STUDY MODULE DESCRIPTION FORM

Name of the module/subject		Code
Multivariate Statistical Analysis		**1010341651010348914**
Field of study: **Mathematics**	Profile of study (general academic, practical): **(brak)**	Year /Semester: **3 / 5**
Elective path/specialty: **-**	Subject offered in: **Polish**	Course (compulsory, elective): **obligatory**
Cycle of study: **First-cycle studies**	Form of study (full-time,part-time): **full-time**	
No. of hours: Lecture: **30** Classes: **-** Laboratory: **30** Project/seminars: **-**		No. of credits: **4**
Status of the course in the study program (Basic, major, other): **(brak)**	(university-wide, from another field): **(brak)**	
Education areas and fields of science and art		ECTS distribution (number and %)

Responsible for subject / lecturer:

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Prerequisites in terms of knowledge, skills and social competencies:

1	**Knowledge**	Student well understands the role and the meaning of proofs in formal sciences. He knows basic definitions, statements and methods of mathematical logic, set theory, algebra, differential and integral calculus, probability theory and mathematical statistics. Moreover, student should know at least one packet of mathematical and statistical software.
2	**Skills**	Is able to apply methods of differential and integral calculus in real problems. Is able to use probability space and random variables in random experiments.
3	**Social competencies**	Student knows restrictions of the own knowledge and understands the need of further education. Is able to precisely formulate questions.

Assumptions and objectives of the course:

This course will give student a solid methodological background in Multivariate Analysis as a backbone of Applied Statistics. Student will learn the theoretical foundations of the most commonly applied multivariate techniques such as mean vector and covariance matrix estimation and testing, estimating and testing of correlations, discriminant analysis, classification and support vector machines, principal components, canonical correlations analysis, cluster analysis and factor analysis. Student will study the properties and the importance of the multivariate normality assumption in the context of each of these methods. SAS, MATLAB or Wolfram Mathematica - based computing will feature prominently in the course. At the end of the course student should be able to use all of the above techniques in his work as applied statistician, for practical analysis of real datasets.

Study outcomes and reference to the educational results for a field of study

Knowledge:

1. Able to use the general terminology, notation and concepts in the theory, methods and applications of Multivariate Statistical Analysis - [K_W01(+++) K_W02(++), K_W03(+++), K_W12(+++)]

2. Able to use creatively the properties of the multivariate normal distribution to justify optimality properties of Statistical Inference procedures based on multivariate normality with computer assistance. - [K_W08(+++), K_W09(+++), K_W12(++)]

Skills:

1. Able to formulate and solve practical problems that use one or multidimensional distributions - [K_U06(+), K_U11(+++), K_U12(++), K_U13(+++)]

2. Able to use matrix algebra in multivariate data analysis with computer assistance. - [K_U16(+++), K_U18(++), K_U20(+++)]

3. Able to use multivariate statistical procedures with computer assistance to research random phenomenon. - [K_U25(++), K_U35(++), K_U37(++)]

Social competencies:

1. These outcomes are closely related to the graduate attributes - research, inquiry and analytical thinking abilities, communication and information literacy. - [K_K02(+++), K_K06(++)]
2. Able to collectively working in solving the compound research projects. - [K_K03(++), K_K05(++)]

Assessment methods of study outcomes

Lecture:

the final examination will assess student mastery of the material covered in the lectures and tutorials.

further details about the final examination will be available in class closer to the time.

Computer laboratory:

current grade of skills for solving tutorial exercises which will be available on Moodle.

the final examination will assess student mastery of the material covered in the lectures and tutorials.

Course description

Matrix algebra. Quadratic forms. Partitioned matrices. Vector and matrix functions. Differentiation with vectors and matrices. Multidimensional random variables. The multinomial distribution. The multivariate normal distribution. Conditional and marginal distributions. Samples from the multivariate population. Estimation of the mean vector, covariance matrix and correlation matrix. Simultaneous inference about regression coefficients. Inferences about the correlation matrix. Measures of data distance. Tests on mean vectors and the T-square Hotelling statistic. Simultaneous inferences for mean vectors. Profile analysis for two and several independent groups. Tests for outlying observations. Testing the normality assumption. MANOVA - the multivariate analysis of variance. MANCOVA - the multivariate analysis of covariance. The linear discriminant function for two and several groups. Hypothesis tests for a single and several covariance matrices. Testing the independence of sets of variates. Canonical correlation. The principal components of multivariate observations and applications. The sampling properties of principal components. Multidimensional scaling. Computer support in solving theoretical and practical problems. Review of the software packages to statistical analysis.

Basic bibliography:

1. Anderson T.W., An Introduction to Multivariate Statistical Analysis.

2. Andrzejczak Karol, Wielowymiarowa analiza statystyczna. Electronic version of lectures.

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

4. Morrison D.F. Multivariate Statistical Methods.

5. Rao, C.R., Modele liniowe statystyki matematycznej. PWN, Warszawa 1982.

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

7. Symbolic Math Toolbox for Use with MATLAB.

Additional bibliography:

1. Brandt S., Analiza danych. Wydawnictwo Naukowe PWN, W-wa 1998.

2. Myers Raymond H. Montgomery Douglas C., Vining Geoffrey G, Generalized Linear Models. John Wiley & Sons, INC, 2002.

3. Draper Norman R., Smith Harry: Applied regression analysis. John Wiley & Sons, Inc. New York 1998.

4. Timm N.H., Applied Multivariate analysis. Springer-Verlag, New York, Inc. 2002.

Result of average student's workload

Activity	Time (working hours)
1. Participation in lectures	30
2. Participation in laboratory	30
3. Consultations and e-consultations	5
4. Laboratory preparation	20
5. Drawing up laboratory reports	20
6. Exam preparation and examination	15

Student's workload

Source of workload	hours	ECTS
Total workload	120	4
Contact hours	70	2
Practical activities	45	2