University of Gdańsk

Subject card

Subject name and code	Stochastic Processes, PG_00155302						
Field of study	Mathematical Modeling and Data Analysis						
Date of commencement of studies	October 2025		Academic year of realisation of subject		2025/2026		
Education level	Master's studies		Subject group		Obligatory subject group 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		6.0		
Learning profile	academic		Assessment form		exam		
Conducting unit							
Name and surname of lecturer (lecturers)	Subject supervisor		dr Anita Dąbrowska				
	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
[MMiADMU2_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
[MMiADMU2_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 being researched and knows the links between the issues of this field and other branches 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
[MMiADMU2_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
[MMiADMU2_K05] is ready to independently search for information in literature, also in foreign languages	The student is prepared to work independently with the literature recommended for the subject.	[SK8] observation of student's independent or team work
[MMiADMU2_U01] can construct mathematical reasoning: prove theorems and disprove hypotheses by constructions and selecting 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 [SU6] demonstration of practical skills
[MMiADMU2_K06] is ready to form an opinion on basic mathematical issues	The student is ready to form an opinion on basic issues concerning stochastic processes.	[SK8] observation of student's independent or team work
[MMiADMU2_U02] can express mathematical content in speech and in writing, in mathematical texts of various nature	The student can apply the methods learned for solving problems, correctly use the learned concepts, interpret the obtained results, and solve practical problems related to the lecture subject.	[SU4] test/exam - oral or written [SU6] demonstration of practical skills
[MMiADMU2_K04] is ready to understand and appreciate the importance of intellectual honesty in the actions of himself and others; is ready to act ethically	The student understands what intellectual honesty is and applies ethical behaviour.	[SK8] observation of student's independent or team work
[MMiADMU2_K02] is ready to precisely formulate questions to deepen his own understanding of a given topic or to find missing elements of reasoning	The student identifies what exactly he/she does not understand and formulates pertinent questions about problems in the field of stochastic processes.	[SK8] observation of student's independent or team work
[MMiADMU2_K01] is ready to recognize the limitations of his own knowledge and is ready to continue his education	The student realistically assesses the level of his/her knowledge, is motivated to develop further, actively seeks opportunities to expand his/her knowledge and acquire new skills.	[SK8] observation of student's independent or team work

Subject contents

1. Basic concepts and theorems of probability used in the theory of stochastic processes.
2. Conditional expectation: definition, properties
3. Stochastic process: definition, sample path, moment functions
4. Gaussian process. Process with independent increments. Stationary processes.
5. Markov property.
6. Wiener process: definition, outline of the construction
7. Properties of the Wiener process: variation and quadratic variation, continuity and non-differentiability of sample paths
8. Stopping times. Martingales, submartingales, supermartingales.
9. Itô stochastic integral: construction and basic properties.
10. Presentation of the subject-related nomenclature in English.

<table>
<tr><td>Prerequisites and co-requisites</td><td colspan="3">Probability theory</td></tr>
<tr><td>Assessment methods and criteria</td><td colspan="3"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Evaluation of the student's attitude</td><td>100.0%</td><td>0.0%</td></tr>
<tr><td>Tests</td><td>51.0%</td><td>50.0%</td></tr>
<tr><td>Final exam</td><td>51.0%</td><td>50.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td colspan="2">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 colspan="2">1. J. Jakubowski, R. Sztencel, Wstęp do teorii prawdopodobieństwa, Script, 2000.
2. I. Karatzas, S. E. Shreye, Brownian motion and stochastic calculus, Springer-Verlag, Berlin-Heidelberg-New York, 1988.
3. I. I. Gichman, A. W. Skorochod, Wstęp do teorii procesów stochastycznych, PWN, 1968.
4. A. D. Wentzell, Wykłady z teorii procesów stochastycznych, PWN 1980.</td></tr>
<tr><td>eResources addresses</td><td colspan="2"></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="3">Not applicable</td></tr>
<tr><td>Work placement</td><td colspan="3">Not applicable</td></tr>
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