LITHUANIAN UNIVERSITY OF HEALTH SCIENCES

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

RENEWED
31st of October, 2026

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: Department of Physics, Mathematics and Biophysics

Kaunas, 2026

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. Nr.	Name, Surname	Responsibilities	Telephone (work)	e-mail address
1.	Assoc. prof. dr. Renata Paukstaitienė	Head of the department, professor	327-370 (5758)	renata.paukstaitiene@lsmuni.lt
2.	dr. Vita Špečkauskienė	Associate professor	327-367	vita.speckauskiene@lsmuni.lt
3	dr. I. Grabauskytė	Associate professor	327-367	ingrida.grabauskytė@lsmu.lt
4.	dr. Robertas Petrolis	Associate professor	327-367	robertas.petrolis@lsmu.lt

DESCRIPTION OF THE SUBJECT PROGRAM

1. The need for the subject program: 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.

THEORETICAL PART - **40** hours

No	Title and Short Description of Lecture	Duration	Teacher
	Application of Mathematical Statistics		
1.	**Introduction to data analysis** Population and sample. Sampling methodology. Interval estimation of population characteristics by sample characteristics	2	dr. R. Paukštaitienė dr. I. Grabauskytė dr. S.Kerzienė
2.	**Testing of statistical hypotheses. Parametric tests** An introduction to statistical hypothesis testing. Parametric tests for two samples. The minimum sample size.	2	dr. R. Paukštaitienė dr. I. Grabauskytė dr. S.Kerzienė
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 dr. S.Kerzienė
4.	**Testing of statistical hypotheses. Rank Tests** Wilcoxon, Mann-Whitney, Kruskal Wallis and Friedman tests.	4	dr. R. Paukštaitienė dr. I. Grabauskytė dr. S.Kerzienė
5.	**Correlation and regression analysis of quantitative data** Correlation coefficients. Linear regression. Linear Mixed Models (LMM) for the Analysis of Repeated Measures	4	dr. R. Paukštaitienė dr. I. Grabauskytė dr. S.Kerzienė
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 dr. S.Kerzienė
7.	**Correlation and regression analysis of qualitative data** Coefficients of association. Binomial logistic regression, and multinomial logistic regression models.	2	dr. R. Paukštaitienė dr. I. Grabauskytė dr. S.Kerzienė
8.	**Survival analysis.** Survival tables. Kaplan-Meier estimates. Comparison of survival functions in groups. Regression models of survival. Cox regression.	2	dr. R. Paukštaitienė dr. I. Grabauskytė dr. S.Kerzienė
9.	**Analysis of questionnaire data.** Reliability and validity analysis of the questionnaire. Factor analysis.	2	dr. R. Paukštaitienė dr. I. Grabauskytė dr. S.Kerzienė
10.	**Fundamentals of applying structural equation models in biomedical data analysis**	2	dr. R. Paukštaitienė dr. I. Grabauskytė dr. V. Špečkauskienė
11.	**Systematic literature review and meta-analysis**	2	dr. R. Paukštaitienė dr. I. Grabauskytė dr. V. Špečkauskienė
	Application of Artificial Intelligence in Data Analysis		
12.	**Basics of artificial intelligence. Machine and deep learning in health data analysis (open and big data analytics).** Open and big data analysis.	2	dr. R. Petrolis dr. V. Špečkauskienė
13.	**Application of decision trees for the determination of diagnostically important risk factors**	2	dr. R. Paukštaitienė dr. I. Grabauskytė dr. V. Špečkauskienė
14.	**Cluster analysis.** The purpose and stages of cluster analysis, Measures of object similarity and classification of methods.	2	dr. R. Paukštaitienė dr. I. Grabauskytė dr. V. Špečkauskienė
15.	**Discriminant analysis** The purpose and stages of discriminant analysis, its model. Selection of the classification rule, its reliability.	2	dr. R. Paukštaitienė dr. I. Grabauskytė dr. V. Špečkauskienė
16.	**Classification using artificial neural networks (perceptrons), network architecture, management of the training process, classification quality**	2	dr. R. Petrolis dr. V. Špečkauskienė
17.	**Application of artificial neural networks and other classifiers in data analysis**	2	dr. R. Petrolis dr. V. Špečkauskienė

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	dr. R. Paukštaitienė prof. A. Kriščiukaitis dr. I. Grabauskytė dr. V. Špečkauskienė dr. R. Petrolis
2.	Testing of statistical hypotheses. Parametric tests	2	
3.	Analysis of variance	2	
4.	Testing of statistical hypotheses. Rank Tests	4	
5.	Correlation and regression analysis of quantitative data	4	
6.	Statistical hypothesis testing by analyzing qualitative data	2	
7.	Regression analysis of qualitative data	2	
8.	Survival analysis.	2	
9.	Analysis of questionnaire data.	2	
10.	Fundamentals of applying structural equation models in biomedical data analysis	2	
11.	Systematic literature review and meta-analysis	2	
	Application of Artificial Intelligence in Data Analysis		
13.	Basics of artificial intelligence.	2	dr. R. Petrolis dr. V. Špečkauskienė dr. I. Grabauskytė dr. R. Paukštaitienė
14.	Machine and deep learning in health data analysis (open and big data analytics).	2	
15.	Application of decision trees for the determination of diagnostically important risk factors	2	
16.	Cluster analysis and discriminant analysis	2	
17	Application of artificial neural networks and other classifiers in data analysis	2	
18.	Test	4	

Independent work - 80 hours.

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

The course on *Mathematical Statistics and its Applications* employs a cumulative assessment method. Doctoral students' practical skills and theoretical knowledge are evaluated through two practical assessments – involving the solution of assigned practical tasks – conducted during the course.
The cumulative course grade is calculated as follows: 50% from the first assessment and 50% from the second assessment**.**

RECOMMENDED LITERATURE

No.	Title	Authors	Years of publication
1.	Basics of Biostatistics	R. Šimoliūnienė, J. Tomkevičiūtė, Ž. Jokšienė et.al.	2016, Kaunas,
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

LIST OF TEACHERS:

1. Professors or senior researchers teaching in the subject program:
   prof. dr. Renata Paukštaitienė

2. Other teachers of the subject program - mathematicians:
   assoc. professor dr. Ingrida Grabauskytė
   assoc. professor dr. Robertas Petrolis
   assoc. professor dr. Vita Špečkauskienė
   assoc. professor dr. Sigita Kerzienė