Stampare su carta intestata del CdS

General information	
Academic subject	***Mathematical Finance***
Degree course	*Master's Degree in Economics of Financial Markets and Institutions*
Academic Year	*Second*
European Credit Transfer and Accumulation System (ECTS)	8
Language	*Italian*
Academic calendar (starting and ending date)	*2022/03/07 – 2022/06/17*
Attendance	*Not compulsory, but strongly recommended*

Professor/ Lecturer	
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Virtual headquarters	*Microsoft Team 0qm32f3*
Tutoring (time and day)	Every Monday from 9.30 to 11.30; if remotely, on Microsoft Team ry4023h in the same hours of the same day

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Syllabus	
Learning Objectives	• Knowledge of the basic concepts in Probability and Stochastic Processes Theory • Knowledge of the structure of the main contingent claims and their non-arbitrage boundaries • Knowledge of the main techniques of option pricing in both discrete and continuous settings
Course prerequisites	Differential calculus in one and more variables, integral calculus, basic concepts in probability and financial mathematics
Contents	**Probability Background:** Probability spaces. Sigma algebra of the events. Conditional probability and independence. Random variables and related distribution functions. Special distributions and their main property. The sigma algebra generated by a random variable. Functions of random variables. Expected value, variance, covariance, correlation coefficient and main properties. Independent random variables. Weak and strong law of great numbers. Central limit theorem. **Stochastic processes:** Introduction to stochastic processes. Brownian motion, geometric Brownian motion and related topics. Sigma algebras and information. Filtration and adapted processes. Conditional expectation and related properties. Topics from martingale theory. Random walks. Riemann-Stiltjes' integral. Ito's integral and Ito's formula. Girsanov's theorem and applications. Markov processes. Basics on stochastic differential equations. **Derivative Instruments:** Financial markets and derivatives. Arbitrage. Risk-neutral valuation. Options and main properties. Arbitrage bounds. Put – call parity formula. **Pricing option theory:** Black-Scholes model. The Black – Scholes option pricing equation and the corresponding formula. The Greeks. Binomial model by Cox-Ross-Rubinstein for European and American options and related topics. Calibration of the parameters.

	Convergence of the binomial model formula towards the Black-Scholes formula. Pricing and Hedging with Monte Carlo Methods. Complete and incomplete markets.
Books and bibliography	1) Agliardi E., Agliardi R., *Mercati finanziari, Analisi Stocastica delle Opzioni,* McGraw-Hill, 2001. 2) Benth F. E., *Option Theory with Stochastic Analysis*, Springer 2004. 3) Bingham N.H., Kiesel R, *Risk – Neutral Valuation*, Springer 2004. 4) Björk T., *Arbitrage theory in continuous time,* Oxford University Press, 2004. 5) Canestrelli E., Nardelli C., *Modelli per la Finanza Quantitativa,* Giappichelli Editore (Torino), 2003. 6) Higham Desmond J., *Introduction to Financial Option Valuation: Mathematics, Stochastics and Computation,* Cambridge University Press, 2004. 7) Hull J. C., *Opzioni, Futures e altri Derivati,* Pearson Prentice Hall, 2022. 8) Kwok, Y. K., *Mathematical Models of Financial Derivatives,* Springer Berlin Heidelberg 2008. 9) Sheldon M. Ross, *An elementary introduction to Mathematical Finance,* Cambridge Uni. Press, 2011. 10) Shreve. S., *Stochastic Calculus for Finance I, The Binomial asset Pricing Model*, Springer Finance, 2004. 11) Shreve. S., *Stochastic Calculus for Finance II, Continuous-Time Models*, Springer Finance, 2004. 12) Whaley Robert E., *Derivatives: Markets, Valuation and Risk Management,* Wiley Finance, 2006. 13) Williams D., *Probability with Martingales*, Cambridge University Press, 1991. 14) Wilmott P., Howison S. and Dewynne J., *The Mathematics of Financial Derivatives,* Cambridge University Press, 1995.
Additional materials	*Teaching material provided during the lessons*

Work schedule			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
Hours			
56	*42*	14 including a crush course about using MATLAB in Finance	*200*
ECTS			
8			

Teaching strategy	*Lectures and tutorials in hybrid mode*
Expected learning outcomes	
Knowledge and understanding on:	○ Learning the main techniques for pricing derivatives both in the discrete and the continuous setting, by using a theoretical approach together with the most common software programs
Applying knowledge and understanding on:	○ Ability to apply suitable quantitative analysis techniques to understand and face up problems of evaluation of contingent claims and related issues

Soft skills	• *Making informed judgments and choices* ○ To be able to evaluate independently and consciously the utility of investments in the contingent claims traded in the markets together with a suitable analysis of the risk management; to be able to correctly compute the no-arbitrage prize of a financial derivative • *Communicating knowledge and understanding* ○ To make use of an appropriate and unambiguous language in communicating the results referred to problems related to the choice, the valuation, and the risk management in Quantitative Finance; the student will acquire a set of methods and techniques to operate as a qualified financial advisor in banking institutions and, more generally, in the financial markets ○ *Capacities to continue learning* ○ To be able to use independently the analytic instruments and the computer skills provided during the lessons to understand and solve problems arising in the pricing of financial instruments

Assessment and feedback	
Methods of assessment	
Evaluation criteria	• *Knowledge and understanding* ○ The student must show a sufficient awareness of the basic mathematical tools in solving problems occurring in Finance • *Applying knowledge and understanding* ○ The student must be able to apply the theoretical issues and the computer skills in solving practical problems related to Business, Economics and Finance • *Autonomy of judgment* ○ The student must be able to use autonomously techniques and instruments in formalizing and solving problems as they arise in different contexts • *Communicating knowledge and understanding* ○ The student must adopt a precise and scientific language when facing up practical and theoretical problems concerning the risk management in the use of financial instruments • *Communication skills* ○ The student must use fluently the scientific and/or mathematical language in communicating his opinions and solutions to the problems occurring in the risk management of financial derivatives • *Capacities to continue learning* ○ The student must possess a deep awareness of the arguments treated during the lessons in such a way that he may identify properly some different problems and find out an optimal solution
Criteria for assessment and attribution of the final mark	*Oral exam with practical and theoretical issues concerning the course program; the final grade will be calculated as the average related to these two different aspects*
Additional information	