University of Gdańsk

Subject card

Subject name and code	Stochastic processes, PG_00208784		
Field of study	Mathematics		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2025/2026
Education level	Master's studies	Subject group	Optional subject group Specialty subject group
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	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	dr Monika Wrzosek	

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_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_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_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_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_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_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_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_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_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
	[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		

<table>
<tr><td>Assessment methods and criteria</td><td colspan="2"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>tests</td><td>51.0%</td><td>45.0%</td></tr>
<tr><td>final exam</td><td>51.0%</td><td>50.0%</td></tr>
<tr><td>student's activity</td><td>51.0%</td><td>5.0%</td></tr>
<tr><td>observation of the student's attitude</td><td>51.0%</td><td>0.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>1. F. Klebaner, Introduction to Stochastic Calculus with Applications, ICP 2005.
2. Z. Brzeźniak, T. Zastawniak, Basic Stochastic Processes, Springer 2005.</td></tr>
<tr><td>Supplementary literature</td><td>1. I. Karatzas, S. E. Shreye, 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.</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">not included</td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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