Course name: **Statistics in environmental studies with R**

ECTS	*4.0*
Course status	*Facultative*
Course final assessment /evaluation of outcomes	*graded credit*
Prerequisite	*Basic Mathematical Analysis*

Main field of study: Environmental Engineering, Agriculture

Educational profile	*General academic*
Code of studies and education level	*Master*
Semester of studies	*winter or summer*
Language of instruction	*English*

Course offered by:

Name of faculty offering the course	*Faculty of Environment Engineering and Land Surveying*
Name of department offering the course	*Department of Applied Mathematics*
Course coordinator	*J. Kopcińska PhD, A. Rutkowska PhD*

Learning outcomes:

Symbol of outcome	Description of the learning outcome	Reference to main field of study outcomes	Area symbol*
KNOWLEDGE – student knows and understands:			
SEE-K1	properties of random variables: parameters, cumulative density distribution function (typical in environmental studies), rules of statistics, the sample data analysis, the methods of inference: estimation and verification of hypotheses, the correlation and regression analysis.	IS2_W01 IS2_W02	*T*
SKILLS – student is able to:			
SEE-S1	calculate the measures of location and dispersion of a random variable, carry out the descriptive sample statistics, perform statistical analysis using estimation and hypothesis testing methods, perform regression and correlation analysis. Is able to complete the statistical analysis of environmental data using the R program.	IS2_U02 IS2_U03	*T*
SOCIAL COMPETENCIES – student is ready to:			
SEE-C1	fulfil the social commitments through drawing conclusions about environmental random variables and processes.	IS2-K03	*T*

Teaching contents

Lectures:	15 hours
Topics	1. Probability function, random variables. 2. Discrete and continues random variables and their parameters 3. Limit theorems 4. Statistical inference: point and interval estimation 5. Statistical inference: hypothesis testing (significance tests for one and two populations for mean, variance, proportion) 6. One way of Analysis of Variance 7. Correlation- coefficient of correlation and significance test, coefficient of determination – usage end interpretation.

	9. Simple and multiple linear regression – Least square estimation and significance test for regression coefficient

Accomplished learning outcomes	SDA-K1
Means of verification, rules and criteria of assessment	*The final test from the theoretical part that covers 20% of the total number of points student can get from the course.*
Classes:	30 hours
Topics	All calculations performed in the R program. 1. Basic algebraic calculations in R 2. Discrete and continues variables; probability distribution function, cumulative distribution function, measures of location and dispersion. 3. The Bernoulli, Poisson, normal, log-normal, exponential, gamma, and other distributions. Examples of environmental random variables. The central limit theorem. 4. Constructing a frequency distribution (histogram). 5. Measures of location and dispersion: mean, variance, st. deviation, quantile, percentile etc. 6. Testing a population mean, a population proportion, a population variance. 7. Comparing between two population means, two population proportions, two population variances; examples of environmental data. 8. One-way ANOVA. 9. The regression analysis (the least squares method), the coefficient of determination. 10. The correlation coefficient for various types of data. 11. Test of significance for the correlation coefficient.
Accomplished learning outcomes	SDA-S1, SDA-C1
Means of verification, rules and criteria of assessment	*The final test from the practical part covers 80% of the total number of points student can get from the course.*
Field practicals:	0 hours
Topics	
Accomplished learning outcomes	
Means of verification, rules and criteria of assessment	

References:

Basic	*1. M.A. Carlton,J. L. Devore. Probability with Applications in Engineering, Science, and Technology. Springer Texts in Statistics. Springer 2017.* *2. . R. Maity, Statistical Methods in Hydrology and Hydroclimatology, Springer Transactions in Civil and Environmental Engineering. Springer 2018* *3. M. Holický, Introduction to Probability and Statistics for Engineers, Springer 2012.*
Supplementary	*4. A. Field, J. Miles, Z. Field, Z. Discovering Statistics using R, Sage Publications 2012..* *5. N. L. Johnson, F. C. Leone "Statistics and experimental design: in engineering and the physical science", New York, John Wiley and Sons, 1969.* *6. M. Tilman, Davies, The Book of R: A First Course in Programming and Statistics, No Starch Press 2016.*

Structure of learning outcomes

Area of academic study: T – technical sciences	4.0	ECTS**

Structure of student activity

Contact hours	52	hrs.	2.1 ECTS**
Including: lectures	15	hrs.	
classes and seminars	30	hrs.	
consultations	10	hrs.	
participation in research	-	hrs.	
obligatory field trips	-	hrs.	

participation in examination	2	hrs.		
e-learning	5	hrs.	0.2	ECTS**
student own work	43	hrs.	1.7	ECTS**

*Areas of academic study in the fields of: A – the arts; H – humanities; M – medical, sport and health sciences; N – natural sciences; P – biological sciences; R – agricultural, forestry and veterinary sciences; S – social studies; T – engineering and technology

** stated with an accuracy to 0.1 ECTS, where 1 ECTS = 25–30 hours of classes