



Subject card

Subject name and code	Risk Processes, PG_00044138						
Field of study	Mathematics						
Date of commencement of studies	October 2025	Academic year of realisation of subject			2025/2026		
Education level	second-cycle studies	Subject group			Specialty 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	2	ECTS credits			5.0		
Learning profile	general academic profile	Assessment form			exam		
Conducting unit	Institute of Applied Mathematics -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. Sergey Kryzhevich					
	Teachers	dr hab. Sergey Kryzhevich					
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	0.0	0.0	30.0	60
	E-learning hours included: 0.0						
	eNauczenie source address: https://enauczanie.pg.edu.pl/2025/course/view.php?id=5220 Moodle ID: 5220 Procesy ryzyka_2026 https://enauczanie.pg.edu.pl/2025/course/view.php?id=5220						
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	Introduction to basic mathematical concepts related to risk modeling in terms of stochastic (Markov) processes and stochastic differential equations.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K7_W04] demonstrates knowledge the rules of stochastic modeling in financial and actuarial mathematics or in natural sciences	Deals with issues related to building mathematical models of risk processes, including ruin processes.			[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation		
	[K7_U03] uses differential and integral calculus, elements of complex analysis, algebraic methods, applies them in typical practical	Analyzes Markov risk processes w continuous time.			[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information		
	[K7_K04] forms opinions on mathematical issues	Applies stochastic process methods to financial engineering, in particular to modeling insurance risk or survival risk.			[SK1] Assessment of group work skills [SK5] Assessment of ability to solve problems that arise in practice		

Subject contents	Course content – lecture		
	<ol style="list-style-type: none"> 1) Winner and Poisson processes. 2) Insurance company business model. 3) Assets, options, Bachelier model. 4) Stochastic equations, Ito integrals. 5) Black-Sholes model. 6) Branching processes. 7) Autoregression. Ornstein-Uhlenbeck model. 8) Heath-Jarrow-Morton model and similar models. 		
	Course content – seminar		
	<ol style="list-style-type: none"> 1) The Risk Process as a Random Walk. Probability of Ruin 2) Fit Coefficient. 3) Probability of Ruin. 4) Probability of Ruin: Continuous Time 5) Claim Process - Renewal Theory. 6) Probability of Ruin: Poisson Claim Process. 7) Probability of Ruin for Phased Distributions. 8) Probability of Ruin for Heavy-Tailed Distributions. 9) Copula Functions. 10) Definition and Properties of Copula Functions. 11) Archimedes' Copula Functions. 12) Randomized Model. 13) Examples of Models with Dependent Claim Sizes. 14) Claims about the Pareto Distribution with Clayton's Copula 15) Claims about the Weibull Distribution with Gumbel's Copula 16) Intervals between Claims about the Pareto Distribution with Clayton's Copula 17) Intervals between Claims about the Weibull Distribution with Gumbel's Copula 18) Further Extensions of the Mixture Method 19) Statistical Techniques for Continuous Distributions 20) Fitting a Distribution to Data 21) Empirical Distribution Function 22) Quantile Plot (Q-Q Plot) 23) Mean Surplus Function 24) Pareto Distribution 25) Pareto-Type Distributions 26) Heavy-tailed distributions 27) Subexponential classes 		
Prerequisites and co-requisites	Knowledge of the matter of subjects: Probability Theory, Stochastic Processes.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Exam	51.0%	50.0%
	Project	51.0%	50.0%
Recommended reading	Basic literature	Jacek Jakubowski, Rafal Scztencel, Wstęp do teorii prawdopodobieństwa. SCRIPT, Warszawa, 2010.	
	Supplementary literature	<ol style="list-style-type: none"> 1) Olav Kallenberg, Foundations of modern probability, Springer, 2002. 2) Ioanis Kartazas and Steven E. Sherve, Brownian Motion and Stochastic Calculus, Springer, 1991. 3) Tomasz R. Bielecki, Marek Rutkowski, Credit Risk, Modeling, Valuating and Hedging, Springer, 2004. 	
	eResources addresses	Basic https://enauczanie.pg.edu.pl/2025/course/view.php?id=5220 -	

Example issues/ example questions/ tasks being completed	During the first lecture, students receive a topic for independent development and presentation of a project by a designated deadline. Theoretical knowledge acquired in the lecture and seminar will be assessed during the exam. 1) State and prove the properties of a homogeneous Markov chain. 2) Solve a problem involving multivariate linear regression. 3) Determine stochastic differentials using Ito's formula.
Practical activities within the subject	Not applicable

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