COURSE DESCRIPTION CARD - SYLLABUS

Course name
Mathematical Analysis [S1DSwB1>AM]

Course

Field of study
Data Science in Business

Year/Semester
1/1

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
0

Laboratory classes
0

Other
0

Tutorials
60

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

Basic mathematical knowledge at the high school level.

Course objective

The aim of the course is to introduce students to the fundamental concepts and methods of mathematical analysis. The course is designed to develop skills in working with matrices, systems of linear equations, and functions of one and multiple variables. Students will learn to compute derivatives, apply integration methods, and analyze the convergence of sequences and series. Additionally, the course will cover partial derivatives and the optimization of multivariable functions, which are essential for data analysis and mathematical modeling.

Course-related learning outcomes

Knowledge:
1. Defines basic concepts of mathematical analysis, such as limit, continuity, derivative, integral, and

their applications in applied mathematics and data analysis [DSB1_W01].
2. Explains the principles of matrix calculus and methods for solving systems of linear equations in the context of data analysis [DSB1_W02].
3. Characterizes the concepts of numerical series, Taylor and Maclaurin expansions, and describes their significance in mathematical modeling [DSB1_W03].

Skills:
1. Applies matrix calculus methods to solve systems of linear equations and interpret them in data analysis [DSB1_U02].
2. Computes derivatives of functions of one or several variables and applies them to analyze the properties of functions and optimization [DSB1_U03].
3. Uses L'Hopital's rule to investigate the limits of functions and series [DSB1_U05].
4. Computes definite and improper integrals and interprets their geometric and analytical significance [DSB1_U08].
5. Applies partial derivatives and optimization methods to analyze functions of multiple variables in mathematical and business problems [DSB1_U09].

Social competences:
1. Conducts a critical analysis of mathematical computation results and assesses their correctness and significance in the context of data analysis [DSB1_K01].
2. Utilizes scientific literature and consults with experts in applied mathematics and data analysis [DSB1_K02].
3. Ensures the precision and reliability of mathematical calculations, adhering to the principles of academic and professional ethics [DSB1_K05].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Two midterm exams, each graded on a 50-point scale. The final grade is determined by the total score from both exams. The first exam takes place in the middle of the course, while the second one is held at the end. The passing threshold is 50 points in total from both exams.

Programme content

The course covers fundamental topics in mathematical analysis, with a particular focus on concepts and methods used in applied mathematics and data analysis. Matrix calculus will be discussed, and students will become familiar with basic methods for solving systems of linear equations.
For real functions of a single variable, their fundamental properties will be examined. The course also includes the theory of numerical sequences and series. Students will learn the concept of a function derivative and methods for its computation. L’Hôpital’s rule, as well as Taylor and Maclaurin series expansions, will be introduced.
Integration methods will also be covered, including the geometric interpretation of definite integrals and improper integrals. In the context of multivariable functions, students will explore the concept of first-order and higher-order partial derivatives and their applications in function analysis and optimization.

Course topics

The concept of a matrix, types of matrices.
Basic matrix operations.
Determinant of a matrix.
Inverse matrix.
Systems of linear equations and basic methods for solving them.
The concept of a function, function domain, argument, and function value; function equality.
Overview of elementary functions.
Monotonicity of functions.
Even and odd functions.
Limits of numerical sequences, convergent and divergent sequences.
The squeeze theorem.
Numerical series. Sum of a numerical series.

Convergence and absolute convergence of a series.
Convergence criteria.
Limit and continuity of a real function of a single variable.
First-order and higher-order derivatives of a function of a single variable.
Methods for computing derivatives.
L'Hôpital's rule.
Applications of derivatives in function analysis.
Power series (Taylor series, Maclaurin series).
Antiderivative and indefinite integral.
Basic integration methods.
The concept and geometric interpretation of the definite integral.
Improper integral.
The concept of a multivariable function.
First-order and higher-order partial derivatives.
Applications of partial derivatives in the analysis of multivariable functions.

Teaching methods

Written exercises. Analysis of teaching materials provided to students. Group work.

Bibliography

Basic:
Krysicki Włodzimierz, Włodarski Lech: Analiza matematyczna w zadaniach, cz. 1 i 2. PWN,Warszawa 2012.

Additional:
Gewert, M., & Skoczylas, Z. (2021). Analiza matematyczna 1: przykłady i zadania. Wydawnictwo Naukowe PWN.

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	60	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	65	2,50