



COURSE DESCRIPTION CARD - SYLLABUS

Course name

Methods of collecting and analyzing data and visualizing results [S2Elmob1-SSP>MGiAD2]

Course

Field of study
Electromobility

Year/Semester
2/3

Area of study (specialization)
Car Onboard Systems

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

dr hab. inż. Piotr Kuwałek
piotr.kuwalek@put.poznan.pl

dr hab. inż. Grzegorz Wiczyński prof. PP
grzegorz.wiczynski@put.poznan.pl

Lecturers

Prerequisites

A student starting this course should have basic knowledge of mathematics, statistics and basic programming, as well as the ability to work in a laboratory group.

Course objective

Expanding the student's knowledge in the field of analysis and presentation of measurement data. Getting to know the methods of descriptive statistics and methods of statistical control of processes and gaining the ability to apply the acquired knowledge to the analysis and presentation of data from technical fields.

Course-related learning outcomes

Knowledge:

1. Student has a theoretically based knowledge of modern methods of data collection, processing and analysis, also in the field of machine learning.
2. Student has extensive knowledge of analysis of measurement data.

Skills:

1. Student is able to obtain information (in Polish and English) from various sources, make their interpretation, critical evaluation, analysis and synthesis, as well as draw conclusions and formulate and justify opinions.
2. Student is able to use modern information and communication tools, advanced programming techniques and machine learning methods when collecting, processing and analyzing data.
3. Student is able to formulate and test hypotheses related to complex engineering problems and simple research problems in the field of electromobility, as well as to interpret the obtained results and draw critical conclusions.
4. Student is able to determine the directions of further learning, organize the process of self-education and indicate the directions of professional development of other people.

Social competences:

1. Student understands that in the field of technology, knowledge and skills are rapidly devaluing, which requires their constant supplementation.
2. Student is aware of the importance of the latest scientific and technical achievements in solving research and practical problems and, if necessary, supporting himself with expert opinions.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lecture:

evaluation of knowledge and skills by tests. The test pass threshold is 50%. Considering activities of students in the laboratory classes as well as lectures.

Laboratory:

The skills acquired during laboratory exercises are verified on the basis of reports prepared by students, and/or a final test, and/or ongoing control of students' preparation for the exercise. Passing the laboratory classes requires performing all exercises and obtaining positive grades for all verified activities.

Programme content

The program content implemented during the lecture includes selected issues related to:

- the problems (necessity) of data analysis and visualization;
- descriptive statistics, including parametric and non-parametric statistics;
- statistical distributions and related content;
- statistical tests;
- methods of analysis and processing of time series, including determining trends, determining cyclical and seasonal fluctuations, data smoothing;
- the problems of automatic processing of large data sets (Big Data).
- statistical process control, including process variability, tools supporting quality management, statistical techniques and methods used for the needs of normative requirements related to statistical process control.

The program content implemented during laboratory classes is closely related to the program content presented during lecture classes. As part of laboratory classes, selected statistical analysis tools available in a selected modern programming language are used. As part of laboratory classes, the emphasis is placed on the conceptual understanding of statistical analysis tools and learning about their limitations in practical applications.

Course topics

Lecture:

L1: Introduction. Presentation of the problems (necessity) of data analysis and visualization on examples. Introduction to Matlab/Python.

L2: Descriptive statistics: tabular description (e.g. distribution series), parametric statistics: distribution measures (e.g. position measures, differentiation measures, asymmetry measures, concentration measures), non-parametric statistics: graphical representation of results (e.g. histogram, kernel density estimation, box plot, Pareto diagram).

L3: Statistical distributions. Central Limit Theorem. The rule of three sigmas. Statistical tests, including distribution tests.

L4-L5: Statistical process control (SPC): process variability, descriptive and dispersion statistics, tools supporting quality management (e.g. Pareto diagram, histograms), techniques and statistical methods for the purposes of ISO 9001 based on ISO TC 176 (standard ISO 10017).

L6: Time series analysis and processing methods. Setting trends. Time series frequency analysis. Correlation analysis. Data smoothing.

L7: The problem of automatic processing of big data sets (Big Data). Selected basic topics of machine learning methods, mainly methods based on unsupervised learning. The problem of data clustering and searching for cluster analysis (searching for similarities, common features).

Laboratory:

Lab1. OHS + introduction to Matlab/Python.

Lab2. Problems of analysis and visualization of large data sets.

Lab3. Descriptive statistics in the process of data analysis.

Lab4. Statistical process control.

Lab5. Time series analysis and processing. Time series frequency analysis. Correlation analysis.

Lab6-Lab7. Data smoothing. Data clustering and cluster analysis search.

Teaching methods

Lecture: Multimedia presentations (including figures, photos, videos) with examples given on the blackboard. Theoretical issues are presented in close connection with practice.

Laboratory: performing laboratory exercises alone or in teams, with the help and under the supervision of the teacher.

Bibliography

Basic:

1. E. Wasilewska, Statystyka matematyczna w praktyce. Wydawnictwo Difin, 2015.
2. I. Bąk, I. Markowicz, M. Mojsiewicz, K. Wawrzyniak, Statystyka opisowa : przykłady i zadania. Wydawnictwo: CeDeWu, Warszawa 2015.
3. W. Starzyńska, Statystyka praktyczna. Wydawnictwo Naukowe PWN, Warszawa 2012.
4. M. Iwińska, B. Popowska, M. Szymkowiak, Statystyka opisowa. Wydawnictwo Politechniki Poznańskiej, 2011.
5. J. Buga, H. Kassyk-Rokicka, Podstawy statystyki opisowej. Wydawnictwo: Vizja Press & IT, Warszawa 2008.
6. Sałaciński T.: SPC statystyczne sterowanie procesami produkcji. Oficyna Wydawnicza Politechniki Warszawskiej 2009 r.
7. Hamrol A., Zarządzanie jakością z przykładami, PWN 2008.

Additional:

1. Smith G. M., Statistical Process Control and Quality Improvement, Pearson Prentice Hall 2004.
2. A. Witkowska, M. Witkowski, Statystyka opisowa w przykładach i zadaniach. Wydawnictwo Uczelni Państwowej Wyższej Szkoły Zawodowej im. Prezydenta Wojciechowskiego, Kalisz 2007.
3. Kuwałek P., Trace of Flicker Sources by Using Non-Parametric Statistical Analysis of Voltage Changes, Proc. of the 19th Int. Conf. on Harmonics and Quality of Power, IEEE, pp. 1-6, 2020, ZEA, Dubaj.
4. Kuwałek P., Selective Identification and Localization of Voltage Fluctuation Sources in Power Grids, Energies, vol. 14, no. 20, art. no. 6585, 2021.

Breakdown of average student's workload

	Hours	ECTS
Total workload	56	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	26	1,00