General Information	
Academic subject	Applied Probability and Stochastic Processes
Degree course	Statistica e Metodi per l'Economia e la Finanza (SMEF)
Curriculum	
ECTS credits	6
Compulsory attendance	No
Language	Italiano

Subject teacher	Name Surname	Mail address	SSD
	Rosa Maria Mininni	rosamaria.mininni@uniba.it	MAT/06

ECTS credits details			
Basic teaching activities			

Class schedule	
Period	I
Year	I
Type of class	Lecture- workshops

Time management	
Hours	42
In-class study hours	42
Out-of-class study hours	108

Academic calendar	
Class begins	
Class ends	

Syllabus	
Prerequisites/requirements	Mathematical knowledge acquired in a basic course of Calculus of Probability
Expected learning outcomes (according to Dublin Descriptors) (it is recommended that they are congruent with the learning outcomes contained in A4a, A4b, A4c tables of the SUA-CdS)	*Knowledge and understanding* In-depth analysis of all the theoretical aspects closely related to the Calculus of Probability and the Theory of Stochastic Processes. Illustration of some probabilistic models typically used to study real stochastic phenomena in different application fields. *Applying knowledge and understanding* Ability to apply the acquired knowledge to the study of stochastic problems in all the applied sciences, especially in Finance. *Making informed judgements and choices* Ability to understand and collect in advance all the information concerning the problems under investigation. Ability to build new statistical-probabilistic models describing real stochastic phenomena and to interpret the related results. *Communicating knowledge and understanding* Acquiring the mathematical language needed to describe, interpret and explain events and processes in different application fields using stochastic models.

	Capacities to continue learning Acquiring an appropriate method of analysis, supported by the resolution of problems proposed during the course.
Contents	•
Course program	• Conditional Probability function (discrete and continuous case). Computing expectation and variance by conditioning with respect to a random variable. Examples. • The Exponential distribution: definition, expected value, variance e moment generating function. Properties of the exponential distribution and its application to finance, queueing theory, industrial processes (hazard function). • Definition of a stochastic process. Some examples. Introduction to discrete stochastic processes: 1) Counting processes and their properties; 2) The Poisson process and its properties. Interarrival and waiting time distribution. Conditional distribution of the arrival times in a Poisson process; 3)vMarkov chains: transition probabilities and transition matrix. Some applications. Chapman-Kolmogorov equations. Classification of states. Definition of irreducible, positive and recurrent Markov chain. Ergodic Markov chains. Limiting probabilities. Some applications: the random walk, the gambler's ruin problem. Computing the mean time spent in transient states. 4) Continuous-time Markov chains: definition and properties. Some applications: birth and death processes, queueing systems. The transition probability function and its properties. Chapman-Kolmogorov equations: forward and backward. Limiting probabilities. 5) Binomial models in Finance: introduction to stock options contracts, the arbitrage condition, risk-neutral probability. Uniperiodal and multiperiodal binomial models for the evaluation of a stock option price. • Continuous stochastic processes: 1)Brownian motion: historical background and its definition. Brownian motion as a limiting process of random walks. Sample paths of a Brownian motion: continuity and non-derivability. Hitting times. Brownian motion with drift. Geometric Brownian motion. Gaussian processes. Integrated Brownian motion. 2) The Martingale stochastic process: historical background and its definition. Definition of a submartingale and a supermartingale. Some approaches to transform a submartingale in a martingale: the Doob-Meyer decomposition theorem, the Girsanov theorem. Applications to stock options. 3) The Black-Scholes-Merton model for option pricing: the historical background, the financial market assumptions, the Black-Scholes formula. Examples. The Delta-Hedging strategy. 4) The Cox-Ingersoll-Ross (CIR) model to study the dynamics of short-term market interest rates.
Bibliography	1. Sheldon M. Ross, Introduction to Probability models (9^{th} edition), Elsevier, USA, 2007. 2. Slides and lecture notes available on the webpage of the teacher

Notes	
Teaching methods	Lectures and exercise sessions
Assessment methods (indicate at least the type written, oral, other)	Oral exam
Evaluation criteria (Explain for each expected learning outcome what a student has to know, or is able to do, and how many levels of achievement there are.	Knowledge and understanding will be evaluated by the teacher during lectures trough the interaction with students and trough an oral exam for the final evaluation.
Further information	