



BOOK OF ABSTRACTS

**21st International Conference on
Operational Research**

September 23-25, 2026, Brela Croatia

Editors: Tea Šestanović & Blanka Škrabić Perić

CRORS

CROATIAN OPERATIONAL
RESEARCH SOCIETY

I m p r e s s u m

BOOK OF ABSTRACTS

21ST INTERNATIONAL CONFERENCE ON
OPERATIONAL RESEARCH KOI 2026

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KOI 2026, September 23-25, Brela, Croatia

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P r e f a c e

Abstracts of plenary lectures and contributed talks, presented at the 21st International Conference on Operational Research KOI 2026, are included in this book. The International Conference on Operational Research (KOI) is the major event organized by the Croatian Operational Research Society (CRORS) since 1991. In the period from 1991 to 1996 it was organized annually while from 1996 onwards, it is organized every two years.

The objective of the KOI conferences is connection of researchers and practitioners from operational research and related scientific disciplines (such as applied mathematics, statistics, quantitative methods in business, simulations, and machine learning) for introducing new operational research achievements in business process improvement. Conference topics include linear and non-linear programming, combinatorial and discrete optimization, multi-objective programming, stochastic models, game theory, statistics, econometrics, information and decision support systems, neural networks and fuzzy systems, data mining, business analytics, control theory simulations, practical OR and applications. The main purpose of the conference is dissemination of new ideas and experiences among researches of common interest, particularly young researchers in order to improve their scientific work.

KOI conferences were successfully held so far in different Croatian cities, such as: Brela, Rab, Rovinj, Trogir, Pula, Split, Šibenik, Zadar, Zagreb and Osijek. The conference KOI 2026, organized by Croatian Operational Research Society in collaboration with Faculty of Economics, Business and Tourism, University of Split, is held in Brela, Croatia, from September 23 to September 25, 2026. The conference KOI 2026 brings together various topics grouped into the following sessions:

Plenary sessions

Plenary lectures are given by eminent international experts:

- Yurii Nesterov, Shenzhen Loop Area Institute, China
- Ivana Ljubic, WU Wien, Institute for Statistics and Mathematics, Vienna, Austria
- Andrej Bregar, Deputy CEO & Lead Researcher, Informatika d.o.o., Slovenia

Special sessions on:

- Advances in convex optimization - Goran and Yurii 70
- Advances in systematic reviews and meta-analyses in management science: Applications of AI tools
- Applied statistics under SDG context
- Empowering digital transformation through OR
- Game theory
- Graph theory and its applications
- Greening the financial sector: financial innovation, climate risks and sustainability reporting
- Modern challenges in the context of global change
- Operational research for high-performing health systems
- Operational research in fiscal sustainability and public policy: Navigating uncertainty and transitions
- Operations research applied to sustainable natural resource management
- Project presentation and networking
- Quantitative modelling of resilience and sustainability in organizations and socio-economic systems

Regular sessions on:

- Applied statistics and econometrics
- Behavioral operational research
- Machine learning and data mining
- Mathematical programming
- Multicriteria decision making
- Optimization in human environment

In addition to 3 plenary lectures there are 106 contributed talks. The total of 130 registered authors and co-authors participate the conference from 20 different countries: Austria, Canada, China, Croatia, Czech Republic, Germany, Hungary, Macedonia, Netherlands, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Turkey, United States (US).

In addition to sessions, the KOI 2026 conference offers a workshop held by Yurii Nesterov and Goran Lešaja titled: “Introduction to interior-point methods”.

The KOI 2026 conferences also includes special methodological workshop for students enrolled in Postgraduate study programmes.

Finally, a special In Memoriam session was held in honour of the late Professor Emeritus Luka Neralić.

The conference has an international Program Committee and is held in English language.

After the conference, the authors can send full papers for possible publication in the Croatian Operational Research Journal - CRORR (indexed in WoS ESCI, SCOPUS and other important scientific databases). Full papers will be blindly reviewed by two independent reviewers and accepted ones will be published.

Editors

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Plenary Speakers

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Education

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Additional info

Research interests are related to complexity issues and efficient methods for solving various optimization problems. The main results are obtained in Convex Optimization (optimal methods for smooth problems, polynomial-time interior-point methods, smoothing technique for structural optimization, complexity theory for second-order methods, optimization methods for huge-scale problems). Author of 6 monographs and more than 150 refereed papers in the leading optimization journals. Several international prizes and recognitions. International member of National Academy of Sciences (USA), member of Academia Europaea and Montenegrin Academia of Sciences and Arts.

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Additional info

Ivana Ljubic is Professor of Operations Research at WU Vienna. Prior to that, she was appointed at ESSEC Business School in Paris (2015-2026) and University of Vienna (2007-2015). She serves as Area Editor for Transportation Science and Associate Editor for Operations Research and Networks. She has also served as Guest Editor for the European Journal of Operational Research and the Annals of Operations Research, and is a former Chair of the INFORMS Telecommunications Section. Her research interests include network design, combinatorial optimization, optimization under uncertainty, and bilevel optimization. Her work focuses on the development of mixed-integer linear and nonlinear optimization methods for applications in telecommunications, transportation, logistics, data and distribution network design, and social networks.

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Additional info

Andrej Bregar, PhD has more than two decades of experience in IT, R&D, and the energy sector. He has worked extensively on decision support systems, multicriteria decision-making, robustness analysis, and cybersecurity in energy-related infrastructures. Andrej Bregar has authored several scientific papers in these fields and regularly participates in international conferences. In his managerial role, he leads complex digitalization, interoperability, and cybersecurity projects, focusing on the integration of advanced IT solutions in the energy industry.

Plenary Lectures

Asymmetric long-step primal-dual interior-point methods with dual centering

YURI NESTEROV

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Abstract | We discuss a new way of development of asymmetric Interior-Point Methods for solving primal-dual problems of Conic Optimization. It is very efficient for problems, where the dual problem is simpler than the primal one. The problems of this type arise often in Semidefinite Optimization (SDO), for which we propose a new primal-dual method with very attractive computational cost.

In this approach, we do not need sophisticated Linear Algebra, restricting ourselves by standard Cholesky factorization. However, our complexity bounds correspond to the best-known polynomial-time results. Moreover, for symmetric cones the bounds automatically depend on the minimal barrier parameter between the primal and the dual feasible sets. We show by SDO-examples that the corresponding gain can be very big. We discuss some classes of SDO-problems, where the complexity bounds are proportional to the square root of the number of linear equality constraints and the computational cost of one iteration is as in Linear Optimization. Our theoretical developments are supported by encouraging numerical testing.

Key words | *asymmetric Interior-Point Methods, primal-dual problems, Semidefinite Optimization*

Modeling fairness through the lenses of ordered and bilevel optimization

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Abstract | Fairness has become an increasingly important consideration in contemporary societies, which are marked by growing economic and social inequalities. Consequently, policymakers and decision-makers are placing greater emphasis on incorporating fairness considerations into their decision-making processes. In this talk, we establish a connection between fairness modeling in optimization problems and bilevel optimization.

We present a unifying and flexible modeling framework based on the principles of ordered optimization that captures a broad class of fairness measures proposed in the literature. These include both linear and nonlinear notions of fairness, such as the range, the Gini index, least absolute deviations, least squares deviations, and several others. Many of these practically relevant fairness measures are inherently non-monotone, which necessitates the imposition of appropriate optimality conditions. This observation naturally leads to a bilevel optimization perspective.

To illustrate the practical implications of the proposed framework, we consider its application to vehicle routing problems, highlighting how bilevel optimization can be leveraged to model and solve fairness-aware optimization problems in real-world settings. This presentation is based on joint work with Justo Puerto and Alberto Torrejon.

Key words | *bilevel optimization, fairness measures, vehicle routing problems*

Advances in group consensus-seeking procedures – from disaggregation analysis to agentic AI

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Abstract | Consensus-seeking and negotiation processes are an important topic in the theory and practice of multi-criteria decision-making. Many approaches have been developed over the past decades. Recently, autonomous AI agents have become increasingly relevant in decision systems and collaborative processes. They rely on machine learning and LLMs (Large Language Models) to facilitate human decision-makers. However, the aggregation-disaggregation analysis was established before the rise of agentic AI as an approach that follows the paradigm of constructive learning to advance classical machine learning. As a regression-based technique, it derives preferential parameters from holistic decisions, provides thorough insight into the multi-criteria model, and enables decision-makers to refine their judgments and knowledge across consecutive iterations. We present the evolution of group consensus-seeking approaches from the aggregation-disaggregation paradigm to contemporary cooperative multi-agent systems. We focus on several approaches we developed to address different preference structures, including outranking, value functions, and hybrid Delphi procedures. Furthermore, we address the necessity of robustness and proximity measures to achieve convergence. Based on the complementary capabilities of both paradigms, we incorporate agents into multi-criteria consensus-seeking processes to automate decision-making, reduce cognitive load, and enhance the elicitation and modelling of preferential information. At the center of such processes, an autonomous multi-agent consensus-seeking protocol applies integrative negotiation, agent collaboration patterns, agent coalition building, dynamic constraints, proximity measures, and aggregation-disaggregation analysis. Agents participate in this protocol to represent decision-makers at multiple organizational levels across all phases of the decision process. We also discuss possible applications of consensus-seeking

procedures, with a special focus on the energy sector and group multi-criteria decision-making methods for cybersecurity. We present a multi-agent protocol that advances a collaborative Delphi methodology for cyberattack mitigation, facilitating proactive and reactive cybersecurity strategies. In the intelligence and design phases, agents leverage LLMs to reason about attack techniques and help develop mitigation strategies. A key aspect of the choice phase is modelling, aggregation, and disaggregation of preferences to achieve convergence of opinions on the most cost-effective strategies. Finally, many issues arise related to automated systems making decisions or judgments based on AI and LLMs, including bias, ethical concerns, user trust, lack of expertise, loss of human oversight, transparency, and reliability. We expose and systematize these factors in the context of agentic decision processes.

Key words | *AI agents, large language models, consensus-seeking, cybersecurity, energy sector*

**Special session on Advances in convex
optimization – Goran and Yurii 70**

TIBOR ILLÉS, MARIANNA E.-NAGY, & PETRA
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On Frankl's union-closed conjecture

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Abstract | A family F of distinct subsets of a finite set X is union-closed (UC) if the union of any two subsets in F belongs to F . Péter Frankl conjectured in 1979 that for any such family there exists an element $x \in X$ that belongs to at least half of its sets. This conjecture is still unsolved. The interest in the conjecture was renewed three years ago when it was shown that a so-called Frankl element exists with a probability of at least 1%. Since then this result has been improved to about 38%. Our approach is non-probabilistic. To start with we modelled the problem as a linear optimization problem with binary variables. Experiments with this model made clear that the conjecture is ‘tight’ only if F consists of all subsets of X ; in all other cases the inequality in the conjecture holds strictly. We present some old and new results related to the conjecture. The older results can all be derived from a deep result of B. Poonen which is based on the classical separating hyperplane theorem for two nonempty disjoint convex sets. The newer results are partly based on evidence provided by our model.

Key words | *union-closed families, conjecture of Frankl, optimization model*

Convex optimization in the era of AI**YINYU YE**

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Abstract | We present recent algorithmic developments in classical Convex Optimization, particularly in Linear Programming and Semidefinite Programming, aided by AI-related techniques such as online-learning, first-order acceleration, the low-rank SDP theorem, and their GPU implementations. We describe how these resulting advances to many other different fields and applications.

Key words | *linear programming, semidefinite programming, online learning, GPU acceleration*

**Kernel to AET functions and vice versa producing same
search directions for the related IPMs**

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Abstract | This paper investigates connections between kernel-based interior-point methods (IPMs) and the Algebraically Equivalent Transformation (AET) technique. We give an explicit construction showing that for a large class of kernel functions, there exists an AET function, and vice versa, for a given AET function, there exists a kernel function such that related IPMs produce the same search directions at each iteration of IPMs. Several illustrative examples of these constructions and relationships are provided.

Key words | *interior-point methods, kernel functions, algebraic equivalence technique, Newton search directions*

**An interior-point method for monotone weighted linear
complementarity problems**

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Abstract | The Weighted Linear Complementarity Problem (WLCP), introduced by Potra, generalizes the classical Linear Complementarity Problem (LCP) by replacing the zero right-hand side of the complementarity equation with a nonnegative weight vector; setting this vector to zero recovers the standard LCP. The WLCP is significant because it provides a unified model for a broad class of equilibrium problems arising in economics, science, and

engineering, including the Fisher market equilibrium and linear and quadratic programming with weighted centering. This talk presents a full-Newton step interior-point method for the monotone WLCP. Because the algorithm takes only full Newton steps along the search directions, it avoids any line search or step-size computation, and it traces a central path whose initial point is feasible by construction. Under a suitable proximity condition, we establish the feasibility of the full steps and prove that the proximity measure decreases quadratically, yielding quadratic convergence to the target points on the central path. The derived iteration bound matches, in order of magnitude, the best known bound for these problems, and reduces to the best known bound for monotone LCP when the vector of weights is zero.

Key words | *Full-Newton step, interior-point method, quadratic convergence, weighted complementarity problem*

The first years of interior point methods

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Abstract | The introduction of polynomial-time interior point methods is one of the most important developments in the last 40 years. Also the idea of approaching the optimal solution of an optimization problem through the interior of the feasible set appeared earlier, and the first polynomial-time algorithm for linear programming was published by Khachian in 1979, intensive development of interior point methods started in 1984 with Karmarkar's seminal paper: „A new polynomial-time algorithm for linear programming“, *Combinatorica* 4 (1984). This talk will address personal contributions of the author which were inspired by Karmarkar's algorithm.

Key words | *Interior point methods, Polynomial-time algorithms*

Mirror descent with barriers

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Abstract | There are two primary ways of analyzing the mirror descent algorithm for smooth optimization: one based on the descent lemma and the other on relative smoothness. However, neither approach can handle the case when the mirror map is a barrier function, due to its blow-up on the boundary — such as the popular log-barrier. In this talk, we will suggest a new way of analyzing the algorithm for when the mirror map is a self-concordant barrier. As a side note, this approach leads to a different interpretation of interior point methods, which is of independent interest.

Key words | *Mirror descent, barrier, interior point methods, self-concordance*

Parabolic target space interior-point algorithms**PETRA RENÁTA RIGÓ**

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Abstract | We present parabolic target space interior-point algorithms for monotone linear complementarity problems that operate in a lifted space and are based on a parabolic barrier function. We investigate two types of search directions, namely the universal tangent direction and the auto-correcting version one. We show that the theoretical complexity of the method coincides with the best known ones for interior-point algorithms. We also discuss possible extensions of these methods to more general problems.

Key words | *interior-point algorithm, parabolic target space, parabolic barrier function, universal tangent direction*

Recovering Nesterov accelerated dynamics from Heavy Ball dynamics via time rescaling

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Abstract | In a real Hilbert space, we consider the global minimization of a smooth and convex function f . Attached to the optimization problem, first we study the asymptotic properties of the trajectories generated by a second-order dynamical system which features a constant viscous friction coefficient and a positive, monotonically increasing function $b(t)$ multiplying ∇f . For a generated solution trajectory $y(t)$, we show small o convergence rates dependent on $b(t)$ for $f(y(t)) - \min f$, and the weak convergence of $y(t)$ towards a global minimizer of f . As a first key point of this talk, we show that for a special choice for $b(t)$, this system is closely connected with the continuous-time counterpart of Nesterov's accelerated gradient, namely, they are time reparametrizations of each other. As the second key point of this talk, we show that this connection extends beyond the optimization setting: the Fast OGDA dynamics introduced by Bot, Csetnek and Nguyen in 2022, which can be seen as an analog of the continuous accelerated gradient dynamics, but for monotone operators, may be recovered from a Heavy Ball-like system.

Key words | *accelerated gradient method, heavy ball with friction, time scaling, monotone equations*

Feasible predictor-corrector IPM for $P_*(\kappa)$ -WLCP via new search directions

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Abstract | As a generalized variant of the classical linear complementarity problem, the weighted linear complementarity problem (WLCP) reformulates the complementarity condition by replacing the zero vector on its right-hand side with a nonnegative weight vector. The importance of such a model lies in its capacity to characterize a wide range of equilibrium problems encountered in economics, engineering, and various scientific fields. In this paper, we develop a feasible predictor-corrector interior-point method for $P_*(\kappa)$ -WLCP that employs novel search directions derived from a specific function. The proposed method adopts full-Newton steps throughout the corrector phase, whereas the step length in the predictor stage is computed via a straightforward scheme that eliminates the need for computationally expensive and complex line search procedures. Under appropriate assumptions, the algorithm is shown to be globally convergent and possesses a polynomial iteration complexity that coincides with the best known bounds for this class of algorithms. Preliminary numerical experiments illustrate the numerical performance and promising efficiency of the presented method.

Key words | *predictor-corrector interior-point method, $P_*(\kappa)$ -weighted linear complementarity problem, new search direction, polynomial complexity*

You've never thrown a ball in your life: What neuroscience teaches agentic AI

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Abstract | In 1958, the perceptron, an early building block of deep learning, was designed to mimic its biological counterpart. In 2026, agentic AI still has much to learn from neuroscience. Indeed, many emerging state-of-the-art practices can, and we argue should, be viewed in the neurological frame. We synthesize recent advances in AI engineering, including agent harnesses, subagents, and the J-space paper, and connect them to human brain architecture: neural circuits, hierarchical processing, critical periods, and a shared embedding space. We argue that framing these two systems in reference to each other is increasingly critical to building robust agentic AI for human use: a connected field of “cognitive systems” studying the similarities, differences, interfaces, and interplay between biological and synthetic intelligence. We ground these themes in high-stakes clinical decision support, detailing a system for solid organ transplantation that combines conventional machine learning models with agentic AI to deliver timely, contextualized information to a decision-maker during allocation.

Key words | *neuroscience, AI agents, brain-computer interfaces, decision systems*

**Special session on Advances in systematic
reviews and meta-analyses in management
science: Applications of AI tools**

VELJKO JEREMIĆ
& MILICA MARIČIĆ

Mapping highly cited researchers in economics and business: A bibliometric and STM approach

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Abstract | Highly cited researchers (HCRs), defined as scholars whose publications rank among the top 1% most cited within their field and year in the Web of Science (Clarivate, 2025) are widely recognized as key contributors to contemporary science. However, the thematic mapping of their scholarly output has received limited attention. This study investigates the intellectual landscape of 79 HCRs in Economics and Business by integrating bibliometric approach with structural topic modelling (STM). Bibliometric analysis is a quantitative approach for examining research productivity, collaboration networks, and citation impact (Glänzel, 2003) and combined with STM, it enables uncovering of thematic structure within a research corpus. A total of 720 Web of Science publications are analyzed to explore publication patterns, collaboration structures, citation dynamics, and dominant research topics. Building on recent advances in science mapping (Schmiedel et al., 2019), this study offers a data-driven examination of the field's intellectual structure, highlighting themes and research directions associated with its most highly cited scholars.

Key words | *highly cited researchers, structural topic modelling, bibliometric analysis*

Nomological network of SEM-based sharing economy communication research: An LLM-assisted review

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Abstract | This paper examines whether large language models (LLMs) can assist systematic literature review, taking SEM-based sharing economy (SE) communication research as its testbed, with two objectives: evaluating LLM screening reliability and mapping the nomological network of the field. We retrieved 182 studies from Web of Science and compared Claude and ChatGPT-4o on an identical task. Despite identical instructions, models disagreed sharply, revealing calibration differences that make them non-interchangeable. Manual

review yielded 115 studies with adequate fit to the defined research topic. Trust dominates the corpus across all construct roles and anchors most mediation models. Constructs such as source credibility and uncertainty reduction, are near-absent, suggesting the field tracks what communication produces rather than how it works. Fewer than one in five papers names the SEM algorithm used, while Trust Theory (37 papers) outpaces Signaling Theory (17 papers), confirming researchers arrive at this literature through trust, not communication. The study offers a methodological warning about LLM interchangeability and a bibliometric mapping of the communication research in the SE.

Key words | *nomological network, LLM-assisted literature review, sharing economy, communication, bibliometric mapping*

Mapping the evolution of fashion sharing research: A structural topic modeling perspective on global and regional knowledge dynamics

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Abstract | Fashion sharing has evolved from a sustainability initiative into a structural component of contemporary fashion systems and a platform-based consumption model. Situated at the intersection of circular economy and digital market transformation, it reflects a broader socio-technical shift in ownership. Despite rapid growth in scholarly output, the structural evolution of the field remains underexamined. This study identifies dominant thematic paradigms and trace their temporal and regional reconfiguration. We conceptualize academic literature as a dynamic knowledge system and analyze 339 peer-reviewed WoS publications using Structural Topic Modeling, with publication year and region specified as prevalence covariates. Findings show a transition from early sustainability legitimization and consumer adoption studies toward platform experimentation and, more recently, infrastructure-oriented recommerce research. Distinct regional trajectories emerge, with North America catalyzing early platform innovation, Europe consolidating sustainability frameworks, and Asia accelerating market operationalization, indicating a sequentially evolving and geographically distributed knowledge domain.

Key words | *Fashion sharing, Structural Topic Modeling, Circular economy, Knowledge mapping*

**Special session on Applied statistics under SDG
context**

HELENA SOFIA RODRIGUES, ÂNGELA SILVA
& JORGE ESPARTEIRO GARCIA

Analytical impact of gender-affirming hormone therapy – a statistical study

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Abstract | Gender-Affirming Hormone Therapy (GAHT) is generally safe, yet studies report analytical alterations: increased hemoglobin, hematocrit, and red blood cell count in transmasculine individuals, and variable changes in creatinine, albumin, and alkaline phosphatase in transfeminine individuals. Portuguese evidence remains scarce, limiting care and reinforcing stigma. This longitudinal retrospective study evaluates the impact of GAHT on the hemogram, renal function, and hepatic panel of adults followed at a Portuguese transgender medicine clinic (October 2021 – January 2025), across the first year of therapy (T0, T3, T6, T12), applying inferential statistics to quantify variations while adjusting for clinical covariates. The work is framed within three UN Sustainable Development Goals: SDG 3, supporting safer prescribing and individualized monitoring; SDG 5, contributing to gender-sensitive reference intervals and reducing cis-normative bias; and SDG 10, addressing the underrepresentation of transgender populations in biomedical research. Integrating statistical rigor with a human rights perspective, this study bridges precision medicine and social justice.

Key words | *Gender Affirming Hormonal Therapy, hemogram, hepatic panel, renal function, inferential statistics*

Measuring Croatia's competitiveness after the discontinuation of GCI reporting

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Abstract | The Global Competitiveness Index (GCI), provided by the World Economic Forum, has been one of the most internationally recognized benchmark for assessing national competitiveness, along with the IMD World Competitiveness Index. However, reporting of the GCI was discontinued after 2019 due to the COVID-19 pandemic, creating a gap in longitudinal competitiveness measurement, despite the accessibility of similar indices such as Global Sustainable Competitiveness Index (GSCI). The objective is to reconstruct national competitiveness index for Croatia, and to test its performance when survey data are omitted. Accordingly, the strengths and limitations of the original GCI methodology are examined and compared with the GSCI approach, focusing on sub-indices, weighting schemes, and aggregation procedures. The validity of the reconstructed index is tested through comparison with official GCI scores available for Croatia up to 2017, and through benchmarking against GSCI for later years.

Key words | *national competitiveness, composite index, Croatia*

Acknowledgement | This research was funded by the European Union - NextGenerationEU within the institutional research project IIP-581-2025.

Special session on Game theory

MIKLÓS PINTÉR & TAMÁS SOLYMOSI

Type space with partial observation

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Abstract | Type spaces with partial observation are considered. Partial observation means the players don't have access, they can't observe some combinations of their types. The consistency in this setting is defined and we prove a result on the relation of consistency and arbitrage in this setting.

Key words | *Type space, beliefs, consistency, arbitrage*

Coalition formation and cost allocation in subsidized pipeline developments

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Abstract | Inspired by a case study of a European cross-border hydrogen pipeline development project, we apply linear optimization and cooperative game theory to model and analyze the potential for incentivizing cross-border collaboration through external financial support. We examine various objectives of the external financier for subsidy rate schemes that support the formation of the grand coalition of all involved countries. The situation is modeled as a cooperative cost game where only groups of countries that develop both the internal and cross-border segments of the pipeline are eligible for subsidies. The main question is: under which subsidy rate schemes is the core of the resulting pipeline cost game non-empty? We also utilize refinements of the core, specifically, the least core and the nucleolus, to recommend allocations of the total subsidized cost that ensure stable incentives for countries to participate in the pipeline development project.

Key words | *cooperative cost game, core, least core, pipeline network, linear optimization*

Acknowledgement | Supported by NKFI grants K146649 and FK146575.

**Special session on Graph theory and its
applications**

DARJA RUPNIK POKLUKAR & JANEZ ŽEROVNIK

The multi-state influence maximization problem

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Abstract | The study of diffusion processes in social networks dates back to the 1970s, beginning with the Linear Threshold Model (Granovetter, 1978). In business and marketing applications, the Independent Cascade Model (Goldenberg et al., 2001) was introduced for which Domingos and Richardson (2001) formulated the problem of identifying the most influential individuals. Kempe et al. (2003) unified these approaches by introducing Influence Maximization (IM), a network-based combinatorial optimization problem. Given a directed, weighted graph and a diffusion model, the goal is to select k seed nodes maximizing the expected influence spread, i.e., the expected number of activated nodes after the process terminates. Classical IM problems assume binary node states (active or inactive). However, in many real-world settings influence is not binary. An individual may become aware of information without being fully persuaded, yet still transmit it to others. This motivates multi-state diffusion models, where nodes can occupy different levels of activation. In this talk, we investigate IM problems in multi-state diffusion processes and discuss their theoretical and algorithmic aspects.

Key words | *diffusion processes in networks, influence maximization*

Acknowledgement | Miklós Krész acknowledges the support of the Slovenian Research and Innovation Agency (ARIS) through grants J7-60122, N4-0274 and BI-HU/26-27-006. He has been also supported by the research program CogniCom (0013103) at the University of Primorska.

Graph-topology constrained heuristic search for the optimization of a magnetic levitation system

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Abstract | This research implements a hybrid graph-topology heuristic search approach for optimizing parameters of an engineering system. The objective is to optimize the solenoid's dimensions and controller parameters for a magnetic levitation system. Open-space searching is shifted to structured parameter space navigation. First, we introduce a partition of the search space. We discretize the continuous physical dimensions of the coil and the controller gains into a multi-dimensional grid graph, where each node represents a specific design state. Nodes that violate the physical constraints and stability criterion, along with their connections, are permanently pruned from the network. The solver is constrained to step between adjacent nodes in the pruned subgraph. We test this methodology on heuristic non-gradient algorithms with modified exploration behavior using a custom mutation function. Numerical tests for the designed magnetic levitation system show the impact of the described approach.

Key words | *graph topology, discretization, heuristic search, magnetic levitation*

Acknowledgement | This research was co-funded by ARIS-Slovenian Research and Innovation Agency, grants P2-0270 and P1-0222.

Increase the attractiveness of urban public transit by integrating timetable coordination

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Abstract | In congested cities, the attractiveness of public transport can be ensured by achieving an appropriate level of service. Often, in the operation of public transport systems, a compromise is necessary between service levels and operating costs. At tactical level, this compromise intervenes in the problems of timetabling and vehicle scheduling. The paper focuses on the timetabling problem for the Bucharest metro network. The problem arises from the requirements to correlate timetables at a transfer station between a new line and two existing lines. The objective is to minimise the transfer times between lines and maximise the flow of passengers who benefit from on-time transfers. To solve this, a two-stage approach is used. First, the transfer station is modelled as a multigraph, where nodes represent the access platforms for all directions of the converging lines, and arcs represent pedestrian paths. Based on this graph, the objective function is defined to minimise the transfer and waiting times. Then, the problem is extended to synchronise the timetables on converging lines, taking into account different headway values. A heuristic algorithm is proposed to solve the problem.

Key words | *public transport network, transfer optimisation, timetable coordination*

Decay stability beyond trees: Towards unicyclic and cactus graphs

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Abstract | Decay stability studies whether the ranking of vertices induced by generalized closeness centrality remains unchanged for all values of the decay parameter. Recent work established structural criteria for decay-unstability and proved that almost all trees are decay-unstable using rooted-tree constructions and asymptotic counting. We extend these ideas to graph classes containing cycles. First, we recall the rooted-tree decomposition underlying the proof for trees. We then study analogous decompositions for unicyclic graphs and cactus graphs. For unicyclic graphs, we analyze how the unique cycle affects the position of the center and identify cases that reduce to tree-like structures. For cactus graphs, we present structural results on graph centers, including an eccentricity formula for vertices of a central cycle block in terms of attached rooted components. Our methodology combines metric graph theory, rooted decompositions, BFS-tree representations, and counting techniques. These tools suggest that decay-unstability remains typical beyond trees.

Key words | *decay-stability, trees, cactus graphs, network optimization*

Generalized traveling salesman problem - experimental study

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Abstract | The generalized traveling salesman problem is a variation of TSP in which the vertex set is partitioned into clusters and the task is to find a shortest cycle that meets at least one vertex of each cluster (Laporte et al., 1987). The GTSP has a host of applications: warehouse order picking with multiple stock locations, sequencing computer files, postal routing, airport selection and routing for courier planes, optimization of the order of tasks in a flexible assembly workstation (Karapetyan and Gutin, 2012; Žerovnik and Herakovič, 2021). A comprehensive study of local search heuristics for GTSP was reported by Karapetyan and Gutin (2012). At the previous conference, we have discussed a heuristics that has been previously applied to asymmetric TSP (Brest and Žerovnik, 2005) and probabilistic TSP (Žerovnik, 2015). We report recent results with this heuristics showing competitive results to the best state-of-the-art approaches (Krpán and Žerovnik, 2026).

Key words | *discrete optimization, constructive heuristics, local search*

Financial networks, systemic risk, and Euro adoption in a frontier market

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Abstract | Frontier equity markets differ from developed markets through thinner liquidity, concentrated ownership and exposure to institutional change, yet remain underexplored in systemic-risk research. We analyse the Zagreb Stock Exchange over 2000–2026, covering three crises and Croatia’s 2023 euro adoption, using P-threshold networks from positive and negative conditional-correlation subgraphs. In a pre-specified 10-metric framework with Benjamini–Hochberg correction, negative-subgraph connectivity and spectral co-movement identify all crises, with signals before onset. Network topology predicts next-period realised volatility and Value-at-Risk: LCC fraction and average path length outperform a GARCH(1,1) benchmark on QLIKE loss, while return-direction predictability disappears after multiplicity correction. Euro adoption is linked to asymmetric restructuring: lower spectral co-movement and stressed-regime fragmentation, but higher positive-subgraph hub concentration. Post-adoption evidence covers about nine revision windows and should be interpreted cautiously. Overall, network topology provides monitoring information without implying exploitable return-direction predictability.

Key words | *financial networks, systemic risk, Zagreb Stock Exchange, P-threshold networks*

Acknowledgement | This work was funded by the European Union – NextGenerationEU under Call IIP-581-2025.

**Special session on Greening the financial sector:
financial innovation, climate risks and
sustainability reporting**

ANDRIJANA ROGOŠIĆ

Examining sustainability reporting practices of banks in Croatia and France

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Abstract | Banks have a significant role in supporting Sustainable Development Goals (SDG) as they have the power to allocate resources to organizations and objectives that advance those goals. New studies indicate that the banking industry has shifted its focus to sustainability. Banks have integrated ESG policies into their operations and have made efforts to publicly disclose their activities. Banks worldwide have engaged in voluntary sustainability reporting, which has recently become mandatory for those in the European Union. This study aims to identify differences in sustainability reporting practices between banks in Croatia and banks in France. Combining qualitative and quantitative research methods, findings indicate that banks in France have more integrated ESG strategies and policies than those in Croatia. Sustainability reporting by banks in France is much more common than in Croatia, and banks in France disclose more sustainability-related information.

Key words | *sustainability reporting, banking, industry, ESG*

Acknowledgement | This study is part of the Croatian-French scientific research project “Greening the Financial Sector of Euro-Mediterranean Countries” under the Hubert Curien Program “Cogito” for 2025 and 2026.

**Special session on Modern challenges in the
context of global change**

SILVIA GOLEM

Technical indicators for intraday government bond forecasting

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Abstract | The research investigates the role of technical indicators in enhancing the accuracy of machine learning models for forecasting intraday government bond prices, extending their application from the stock to the bond market. Using 5-minute quote data for the 10-year German government bond during its first month of trading, feedforward neural network, recurrent neural network, and long short-term memory models are evaluated across different input sets combining trading variables with selected trend, momentum, and volatility indicators. The findings show that selected technical indicators can improve predictive performance, with the feedforward neural network providing the most robust results. Trend indicators, particularly moving average convergence/divergence and weighted moving average, together with the relative strength index, provide the most relevant information, while volatility indicators contribute less to forecasting accuracy. Overall, the findings support the applicability of technical analysis to government bond markets and underline the value of selecting indicators according to the specific characteristics of the market being forecast.

Key words | *technical analysis, machine learning, neural networks, government bond*

Acknowledgement | This paper is the result of research conducted within the University of Split institutional project Contemporary Challenges of Sustainability in the Context of Global Change (CHASING), funded by the European Union (NextGenerationEU) under the Croatian Recovery and Resilience Plan

2021–2026 (NRRP), approved by the Ministry of Science, Education and Youth of the Republic of Croatia.

Understanding perceived stress in midlife: Financial strain, social support, and physical activity

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Abstract | This study examines the factors shaping perceived stress among adults in midlife, with particular attention to financial circumstances, socioeconomic characteristics, and coping resources. The analysis is based on survey data collected from 150 adults aged 50–64 in the Greater Indianapolis area and employs regression-based methods to assess the relative importance of these factors. The findings highlight the central role of subjective financial strain in explaining differences in perceived stress. Across four alternative measures, perceived financial difficulties were consistently more strongly associated with stress than objective income. Age was also significantly related to perceived stress, with older respondents reporting lower stress levels, while marital and employment status showed only marginal associations. No significant relationships were found for education, race, or sex. In addition to financial circumstances, coping resources were associated with stress outcomes. Higher levels of social support were linked to lower perceived stress, as was objectively measured physical activity. In contrast, self-reported physical activity was not significantly associated with stress.

Key words | *perceived stress, financial strain, social support, physical activity, midlife*

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Humour messages and sustainable behaviour in P2P accommodation: Quasi – experimental field study

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Abstract | The paper examines how engagement in local activities, such as a tours, can be encouraged among peer-to-peer (P2P) accommodation guests through behavioural intervention in form of messages found in the participating units. The study is set in Split, Croatia, where P2P accounts for a substantial share of tourist accommodation. Drawing on Broaden-and-Build theory, that suggests positive emotions that can be triggered by humorous message can lead to broadening awareness and result in new thoughts and actions, this study tests whether humour-framed welcome messages prompt higher local engagement than neutral or absent messaging (control). Using a quasi-experimental field design, guests in participating properties receive one of welcome-flyer conditions containing theory informed messages evaluated in a pre-test. The primary outcome is actual behaviour — the number of local tours booked by guests in each condition — complemented by an anonymous online exit survey measuring behavioural intentions and perceived value. The aim is to capture real booking behavior and identify the most promising interventions for promoting socially sustainable guest behaviour in P2P stays.

Key words | *peer-to-peer accommodation, quasi-experiment, humour interventions, social sustainability*

Acknowledgement | This paper is the result of research conducted within the University of Split institutional project Contemporary Challenges of Sustainability in the Context of Global Change (CHASING), funded by the European Union (NextGenerationEU) under the Croatian Recovery and Resilience Plan 2021–2026 (NRRP), approved by the Ministry of Science, Education and Youth of the Republic of Croatia.

Do pension fund managers matter? Evidence from Croatian mandatory pension funds

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Abstract | The future of the old-age income is still under threat due to a trade-off between market efficiency and social security. To reconcile the two objectives mandatory pension funds operate in a highly regulated environment that limits investment decisions and reduces differences among fund management companies. In such a framework, an important question arises as to whether pension management companies can achieve significantly different outcomes for fund members within the same fund category. This study analyses the performance of Croatian mandatory pension funds over the period 2015–2025 using monthly fund returns for fund categories A, B and C. Performance differences among funds are examined using Friedman and Wilcoxon tests, complemented by volatility analysis, Jensen’s alpha and beta measures, and a simulation of pension wealth accumulation. The results reveal significant differences in returns and volatility, particularly among categories A and B. The simulation shows that small differences in returns accumulate into substantial differences in retirement savings. The findings indicate the presence of management-company effects even under strong regulatory constraints.

Key words | *mandatory pension funds, fund performance, Jensen’s alpha, Croatia*

Acknowledgement | This paper is the result of research conducted within the University of Split institutional project Contemporary Challenges of Sustainability in the Context of Global Change (CHASING), funded by the European Union (NextGenerationEU) under the Croatian Recovery and Resilience Plan 2021–2026 (NRRP), approved by the Ministry of Science, Education and Youth of the Republic of Croatia.

Organisational resilience in coastal SME tourism: The role of digital platforms

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Abstract | Small and medium-sized (SME) coastal tourism businesses face increasing economic, environmental, and market disruptions associated with global change, making organisational resilience a major managerial priority. This study investigates the relationship between digital platform engagement, business benefits from platform use, and organisational resilience in coastal tourism SMEs. A quantitative research design was employed, using survey data from 57 SMEs collected through a structured questionnaire. The data were analysed with descriptive statistics, Spearman's rank correlation, and multiple regression analysis. The results indicate a significant positive relationship between digital platform engagement and business benefits, while business benefits are strongly associated with organisational resilience. Regression analysis identifies realised business benefits as the strongest predictor of resilience, suggesting that effective platform use is more important than mere presence. This study contributes to research on resilience and digital transformation by empirically testing a model linking digital platform engagement, business benefits, and organisational resilience.

Key words | *digital transformation, organisational resilience, coastal tourism SMEs, global change*

Factors influencing green entrepreneurship intentions in business students: Evidence from Croatia

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Abstract | Amid global efforts to advance sustainability and environmental responsibility, it is essential to examine how young people, especially students, view green business initiatives and what motivates or discourages their interest in starting their own green businesses. This paper explores the main factors affecting green entrepreneurship intentions and investigates how university support encourages green entrepreneurship among students in economics faculties in Croatia. An online questionnaire was the primary instrument for data collection. The data were analysed using correlation and regression analyses. The results show that students in Croatia have low intentions to engage in green entrepreneurship. Furthermore, the findings indicate that the strongest predictors of intention to engage in green entrepreneurship are self-efficacy and social factors, followed by psychological factors. Additionally, the research shows that university support is a statistically significant predictor of these intentions, even though Croatia's education system needs improvement to encourage entrepreneurship and increase student interest in the green sector.

Key words | *green entrepreneurship, green entrepreneurship intentions, Theory of Planned Behavior, University support*

Education 4.0 and digital twins

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Abstract | Education 4.0 requires integrating disruptive technologies such as digital twins (DT) for advanced modeling, simulation, and system optimization. This paper explores DTs' educational role, identifying key applications and supporting technologies for the virtual representation of physical systems. It addresses pedagogical benefits, challenges and risks regarding practical implementation. A systematic literature review using the PRISMA methodology (2018–2026) was conducted by searching the Web of Science and Scopus. Following strict inclusion and exclusion criteria, 74 papers were selected for in-depth analysis. Results show DTs are most prevalent in higher engineering education for simulation-based learning, supported by AI, VR/AR, and IoT. They enable distance learning, hypothesis testing, and process optimization in safe environments, directly bridging theory and practice. Despite their benefits in solving complex problems, implementation is hindered by high infrastructure costs, technical demands, student cognitive overload, and a lack of regulations and specific teacher competencies. DTs are crucial for educational transformation but require further research and standardization.

Key words | *education 4.0, digital twins, teaching, learning*

Acknowledgement | This work has been fully supported by University of Zagreb, Faculty of Organization and Informatics, institutional project Digital Twins and Smart Solutions.

**Special session on Operational research for
high-performing health systems**

LANA KORDIĆ

Optimal schedule of elective surgery operations subject to disruptions by emergencies

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Abstract | We investigate the scheduling of elective surgeries in an operation theater that also treats emergent patients with priority when they arrive randomly. Two types of problems are considered: The first is in the short-term, the number of the patients for elective surgeries are fixed, all waiting at time zero for operations. The problem is to find the optimal policy to determine the order of all operations in waiting. The second is in the long-term, patients requiring surgeries of different types arrive randomly, and the problem is to determine the optimal policy to select the next elective surgery to operate. Optimal policies are derived for both types of problems based on the theory and techniques of stochastic scheduling and open bandit processes.

Key words | *elective surgery, disruptive control, stochastic scheduling*

Acknowledgement | This work is partially supported by the 1+1+1 CUHK-CUHK(SZ)-GDSTC Joint Collaboration Fund under Project Code: 2025A0505000046.

Productivity changes following the development of day hospitals: A DEA–Malmquist study

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Abstract | Healthcare systems face numerous challenges, including population ageing, increasing demand for healthcare services, and limited financial resources. In this context, it is important to identify organisational models that enable more rational use of resources while maintaining or improving the quality of care. As the development of day hospitals is increasingly recognised as one such model, this paper evaluates productivity changes associated with their development. Total factor productivity change was assessed using Data Envelopment Analysis and the Malmquist Productivity Index for homogeneous groups of day hospitals and for the entire sample. The analysis uses day hospitals within the University Hospital of Split during 2021–2023 to examine whether productivity trends differ across technologically heterogeneous hospital groups. The number of employees was used as the input, while the number of procedures and outpatient visits were used as the output variables. The paper contributes to the methodological discussion on the application of the DEA–Malmquist framework to the efficiency analysis of hospital systems composed of technologically heterogeneous organisational units.

Key words | *Data Envelopment Analysis, Malmquist Productivity Index, Day Hospitals, Hospital Efficiency*

The role of health system productivity in life expectancy growth in European countries

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Abstract | This paper investigates the determinants of life expectancy in European countries over the period 2016–2021, using a spatial panel regression model. Previous studies have typically measured health system performance through healthcare expenditure, yielding mixed empirical results. To provide a more comprehensive measure of health system performance, this study employs the Malmquist Total Factor Productivity Index, by considering three groups of inputs: financial, human, and material. Furthermore, the Malmquist index measures changes in health system productivity over time. The findings indicate that health system productivity plays a central role in determining life expectancy. The results also confirm a positive impact of GDP per capita on life expectancy, while unhealthy eating habits and CO₂ emissions have significant negative effects. In contrast, alcohol consumption does not have a statistically significant effect.

Key words | *Malmquist total factor productivity index, spatial panel models*

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**Special session on Operations research applied
to sustainable natural resource management**

LIDIJA ZADNIK STIRN

Sources of uncertainty in decision support methodologies for natural resource management

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Abstract | This contribution differs from common work in natural resource management, which typically compares the performance of DSM. It offers a cross-methodological perspective on uncertainty within DSM methodologies, arising from data, model structure, scenarios, stakeholder preferences, optimization procedures, and other sources. Uncertainties are explored through: (i) forest management using DP, where uncertainty lies in state transitions; (ii) comparison of wood products according to their environmental burden using AHP, where uncertainty arises from weighting and the aggregation of pairwise comparison matrices; (iii) group decision support for protected area management using SWOT and AHP, where uncertainty stems from the articulation of stakeholders' preferences; (iv) competing forest land uses evaluated with SMART, where uncertainty is associated with measurement scales; and (v) assessment of ecosystem functions using DEA, where uncertainty is reflected in the inputs and outputs of landscape units. These examples highlight the interdisciplinary nature of DSM applications, integrating bioeconomy, biodiversity, behavioral economics, and participatory decision-making.

Key words | *natural resource management, decision-support models (DSM), uncertainty in methodologies, participatory decision-making*

Energy-constrained UAV routing for industrial emission monitoring: A team orienteering approach

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Abstract | Industrial facilities are required to monitor emissions, yet fixed continuous monitoring systems are costly and cannot be installed at every source. A gas-sensor-equipped UAV offers a mobile alternative, but its limited battery cannot cover all stacks in one flight. This study addresses the resulting selection-and-routing problem: given an energy-constrained quadcopter and chimneys with monitoring priorities, which chimneys should be visited, and in what order, to maximize total monitoring value within the battery budget while returning to the depot. We model it as a team orienteering problem where each stack carries a priority-based reward and each visit incurs cruise and hover (measurement) energy from a data-driven quadcopter power model. Small instances are solved exactly via mixed-integer linear programming, while larger ones use two metaheuristics: an ant colony optimization approach and a genetic algorithm with 2-opt local search. On a Turkish industrial-zone case, both metaheuristics closely match the exact optimum on small instances and scale to larger ones, with the local-search genetic algorithm giving the strongest priority coverage, above a distance-based baseline.

Key words | *team orienteering problem, UAV emission monitoring, energy-constrained routing, mixed-integer linear programming*

**Special session on Project presentation and
networking**

IVANA BILIĆ

Tourism of tomorrow: Resilience, sustainability and digital transformation (TURBO), IP-UNIST-04

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Abstract | Tourism plays an important role in economic development, but its net benefits are increasingly challenged by rising socio-economic costs and overtourism. Ensuring tourism's sustainability, resilience, and ability to adapt to disruptions such as pandemics, climate change, and geopolitical instability has therefore become a key policy priority. At the same time, innovation and the green and digital transition are essential for the sector's future. This research aims to assess opportunities for transforming tourism in the European Union and Croatia toward a sustainable, balanced, and resilient model, while providing evidence-based policy recommendations. The project comprises three interconnected work packages: WP1 examines tourism's role in economic resilience; WP2 focuses on sustainable tourism development; and WP3 explores digital transformation and innovation. Together, these work packages integrate macroeconomic, organizational, and technological perspectives to support tourism policy and strategic destination development.

Key words | *tourism, resilience, sustainability*

Acknowledgement | This paper/research was funded by the European Union (NextGenerationEU) under the Croatian Recovery and Resilience Plan 2021–2026 (NRRP), through the University of Split institutional project “Tourism of Tomorrow: Resilience, Sustainability and Digital Transformation (TURBO; IP-UNIST-04)”, approved by the Ministry of Science, Education and Youth of the Republic of Croatia. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Commission. Neither the European Union nor European Commission can be held responsible for them.

Network analysis of capital markets: structure, prediction, and optimization – FinNet

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Abstract | FinNet investigates the structure, dynamics, and interconnectedness of capital markets, with particular attention to Croatia and the wider regional context. The project combines three complementary research streams: financial network analysis of relationships among stocks and markets; development of forecasting models that integrate machine-learning methods with network metrics, market sentiment, and macroeconomic indicators; and portfolio optimization using information on market topology and interconnectedness. Based on data on stock prices, trading volumes, sentiment, macroeconomic indicators, and related variables, the project examines market behaviour under uncertainty and financial shocks and explores the potential for early detection of instability. Expected outputs include scientific papers, reproducible analyses, an open analytical tool, and research summaries for professional and institutional audiences. The project also aims to strengthen interdisciplinary research, involve young researchers, support teaching innovation, expand international collaboration, and provide a basis for future competitive grant applications.

Key words | *financial networks; capital markets; financial forecasting; machine learning; portfolio optimization; systemic risk*

Acknowledgement | Project “FINNET” is implemented within the framework of the National Recovery and Resilience Plan 2021–2026 and is funded by European Union funds through the NextGenerationEU instrument under Call IIP-581-2025.

ESG4PMChange: An Erasmus+ project for building ESG competences

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Abstract | ESG4PMChange, an EU-funded project supported by the European Union through the Erasmus+ Programme, addresses the growing need to integrate Environmental, Social, and Governance (ESG) principles into project management education, training, and professional development. Bringing together higher education institutions, vocational education providers, professional associations, and business partners across Europe, the project aims to reshape project management education by developing an innovative learning ecosystem aligned with the evolving needs of the labour market and the contemporary business environment. Focusing on the development of future-ready project management competencies, ESG4PMChange will deliver an ESG competency framework, a problem-oriented curriculum, Living Labs, a Digital Resource Hub, and a Micro-credential Framework that supports the recognition and validation of ESG project management competencies. The project will equip future project managers with the competencies necessary to lead sustainable transformation and support Europe's green and digital transition.

Key words | *ESG, project management, competency framework, Erasmus+*

Acknowledgement | This research was funded through the European Union's Erasmus+ project: The ESG Imperative for the Project Management World: Alliance for Developing and Empowering Changemakers (ESG4PMChange) under grant agreement No. 101187376.

GreenTech horizons: Modernizing higher education for the green and digital transition

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Abstract | The Erasmus+ Capacity Building in Higher Education project GreenTech Horizons supports the twin green and digital transition by developing an innovative competency-oriented learning ecosystem for higher education institutions in Mongolia and Kazakhstan in collaboration with European partners. The project strengthens green, digital and business competences through curriculum modernization and closer cooperation between academia and industry. Key results include a competency framework, a competency-oriented curriculum model, redesigned study programs and courses, an eLearning platform integrating Massive Open Online Courses (MOOCs), and green and digital laboratories. These outputs are complemented by teacher training, institutional capacity building, and quality assurance activities. The presentation will highlight the project's main achievements and the pilot implementation of the modernized curricula and courses during the 2026/2027 academic year. The project is expected to provide a transferable model for curriculum modernization that enhances graduate employability and supports sustainable green and digital transformation.

Key words | *green and digital transition, curriculum modernisation, Erasmus+, higher education*

Acknowledgement | This research was funded through the European Union's Erasmus+ project: Fostering Dual Green and Digital Transitions through Education and Innovation in Neighbourhood East, Central Asia, and Asia (GreenTech Horizons) under grant agreement No. 101177203.

SMART researchers: Strategic micro-credentialing and skills recognition for a dynamic ESRs talent ecosystem

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Abstract | Project is funded under the Horizon Europe WIDERA programme and aims to strengthen research careers establishing sustainable talent development for early-stage researchers in widening countries. Project responds to the European Commission's priorities for modernising research careers by aligning institutional human resource practices with the European Charter for Researchers, the Council Recommendation on a European Framework for Research Careers, and the ResearchComp Competence Framework. Consortium brings together universities, organisations, agencies, and industry partners from Croatia, Serbia, Greece, and Latvia, fostering cross-sectoral collaboration. Through this partnership, the project develops innovative institutional support mechanisms, including Career Support Centres, a ResearchComp-based micro-credentialing and certification framework, a digital Competence Lab for continuous professional development, and Strategic Action Plans designed to strengthen human resource excellence in research institutions. These initiatives aim to enhance researchers' employability, mobility, transferable skills, and well-being fostering stronger links between academia, industry and society.

Key words | *horizon europe, early-stage researchers, micro-credentials, career support centres*

Acknowledgement | This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No 101216967.

Assessing digital, green, creative and innovative skills in Croatian and Slovenian smart cities

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Abstract | Digital and green transitions are key EU priorities, increasing the need for citizens equipped with digital, green, creative and innovative skills. In smart cities (SCs), these competences enable citizens to use technology, support sustainable development, contribute to innovation and address urban challenges. This presentation reports the preliminary outcomes of a bilateral project on digital, green, creative and innovative skills of citizens in SCs of Croatia and Slovenia. The project aims to assess SC-related competences, identify development barriers and analyse educational practices. The project combines literature review, student research and empirical data collection. The empirical phase included a survey conducted in May and June 2026 among 400+ students from universities in Croatia, Slovenia and North Macedonia. The survey assessed digital, green and entrepreneurial competences as well as the use and adoption of SC services. Additional activities examined barriers and educational approaches for smart citizens. The project contributes to understanding citizens' readiness for digital and green transitions and provides recommendations for policymakers and educators.

Key words | *smart cities, smart citizens, digital and green transition, competence development*

Acknowledgement | This work was supported by the Programme of Scientific and Technological Cooperation between the Republic of Croatia and the Republic of Slovenia through the project "Analysis of Digital, Green, Creative and Innovative Skills of Citizens in Smart Cities of Croatia and Slovenia".

A modular operations research framework for climate-neutral mobility systems

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Abstract | Transitioning to climate-neutral mobility systems requires empirical data for mathematical optimization. To provide this data, mobile edge units in public transport continuously preprocess sensor data via Artificial Intelligence (AI). We introduce a modular Decision Support System (DSS) framework built upon this sensor data. This modularity enables dynamic scaling. Acting as a cooperative platform, the DSS framework facilitates the integration of new use cases. We outline the DSS framework's architecture alongside applications: utilizing Agentic AI to orchestrate intermodal travel chains, optimizing strategic network design, and managing innovative public transport modes like autonomous shuttles. Sharing insights from our current projects, we outline the research questions emerging from the DSS framework: How can stochastic edge AI data be incorporated into deterministic models? How can decentralized forecasts dynamically update parameters without compromising computational tractability? Furthermore, what governance structures are required to ensure digital sovereignty and trace AI-driven decisions within cooperative mobility systems?

Key words | *Public Transport, Agentic AI, Decision Support System, Optimization Framework*

Building cross-border innovation ecosystems through technology transfer: The ERIT approach

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Abstract | Universities are increasingly expected to transform research results into innovations that create economic and societal value. However, many higher education institutions, particularly in emerging innovation ecosystems, face challenges related to technology transfer, research commercialisation, and collaboration with industry. The ERIT project (Establishing a Regional Innovation and Technology Transfer Ecosystem), funded under the Interreg VI-A IPA Croatia–Bosnia and Herzegovina–Montenegro Programme 2021–2027, addresses these challenges by supporting Technology Transfer Offices (TTOs), fostering cross-border collaboration, and developing a digital platform for knowledge exchange and innovation services. ERIT aims to build a sustainable cross-border innovation ecosystem by encouraging cooperation between higher education institutions, research organisations, industry, SMEs, and public authorities. The project demonstrates how capacity building, stakeholder engagement, digitalisation, and cross-border cooperation can improve research valorisation, accelerate knowledge transfer, and enhance regional innovation performance.

Key words | *technology transfer, research valorisation, cross-border cooperation, innovation ecosystem*

Acknowledgement | Prepared within the Interreg VI-A IPA Croatia–Bosnia and Herzegovina–Montenegro 2021–2027 project Establishing a Regional Innovation and Technology Transfer Ecosystem (ERIT) (Project ID: HR-BA-ME00522).

**Regular session on Applied statistics and
econometrics**

The production network effects of public procurement

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Abstract | How do public procurement contracts propagate through the production network? Existing evidence stops at the contract-signing firm; our objective is to follow the money further along firm-to-firm linkages. Methodology: we merge bid-level records from Croatian procurement auctions with the near-universe of domestic firm-to-firm VAT invoices (2019-2023) and estimate winner-runner-up event studies: monthly outcome paths of tender winners against firms that bid for the same contract and narrowly lost, exploiting about 1,600 closely decided tenders worth EUR 440 million. Around each contract we observe four groups of firms - the firm experiencing the public demand shock, its suppliers, its business customers, and the runners-up on that tender, its direct competitors - a rare setting to understand how a demand shock travels through a production network. We expect winning to reshape the winner's sourcing (new supplier relationships, reallocation across existing ones) more than its scale, with spillovers to suppliers, capacity effects on private customers, and displacement of competitors. Contribution: the first firm-to-firm evidence on the network effects of public procurement.

Key words | *production network, public procurement, suppliers, customers*

Acknowledgement | This study was supported by the Croatian Science Foundation under the project IP-2022-10-8560.

Tourism-led growth or tourism-led traps? Evidence from EU NUTS-2 regions

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Abstract | Tourism accounts for around 10% of global GDP and employment, yet its contribution to long-term economic development remains debated. While the tourism-led growth hypothesis suggests tourism stimulates growth, critics argue that tourism specialization may generate crowding-out effects, productivity constraints, and dependence on a single sector. Despite extensive research on tourism and regional growth, the relationship between tourism and regional development traps has received little attention. This study examines whether tourism is associated with development-trap risk across EU NUTS-2 regions using spatial econometric models. Tourism is measured through tourism intensity, density, length of stay, and the share of international tourists. The dependent variable is a regional development-trap risk index. Preliminary results

indicate that greater tourism intensity and international tourism orientation are associated with higher trap risk, whereas tourism in neighbouring regions is linked to lower risk. The findings contribute to debates on tourism-led growth, regional resilience, and EU cohesion policy.

Key words | *tourism demand, tourism-led growth, regional development trap, NUTS 2 regions, spatial econometrics*

Acknowledgement | This research was funded by the European Union (NextGenerationEU) under the Croatian Recovery and Resilience Plan 2021–2026 (NRRP), through the University of Split institutional project “Tourism of Tomorrow: Resilience, Sustainability and Digital Transformation (TURBO; IP-UNIST-04)”, approved by the Ministry of Science, Education and Youth of the Republic of Croatia. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Commission. Neither the European Union nor European Commission can be held responsible for them.

Lifestyle and life expectancy in Europe: A spatial analysis

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Abstract | Life expectancy is widely used as an indicator of population health and is influenced by socioeconomic, health system, environmental, and lifestyle factors. This study examines the contribution of these determinants to life expectancy across 29 European countries using spatial regression analysis, with particular attention given to lifestyle behaviors. Lifestyle is represented by alcohol consumption, smoking, fruit and vegetable intake, physical activity, and overweight prevalence, while other variables capture socioeconomic conditions, health expenditure, and environmental characteristics. The results show that GDP per capita and health expenditure remain the main determinants of life expectancy. Among lifestyle variables, alcohol consumption and insufficient fruit and vegetable intake have the strongest negative influence, while environmental indicators are not statistically significant. Results suggest that improving population health requires not only continued investment in healthcare, but also stronger public health policies aimed at promoting healthier lifestyles.

Key words | *Life expectancy, spatial analysis*

Acknowledgement | **Acknowledgement** | This paper is the result of research conducted within the University of Split institutional project Contemporary Challenges of Sustainability in the Context of Global Change (CHASING), funded by the European Union (NextGenerationEU) under the Croatian Recovery and Resilience Plan 2021–2026 (NRRP), approved by the Ministry of Science, Education and Youth of the Republic of Croatia.

An empirical analysis of the availability of household credit in the Republic of Croatia

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Abstract | The paper investigates the impact of bank credit risk on the financial inclusion of the population through the availability of household credit in the Republic of Croatia. The contribution of the paper lies in the observation of bank credit risk as a factor that affects the availability of household credit and indirectly on the financial inclusion of the population, unlike most previous research that focuses on the analysis of the determinants of non-performing loans. The aim of the paper is to examine how bank credit risk and selected macroeconomic factors affect the availability of household credit as one of the important dimensions of financial inclusion. The empirical analysis is based on quarterly data for the period from 2016 to 2025, and was conducted using the autoregressive distributed lag (ARDL) model. The results confirm the existence of a long-term equilibrium between the observed variables. In conclusion, the research results confirm the importance of observing credit risk not only as a consequence of macroeconomic developments, but also as a factor that can affect the availability of household lending and indirectly on the financial inclusion of the population.

Key words | *credit risk, non-performing loans, financial inclusion, ARDL*

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On indicators of selected properties of parliaments in electoral systems

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Abstract | In electoral systems, electoral volatility is usually analyzed using indicators that measure changes in vote shares between successive elections. Party vote shares are also used in several indicators describing properties of electoral systems, such as the effective number of electoral parties, vote fractionalization, and electoral volatility. In the post-election phase, after votes have been translated into parliamentary seats (i.e., mandates), one may instead consider the seat shares of parties. By taking these seat shares into account, it is possible to define analogous indicators that describe corresponding properties of a parliament, including the effective number of parliamentary parties, seat fractionalization, seat-based electoral volatility, and related measures. We examine an indicator of seat fractionalization and an indicator of relative seat fluctuation using data from several successive elections in a few countries.

Key words | *electoral systems, electoral volatility, seat fractionalization, indicator of relative seat fluctuation*

Acknowledgement | T. Marošević was partially supported from the project “Stochastic Models and Applications (581-UNIOS-56)”, funded by the European Union – NextGenerationEU through the National Recovery and Resilience Plan 2021–2026 of the Republic of Croatia.

Comparing students' and bookmaker forecasts of FIFA world cup matches using the Brier score

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Abstract | Forecasting sporting events provides a setting for studying decision-making under uncertainty and the calibration of probability judgments. Prior to the start of the 2026 FIFA World Cup, 95 university students provided probability forecasts for all 72 group-stage matches by assigning probabilities to the three possible outcomes: home win, draw, and away win. Bookmaker odds were transformed into implied probabilities and used as a benchmark. Forecasting performance was evaluated using the Brier Score, which quantifies the discrepancy between predicted probabilities and observed outcomes. Brier Scores were calculated for each student and compared with scores obtained from bookmaker-implied probabilities. The analysis focused on identifying matches with the largest differences in Brier Scores between students and bookmakers and exploring factors associated with these discrepancies. For example, in the Canada–Bosnia and Herzegovina match, the student forecast achieved a Brier Score of 0.35, compared with 0.28 for bookmaker-implied probabilities. The findings contribute to understanding accuracy, calibration, and judgment under uncertainty.

Key words | *Brier Score, sports analytics, FIFA World Cup, football forecasting*

Behavioral drivers of cryptocurrency investment intentions: An integrated PLS-SEM and NCA approach

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Abstract | This research examines how behavioral factors shape individuals' intention to invest in cryptocurrencies, focusing on overconfidence, fear of missing out (FOMO), crypto decision bias and gamified trading. Drawing on behavioral finance and crypto market characteristics, a latent variable model was validated using exploratory factor analysis (EFA) and partial least squares structural equation modeling (PLS-SEM) on survey data from 208 investors in Croatia. Results show that FOMO and gamified trading have significant positive effects on investment intention, while overconfidence and crypto decision bias are insignificant. To complement the sufficiency logic of PLS-SEM, necessary condition analysis (NCA) was applied to examine whether these behavioral factors are necessary conditions for achieving certain levels of investment intention. Findings indicate that FOMO and gamified trading are necessary for high investment intention, highlighting their role as preconditions rather than additional predictors. By integrating EFA, PLS-SEM and NCA, the study validates the proposed scales and demonstrates how sufficiency and necessity logic can be combined in behavioral finance research.

Key words | *behavioral biases, cryptocurrency investment intention, PLS-SEM, NCA*

Understanding the Big 4 effect on earnings quality via audit adjustments

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Abstract | This paper investigates whether the differences in audited financial reporting quality between Big 4 and non-Big 4 clients are mainly driven by client's pre-audit financial reporting quality or by audit treatment via audit adjustments. Since detailed pre-audit data are usually not available to the researchers, prior literature could only control the audit effect for different client characteristics between two groups of auditors. By using detailed pre-audit/audited financial statement data of Croatian listed companies, we are able to estimate the impact of Big 4 audit adjustments on audited earnings quality while controlling for the differences in the clients' pre-audit earnings quality. We find that Big 4 clients have significantly higher pre-audit and audited accrual quality. However, after adopting regression analysis, PSM and staggered DID techniques to control for clients' pre-audit earnings quality; we find that the effect of Big 4 adjustments on audited accrual quality is not significantly different from the non-Big 4 adjustments. The results suggests that Big 4 effect arises mainly from the pre-audit earnings quality and not from the audit adjustments.

Key words | *pre-audit financial statements, audit adjustments, earnings quality, audit quality*

Acknowledgements | This work has been supported by Croatian Science Foundation under the project IP-2020-02-9372 “Disentangling Financial Reporting Quality“.

Intertemporal consumption behavior in EU post-communist countries

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Abstract | Using data on risk-free reference interest rates, nondurable consumption, and GDP across EU post-communist countries, this paper estimates a nonlinear specification of the Euler equation. The results suggest a discount factor consistently close to unity, while relative risk aversion ranges between 0.51 and 1.26. We further document pronounced heterogeneity in γ across households, reflecting diverse intertemporal preferences and risk sensitivities. This finding carries important implications. For policy, it indicates that uniform monetary and fiscal interventions may produce uneven and potentially suboptimal effects, calling for more targeted and differentiated policy design. For research, it underscores the need for frameworks that explicitly allow for a distribution of γ and for greater use of micro-level data, as neglecting heterogeneity may lead to systematically biased estimates of consumption behavior and policy effectiveness.

Key words | *Euler equation, discount factor, risk aversion, generalized methods of moments*

Acknowledgements | This work was supported by the Grant Agency of Slovak Republic – VEGA grant no. 1/0052/24, “Estimation of key structural parameters of current macroeconomic models” and Cultural and Educational Grant Agency of the Ministry of Education, Research, Development and Youth of the Slovak Republic - KEGA - grant no. 026EU-4/2024, “Building an interactive book called Quantitative Economic Analysis”.

Monetary integration and bank efficiency: Evidence from Croatia's entry into the Euro Area

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Abstract | Efficiency in the banking sector is essential for financial intermediation, economic growth, and systemic stability, particularly in bank-based systems such as the European Union. Euro adoption represents a major monetary shift that may affect bank performance through reduced exchange rate risk, interest rate convergence, and deeper financial integration, yet empirical evidence for newer member states remains scarce. The objective of this paper is to evaluate the impact of euro adoption on the efficiency of the Croatian banking sector, focusing on whether the 2023 introduction of the euro improved bank efficiency. The methodology relies on a panel dataset of 17 banks, applying Data Envelopment Analysis (DEA) within the intermediation framework and the Malmquist productivity index to capture dynamic changes and decompose productivity into efficiency and technological components. Results indicate that euro adoption is associated with productivity growth driven mainly by technological progress, alongside heterogeneous bank-level adjustments, contributing new evidence on monetary integration effects in small open economies.

Key words | *euro adoption, bank efficiency, DEA, Malmquist index*

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Environmental fiscal policy and greenhouse gas emissions in the EU-27: Evidence from a dynamic panel

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Abstract | This paper examines the effects of environmental fiscal policy variables on greenhouse gas (GHG) emissions in the EU-27 from 2009 to 2023. The panel model is estimated using the total GHG emissions as the dependent variable, while energy taxes, transport taxes, and government environmental protection expenditure serve as independent variables. The results indicate significant persistence in GHG emissions. Energy taxes and government environmental protection expenditure have a negative and statistically significant effect on emissions in both the short run and the long run, confirming the effectiveness of these fiscal instruments in reducing emissions. However, transport taxes show a positive and significant relationship with emissions, suggesting that their current structure, which is linked primarily to vehicle ownership rather than fuel consumption, is not effective in reducing emissions. The findings suggest that energy taxes and environmental expenditures are effective fiscal instruments for reducing emissions in the EU, while the design of transport taxes requires reconsideration to improve their environmental effectiveness.

Key words | *greenhouse gas emissions, environmental fiscal policy, dynamic panel GMM, European Union*

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Data-driven indicator selection via bootstrap I-distance: The OECD regional well-being case

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Abstract | This paper proposes a bootstrap-augmented post-hoc I-distance framework with statistical stopping criteria for indicator selection in composite indices. Applied to the OECD Regional Well-Being dataset (363 regions, 11 indicators), we employ 1,000 bootstrap iterations to evaluate seven stopping criteria, including Kendall's W , Spearman ρ , rank disruption metrics, and a normalized combined disruption score. The conservative stopping point retains seven indicators (Income, Jobs, Education, Safety, Access to services, Community, Life satisfaction), achieving $W = 0.997$. Rank oscillation analysis shows top regions (New Hampshire, Montana) hold ranks 1–2 across all iterations, while mid-table regions exhibit ranges exceeding 88 positions. Country-level Gini coefficients reveal a paradox: top-performing countries (Switzerland, Gini = 0.550; USA, Gini = 0.457) display the greatest internal regional inequality. The framework replaces ad hoc stopping rules with a replicable, data-driven procedure generalizable to any I-distance application.

Key words | *bootstrap I-distance, composite indicators, OECD Better Life Index, regional well-being*

Acknowledgements | This research was supported by the University of Belgrade-Faculty of Organizational Sciences and, in part, by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia through institutional funding (grant number: 200151).

Croatian Sunday shopping restrictions: A regression discontinuity in time approach

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Abstract | This study evaluates the financial impact of the 2023 Sunday retail trading restrictions in Croatia. Utilizing a high-frequency daily database of fiscalized retail receipts (2022–2024), we estimate causal policy effects via a Regression Discontinuity in Time approach. Our methodology features four distinct designs: intra-weekly redistribution, aggregate weekly impact, subsector analysis, and placebo tests on unaffected sectors. We estimate the global polynomial, separate polynomial, and local linear model, specifically incorporating autoregressive dynamics to capture time-varying effects across two different policy implementation phases. Our findings are validated through various robustness checks, including donut estimates, placebo tests, bandwidth sensitivity analysis, and an alternative Difference-in-Differences specification. The results reveal no significant overall impact on aggregate retail revenue. On the contrary, we show that consumers have successfully reallocated their spending from Sundays to other days of the week. However, specialized food stores faced significant revenue losses, revealing an asymmetric policy burden on small retailers.

Key words | *regression discontinuity in time, retail trade, Sunday trading, labour regulation*

Acknowledgements | This article was funded by the European Union – NextGenerationEU under Call IIP-581-2025.

**Regular session on Behavioral operational
research**

Knowing more or feeling more confident? Financial literacy and cryptocurrency Investing

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Abstract | Cryptocurrency markets provide a useful setting for examining whether investment decisions are more strongly associated with objectively assessed financial literacy or with perceived financial competence. This study distinguishes between these two dimensions in explaining cryptocurrency participation and investment behaviour. Objective financial literacy is measured using the OECD framework covering financial knowledge, attitudes and behaviour, while subjective financial literacy reflects self-assessed financial capability. Survey data from Croatian adults are analysed using structural equation modelling. The results show that objective financial literacy is more strongly associated with cryptocurrency ownership and portfolio diversification, whereas subjective financial literacy becomes more relevant among cryptocurrency investors, being linked to greater portfolio exposure and more favourable perceived outcomes. The findings suggest that being financially literate and feeling financially capable may be associated with different aspects of cryptocurrency investment

decisions.

Key words | *financial literacy, cryptocurrency, investor confidence, investment behaviour*

Acknowledgements | This study was supported by the Croatian Science Foundation under project IP-2019-04-7816.

Robustness of the new 7-member Eurovision jury voting system

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Abstract | Detailed voting results of the Serbian professional jury at Eurovision 2026 enabled an empirical analysis of the newly introduced 7-member jury system. The study investigates the robustness of final voting outcomes under changes in jury composition. Using the original 7-member jury, 21 alternative 5-member juries (old system) were generated by excluding two jurors at a time. Differences in rankings and awarded points were analysed between the original and simulated juries, together with inter-jury correlations and aggregate point deviations. Additional simulations included alternative 7-member juries in which one juror was replaced by a synthetic juror representing the average preferences of all original jurors. Results show that even minimal changes in jury composition can substantially affect final voting outcomes. Aggregate point differences between the original 7-member jury and simulated 5-member juries ranged from 2 to 20 points, while differences among 5-member juries reached up to 34 points. The findings suggest that increasing the number of jurors may improve the robustness and stability of Eurovision voting outcomes.

Key words | *Eurovision, voting, jury, robustness*

Acknowledgements | This work was supported by the European Union through the NextGenerationEU programme, under the call for Institutional Research Projects financed from source 581 – Recovery and Resilience Facility (2025), within the project StartUp.Score: Development of a Model for Deciding on the Readiness of an Entrepreneurial Venture for Incubation‘.

ChatGPT acceptance in Croatian IT: The role of knowledge acquisition and application

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Abstract | This paper examines the factors driving ChatGPT acceptance within Croatian IT companies using an extended Technology Acceptance Model (TAM). Data from 224 professionals were analyzed using PLS-SEM. The results offer critical operational insights for managing AI integration in tech-driven environments. Perceived intelligence and system updates strongly enhance knowledge acquisition and application, with knowledge application emerging as the key predictor of perceived usefulness. Crucially, perceived ease of use lacks statistical significance, indicating that digitally literate teams prioritize functional depth over interface simplicity. Practical implications suggest that organizations should bypass basic usability training and instead focus resources on advanced prompt engineering and problem-solving scenarios where immediate knowledge transfer occurs. Furthermore, corporate culture directly drives usage intentions, meaning AI adoption must be operationally supported by open knowledge-sharing and structured risk management, rather than left solely to individual initiative.

Key words | *ChatGPT, Technology Acceptance Model (TAM), knowledge management, IT sector*

**Regular session on Machine learning and data
mining**

Comparing generative AI and regression models for student performance prediction in higher education

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Abstract | The increasing use of generative artificial intelligence in higher education raises the question of whether its predictions differ from those obtained using traditional statistical models and how such differences may affect educational practice. This study compares ChatGPT-based predictions with predictions obtained from a multiple linear regression model for estimating students' performance on the first midterm examination. Predictions were generated for 66 undergraduate students and evaluated using correlation analysis, prediction errors, and agreement with achieved scores. In addition to predictive performance, the study examined the potential impact of each prediction approach on a gamified reward system (students received a reward for exceeding their predicted score). Although the regression model provided slightly lower prediction errors, the two approaches differed in the classification of rewarded students. In particular, several students who exceeded the ChatGPT prediction would not have been rewarded under the regression-based approach. These findings suggest that the choice of prediction method influences not only predictive performance but also pedagogical decisions.

Key words | *generative artificial intelligence (GAI), regression analysis, educational decision-making, student performance prediction*

Acknowledgements | This work was supported by the European Union through the NextGenerationEU program under the call for Institutional Research Projects financed from source 581–Recovery and Resilience Facility

(2025) under the project StartUp.Score: Development of a model for deciding on the readiness of an entrepreneurial venture for incubation.

Can machine learning uncover hidden FinTech personas among students?

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Abstract | As financial services become increasingly digital, understanding how young people engage with FinTech has become essential for building inclusive and sustainable financial ecosystems. Rather than viewing students as a homogeneous population, this study explores the hidden diversity of FinTech users among university students in North Macedonia. Using survey data from 1,567 respondents, machine learning clustering techniques are applied to identify distinct FinTech adoption personas based on awareness, usage, trust, financial literacy, security perceptions, and future adoption intentions. The analysis is expected to reveal meaningful behavioral segments ranging from digitally confident adopters to cautious and reluctant users. By uncovering these latent profiles, the study moves beyond traditional explanatory approaches and provides a data-driven perspective on FinTech readiness among young adults. The findings offer valuable insights for universities, financial institutions, and policymakers seeking to design more targeted strategies for financial education, digital inclusion, and responsible FinTech adoption.

Key words | *FinTech, clustering, students, machine-learning*

Acknowledgements | This study is funded by University North, Croatia (NextGeneration EU project, grant number IP-UNIN-DIH-2025-6).

Machine learning and MCDA for functional labour region prediction

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Abstract | Functional regions are commonly delineated from commuting flows, yet such data are often difficult to obtain and update. This study investigates whether Slovenia's functional labour regions can be reproduced using only openly available municipal indicators. The analysis covers all 212 Slovenian municipalities. Functional regions derived from commuting data serve as the reference regionalisation. Three approaches are compared: Elastic Net regression, Random Forest, and a multicriteria decision analysis (MCDA) model. Predictor variables describe employment, service provision, demographics, and road-network accessibility, while commuting flows are used only as model targets.

Besides predictive accuracy, the study examines model interpretability and the contribution of individual predictor groups. Model performance is evaluated by the ability to reproduce the observed regionalisation and through comparison with Slovenia's official statistical regions. The results demonstrate the potential of combining machine learning and MCDA for regional analysis and spatial decision support.

Key words | *machine learning, multicriteria decision analysis, functional regions, explainable AI*

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Evolving dispatching rules for unrelated parallel machine scheduling with resource constraints

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Abstract | The unrelated parallel machine scheduling problem with resource constraints is a combinatorial optimization problem in which jobs require both a machine and additional resources (e.g., tools, operators) for processing, and for which many solution methods exist. Due to its NP-hardness, these methods are predominantly heuristics. However, most target static conditions, i.e., systems in which all information is known in advance and does not change over time. In practice, such problems usually arise in dynamic environments, where many proposed methods do not apply. One of the few methods suited to such environments is Dispatching Rules (DRs) - simple, fast heuristics with one drawback: manually designing high-quality DRs is difficult and time-consuming, requiring an expert with deep problem knowledge. To overcome this, genetic programming (GP) is used for evolving DRs. GP is used as a hyper-heuristic that, based on a set of instances, evolves DRs which are then applied to new problems. This presentation will highlight the key components needed to evolve high-quality DRs for this problem, and show how this approach can produce rules that outperform existing manually-designed DRs.

Key words | *dispatching rules, genetic programming, scheduling problem, resources*

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A heterogeneity-aware ensemble framework for continuous outcome prediction

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Abstract | Operational prediction problems often involve heterogeneity across population, subgroup, and local neighborhood structures, while standard ensemble methods usually combine learners at a single modeling resolution. This study proposes a heterogeneity-aware ensemble framework for continuous outcome prediction that integrates global models trained on the full sample, clustered models specialized to latent segments, and local models adapted to nearby observations. A formal motivational model shows that prediction error depends

on a trade-off between omitted heterogeneity and estimation variance across modeling resolutions. The framework uses out-of-fold, level-specific predictions and an external meta-ensemble to select informative signals without imposing fixed contributions from each layer. Empirical results from public benchmark regression datasets show improved out-of-sample accuracy relative to strong non-meta and single-level ensemble alternatives. Ablation and heterogeneity-gain analyses further show that the benefits depend on observable data properties, including response spread, clusterability, geometry, and distributional shape.

Key words | *predictive analytics, ensemble learning, multilevel data heterogeneity, machine learning*

Regular session on Mathematical programming

A generalized k -station tandem queueing model with class-dependent routing and convex service optimization

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Abstract | This paper develops a generalized k -station tandem queueing system with class-dependent probabilistic entry and routing mechanisms. Unlike classical tandem models, where all customers enter the first station and sequentially traverse the entire network, customers in the proposed model are classified upon arrival and may enter the system at different stations according to predefined routing probabilities. This framework provides a flexible representation of heterogeneous service requirements encountered in healthcare, manufacturing, logistics, and communication systems. Under Markovian assumptions, the system is formulated as a multidimensional continuous-time Markov chain. Effective arrival rates at all stations are derived using Poisson thinning and superposition principles, and necessary and sufficient stability conditions are established. Exploiting the network structure, a product-form stationary distribution is obtained, connecting the proposed model with the theory of open

Jackson networks while extending it through probabilistic entry mechanisms. Closed-form expressions are derived for key performance indicators, including queue lengths, waiting times, sojourn times, and customer populations at both station and system levels. To support service design decisions, a cost function incorporating class-dependent waiting costs and station capacity-dependent service costs is formulated. The resulting optimization problem is shown to be separable and strictly convex, guaranteeing the existence and uniqueness of the optimal service configuration. Numerical experiments, sensitivity analysis, uncertainty analysis, and Monte Carlo simulations illustrate the effects of routing probabilities, customer composition, and service capacities on system performance and optimal design decisions. The proposed framework provides a tractable analytical approach for modeling and optimizing multi-stage service systems with heterogeneous customer requirements.

Key words | *tandem queueing network, probabilistic routing, class-dependent customers, service optimization*

The merge scheduling problem under makespan and tardiness objectives

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Abstract | In laboratory quality assurance, analyses of the same type can be carried out for several products at once. The Merge Scheduling Problem (MSP) captures this setting as an open-shop scheduling problem in which operations of the same category may be merged and processed jointly, each job is supervised throughout by a qualified supervisor of limited capacity, and jobs carry arrival times and deadlines. Makespan and total tardiness are the objectives. The problem is solved exactly by a mixed-integer linear programming model and heuristically by a two-phase method that first merges compatible operations and then improves the merging with a metaheuristic search. On a dedicated benchmark set the exact model solves small instances to optimality, while the heuristic matches these optima on makespan and scales to instances the exact model cannot handle.

Key words | *open-shop scheduling, operations merging, matheuristics, total tardiness*

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Public transport anchored flow termini coverage model for dock placement in bicycle sharing systems

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Abstract | Facility location models for docked bicycle sharing systems (BSS) typically treat demand as single-point coverage and leave public transport (PT) integration exogenous, preventing planners from controlling the trade-off between direct cycling accessibility and multimodal connectivity. We propose the Public Transport Anchored Flow Termini Coverage Model (PT-FTCM), a mixed-integer linear program that extends flow-termini coverage - requiring both trip endpoints to be served - with a tiered objective rewarding direct BSS coverage, PT-hop coverage, and their conjunction, weighted via planner-controlled parameters. We evaluate the model on origin-destination commute data and PT networks from two real-world operating BSS systems, assessing whether tier weights shift placements toward PT-adjacent stations without sacrificing overall coverage, and whether these gains remain stable under multiplicative demand perturbations. We believe the model can serve as a practical, tunable planning tool for BSS operators seeking to weigh PT integration against direct-coverage demand.

Key words | *bicycle sharing systems, facility location, public transport integration, mixed-integer linear programming*

Acknowledgements | This work has been supported by the European Commission's Horizon Europe Research and Innovation programme through the Marie Skłodowska-Curie Actions Staff Exchanges (MSCA-SE) under Grant Agreement no.101182819 (COVER: (C)ombinatorial (O)ptimization for (V)ersatile Applications to (E)merging u(R)ban Problems).

Laguerre tessellations in continuous price–location competition

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Abstract | This talk deals with the competitive facility location problem in two dimensions. While location competition under various distance metrics has been extensively studied for both discrete and continuous demand, as well as in the discrete variant of price–location competition, the continuous price–location variant appears to be considerably less explored. The price factor introduces weights into the underlying market partition, leading to weighted Voronoi-type tessellations that may result in nonconvex market regions. This talk discusses the use of quadratic distances, for which the induced market partition is a Laguerre tessellation. In contrast to more general weighted tessellations, this framework preserves the convexity of market regions and retains many favorable geometric and analytical properties. The challenges and advantages of the quadratic-distance model are discussed and compared with existing results obtained under alternative demand assumptions and distance metrics, including discrete-demand models and Manhattan-distance formulations.

Key words | *competitive facility location, price-location competition, Voronoi diagrams, Laguerre tessellation*

A skew-normal benchmark for second-order stochastic dominance portfolio optimization

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Abstract | Stochastic dominance portfolio optimization models commonly rely on empirical benchmark distributions derived from market indices. This paper proposes the use of a skew-normal distribution as a benchmark in second-order stochastic dominance portfolio optimization. The proposed framework allows investors to directly specify desirable distributional characteristics, including expected return, volatility, and skewness, through a small set of benchmark parameters. The resulting optimization model is intended to provide greater flexibility than conventional benchmark-based approaches by enabling benchmark construction independent of specific historical market realizations. The proposed framework preserves the theoretical foundations of stochastic dominance while offering a more transparent way of incorporating investor preferences into the portfolio optimization process.

Key words | *stochastic dominance, portfolio optimization, skew-normal distribution, benchmark distribution*

Acknowledgements | The research project was supported by the Internal Grant Agency, Faculty of Informatics and Statistics, Prague University of Economics and Business [Grant No. IGA F4/18/2024].

Hybrid metaheuristics for d-relaxed temperature-constrained in-store order picking

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Abstract | Quick commerce growth shifted grocery fulfillment to in-store picking. Since labor dominates costs and is mostly walking, shortening routes improves efficiency. We study single picker Fast-Moving Consumer Goods (FMCG) routing under strict temperature priorities (Standard, Fresh, Cold), formulated as an Ordered Clustered Traveling Salesman Problem. As exact methods are tractable only for small baskets (~18 items/class), we solve larger instances via two hybrid metaheuristics: a memetic Genetic Algorithm (GA) and a Greedy Randomized Adaptive Search Procedure-Iterated Local Search (GRASP-ILS), coupling greedy-randomized construction with Iterated Local Search on a corridor graph with all-pairs shortest paths. Both are validated against exact solvers, standalone GRASP, and ILS. To mitigate strict sequencing inefficiencies, we adapt the d-relaxed priority rule, quantifying the distance-degradation tradeoff via a cold exposure penalty. Both algorithms reach exact optima on small baskets, while GRASP-ILS performs best on larger ones. Moderate relaxation ($d=1$) sharply cuts distance with marginal added exposure. Full relaxation ($d=2$), however, yields negligible savings while disproportionately escalating cold chain risks.

Key words | *ordered clustered TSP, GRASP-ILS, d-relaxed priority, cold chain routing*

QUBO formulations for quantum optimization of the traveling salesman problem

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Abstract | Quantum optimization methods rely on binary quadratic models, such as Quadratic Unconstrained Binary Optimization (QUBO) or Ising formulations. Thus, encoding routing problems is an important methodological decision. This work compares QUBO formulations of the Traveling Salesman Problem (TSP) as a step toward Vehicle Routing Problem (VRP) models. We study position-based and directed and undirected edge-based encodings. In the position-based model, tour order is encoded explicitly, so subtours are avoided by construction. In edge-based models, degree constraints alone can produce disconnected cycles. Therefore, we compare models without subtour elimination with single-commodity flow, Miller-Tucker-Zemlin (MTZ), and iterative Dantzig-Fulkerson-Johnson (DFJ) constraints. The formulations are evaluated through Python experiments on small benchmark instances adapted for TSP testing. We compare QUBO size, tour feasibility, and best tour quality. Preliminary results show that position-based encoding gives stable feasibility, whereas edge-based encodings may yield better tour quality, although adding explicit subtour control can substantially increase QUBO size.

Key words | *qubo, traveling salesman problem, subtour elimination, quantum optimization*

A fuzzy programming-based approach for humanitarian aid distribution under demand uncertainty

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Abstract | Effective management of post-disaster humanitarian aid logistics is of critical importance in ensuring that disaster victims can access aid in a timely and safe manner. However, the dynamic and uncertain conditions that emerge in the post-disaster make it extremely difficult to organize aid distribution systems and complicate decision-making. In this context, study addresses demand uncertainty in post-disaster humanitarian aid logistics using a fuzzy programming approach. Thus, by incorporating the uncertain nature of needs at demand points in the disaster area into the model, study proposes a flexible distribution plan. The applicability of the proposed approach is being demonstrated through a case study on the post-disaster aid distribution process. Within the scope of the case study, impact of demand uncertainty on aid distribution decisions is evaluated through scenario analyses. Thus, study offers more resilient and flexible distribution decisions under conditions of uncertain demand in this area. Consequently, the proposed fuzzy programming approach contributes by providing decision-makers with the ability to evaluate alternative planning scenarios under different levels of uncertainty.

Key words | *demand uncertainty, disaster management, humanitarian aid logistics*

Basic stability in interval convex quadratic programming**CYRIL KOTECKÝ**

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Abstract | Basis stability is a well-studied topic in the domain of interval linear programming, where we examine sets of linear programs, defined by intervals within which the coefficients can vary. We define a basis as a subset of the index set of the inequality constraints, determined by which of them are active for a given solution. An optimal basis is associated with an optimal solution, and an interval linear program is stable under a given basis if the basis is optimal for all programs in the set. Basis stability implies some useful properties of the set of optimal solutions, mainly its compactness, connectedness, and convexity. We adapt the notion of basis stability for interval convex quadratic programs, which lend themselves to similar analysis. While basis stability in the quadratic case does not imply convexity of the optimal set, it does guarantee its connectedness and compactness, which in turn makes the set of optimal values a closed interval. Similarly to the linear case, testing basis stability is co-NP-hard, but there are several special cases that can be tested efficiently. Moreover, an efficiently checkable sufficient condition can also be adapted from the linear case.

Key words | *optimization, basis stability, interval analysis, quadratic programming*

A multi-period optimization model for mobile production-based vehicle routing

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Abstract | This study introduces the Multi-Period Mobile Manufacturing-Based Vehicle Routing Problem (MP-MMVRP), where production is carried out not in an existing fixed facility, but along a route in a mobile manufacturing unit mounted on a vehicle. The problem is formulated with an integrated mathematical model that includes capacity constraint, selective service, and production-travel time balance, and is classified in the mixed integer nonlinear programming (MINLP) class. The proposed problem optimizes production and distribution decisions simultaneously; it differs significantly from traditional vehicle routing problems by establishing a binding balance between the travel time of the vehicle between two nodes and the production time that the mobile manufacturing unit can achieve. The objective is to maximize the total profit. The performance of the proposed model was evaluated through a series of computational experiments involving test problems of varying sizes and levels of component complexity.

Key words | *mobile manufacturing, vehicle routing problem, multi-period optimization, 3D printer*

A triple bottom line approach for disassembly line rebalancing under robot failures and maintenance

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Abstract | Disassembly lines play a key role in the implementation of circular economy practices by enabling the recycling and reuse of end-of-life (EOL) products. The disassembly line balancing problem has been widely studied to improve the efficiency of these systems. However, in real-life operations, initial line balances may become ineffective due to unforeseen disruptions such as operational failures, supply-demand fluctuations, and workload variability. Therefore, disassembly line rebalancing has become a necessity. In this context, the disassembly line rebalancing problem under conditions of robot failure and preventive maintenance has been addressed with human-robot collaboration. Additionally, a mixed-integer programming model (MIP) has been proposed to solve the problem using a “triple bottom line” approach, which incorporates the three pillars of sustainability: economic, social, and environmental objectives.

Key words | *disassembly line rebalancing, human-robot collaboration, robot failure and preventive maintenance, triple bottom line approach*

An integrated reverse logistics and additive manufacturing network for end-of-life product recovery

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Abstract | This study addresses an integrated optimization problem that combines disassembly operations, vehicle routing, and additive manufacturing. End-of-life products are processed at multiple distributed disassembly centers to recover reusable components, which are then delivered to customers through vehicle routing operations to satisfy their demands. Since each customer can be served from several disassembly centers, recovered components can be flexibly allocated across the network. However, due to the limited processing time of the disassembly lines, the recovered components may be insufficient to meet all customer demands within the planning period; in such cases, the remaining demand is fulfilled through 3D printing operations. To this end, a mixed-integer nonlinear programming model is developed that simultaneously optimizes disassembly, routing, and additive manufacturing. The objective is to minimize the total cost, including transportation, disassembly, additive manufacturing, inventory holding, and workstation opening costs. Computational results demonstrate that the proposed model effectively coordinates component recovery, distribution and additive manufacturing operations.

Key words | *distributed disassembly center, vehicle routing problem, additive manufacturing, reverse logistics*

Inertia and fairness in medical emergency system

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Abstract | The classical approach to a medical emergency system design consists in minimization of average response time of the system to demands for service. This approach does not consider the worse situated communities. In addition, each system has its history of development. In most regions the service systems had been built up by locating additional ambulances and the change of ambulance locations was rarely done. Since the relationship between the minimized size of communities outside an acceptable response time from the nearest service center and of system modification is not known, a tendency can be observed to keep the current deployment of ambulances as long as possible. This paper attempts to express the cost of inertia by comparing the minimized size of communities outside an acceptable response time calculated for the current number of ambulances with the characteristic of the system in which the original ambulances remain in their original locations and additional ambulances are optimally deployed. We try to answer the question how many ambulances need to be added to achieve the same value of fairness that could be obtained by optimally positioning the original fleet.

Key words | *location problems, emergency services, mathematical modelling, inertia and fairness*

Acknowledgements | This work was supported by Slovak national research grants: VEGA 1/0220/25 “Regional equality in access to public rescue services provided from service centers on the transport network”, VEGA 1/0696/26 “Predictions of delays and vehicle occupancies to inform the planning of public transport”, and VEGA 1/0516/26 “Optimal design of charging infrastructure for electric vehicles and its efficient operation in urban mobility conditions”.

When basis invariancy fails: Tolerance analysis for degenerate linear programs

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Abstract | Tolerance analysis studies how much the coefficients of a linear programming problem can vary while preserving optimality of a given solution. The classical approach is based on basis invariancy and computes tolerances efficiently, but it often yields poor results for degenerate problems. Moreover, determining the maximum tolerances is NP-hard and even hard to approximate. In this talk, we present new lower- and upper-bound methods for the maximum tolerances of objective coefficients under simultaneous and independent perturbations. The approach is based on a novel characterization of the maximum tolerance using tangent and normal cones. Besides direct lower and upper bounds, we also introduce an iterative lower-bound method that progressively improves tolerances obtained from an optimal basis. The proposed methods are further extended to the case of linearly dependent cost coefficients. Their performance is illustrated on a production planning example and assessed through extensive computational experiments on randomly generated LP problems, transportation problems, and Netlib benchmark instances.

Key words | *linear programming, sensitivity analysis, tolerance analysis, robustness*

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Polyhedrality of optimal solution sets in interval linear programming

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Abstract | Interval linear programming provides a natural framework for optimization under uncertainty, where the input data are only known within prescribed bounds. One of the main goals of interval programming is to describe the set of optimal solutions over all admissible realizations. In this talk, we discuss the geometric properties of the optimal sets, with particular emphasis on the question of polyhedrality, i.e. whether they can be represented as a union of finitely many convex polyhedra. For interval programs with a fixed constraint matrix, a previous result proves that the optimal set admits a complementary slackness decomposition into exponentially many polyhedra. While the result yields a simple structural description for the special case, for an interval constraint matrix it leads to nonlinear conditions and parametric dependencies. We thus examine the existence of such representations for more general models allowing uncertainty in the constraint matrix. The talk highlights the obstacles to polyhedrality in the broader setting and explores an alternative approach to overcoming them, leading to a deeper understanding of the geometry of optimal sets under interval uncertainty.

Key words | *linear programming, interval uncertainty, optimal set*

Non-linear min-max problem

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Abstract | The main goal of this study is to present a mathematical approach to advanced service system designing. We address a particular location problem that necessitates consideration of a certain degree of fairness. The analyzed min-max problem encompasses multiple distinct user pools; each attended to by a specific procedure. The quality of each process is assessed using a quantified disutility metric that is contingent upon the amount of provided facilities. The disutility diminishes nonlinearly as the quantity of allocated facilities rises, with the precise nature of the disutility function varying among pools. The aim is to distribute all available facilities among the pools to minimize the maximal disutility across all operations. To find the best way to distribute ambulances among different locations, we convert non-linear models to linear ones and utilize a standard integer programming solver. The theoretical summary with a short case study are the most important results to share.

Key words | *min-max problem, non-linear model, public service system design, standard IP solver*

Acknowledgements | This work was supported by the following Slovak national research grants: VEGA 1/0220/25 “Regional equality in access to public rescue services provided from service centers on the transport network”, VEGA 1/0696/26 “Predictions of delays and vehicle occupancies to inform the planning of public transport”, and VEGA 1/0516/26 “Optimal design of charging infrastructure for electric vehicles and its efficient operation in urban mobility conditions”.

Potential of ridge regularization for portfolio optimization in a small frontier market

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Abstract | The purpose of this research is to test whether ridge regularization improves out-of-sample portfolio performance on a small frontier market relative to equally weighted portfolio, Global Minimum Variance and Minimum Conditional Value-at-Risk. The empirical analysis begins in 2004 and relies on stock returns of all CROBEX index constituents, including a total of 43 CROBEX revisions. Previous research conducted on the constituents of the CROBEX index has shown that the CROBEX index remains a benchmark that is difficult to outperform. Due to the small number of CROBEX constituents and limited sample size, covariance estimation becomes unstable. Ridge regularization addresses this issue by stabilizing covariance estimation by adding a penalty factor that shrinks portfolio weights toward equally-weighting and reducing sensitivity to estimation noise. Improved out-of-sample performance is expected due to the dynamic adjustment of the penalty factor across different market conditions. By allowing the level of regularization to vary between crisis and tranquil periods, the proposed approach aims to achieve a more appropriate balance between estimation stability and portfolio flexibility.

Key words | *ridge regularization, portfolio optimization, out-of-sample estimation, CROBEX*

Acknowledgement | This work was funded by the European Union – NextGenerationEU under Call IIP-581-2025.

Regular session on Multicriteria decision making

A DEX-based assessment model for evaluating enterprise readiness for Data Act implementation

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Abstract | The European Data Act (2023) establishes harmonised rules for fair access to and use of data and supports the development of European data spaces. While the regulatory framework promotes secure data sharing and data sovereignty, empirical evidence indicates that many enterprises remain unaware of the Data Act, rarely participate in data spaces, and approach data sharing primarily from a compliance perspective. Building on a prior qualitative study conducted among ten Slovenian enterprises, we propose a conceptual DEX-based multi-criteria assessment model designed to operationalise enterprise readiness for Data Act implementation. The model organises enterprise readiness in two dimensions: Internal factors (Organizational capabilities, Technological capabilities, Compliance) and External factors (Support environment, Market dynamics, Ecosystem maturity). Each dimension is decomposed into sub-dimensions with qualitatively defined value scales and decision rules, producing a readiness profile that identifies specific developmental gaps and prioritisation pathways. The paper contributes to both theory (structured model) and practice (diagnostic instrument).

Key words | *Data Act, data sharing, enterprise readiness, DEX methodology, multi-criteria decision modelling, data governance*

Acknowledgements | This research was supported by the Slovenian Research and Innovation Agency (ARIS) and the Ministry of Digital Transformation of the Republic of Slovenia under Grant No. V2-24066 — Development of a model

of indicators for measuring the effectiveness of the implementation of the Data Act in data spaces; and by ARIS Program No. P5-0018.

SNAP-based strategic goal prioritization in a Smart Industry pre-incubation center

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Abstract | The Regional Pre-Incubation Center for Smart Industry represents a model of collaboration between higher education, industry, and innovation-driven entrepreneurship. The strategic development of the Center includes goals related to startup ecosystem development, integration of academia and industry, specialization in smart industry domains, talent retention, and the creation of a sustainable innovation environment. Strategic goals will be identified through a focus group involving FOI experts, public sector decision-makers, and private sector representatives. Since the identified goals are interdependent and mutually influential, the SNAP (Social Network Analytic Process) method will be applied for goal prioritization and resource allocation. SNAP combines the Analytic Hierarchy Process (AHP) and the PageRank centrality measure from Social Network Analysis. Expert pairwise comparisons will be used to determine both the relative importance of goals through AHP and the unequal influence among goals through network relations. By aggregating importance and influence values, SNAP generates final priorities that serve as a basis for budget allocation and strategic planning of the Center.

Key words | *Pre-incubation, resource allocation, prioritisation*

Acknowledgements | This work was supported by the European Union through the NextGenerationEU programme, under the call for Institutional Research Projects financed from source 581 – Recovery and Resilience Facility (2025), within the project StartUp.Score: Development of a Model for Deciding

on the Readiness of an Entrepreneurial Venture for Incubation.

On a special property of eigenvalue-minimization-based completion of incomplete pairwise comparison

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Abstract | Pairwise comparison matrices play a crucial role in the Analytical Hierarchy Process (AHP). Early research in this area focused primarily on complete pairwise comparison matrices; however, attention has gradually shifted toward the analysis of incomplete matrices as well. In such cases, the central problem is to determine appropriate values for the missing elements. One widely studied approach is eigenvalue-minimization-based completion, in which the unknown entries are determined so as to minimize the dominant eigenvalue of the completed matrix. Although the optimization framework underlying this method has been available for a long time, its theoretical properties have received comparatively limited attention. In this work, we present new results on the structural properties of the eigenvalue minimization approach. In particular, we highlight a previously unrecognized phenomenon that reveals a paradoxical aspect of the method.

Key words | *pairwise comparison, eigenvalue method, optimization*

**Regular session on Optimization in human
environment**

A multi-objective mixed-integer programming model for noise-aware drone-assisted last-mile delivery

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Abstract | The increasing use of unmanned aerial vehicles (UAVs) in last-mile delivery has highlighted the need to consider environmental impacts alongside operational performance. While existing truck-drone routing models primarily focus on minimizing transportation cost or delivery time, the effect of drone noise has received limited attention. This paper presents a mixed-integer programming model for the Flying Sidekick Traveling Salesman Problem (FSTSP) that incorporates drone noise into the routing process. The problem is formulated as a multi-objective optimization model to simultaneously minimize transportation cost and noise exposure. By considering noise as an optimization objective rather than a post-optimization evaluation measure, the proposed model supports more sustainable routing decisions for drone-assisted last-mile delivery. The proposed framework addresses an important gap in the literature and provides a basis for incorporating environmental noise into future truck-drone routing models.

Key words | *Last-mile delivery, Flying Sidekick Traveling Salesman Problem (FSTSP), Multi-objective optimization, Drone noise*

Maximizing revenue through optimized patient scheduling on a linear particle accelerator

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Abstract | Patient scheduling is regarded as one of the most important and most complex tasks in hospital management, given the range of restrictions imposed by medical machines, patient diagnoses, and hospital staff. Scheduling patients manually on a first-come, first-served basis can create substantial opportunity costs for hospitals whose expensive, state-of-the-art diagnostic and treatment equipment must be utilized at maximum capacity. This paper develops a simple 0–1 linear integer programming model that optimizes the scheduled patient mix to maximize the revenue generated by a linear particle accelerator. The decision variables assign patient treatments to time slots, subject to constraints on daily machine capacity, limitations that keep each specialty within $\pm 15\%$ of its historical share of machine time, priority requirements for urgent treatments, and the peer-review capacity of the physicist–physician pipeline. Using real scheduling data from a single accelerator and illustrative treatment prices, the optimized schedule is compared against the current practice of a radiotherapy department at a private hospital.

Key words | *linear integer programming, healthcare scheduling, linear accelerator, revenue optimization*

Trust, explainability, and digital resilience in human-centred AI-assisted cybersecurity

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Abstract | Artificial intelligence (AI) is becoming an important component of contemporary cybersecurity systems, supporting threat detection, automated incident response, and user-oriented cybersecurity assistance. The emergence of generative AI (GAI), large language models (LLMs), and interactive AI systems further expands AI-supported decision-making for everyday users. However, most AI-assisted cybersecurity solutions are still evaluated primarily from technical perspectives, while user trust, transparency, explainability, and responsible AI adoption remain underexplored. This paper addresses this research gap through a human-centred, interdisciplinary perspective that integrates cybersecurity, trustworthy AI, explainable AI (XAI), behavioural cybersecurity, and digital resilience. The paper proposes a conceptual framework connecting transparency, explainability, user trust, responsible AI adoption, and digital resilience in AI-assisted cybersecurity environments. Attention is devoted to everyday users, who often lack advanced technical knowledge yet remain primary targets of phishing and social engineering attacks. *ared against the current practice of a radiotherapy department at a private hospital.*

Key words | *trustworthy AI, user trust, digital resilience, behavioural cybersecurity*

Acknowledgements | This work was supported by the Slovenian Research and Innovation Agency (ARIS) through the following research projects and programmes: project J5-60085 Bridging the Digital Divide – A Cybersecurity Competence Framework for Older Adults; project L5-50163 Assessing and Strengthening Information Security Culture among Essential Service Providers: Analysis of Organisational Factors in Cyber Threat Re-silience; and research programme P5-0397 Safety and Security in Local Communities – Comparison of Rural and Urban Environments.

Regular session on Mixed OR methods

Fair division of indivisible goods on graphs and other structures

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Abstract | The talk studies the fair division of indivisible goods when allocations must satisfy structural constraints or when the perception of fairness is restricted by a combinatorial structure, such as a graph. In particular, we consider settings in which feasible bundles must satisfy specific graph-based constraints, or agents compare their allocations only with those of their neighbors in a graph. Our main focus is on the fairness notions of envy-freeness up to one good (EF1), envy-freeness up to any good (EFX), and the Maximin Share (MMS) guarantee. We present several existence results, describe algorithms for computing fair allocations, and illustrate them with illustrative examples.

Key words | *constrained fair division, EFX, EF1, MMS*

Acknowledgements | This research was funded by the National Science Centre, Poland (grant number: 2023/51/B/HS4/00829).

Exact maximin share allocations in permutation domains**MACIEJ BARTKOWIAK**

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Abstract | We study fairness in the allocation of indivisible goods through two related concepts: envy-freeness up to any good (EFX), and the maximin share (MMS) guarantee. Our main result establishes the existence of exact MMS allocations in a permutation domain, where every agent assigns the values $(1, \dots, m)$ to the goods in an individual order. The allocation is obtained by a sequential picking algorithm derived from a balanced partition of ranks.

Key words | *Envy freeness, maximin fair share guarantee, fair division, indivisible goods*

Acknowledgements | This research was funded by the National Science Centre, Poland (grant number: 2023/51/B/HS4/00829).

Financial literacy across countries: Multilevel analysis of the OECD/INFE 2023 survey

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Abstract | Can financial literacy be explained solely by individual characteristics, or does national context also matter? Using harmonised data from 29 countries and economies in the OECD/INFE 2023 survey, this study investigates variation in financial knowledge, behaviour, attitudes, and overall financial literacy, calculated following the OECD/INFE 2023 report methodology. Two-level random-intercept models were estimated separately for all four outcomes. Empty models revealed country-level clustering, strongest for financial knowledge and overall financial literacy. Extended models included gender, age, education, and employment status at the individual level and GDP per capita (PPP) at the country level. Individual characteristics were associated with the outcomes, with education showing the strongest and most consistent associations. Higher national economic development was associated with greater financial knowledge and overall financial literacy, but not with financial behaviour or attitudes. The findings show that national context contributes differently across dimensions of financial literacy, supporting a multilevel approach and further examination of country-level determinants.

Key words | *financial literacy, financial knowledge, multilevel modelling, national context*

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Artificial intelligence and the transformation of work in banking

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Abstract | The rapid diffusion of Artificial Intelligence (AI) is reshaping the banking industry, yet research on employees' acceptance of AI and its consequences for organizational outcomes remains limited. This study examines how AI adoption influences banking employees, their productivity, and overall organizational performance. Drawing on technology acceptance theory and organizational behavior, it investigates the determinants of AI acceptance among employees and the mechanisms through which AI-enabled productivity gains translate into firm-level results. The research is conducted on a sample of banks operating in Croatia, using Partial Least Squares Structural Equation Modeling (PLS-SEM) to test the proposed relationships. The findings are expected to show that employee acceptance drives AI use, which enhances productivity and engagement, thereby mediating the effect of AI adoption on organizational performance, including sales, customer satisfaction, and innovation capacity. The study offers theoretical contributions and managerial guidance for effective AI implementation in banking.

Key words | *artificial intelligence, banking, PLS-SEM*

Acknowledgements | This research was funded by European Union – NextGenerationEU. This paper is the result of research conducted within the project “Društvene dimenzije monetarne i digitalne transformacije (DDMDT)” (Social Dimensions of Monetary and Digital Transformation), funded from source 581 – Recovery and Resilience Mechanism. Disclaimer: The views and opinions

expressed are solely those of the author(s) and do not necessarily reflect the official position of the European Union or the European Commission. Neither the European Union nor the European Commission can be held responsible for them.

Comparative analysis of the tax burden on short-term rentals in tourism

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Abstract | Short term rentals constitute a significant yet increasingly contested component of Mediterranean tourism systems. While they contribute to household income, they simultaneously intensify fiscal, housing, and destination level pressures. This paper evaluates the tax burden borne by small scale family accommodation providers in Croatia and compares it with regulatory and fiscal arrangements in Italy, Spain, Greece, and Portugal. The analysis draws on legal and regulatory frameworks, official statistical and administrative sources. The results show that Croatia continues to apply a simplified lump sum taxation model based on accommodation capacity, whereas the 2025 reform enhances local discretion and introduces a mandatory property tax. In contrast, competing countries rely more extensively on income sensitive taxation, local levies, licensing regimes, and digital reporting systems. The findings highlight the importance of maintaining simplified tax treatment for small family run providers, while strengthening the differentiation of commercial multi unit operators and linking higher local charges to destination level and housing related benefits.

Key words | *tourism, short-term rental, private accommodation, tax burden, Croatia*

Acknowledgements | This research was funded by European Union – NextGenerationEU. This paper is the result of research conducted within the project “Društvene dimenzije monetarne i digitalne transformacije (DDMDT)” (Social

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Periodic arc routing with synchronization of service modes

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Abstract | Arc routing problems arise in applications where service is performed along the arcs of a network instead of visiting specific customer locations. A classical variant is the Capacitated Arc Routing Problem (CARP), in which daily vehicle routes are constructed subject to capacity limits. CARP is often used in areas like municipal waste collection or winter road maintenance. However, such activities are usually not carried out for independent days, but are planned over a longer horizon. This extension is tackled by the Periodic CARP (PCARP), where the repeated services of arcs must satisfy a certain frequency or visit pattern over the planning horizon. Synchronization of CARP has also been studied, where an arc has to be serviced by multiple vehicles or service modes on a given day, and routes are constructed subject to the dependencies of these visits. This presentation combines the above concepts and introduces a model for the Synchronized Periodic CARP (S-PCARP), integrating periodic service planning with the synchronization of service modes. This model will be tested on benchmark datasets from the literature.

Key words | *arc routing, MILP, street cleaning*

Acknowledgements | This work has been supported by the European Commission's Horizon Europe Research and Innovation programme through the Marie Skłodowska-Curie Actions Staff Exchanges (MSCA-SE) under Grant Agreement no.101182819 (COVER: (C)ombinatorial (O)ptimization for (V)ersatile Applications to (E)merging u(R)ban Problems). The author is also gratefully acknowledges the support of the Slovenian Research and Innovation Agency (ARIS) through grants N2-0486 and N2-0434, and the combined support of the Slovenian Research and Innovation Agency (ARIS) and the Ministry of the Economy, Tourism and Sport (MGTŠ) through the grant V4-2512.

Organizational performance analysis: Empirical findings from primary and secondary schools in Croatia

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Abstract | This paper examines the organizational performance of educational institutions and analyzes the factors that constitute their performance, as well as the level and structure of organizational performance within these institutions. The research objectives are verified through a comprehensive review of the relevant literature, which identifies the specific dimensions and determinants of performance in educational institutions. The level and structure of organizational performance were empirically examined using a sample of Croatian educational institutions. Within the framework of this study, a performance measurement instrument was developed and validated through confirmatory factor analysis in the context of principals of primary and secondary schools in Croatia. The results indicate that the overall model demonstrated a satisfactory level of statistical significance and validity. The findings confirm the adequacy of the measurement model, enabling the assessment of organizational performance in educational institutions and facilitating its examination in relation to other relevant organizational constructs.

Key words | *organizational performance, educational institutions, school principals, Croatia*

Do future employees value all ESG dimensions equally? The effects of ESG perceptions on employer attractiveness

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Abstract | Employer branding has become a strategic tool for attracting and retaining talented employees in an increasingly competitive labor market. Recent studies highlight that a positive employer image significantly influences applicants' perceptions, facilitates recruitment processes, and strengthens organizational attractiveness. At the same time, growing attention to environmental, social, and governance (ESG) practices has reshaped how prospective employees evaluate potential employers. Despite the increasing importance of ESG in organizational communication and employer branding, limited research has explored how ESG perceptions influence employer attractiveness and employment intentions among students entering the labor market. This study addresses this gap by examining the relationships between ESG perceptions, employer attractiveness, and students' intention to apply for and work for a desired employer. Using PLS-SEM, the results show that ESG perceptions positively affect employer attractiveness, which in turn positively influences students' intention to apply for and seek employment with a preferred employer. ESG was modeled as a higher-order construct, capturing students' overall perceptions of an employer's ESG orientation. Additional analyses reveal significant differences in the evaluation of ESG dimensions, with Social factors receiving the highest ratings, followed by Governance, while Environmental factors are evaluated less positively. Overall, students perceive ESG primarily as a holistic indicator of a responsible and attractive employer.

Key words | *ESG, employer attractiveness, employer branding, PLS-SEM*

Acknowledgements | This research was funded through the European Union's Erasmus+ project: The ESG Imperative for the Project Management World: Alliance for Developing and Empowering Changemakers (ESG4PMChange)

under grant agreement No. 101187376.

A comparative study of e-commerce and e-sports-related digital purchasing behavior

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Abstract | The rapid advancement of digitalization has significantly increased digital purchasing activities across both traditional commerce and the gaming and e-sports sectors. E-commerce encompasses the transaction of goods and services via digital platforms or applications, whereas e-sports commerce, a subset of e-commerce, pertains to the acquisition of in-game digital items and services within the e-sports ecosystem. Consequently, e-sports commerce maintains a significant position within the digital economy. This study aims to comparatively examine consumer perceptions of e-commerce and e-sports commerce, both of which are elements of the digital commerce ecosystem. To accomplish this, consumer attitudes were measured using a survey that included five dimensions: need-based consumption, addiction, prestige, the impact of social media, and an investment-oriented approach. Ultimately, this study contributes by offering a comparative perspective on consumers' behavioral perceptions within the traditional e-commerce and e-sports commerce ecosystems.

Key words | *e-commerce, e-sports commerce, digital purchasing behavior, consumer perception*

Acknowledgements | The authors acknowledge the support of the E4PROSPERITY project, "Professional Roadmap and Opportunities for

Sustainable Participation in E-sports for the Youth” (Project No. 2023-2-TR01-KA220-YOU-000179757), co-funded by the Erasmus+ Programme of the European Union.

**Where defense euros create value: FIGARO evidence
from Austria and Slovakia**

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Abstract | This paper estimates the economic effects of higher defense procurement in Austria and Slovakia using a multi-country input-output model based on Eurostat FIGARO tables. A EUR 1 billion final demand shock is allocated across alternative defense baskets and sourcing regimes, and the resulting Leontief output effects are converted into domestic value added and cross-border spillovers through sectoral value added coefficients. The results show that headline spending substantially overstates domestic economic gains when procurement relies on imported inputs. Under current sourcing patterns, broad defense procurement generates domestic value added multipliers of only 0.186 in Austria and 0.067 in Slovakia. European joint procurement improves retention modestly, to 0.240 and 0.084, respectively, while a home production benchmark raises them to 0.499 and 0.390. The findings indicate that the growth impact of defense spending depends less on the size of the budget increase than on procurement composition, sourcing geography, domestic supplier capacity and the ability to retain value added within national and European production networks.

Key words | *defense spending, input-output models, multipliers*

Acknowledgements | This paper was financially supported by the PostDoc-Grant project no. APD0215 of the Slovak Academy of Sciences and project VEGA 2/0165/24.

**Pure technical efficiency and its determinants: A
two-stage analysis of public general high schools in Croatia**

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Abstract | This paper offers a two-stage empirical framework to assess the pure technical efficiency (PTE) of all public general high schools (PGHS) in Croatia in the 2024/2025 school year in transforming observable educational resources into measurable academic outcomes. In the first stage, it applies an output-oriented BCC model using Data Envelopment Analysis (DEA) to estimate efficiency scores using two inputs (total non-labour expenditures and number of teachers) and four outputs (average state graduation exam performance in three compulsory subjects and graduation passing rate). This stage provides a measure of the relative efficiency of each PGHS and the potential scope for output improvements given existing resource levels. The second stage, using Simar-Wilson double bootstrap regression, examines the determinants of efficiency using the DEA inefficiency score as the dependent variable. Explanatory variables include school size (number of pupils and pupil-teacher ratio), the city's level of development, the city's fiscal capacity, the city's population, and a proxy for pupils' academic achievement before entering PGHS, which allows us to separate efficiency differences from pupil selection effects. The results indicate that overall PTE among Croatian PGHS is very high, with relatively small differences between most PGHS and the efficiency limit. In the second stage, only Mathematics achievement before entering PGHS

is statistically significant at the 5% level. These findings suggest that pre-entry mathematics achievement is an important factor associated with differences in PGHS efficiency, highlighting the potential importance of strengthening students' mathematical competencies before entry into secondary education. A second important policy recommendation is that it is important to account for pupils' academic achievement before entering school when evaluating a school's efficiency.

Key words | *public general high schools, DEA, Simar-Wilson double bootstrap, Croatia*

Workshop

YURI NESTEROV & GORAN LEŠAJA

Introduction to Interior-Point Methods

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Abstract | Interior-point methods (IPMs) have become a standard component of modern optimization software packages, yet many graduate students encounter these powerful algorithms only indirectly—through solvers—without a clear understanding of the underlying theory. This two-hour workshop aims to bridge that gap by introducing the basic elements of IPMs for linear optimization and generalizations to convex (conic) optimization in an accessible and self-contained manner.

The first part of the workshop will cover fundamental concepts such as the central path, neighborhoods of the central path, the role of Newton’s method in determining the search directions, and convergence and polynomial complexity of IPMs for linear optimization.

The second part of the workshop will cover generalizations of IPMs to convex (conic) optimization problems via fundamental concepts of self-concordant functions and barriers.

In the third part of the workshop, optimization software package MOSEK will be used to illustrate the performance of IPMs on several examples from linear and conic optimization, giving participants concrete insight into how IPMs work in practice. The hard copy of the “MOSEK modeling-cookbook” will be available for the participants of the workshop.

No prior knowledge of IPMs is assumed; a solid background in linear algebra and basic calculus is sufficient. The workshop is intended primarily for researchers, as well as students, who wish to gain a basic understanding of one of the most widely used algorithmic frameworks in modern optimization.

Key words | *interior-point methods, fundamentals and generalization*

**Special methodological workshop for
postgraduate students**

The impact of uncertainty on capital market volatility in Central and Eastern Europe

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Abstract | This study examines the impact of different forms of uncertainty on capital market volatility in Central and Eastern European (CEE) countries. Unlike previous research, which typically focuses on a single source of uncertainty, this paper compares the relative importance of multiple uncertainty indicators, including the Economic Policy Uncertainty (EPU) Index, Financial Stress Index (FSI), World Uncertainty Index (WUI), Geopolitical Risk Index (GPR), and Tourism Uncertainty. The analysis recognizes that CEE countries differ in financial market development, economic structure, and exposure to external shocks, suggesting heterogeneous effects across markets. Particular attention is given to whether tourism-related uncertainty exerts a stronger influence on countries with tourism-dependent economies, such as Croatia. Methodologically, the study applies both GARCH-X and GARCH-MIDAS models to evaluate the impact of uncertainty indicators and to assess whether incorporating a long-run volatility component improves model performance. The findings are expected to provide new evidence on the determinants of stock market volatility and the suitability of alternative volatility models in emerging capital markets.

Key words | *capital market volatility, uncertainty, GARCH-MIDAS, GARCH-X, Economic Policy Uncertainty, Geopolitical Risk, Central and Eastern Europe*

A two-stage hybrid framework for evaluating innovative products in wood value chains

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Abstract | Wood value chains for different quality grades are well established, and lower-quality roundwood is usually used for energy. However, these grades could also supply new, innovative products, whose production would compete for the same facilities and capacities as the traditional ones. This presentation studies the impact of adding such new products using a two-stage hybrid framework. Stage one builds a production plan for the traditional chains alone, utilizing a multi-objective MILP combining facility location with material-flow allocation across a multi-echelon network, reusing processing residues and weighing cost against environmental impact. Because these products are hypothetical and their transformation processes highly uncertain, stage two introduces them into a discrete-event simulation that stress-tests the plan under stochastic supply, yield and residue-reuse variability, against the traditional-only baseline. The system is tested across different scenarios that vary the share of traditional production the innovative products replace and the level of uncertainty in the system.

Key words | *wood value chain, facility location, discrete-event simulation, multi-objective optimisation*

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Agency (ARIS) and the Ministry of the Economy, Tourism and Sport (MGTŠ) through the grant V4-2512.

Exploring the link between ESG performance and Taxonomy-eligible investments in the European Union

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Abstract | The establishment of the EU Taxonomy represents one of the most significant regulatory initiatives in the field of sustainable finance, introducing a unified and transparent framework for the classification of environmentally sustainable economic activities. This study investigates the link between ESG performance and how capital expenditures (CapEx) are reported under the EU Taxonomy among publicly listed companies in the European Union. The analysis covers the 2024 financial year, the first financial year for which mandatory Taxonomy eligibility and alignment disclosures encompass all six environmental objectives. ESG data are obtained from the LSEG database, while taxonomy-related investment data are manually collected from annual and sustainability reports. Given the bounded nature of the dependent variable and the strong sectoral determination of taxonomy eligibility, the analysis relies on estimation methods appropriate for proportions and accounts for differences across sectors. The findings contribute to a better understanding of the relationship between corporate ESG performance and investment behaviour in the context of EU Taxonomy-eligible activities.

Key words | *ESG performance, EU Taxonomy, sustainable finance*

**Governance and urban development in Riyadh:
Policymaker insights on sustainable urban growth under
Vision 2030**

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Abstract | This paper examines urban development governance in Riyadh under Vision 2030, based on interviews with policymakers across municipal, regulatory, and national institutions. Using a transition management framework, the study shows how institutional centralization, particularly through the Royal Commission for Riyadh City, has accelerated investment and strengthened institutional capacity, while also exposing persistent challenges in cross-agency coordination, transparency, data management, and balancing growth with affordability. The paper argues that Riyadh offers a timely case for understanding the links between centralized governance, urban sustainability, and institutional resilience in rapidly transforming cities, and it proposes policy pathways to align local development with national sustainability goals.

Key words | *Urban Sustainability management governance*

About KOI

The **International Conference on Operational Research (KOI)** is the major event organized by the Croatian Operational Research Society (CRORS) since 1991. In the period from 1991 - 1996 it was organized annually, while from the 1996 onwards it is organized every two years.

Aims and scope

The objective of the KOI conference is to bring together researchers and practitioners from operational research and related scientific disciplines (such as applied mathematics, statistics, quantitative methods in business, simulations, and machine learning) for introducing new operational research achievements in business process improvement. Conference topics include linear and non-linear programming, combinatorial and discrete optimization, multi-objective programming, stochastic models, game theory, statistics, econometrics, information and decision support systems, neural networks and fuzzy systems, data mining, business analytics, control theory simulations, practical OR and applications. Main intention of the conference is to exchange ideas and experiences through direct contacts with researches of common interest, particularly including young researchers in improving their scientific work. Main intention of the conference is to exchange ideas and experiences through direct contacts with researches of common interest, particularly including young researchers in improving their scientific work.

20 KOI conferences were successfully held so far in different cities of Croatia settled at the beautiful Adriatic seaside or in the continental part of Croatia, such as: Brela, Rovinj, Rab, Trogir, Pula, Split, Šibenik, Zadar, Zagreb and Osijek. From 1991-2008 the papers that were presented at the conference and positively reviewed, were published at the conference proceedings. From 2010 and further, the accepted papers are published in the **Croatian Operational Research Review (CRORR)** journal which is indexed in relevant databases. Book of Abstracts from the conference is also published and distributed at the conference.

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- KOI 2024 - 20th International Conference on Operational Research, September 25-27, 2024 in Brela, Croatia
- KOI 2022 - 19th International Conference on Operational Research, September 28-30, 2022 in Šibenik, Croatia
- KOI 2020 - 18th International Conference on Operational Research, September 23-25, 2020 in Šibenik, Croatia
- KOI 2018 - 17th International Conference on Operational Research, September 26-28, 2018 in Zadar, Croatia
- KOI 2016 - 16th International Conference on Operational Research, September 27-29, 2016 in Osijek, Croatia
- KOI 2014 - 15th International Conference on Operational Research, September 24-26, 2014 in Osijek, Croatia
- KOI 2012 - 14th International Conference of Operational Research, September 26-28, 2012 in Trogir, Croatia
- KOI 2010 - 13th International Conference of Operational Research, September 29-October 1, 2010 in Split, Croatia
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- KOI 2006 - 11th International Conference on Operational Research KOI 2006, September 27-29, 2006, Pula, Croatia
- KOI 2004 - 10th International Conference on Operational Research KOI 2004, September 22-24, 2004, Trogir, Croatia
- KOI 2002 - 9th International Conference on Operational Research KOI 2002, October 2-4, 2002, Trogir, Croatia
- KOI 2000 - 8th International Conference on Operational Research KOI 2000, Rovinj, Croatia
- KOI 1998 - 7th International Conference on Operational Research KOI 1998, September 30-October 2, 1998, Rovinj, Croatia

- KOI 1996 - 6th International Conference on Operational Research KOI 1996, Rovinj, Croatia
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We are pleased to invite all academicians, practitioners and particularly young researchers, as well as students, interested in all branches of operational research, mathematical modelling and economic analysis to participate in the conference by presenting their papers and exchanging ideas in order to improve the quality of the scientific work in this area.

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- to publish a scientific journal Croatian Operational Research Review (CRRR).

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