



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## COURSE SYLLABUS

### Financial Mathematics - 1

2122-2-E1803M051-T1

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#### Learning objectives

- Being able of using a formalized mathematical language
- Understanding and being able to repeat simple mathematical arguments
- Being able to do simple mathematical calculations, similar to those discussed during the lectures
- Being able to use Excel for simple financial calculations

#### Contents

- Series
- Integrals
- Linear Algebra
- Linear Programming
- Financial Mathematics
- Bonds
- Introduction to derivative instruments

#### Detailed program

- 1) Sequences and series
  - Convergent, divergent and oscillating series
  - Necessary condition for convergence
  - Geometric series, harmonic series, telescopic sums
  - Sufficient conditions for convergence
  - Leibniz criterion
- 2) Integrals

- Construction of the Riemann integral and first properties
- Theorems on integrals
- Computations of integrals: integration by parts and by substitution. Integration of rational functions.
- Improper integrals
- Sufficient conditions for convergence of improper integrals

### 3) Linear algebra

- Vectors, vector spaces
- Matrices, linear functions
- Operations with matrices
- Determinant, Rank, Inverse matrix
- Linear systems and Rouché-Capelli Theorem
- Gauss algorithm

### 4) Linear programming

- Examples of linear problems
- Geometric solution

### 5) Financial mathematics

- Elementary definitions of financial mathematics
- Interest rates. Force of interest.
- Annuities and their net present values
- Time indexes
- Amortizing plans
- Choice between financial operations
- Net Present Value and Internal Rate of Return
- Term structure of interest rates

### 6) Bond mathematics

- Interest rate risk and duration
- Properties of duration
- Duration in Excel
- Geometric interpretation of duration
- Convexity
- Immunization
- Term structure

### 7) Introduction to derivative instruments

- Options, forward, futures
- Marking to market
- Elementary payoffs, Merton bounds
- No arbitrage principle
- Binomial model in one and two periods
- Black-Scholes formula
- Sensitivity analysis: computation of Delta and Gamma

## Prerequisites

It is necessary to have passed the exam of Matematica Generale.

## Teaching methods

All lectures will be recorded. Approximately 80% of the lectures will be in asynchronous mode, while the remaining 20% of the lectures and the exercise classes will be in synchronous mode.

## **Assessment methods**

Esame scritto con orale facoltativo.

## **Textbooks and Reading Materials**

- Slides and recorded lessons
- "Successioni, serie e integrali", Manuale modulare di Metodi Matematici, vol. 5, a cura di Giovanna Carcano, edizioni Giappichelli Torino
- "Algebra lineare", Manuale modulare di Metodi Matematici, vol. 4, a cura di Maria Ida Bertocchi, edizioni Giappichelli Torino
- "Elementi di Matematica Finanziaria e cenni di Programmazione Lineare", S. Stefani, A. Torriero e G. Zambruno, edizioni Giappichelli Torino
- "Opzioni e futures", J. Hull

## **Semester**

First Semester

## **Teaching language**

Italian

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