Subject code	ECTS credits
MAT 4005	6

Course title in Lithuanian

DAUGIAMATĖ STATISTIKA

Course title in English

MULTIVARIATE STATISTICS

Short course annotation in Lithuanian (up to 500 characters)

Daugiamačių atsitiktinių dydžių pasiskirstymo ir skaitinės charakteristikos, jų statistinis įvertinimas. Daugiamatis normalusis skirstinys, jo savybės. Pagrindiniai daugiamatės statistikos metodai: regresinė, klasterinė, diskriminantinė ir faktorinė analizės, jų įvairiapusiai taikymai.

Short course annotation in English (up to 500 characters)

The course covers distributional characteristics of multivariate random variables and their statistical estimation, multivariate analysis methods including multivariate regression and MANOVA, data reduction through the use of principal components or factor analysis, multivariate classification and clustering methods.

Prerequisites for entering the course

Mathematical Analysis, Probability Theory, Mathematical Statistics

Course aim

The aim of the course is to introduce a variety of standard statistical methods used to analyze multivariate data.

Links between course outcomes, criteria of learning achievement evaluation, study methods and methods of learning achievement assessment

No	Course outcomes	Criteria of learning achievement evaluation	Study methods	Methods of learning achievement assessment
1.	Understanding the multivariate normal distribution.	Student demonstrate the ability to describe properties of multivariate normal and related distributions.	Lectures, practical works, individual work, consulting.	Mid-term exam, assessment of practical works.
2.	Understanding the properties of sample mean vectors and correlation in multivariate data contexts.	Student knows main concepts and demonstrate ability to summarize multivariate data.	Lectures, practical works, individual work, consulting.	Final exam, mid-term exam, assessment of practical works.
3.	To select appropriate methods of multivariate data analysis, given multivariate data and study objectives.	Student demonstrates the ability to perform principal component analysis, factor analysis or cluster analysis.	Lectures, practical works, individual work, consulting.	Final exam, mid-term exam, assessment of practical works.
4.	To use R programming language to carry out multivariate data analyses.	Student demonstrates the ability to solve standard problems in multivariate statistical analysis.	Lectures, practical works, individual work, consulting.	Mid-term exam, assessment of practical works.

Links between study programme outcomes and course outcomes

Study programme outcomes	Running number of course outcome

	1	2	3	4
Comprehend and be able to apply probabilistic and statistical methods for data analysis	+	+	+	+
Summarize and evaluate critically scientific and professional literature, as well as use various tools for collecting of information for the study process and for solving fixed practical/theoretical problems	+	+	+	+
Identify the problem, collect and analyze real/theoretical data using various mathematical methods, tools and IT technologies			+	+
Having good foundations of mathematics, logically and critically recognize and describe relations between quantities of real life and mathematical concepts	+		+	
Operating with formal mathematical symbols and terms, determine mathematical connections between various mathematical quantities; conceive mathematical propositions and logical proofs, construct and prove new statements	+	+	+	
Think logically and analytically, evaluate alternative ways of task solving and implement optimal solutions	+		+	+

Content

No	Content (topics)
1.	Basic properties of random vectors and their statistical estimation.
2.	The multivariate normal distribution. Marginal and conditional distributions.
3.	Estimation of the mean vector and the covariance matrix.
4.	The Wishart distribution. The Hotelling T^2 distribution. Hypothesis testing.
5.	Discriminant analysis. Multivariate analysis of variance.
6.	Principal component analysis.
7.	Factor analysis.
8.	Cluster analysis.

Distribution of workload for students (contact and independent work hours)

Lectures	45
Practical work	30
Individual students work	85
Total:	160

Structure of cumulative score and value of its constituent parts

Final written exam (50%), mid-term written exam (25%), assessment of practical works (25%).

Recommended reference materials

No	Publication year	Authors of publication and title	Publishing house	Number of copies in		
				University library	*Self study rooms*	*Other libraries*
Basic materials						
1.	2003	Anderson T.W., An introduction to multivariate statistical analysis, 3rd edition	John Wiley			
2.	2015	Bagdonavičius V., Kruopis J., Matematinė statistika, IV dalis. Daugiamatė statistika	Vilniaus universiteto leidykla			http://www.statistika.mif.vu.lt/wp-content/uploads/2014/04/Bagdo_Kruop_Matem_stat_4dalis_2015.pdf
Supplementary materials						
1.	2011	Everitt B., Hothorn T., An Introduction to Applied Multivariate Analysis with R	Springer			

| 2. | 2012 | Rencher A.C., Christensen W.F., Methods of multivariate analysis, 3rd edition | John Wiley | |

Course programme designed by

Assoc. prof. dr. Tomas Rekašius