UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

CONSIGLIO INTERCLASSE IN MATEMATICA

COURSE OF STUDY — TWO-YEAR MASTER OF SCIENCE PROGRAMME IN MATHEMATICS

ACADEMIC YEAR — 2023-2024

ACADEMIC SUBJECT — ANALYTICAL METHODS IN FINANCE

General information	
Programme year	Second
Term	First semester (September 25, 2023 – December 22, 2023)
European Credit Transfer and Accumulation System credits (ECTS)	7
SSD	MAT/05 – Mathematical Analysis
Language	Italian
Mode of attendance	Not mandatory

Lecturer	
Name and surname	Carlo Sgarra
E-mail	
Telephone	+39 080
Department and office	Department of Mathematics
Virtual meeting room	
Web page	
Office hours	

Work schedule				
	Total	Lectures	Hands-on learning	Self-study
Hours	175	56		119
ECTS credits	7	7		

Learning objectives	
	Arbitrage theory in continuous time. Derivatives pricing methods for continuous time models.

Course prerequisites	
	Stochastic Calculus and Stochastic Processes. Basic notions of Partial Differential Equations.

Syllabus	
Course contents	Stochastic Calculus reminder: Ito Integral, Ito Lemma, stochastic differential equations, Feynman-Kac representation theorem. The concept of arbitrage and the fundamental theorems of Asset Pricing. European Options pricing and hedging. The Black-Scholes- Merton model. Exotic options pricing: Barrier, Lookback, Asian options. The optimal stopping problem in a Black-Scholes-Merton setting and American options valuation. Its connection with free-boundary parabolic problems. Interest rates derivatives in continuous time. The change of-numéraire technique for derivatives valuation.
Reference books	Bjork, T., Arbitrage Theory in Continuous Time, Oxford University Press, 3-rd Ed. 2019. Pascucci, A., PDE and Martingale Methods in Option Pricing, Springer, 2010.

	Rosazza Gianin, E., Sgarra, C., Mathematical Finance (Theory Review and Exercises), Springer, 2-nd Ed., 2023.
Additional course materials	
Repository	

Expected learning outcomes	
Knowledge and understanding	Basic Notions achievements of arbitrage theory in continuous time and applications to derivatives valuation in continuous time models.
Applying knowledge and understanding	Ability to apply the basic notions provided to evaluate financial derivatives in continuous time models.
Soft skills	*Making judgements*: ability to verify theoretical consistency in valuating and constructing hedging strategies with more complex derivatives instruments.
	Communication skills: familiarity with the language of more complex tools of financial markets and ability to express and interpret valuation and hedging results.
	Learning skills: achievements of the basic mathematical methodologies in financial instruments valuation and hedging in continuous time models.

Teaching methods	
	The course will be given in the classroom.

Assessment	
Assessment methods	Oral Exam with 3 questions (4 for "laude"), one of which related to some numerical application. The questions will be strongly aimed at verifying the achievement of the expected learning outcomes.
Evaluation criteria	• *Knowledge and understanding*: familiarity with the basic notions of arbitrage theory and with the basic valuation methods provided by the course. • *Applying knowledge and understanding*: ability to apply the methodologies illustrated in the course to specific valuation and hedging problems in continuous time financial models. • *Making judgement*: ability to develop a critical approach to the choice of valuation and hedging strategies for specific financial instruments. • *Communication skills*: familiarity with the language of more complex financial markets, ability to illustrate rigorously methods and ideas. • *Learning skills*: ability to approach critically and autonomously new concepts and ideas related to the contents of the course.
Grading policy	Each question will be evaluated with points 0-10, if all three will obtain 10, a fourth question will be proposed in view of the "Laude".

Further information	
	Attending the course is strongly suggested.