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 STOCHASTIC PROCESSES

General information	
Programme year	First
Term	First semester (September 25, 2023 – December 22, 2023)
European Credit Transfer and Accumulation System credits (ECTS)	7
SSD	MAT/06 – Probability and Mathematical Statistics
Language	Italian
Mode of attendance	Not mandatory

Lecturers	
Name and surname	Yun Gang Lu
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Telephone	+39 080 544 2670
Department and office	Department of Mathematics, room 21 second floor
Virtual meeting room	Microsoft Teams codice dnuvlf1
Web page	https://www.dm.uniba.it/it/members/lu
Office hours	Monday and Wednesday 15:00-17:00

Work schedule	Total	Lectures	Hands-on learning (recitations)	Self-study
Hours	175	40	30	105
ECTS credits	7	5	2	

Learning objectives	
	Acquisition of the knowledge of stochastic processes and stochastic calculus. Applying these to understand, analyze and solve problems in the presence of random evolution.

Course prerequisites	
	Probability Theory, elementary functional analysis

Syllabus	
Course contents	1. Basic concepts of stochastic process; separability of a stochastic process 2. The conditional expectation and probability by knowing a sigma-algebra: motivation and definition; examples; some its elementary properties; its probabilistic properties; its analytic properties; some important inequalities 3. Consistence of a family of probability measures and the Kolmogorov's theorem for constructing a process based on a consistent family of probability measures. 4. Processes with independent increments: motivation and definition; examples; some characterizations of the processes with independent increments 5. Markovian processes: motivation and definition; examples; some

	characterizations of the property of Markov; transition function and Markovian processes; transition function and semi—group; Markov chain 6. Wiener process and the Brownian motion: definition; their Markovian property; the properties of their trajectories 7. Martingale, sub-martingale and super-martingale: definition; examples; some elementary properties and some important inequalities 8. Stochastic Calculus: stochastic integral, Ito formula, some important properties of stochastic integral; calculation of some stochastic integral; quadratic variation of a martingale; application of the Ito formula; a class of stochastic differential equations, their existence--uniqueness of solution and application
Reference books	- N. Ikeda, S. Watanabe: Stochastic Differential Equations and Diffusion Processes. (North Holland Mathematical Library) - I. Karatzas, S.E. Shreve: Brownian Motion and Stochastic calculus (Springer) - A.N. Shiyayev: Probability (GTM, v. 95, Springer) - K. Yosida: Functional Analysis (Springer)
Additional course materials	Lecture notes made available on the Microsoft Teams channel of the course
Repository	

Expected learning outcomes	
Knowledge and understanding	○ Fundamental knowledge of stochastic process ○ Computation techniques
Applying knowledge and understanding	○ Comprehension of conditional expectation and consistence ○ Computation of conditional expectation ○ Comprehension of several important classes of stochastic processes ○ Understand the motivation and main idea to introduce stochastic integral and the Ito formula ○ Computation of stochastic integral ○ Comprehension of stochastic differential equation
Soft skills	*Making judgements*: At the end of the course the student should be able to: ○ Understanding concepts, theorems and their proof ○ Resolving problems and exercises
	Communication skills: At the end of the course the student must be able to acquire the necessary terminologies and formalism for: ○ Exposing acquired knowledge. ○ Understanding and solving problem
	Learning skills: At the end of the course the student should be able to: ○ Acquire an adequate study method with a help of the consultation of textbooks. ○ Solve exercises and questions

Teaching methods	
	Frontal teaching and guided problem solving during the exercise's sessions. The teaching course is not delivered in e-learning mode, unless modified due to the pandemic.

Assessment	
Assessment methods	Verification will be performed through an oral test, in which the student's understanding of the theoretical topics covered in class and ability to solve problems related to stochastic processes are assessed, according to those

	carried out in the hours of classroom exercises.
Evaluation criteria	• *Knowledge and understanding*: Evaluation of the knowledge of fundamentals on stochastic processes and computation techniques. • *Applying knowledge and understanding*: statement and proof of some important results. • *Making judgement*: Applicating main results to resolve some problems. • *Communication skills*: Evaluation of the ability in exposing knowledge. • *Learning skills*: Evaluation of autonomous studying
Grading policy	The final score is given out of thirty and the minimum score for passing the examination is 18/30. It derives from the evaluation criteria presented above. The evaluation will take into account the acquired knowledge as well as the transversal skills. To achieve a high evaluation, the student must have developed independent judgment and adequate capacity for argumentation and exposition.

Further information	