COURSE DESCRIPTION CARD - SYLLABUS

Course name
Statistics for Engineers [S1MNT1>SdI]

Course

Field of study
Mathematics of Modern Technologies

Year/Semester
2/4

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
30

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

The student has basic knowledge of combinatorics and probability calculus resulting from the program of the subject Probability Calculus / Probabilistics. The student has basic knowledge of mathematical analysis (differential calculus of functions of one variable, differential calculus of functions of several variables, integral calculus of functions of one variable and the basics of matrix algebra). Can think logically. The student is able to apply the language of mathematics (differential and integral calculus) to describe simple problems in technology. The student has the ability to self-study with the use of modern didactic tools. Can obtain information from literature. The student is aware of the purpose of learning.

Course objective

The aim of the course is to familiarize students with selected statistical issues. Students acquire the ability to use statistical methods to analyze real data and describe technical issues.

Course-related learning outcomes

Knowledge:
• and understands selected areas of mathematics to an advanced degree and has detailed knowledge of the applications of mathematical methods and tools in engineering and technical sciences [K_W 01(P

6S_W G)];
• knowsandunderstandstheconcepts,theoremsandmethodsformathematicalmodeling[K_W02(P6S_WG)];
• knows and understands terminology in the field of mathematics and selected issues in the field of engineering and technical sciences related to the field of study to an advanced degree [K_W03(P6S_WG)];
• the programming language (R) [K_W07(P6S_WG)];
• and understands the techniques of data processing and analysis to an advanced degree [K_W 08(P 6S_W G)].

Skills:
• use knowledge of higher mathematics [K_U01(P6S_UW)];
• build and analyze simple mathematical models [K_U02(P6S_UW)];
• able to interpret the obtained results and draw conclusions [K_U07(P6S_UW)];
• use the basic methods of data processing and analysis [K_U09(P6S_UW)];
• able to use the acquired knowledge and appropriate methods and tools to solve typical engineering tasks [K_U12(P6S_UW)];
• able to prepare a speech with a multimedia presentation related to the implementation of the task [K_U14(P6S_UK)].

Social competences:
• ready to critically assess the level of his knowledge [K_K01(P6S_KK)];
• ready to deepen and expand knowledge to solve new technical problems [K_K02(P6S_KK)];
• ready to think and act in a creative and entrepreneurial way [K_K03(P6S_KO)].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures: assessment of knowledge and skills acquired during the lecture is verified on the basis of a written test;
Laboratory classes: assessment of knowledge and skills acquired in the laboratory is verified on the basis of tests (computer work).

Programme content

• Introduction to the RStudio environment.
• Random variables.
• Sample and statistics
• Estimation theory
• Hypothesis testing theory
• Term: p-value
• Two-dimensional data - correlation analysis
• Bivariate data – regression analysis
• Comparison of multiple populations - ANOVA
• Non-parametric tests

Course topics

Lectures:
• Introduction to the RStudio environment.
• Random variables (discrete and continuous) in R
• Sample and statistics (visualization of the distribution of the mean and the distribution of the sum of random variables from the sample)
• Estimation theory: estimator and properties; point estimation, interval estimation
• Hypothesis testing theory one population: test for mean, test for variance, test for proportions
• Hypothesis testing theory two populations: test for two means, test for two variances, test for two proportions
• Examples in R, p-value;
• Two-dimensional data - correlation analysis
- sample covariance, sample linear correlation coefficient;
- testing of Pearson's linear correlation coefficient;

- test for two correlation coefficients;
- test for multiple correlation coefficients
- multiple correlation coefficient;
- rank correlation coefficients (Spearman and Kendall);
• Linear regression, multiple regression, polynomial regression
• Comparison of multiple populations - ANOVA
• Non-parametric tests

Laboratories:
• Introduction to the RStudio environment.
• Discrete random variables (binomial distribution, Poisson distribution, geometric distribution). Calculating probabilities using R codes.
• Continuous random variables (uniform distribution, exponential distribution, normal distribution). Calculating probabilities using R codes.
• Sample and statistics in R.
• Visualization of the distribution of the mean and the distribution of the sum of random variables from the sample in R (Plots of probability distribution functions, boxplots)
• Point and interval estimation
• Colloquium No. 1
• Testing hypotheses one population (test for mean, test for variance, test for proportions)
• Hypothesis testing (two populations: test for two means, test for two variances, test for two proportions)
• Two-dimensional data - correlation analysis
• Two-dimensional data - linear regression
• Colloquium No. 2
• Multiple regression and polynomial regression
• Comparison of many populations - ANOVA

Teaching methods

Lectures: a lecture with a multimedia presentation supplemented with practical examples (solved, among others, in the R program); an interactive lecture with the formulation of current questions for a group of students; students actively participate in the lecture; each presentation of a new topic is preceded by a reminder of the content related to the discussed issue (content known to Students from other subjects); the main content of each lecture posted on eCourses;
Laboratory classes: the eCourses contain files with the content of tasks solved at the Laboratory; files: theory, formulas and graphs are provided electronically; the tasks are solved with the active participation of the Students; tasks placed by Students on eCourses activate them for systematic work.

Bibliography

Basic:
• D. Bobrowski, (1986) Probabilistyka w zastosowaniach technicznych, Wydawnictwo Naukowo Techniczne;
• D. Bobrowski, K. Maćkowiak-Łybacka, (2006) Wybrane metody wnioskowania statystycznego, Wydawnictwo Politechniki Poznańskiej;
• J. Koronacki, J. Melniczuk (2001) Statystyka dla studentów kierunków technicznych i przyrodniczych. WNT, Warszawa;
• W. Kordecki (2010) Rachunek prawdopodobieństwa i statystyka matematyczna, Definicje, twierdzenia, wzory, Oficyna Wydawnicza GiS;
• H. Jasiulewicz, W. Kordecki, (2003) Rachunek prawdopodobieństwa i statystyka matematyczna, Przykłady i zadania Oficyna Wydawnicza GiS;
• T. Górecki (2011), Podstawy statystyki z przykładami w R, Wydawnictwo BTC.

Additional:
• Plucińska A., Pluciński E., Probabilistyka, Wydawnictwo WNT, Warszawa;
• R. L. Scheaffer, J. T. McClave (1995) Probability and Statistics for Engineers, Duxbury.

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	62	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	63	2,50