

Subject card

Subject name and code	Stochastic processes, PG_00155556						
Field of study	Mathematics						
Date of commencement of studies	October 2024		Academic year of realisation of subject		2025/2026		
Education level	Master's studies		Subject group		Optional subject group		
Mode of study	full-time studies		Mode of delivery		at the university		
Year of study	2		Language of instruction		Polish		
Semester of study	3		ECTS credits		6.0		
Learning profile	academic		Assessment form		exam		
Conducting unit	Institute of Mathematics -> Faculty of Mathematics, Physics and Informatics -> Rector						
Name and surname of lecturer (lecturers)	Subject supervisor		dr Monika Wrzosek				
	Teachers						
Lesson types	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: 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		10.0		80.0	150
Subject objectives	The aim of the course is to familiarize students with the basics of the theory of stochastic processes, the construction of the Wiener process and its basic properties, the basics of the theory of martingales and Ito stochastic integral.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[MATMU2_U01] can construct mathematical reasoning: prove theorems and refute hypotheses through construction and selection of counterexamples	The student can apply the theorems and proof methods learned during the lecture, utilize the ideas and techniques used in the proofs of the theorems and examples presented during the lecture, identify the applications of the learned theorems, solve practical problems related to the lecture subject.	[SU4] test/exam - oral or written
	[MATMU2_W02] knows and understands well the role and importance of the construction of mathematical reasoning	The student is familiar with the methods of proof, the significance of rigorous reasoning and precise formulation of problems, and understands the basic concepts of the theory of stochastic processes. The student knows basic examples that illustrate specific concepts in this field and can use them to disprove false hypotheses or unjustified reasoning.	[SW4] test/exam - oral or written
	[MATMU2_U03] can understand mathematical texts of various types from selected fields of mathematics	The student is able to correctly use the basic concepts of probability theory and stochastic processes.	[SU4] test/exam - oral or written
	[MATMU2_K05] is ready to independently search for information in literature, also in foreign languages	The student is ready to independently search for information in literature.	[SK8] observation of student's independent or team work
	[MATMU2_W03] knows and understands in-depth a selected field of theoretical or applied mathematics and is able to understand the formulations of issues in this field that are still at the research stage and knows the connections of issues in this field with other areas of mathematics	The student is familiar with the current state of knowledge in the field of stochastic processes theory, knows what problems contemporary researchers are dealing with, and can identify its connections with other branches of mathematics.	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion
	[MATMU2_K06] is ready to formulate opinions on basic mathematical issues	The student is ready to express opinions on fundamental mathematical concepts.	[SK8] observation of student's independent or team work
	[MATMU2_U07] is able to define his/her interests and develop them; in particular, is able to establish contact with specialists in his/her field, e.g. understand their lectures intended for young mathematicians	Is able to define his/her interests and develop them; in particular, is able to establish contacts with specialists in the field of stochastic processes.	[SU1] oral statement/conversation/ discussion
	[MATMU2_U06] is able to apply methods and examples from a selected field of mathematics in related fields	Is able to apply methods and examples from the field of stochastic processes in related fields.	[SU4] test/exam - oral or written
	[MATMU2_U05] can perform proofs in a selected field and, if necessary, also use tools from other areas of mathematics	Is able to prove theorems concerning stochastic processes, using, if necessary, tools from other areas of mathematics.	[SU4] test/exam - oral or written
	[MATMU2_U04] is able, at an advanced level and including modern mathematics, to apply and present, orally and in writing, methods of at least one selected branch of mathematics	Is able, at an advanced level covering modern mathematics, to apply and present methods of stochastic processes.	[SU1] oral statement/conversation/ discussion [SU4] test/exam - oral or written
	[MATMU2_K02] is ready to precisely formulate questions to deepen his/her understanding of a given topic or find missing elements of reasoning	The student is ready to formulate precise questions concerning stochastic processes.	[SK8] observation of student's independent or team work
	[MATMU2_K01] is willing to acknowledge the limitations of his or her own knowledge and is willing to pursue further education	The student is ready to acknowledge the limitations of their knowledge and pursue further education.	[SK8] observation of student's independent or team work
	[MATMU2_W01] knows and understands in-depth the theory of selected areas of mathematics	The student knows and understands the elements of the theory of stochastic processes, in particular the theorems that are the subject of the lecture along with the appropriate definitions, examples, and proofs.	[SW4] test/exam - oral or written

	Course outcome	Subject outcome	Method of verification
	[MATMU2_K04] is ready to understand and appreciate the importance of intellectual honesty in one's own and other people's actions; ethical conduct	The student is ready to understand the importance of intellectual honesty and ethical conduct.	[SK8] observation of student's independent or team work
Subject contents	1. Stochastic process: definition, process trajectory, independent and stationary increases, Gaussian process. 2. Wiener process: definition, construction sketch. 3. Properties of the Wiener process (variation and quadratic variation, continuity and non-differentiability of trajectories) 4. Conditional expected value: definition, properties. 5. Stopping times. Martingales, submartingales, supermartingales. Doob inequality. 6. Ito stochastic integral: construction, basic properties.		
Prerequisites and co-requisites	Probability theory		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	observation of the student's attitude	51.0%	0.0%
	student's activity	51.0%	5.0%
	final exam	51.0%	50.0%
	tests	51.0%	45.0%
Recommended reading	Basic literature	1. F. Klebaner, Introduction to Stochastic Calculus with Applications, ICP 2005. 2. Z. Brzeźniak, T. Zastawniak, Basic Stochastic Processes, Springer 2005.	
	Supplementary literature	1. I. Karatzas, S. E. Shreve, Brownian motion and stochastic calculus, Springer-Verlag, Berlin-Heidelberg-New York, 1988. 2. I. I. Gichman, A. W. Skorochod, Wstęp do teorii procesów stochastycznych, PWN, 1968. 3. J. Jakubowski, R. Sztencel, Wstęp do teorii prawdopodobieństwa, Script, 2000. 4. A. D. Wentzell, Wykłady z teorii procesów stochastycznych, PWN 1980.	
	eResources addresses		
Example issues/ example questions/ tasks being completed	not included		
Work placement	Not applicable		

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