COURSE DESCRIPTION CARD - SYLLABUS

Course name
Multivariate Statistics [S2SI1E>STA]

Course

Field of study
Artificial Intelligence

Year/Semester
1/1

Area of study (specialization)
–

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
30

Laboratory classes
30

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

Prerequisites

Probability theory, mathematical statistics, matrix algebra, basic skills in R

Course objective

The aim of the course is to provide students with knowledge of multivariate mathematical statistics, including the theory of estimation and testing hypotheses in multivariate models, principal components analysis, discriminant analysis and classification, and to gain practice in their implementation

Course-related learning outcomes

Knowledge
Student knows advanced methods, techniques and tools used to solve complex engineering tasks and conduct research in the field of artificial intelligence and related fields [K2st_W6]

Skills
Student is able to obtain information from literature, databases and other sources (both in Polish and English), integrate them, interpret and critically evaluate them, draw conclusions and formulate and fully justify opinions [K2st_U1]

Student is able to plan and carry out experiments, including computer measurements and simulations, interpret the obtained results and draw conclusions and formulate and verify hypotheses related to complex engineering problems and simple research problems [K2st_U3]
Student is able to interact in a team, taking various roles in it [K2st_U15]

Social competences
Student understands the importance of using the latest knowledge in the field of computer science and artificial intelligence in solving research and practical problems [K2st_K2]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures – exam covering the issues presented in lectures

Laboratory classes – two tests covering the issues presented during labs with the use of computers

Programme content

• matrix algebra - revisited
• random vectors and their distributions
• basic statistics and multivariate sampling distributions
• problem of missing observations
• tests of multivariate normality
• tests of expectation and covariance matrix
• multivariate linear models
• multivariate regression
• principal component analysis
• discriminant analysis
• classification analysis

Course topics

• matrix algebra - revisited;
 - eigenvalues and eigenvectors;
 - positive definite matrices;
 - partitioned matrices and their properties;
 - vector and matrix derivatives;
• radnom vectors and their distributions;
 - vector of expectation, covariance matrix, correlation matrix;
 - multivariate distributions, including multivariate normal distribution;
 - regression and correlation;
• basic statistics and multivariate sampling distributions;
 - vector of means, sample covariance matrix;
 - discrepancy measures between vectors;
 - generalized variance;
 - quadratic form distributions;
 - wishart distribution and its properties;
 - distribution of sample correlation coefficient;
• problem of missing observations
• tests of multivariate normality;
• tests of expectation and covariance matrix;
 - test of expectation for known covariance matrix;
 - test of expectation for unknown covariance matrix;
 - test of expectation equality for two populations;
 - sphericity test of covariance matrix;
 - test for equality of covariance matrices;
• multivariate linear models;
 - one-way models;
 - multivariate analysis of variance (MANOVA);
• multivariate regression;

- multiple regression;
- multivariate multiple regression;
• principal component analysis (PCA);
- population and sample principal components;
- methods of principal components selection;
- testing hypotheses related to principal components;
• discriminant analysis;
- linear discriminant function;
- discriminant analysis for two groups case;
- discriminant analysis for several groups case and association measures between discriminant functions;
- tests of significance;
• classification analysis;
- linear and quadratic classification functions;
- classification analysis for two groups case;
- classification analysis for several groups case.

Teaching methods

Lectures – theory presented in connection with the current knowledge of students, presentation of new topic preceded by a reminder of related content, known to students from other subjects

Laboratory – individual and team programming, computational experiments (using R package)

Bibliography

Basic:
1. Krzyśko, M. (2010). Podstawy wielowymiarowego wnioskowania statystycznego. Wydawnictwo Naukowe UAM w Poznaniu

Additional:
1. Anderson, T.W.(2003). An Introduction to Multivariate Statistical Analysis (3 ed). John Wiley & Sons
2. Rencher, A.C. (2002). Methods of Multivariate Analysis. John Wiley & Sons
3. Hardle, W., Simar, L. (2003). Applied Multivariate Statistical Analysis. Springer
4. Johnson, R.A, Wichern, W.A. (2007). Applied Multivariate Statistical Analysis. Pearson Prentice Hall

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	40	1,50