Course name: **Statistical data analysis 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	*A. Rutkowska PhD, W. Młocek 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:			
SDA-K1	the distribution of random variable, various types of distributions, descriptive statistics, and methods of statistical data analysis using the R environment with examples from various engineering fields.	IS2_W01 IS2_W02	*T*
SKILLS – student is able to:			
SDA-S1	compute characteristics of a random variable, perform the sample data analysis, conduct statistical inference based on estimation and hypothesis testing, perform correlation and regression analysis using the R program.	IS2_U02 IS2_U03	*T*
SOCIAL COMPETENCIES – student is ready to:			
SDA-C1	use objective sources of scientific information and apply the principles of critical inference in solving practical problems related to environment.	IS2-K03	*T*

Teaching contents

Lectures:	15 hours
Topics	1. Probability, random variable, cumulative distribution function (CDF), probability distribution function (PDF), characteristics. 2. Families of distribution functions: Bernoulli, Poisson, Gaussian, Exponential, log-normal, Gamma, Weibull, GEV, Pareto, and others. 3. Population, sample, descriptive statistics, sample distribution functions, sample characteristics, Box-Cox transformation. 4. Statistical inference: confidence intervals for the mean, variance, fraction, the goodness of fit tests: chi-squared, Kolmogorow-Smirnov, Shapiro-Wilk, Anderson-Darling, Cramer-von Mises, the tests of the mean, variance, fraction for one population and for two populations, One way Analysis of Variance (ANOVA). 5. Correlation and regression analysis. 6. Nonparametric methods in statistics.

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	1. Introduction to R: algebraic calculations, R objects: vectors, data frames, matrices, lists. Packages. Functions, loops. Graphical instructions. 2. Probability, random variable, probability distribution functions (PDF, CDF), calculating of characteristics and visualizing the plots of the distribution functions using R instructions. 3. R functions for various families of distributions. 4. Descriptive statistics, practical approach to sample distribution functions and to sample characteristics using R instructions, graphical visualization of data sample. Practical approach with examples from engineering and from natural and environmental sciences. 5. Statistical inference with R: confidence intervals, tests for means, variances, fractions, goodness of fit tests, ANOVA. Practical approach with examples in R from engineering and from natural and environmental sciences. 6. Correlation and regression analysis (linear, non-linear). Practical approach with examples in R. 7. Nonparametric statistics based on ranks. Practical approach with examples in R.
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. P. Dalgaard. Introductory Statistics with R, Springer 2008.* *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. Tattar Prabhanjan, Ramaiah Suresh and Manjunath B. G., A Course in Statistics With R, Wiley 2016.* *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