GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Mathematical statistics, PG_00045298		
Field of study	Data Engineering, Data Engineering		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2027/2028
Education level	first-cycle studies	Subject group	Obligatory subject group in the field of study Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	2	Language of instruction	English
Semester of study	3	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Statistics and Econometrics -> Faculty of Management and Economics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Karol Flisikowski	
	Teachers	dr inż. Karol Flisikowski	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	30.0	15.0	0.0	0.0	75

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	75	8.0	17.0	100

Subject objectives

Main aim of the course is to teach students the basic concepts of probability and their application in mathematical modeling. After the course students will be able to perform the procedure of testing of statistical hypotheses (parametric and nonparametric) using R and R-studio environment.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W05] integrates data from multiple sources in order to analyze complex business problems	Students will be familiar with the basic mathematical techniques necessary to carry out calculations in probability calculus, mathematical statistics.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects
[K6_U07] uses information technologies to improve the acquisition, analysis and processing of data in business applications	The student is able to use IT tools to collect, analyze, and process statistical data, supporting decision-making processes in business applications	[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
[K6_U05] develops innovative solutions for data analysis and processing, using appropriate methods and tools	The student is able to select and apply advanced mathematical statistics methods and analytical tools to design innovative solutions for data analysis and processing.	[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools

Subject contents

Course content – lecture
Probability space: the classic scheme, drawing with replacement and without replacement. Geometric Probability. Conditional probability, total probability, Bayes' formula. Independence of events.

Discrete random variable: probability distribution function and cumulative distribution. A review of selected distributions of discrete random variables: the distribution of single-point, two-point, Binomial, Poisson. Continuous random variable: probability density function and cumulative distribution. A review of selected distributions of continuous random variables: uniform distribution, exponential, normal, chi-square, Student's t. The basic numerical characteristics of discrete and continuous random variables.

Population and sample; Sampling schemes; the sample distributions. Basic statistics and their distributions; Estimators and their properties; Methods of obtaining estimators; Point estimation; Interval estimation; Testing of statistical hypotheses; The level of significance and power of the test; Parametric tests for one-dimensional population. Parametric tests for two-dimensional population. Tests for multidimensional population. Analysis of variance. Manova. Mancova. Nonparametric tests; Normality tests; Test of independence (chi-square test); Tests of randomness. Sign tests. Tests for outliers; Tests used in the analysis of correlation and regression.

Course content – exercises
Overview of selected distributions of discrete random variables: single-point, two-point, binomial, Poisson distributions. Continuous random variable: probability density function and cumulative distribution function. Overview of selected distributions of continuous random variables: uniform, exponential, normal, chi-square, Student's t-distribution. Basic numerical characteristics of the distribution of discrete and continuous random variables.

Basic statistics and their distributions; Estimators and their properties; Methods of obtaining estimators; Point estimation; Interval estimation; Testing statistical hypotheses; Significance level and test power; Parametric tests for one-dimensional populations. Parametric tests for two-dimensional populations. Tests for multidimensional populations. Analysis of variance. Ancova. Manova. Mancova. Nonparametric tests. Goodness-of-fit test; Normality tests; Chi-square independence test; Randomness tests. Sign tests. Series test. Outlier tests; Tests in correlation and regression analysis.

Course content – laboratory
Overview of selected distributions of discrete random variables: single-point, two-point, binomial, Poisson distributions. Continuous random variable: probability density function and cumulative distribution function. Overview of selected distributions of continuous random variables: uniform, exponential, normal, chi-square, Student's t-distribution. Basic numerical characteristics of the distribution of discrete and continuous random variables.

Basic statistics and their distributions; Estimators and their properties; Methods of obtaining estimators; Point estimation; Interval estimation; Testing statistical hypotheses; Significance level and test power; Parametric tests for one-dimensional populations. Parametric tests for two-dimensional populations. Tests for multidimensional populations. Analysis of variance. Ancova. Manova. Mancova. Nonparametric tests. Goodness-of-fit test; Normality tests; Chi-square independence test; Randomness tests. Sign tests. Series test. Outlier tests; Tests in correlation and regression analysis.

Prerequisites and co-requisites

Mathematics, descriptive statistics.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Final test (seminar)	60.0%	30.0%
Final exam (lecture)	60.0%	40.0%
Mid-term and final test (laboratory)	60.0%	30.0%

Recommended reading

Basic literature	1. Cohen, M. X. (2023). Modern statistics: Intuition, math, Python, R. Independently Published. ISBN: 979-8867723736 2. Kenett, R. S., Zacks, S., & Gedeck, P. (2022). Modern statistics: A computer-based approach with Python. Springer International Publishing. https://doi.org/10.1007/978-3-031-07566-7 3. Haslwanter, T. (2016). An introduction to statistics with Python: With applications in the life sciences. Springer. https://doi.org/10.1007/978-3-319-28316-6
Supplementary literature	1. Downey, A. B. (2024). Think stats: Exploratory data analysis in Python (3rd ed.). OReilly Media. 2. Kenett, R. S., Zacks, S., & Gedeck, P. (2022). Modern statistics: A computer-based approach with Python. Springer. 3. Haslwanter, T. (2022). An introduction to statistics with Python (2nd ed.). Springer.
eResources addresses	

Example issues/ example questions/ tasks being completed	1. Theoretical and empirical probability distribution and central limit theorem. 2. Point and interval estimation, precision of the estimator, the minimum sample size required to obtain a specific precision. 3. Parametric and nonparametric hypothesis testing. The final exam will test your knowledge of all the course material taught in the entire course.
Practical activites within the subject	Not applicable

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