear algebra methods in Econometrics and Multivariate Statistics. Special attention is paid to how to bridge the gap between textbook formulas and the computer.

Objectives

The objective of the Basic Mathematics course is to refresh matrix algebra and to introduce the R language. It covers the essentials of matrix algebra, including diagonalization and classification of quadratic forms. There are two complementary computer sessions, based on the R language.

Learning Outcomes

i. Identify the roots of a polynomial.
ii. Apply exponential and logarithmic transformations.
iii. Verify linear independence and orthogonality.
iv. Find the rank of matrix.
v. Calculate determinants.
vi. Calculate the eigenvalues and eigenvectors of a square matrix.
vii. Classify a quadratic form.
viii. Implement matrix algebra in the computer.

Competencies

General Competencies

- CG6: Use appropriate tools and techniques for problem solving, correction contrasting and decision validation.

Basic Competencies

- CB9: Students should be able to communicate clearly and concisely their conclusions, underlying

knowledge and reasons to a specialized and non-specialized audience.
- CB 10: Students should possess the learning outcomes that enable them to continue studying in a way that will be largely self-directed or autonomous.

Specific Competencies
- CE2: Profound knowledge of tools in the fields of mathematics, statistics, econometrics and multivariable analyzes in order to carry out relevant research projects on a global level.
- CE8: Analyze business phenomena formal analysis tools (logic and mathematics) in order to develop consistent structural theories.
- CE9: Knowledge of and ability to use the tools of economic analysis and the classical theory of markets in the analysis of organizations.

Content

1. Introduction to R
2. Vectors
3. Matrices
4. Eigenvalues and eigenvectors
5. Quadratic forms

Methodology

The course is based on lectures, given in a traditional, professor-to-student way. The topics covered in the lectures are explained in a set of lecture notes.

Evaluation

Grading is based on the exercises proposed at the end of each session (50%) and the final exam (50%).

Course Outline

TITLE OF SESSION & MATERIAL

1	*Refreshing functions* Lecture notes: [MATH-01] Refreshing functions
2	*Vectors* Lecture notes: [MATH-02] Vectors
3	*Computer session*

4	*Product of vectors* Lecture notes: [MATH-03] Product of vectors
5	*Matrices* Lecture notes: [MATH-04] Matrices
6	*Determinants* Lecture notes: [MATH-05] Determinants
7	*The product of a matrix and a vector* Lecture notes: [MATH-06] The product of a matrix and a vector
8	*The product of two matrices* Lecture notes: [MATH-07] The product of two matrices
9	*Eigenvalues and eigenvectors* Lecture notes: [MATH-08] Eigenvalues and eigenvectors
10	*Orthogonal matrices* Lecture notes: [MATH-09] Orthogonal matrices
11	*Quadratic forms* Lecture notes: [MATH-10] Quadratic forms
12	*Computer session*
13/14	*Final exam*

Bibliography

- TMApostol (1967), *Calculus*, Wiley.

Professor's Biography

Prof. Miguel-Angel Canela

Associate Professor of Managerial Decision Sciences

Prof. Canela holds a Ph. D. degree in Mathematics from the Universitat de Barcelona (1980). Before joining IESE in 2009, he was a professor at the Department of Applied Mathematics and Analysis of that university and a part-time professor of the Ph. D. Program at IESE. He also worked many years as a consultant at the Institut Català de Tecnologia.

His Ph. D. Dissertation and first research papers were concerned with various problems of Functional Analysis. Later, his interest switched towards interdisciplinary research, entering diverse fields, such as Management Science, Nutrition, Botany, Toxicology and Biochemistry. He has coauthored several research papers with IESE professors and students. Nowadays, his attention is focused on the application of Data Science to various aspects of management.