UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

# COURSE SYLLABUS

# Linear Algebra and Geometry

**2324-1-E3101Q132**

## Aims

Students will have to gain the ability to use vector spaces and matrices' basic structural operations. By means of such operations we define linear (in)dependence, bases of vector spaces and matrix rank. These concepts, along with linear maps, form the abstract tools needed for applications to systems of linear equations and analytic geometry.

Students will learn to express an analytic geometrical question in a linear algebraic statement and apply the results in this field to solve it.

## Contents

Basic topics in Linear Algebra. Systems of Linear Equations; definition of Simple Linear Regression. Two-dimensional Analitic Geometry, Conics classification. Three dimensional Analytic Geometry: Planes, Straight Lines.

## Detailed program

1. Linear Algebra: vector spaces, linear dependence, bases, Euclidean scalar product, vector product and their geometrical interpretations.

2. Matrices: operations, rank, invertibility, determinant, elementary operations, reduction to row/colum echelon form.

3. Systems of Linear Equations: Rouché-Capelli and Cramer Theorems. Definition of simple linear regression and formula for determining the regressive line.

4. Linear Transformations: associated matrix, properties.

5. Matrix diagonalization: eigenvalues, eigevectors, algebraig and geometric multeplicity. Spectral Theorem.

6. Two-dimensional Analytic Geometry: affine linear subspaces, conics classification.

7. Three-dimensional Analytic Geometry: affine linear subspaces.

## Prerequisites

Basic Set Theory. Sets endowed with structures (monoids, groups). Proof by contradiction and by induction.

## Teaching form

The course will be taught in ITALIAN.

-- 5 weekly hours of classes.

-- 2 weekly hours of exercise sessions: the teaching assistant solves specific exercises.

-- Tutoring: 2 weekly hours. The teaching assistant assigns exercises to the students divided in groups and allows few minutes for solving each of them, encouraging communications between group members. Afterwards, he asks the students to expose their work, and corrects or explains a possible solution of the exercises.

## Textbook and teaching resource

suggested textbooks:

Anichini-Conti “Geometria analitica e algebra lineare” (Pearson).

Rita Fioresi Marta Morigi "Introduzione all'algebra lineare". Seconda edizione
2021 (Zanichelli)

## Semester

second semester

## Assessment method

The written examination may comprise either:

-- 1 midterm and a final (in April and June), each consisting in 10 questions and which may be multiple-choice and numerical open. The first midterm will cover the first half of the course, while the second one the remaining part.

-- "regular" exams offered thoughout the year: each will include a written examination consisting in 10 questions which may be multiple-choice and numerical open, regarding the topics of the whole course.

The oral examination is mandatory for students who have been admitted to this examination with an insufficient grade. Such students will have to answer to one further question regarding "basic" topics (as listed in the course elearning site) in order to earn a final score of 18.

The oral examination is voluntary for students who got a passing grade in the written examination.

The proposed questions may require: deduction reasoning, modelization, computing finalized to getting a numerical answer.

## Office hours

Prof. Borghesi: email for appointment.
Prof. Pireddu: email for appointment.

Prof. Haution: email for appointment.

## Sustainable Development Goals