University of Gdańsk

Subject card

Subject name and code	Statistical Analysis and Probability Theory in Bioinformatics, PG_00193519						
Field of study	Bioinformatics						
Date of commencement of studies	October 2026		Academic year of realisation of subject	2027/2028			
Education level	Bachelor's 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	Polish			
Semester of study	3		ECTS credits	6.0			
Learning profile	academic		Assessment form	exam			
Conducting unit	Institute of Theoretical Physics and Astrophysics -> Faculty of Mathematics, Physics and Informatics -> Rector						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. Anita Dąbrowska				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	45.0	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		0.0	75.0	150	
Subject objectives	The aim of the course is to familiarize students with the basics of probability theory, statistical inference methods, statistical basis for planning experiments, and data processing and analysis in Python.						

<table>
<tr><td>Learning outcomes</td><td>
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<tr><th>Course outcome</th><th>Subject outcome</th><th>Method of verification</th></tr>
<tr><td>[BIOINL3_U03] Graduate applies mathematical and statistical methods to describe phenomena and analyze data; has the ability to perform data analysis in professional databases used in bioinformatics</td><td>Student can:
prepare data for statistical analysis,
present data in tabular and graphical form;
calculate basic descriptive statistics from the sample,
determine confidence intervals for mean, fraction and variance;
perform parametric and non-parametric tests,
test normality of distribution;
analyze relationships between variables;
select and apply appropriate statistical methods to develop research results and present and interpret the results of statistical analyses;
use computer software for the presentation and statistical analysis of research results</td><td>[SU4] test/exam - oral or written
[SU6] demonstration of practical skills</td></tr>
<tr><td>[BIOINL3_W03] Has sufficient knowledge of mathematical and statistical methods in order to describe and model biological phenomena and processes</td><td>Student knows:
definition of probabilistic space,
definition of the probability distribution of a continuous random variable and its distribution function,
examples of continuous distributions and their applications,
definition and interpretation of numerical characteristics of single- and multidimensional random variable distributions,
descriptive statistics methods,
point estimators and the construction of interval estimators,
principles of formulating statistical hypotheses and verifying them,
selected parametric and non-parametric tests, including normality tests,
methods of analyzing relationships between variables.</td><td>[SW4] test/exam - oral or written</td></tr>
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<tr><td>Subject contents</td><td>
1. Probabilistic foundations of mathematical statistics: One-dimensional continuous random variables: Parameters of the distribution of a random variable and its distribution function, Examples of the distribution of a random variable: uniform distribution, exponential distribution and normal distribution; Continuous multidimensional random variables: Parameters of the distribution of a random variable and its distribution function: Marginal distributions, Independence of random variables, Correlation coefficient and covariance matrix, Distributions related to the normal distribution: chi-square, Student's t, F-Snedecor, Laws of large numbers and the central limit theorem
2. Descriptive statistics: Frequency distribution, Graphical presentation of empirical data, Measures of location and dispersion of results, Measures of asymmetry and concentration
3. Random sample and distribution of sample statistics
4. Point and interval estimation. Confidence interval for mean, fraction and variance. The problem of minimum sample size
5. Statistical inference: Type I and II error, Critical value, Statistical probability
6. Selected parametric tests for one population: Significance test for mean, Significance test for fractions, Significance test for variance,
7. Selected parametric tests for two populations, Significance test for two means, Significance test for two fractions, Two-variance significance test
8. Testing for normality of distribution
9. Selected non-parametric tests: Mann-Whitney test; Kolmogorov-Smirnov test; Wilcoxon test; Chi-square test
10. Statistical inference in correlation and regression analysis
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<tr><td>Prerequisites and co-requisites</td><td>Knowledge of the basics of discrete probability theory.</td></tr>
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<tr><td>Assessment methods and criteria</td><td colspan="2"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>60% of the maximum score can be earned through several tests during the lectures (4-8). The remaining 40% is obtained from a written exam conducted during the examination period.</td><td>51.0%</td><td>50.0%</td></tr>
<tr><td>4 tests and 1 colloquium. One can obtain 60% of the maximum number of points for the tests and 40% for tests. Pass mark: at least 51% in the tests and 51% in tests and colloquium together.</td><td>51.0%</td><td>50.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>1. A. Plucińska, E. Pluciński, Rachunek prawdopodobieństwa. Statystyka matematyczna. Procesy stochastyczne, Wydawnictwo Naukowe PWN, Warszawa 2020
2. J. Podgórski, Statystyka dla studiów licencjackich, PWE, Warszawa 202
3. M. Zalewska, W. Niemiro, Biostatystyka, PZWL, Warszawa 2024</td></tr>
<tr><td>Supplementary literature</td><td>1. A. Baranowska, Elementy statystyki dla studentów uczelni medycznych, Oficyna Wydawnicza GiS, Warszawa 2022
2. A. Stanisz, Przystępny kurs statystyki z zastosowaniem STATISTICA PL na przykładach z medycyny. Tom 1. Statystyki podstawowe. StatSoft Polska, Kraków 2006
3. M. Gągolewski, M. Bartoszuk, A. Cena, Przetwarzanie i analiza danych w języku Python, Wydawnictwo Naukowe PWN, Warszawa 2016</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">Not required</td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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