

LITHUANIAN UNIVERSITY OF HEALTH SCIENCES

APPROVED Kaunas Medical University Senate 17 th of December in 2004 Resolution Nr. 3-11

RENEWED 19 th of October, 2023

APPLICATION OF MATHEMATICAL STATISTICS AND ARTIFICIAL INTELLIGENCE IN DATA SCIENCE DOCTORAL STUDIES SUBJECT PROGRAM

Subject program coordinators:

Department of Physics, Mathematics and Biophysics assoc. prof. dr. Renata Paukštaitienė

Departments participating in the subject program: <u>Department of Physics, Mathematics and</u> <u>Biophysics</u>

Kaunas, 2023

Subject program data

Fields of science	Medical and health sciences, Natural sciences,	
	Agricultural sciences	
Field of study (code)	For all fields	
Title of the subject	Application of Mathematical Statistics and Artificial	
	Intelligence in Data Science	
Scope of the program	160 hours. (6 ECTS)	
Lectures	40 h	
Seminars	40 h	
Independent work	80 h	

Subject program preparation group

Eil.	Name, Surname	Responsibilities	Telephone	e-mail address
Nr.			(work)	
1.	Assoc. prof. dr.	Head of the	327-370	renata.paukstaitiene@lsmuni.lt
	Renata Paukstaitienė	department,	(5758)	
		associate professor		
2.	prof. dr. Algimantas	professor	327-367	algimantas.krisciukaitis@lsmu
	Kriščiukaitis	_		<u>ni.lt</u>
3.	dr. Vita	associate professor	327-367	vita.speckauskiene@lsmuni.lt
	Špečkauskienė			_

DESCRIPTION OF THE SUBJECT PROGRAM

1. <u>The need for the subject program</u>: Nowadays, doctoral student of the field of medicine, health, natural or agricultural sciences must be able to apply the methods of mathematical statistics and artificial intelligence in data analysis using computer program packages.

2. Objectives of the subject program:

1. To provide doctoral students with knowledge and practical skills about the collection, systematization and presentation of the health data and the estimation of the necessary minimum size of the research sample according to the purpose and tasks of the planned scientific work.

2. To provide doctoral students with knowledge and practical skills in choosing and using the necessary methods of statistical data analysis, in formulating the conclusions of research and in presenting the results.

3. To provide doctoral students with knowledge and practical skills in choosing and using the necessary artificial intelligence methods in data analysis.

4. To provide doctoral students with practical skills in using statistical analysis computer software packages.

No	Title and Short Description of Lecture	Duration	Teacher
	Application of Mathematical Sta	tistics	
1.	Introduction to data analysis Population and sample. Sampling methodology. Interval estimation of population characteristics by sample characteristics	2	dr. R. Paukštaitienė prof. A. Kriščiukaitis
2.	Testing of statistical hypotheses. Parametric tests An introduction to statistical hypothesis testing. Parametric tests for one sample and two samples. The minimum sample size.	4	dr. R. Paukštaitienė dr. I. Grabauskytė
3.	Analysis of variance Analysis of variance (ANOVA). Analysis of covariates (ANCOVA). Analysis of variance of blocked data.	4	dr. R. Paukštaitienė dr. I. Grabauskytė
4.	Testing of statistical hypotheses. Rank Tests Wilcoxon, Mann-Whitney, Kruskal Wallis and Friedman tests.	2	dr. A. Kriščiukaitis dr. V. Špečkauskienė
5.	Correlation and regression analysis of quantitative data Correlation coefficients. Linear regression	2	dr. R. Paukštaitienė dr. I. Grabauskytė
6.	Statistical hypothesis testing by analyzing qualitative data Chi-squared test and evaluation of baseline estimates, Cochran's Q test	2	dr. R. Paukštaitienė dr. I. Grabauskytė
7.	Correlation and regression analysis of qualitative data Coefficients of association. Binomial logistic regression, multinomial logistic regression and ordinal logistic regression models, their selection and application.	4	dr. R. Paukštaitienė dr. I. Grabauskytė
8.	Survival analysis. Survival tables. Kaplan-Meier estimates. Comparison of survival functions in groups. Regression models of survival.	2	dr. R. Paukštaitienė dr. I. Grabauskytė
9.	Analysis of questionnaire data. Reliability and validity analysis of the questionnaire. Factor analysis.	2	dr. R. Paukštaitienė dr. I. Grabauskytė
10.	Systematic literature review and meta-analysis	2	dr. R. Paukštaitienė dr. V. Špečkauskienė
	Application of Artificial Intelligence in Data Analysis		
11.	Basics of artificial intelligence. Concept and classification, overview of basic methods	2	dr. R. Petrolis dr. V. Špečkauskienė
12.	Machine and deep learning in health data analysis (open and big data analytics).	3	dr. R. Petrolis dr. V. Špečkauskienė
13.	Application of decision trees for the determination of diagnostically important risk factors	2	dr. I. Grabauskytė dr. V. Špečkauskienė
14.	Cluster analysis. The purpose and stages of cluster analysis, its mathematical model. Measures of object similarity and classification of methods.	2	dr. R. Petrolis dr. A. Kriščiukaitis
15.	Discriminant analysis The purpose and stages of discriminant analysis, its model. Selection of the classification rule, its reliability.	2	dr. R. Petrolis dr. A. Kriščiukaitis
16.	Application of artificial neural networks and other classifiers in data analysis	3	dr. R. Petrolis dr. A. Kriščiukaitis

PRACTICAL PART – 40 hours.

Practical classes and seminars are held in computer classrooms. During them, doctoral students use computer statistical programs to perform statistical analysis of the given data by applying the theoretical material presented in the lectures.

No	Title and Short Description of Lecture	Duration	Teacher	
	Application of Mathematical Statistics			
1.	Introduction to data analysis	2		
2.	Testing of statistical hypotheses. Parametric tests	4		
3.	Analysis of variance	4		
4.	Testing of statistical hypotheses. Rank Tests		dr. R. Paukštaitienė prof. A. Kriščiukaitis dr. I. Grabauskytė	
5.	Correlation and regression analysis of quantitative data			
6.	Statistical hypothesis testing by analyzing qualitative data			
7.	Correlation and regression analysis of qualitative data		dr. V. Speckauskiene	
8.	Survival analysis.		ul. K. Peuolis	
9.	Analysis of questionnaire data.	2		
10.	Systematic literature review and meta-analysis	2		
11	Control work 2			
	Application of Artificial Intelligence in I	Data Analysis	3	
12.	Basics of artificial intelligence.	2		
13.	Machine and deep learning in health data analysis (open and big data analytics).		dr. R. Petrolis	
14.	Application of decision trees for the determination of diagnostically important risk factors		dr. V. Speckauskiene dr. I. Grabauskytė	
15.	Cluster analysis and discriminant analysis	2	dr. P. Paukštaitianė	
16.	Application of artificial neural networks and other		ur. IX. Faukstattielle	
	classifiers in data analysis			
17.	Contol work	2		

Independent work - 80 val.

During independent work, doctoral students study special literature, critically analyze scientific articles, use information databases, independently solve additional tasks obtained during practice seminars. Throughout this work, doctoral students are advised by professors.

EVALUATION OF STUDIES

In the course of mathematical statistics and its applications cumulative assessment of knowledge is applied. The practical skills of doctoral students are evaluated during the control works. Practical data analysis tasks are solved by using computer software. Acquired theoretical knowledge is evaluated during the exam at the end of the course. The exam task consists of 3 questions related to the material of the studied subject.

The cumulative grade of the course consists of: First control work 35 % + second control work 25 % + 40% exam test.

No.	Title	Authors	Years of
			publication
1.	Basics of Biostatistics	R. Šimoliūnienė, J. Tomkevičiūtė,	2016, Kaunas,
		Ž. Jokšienė et.al.	
2.	Artificial Intelligence By Example	Rothman, Denis	2018, Packt
			Publishing
3.	Design and analysis of Clinical Trials	Shein-Chung Chow, Jen-Pei Liu	2014, Wiley

RECOMMENDED LITERATURE

LIST OF TEACHERS:

1. Professors or senior researchers teaching in the subject program: Prof. dr. Algimantas Kriščiukaitis

- 2. Other teachers of the subject program mathematicians:
 - assoc. prof. dr. Renata Paukštaitienė
 - dr. Ingrida Grabauskytė
 - dr. Robertas Petrolis
 - dr. Vita Špečkauskienė