UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

# COURSE SYLLABUS

# Mathematical Finance

**2223-3-E4101B019**

## Learning objectives

This class aims to give the student a solid foundation for the mastering of the fundamental concepts related to Mathematical Finance.

At completion, the student will be able 1) to master the most important models used in the study of Interest, Discount, Loans and Costs of Borrowing, Fixed-Income securities and valuation, Bonds, and No Arbitrage Principle, and 2) to apply the major techniques to price in the Binomial Model European Derivatives and American Derivatives. Moreover, the student will become familiar with some of the mathematical techniques which underlie the named applications.

## Contents

In this class the first part will focus on Interest, Discount, Loans and Costs of Borrowing, Fixed-Income securities and valuation, Bonds, Yield of Bonds, Spot Rates and Forward Rates, No Arbitrage Principle and Internal rate of return. In the second part the focus will be on the pricing techniques in the Binomial Model.

## Detailed program

Interest, Discount, Loans and Costs of Borrowing, Fixed-Income securities and valuation, Bonds. Yield of Bonds. Spot Rates and Forward Rates. Internal Rate of return and algorithm of Newton. Costs of Borrowing. Amortization schedule. Different types of Amortization and their computation. Rating. No Arbitrage Principle. Binomial Model. Probability for the Binomial Models: Conditional Expectations and its properties. Martingales and Prices of European Derivatives. The main properties of Martingales. Replications and Portfolios. America Derivatives and Supermartingales. Stopping Times and Pricing of American Derivatives. Optimal Execution. American Call.

Random Walk and its applications to Perpetual American Put.

## Prerequisites

Algebra Lineare e Analisi Matematica I (Linear Algebra and Mathematical Analysis I)

## Teaching methods

The lectures will be delivered in lecture theatres. The class will be taught in Italian.

The lectures aim to present the theoretical results related to the class's material. In the lectures we will focus on presenting the theorems and mathematical results listed above. In addition, we will also present and discuss problems and exercises to illustrate the theoretical results.

## Assessment methods

A written exam.

The student can substitute the final exams with two mid-term exams.

The aim of the written exams is to establish if the student has developed a reasonable level of problem solving ability. Therefore there will be exercises similar to the ones presented in the suggested textbooks.

In the case the student opts for the mid-term exams then the final grade will be the average of the two grades.

## Textbooks and Reading Materials

1. Introduzione alla Matematica Finanziaria, Riccardo Cesari e Elisa Susini, McGraw-Hill

2. Stochastic Calculus for Finance I (The Binomial Asset Pricing Model), Steven E. Shreve, Springer

3. Finanza Matematica. Teoria e Problemi per Modelli Multiperiodali, Andrea Pascucci e Wolfgang Runggaldier, Springer

## Semester

Second Semester

## Teaching language

Italian

## Sustainable Development Goals