Data analysis methods - course description

General information

Course name	Data analysis methods
Course ID	11.2-WE-ELEKTP-MetoDA-Er
Faculty	Faculty of Computer Science, Electrical Engineering and Automatics
Field of study	Electrical Engineering
Education profile	academic
Level of studies	First-cycle Erasmus programme
Beginning semester	winter term 2022/2023

Course information

Semester	2
ECTS credits to win	4
Course type	obligatory
Teaching language	english
Author of syllabus	• prof. dr hab. inż. Dariusz Uciński

Classes forms

The class form	Hours per semester (full-time)	Hours per week (full-time)	Hours per semester (part-time)	Hours per week (part-time)	Form of assignment
Lecture	30	2	-	-	Credit with grade
Class	15	1	-	-	Credit with grade

Aim of the course

Provide basic knowledge of qualitative and quantitative data analysis.
Form a critical view on the credibility of statistical analysis in engineering.
Give basic skills of uncertainty estimation in practical experimental studies in engineering.

Prerequisites

Mathematical analysis, Linear algebra with analytic geometry.

Scope

Measurement uncertainty. Propagation of uncertainty. Random and systematic errors. Statistical sampling study. Frequency distribution. Histogram. Summary statistical measures of location, variability, asymmetry and concentration. Rejection of outliers.

Probability. Sample space. Basic definitions of probability: classical, frequency and modern. Fundamental properties of probability. Conditional probability. Independence. Total probability theorem. Bayes' Theorem.

Discrete and continuous random variables. Discrete random variables. Distributions: binomial, Bernoulli, Poisson and geometric. Functions of random variables. Expected value and variance. Joint probabilisty distributions of many random variables. Independence of random variables. Continuous random variables. Uniform distribution. Exponential distribution. Cumulative distribution function of a random variable. Normal distribution.

Fundamentals of statistical inference. Types of random samples. Simple random sample. Distributions: chi-square, t-Student and Fisher-Snedecor. Point and interval estimation. Unbiasedness, consistency, efficiency and sufficiency. Parameter and non-parameter estimation. Confidence intervals for the mean. Limit theorems. Interval estimates of the proportion, variance, standard deviation, differences between proprtions and means. Determining the required sample size.

Hypothesis testing. One- and two-sided tests of the mean. Testing the proportion. Testing the variance. Selecting the test procedure.

Teaching methods

Lecture, exercise classes.

Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form
Can critically assess the reliability of statistical analyses		• a quiz • test	• Class

Outcome description	Outcome symbols	Methods of verification	The class form
Can construct and interpret confidence intervals		• a quiz • an ongoing monitoring during classes • on-going assessment in the classroom, test	• Lecture • Class
Knows and understands the assumptions of statistical tests		• a quiz • an ongoing monitoring during classes • on-going assessment in the classrom, test	• Lecture • Class
Can make use of common probability distributions (Bernoulli, Poisson, normal, t-Student, F, chi-square)		• a quiz • an ongoing monitoring during classes • ongoing assessment in the classroom, test	• Lecture • Class
Can make preliminary data analysis and pass from a probabilistic model to statistical inference		• a quiz • an ongoing monitoring during classes • on-going assessment in the classrom, test	• Class
Is aware of the importance of data analysis in engineering practice		• a quiz • test	• Lecture
Can properly select and evaluate measures of centrality and dispersion		• a quiz • an ongoing monitoring during classes • on-going assessment in the classrom, test	• Class

Assignment conditions

Lecture – the passing condition is to obtain positive marks from written or oral tests conducted at least once per semester.

Exercice classes – the passing condition is to obtain positive marks from all exercises and tests conducted during the semester.

Calculation of the final grade: lecture 50% + exercice classes 50%

Recommended reading

1. Bertsekas, D. P., and Tsitsiklis, J.N., Introduction to Probability, Second Edition, Athena Scientific, 2008
2. Montgomery, D.C., and Runger, G.C., Applied Statistics and Probability for Engineers, Wiley, 2013
3. Wasserman, L., All of Statistics: Concise Course in Statistical Inference, Springer, 2004
4. Black, K., Applied Business Statistics: Making Better Business Decisions, Wiley, 2013

Further reading

1. Stephens, L.J., Schaum's Outlines of Beginning Statistics, Second Edition, McGraw-Hill, 2009
2. Spiegel, M., and Stephens, L., Schaum's Outlines of Statistics, Fourth Edition, McGraw-Hill, 2011

Notes

Modified by dr hab. inż. Paweł Szcześniak, prof. UZ (last modification: 06-04-2022 22:42)