

## Subject card

|                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                          |                                         |                                     |                                                                                                                                                |            |     |
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| Subject name and code                       | Text and Social Network Mining, PG_00177507                                                                                                                                                                                                                                                                                                                                                                                             |                                                          |                                         |                                     |                                                                                                                                                |            |     |
| Field of study                              | Informatics and Econometrics                                                                                                                                                                                                                                                                                                                                                                                                            |                                                          |                                         |                                     |                                                                                                                                                |            |     |
| Date of commencement of studies             | October 2025                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                          | Academic year of realisation of subject |                                     | 2026/2027                                                                                                                                      |            |     |
| Education level                             | Master's studies                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                          | Subject group                           |                                     | Obligatory subject group in the field of study<br>Optional subject group<br>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                               | 2                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                          | Language of instruction                 |                                     | Polish                                                                                                                                         |            |     |
| Semester of study                           | 3                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                          | ECTS credits                            |                                     | 5.0                                                                                                                                            |            |     |
| 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. Krzysztof Najman                |                                     |                                                                                                                                                |            |     |
|                                             | 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                                                       |                                         | 4.0                                 |                                                                                                                                                | 61.0       | 125 |
| Subject objectives                          | Familiarizing students with theoretical and practical aspects of text data mining.<br>Familiarizing students with the process of text mining analysis, searching unstructured documents and practical applications of text mining.<br>Familiarizing students with theoretical and practical aspects of building and analyzing social networks as structures describing relationships between entities (people, organizations, objects). |                                                          |                                         |                                     |                                                                                                                                                |            |     |

| Learning outcomes | Course outcome                                                                                                                                                                                                                                        | Subject outcome                                                                                                                               | Method of verification                                                       |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
|                   | [liEMU2_U06] Students can utilize structured and detailed knowledge of management, quality sciences, economics, and finance to address dilemmas and develop innovative solutions for complex or unusual problems that arise in professional settings. | The student builds and applies selected models of Text Mining and social network analysis in practice.                                        | [SU2] presentation/project/paper/report                                      |
|                   | [liEMU2_W08] The student possesses a comprehensive understanding of the methods, conditions, directions, and dilemmas involved in applying advanced econometrics, informatics or statistics tools in response to dynamic environmental changes.       | The student knows the theoretical foundations of Text Mining analysis and social network analysis.                                            | [SW4] test/exam - oral or written<br>[SW2] presentation/project/paper/report |
|                   | [liEMU2_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 knows the principles of construction, verification and evaluation of selected methods of Text Mining and social network analysis. | [SW4] test/exam - oral or written<br>[SW2] presentation/project/paper/report |
|                   | [liEMU2_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 can collect, record, verify, and evaluate data necessary for Text Mining and social network analysis.                             | [SU2] presentation/project/paper/report                                      |

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| Subject contents                | <p><b>Definition, essence, purpose, scope and benefits of using text mining</b> (text data mining).</p> <p><b>Areas and examples of text mining applications.</b></p> <p><b>Text mining analysis process.</b> Defining the purpose, scope and costs of analysis, determining sources of unstructured data, transforming source documents into a text file. Lexical process - marking parts of speech. Extraction of expression roots (stemming) automatic finding of roots or word stems, assigning words to their base form. Parsing - excluding words with low information value. Tagging - selection of morphosyntactic description. Lemmatization - identification of lexemes. Construction of stop lists, removal of irrelevant words (tags). Pruning - removal of unnecessary words: an approach based on removing expressions that occur most frequently (most frequent) and least frequently (least frequent). Construction of a frequency matrix of words in a document, text filtering and extraction of facts (document-expression matrix, term-document matrix). Representation of text documents, vector space model (VSM) and graph representation: standard, simple, n-distance, simple n-distance, absolute frequency, relative frequency.</p> <p><b>Searching unstructured documents:</b> full text search FTS (Full Text Searching). Term-by-document frequency matrix. Weighting words. Methods for determining the number of occurrences of a given expression in a set of documents (collections).</p> <p><b>Topic modeling of text documents.</b> Introduction to probabilistic models: Latent Semantic Analysis (LSA), Probabilistic Latent Semantic Analysis (PLSA), and Latent Dirichlet Allocation (LDA). Interpreting topics as distributions of words and documents as distributions of topics.</p> <p><b>Determining the emotional nature of statements</b> (sentiment analysis). Lexicon-based and statistical-based approaches: learning classification models (e.g. Naive Bayes Classifier) from labeled data sets. Sentiment assessment on various types of text representations.</p> <p><b>Definition, essence and characteristics of social networks</b> as structures describing relationships between entities (persons, organizations, objects). Network components: nodes (actors) and edges (relations). Examples of applications of social networks in social, information and business contexts. The importance of networks in the analysis of social structures, information flow, group dynamics and social influence.</p> <p><b>Basic concepts graph theory:</b> directed and undirected graph, weighted graph, graph connectivity, path, cycle. Converting relational data to network format. Representation of relations in a graph using: a simple list of relations (linked list), a weighted list of relations (edge list), an adjacency matrix (adjacency matrix), an incident matrix (incidence matrix). Principles of constructing graphs from text data.</p> <p><b>Techniques for presenting network structure</b> using graphical tools. Aesthetics and readability of visualizations: application of different layouts, coloring, scaling of nodes and edges. Interpretation of visualizations as a tool supporting analysis of results and extraction of conclusions.</p> <p><b>Identification and interpretation of the position of actors</b> (nodes) in the structure of a social network. Centrality measures: degree centrality, betweenness centrality, closeness centrality and eigenvector centrality. Application of centrality indicators to detect influential users and assess their importance in the context of the flow of information, opinions and resources in the network. Analysis of the role of actors in the network.</p> <p><b>Study of topological properties of networks:</b> connectivity, density, average path length, average degree of vertices. Using metrics to assess network structure, analyze atypical areas and nodes critical to its integrity. Assess network resilience to disruptions and assess its effectiveness in the context of information propagation.</p> <p><b>Analysis of node groups.</b> Extraction of key structures such as the largest components, cliques and n-cliques. Review of community detection methods, including Girvan-Newman, Louvain algorithms and modularity methods. Application of community detection techniques to user segmentation and identification of cohesive groups in social networks.</p> <p><b>Use of Markov models to predict message coverage,</b> identify potential paths of message propagation in the network, detect anomalies and predict further user behavior in the network. Simulation of information propagation using a random graph walk.</p> |                   |                               |
| Prerequisites and co-requisites | Fundamentals of linear algebra, statistics, and multivariate statistical analysis.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                   |                               |
| Assessment methods and criteria | Subject passing criteria                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Passing threshold | Percentage of the final grade |
|                                 | semester project                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 51.0%             | 60.0%                         |
|                                 | written exam                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 51.0%             | 40.0%                         |

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|----------------------------------------------------------------|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Recommended reading                                            | Basic literature         | <p>Feldman R., Sanger J., 2006, Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data, Cambridge University Press New York</p> <p>Berry M.W., Kogan J., 2010, Text Mining, Applications and Theory, A John Wiley and Sons, Ltd.</p> <p>Solka J. L., 2008, Text Data Mining: Theory and Methods, Statistic Survey</p> <p>Majkowska, A., Migdał-Najman, K., Najman, K., i Raca, K. 2021. Identification of the words most frequently used by different generations of twitter users. Data analysis and classification: methods and applications, Springer, 2747.</p> <p>R. A. Hanneman, M. Riddle, Introduction to social network methods. Riverside, CA: University of California, Riverside, 2005.</p> <p>P.J. Carrington, J. Scott, S. Wasserman (eds.), Models and Methods in Social Network Analysis. Cambridge University Press, 2005.</p> <p>M. Kamola, P. Arabas, Sieci społeczne i technologiczne. Jak zrozumieć, jak wykorzystać, wyd. PWN, 2018</p> <p>M. A. Russell, M. Klassen, Data mining. Eksploracja danych w sieciach społecznościowych, wyd. Helion, 2019</p> |
|                                                                | Supplementary literature | P.Lula, Statystyczne modelowanie zawartości dokumentów tekstowych, WUEK, 2018.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                                                                | eResources addresses     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
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| Example issues/<br>example questions/<br>tasks being completed |                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Work placement                                                 | Not applicable           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

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