GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Introduction to stochastic modeling, PG_00025513		
Field of study	Mathematics		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2026/2027
Education level	first-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	3	Language of instruction	Polish
Semester of study	5	ECTS credits	4.0
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	dr inż. Anna Szafrańska	
	Teachers		

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	15.0	0.0	15.0	0.0	60

E-learning hours included: 8.0

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	35.0	100

Subject objectives

Introduction to modelling of random events and their simulations in R.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_U11	Student designs and simulates random numbers generators with a given distribution. Student simulates Markov chains.	[SU3] Assessment of ability to use knowledge gained from the subject [SU1] Assessment of task fulfilment
K6_W09	Student programs in the R package.	[SW3] Assessment of knowledge contained in written work and projects
K6_K02	Student simulates and analyzes random phenomena occurring in biology and medicine.	[SK5] Assessment of ability to solve problems that arise in practice [SK2] Assessment of progress of work
K6_U10	Student studies asymptotic properties of trajectories of discrete dynamical systems. Designs random numbers generators with a given distribution. Simulates Markov chains.	[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU1] Assessment of task fulfilment
K6_U07	Student analyzes models of random phenomena occurring in biology and medicine.	[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject

<table>
<tr><td>Subject contents</td><td>LECTURES General notions of mathematical modeling. Random and deterministic events in technology, physic, biology and socio-economic life. Deterministic dynamical systems. Deterministic chaos. Random variables. Pseudo random numbers and their generators. Random walks and their simulations. Markov chains and their simulations. Birth and death processes. Monte Carlo methods.

TUTORIALS Analysis of asymptotic properties of trajectories of discrete time dynamical systems. Generating pseudo random numbers with given distributions. Algebraic methods of iterating of stochastic matrices,. Recurrence of random walks. Expected time of the first return for n-dimensional random walks. Stationary distributions.

PROJECTS Computer supported analysis of asymptotic properties of trajectories of discrete time dynamical systems. Generating of pseudo-random sequences of a given distribution. Simulation of random walks and Markov chains.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Courses completed: Probability Theory term IV (MAT1013/1), Mathematical Analysis (MAT1001)</td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Exam</td><td>50.0%</td><td>50.0%</td></tr>
<tr><td>Research project 1</td><td>50.0%</td><td>10.0%</td></tr>
<tr><td>Research project 2</td><td>50.0%</td><td>20.0%</td></tr>
<tr><td>Test 1, 2</td><td>50.0%</td><td>20.0%</td></tr>
</table>
</td></tr>
<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>1. P. Biecek, Przewodnik po pakiecie R, GiS, Wrocław, 2014.
2. R. Wieczorkowski, R. Zieliński, Komputerowe generatory liczb losowych, WNT, Warszawa, 1997.
3. R. Snopkowski, Symulacja stochastyczna, AGH, Kraków, 2007.
4. Urszula Foryś, Matematyka w Biologii, WNT Warszawa 2005.</td></tr>
<tr><td>Supplementary literature</td><td>1. M. Gągolewski, Programowanie w języku R, Wydawnictwo Naukowe PWN, 2014.
2. A. Janicki, A. Izydorczyk, Komputerowe metody w modelowaniu stochastycznym, WNT, Warszawa, 2001.
3. L. Smith, Chaos, Oxford University Press, Oxford, 2007.
4. D.E.Knuth, The Art of Computer Programming, Addison-Wesley, New York, 1997.
5. J. Jakubowski, R. Sztencel, Wstęp do teorii prawdopodobieństwa, Script, Warszawa, 2001.
6. J.Haigh, Probability Models, Springer, 2013.</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
</table>
</td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>Analyse asymptotic properties of trajectories of discrete time dynamical systems. Generate pseudo-random sequences of a given distribution. Simulate Markov chain.</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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