



Subject card

Subject name and code	Mathematical Statistics, PG_00021039						
Field of study	Mathematics						
Date of commencement of studies	October 2025		Academic year of realisation of subject		2025/2026		
Education level	second-cycle studies		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		4.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Institute of Applied Mathematics -> Faculty of Applied Physics and Mathematics -> Wydziały Politechniki Gdańskiej						
Name and surname of lecturer (lecturers)	Subject supervisor		dr Maryna Shcholakova				
	Teachers		dr Maryna Shcholakova				
Lesson types and methods of instruction	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		5.0		35.0	100
Subject objectives	The aim of the course "Mathematical Statistics" is to teach students how to analyze and interpret statistical data using methods of descriptive and mathematical statistics. This course aims to equip students with a specialized mathematical toolkit that supports technical subjects related to mathematical modeling, data analysis, and applications of statistics.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[K7_W02] has enhanced knowledge of a selected branch of mathematics,theoretical or applied, knows classical definitions and theorems and their proofs and connections with other fields,understands problems being examined		The student is able to list and understand classical definitions, theorems, and their proofs in the context of mathematical statistics. The student understands the connections between mathematical statistics and other fields of mathematical sciences. The student is capable of collaborating in a group on projects that require advanced statistical methods.		[SW2] Assessment of knowledge contained in presentation [SW1] Assessment of factual knowledge		
	[K7_U03] uses differential and integral calculus, elements of complex analysis, algebraic methods, applies them in typical practical		The student is able to apply differential and integral calculus, elements of complex analysis, and algebraic methods to solve statistical problems.		[SU3] Assessment of ability to use knowledge gained from the subject		
	[K7_U06] uses probability distributions and their properties in practical issues, is familiar with the basics of statistics and the basics of statistical data processing		The student is able to apply probability distributions to solve practical problems. The student identifies sufficient statistics. They construct unbiased estimators with minimal variance using the Rao-Cramer theorem, determined by the method of maximum likelihood and the method of least squares. The student recognizes statistical tests. The student has the ability to analyze and interpret statistical data using methods of descriptive and mathematical statistics.		[SU2] Assessment of ability to analyse information [SU5] Assessment of ability to present the results of task		

Subject contents	<p>Statistical space, simple random sample, statistics. Empirical distribution function, basic theorems of statistics. Positional statistics, sample quantiles. Estimators, Rao-Cramer theorem. Estimation methods. Properties of estimators. Point and interval estimation. Introduction to hypothesis testing. Testing statistical hypotheses. Parametric and non-parametric tests. Type I and Type II errors, test power. Regression analysis. Linear and non-linear regression.</p>		
Prerequisites and co-requisites	<p>Before starting the course Mathematical Statistics, a student should possess the following knowledge, skills, and competencies:</p> <ol style="list-style-type: none"> 1. Basic knowledge of probability calculus understanding concepts such as random variables, probability distributions, expected value, and variance. 2. Ability to use differential and integral calculus familiarity with basic differential and integral operations and their applications. 3. Fundamentals of linear algebra understanding concepts such as matrices, vectors, determinants, and systems of linear equations. 4. Knowledge of basic descriptive statistics concepts ability to calculate and interpret measures of central tendency (mean, median, mode) and measures of dispersion (standard deviation, variance). 5. Basic programming skills familiarity with basic tools used in data analysis. 		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	A midterm exam at the end of the semester	50.0%	60.0%
	Group projects (up to 3 people) / individual projects – students work on one of the proposed topics, create a presentation, and present it to the group.	50.0%	40.0%

Recommended reading	Basic literature	<p>1. W. Kordecki: Probability Calculus and Mathematical Statistics. Definitions, Theorems, Formulas.</p> <p>2. H. Jasiulewicz, W. Kordecki: Probability Calculus and Mathematical Statistics. Examples and Exercises.</p> <p>3. I. Bąk, I. Markowicz, M. Mojsiewicz, K. Wawrzyniak: Statistics in Exercises. Part 1. Descriptive Statistics.</p> <p>4. I. Bąk, I. Markowicz, M. Mojsiewicz, K. Wawrzyniak: Statistics in Exercises. Part 2. Mathematical Statistics.</p> <p>5. W. Kryszicki, J. Dyczka, K. Królikowska, M. Wasilewski: Probability Calculus and Mathematical Statistics in Exercises. Part 2. Mathematical Statistics.</p> <p>6. A. Jokiel-Rokita, R. Magiera: Models and Methods of Mathematical Statistics in Exercises.</p> <p>7. C. Radhakrishna Rao: Statistics and Truth.</p> <p>8. W. Regel: 101 Exercises in Mathematical Statistics with Complete Solutions.</p>
	Supplementary literature	<p>1. W. Regel: 101 Exercises in Mathematical Statistics with Complete Solutions.</p>
	eResources addresses	<p>Supplementary</p> <p>https://bdl.stat.gov.pl/bdl/pomoc - User Manual for BDL (Local Data Bank) The Local Data Bank (BDL) is Poland's largest database of the economy, society, and environment. It offers a wide range of statistical data and indicators, which are grouped thematically and updated regularly. The user manual provides detailed instructions on how to navigate and utilize the database effectively.</p> <p>https://www.impan.pl/~rziel/7ALL.pdf - RYSZARD ZIELIŃSKI: Seven Introductory Lectures to Mathematical Statistics This book provides a comprehensive introduction to mathematical statistics, covering essential topics and concepts.</p> <p>https://www.stat.cmu.edu/~cshalizi/ADAfaEPoV/ADAfaEPoV.pdf - Cosma Rohilla Shalizi Advanced Data Analysis from an Elementary Point of View.</p>

Example issues/ example questions/ tasks being completed	<p>1. Discuss the methods of point and interval estimation. 2. What are the properties of a good estimator? 3. Explain the differences between parametric and non-parametric tests. 4. What are Type I and Type II errors? 5. How do you calculate the power of a test? 6. Present the linear regression model and discuss its applications.</p> <p>Presentation Topics 1. Application of Statistical Methods in Machine Learning 2. Data Analysis in Deep Learning: <i>How Statistics Helps in Analyzing and Processing Large Data Sets in Neural Networks</i> 3. Bayesian Neural Networks: <i>Application of Bayesian Statistics in Modeling Uncertainty in Neural Networks</i> 4. Logistic Regression in Classification: <i>Using Logistic Regression as a Statistical Tool in Classification Problems</i> 5. Model Validation Methods in AI: <i>Techniques such as Cross-Validation and Their Importance in Evaluating AI Models</i> 6. Statistical Methods for Dimensionality Reduction: <i>PCA, LDA, and Other Techniques in the Context of Data Processing in AI</i> 7. Clustering Analysis in Artificial Intelligence: <i>Application of Methods such as k-means and Hierarchical Clustering in Data Analysis</i> 8. Statistical Approach to Anomaly Detection: <i>How Statistics Helps in Identifying Anomalies and Irregularities in Data</i> 9. Probabilistic Modeling in Artificial Intelligence: Application of Probabilistic Models, such as Markov Models, in AI 10. Statistics in Natural Language Processing (NLP): <i>The Role of Statistics in Text Analysis and Natural Language Processing.</i></p>
Work placement	Not applicable

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