COURSE UNIT DESCRIPTION

Course unit title	Code
Statistical Evaluation and Modelling of Ecological Data	

Annotation
The course is intended for students of the Master Study Programme "Management of Natural Systems". During the studies, the students will get to know the statistical methods of data analysis and modelling (descriptive statistics; hypothesis testing; correlation, regression and dispersion analysis; multidimensional statistical methods); the principles of their selection and application in ecology; the aspects of results' evaluation. The real tasks are solved, the specialized software (Excel, SPSS, R) for data processing and modelling are used.

Lecturer(s)	Department, Faculty
Coordinating: prof. dr. Renata Macaitienė **Other:** assoc. prof. dr. Laura Šukienė	Vilnius University Šiauliai Academy

Study cycle	Type of the course unit
Second	Mandatory

Mode of delivery	Semester or period when it is delivered	Language of instruction
Mixed learning	Autumn	Lithuanian, English

Requisites	
Prerequisites: basic courses of mathematics.	**Co-requisites (if relevant):** -

Number of ECTS credits allocated	Student's workload (total)	Contact hours	Individual work
10	280	72	208

Purpose of the course unit: programme competences to be developed
To master the main principles and options for data processing, selection and application of statistical methods and models, and data analysis software tools used for modern ecological investigations; to develop abilities to perform statistical research independently, to evaluate and reasonably interpret the results; to present generalized reasonable conclusions and recommendations.

Learning outcomes of the course unit	Teaching and learning methods	Assessment methods
Will know, understand and be able to explain the notions, propositions, methods and models of mathematical statistics; principles of research planning and implementation; techniques of results interpretation and presentation.	Literature analysis, problem-based learning, modelling of real-life situations, formal lectures, seminars	Report on the results of the practical tasks and defence of them
Will be able to solve classical ecological challenges, selecting and applying methods of descriptive statistics, hypothesis testing, regression and multivariate statistics using specialized software tools.	Practical work, practical exercises, simulation of real-life situations, modelling of real-life situations, formal lectures, seminars	Report on the results of the practical tasks and defence of them

Will be able to model and perform the statistical research independently, reasonably interpret and evaluate results, to present reasonable conclusions and recommendations about the state of the ecosystem.	Individual consultations, modelling of real-life situations, literature analysis, application of special software packages, seminars, workshops	Report on the results of the practical tasks and defence; individual homework and its defence
Will be able to forecast the indicators of ecosystem changes and, according to the available information, assess possible threats to the natural environment.	Modelling of real-life situations, seminars, workshops	Report on the results of the practical tasks and defence; individual homework and its defence

Course content: breakdown of the topics	**Contact hours**							**Individual work: time and assignments**	
	Lectures, e-learning	Tutorials	Seminars	Workshops	Laboratory work	Internship/work placement	**Contact hours, total**	**Individual work**	**Assignments**
1. Data collection, coding, selection criteria. Parameters of descriptive statistics.	0,5			1			**1,5**	**4**	Study of literature on relevant topics, solving of given theoretical self-control tasks and practical tasks using specialized software (according to the specified literature sources and descriptions of specialized tasks indicated in the *Moodle* environment).
2. Distributions: normal (Binomial), exponential et al. Evaluation of unknown parameters.	0,5			1			**1,5**	**4**	
3. Point estimates and confidence intervals. Graphical presentation.	0,5			2			**2,5**	**4**	
4. Correlation and regression analysis. Linear and nonlinear models. Prediction.	0,5			2			**2,5**	**6**	
Preparation of practical tasks (L_1). Performance and defence of the results			2	1			**3**	**8**	
5. Hypothesis testing. Null and alternate hypothesis. α and *p* values.	1						**1**	**4**	Study of literature on relevant topics, solving of given theoretical self-control tasks and practical tasks using specialized software (according to the specified literature sources and descriptions of specialized tasks indicated in the *Moodle* environment).
6. Qualitative variables. Statistical model of two qualitative variables. Relationships' measures of Nominal and Ordinal variables.	1			1			**2**	**4**	
7. Nonparametric hypotheses (compatibility of distributions, independence of variables, homogeneity of populations).	1			2			**3**	**6**	
Preparation of practical tasks (L_2). Performance and defence of the results			2	1			**3**	**8**	
8. Hypotheses for correlation coefficient.	0,5			2			**2,5**	**4**	Study of literature on relevant topics, solving of given theoretical
9. Parametric hypotheses for one sample.	0,5			2			**2,5**	**4**	

10. Parametric hypotheses for two (or more) independent or dependent samples. Univariate and multivariate analysis of variance.	2			4			**6**	**12**	self-control tasks and practical tasks using specialized software (according to the specified literature sources and descriptions of specialized tasks indicated in the *Moodle* environment).
Preparation of practical tasks (L_3). Performance and defence of the results			2	1			**3**	**8**	
Preparation of individual homework			2				**2**	**28**	Study of literature. Preparation of individual thesis and its presentation according to given requirements.
11. Ecological models, analytical models in ecology. Overview of the model types available for ecological modelling.	2			2			**4**	**12**	Study of literature (according to the literature sources indicated in the *Moodle* environment, specialised tasks of relevant topics); solving the given tasks using specialised software.
12. Components of the model, conceptualization. Data handling and model construction.	1		4	2			**7**	**12**	
Preparation for practical tasks (L_4). Performance and defence of work				2			**2**	**8**	
13. Verification, sensitivity analysis, parameter calibration.	1			2			**3**	**12**	Study of literature (according to the literature sources indicated in the *Moodle* environment, specialised tasks of relevant topics); solving the given tasks using specialised software.
14. Evaluation of model results and error correction solutions.	1			2			**3**	**12**	
Preparation for practical tasks (L_5). Performance and defence of work				2			**2**	**8**	
15. Dynamic and spatial models in ecology, examples.	1		2	2			**5**	**12**	Study of literature (according to the literature sources indicated in the *Moodle* environment, specialised tasks of relevant topics); solving the given tasks using specialised software.
16. Modelling tools in ecology and environmental science. Selection and application of created models.	2		4	2			**8**	**20**	
Preparation for practical tasks (L_6). Performance and defence of work				*2*			**2**	**8**	
Total	**16**	**-**	**18**	**38**	**-**	**-**	**72**	**208**	

Assessment strategy	Weight %	Deadline	Assessment criteria
Report on the results of the practical tasks and defence of them	80	During the semester	The student studies the material provided by the teacher, uses specialised statistical programs, analyses the obtained results, interpret them, uses the terms correctly. The report of solved practical tasks is evaluated according to:

			9-10 points - demonstrates undoubted preparation, knows the material presented in the task well, applies the methods correctly, can describe the results, can interpret them, make conclusions, defends them with arguments. 7-8 points - knows the given material, performs calculations correctly, applies methods, can describe the results, make conclusions, defends them with arguments. 5-6 points - familiar with the material, apply the methods with the help of the teacher, presents the results and conclusions, defends them. 3-4 points - does not know the material, applies the methods with the help of the teacher, presents results with errors, does not provide conclusions, and does not know how to defend the obtained results. 1-2 points - the student is slow to participate in the work. The defence of solved practical tasks is assessed according to: 10-9 points - original presentation of results, detailed, reasoned, terms are used correctly, answers to questions are clear, reasoned. 8-7 points - presentation of results is complete; terms are used correctly, answers to questions are argued. 6-5 points - presentation of results are incomplete, inconsistent, errors in terms, some questions are answered with arguments. 1-4 points - the results are presented in a patchy way, the terms are used incorrectly, the questions are not answered.
Individual homework	15	During the semester	Individual homework is evaluated according to the detailed requirements provided in the description (selection of investigation field, collection of data, testing of hypotheses, interpretation of the results obtained, discovering of generalized and reasonable conclusions).
Presentation and defence of individual homework	5	During the exam session	The presentation of individual homework is assessed by colleagues and the teacher (according to a system provided in advance). The aim of the presentation is to find out the student's insight into the problem, the appropriateness of the choice of methods, the validity of the results' interpretation and the ability to make recommendations. Each student must be asked at least 5 questions.

Author	Publishing year	Title	Issue of a periodical or volume of a publication; pages	Publishing house or internet site
Required reading				
R. R. Sokal, F. J. Rohlf	2012	Biometry: the principles and practice of statistics in biological research. 2nd ed		W. H. Freeman
A. Garth	2018	Analysing data using SPSS		Sheffield Hallam University

S. E. Jorgensen	2011	Fundamentals of Ecological Modelling: Applications in Environmental Management and Research		Elsevier
F. Jordan, S. E. Jørgensen	2012	Models of the ecological hierarchy: from molecules to the ecosphere		Oxford: Elsevier
Methodological material prepared by teachers (placed in the *Moodle* environment)				https://emokymai.vu.lt/
Recommended reading				
J. H. Zar	2013	Biostatistical Analysis		Cloth
M. Logan	2010	Biostatistical design and analysis using R		Wiley
B. Bolker	2007	Ecological Models and Data in R		Princeton University Press