GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Stochastic processes, PG_00062081						
Field of study	Mathematics						
Date of commencement of studies	October 2023		Academic year of realisation of subject	2023/2024			
Education level	second-cycle studies		Subject group	Optional subject group 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	1		Language of instruction	Polish			
Semester of study	1		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 -> Wydziały Politechniki Gdańskiej						
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. inż. Tomasz Szarek				
	Teachers		prof. dr hab. inż. Tomasz Szarek				
Lesson types and methods of instruction	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: 30.0						
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		5.0	60.0	125	
Subject objectives	Introduction to basic notions and theorems of the theory of stochastic processes. Equipping a student in the knowledge supporting modelling of the dynamics of random phenomenon.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U08] Knows probability distributions and their properties; is able to use them in practical issues, is familiar with the basics of statistics (estimation issues and hypothesis testing) and the basics of statistical data processing.	Describes families of finite dimensional distributions using classical probability measures.	[SU3] Assessment of ability to use knowledge gained from the subject
[K7_W05] Has enhanced knowledge of a selected branch of mathematics: knows most classical definitions and theorems and their proofs, Understands problems being examined, Knows relations between problems from particular field with other branches of mathematics, theoretical and applied	Finds analytical formulae for transition probabilities after elapsed time t.	[SW1] Assessment of factual knowledge
[K7_U11] Can construct mathematical models used in specific advanced applications of mathematics, can use stochastic processes as a tool for modeling phenomena and analyzing their evolution.	Constructs risk models of selected problems in non-life and life insurance.	[SU2] Assessment of ability to analyse information
[K7_W04] Has enhanced knowledge of a selected branch of mathematics, theoretical or applied.	Extends real stochastic processes to general random elements.	[SW1] Assessment of factual knowledge
[K7_U05] Knows the construction of the Lebesgue measure and integral; is able to apply the concepts of measure theory in typical theoretical and practical problems.	Evaluates characteristics of stochastic processes using methods of measure theory and Lebesgue integral.	[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools

Subject contents

LECTURES Revision of selected parts of probability theory and introduction of notion. Moment generating function and its properties. Stochastic processes - definition and examples. Finite dimensional distributions of a stochastic process. Homogeneous Poisson process. Non - homogeneous Poisson process. Markov chains. Branching processes. Martingales. Doob Theorem. Renewal processes. Classical Brownian motion process. Gaussian processes. Trajectories of a classical Brownian motion and their properties. Diffusion processes. Kolmogorov Theorem.

SEMINARS Revision of methods of probability theory. Sequences of random variables (exponential, Bernoulli, geometrical) and their asymptotic properties. Moment generating function. Random walks. Markov chains. Poisson processes. Renewal processes. Stochastic matrices. Ergodic theory of Markov operators. Reversible chains. Markov semigroups and their generators. Martingales. Stationary processes. Gaussian processes.

Prerequisites and co-requisites

Courses completed: Probability Theory (MAT1013)

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Tests	51.0%	50.0%
Research project	51.0%	20.0%
Exam	51.0%	30.0%

Recommended reading

Basic literature

S.Ross, Stochastic Processes, John Wiley and Sons, New York, 1996.

I.I.Gichman, A.W.Skorochod, Wstęp do teorii procesów stochastycznych, PWN, Warszawa, 1968.

G.Grimmett, D.Stirzaker, Probability and Random Processes, Oxford University Press, 2006.

	Supplementary literature	J.Jakubowski, R.Sztencel, Wstęp do teorii prawdopodobieństwa, Wydawnictwo SCRIPT, Warszawa, 2012. W.Feller, Wstęp do rachunku prawdopodobieństwa, t.I i II, PWN, Warszawa, 2014. J.R.Norris, Markov Chains, Cambridge University Press, Cambridge, 2007. S.R.S.Varadhan, Stochastic Processes, AMS, Rhode Island, 2007.
	eResources addresses	Adresy na platformie eNauczanie: Procesy Stochastyczne_23/24_nowy - Moodle ID: 34761 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=34761
Example issues/ example questions/ tasks being completed	At the beginning of the term the student is provided with the list of problems and exercises to be solved. The student presents his/her solutions on the seminar accordingly to a fixed schedule. Tests problems are selected from mentioned lists and the exam on topics from lectures. Evaluate the extinction/ruin probability. Find stationary distribution. Find one-parameter semigroup from its generator. Classify states. Verify whether a given process is a martingale. Verify the strong Markov property.	
Work placement	Not applicable	

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