University of Gdańsk

Subject card

Subject name and code	Modelling extreme events in R, PG_00210599						
Field of study	Informatics						
Date of commencement of studies	October 2026		Academic year of realisation of subject	2026/2027			
Education level	Master's studies		Subject group	Obligatory subject group in the field of study Optional subject group			
Mode of study	full-time studies		Mode of delivery	at the university			
Year of study	1		Language of instruction	Polish			
Semester of study	2		ECTS credits	6.0			
Learning profile	academic		Assessment form	exam			
Conducting unit							
Name and surname of lecturer (lecturers)	Subject supervisor		dr Joanna Czarnowska				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	30.0	0.0	0.0	60
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study	SUM
	Number of study hours	60		0.0		0.0	60
Subject objectives	Introducing students to the problem of modeling extreme events using selected probability distributions, extreme value theory, and copula theory, with the application of R libraries. To introduce students with the fundamentals of modeling and analyzing extreme events using selected probability distributions, extreme value theory, copula theory, and R-based tools.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[INFMU2_U09] is able to present the results of research in the form of an independently prepared dissertation (paper) containing a description and justification of the purpose of the work, the methodology adopted, the results and their significance in comparison with other similar studies	Is able to present the results of analyses of extreme events in the form of a report and critically discuss the obtained results and the methods used.	[SU2] presentation/project/paper/ report [SU4] test/exam - oral or written
[INFMU2_K02] knows the limits of his own knowledge and understands the need for further learning	Understands the need to expand their knowledge in the field of modeling and analysis of extreme events.	[SK2] presentation/project/paper/ report
[INFMU2_U09] is able to present the results of research in the form of an independently prepared dissertation (paper) containing a description and justification of the purpose of the work, the methodology adopted, the results and their significance in comparison with other similar studies, is able to formulate and test hypotheses related to simple research problems	Is able to present the results of analyses of extreme events in the form of a report and critically discuss the obtained results and the methods used.	[SU2] presentation/project/paper/ report [SU4] test/exam - oral or written
[INFMU2_K01] knows the limits of his own knowledge and understands the need for further learning	Understands the need to expand their knowledge in the field of modeling and analysis of extreme events.	[SK2] presentation/project/paper/ report

Subject contents

1. Introduction to the R language.
2. Selected probability distributions with application examples, including modeling of extreme meteorological phenomena. Parameter estimation of distributions, goodness-of-fit analysis using information criteria such as AIC and BIC.
3. Extreme value theory. Modeling extreme events using, among others, the Generalized Extreme Value (GEV) distribution and the Generalized Pareto Distribution (GPD).
4. Modeling multivariate dependencies using copulas, with application examples.
5. Monte Carlo and bootstrap methods in the discussed topics.

Prerequisites and co-requisites

Basic concepts of mathematical analysis and probability theory, as covered in the Computer Science program.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
laboratory - a project developed systematically during classes, along with a presentation	51.0%	40.0%
exam - an exam project, which is an extension of the laboratory project and is presented during the exam	51.0%	60.0%

Recommended reading

Basic literature	1. S. Coles, An Introduction to Statistical Modeling of Extreme Values, Springer 2. C. Czado, Analyzing Dependent Data with Vine Copula. A practical Guide With R, Springer 3. R. Rigby, M. Stasinopoulos, G. Heller, F. De Bastiani, Distributions for Modelling Location, Scale and Shape: Using GAMLSS in R, Chapman and Hall/CRC, 2029 4. Materials from the website: https://cran.r-project.org/ (Manuals, Contributed, Packages)
Supplementary literature	1. C. Boehmke. Data Wrangling with R, Springer 2. H. Wickham, ggplot2. Elegant Graphics for Data Analysis, Springer 3. M. L. Delignette-Muller, C. Dutang, fitdistrplus: An R Package for Fitting Distributions, Journal of Statistical Software 2015, Volume 64, Issue 4. http://www.jstatsoft.org/ 4. E.C. Brechmann, U.Schepsmeier, Modeling Dependence with C- and D-Vine Copulas: The R Package CDVine, ournal of Statistical Software January 2013, Volume 52, Issue 3. http:// www.jstatsoft.org/
eResources addresses	

Example issues/ example questions/ tasks being completed

1. Compare the 20-year and 50-year return levels (levels exceeded once every such number of years) estimated using the block maxima method and the peaks-over-threshold method.
2. Examine whether there is a dependence between extreme wind speeds and temperatures using appropriate copulas and extreme dependence measures.
3. Using copula regression, analyze changes in the 20-year and 50-year return levels for wind speed depending on temperature variations.

Work placement

Not applicable

Document generated electronically. Does not require a seal or signature.