



Subject card

Subject name and code	Nonlinear Data Analysis Methods, PG_00050486						
Field of study	Mathematics						
Date of commencement of studies	October 2022	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	2	Language of instruction			Polish		
Semester of study	3	ECTS credits			5.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Zakład Równań Różniczkowych i Zastosowań Matematyki -> Instytut Matematyki Stosowanej -> Faculty of Applied Physics and Mathematics						
Name and surname of lecturer (lecturers)	Subject supervisor		mgr inż. Katarzyna Tessmer				
	Teachers		mgr inż. Katarzyna Tessmer				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	30.0	0.0	0.0	60
	E-learning hours included: 56.0						
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	The use of mathematical tools for selected methods of data and time series analysis; increasing awareness about the limitations of linear methods and the problem of proper selection of nonlinear methods; solving theoretical and implementation problems; ability to use advanced mathematical methods for data analysis and modeling of phenomena from other fields of science and engineering.						
Learning outcomes	Course outcome		Subject outcome			Method of verification	
	K7_U13		constructs and implements algorithms and programs useful in nonlinear data analysis in selected programming language, verifies their correctness and effectiveness, analyses the results obtained			[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	
	K7_U11		discusses various classes of mathematical models describing phenomena and relationships in other fields of science (medicine, biology, chemistry, physics, technical sciences); knows the basics and paradigms of mathematical modeling; thoroughly analyses the obtained models using knowledge from various branches of mathematics (dynamical systems, chaos theory, stochastic processes, statistics); uses mathematical models for forecasting and data classification			[SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment	
	K7_W07		skillfully synthesises elements of various branches of mathematics to solve problems of modern data analysis			[SW1] Assessment of factual knowledge	

Subject contents	<p>The notions of signal, time series, data predicting, Banach space and Hilbert space.</p> <p>Continuous-time Fourier transform, discrete-time Fourier transform and properties. Energy and power of a signal, power spectrum.</p> <p>Regression analysis. Linear regression, least squares method and its variants (weighted and generalized least squares method). Nonlinear regression. Logistic regression. Predicting and data classification with the use of logistic regression.</p> <p>Fundamentals of dynamical systems theory (phase space, stability, attractor). Deterministic chaos: Henon map and Lorenz system, strange attractors.</p> <p>Lyapunov exponents.</p>											
Prerequisites and co-requisites	<p>Knowledge from the courses: Mathematical Analysis, Linear Algebra, Differential Equations. Additionally: selected concepts of Functional Analysis, Stochastic Processes, Statistics, Dynamical Systems, Ergodic Theory.</p>											
Assessment methods and criteria	<table border="1"> <thead> <tr> <th data-bbox="453 649 794 678">Subject passing criteria</th> <th data-bbox="799 649 1141 678">Passing threshold</th> <th data-bbox="1145 649 1492 678">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="453 685 794 759">Completion of the laboratory classes (tasks solving – programs writing)</td> <td data-bbox="799 685 1141 759">50.0%</td> <td data-bbox="1145 685 1492 759">60.0%</td> </tr> <tr> <td data-bbox="453 766 794 813">Completion of the lecture classes (colloquiums)</td> <td data-bbox="799 766 1141 813">50.0%</td> <td data-bbox="1145 766 1492 813">40.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Completion of the laboratory classes (tasks solving – programs writing)	50.0%	60.0%	Completion of the lecture classes (colloquiums)	50.0%	40.0%
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	eResources addresses	<p>Podstawowe</p> <p>https://www.dbc.wroc.pl/Content/19612/muciek_wyznaczanie_modeli.pdf - A. Muciek, Wyznaczanie modeli matematycznych z danych eksperymentalnych, Oficyna Wydawnicza Politechniki Wrocławskiej, Wrocław, 2012 (accessed 22nd September 2022).</p> <p>https://ftp.idu.ac.id/wp-content/uploads/ebook/ip/REGRESI%20LOGISTIK/epdf.pub_applied-logistic-regression-wiley-series-in-probab.pdf - D.W. Hosmer, S. Lemeshow, Applied Logistic Regression, John Wiley & Sons, New York, 2000 (accessed 22nd September 2022).</p> <p>http://han.bg.pg.edu.pl/han/ibuk-libra/https/libra.ibuk.pl/reader/metody-i-modele-eksploracji-danych-daniel-t-larose-67154 - D.T. Larose, Metody i modele eksploracji danych, PWN, Warszawa, 2012 (accessed 22nd September 2022).</p> <p>http://han.bg.pg.edu.pl/han/ibuk-libra/https/libra.ibuk.pl/book/168290 - M. Gagolewski, M. Bartoszek, A. Cena, Przetwarzanie i analiza danych w języku Python, PWN, Warszawa, 2016 (accessed 22nd September 2022).</p> <p>Uzupełniająca</p> <p>Adresy na platformie eNauczenie:</p> <p>Metody nieliniowej analizy danych 2023/24 - Moodle ID: 30943 https://enauczenie.pg.edu.pl/moodle/course/view.php?id=30943</p>
Example issues/ example questions/ tasks being completed	Write a program that determines the formula for a continuous-time Fourier transform CTFT of signal $x(t)$. Without using a ready-made function, write a program that draws a step-by-step linear regression model for a dataset using the classical least squares method.	
Work placement	Not applicable	