University of Gdańsk

Subject card

Subject name and code	Chemometrics in the court - case study, PG_00211777		
Field of study	Forensic Analytics		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2027/2028
Education level	Bachelor'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	2	Language of instruction	Polish -
Semester of study	3	ECTS credits	3.0
Learning profile	academic	Assessment form	credit
Conducting unit	Faculty of Chemistry -> Rector		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Karolina Jagiełło	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	0.0	0.0	45.0	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	5.0	25.0	75

Subject objectives

1. To familiarize students with the basic chemometric methods used in forensic science.
2. To develop students' ability to understand the principles underlying multidimensional data analysis methods, as well as their assumptions, capabilities, and limitations.
3. To prepare students to critically analyze scientific publications on the application of chemometrics in the examination of evidence.
4. To develop the ability to interpret the results of chemometric analyses in the context of hypotheses regarding the origin, similarity, or classification of evidence.
5. To develop the ability to formulate and defend arguments based on scientific research findings, taking into account the differing perspectives of the prosecution, the defense, and the expert witness.
6. To foster a critical approach to the results of statistical models, particularly with regard to validation, uncertainty, the risk of misclassification, and overinterpretation of results.
7. To prepare students to communicate the results of chemometric analyses to individuals without specialized statistical knowledge.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[AKRL3_U08] The graduate is able to prepare oral and written presentations and reports in Polish and in chosen foreign language, as well as present and evaluate different viewpoints and engage in discussion in those languages.	Student: is familiar with the basic concepts related to chemometrics and multidimensional data analysis; understands the difference between exploratory, classification, and regression methods; is familiar with the general principles underlying principal component analysis, cluster analysis, and selected classification methods; understands the importance of data preparation prior to analysis; is familiar with basic methods for assessing the quality and reliability of models; understands the importance of validation, training and test sets, and the risk of model overfitting; is familiar with examples of chemometrics applications in the analysis of drugs, biological materials, glass, paints, inks, gunshot residues, toxicological data, and fire traces; understands the difference between determining the similarity of samples, classifying a sample, and inferring a common source; is familiar with the basic limitations of using chemometric results as evidence in legal proceedings.	[SU1] oral statement/conversation/ discussion [SU2] presentation/project/paper/ report [SU5] implementation of a problem task
	[AKRL3_K05] The graduate is ready to promote science and raise social awareness in the field of forensic analytics.	Student: identifies the type of research problem addressed by a given chemometric technique; interprets basic graphs and tables presenting the results of multidimensional analyses; interprets the results of PCA, cluster analysis, and classification without having to program these methods independently; identifies the strengths and weaknesses of the analysis described in a scientific publication; assesses whether the method used and the validation procedure are appropriate for the problem at hand; recognizes the risk of overinterpreting results and drawing conclusions not directly supported by the data; compares arguments supporting different interpretations of the results; formulates arguments from the perspective of the prosecution, the defense, or an expert witness; presents specialized findings in a way that is understandable to non-expert audiences; prepares a critical analysis of a publication or a court case.	[SK1] oral statement/conversation/ discussion [SK2] presentation/project/paper/ report

	Course outcome	Subject outcome	Method of verification
	[AKRL3_W03] The graduate knows and understands the structure and chemical properties of compounds relevant in forensic examinations.	Student: is aware of the responsibilities associated with the use of statistical methods in forensic science; recognizes the need for an unbiased interpretation of results; understands that the absence of a clear-cut result also constitutes important information; is prepared to participate in a substantive discussion and defend their position while taking into account the arguments of the opposing side; critically evaluates the reliability of scientific information; adheres to the principles of ethical communication regarding the uncertainty and limitations of results.	[SW1] oral statement/ conversation/discussion [SW5] implementation of a problem task

Subject contents	Introduction to chemometrics and its applications in forensic science. Types of analytical data and the fundamentals of their preparation, visualization, and quality assessment, including normalization, standardization, and identification of outliers. Basic methods of multidimensional analysis: similarity measures, principal component analysis, hierarchical cluster analysis, classification, and variable selection. Interpretation of results, model quality assessment, validation, and identification of overfitting and misclassification risks. Application of chemometrics in the analysis of spectroscopic, chromatographic, toxicological, elemental, and imaging data, including in the analysis of drugs, glass, paints, inks, and fire and gunshot residues. Critical analysis of scientific publications and assessment of the reliability of conclusions. Interpretation of results in a legal context, taking into account uncertainties, competing hypotheses, and methodological limitations. Communicating results during panel discussions and mock trials from the perspectives of an expert witness, the prosecution, and the defense.
Prerequisites and co-requisites	Basics in Mathematics

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Participation in scientific discution	51.0%	50.0%
	Project	51.0%	50.0%

Recommended reading		
	Basic literature	Scientific papers and materials prepared by the teacher
	Supplementary literature	NA
	eResources addresses	

Example issues/ example questions/ tasks being completed	Interpretation of PCA, HCA, and classification results; evaluation of model validation accuracy; critical analysis of scientific publications; identification of limitations and sources of error; preparation of prosecution and defense arguments, as well as expert opinions, based on the results of chemometric analyses; participation in discussion panels and mock trials
Work placement	Not applicable

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