COURSE UNIT (MODULE) DESCRIPTION

Course unit (module) title	Code
Nonparametric statistics	

Lecturer(s)	Department(s) where the course unit (module) is delivered
Coordinator: assoc. prof. Jurgita Markevičiūtė	Faculty of Mathematics and Informatics Institute of Applied Mathematics Department of Statistical Analysis

Study cycle	Type of the course unit (module)
First	Compulsory

Mode of delivery	Period when the course unit (module) is delivered	Language(s) of instruction
Face-to- face	Fifths (autumn) semester	English/Lithuanian

Requirements for students	
Prerequisites: Mathematical analysis I and II, Probability theory, Research Data Analysis, Parametric statistics	**Additional requirements (if any): -**

Course (module) volume in credits	Total student's workload	Contact hours	Self-study hours
5	150	64	86

Purpose of the course unit (module): programme competences to be developed		
The goal of the course is to introduce nonparametric hypothesis testing methods, to understand the differences between parametric and nonparametric hypothesis testing, to be able to choose the suitable method and apply to a practical situation, enhance critical and analytical thinking.		
Learning outcomes of the course unit (module) The student after the course:	**Teaching and learning methods**	**Assessment methods**
will be able to describe nonparametric tests; will be able to apply nonparametric tests for real data analysis; will be able to apply nonparametric tests using R software; will be able to choose suitable criteria for hypothesis testing according to the assumptions; will demonstrate the understanding of terminology, methods and principles; will be able to demonstrate ability solve the task that requires understanding of field concepts.	*Lectures* devoted for the theoretical results and practical case studies. *Labs*, devoted to the practical problem solving with R. *Self study* for the additional problem solving and preparing for exam and control works.	Practical tasks with computer, mid-term exam, exam.

Content: breakdown of the topics	Contact hours	Self-study work: time and assignments

	Lectures	Laboratory work	Exercises	**Contact hours**	**Self-study hours**	**Assignments**
1. Hypothesis testing: parametric vs. nonparametric criterias.	4	4		**8**	**10**	Read [1, 4.1, 4.2 ch.], [2, 3.2 ch.] and solve the tasks in the chapters; Read [1, 5 ch. introduction], [3, 1.1 ch.]
2. Contingency tables. Chi squared criteria for independence and homogeinity.	4	4		**8**	**10**	Read [1, 5.2 ch.], [2, 3.5 ch.], [4, 2 ch.], solve the tasks in the chapters.
3. Goodness of fit criteria based on distance Kolmogorov-Smirnov, Cramer-Mises, Anderson-Darlingo criterias.	8	6		**14**	**16**	Read [1, 5.1.3-5.1.6 ch.], [4, 3 ch.], solve the tasks in the chapters.
4. Rank criterias. Ranks and their properties.	12	14		**26**	**26**	Read [1, 5.3, 5.4 ch.], [3, 1 ch.], [4, 4 ch.], solve the tasks in the chapters.
5. Other nonparametric criterias	4	4		**8**	**8**	Read [1, 5.1.1], [4, 5 ch.], solve the tasks in the chapters.
Preparation for te middle-term exam and exam.					**16**	Repeat all the course material.
Total	**32**	**32**		**64**	**86**	

Assessment strategy	**Weight ,%**	**Deadline**	**Assessment criteria**
Mid-term exam Mid-term written exam lasts 1 academic hour. Students should solve practical problems. It is allowed to have one A4 format paper with formulas and definitions.	**20**	**Middle of the semester**	Task are evaluated according to what part of problem is solved. Points are converted into mark at 10 points scale according to formula: $$\boldsymbol{m = \frac{10 \cdot x}{y}},$$ where m – is a final mark of a mid-term exam at 10 points scale, x – number of points the student got during the mid-term exam, y – maximal number of points in the mid-term exam.
Practical tasks with computer 8 tasks during the semester, for each task 15 minutes are given to submit solution.	**20**	**During semester**	Task are evaluated according to what part of problem is solved. Points are converted into mark at 10 points scale according to formula: $$\boldsymbol{p = \frac{1}{8}\sum_{i=1}^{8} \frac{10 \cdot x_i}{y_i}},$$ where p – is a final mark of practical tasks with computer at 10 points scale, x_i – number of points the student got during the i-th task, y_i – maximal number of points in the i-th task.
Final exam Final written exam 2 academic hours. Students should solve practical problems and answer theoretical questions. It is allowed to have two A4 format paper with formulas and definitions.	**60**	**During exam session**	Task are evaluated according to what part of problem is solved or answered to the theoretical question. Points are converted into mark at 10 points scale according to formula: $$\boldsymbol{e = \frac{10 \cdot x}{y}},$$ where e – is a final mark of the exam at 10 points scale, x – number of points the student got during the exam, y – maximal number of points in the exam.
Final mark of the course is obtained by the formula: $$\boldsymbol{final\ mark = 0,2m + 0,2p + 0,6e}.$$			

Author	**Year of**	**Title**	**Issue of a periodical**	**Publishing place and house or web link**

	publication		or volume of a publication	
Compulsary reading				
1. J. P. Marques de Sa	2007	Applied Statistics Using SPSS, STATISTICA, MATLAB and R	2nd edition	https://link.springer.com/content/pdf/10.1007%2F978-3-540-71972-4.pdf
2. V. Čekanavičius ir G. Murauskas	2000	Statistika ir jos taikymai.	I part	Vilnius, TEV
3. V. Čekanavičius ir G. Murauskas	2002	Statistika ir jos taikymai.	II part	Vilnius, TEV
4. V. Bagdonavičius ir J. Kruopis	2007	Matematinė statistika	III part	http://www.statistika.mif.vu.lt/wp-content/uploads/2014/04/Bagdo_Kruop_Matem_stat_3dalis_2015.pdf
Optional reading				
5. R.V. Hogg ir E.A. Tanis	1988	Probability and statistical inference	3rd edition	Niujorkas-Londonas, Macmillan
6. M. L. Berenson, D. M. Levine		Basic business statistics. Concepts and Applications	5th edition	Prentice hall , Englewood Cliffs, New Jersey