COURSE DESCRIPTION CARD - SYLLABUS

Course name
Multivariate statistical analysis

Course

Field of study
Mathematics in technology

Year/Semester
4/7

Area of study (specialization)

Profile of study
general academic

Level of study
First-cycle studies

Course offered in
polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
30	15	
Tutorials	Projects/seminars	

Number of credit points

4

Lecturers

Responsible for the course/lecturer:
dr hab. Karol Andrzejczak, prof. PP

Responsible for the course/lecturer:

Prerequisites

Student starting this course should have knowledge of mathematical logic, set theory, differential and integral calculus of single and multivariable functions, matrix algebra, probability theory, measure theory, basics of mathematical statistics and basic programming. He/she should also be able to work in an MS Microsoft cloud environment. Should be able to use at least one computer program enabling symbolic, probabalistic and statistical calculations (MATLAB, R, Statgraphics, Mathematica, Statistica). He should also have the ability to independently obtain information and be ready to cooperate within the team.

Course objective

The aim of the course is to provide students with knowledge of the basic methods of multivariate mathematical statistics. Developing students' skills in solving theoretical and practical problems with computer support. To acquaint students with probabilistic models of multidimensional observations. In addition, the aim is for students to master tests for multivariate data and the ability to apply statistical packages in testing and modeling engineering problems.

Course-related learning outcomes

Knowledge

As a result of the conducted classes, the student knows:

1. in the field of using advanced probabilistic and statistical theorems in research with multidimensional measurements or observations,

2. in the field of data preparation and computer-aided statistical research

Skills

As a result of the conducted classes, the student will have the following skills:

1. modelling and solving engineering problems with the use of multidimensional distributions,

2. using the methods of multivariate statistics with computer support to study random phenomena and processes in order to make optimal decisions.

Social competences

As a result of the conducted classes, the student will acquire the following competences:

1. the ability to precisely formulate questions to deepen your own understanding of advanced probabilistic and statistical methods,

2. the ability to work in a team in solving complex research projects.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures:Assessment of the knowledge and skills demonstrated at the final oral exam in the scope of the presented theoretical methods (0-50 point scale). Current assessment of students' activity in solving tasks intended for independent solving - checking the practical skills of applying the presented methods (50% of the points obtained in the laboratory exercises in the final assessment). The scale of the final exam grade: from 45 points - 3.0; from 55 - 3.5; from 65 - 4.0; from 75 - 4.5; from 85 - 5.0.

Laboratory classes: assessment of new skills of practical use of the learned principles and methods - independent solving of tasks given during lectures (scale 0-50 points of participation in the final grade). Final test assessing the effectiveness of applying the acquired knowledge (scale 0-50 points). The scale of the final test grade for laboratory exercises: from 45 points - 3.0; from 55 - 3.5; from 65 - 4.0; from 75 - 4.5; from 85 - 5.0.

Programme content

Update 08/22/2022.

Lectures: Selected problems of matrix algebra - block matrices. Multidimensional distributions and their functional characteristics. The vector of the expected values. Covariance and correlation matrices and their properties and applications. Multinomial distribution. Multivariate normal distribution and its applications in linear modeling. Multidimensional data and their presentation. Data distance measures.

Correlation diagram. Estimation of parameters of multidimensional distributions. Hotelling's T-square statistics. Tests for single and multiple expectation vectors. Tests for covariance matrices. Tests of multidimensional normality. Tests of independence of many sub-sectors. Analysis of variance and its applications. Application of mathematical and statistical packages and spreadsheets in stochastic modeling and statistical issues. Review of multivariate statistics methods: discriminant analysis, principal components analysis, factor analysis. Formulating tasks to be solved during laboratory exercises.

Laboratory classes: Discussion and solving problems thematically related to the issues presented in the lectures. The tasks are scored and their content is posted in advance on the e-courses.

Teaching methods

Lectures: presenting a new topic is preceded by reminding the content that should be already known to students, discussions with students on the possibilities of generalizing the presented results and conclusions, supporting the lecture with a multimedia presentation, a blackboard presentation of the methodology of solving formulated stochastic problems. Presentations and supporting materials are made available after lectures.

Laboratory classes: discussion on the methods of solving theoretical and practical problems with computer support and solving tasks provided one week in advance.

Bibliography

Basic

1. Krzyśko Mirosław, Podstawy wielowymiarowego wnioskowania statystycznego, Wydawnictwo Naukowe UAM, Poznań 2009.

2. Renczer, A.C., Methods of multivariate analysis, Wiley, New York 2002.

Additional

1. Johnson R.A., Wichern D.W. Applied Multivariate Statistical Analysis. Pearson Education, Inc. 2007.

2. Koronacki J., Ćwik J., Statystyczne systemy uczące się, Wydawnictwo Naukowo-Techniczne , W-wa 2005.

3. Jolliffe I.T. Principal Component Analysis. Springer-Verlag 2002.

4. Andrzejczak K. Wielowymiarowe monitorowanie stanu pojazdu, w Nowakowski, T., Rosiński, A., Siergiejczyk, M. (red.). Problemy niezawodności systemów technicznych – teoria i zastosowania, 13-24, Oficyna Wydawnicza Politechniki Warszawskiej.

5.Andrzejczak K., Statystyka elementarna z wykorzystaniem systemu Statgraphics. Wydawnictwo PP, 1997.

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,0
Classes requiring direct contact with the teacher	45	2,0
Student's own work (literature studies, preparation for laboratory, preparation for exam, project preparation) [1]	55	2,0

[1] delete or add other activities as appropriate