



## Subject card

Subject name and code	, PG_00055430						
Field of study	Mathematics						
Date of commencement of studies	October 2023	Academic year of realisation of subject			2023/2024		
Education level	second-cycle studies	Subject group			Optional subject group Subject group related to scientific research in the field of study		
Mode of study	Full-time studies	Mode of delivery			at the university		
Year of study	1	Language of instruction			Polish		
Semester of study	1	ECTS credits			5.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Instytut Matematyki Stosowanej -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. Karol Dziejul				
	Teachers		dr hab. Karol Dziejul				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	15.0	0.0	15.0	0.0	60
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study	SUM
	Number of study hours	60		5.0		60.0	125
Subject objectives	Getting to know the models of the derivative market and mathematical modeling. An introduction to effective Monte Carlo methods based on continuous models for pricing option.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[K7_W05] Has enhanced knowledge of a selected branch of mathematics: knows most classical definitions and theorems and their proofs, Understands problems being examined, Knows relations between problems from particular field with other branches of mathematics, theoretical and applied		The subject combines probability theory, stochastic processes and numerical methods. This is done in the context of the valuation of derivatives. The ability to evaluate them is rather intuitive, combining theory with practice.		[SW2] Assessment of knowledge contained in presentation [SW3] Assessment of knowledge contained in written work and projects		
	[K7_U09] Is able, at an advanced level and covering modern mathematics, to apply and present in speech and in writing the methods of at least one selected branch of mathematics: mathematical and functional analysis, theory of differential equations and dynamical systems, algebra and number theory, geometry and topology, calculus probability and statistics, discrete mathematics and graph theory, logic and set theory.		An ability to solve analytically stochastic equations. It uses these methods to value options.		[SU1] Assessment of task fulfilment		
Subject contents	Discrete model: self-financing portfolio, arbitrage. Equivalence theorem of local martingales, generalized martingales, martingales transformations. Theorem on the existence of a martingale measure for markets without arbitrage. Esher Lemma. Continuous models. Stochastic differential equations, Equations with affine coefficients solved exact. Numerical solutions. Standard Black Scholes model Heston model. Short-term rate models, Vasick's model.						
Prerequisites and co-requisites	Probability theory. Measure theory						

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
		60.0%	100.0%
Recommended reading	Basic literature	1. J. Jakubowski, A. Palczewski, M. Rutkowski, Ł. Stettner „Matematyka finansowa Wydawnictwo Naukowo-Techniczne 2003.  2. J. Hull „ Options, Futures, and the Other Derivatives Englewood Cliffs, Prentice-Hall 2007  3. A.N. Shiryaev „Essentials of Stochastic Finance:Facts, Models, Theory Singapore, World Scientific 1999  4. Glasserman P, Monte Carlo Methods In Financial Engineering, Springer, 2003	
	Supplementary literature	[JYC] M. Jeanblanc, M. Yor, M. Chesney, Mathematical methods for financial markets. Springer Finance. Springer-Verlag London, Ltd., London, 2009.	
	eResources addresses	Uzupełniająca Adresy na platformie eNauczanie: Kontrakty terminowe - Moodle ID: 6153 <a href="https://enauczanie.pg.edu.pl/moodle/course/view.php?id=6153">https://enauczanie.pg.edu.pl/moodle/course/view.php?id=6153</a>	
Example issues/ example questions/ tasks being completed	Determine the value of a financial instrument $(S_T - K)^2$ . Solve stochastic differential equation with Affine Coefficients: Method of Variation of Constants. Example 1.5.4.8 [JYC]		
Work placement	Not applicable		