University of Gdańsk

Subject card

Subject name and code	Multivariate Analysis, PG_00177482						
Field of study	Informatics and Econometrics						
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 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	1		Language of instruction		Polish		
Semester of study	2		ECTS credits		7.0		
Learning profile	academic		Assessment form		exam		
Conducting unit	Department of Statistics -> Faculty of Management -> Rector						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. Kamila Migdał-Najman				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	15.0	30.0	0.0	0.0	75
	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	75		4.0		96.0	175
Subject objectives	The student understands the essence of the multivariate approach in statistical research and confidently applies the acquired knowledge to solve selected socio-economic problems.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[IiEMU2_U01] The student can creatively and profoundly analyze complex social and economic processes using structured knowledge, econometrics, informatics, or statistics tools.	The student knows and is able to apply selected multivariate analysis methods, such as principal component analysis, factor analysis, cluster analysis, correspondence analysis, canonical analysis, linear ordering methods, as well as techniques for assessing the reliability of measurement tools. The student is capable of selecting appropriate analytical tools to examine complex socio-economic phenomena and interpreting results using specialized software.	[SU1] oral statement/conversation/ discussion [SU2] presentation/project/paper/ report
[IiEMU2_W06] The student possesses a structured understanding of the processes, methods, and tools necessary for the design, creation, development, and provision of suitable conditions for informatics, econometrics or statistics tools.	The student possesses structured, theoretically grounded knowledge of multivariate analysis methods, such as principal component analysis, factor analysis, cluster analysis, correspondence analysis, canonical analysis, and linear ordering methods. The student is also familiar with statistical, econometric, and IT tools that enable the practical application of these methods.	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion [SW2] presentation/project/paper/ report
[IiEMU2_U03] The student is able to obtain and verify data from properly selected sources and to collect, process, and visualize it using modern econometrics, informatics or statistics tools.	The student is able to efficiently acquire, transform, and process multivariate data by preparing it for analysis (including identifying missing data, detecting outliers, and transforming variables), and subsequently apply appropriate methods of multivariate statistical analysis. During the analytical process, the student is capable of using specialized software tools for data processing, result visualization, and drawing conclusions in the context of complex socio-economic phenomena.	[SU2] presentation/project/paper/ report

Subject contents

Introductory topics: The essence of multivariate analysis and a brief historical overview. Scope and classification of multivariate analysis methods. Multivariate observations. Covariance and correlation matrices. **Principal Component Analysis (PCA):** Model and essence of PCA. Hotellings method for extracting components. Stages and interpretation of results. Applications. **Factor Analysis:** Exploratory Factor Analysis (EFA). Confirmatory Factor Analysis (CFA). Dimensionality reduction and identification of latent structures. Factor extraction methods. Factor rotations: orthogonal and oblique. Applications in socio-economic and psychological research. **Linear Ordering Methods:** Essence of linear ordering. Development pattern method (Hellwig): determining variable characteristics, weighting, normalization. Other linear ordering methods with their advantages and limitations. **Cluster Analysis:** Grouping objects based on similarity. Similarity measures and distance matrices. Variable normalization. Agglomerative hierarchical clustering methods. Cluster evaluation. Non-hierarchical clustering methods. Interpretation and profiling of clusters based on statistical characteristics. **Reliability Analysis and Measurement Scales:** Role of measurement scales. Reliability measures. Reliability analysis methods: internal consistency, repeatability, inter-rater reliability, reliability in factor models. **Correspondence Analysis:** Origin and development. Indicator matrix, correspondence matrix, row and column profiles, average profiles. Analysis algorithm and chi-square distance. Singular value decomposition. Graphical presentation and interpretation of results. Concept of total inertia. Multiple correspondence analysis: Burt matrix, contingency tables. Criteria for dimension selection (inertia contribution, elbow criterion, number of features). Quality of representation assessment: reconstruction matrix, maximum likelihood and chi-square statistics. Applications in marketing, social, and economic research. **Canonical Analysis:** Essence of the method, examining dependencies between two sets of variables. Canonical variables, canonical correlations. Measures: canonical coefficients, structural correlations, significance tests. Applications in economics, psychology, and other fields. Multiset Canonical Correlation Analysis (MCCA).

Prerequisites and co-requisites

Students should have a basic understanding of descriptive statistics and mathematical statistics.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Semester project	51.0%	50.0%
Written exam	51.0%	50.0%

Recommended reading	Basic literature	1. Balicki A. (2009), *Multivariate Statistical Analysis and Its Socio-Economic Applications*, University of Gdańsk 2. Jajuga K. (1993), *Multivariate Statistical Analysis*, PWN 3. Migdał-Najman K., Najman K. (2013), *Self-Learning Artificial Neural Networks in Clustering and Data Classification*, University of Gdańsk Publishing 4. Stanimir A. (2005), *Correspondence Analysis as a Tool for Studying Economic Phenomena*, Publishing House of the Wrocław University of Economics 5. Ostasiewicz W. (ed.) (1999), *Statistical Methods of Data Analysis*, Publishing House of the Wrocław University of Economics 6. Migdał-Najman K. (2011), *Assessment of the Quality of Clustering Results A Literature Review*, Statistical Review, vol. 58, no. 3-4, pp. 281-299
	Supplementary literature	1. Gatnar E., Walesiak M. (2004), *Statistical Methods of Multivariate Analysis in Marketing Research*, Publishing House of the Wrocław University of Economics 2. Ostasiewicz W. (ed.) (1999), *Statistical Methods of Data Analysis*, Publishing House of the Wrocław University of Economics 3. Greenacre M.J. (1993) Correspondence Analysis in Practice. Academic Press, London, San Diego New York, Boston, Sydney, Tokyo. 4. Manly B.F.J. (1994) Multivariate Statistical Methods, Chapman & Hall / CRC, Boca Raton 5. Morrison D.M. (1990), *Multivariate Statistical Analysis*, PWN, Warsaw
	eResources addresses	
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	

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