University of Gdańsk

Subject card

Subject name and code	Extreme Event Modeling in R, PG_00123541		
Field of study	Informatics		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2025/2026
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	
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.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[INFMU2_K01] knows the limits of his own knowledge and understands the need for further learning	Understands the importance of expanding their knowledge in the field of extreme event modeling, for example by reading specialized literature.	[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 present the results of conducted analyses on extreme events in meteorology in the form of a report, as well as critically discuss the obtained results and the applied methods.	[SU2] 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.

<table>
<tr><td>Assessment methods and criteria</td><td colspan="2"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>exam - an exam project, which is an extension of the laboratory project and is presented during the exam</td><td>51.0%</td><td>60.0%</td></tr>
<tr><td>laboratory - a project developed systematically during classes, along with a presentation</td><td>51.0%</td><td>40.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>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)</td></tr>
<tr><td>Supplementary literature</td><td>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.</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">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.</td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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