



Subject card

Subject name and code	Probability Theory, PG_00025511						
Field of study	Mathematics						
Date of commencement of studies	October 2023	Academic year of realisation of subject				2025/2026	
Education level	first-cycle studies	Subject group				Obligatory subject group in the field of study Subject group related to scientific research in the field of study	
Mode of study	Full-time studies	Mode of delivery				blended-learning	
Year of study	3	Language of instruction				Polish	
Semester of study	5	ECTS credits				5.0	
Learning profile	general academic profile	Assessment form				exam	
Conducting unit	Department of Probability Theory and Biomathematics -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Tomasz Szarek					
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	30.0	0.0	0.0	0.0	60
	E-learning hours included: 28.0						
	Adresy na platformie eNauczanie:						
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 notions of modern probability based on measure theory. Equipping a student in the knowledge necessary for understanding randomness and relevant interaction with the surrounding environment and sociopolitical reality.						
Learning outcomes	Course outcome	Subject outcome				Method of verification	
	K6_U11	Precisely describes different types of random events using the language of axiomatic probability theory. Distinguishes different types of random variables and evaluates their expectations, variances and other moments. Interprets (in applications) laws of large numbers. Estimates parameters of distributions. Performs statistical inference.				[SU3] Assessment of ability to use knowledge gained from the subject	
	K6_W04	Uses methods of logic, analysis, algebra and measure theory in probability.				[SW1] Assessment of factual knowledge	
	K6_W02	Recognizes conditional probability, independence of events and random variables.				[SW1] Assessment of factual knowledge	
	K6_U02	Explains different nodes of stochastic convergence.				[SU1] Assessment of task fulfilment	
K6_U03	Constructs probability space to a concrete phenomena. Applies methods of linear algebra and analysis to describe multivariate random effects.				[SU4] Assessment of ability to use methods and tools		

Subject contents	<p>LECTURES Radon-Nikodym theorem. Conditional expectation. Regression. Sums of independent random variables. Weak law of large numbers. L^2 law of large numbers. Strong law of large numbers (Kolmogorov, Etemadi). Stationary sequences. Maximal ergodic lemma. Individual ergodic theorem for stationary sequences. Empirical distributions. Glivenko-Cantelli theorem. Weak convergence of measures. Characteristic functions. Central limit theorem. Multivariate Gaussian distributions. Fourier transform of measures on \mathbb{R}^n. Descriptive statistics. Point estimators. Confidence intervals. Hypothesis testing. Statistical inferring.</p> <p>TUTORIALS During tutorial classes (closely correlated with lectures) students solve numerical exercises and selected theoretical problems.</p>														
Prerequisites and co-requisites	Courses completed: Probability Theory term IV (MAT1013/1)														
Assessment methods and criteria	<table border="1"> <thead> <tr> <th>Subject passing criteria</th> <th>Passing threshold</th> <th>Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td>Test 1</td> <td>51.0%</td> <td>25.0%</td> </tr> <tr> <td>Test 2</td> <td>51.0%</td> <td>25.0%</td> </tr> <tr> <td>Exam</td> <td>51.0%</td> <td>50.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Test 1	51.0%	25.0%	Test 2	51.0%	25.0%	Exam	51.0%	50.0%
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Example issues/ example questions/ tasks being completed	<p>At the beginning of the term students are provided with the list of problems and exercises to be solved or worked out by themselves. Their solutions are presented on exercises where students give their comments and suggest improvements. Test problems are based on mentioned lists and exam on topics from lectures.</p> <p>Find conditional expectation with respect to a fixed sigma algebra. Study weak convergence and find the limit distribution for a given sequence of random variables. Estimate a probability of a random event using the central limit theorem.</p>														
Work placement	Not applicable														