SLOVAK UNIVERSITY OF TECHNOLOGY IN BRATISLAVA

FACULTY OF CHEMICAL AND FOOD TECHNOLOGY

INSTITUTE OF INFORMATION ENGINEERING, AUTOMATION,
AND MATHEMATICS

DEPARTMENT OF MATHEMATICS

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ANNUAL REPORT

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Address:

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From left: M. Gall, A. Maťašovský, P. Jánoš, I. Hrivová, M. Baumgartner, T. Visnyai, M. Langerová, S. Pavlíková, Ľ. Horanská, Z. Takáč, P. Viceník, N. Krivoňáková

Contents

1 Preface

The Department of Mathematics at our Faculty has a rich history dating back to the establishment of the Slovak University of Technology in Bratislava. Since its constitution, the department has been responsible for teaching mathematics across all study programs offered at the faculty. In addition to fundamental courses such as Mathematics I and II for first-year students, the department also teaches specialized subjects, including Mathematical Statistics, Numerical Methods, Fuzzy Systems, and other applied mathematics courses for undergraduate students in specific fields. Recently, the department has also been actively addressing gaps between the level of knowledge required for university studies and the preparedness of students coming from high schools. Furthermore, the department actively participates in postgraduate and doctoral education across all fields of study.

The department's teaching and research activities focus on a broad spectrum of topics in mathematics and its applications. In recent years, special attention has been given to integrating new trends such as data science, numerical modeling, and machine learning into the curriculum and research. The department's aim is to prepare graduates for successful careers in academia, industry, or entrepreneurial ventures, equipping them with the necessary skills to thrive in a competitive and technology-driven environment.

Since of May 2023, the department is lead by Ľ. Horanská together with the deputy N. Krivoňáková.

doc. Mgr. Ľubomíra Horanská, PhD.

2   Introduction

This report summarizes the teaching and research activities at the Department of Mathematics at the Faculty of Chemical and Food Technology at the Slovak University of Technology in Bratislava during the period January 1st – December 31st of 2024.

Department of Mathematics of the Faculty of Food and Chemical Technology (FCFT), Slovak University of Technology in Bratislava was officially founded in 1964. Originally, a unified Department of Mathematics was part of the Faculty of Electrical Engineering until 1960, led by Prof. RNDr. Štefan Schwarz, DrSc. This unified department included working groups responsible for teaching mathematics at various faculties of the university. These groups later served as a foundation for establishing separate departments of mathematics across the faculties. The first head of the department was doc. Dorota Krajňáková in 1964 – 1985. Prof. Vladimír Kvasnička, DrSc. headed the department in 1985 – 2006. The head in 2006 – 2010 was doc. Štefan Varga, CSc. Doc. Vladimír Baláž, CSc. was head of the department in 2010 – 2016 and doc. Zdenko Takáč, PhD was head of department in 2016 – 2023. Current head of the department is doc. Ľubomíra Horanská, PhD.

Since 2005, Department of Information Engineering and Process Control and Department of Mathematics have formed Institute of Information Engineering, Automation, and Mathematics currently headed by prof. Miroslav Fikar, DrSc.

Department of Mathematics is one of the 24 departments at the FCFT STU, and it provides mathematical education for all fields and degrees of study, while also offering its mathematical skills to colleagues from other departments for applications in different areas of research.

3 Staff

3.1 Head of Department

Head of Department

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4 Educational Activities

4.1 Bachelor Study

1st semester (Winter)

Fundamentals of Mathematics I	2/4/0	Baumgartner, Jánoš, Krivoňáková, Maťašovský
Fundamentals of Matlab	0/0/2	Baumgartner
Mathematics I	4/4/0	Gall, Horanská, Hrivová, Jánoš, Langerová, Maťašovský, Pavlíková, Viceník, Visnyai
Seminar of Mathematics	0/2/0	Baumgartner, Gall, Horanská, Hrivová, Jánoš, Langerová, Maťašovský, Visnyai

2nd semester (Summer)

Applied Statistics	1/0/1	Takáč
Informatics	0/0/2	Baumgartner, Gall, Jánoš
Informatics I	0/0/2	Baumgartner, Gall
Mathematics II	2/3/0	Baláž, Gall, Horanská, Jasem, Krivoňáková, Langerová, Maťašovský, Pavlíková, Viceník, Visnyai
Seminar of Mathematics II	0/2/0	Baláž, Horanská, Jasem, Krivoňáková, Maťašovský, Viceník, Visnyai
Fundamentals of Mathematics II	2/4/0	Jánoš, Krivoňáková, Maťašovský

3rd semester (Winter)

Applications of differential equations	1/1/0	Langerová
Numerical Mathematics	1/0/1	Horanská
Statistics	2/0/2	Krivoňáková

4.2 Master Study

1st semester (Winter)

Numerical Methods in MATLAB	0/2/0	Horanská
Selected Topics in Mathematics	0/2/0	Pavlíková

3rd semester (Winter)

Advanced Concepts in Machine Learning	0/3/0	Gall
Fundamentals of Fuzzy Systems	2/1/0	Takáč
Statistic and Optimization Methods	1/2/0	Krivoňáková

4.3 PhD Study

1st year

Mathematical Statistics	5/0/0	Takáč
Mathematical Statistics	2/0/0	Krivoňáková
Mathematical Methods in Environmental Engineering	5/0/0	Takáč
Modern Optimization Methods	2/0/0	Viceník
Theory of Fuzzy Systems	2/0/0	Takáč

4.4 Course Contents

4.4.1 Lectures in Bachelor Study

Fundamentals of Mathematics I (2h/week, 1ˢᵗ semester) In this course students improve the foundations of secondary school mathematics and acquire new knowledge of mathematics to the extent necessary for the study of other bachelor study subjects. The course is focused on the following concepts: set of numbers, sets and logic; expressions and fractions; equations; inequations; systems of equations and inequations and functions.

Mathematics I (4h/week, 1ˢᵗ semester) The course is divided into four main parts. The first one is devoted to selected topics in algebra. The second part deals with real functions of one variable. The third part is devoted to the differential calculus of univariate functions. The final part deals with the integral calculus of univariate functions.

Fundamentals of Mathematics II (2h/week, 2ⁿᵈ semester) This course follows on from the Fundamentals of Mathematics I course and focuses on the following concepts: exponential and logarithmic functions; goniometric functions; complex numbers; analytic geometry in the plane (straight line, circle, parabola, hyperbola, ellipse) and sequences of numbers.

Mathematics II (2h/week, 2ⁿᵈ semester) The course is focused on basic knowledge in differential and integral calculus of real functions of several variables; ordinary differential equations, in particular, linear differential equations of the first and second order with constant coefficients and their applications in physics and chemistry; double integrals and their applications; line integrals; conservative vector fields; Green's theorem.

Applied Statistics (1h/week, 2ⁿᵈ semester) The course is divided into three main parts. The first one is devoted to an introduction to probability and statistics with emphasis on the probability distribution of a random variable, density and distribution function. The second part deals with statistical analyzes of one-dimensional data, especially interval estimates of parameters and testing of hypotheses. In the last part, statistical analyzes of multidimensional data such as correlation analysis, regression models, ANOVA or time series analysis are studied.

Applications of differential equations (1h/week, 3ʳᵈ semester) The course focuses on mathematical modeling of dynamic processes based on differential equations. Analytical and numerical methods of solving differential equations and their systems and applications of differential equations in chemistry, physics, economics and other areas are studied.

Numerical Mathematics (1h/week, 3ʳᵈ semester) The course deals with basic numerical methods for solving engineering problems and focuses on the creating of MATLAB codes for those methods. Basics of MATLAB; Numerical solution of systems of linear equations; Numerical solution of nonlinear equations; Langrange and Newton interpolating polynomials; Spline interpolation; Numerical integration; Numerical solution of differential equations; Numerical solution of partial differential equations.

Statistics (2h/week, 3ʳᵈ semester) The course is divided into three main parts. The first one is devoted to an introduction to probability and statistics with emphasis on the probability distribution of a random variable, density and distribution function. The second part deals with statistical analyzes of one-dimensional data, especially interval estimates of parameters and testing of hypotheses. In the last part, statistical analyzes of multidimensional data such as correlation analysis, regression models, ANOVA or time series analysis are studied.

4.4.2 Laboratory Exercises in Bachelor Study

The curriculum of exercises follows the topics of lectures of this course.

Fundamentals of Mathematics I (4h/week, 1ˢᵗ semester) The curriculum of exercises follows the topics of lectures of this course.

Mathematics I (4h/week, 1ˢᵗ semester) The curriculum of exercises follows the topics of lectures of this course.

Seminar of Mathematics (2h/week, 1ˢᵗ semester) The course focuses on basic concepts of mathematics such as real numbers, complex numbers, special formulas, equations and inequations, functions and their graphs, sequences, combinatory, analytic geometry in the plane, conic sections.

Fundamentals of Mathematics II (4h/week, 2ⁿᵈ semester) The curriculum of exercises follows the topics of lectures of this course.

Mathematics II (3h/week, 2ⁿᵈ semester) The curriculum of exercises follows the topics of lectures of this course.

Applied Statistics (1h/week, 2ⁿᵈ semester) The curriculum of exercises follows the topics of lectures of this course.

Informatics (2h/week, 2ⁿᵈ semester) The course is divided into 4 main parts. The first is devoted to working with a spreadsheet in the Excel environment, the organization of the address space, mathematical and statistical functions, structured constructions, methods of data analysis, graphs, matrices, solving equations, solver. The second part deals with the graphical representation of chemical structures and laboratory equipment, which takes place in the ChemSketch program. The third part deals mainly with working with a text editor in Word formatting and styles, chemical and mathematical texts, spreadsheets, advanced functions and writing academic documents. In the last part, the graphic and presentation software PowerPoint and the correct technique and practice of presentations are taken over.

Informatics I (2h/week, 2ⁿᵈ semester) Computer architecture. Layered architecture and structure of folders. Functionality and architecture of laboratory management information systems. Spreadsheet MS Excel. Address space organization of MS Excel, mathematical

and statistical functions. Structured constructions, data analysis methods, charts, matrices and equation solving. Text editor MS Word, formatting and styles. Chemical and mathematical texts, tables. Advanced functions and academic writing. Presentation and visualization, graphical and presentation software.

Seminar of Mathematics II (2h/week, 2nd semester) The seminar is designed to deepen and thoroughly practice the knowledge acquired in the subject Mathematics II, i.e. solving problems on the topics of differential and integral calculus of functions of several variables, differential equations, line and double integral and the application of mathematical methods in chemistry and physics.

Applications of differential equations (1h/week, 3rd semester) The curriculum of exercises follows the topics of lectures of this course.

Numerical Mathematics (1h/week, 3rd semester) The curriculum of exercises follows the topics of lectures of this course.

Statistics (2h/week, 3rd semester) The curriculum of exercises follows the topics of lectures of this course.

4.4.3 Lectures in Master Study

Fundamentals of Fuzzy Systems (2h/week, 3rd semester) The course is divided into three main parts. The first one is devoted to an introduction to the theory of fuzzy sets and fuzzy logic with emphasis on operations and relations between fuzzy sets. The second part deals with fuzzy systems and their application to model situations characterized by the existence of uncertain information. The last part deals with fuzzy controllers, specifically fuzzy PD, fuzzy PI and fuzzy PID controllers, their designs and simulations in the Matlab Simulink.

Statistic and Optimization Methods (1h/week, 3rd semester) The course is divided into three main parts. The first one is devoted to an introduction to probability and statistics with emphasis on the probability distribution of a random variable, density and distribution function. The second part deals with statistical analyzes of one-dimensional data, especially interval estimates of parameters and testing of hypotheses. In the last part, statistical analyzes of multidimensional data such as correlation analysis, regression models, ANOVA or time series analysis are studied.

4.4.4 Laboratory Exercises in Master Study

Numerical Methods in Matlab (2h/week, 1st semester) The course focuses on basic numerical methods and their applications for solving engineering problems. They know how to create a program code for all basic numerical methods in Matlab. Basics of MATLAB; Numerical solution of systems of linear equations; Numerical solution of nonlinear equations; Langrange and Newton interpolating polynomials; Spline interpolation; Numerical integration; Numerical solution of differential equations; Numerical solution of partial differential equations.

Selected Topics in Mathematics (2h/week, 1st semester) The course is divided into three main parts. The first part deals with the basics of solving difference equations. The second deals with the variational calculus and search for extremal functionals. The third part deals with the basics of optimal control.

Advanced Concepts in Machine Learning (3h/week, 3rd semester) The course is roughly divided into three main parts. The first is devoted to repetition and introduction to the theory of machine learning and artificial intelligence with emphasis on the application and implementation component in the Python language environment. The second part deals mainly with neural networks and their application to model various situations in the field of prediction and classification of input data. In the last part, other approaches to machine learning are discussed, such as decision trees, their design and implementation in the Python language environment.

Fundamentals of Fuzzy Systems (1h/week, 3rd semester) The curriculum of exercises follows the topics of lectures of this course.

Statistic and Optimization Methods (2h/week, 3rd semester) The curriculum of exercises follows the topics of lectures of this course.

4.4.5 Lectures in PhD Study

Mathematical Statistics (5h/week)   The subject is divided into three main parts. The first one is devoted to an introduction to probability and statistics with emphasis on the probability distribution of a random variable, density and distribution function. The second part deals with statistical analyzes of one-dimensional data, especially interval estimates of parameters and testing of hypotheses. In the last part, statistical analyzes of multidimensional data such as correlation analysis, regression models, ANOVA or time series analysis are studied.

Modern Optimization Methods (2h/week)   The contents of the subject is divided into three parts. The first part is devoted to linear optimization and is focused on the simplex method and the interior point method. In the second part there are explained several fundamental results and methods of nonlinear optimization. The third part covers an introduction to genetic algorithms and neural networks.

Theory of Fuzzy Systems (2h/week)   The course is divided into three main parts. The first one is devoted to an introduction to the theory of fuzzy sets and fuzzy logic with emphasis on operations and relations between fuzzy sets. The second part deals with fuzzy systems and their application to model situations characterized by the existence of uncertain information. The last part deals with fuzzy controllers, specifically fuzzy PD, fuzzy PI and fuzzy PID controllers, their designs and simulations in the Matlab Simulink.

5 Current Research Activities

Research in the Department of Mathematics focuses on several main areas: uncertainty modeling, discrete mathematics, mathematical analysis and number theory, and didactics of mathematics. In addition, the Department provides its expertise in statistics and neural networks to support research in other departments in various areas.

5.1 Main Research Areas

Uncertainty Modeling (Ľ. Horanská, Z. Takáč, P. Viceník, Z. Ontkovičová)   Research in this area focuses on theory of aggregation operators and fuzzy sets and fuzzy logic. This includes the construction and investigation of properties of non-additive integrals, t-norms and t-conorms. The driving force of this research is applications in areas such as decision making theory, image processing, neural networks, etc.

Didactics of Mathematics (N. Krivoňáková, Ľ. Horanská, P. Jánoš, M. Langerová, A. Maťašovský)   The group's research focuses on implementing modern didactic approaches in teaching to enhance the efficiency and attractiveness of the educational process. It explores the potential of e-learning platforms like LMS Moodle for developing interactive courses and test question databases. The group also conducts research on active learning and personalized education through innovative methods and technologies.

Discrete Mathematics (S. Pavlíková, P. Jánoš, I. Hrivová, M. Baumgartner)   The research focuses on algebraic graph theory, which includes investigation of higly symmetric embeddings of graphs on compact surfaces, coverings of graphs and designs with given properties and determination of their spectra, constructions of extremal graphs of given degree and diameter or girth, and application of graph spectra in chemistry.

Mathematical Analysis (T. Visnyai, V. Baláž, A. Maťašovský, M. Langerová)   The research deals with special types of convergence of sequences of real numbers and elements of Banach spaces (statistical convergence, ideal convergence, matrix summability methods), with convergence according to the ideal containing null-sets for a given density. Further, the generalized continuity of real functions (separately, strongly separately, quasi separately continuity) and solvability of fractional differential equations using fixed point theorems and stability conditions are investigated. Many of the results can be applied in number theory, probabilistic number theory and mathematical analysis.

Applications of Statistics and Neural Networks (M. Gall, N. Krivoňáková, Z. Takáč)   The research is dedicated to advancing both traditional statistical methodologies and modern machine learning techniques for data preprocessing and analysis. It focuses on developing robust statistical tools such as regression models, estimation theory, and dimensionality reduction methods, including Principal Component Analysis (PCA), to extract meaningful insights from complex datasets across diverse domains and it leverages neural networks (NN) and other machine learning algorithms as versatile tools for classification and regression tasks.

5.2   Research Projects

5.2.1   Projects at the Department

The Department is co-leading the project Hybrid learning in engineering education in cooperation with Institute of Control and Informatization of Production Processes, Faculty of Mining, Ecology, Process Control and Geotechnologies,Technical University in Košice.

KEGA 006TUKE-4/2024 (Hybrid learning in engineering education)

(Ľ. Horanská, M. Fikar, N. Krivoňáková, P. Jánoš, M. Langerová, A. Maťašovský)

Period: 2024 – 2026

This project is focused on complex innovation and modernization of the teaching process in subjects with mathematical content at the two largest technical universities in Slovakia. Among the fundamental innovations that should be mentioned is the automation of the process of self-education of students in the home environment and the change in the approach to the management of "face-to-face" teaching using the SCRUM framework. In addition to modernizing and increasing the attractiveness of the electronic teaching materials (text, multimedia, software, etc.), the "AI-assistant" will be significantly involved in the process in three different roles creating well-todo space for extensive didactic research, including research and recording impacts of implemented innovations.

5.2.2   Other projects

Projects in which department members participate (name in brackets).

VEGA 1/0239/24
Advanced control of energy-intensive chemical-technological processes using learned approximate explicit controllers (2024-27, Ľ. Horanská, P. Viceník)

VEGA 1/0193/22
Design of an identification and monitoring system for production equipment parameters for predictive maintenance needs in accordance with the Industry 4.0 concept using Industrial IoT technologies (2022-24, Z. Takáč)

STU Program for supporting young researchers
Design of network models of the given cycle structure using coverings (2024, P. Jánoš)

VEGA 1/0567/22
Metric problems in graphs (2022 - 2024, P. Jánoš, I. Hrivová)

APVV 19-0308
Exceptional structures in discrete mathematics (2020 - 2024, P. Jánoš, I. Hrivová)

VEGA 2/0062/24
Qualitative properties and oscillations of differential equations and dynamical systems (2024 - 2026, M. Langerová)

VEGA 1/0239/24
Advanced control of energy-intensive chemical-technological processes using learned approximate explicit controllers (2024 - 2026, Ľ. Horanská, P. Viceník)

VAIA 09I04-03-V03-00011

Supporting the development of innovative solutions in the field of decarbonization: Attract - isolate -charge -deploy -make use of phage in wastewater treatment and beyond (TYCHE) (M. Gall, N. Krivoňáková)

APVV-22-0005

Regular maps: constructions and classification (2023 - 2027, S. Pavlíková, I. Hrivová)

VEGA 1/0069/23

Graphs, maps and designs with a high degree of symmetry, (2023 - 2026, S. Pavlíková, I. Hrivová)

APVV-23-0006

Photoswitchable Single Molecule Magnets and Spin Crossover Complexes for the Surface Deposition, (2024 - 2028, M. Gall)

APVV-20-0213

The synergy of approaches in theoretical chemistry, crystallography, spectroscopy, and organic synthesis in addressing the vital challenges of our time (pandemic threats and drug development) (2021 - 2025, M. Gall)

VEGA 1/0175/23

Study of the differences between the electronic structure in a crystal and in an isolated molecule, and their influence on changes in the chemical and physicochemical properties of the ground and excited states (2024 - 2026, M. Gall)

VEGA 1/0260/23

Artificial intelligence, robust MANETs and multi-hop D2D networks integrated into a 6th generation network (2023 - 2025, M. Baumgartner)

6 Cooperations

6.1 International Cooperations

- Faculty of Applied Informatics, Tomas Bata University, Zlín, Czech Republic
- Department of Statistics, Computer Science and Mathematics, Public University of Navarre, Pamplona, Spain
- Center for Computational Science, Federal University of Rio Grande, Rio Grande, Brazil
- Universitat de Lleida Igualada, Barcelona, Catalonia, Spain
- Department of Computing Science, Umeå University, Sweden

6.2 Cooperations in Slovakia

- National Supercomputing Center (NSCC), Bratislava
- Computing Center of the Slovak Academy of Sciences, Bratislava
- Institute of Mathematics, Slovak Academy of Sciences, Bratislava
- Institute of Control and Informatization of Production Processes, Faculty of Mining, Ecology, Process Control and Geotechnologies, Technical University of Košice, Košice
- Institute of Mathematics, Faculty of Science, Pavol Jozef Šafárik University in Košice, Košice
- Faculty of Natural Sciences, Matej Bel University in Banská Bystrica, Banská Bystrica
- Department of Mathematics and Descriptive Geometry,Faculty of Civil Engineering STU in Bratislava, Bratislava
- Department of electronics and multimedia communications, Faculty of Electrical Engineering and Informatics, Technical University of Košice, Košice
- Eurachem Slovakia, Bratislava
- Slovak national accreditation service, Bratislava
- Institute of Measurement Science, Slovak Academy of Sciences, Bratislava

6.3 Membership in International Organizations and Societies

- EUSFLAT (European Society for Fuzzy Logic and Technology)
  (Z. Takáč, Ľ. Horanská, Z. Ontkovičová)

6.4 Membership in Domestic Organizations and Societies

- Union of Slovak Mathematicians and Physicists (Z. Takáč, Ľ. Horanská, S. Pavlíková)
- Slovak Society of Chemical Engineering (M. Gall)
- Eurachem Slovakia (N. Krivoňáková, Z. Takáč)

7 Theses and Dissertations

7.1 PhD's Theses (PhD. Degree)

for state examinations after four years of study (supervisors are written in parentheses)

M. Ferrero Jaurrieta   Multivalued and non-symmetric operators for sequential information processing
(Z. Takáč)

I. Rodríguez Martínez   Modification of information reduction processes in Convolutional Neural Networks
(Z. Takáč)

8 Publications

8.1 Articles in Journals

1. N. Dilna – G. Fekete – M. Langerová – B. Tóth: Ulam–Hyers and Generalized Ulam–Hyers Stability of Fractional Differential Equations with Deviating Arguments. *Mathematics*, 2024. DOI

2. N. Dilna – M. Langerová: Ulam-Hyers and generalized Ulam-Hyers stability of fractional functional integro-differential equations. *IFAC-PapersOnLine*, pp. 280 – 285, 2024. DOI

3. M. Ferrero-Jaurieta – R. Paiva – A. Cruz – B. Bedregal – L. De Miguel – Z. Takáč – C. Lopez-Molina – H. Bustince: Non-symmetric over-time pooling using pseudo-grouping functions for convolutional neural networks. *Engineering Applications of Artificial Intelligence*, 2024. DOI

4. M. Ferrero-Jaurieta – R. Paiva – A. Cruz – B. Bedregal – X. Zhang – Z. Takáč – C. Lopez-Molina – H. Bustince: Reduction of complexity using generators of pseudo-overlap and pseudo-grouping functions. *Fuzzy Sets and Systems*, 2024. DOI

5. Š. Gyurki – R. Jajcay – P. Jánoš – J. Širáň – Y. Wang: Using bi-coset graphs to construct small regular and biregular graphs. *Discrete Mathematics*, 2024. DOI

6. W. He – R. Rodríguez – Z. Takáč – L. Martínez: Ranking of Fuzzy Numbers on the Basis of New Fuzzy Distance. *International Journal of Fuzzy Systems*, pp. 17 – 33, 2024. DOI

7. F. Neres – R. H. N. Santiago – A. F. Roldán López de Hierro – A. Cruz – Z. Takáč – J. Fernandez – H. Bustince: The alpha-ordering for a wide class of fuzzy sets of the real line: the particular case of fuzzy numbers. *Computational and Applied Mathematics*, pp. 1 – 30, 2024. DOI

8. Z. Ontkovičová – V. Torra: Computation of Choquet integrals: Analytical approach for continuous functions. *Information Sciences*, pp. 121105, 2024. DOI

9. S. Pavlíková – D. Ševčovič: Qualitative, statistical, and extreme properties of spectral indices of signable pseudo-invertible graphs. *Electronic Journal of Linear Algebra*, pp. 343 – 360, 2024.

10. S. Pavlíková – D. Ševčovič – J. Širáň: Extreme and statistical properties of eigenvalue indices of simple connected graphs. *Discrete Mathematics*, pp. 1 – 11, 2024.

11. I. Rodríguez-Martínez – P. Ursua-Medrano – J. Fernandez – Z. Takáč – H. Bustince: A study on the suitability of different pooling operators for Convolutional Neural Networks in the prediction of COVID-19 through chest x-ray image analysis. *Expert Systems With Applications*, 2024. DOI

12. P. Viceník: Explicit formulas for t-conorms constructed by the sum of ranges of discrete additive generators of t-conorms. *Fuzzy Sets and Systems*, 2024. DOI

8.2 Articles in Conference Proceedings

1. N. Dilna – M. Langerová: Ulam-Hyers and generalized Ulam-Hyers stability of fractional functional integro-differential equations. In *2024 IFAC International Conference on Fractional Differentiation and its Applications*, 2024.

2. M. Gall – L. Bučinský – M. Štekláč – J. Matúška – M. Pitoňák: Neural Networks Prediction of Docking Scores. In *XXIX. International Conference on Coordination and Bioinorganic Chemistry*, pp. 29 – 29, 2024.

3. X. Gonzales - Garcia – J. Nunez Do Rio – Ľ. Horanská – H. Bustince: Generalized Takagi Sugeno Kang fuzzy inference system on intensity-modulated radiotherapy treatment selection. In *Book of Abstracts of The Seventeenth International Conference on Fuzzy Set Theory and Applications*, pp. 22 – 23, 2024.

4. Ľ. Horanská: Mobius transform: History, generalizations and applications in aggregation theory. Editor(s): O. Hutník, In *Uncertainty Modeling 2024*, Pavol Jozef Šafárik University in Košice, pp. 6 – 7, 2024.

5. Ľ. Horanská – R. Mesiar: Constructions of aggregation functions based on generalized Möbius transform. In *Book of Abstracts of The Seventeenth International Conference on Fuzzy Set Theory and Applications*, pp. 27 – 28, 2024.

6. N. Krivoňáková – I. Hrivová: Improving of mathematical education of generation Z. Editor(s): Luis Gómez Chova, Chelo González Martínez, Joanna Lees, In *15th International Conference on Education and New Learning Technologies*, IATED Academy, Valencia, Spain, pp. 5020 – 5026, 2024. DOI

7. N. Krivoňáková – P. Jánoš – M. Nehéz: On size of dominating sets in power-law graphs. Editor(s): Tomáš Madaras, In *Abstracts of the 58th Czech and Slovak Conference on Graph Theory 2003*, pp. 15 – 15, 2024.

8. N. Krivoňáková – A. Maťašovský – P. Jánoš: Experience with innovating the teaching of mathematical subjects. Editor(s): Luis Gómez Chova, Chelo González Martínez, Joanna Lees, In *EDULEARN24 Proceedings -16th International Conference on Education and New Learning Technologies*, IATED Academy, Valencia, Spain, vol. 2024, pp. 7542 – 7547, 2024. DOI

9. Z. Ontkovičová: Differential entropy in the context of fuzzy measures. In *Book of Abstracts of The Seventeenth International Conference on Fuzzy Set Theory and Applications*, pp. 71 – 72, 2024.

10. Z. Ontkovičová – Y. Narukawa – K. Fujimoto – V. Torra: The Past and Future of Fuzzy Measures and Fuzzy Integrals. In *Modeling Decisions for Artificial Intelligence*, Springer Nature Switzerland, pp. 3 – 7, 2024. DOI

11. J. Pócsová – A. Mojžišová – K. Valentová – D. Khistyeva – N. Krivoňáková: Active learning in engineering education. Editor(s): Luis Gómez Chova, Chelo González Martínez, Joanna Lees, In *EDULEARN24 Proceedings -16th International Conference on Education and New Learning Technologies*, IATED Academy, Valencia, Spain, vol. 2024, pp. 9020 – 9028, 2024. DOI

12. I. Rodriguez – L. Horanská – Z. Takáč – F. Herrera – H. Bustince: Fusion function combination through an extension of penalty-based functions for feature reduction in Convolutional Neural Networks. In *Book of Abstracts of The Seventeenth International Conference on Fuzzy Set Theory and Applications*, pp. 64 – 65, 2024.

13. Z. Takáč: Fuzzy Integrals in the Interval-Valued Setting. Editor(s): Andrea Stupňanová, Martin Dyba, Viktor Pavliska, In *Book of Abstracts of The Seventeenth International Conference on Fuzzy Set Theory and Applications*, University of Ostrava, pp. 16 – 17, 2024.

14. T. Visnyai: Convergence of series along the sets from special ideal. In *Matematika, informační technologie a aplikované vědy*, Univerzita obrany, Brno, pp. 27 – 27, 2024.

15. T. Visnyai – A. Maťašovský: Exploring Convergence and Optimization Strategies in Machine Learning Algorithms. In *Workshop on Data-oriented and Economically Efficient Process Control II.*, pp. 15 – 15, 2024.

9 Research Seminars

Fuzzy sets and their applications
The seminar is held every two weeks and is attended by members of the department from the Uncertainty Modeling working group as well as guests from cooperating institutions. The seminar presents the latest research results of the participants. In addition, it also serves as a place to present open problems in this area, or as a place for brainstorming and workshops aimed at solving any problems that have been occurred during the research.

Graph Theory Seminar
The seminar is held regularly every Thursday, and is attended by members of the Discrete Mathematics working group as well as by researchers and PhD students from the field of discrete mathematics from other faculties. New results from graph theory, discrete mathematics and application to various areas of mathematics are presented on it. The seminar is always with international participation. Venue: FMFI UK

Algebraic Graph Theory Seminar
The seminar is specially focused on the algebraic theory of graphs and is attended by members of the Discrete Mathematics working group. New results from algebraic graph theory are presented at this seminar, for example new results from higly symmetric embeddings of graphs on compact surfaces, coverings of graphs and designs with given properties and determination of their spectra, etc. The seminar is always with international participation. Venue: FMFI UK

10 International Visits

10.1 Visits at our Department

Mikel Ferrero – PhD student (Public University of Navarre, Pamplona, Spain), three-month stay

10.2 Visits from our Department

Participation at Conferences

- Jan 28 – Feb 2   Ľ. Horanská, Z. Takáč, Z. Ontkovičová   The 17th International Conference on Fuzzy Set Theory and Applications (FSTA), Liptovský Ján, Slovakia
- May, 24 – 25   Ľ. Horanská   Uncertainty modeling 2024, Košice, Slovakia
- June, 2–7   M. Gall   XXIX. International Conference on Coordination and Bioorganic Chemistry, Smolenice, Slovakia
- July, 15–19   S. Pavlíková   9 th European Congress of Mathematics, Sevilla, Spain
- July, 1–3   N. Krivoňáková   15th International Conference on Education and New Learning Technologies (EDULEARN), Palma de Mallorca, Spain
- July 22 – 26   Z. Takáč, Z. Ontkovičová   20th International Conference on Information Processing and Management of Uncertainty in Knowledge-Based Systems (IPMU), Lisbon, Portugal
- June, 20–21   T. Visnyai   Matematika, informační technologie a aplikované vědy (MITAV), Brno, Czechia

Research Stays

- Feb, 19–23   Ľ. Horanská, Z. Takáč   Public University of Navarre, Pamplona, Spain
- Mar, 2–May, 5   I. Hrivová   University of Ljubljana, Slovenia
- Apr, 8–14   S. Pavlíková   Universitat de Lleida Igualada, Barcelona, Spain
- Jan, 1–Feb, 3   S. Pavlíková   Open University Milton Keynes, United Kingdom
- June, 25–30   S. Pavlíková   Open University Milton Keynes, United Kingdom
- Nov, 11–15   S. Pavlíková   Open University Milton Keynes, United Kingdom

11 Miscellaneous

11.1 Organisation of International Conferences

- WANT-ED: Workshop on Advanced Technologies in Education (May, 13–15) (Ľ. Horanská, N. Krivoňáková, P. Jánoš, M. Langerová, A. Maťašovský, M. Fikar)

11.2 Trainings

- STACK module training in LMS MOODLE, TBU, Zlín, CZ (Jan, 22–23) (A. Maťašovský)
- STACK module training in LMS MOODLE, TUKE, Košice (Oct, 25) (A. Maťašovský)

11.3 Workshops

- Workshop Extraordinary Structures at Discrete Mathematics, Modra - Harmónia (Feb, 8–12) (co-org.: S. Pavlíková, P. Jánoš)
- Workshop Extraordinary Structures at Discrete Mathematics, Modra - Harmónia (Oct, 21–25) (co-org.: S. Pavlíková, P. Jánoš)
- Workshop - Preparation of the Erasmus+ project - Capacity Building in Higher Education (June, 26–27) (Ľ. Horanská, N. Krivoňáková, P. Jánoš, M. Langerová, A. Maťašovský, M. Fikar)
- Workshop - Preparation of the Erasmus+ project - Capacity Building in Higher Education (Dec, 2–4) (Ľ. Horanská, N. Krivoňáková, P. Jánoš, M. Langerová, A. Maťašovský, M. Fikar)

11.4 Awards

- Union of Slovak Mathematicians and Physicists awarded the Academician Schwarz Prize to Zuzana Ontkovičová
- Tomáš Visnyai was awarded as the Teacher of the Year 2024 at FCFT STU

11.5 Other events

- MiniErasmus - lectures for high school's students at FCFT STU (T. Visnyai)