COURSE DESCRIPTION CARD - SYLLABUS

Course name
Statistical Methods in Scientific Research [S2IZarz1E>MSwBN]

Course

Field of study
Engineering Management

Year/Semester
1/1

Area of study (specialization)
Managing Enterprise of the Future

Profile of study
general academic

Level of study
second-cycle

Course offered in
English

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
0

Other
0

Tutorials
15

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

1. The student has knowledge of mathematics in the field of mathematical analysis and probability theory and is able to use a calculator and statistical tables 2. The student has the ability to think logically, associate facts, analyze issues and correctly reasoning 3. The student is aware of the need to know the methods of data analysis when studying various subjects in the field of management engineering

Course objective

The aim of the course is to learn the basic methods of mathematical statistics and to gain the ability to apply acquired knowledge to analyze problems in various fields, including technical

Course-related learning outcomes

Knowledge:
The student defines advanced statistical methods such as estimation, inference, hypothesis testing, and regression analysis, demonstrating their importance in scientific research [P7S_WG_02].

The student names a variety of qualitative and quantitative data collection and analysis techniques that are used in market and organizational research, and characterizes their application [P7S_WG_03].
The student describes methods of time series and cross-sectional analysis, cites their advantages and limitations, and identifies their role in forecasting economic and social phenomena [P7S_WG_07].

Skills:
The student applies statistical methods to economic model, social and organizational phenomena and develop research strategies [P7S_UW_01].
The student uses statistical software to analyze data, interpret results and draw scientific conclusions [P7S_UW_02].
The student performs complex data analysis, including multivariate and econometric modeling, to identify trends and patterns of behavior [P7S_UW_06].
The student critically evaluates the quality and usefulness of data, identifies potential errors and applies appropriate techniques to correct them [P7S_UW_07].

Social competences:
The student integrates statistical methods with other scientific disciplines, creating interdisciplinary research projects [P7S_KK_01].
The student evaluates the importance and impact of statistical results on decision-making in organizations and public policy [P7S_KK_02].
The student demonstrates an awareness of the ethical aspects of data research, including the privacy of respondents and the interpretation of research results while respecting cultural and social diversity [P7S_KR_01].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The basis for passing the lecture and exercises are: formative assessment for activities, bonuses for solving tasks during exercises and summative assessment.
The exercises tasks (100 points):
1. Installation and configuration of R; importing datasets (CSV/Excel); cleaning and recoding variables; preparing a structured dataset for analysis (10 points).
2. Calculation of mean, median, standard deviation, and frequency tables; construction of histograms, boxplots, and bar charts to summarise data (15 points).
3. Formulation of research hypotheses; conducting t-tests, ANOVA, and chi-square tests; interpretation of statistical significance and effect sizes (15 points).
4. Estimation of simple and multiple linear regression models; testing model assumptions; interpretation of regression coefficients (15 points) .
5. Estimation of logistic regression models; calculation and interpretation of odds ratios; assessment of model fit (15 points).
6. Estimation of multilevel models for hierarchical data; interpretation of fixed and random effects (15 points).
7. Identification of structural breakpoints; estimation of segmented regression models; interpretation of changes in slopes and trends (15 points).

Summative assessment. Final test at the final classes Max 100 points.
The final grade for the lecture and exercises is counted from the total number of points obtained.

Programme content

The course provides an in-depth understanding of statistical methods applied in scientific research in management. It begins with research design and data collection, focusing on formulating research questions, operationalising variables, selecting appropriate sampling strategies, and ensuring data quality. Students then explore descriptive statistics and data exploration techniques to summarise, visualise, and interpret managerial data. The programme introduces the foundations of probability and statistical inference, enabling students to draw reliable conclusions from samples to populations.

Further, the course covers hypothesis testing in management research, including the appropriate selection and interpretation of parametric and non-parametric tests. Students develop competencies in correlation

and regression analysis to examine relationships between variables and support evidence-based managerial decision-making. The curriculum also includes multivariate statistical methods and an introduction to advanced and applied techniques, equipping students with analytical tools necessary for conducting independent empirical research and preparing a master's thesis.

Course topics

1. Introduction to Statistical Methods in Management Research. The role of statistics in management sciences; types of research; stages of the research process; ethics and data quality.
2. Research Design and Data Collection. Formulating research problems and hypotheses; operationalisation of variables; sampling strategies; primary and secondary data sources.
3. Descriptive Statistics and Exploratory Data Analysis. Measures of central tendency and variability; data visualisation; interpretation of results in a management context.
4. Probability Theory and Statistical Inference. Basic probability distributions; parameter estimation; confidence intervals; inference based on samples.
5. Hypothesis Testing in Management Research. The logic of hypothesis testing; parametric and non-parametric tests; interpretation of statistical significance and effect size.
6. Correlation and Regression Analysis in Managerial Decision-Making. Relationships between variables; linear regression; interpretation of models in a decision-making context.
7. Multivariate Methods and Introduction to Advanced Techniques. Multivariate statistical methods; models for qualitative and hierarchical data; applications in empirical research and master's thesis preparation.

Teaching methods

Lectures: informative lecture, problem-based lecture, discussion-based lecture.
Classes (practical sessions): workshop method using the R environment.

Bibliography

Podstawowa:
1. Jakubowski J., Wątroba J.(2017). Zastosowania statystyki i data mining w badaniach naukowych. Kraków: StatSoft Polska.
2. A.D. Aczel, Statystyka w zarządzaniu. Wydawnictwo Naukowe PWN, Warszawa.
3. Stanisz A., (2016). Modele regresji logistycznej. Kraków: Wydawnictwo StatSoft Polska.
4. Culhane A., (2013) (Introduction to Programming and Statistical Modelling in R , https://ds.dfci.harvard.edu/~aedin/courses/R/Bio503_winter13.pdf
Uzupełniająca:
1. M. Sobczyk, Statystyka, Wydawnictwo Naukowe PWN, 2007.
2. Martin, P. (2021). Linear regression. (Vols. 1-0). SAGE Publications Ltd, https://doi.org/10.4135/9781529682731
4. Jokiel-Rokita A., Magiera R. & Oficyna Wydawnicza GIS. (2005). Modele i metody statystyki matematycznej w zadaniach. Wrocław: Oficyna Wydawnicza GiS.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
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)	45	2,00