GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Risk management in insecure enviroment , PG_00025524		
Field of study	Mathematics		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2026/2027
Education level	first-cycle studies	Subject group	Optional subject group Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	3	Language of instruction	Polish
Semester of study	5	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Nonlinear Analysis and Statistics -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. Karol Dziedziul	
	Teachers	dr hab. Karol Dziedziul	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	15.0	15.0	0.0	0.0	45
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	45	6.0	49.0	100

Subject objectives

Presentation of knowledge in the field of risk management methods. Development of analytical skills in the field of risk management.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_W03	A student has in-depth knowledge used in the risk management process. A student has in-depth knowledge of the methods and tools used in the risk management process.	[SW3] Assessment of knowledge contained in written work and projects
K6_U10	The student is able to program in SAS and in the R language.	[SU1] Assessment of task fulfilment
K6_U05	A student knows the theory of copulas. A student can apply Sklar's theorem. A student understands the Strong Law of Large Numbers. A student knows and applies the Monte Carlo method.	[SU1] Assessment of task fulfilment [SU5] Assessment of ability to present the results of task

Subject contents

Course content – lecture

Topics include: coherent risk measures; EU regulatory risk measures; Sklars theorem; Archimedean copulas; the multivariate normal distribution; Cholesky decomposition; capital allocation; sensitivity analysis; bootstrap methods; and data generation from multivariate distributions, including the multivariate normal case as well as constructions with prescribed marginal distributions and a specified copula.

Course content – exercises

During the tutorials, we revisit fundamental concepts of probability theory. Students understanding of newly introduced material is continuously assessed through oral questions and short quizzes. A clearly specified list of questions is provided and discussed in advance. Subsequently, students present their projects, developing both conceptual precision and the use of professional terminology. The project focuses on constructing a multivariate distribution for lines of business. The relevant methods are introduced in the lectures and laboratory sessions, together with practical implementation using either SAS or R (students choice).

Course content – laboratory

During the laboratory sessions, we begin with applications of the strong law of large numbers to numerical integration (Monte Carlo methods). We then proceed to techniques for constructing multivariate distributions for lines of business, initially using real-world datasets. In subsequent sessions, students work with their own datasets, learning how to select appropriate marginal distributions, how to construct the joint distribution, and ultimately how to choose an optimal modelunderstood here as one that minimizes the required reserves. This constitutes the core component of the laboratory work. The remaining part of the course is devoted to limit theorems. After being introduced to the theory of domains of attraction, students are tasked with determining, for a given distribution, the domain of attraction of its maximum.

Prerequisites and co-requisites

the probability theory and an introduction to statistics

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
grade for exercises	60.0%	33.3%
lab evaluation	60.0%	33.3%
assessment of knowledge of the subject basics (24 questions)	60.0%	33.4%

Recommended reading

Basic literature

- Hans Föllmer, Alexander Schied, **Stochastic Finance**, An Introduction in DiscreteTime, 2nd Revised and Extended Edition, de Gruyter, Berlin, New York, 2004.
- A. McNeil, R. Frey, P. Embrechtes, **Quantitive Risk Management** , Princeton University Press, 2005.

Supplementary literature

- Ravindra Khattree, Dayanand N. Naik, **Applied Multivariate Statistics with SAS Software**, John Wiley & Sons, Inc., 2nd edition, 2003.
- R.B. Nelsen, **An introduction to copulas**, Springer, 2006

eResources addresses

Example issues/ example questions/ tasks being completed

Please specify reserves for investment exposure to gold and stock markets.

Practical activites within the subject

Not applicable