SYLLABUS

Name: ***Probability and statistics (AEIAu>SI3PAS23)***
Name in Polish:
Name in English: ***Probability and mathematical statistics***

Information on course:

Course offered by department: Faculty of Automatic Control, Electronics and Computer Science
Course for department: Silesian University of Technology

Default type of course examination report:

ZAL

Language:

English

Course homepage:

https://platforma2.polsl.pl/rau1/course/view.php?id=141

Short description:

The objective of this course is to give a theoretical basis of probability theory and statistics in very general context and to demonstrate the possible applications of this theory to applied models in system engineering, in operation research, and time series.

Description:

The course consists of two parts: probability theory and applied statistics. The probability part starts with set theoretic concepts such as sigma-algebras, and denumerable operations on sets. Then, probability is introduced as a denumerably additive nonnegative normed set function. Properties of probabilities, including conditional probability follow. Random variables are introduced as measurable maps from the probability space in to the set of real numbers with Borel sigma-algebra. Distribution functions are discussed, including important examples of continuous and discrete distributions binomial/Poisson, geometric, uniform, exponential, normal, multivariate normal, gamma and chisquare). Independence of events is shown to lead to strong results such as Borel-Cantelli theorems and Kolmogorov 0-1 law. Expected values are defined as Lebesgue integrals of random variables. Monotone and Dominated Convergence theorems follow. Law of Large Numbers and Central Limit Theorem are discussed.
The second part starts with the survey of the methods of basic statistical testing where special emphasis is put on the hypothesis tests for the mean and variance of a normal population. Then the nonparametric methods are introduced followed by the ANOVA algorithms. Next we focus on the way of describing the relations among random variables. We introduce the measures of correlation (for both Gaussian and non – Gaussian random variables) and basic statistical tests. We give a general introduction to linear regression and consider the estimation problem for unknown parameters of probability distribution. Here we discuss the following three main methods: maximum likelihood method, the least squares method and the method of moments. Finally we present the basis of the analysis of frequencies.
All the theoretical material is broadly illustrated by the examples whose purpose is to help understanding the theoretical concepts and to show the possibility of applications of the probability methods in engineering practice

Lectures and laboratory topics:
1. Probability theory, part 1 – total and conditional probability
2. Probability theory, part 2 – distribution functions
3. Descriptive statistics
4. Graphical representation
5. Elements of theory of estimation. Point and interval estimators
6. Parametric tests, part 1 – testing for population mean,
7. Parametric tests, part 2 – testing for population variance
8. Goodness of fit tests
9. Nonparametric tests - unpaired measurements
10. Nonparametric tests – paired measurements
11. Inference for proportions – testing for population proportion
12. Inference for proportions – odds ratio, test of independence
13. Measures of correlation, linear regression

Exercises and laboratories
The curriculum of exercises and laboratories is closely related to the program of lectures. During the laboratories, students use the MATLAB software.

Number of ECTS credits: 5
Total Hours: 125h (70 contact hours / 55 student's own work hours)
Lecture: contact 30
Laboratory: contact 30
Other contact (discussion of the report): 10
Student's own work: preparation for classes, writing reports

including
Number of ECTS points obtained during classes with the direct participation of the academic teacher: 5
Number of ECTS points obtained in practical classes (laboratories, projects): 3

Bibliography:

1. Feller W: An Introduction to Probability Theory and Its Applications, Vol. 1, Wiley, 3rd edition or later
2. Sokal RR, Rohlf JF: Biometry WH Freeman, 3rd edition or later
3. Zar JH: Biostatistical Analysis, Prentice Hall, 4rd edition or later
4. J. Koronacki, J. Mielniczuk: Statystyka dla studentów kierunków technicznych i przyrodniczych, WNT Warszawa 2001
5. J. Greń: Modele i zadania statystyki matematycznej. PWN Warszawa 1970

Learning outcomes:

Knowledge
Zna podstawy teorii prawdopodobieństwa (K1A_W02)
zna techniki przetwarzania i prezentacji danych statystycznych (K1A_W02)

Zna podstawowe pojęcia ze statystyki opisowej: miary położenia, rozproszenia, symetrii i koncentracji (K1A_W02)
Zna metody konstruowania estymatorów i oceny ich własności (K1A_W02)
Wie, jak formułować i weryfikować proste hipotezy statystyczne (K1A_W02)
zna metody pomiaru korelacji między zmiennymi (K1A_W02)

Skills
Can perform correct sampling from population and define the type of the variable (K1A_U07, K1A_U10)
Can propose descriptive statistics for different types of variables and construct point and interval estimators (K1A_U07)
Can perform statistical inference in one dimensional data space (K1A_U10, K1A_U21)
Can verify hypotheses about correlation between variables (K1A_U07)
Can use Excel and Matlab software to support statistical analysis of data (K1A_U21)
Can cooperate with others in teamwork (K1A_U30)

Social competence
Can make his own decisions about the best solutions (K1A_K01)
Can present and defend the proposed solution (K1A_K01)
Can interact and work in a group, assuming different roles (K1A_K01, K1A_K02)

Assessment methods and assessment criteria:

Final Grade:
Completion of the laboratory is assessed in the form of reports. Students need to pass all laboratory reports and obtain at least a 40% grade from each. To calculate the final grade, the mean value from all reports is calculated (L). In the scope of lectures, two tests are organised. Both tests are organised independently; the first test (T1) will be held in the middle of the semester and will cover about the first half of the material. The second test (T2) will be held at the end of the semester and will cover about the second half of the material. Students need to pass each test with at least a 40% grade (T1 and T2).

The final grade is calculated as:
Grade = (0.3T1 + 0.3T2 + 0.4L)

The grade is rounded according to the following rules:
[0;40) – Failed
[40;50) – 3
[50;60) – 3.5
[60;70) – 4
[70;80) – 4.5
[80;100] – 5

An adjustment of the final grade based on lecture attendance will be possible.

Absence on laboratories:
For any absences, the student must provide a justification in the form of one of the following: medical certificate issued by a licensed healthcare professional, official notice of a family emergency, documented participation in an official school or academic event, court summons or legal obligation or other official documentation subject to approval by the administration.

In the cases of early departure of foreign students for the holiday season or late arrival due to communication issues, the student is required to provide the evidence in the form of a boarding pass or travel ticket with name and surname, and inform the teacher before the date of the laboratory classes.

Retakes of laboratories:
Only one retake session is scheduled for each group after all the laboratory sessions are completed. For this session, students with justified absence or one laboratory score below 40 points are eligible to join. Additional retake sessions may be arranged if needed. For this session, only the students with valid justification are eligible to join. Only one laboratory session can be retaken during a single retake session.

Usage of AI during laboratories:
The use of AI tools during laboratory classes is forbidden. The first instance of AI tools usage will result in a warning, while the second will result in expulsion of the whole section from the laboratory class. The students are awarded 0 points for this laboratory.

The syllabus is valid from the academic year 2025/26 and its content cannot be changed during the semester.

Course credits in various terms:

<without a specific program>

Type of credits	Number	First term	Last term
European Credit Transfer System (ECTS)	5	2023/2024-Z	