# Mathematical Finance

## Prof. Paola Biffi

***COURSE AIMS AND INTENDED LEARNING OUTCOMES***

The course is aimed at developing financial valuation over time and in conditions of uncertainty. Students will acquire the basic tools to deal with finance in quantitative terms, by developing their own understanding and knowledge of the aspects of formalisation necessary for the analysis and management of financial problems.

The course presents the principles which govern the financial markets and the most important financial instruments for market intervention and control of risk.

At the end of the course, students will have the knowledge, methodologies and abilities to analyse and solve financial problems, which will enable them to interact and knowingly operate in the financial markets.

***COURSE CONTENT***

Module I

*Time development of financial products.*

Present and future value in the equitable determination of sequences of monetary amounts.

1. *Capital accumulation and annuity products*. Indexing of annuities. Present value and expected present value.

2. *Capital loans and bond loans*. Amortisation plans and loan valuation.

*Introduction to risk*

Description of uncertainty in investment selection in order to highlight the role of market and investors.

3. *Normal distribution*. The role of mean and variance for financial applications.

4. *The classic problem of portfolio selection*. Determination of efficient investments and optimal choice of expected utility.

Module II

Review of perfect market conditions and their role over time with the no-arbitrage principle for determination of prices and for laws that govern the interest rates trend.

*The role of the market*

The conditions of equity for the market in the computation of the prices of financial products.

1. *The market model*. Difference between systematic and non-systematic risk; presentation of a one-index model; introduction to managed savings, with the main measures of performance.

2. *The no-arbitrage principle in conditions of certainty and uncertainty.* Description of relationships of equilibrium for financial products and implications in price formation.

*Uncertainty and time in financial problems*

The main models for pricing modern financial instruments, as considered in a scenario of variable rates.

3. *Introduction to modern derivatives instruments*. Derivatives contracts and their valuation. The price of options: from the discrete model to the continuous model. Generalisation of compound capitalisation for equity securities.

4. *The time dynamics in interest rates*. Function of time and of uncertainty for rate models.

***READING LIST***

Text adopted

P. Mazzoleni, *Finanza matematica,* EDUCatt.

Further material will be provided during the course.

***TEACHING METHOD***

Lectures and guided practical work.

***ASSESSMENT METHOD AND CRITERIA***

Written test with exercises and theoretical questions. The exercises aim to verify the student's ability to understand and process the information concerning an economic-financial problem, to find a solution, using the techniques and concepts acquired during the course. The theoretical questions allow students to demonstrate their formalisation skills and their ability to describe economic-financial problems.

***NOTES AND PREREQUISITES***

The Mathematical Finance exam may be taken also by students who have not yet passed the examination in Financial Mathematics.

Further information can be found on the lecturer's webpage at http://docenti.unicatt.it/web/searchByName.do?language=ENG, or on the Faculty notice board.