



Department of Civil Engineering
University of West Attica



HELORS

HELLENIC OPERATIONAL
RESEARCH SOCIETY

9th International Symposium & 31st National Conference on Operational Research (HELORS 2023)

June 29-30 and July 1, Athens, Greece



Book of Abstracts

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1. Welcome



Nikolaos Matsatsinis
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1.1 President of HELORS

Dear Colleagues and Dear Friends,

On behalf of the Hellenic Operational Research Society (HELORS), let me warmly welcome you to our country and to HELORS 2023, the 9th International Symposium and 31st National Conference on Operational Research. We would like to offer a warm welcome to participants from countries around the world.

The Hellenic Operational Research Society (HELORS - www.eeee.org.gr) was founded in 1963, with the objective of promoting the study and applications of Operational Research methodology, for the benefit of the Hellenic economy and society. HELORS is a member of the 'Association of European Operational Research Societies - EURO' within IFORS, the 'International Federation of Operational Research Societies'. In 1984, the Macedonia-Thrace annex was founded, aiming primarily at the growth of Operational Research in the greater area of Balkans and at an improved organization and communication of the members of Northern Greece.

In the sixty years since its inception, HELORS has evolved into a scientific entity with an important presence in the scientific and economic life of the country, with hundreds of members that stand out for their theoretical background, their entrepreneurial endeavors, and their professionalism. Our members are mainly engineers, mathematicians, economists, etc. Over 35% of the members hold an MSc in Operational Research / Business Administration, and 40% hold a PhD. The rest are PhD candidates, postgraduate students, and undergraduate students.

During these years, our society presents a wide range of activities. Among them, HELORS publishes in collaboration with Springer, the scientific journal 'Operational Research' with IF 2021: 2,708, in which we invite you to consider submitting your valuable work. HELORS has organised in various Greek cities thirty (30) National Conferences, of which the last eight (8) are international conferences, and six (6) Balkan Conferences on Operational Research (BALCOR). It has organised the 12th International Conference on Operational Research of IFORS in Athens (June 1990), the European Conference EURO XX in Rhodes (July 2004) and the 31st European Conference of EURO in Athens (July 2021)

In closing, I would like to thank the University of West Attica, the Conference Chairs, the Organizing and Scientific Committees, and those who worked and contributed to the success of this conference.

Above all, I would like to thank all of you who, with your participation contribute to the advancement and dissemination of operational research.

Let's enjoy the Conference.

Nikolaos Matsatsinis

President of HELORS



Isaak Vryzidis

General Chair of the Conference organising committee

University of West Attica

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1.2 Chair of the HELORS 2023 Organisation Committee

Dear Colleagues and Dear Friends,

On behalf of the Organizing Committee, I am very pleased and proud to welcome you to the University of West Attica, host of the 9th International Symposium and 31st National Conference on Operational Research.

I would like to thank the Hellenic Operational Research Society for entrusting us with the organisation of HELORS 2023. Organising such a great conference is a great honour for the Department of Civil Engineering but also a challenge. When we were appointed to organise this conference, we accepted the challenge of organising the first conference of HELORS on site since the beginning of the COVID-19 crisis. Our target was to provide an atmosphere capable of facilitating networking, debate, and presentation of new applications and advances in OR.

Unfortunately, the uncertainty caused by the different possible dates of Greece's National Elections forced us to constantly review our goals and plans. In these dynamic conditions, we decided to organise the conference in the last week of June and set as our primary goal to hold a successful conference. To achieve this, we increased the degrees of freedom of the conference participants by giving them more opportunities to make decisions about their participation as close to the conference dates as possible. This was made possible by postponing the submission deadlines, registrations and changes as late as possible.

We knew that with these key decisions, we faced a significant risk for the conference's success, but with the hard work of the Organizing Committee, the Program Committee, and the HELORS, we turned this into a great success in the current circumstances.

The result of this effort is the correspondence from more than 170 authors and co-authors from 18 countries and the submission of more than 80 papers. The schedule promises to be exhausting, and we hope we managed to achieve the desired atmosphere for interacting with old and new friends and make your participation in the conference a memorable and fruitful experience.

Welcome to the University of West Attica.

Isaak Vryzidis

General Chair of the Conference organising committee

2. Organisation

The [Hellenic Operational Research Society](#) (HELORS) and the [Department of Civil Engineering of University of West Attica](#) are organising the conference with the contribution of the Postgraduates programs of the University of West Attica.



HELORS
HELLENIC OPERATIONAL
RESEARCH SOCIETY



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University of West Attica



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Civil Engineering Department,
University of West Attica



MSc in Health and Social Care
Management
Business Administration Department,
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MSc in Business Administration (MBA)
Business Administration Department,
University of West Attica



MSc in Management of Educational
Organisations
Business Administration Department,
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MSc in Operations Management
Tourism Management Department, UNIWA
Wine, Vine & Beverage Sciences Department UNIWA
Production Engineering & Management School, TUC



MSc in Digital Transformation and
Educational Practice
Informatics and Computer Engineering
Department, University of West Attica
Educational Studies Department, National
& Kapodistrian University of Athens
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MSc in Information Technology and
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2.1 Organising Committee

General chair

Isaak Vryzidis	University of West Attica	Greece
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Ypsilantis, P.	University of Thessaly	Greece
Zazanis, M.	Athens University of Economics and Business	Greece
Zeimpekis, V.	University of the Aegean	Greece
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Ziakis, Ch.	University of Macedonia (Greece)	Greece
Ziliaskopoulos, A.	University of Thessaly	Greece
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2.3 Secretariat

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3. Conference Programme

3.1 Invited Plenary Speaker



Professor Christos H. Papadimitriou

DONOVAN FAMILY PROFESSOR OF COMPUTER SCIENCE, COLUMBIA UNIVERSITY, USA

Central Amphitheatre, Room 1
Thursday, June 29, 11.30-12.30

One of world's leading computer science theorists, Christos Papadimitriou is best known for his work in computational complexity, helping to expand its methodology and reach. He has also explored other fields through what he calls the algorithmic lens, having contributed to biology and the theory of evolution, economics, and game theory (where he helped found the field of algorithmic game theory), artificial intelligence, robotics, networks and the Internet, and more recently the study of the brain.

Research Interests

Theory of algorithms and complexity, and its applications to the study of databases, optimization, AI, the Internet, game theory, evolution, and the brain

Research Areas

Algorithms, Artificial Intelligence, Computing Systems, Data Science, Neuroscience & Neuroengineering, Robotics, Sustainable Humanity: Water, Healthy Humanity, Connected Humanity, Creative Humanity

3.2 Programme Overview

CONFERENCE PROGRAM – WEEK OVERVIEW

June 29-30 and July 1, 2023

	Thursday, June 29, 2023	Friday, June 30, 2023	Saturday, July 1, 2023
9:00	Registration open 09:00 - 11:00	<u>Parallel Sessions IV</u> Session 9: Mathematical Modeling & Optimization Session 10: Urban Planning & Sustainability Session 11: Organizational Processes	<u>Parallel Sessions VIII</u> Session 19: OR & Covid-19 Session 20: MCDA in Education: Enhancing Decision-Making & Educational Quality Session 21: OR Applications II
9:15			
9:30			
9:45			
10:00			
10:15			
10:30			
10:45			
11:00			
11:15	Opening Session / HELORS Awards and Prizes	Coffee Break	Closing session
11:30			
11:45	Plenary Speech <i>Christos H. Papadimitriou</i>	<u>Parallel Sessions V</u> Session 12: OR in Social Care Management Session 13: Environmental Management Session 14: OR in Structural Engineering	Closing session
12:00			
12:15			
12:30			
12:45	Coffee Break	LUNCH	Closing session
13:00	<u>Parallel Sessions I</u>		
13:15	Session 1: Decision Making Applications		
13:30	Session 2: DEA & Data Analysis	<u>Parallel Sessions VI</u> Session 15: OR Applications I Session 16: Logistics	Closing session
13:45			
14:00	Session 3: Operations Management & Optimization		
14:15	LUNCH	<u>Parallel Sessions VII</u> Session 17: OR and Customer Satisfaction Session 18: OR in Educational Management	Closing session
14:30			
14:45	<u>Parallel Sessions II</u>	Coffee Break	Closing session
15:00			
15:15	Session 4: OR in Energy	<u>Parallel Sessions III</u> Session 7: MCDA & DSS	Closing session
15:30			
15:45	Session 5: OR & Digital Business	Session 8: MCDA Applications	Closing session
16:00			
16:15	Session 6: Data Analysis	GALA DINNER	Closing session
16:30			
16:45	Coffee Break	GALA DINNER	Closing session
17:00			
17:15	<u>Parallel Sessions III</u>	GALA DINNER	Closing session
17:30			
17:45	Session 7: MCDA & DSS	GALA DINNER	Closing session
18:00			
18:15	Session 8: MCDA Applications	GALA DINNER	Closing session
18:30			
18:45	GALA DINNER	GALA DINNER	Closing session
19:00			
19:30	GALA DINNER	GALA DINNER	Closing session
20:00			

CONFERENCE PROGRAM – DAY OVERVIEW

Thursday, June 29, 2023

University of West Attica Conference Center, Ancient Grove Campus

20 min of Presentation + 5 min of Q/A

09:00 – 11:00	Registration	
11:00 – 11:20	Opening and welcome address (Central Amphitheatre) <i>Isaak Vryzidis, Dimitrios Em. Alexakis, Vassilios C. Moussas</i>	
11:20 – 11:30	HELORS Awards and Prizes (Central Amphitheatre) <i>Nikolaos Matsatsinis</i>	
11:30 – 12:30	Invited Plenary Speaker (Central Amphitheatre) <i>Professor Christos H. Papadimitriou</i>	
12:30 – 12:45	Coffee Break	
12:45 – 14:30	Parallel Sessions	
Session 1 Room 1	Decision Making Applications	<i>Chair: Takis Varelas</i>
12:45 – 13:10	MCDA in the Context of Health Technology Assessment (HTA). <i>Ioannis Agorastos, Elpida Pavi and Kostas Athanasakis</i>	
13:10 – 13:35	A discount-enabled mixed integer linear programming model with discrete states of changeover costs for the production planning of a steel tube mill. <i>Paraskevas Georgiou and Nikolaos Tsaparas</i>	
13:35 – 14:00	Optimizing complexus Bunkering Plan Plan B. <i>Artemis Flori, Dimitris Kaklis and Takis Varelas</i>	
14:00 – 14:30	Turn Benefit of Doubt to trustworthiness of MCDA. <i>Takis Varelas, Dimotikalis John, Dimitris Kaklis, Sofia Archontaki and Artemis Flori</i>	
Session 2 Room 2	Data Envelopment Analysis and Data Analysis	<i>Chair: Maria Trnovska</i>
12:45 – 13:10	Advanced preprocessing methods for large-scale Data envelopment analysis. <i>Terézia Fulová, Mária Trnovská and Lenka Filová</i>	
13:10 – 13:35	Utilizing Process Mining Techniques to Improve Chemotherapy Treatment for Breast Cancer Patients. <i>Fatin Ramli</i>	
13:35 – 14:00	Prospects from a European Study on OR/MS Education - The Transition of Graduates onto the Labor Area. <i>Joao Luis de Miranda</i>	
14:00 – 14:30	Path-based models in Data envelopment analysis. <i>Maria Trnovska and Margareta Halicka</i>	
Session 3 Room 3	Operations Management & Optimization	<i>Chair: Iris Forma</i>
12:45 – 13:10	Treatment effect estimation of initial attack activities in wildfire suppression. <i>Mostafa Rezaei, Ilbin Lee and Jen Beverly</i>	
13:10 – 13:35	An Iterative Matheuristic for the Traveling Purchaser Problem with Fast Service Option. <i>Mustafa Avci</i>	
13:35 – 14:00	Building Wildfire Resilience into the Forest Road Network Design. <i>Mualla Gonca Avci</i>	

14:00 – 14:30 Maximizing Company Profit through Employee Retention: A bi-level Optimization Approach.
Iris Forma, Inbal Singer, Yossi Bukchin, Gonen Singer and Hila Chalutz-Ben Gal

14:30 -15:15 Lunch

15:15 – 17:00 Parallel Sessions

Session 4 Room 1	OR in Energy	Chair: Haris Doukas
15:15 – 15:40	Sustainable investment in the building sector: A critical review of financing tools and methods. <i>Ioanna Andreoulaki, Aikaterini Papapostolou, Charikleia Karakosta, Filippos Dimitrios Mexis and John Psarras</i>	
15:40 – 16:05	An integrated indexing system for assessing the climate resilience of buildings. <i>Elissaios Sarmas, Eustathios Stamatopoulos, Katerina Forouli and Vangelis Marinakis</i>	
16:05 – 16:30	Investigating a Building Typology for Supporting Renovation Investments. <i>Aikaterini Papapostolou, Ioanna Andreoulaki, Konstantinos Touloumis, Panagiotis Kapsalis and John Psarras</i>	
16:30 – 17:00	A data-driven methodology for optimizing power recharging management. <i>Eustathios Stamatopoulos, Elissaios Sarmas and Haris Doukas</i>	
Session 5 Room 2	OR and Digital Business	Chair: Dimitris Papakyriakopoulos
15:15 – 15:40	Factors influencing Greek consumers' willingness-to-pay for online streaming services. <i>Georgios Katsamperis, Maria Kamariotou and Fotis Kitsios</i>	
15:40 – 16:05	Customer satisfaction and online ratings in the tourism sector: An evaluation of MUSA on Greek islands. <i>George Okantaris, Maria Kamariotou and Fotis Kitsios</i>	
16:05 – 16:30	Public crisis response strategy and innovation performance: Perceptions on digital transformation during COVID-19. <i>Fotis Kitsios, Evangelia Nousopoulou and Maria Kamariotou</i>	
16:30 – 17:00	Network theory for market basket analysis: A Do-It-Yourself home improvement retail case. <i>Dimitris Papakyriakopoulos and Anastasia Griva</i>	
Session 6 Room 3	Data Analysis	Chair: Vassilis Kostoglou
15:15 – 15:40	Forecasting Models and Subjective Predictions in the Forecasting of Pharmaceutical Market Demand. <i>Dimitrios Kallivokas, Stavros Tzevelekis</i>	
15:40 – 16:05	Tackling the Balance of Performance (BoP) Debate in Motorsports: Development and Simulated Application of Algorithm for BoP Scheme Evaluation and Adjustment. <i>Angelos Kottas, Michail Bozoudis and Michael Madas</i>	
16:05 – 16:30	Benchmarking of European Countries in terms of sustainability: A DEA approach. <i>Magda Benjelloun Arabi and Michael Madas</i>	
16:30 – 17:00	Climate change opinion analysis on tweets using machine learning techniques. <i>Maria Papaefthymiou, Georgios Tsaples, Jason Papathanasiou and Vassilis Kostoglou</i>	

17:00 -17:15 Coffee Break

17:15 – 19:00 Parallel Sessions

Session 7 Room 1	MCDA and Decision Support Systems	Chair: Nikos Tsotsolas
17:15 – 17:40	Generating criteria in a Decision Support System for use in Circular Economy Decisions. <i>Lykourgos Lalis, Nikos Tsotsolas</i>	
17:40 – 18:05	Towards the application of Multi-Criteria Decision-Making (MCDM) approaches in Corporate Risk Disclosure. <i>Iakovina Kanellopoulou, Nikos Tsotsolas</i>	
18:05 – 18:30	The application of Supply Chain Operations Reference (SCOR) model with Multi-Criteria Decision-Making (MCDM) methods in the Agri-food sector: A systematic literature review. <i>Georgios Sidiropoulos, Vasileios Zeimpekis, Nikos Tsotsolas</i>	
18:30 – 19:00	Towards the development of a MCDA DSS supporting the evaluation of agri-food products at B2B and B2C level. <i>Nikos Tsotsolas, Georgios Sidiropoulos, Eleni Koutsouraki, Aspasia Antonakaki, Achilleas Kontogeorgos, Angelos Patakas</i>	
Session 8 Room 2	Multi-Criteria Decision Analysis	Chair: Athanasios Spyridakos
17:15 – 17:40	Evaluation of earthquake vulnerability of existing buildings: Towards a Multi-Criteria Decision Aid Approach. <i>Isaak Vryzidis, Constantinos Repapis and Pnevmatikos Nikos</i>	
17:40 – 18:05	A multicriteria assessment of alternative structural and anti-seismic solutions for buildings design considering sustainability factors. <i>Zoi Staikou, Constantinos Repapis and Isaak Vryzidis</i>	
18:05 – 18:30	Applying Multicriteria value systems for the estimation of global environmental footprint in refractories. <i>Athanasios Spyridakos, Dimitrios Alexakis, Isaak Vryzidis, Nikolaos Tsotsolas, George Varelidis and Efthimios Kagiara</i>	
18:30 – 19:00	Multicriteria approach for the assessment of water lakes ecological status. <i>Athanasios Spyridakos, Dimitrios Alexakis, Isaak Vryzidis and Constantin Zopounidis</i>	
20:00 –	Gala Dinner	

CONFERENCE PROGRAM – DAY OVERVIEW

Friday, June 30, 2023

University of West Attica Conference Center, Ancient Grove Campus

20 min of Presentation + 5 min of Q/A

09:30 – 11:10 Parallel Sessions

Session 9 Room 1	Mathematical Modeling & Optimization	Chair: Sergiy Yakovlev
09:30 – 09:55	The Coordinate Method of Solving Multi-Objective Problems Optimization on the Combinatorial Configuration on Permutations. <i>Liudmyla Koliechkina, Olena Dvirna, and Oksana Pichugina</i>	
09:55 – 10:20	New Classes of Polynomially Solvable Permutation-based Linear Optimization Problem. <i>Oksana Pichugina, Sergiy Yakovlev, Liudmyla Koliechkina and Iryna Yakovleva</i>	
10:20 – 10:45	Sustainability Factors Affecting Manual Assembly Lines. <i>Rhitankar Saha Roy, Mahdi Bashiri and Benny Tjahjono</i>	
10:45 – 11:10	Mathematical Modeling and Solving of Maximum Coverage Location Problem with Irregular Geometric Items. <i>Sergiy Yakovlev, Adam Wojciechowski, Dmytro Podzheha and Iryna Yakovleva</i>	
Session 10 Room 2	Urban Planning and Sustainability	Chair: George Varelidis
09:30 – 09:55	Urban Accessibility and Walkability: Current Approaches and Future Prospects. <i>Athina Mela, Isaak Vryzidis and George Varelidis</i>	
09:55 – 10:20	Integration of Passenger Unmanned Aerial Vehicles (UAVs) in Urban Areas Transportation. <i>Nektarios Fotios Pouresfantiani Karagiannis, Vassilios Moussas and Isaak Vryzidis</i>	
10:20 – 10:45	Opening the agenda for proposing standards on “sustainability proofing” of inland transport infrastructure investments and networks, targeting Resilience. <i>Ioulia Moraitou</i>	
10:45 – 11:10	Introducing a “Smart” Urban Governance concept through novel policy and process holistic approaches. <i>Ioulia Moraitou, Georgios Varelidis</i>	
Session 11 Room 3	Organizational Processes	Chair: Angelos L. Protopapas
09:30 – 09:55	Modelling and deployment of Internal Affairs processes for automated anti-corruption reactive measures. <i>Konstantinos Dimitriadis, George Fakidis, George Tsakalidis and Kostas Vergidis</i>	
09:55 – 10:20	Advanced integrated systems in Non-Governmental Organizations. <i>John Issaris</i>	
10:20 – 10:45	A Tool for Automated Assessment of Organizational Business Processes. <i>George Fakidis, George Tsakalidis, Michael Madas and Kostas Vergidis</i>	
10:45 – 11:10	Agent-based Modeling Social Systems – The Case of COVID-19. <i>Angelos L. Protopapas, Eudokia T. Mitsou and Eleftheria N. Katsiri</i>	
11:10 – 11:30 Coffee Break		

11:30 – 13:10 Parallel Sessions

Session 12 Room 1	OR in Social Care Management	Chair: George Pierrakos
11:30 – 11:55	The risk of poverty and social exclusion for single-parent families and big families during the crisis. <i>Dimitra Melidi, Dimitra Latsou, Chrysostomos Natsis, Anastasios Sepetis and George Pierrakos</i>	
11:55 – 12:20	Sustainable Development without exclusions (Agenda 2030 for Sustainable Development to "Leave No One Behind") with emphasis on social protection in Greece. <i>Eleni Apostolos Karanasiou, Anastasios Sepetis, Vasileios Kormazos, Aspasia Goula, George Pierrakos and Konstantinos Dalakouras</i>	
12:20 – 12:45	Sustainable Local Development without exclusion: A case study on social protection programmes within the region of Athens. <i>Anastasia Kremmida, Anastasios Sepetis, George Pierrakos and Aspasia Goula</i>	
12:45 – 13:10	Sustainable local development without exclusive: a focus on migration social policy in Greece. <i>Eleni Karanasiou, Anastasios Sepetis, Aspasia Goula, George Pierrakos and Konstantinos Dalakouras</i>	
Session 13 Room 2	Environmental Management	Chair: Dimitrios Dimitriou
11:30 – 11:55	Climate change mitigation and adaptation in the public sector: placing municipal enterprises in the heart of the problem <i>George Stravodimos, Apostolis Arsenopoulos, Anastasia Spanou, Sofoklis Strobolas, Ioannis Georgizas and Theodora Andrinopoulou</i>	
11:55 – 12:20	An integrated framework of Sustainability Balanced Scorecard with neutrosophic AHP for smart port performance evaluation. <i>Antonios Paraskevas and Michael Madas</i>	
12:20 – 12:45	A multi-criteria decision methodology for academic staff selection in a neutrosophic environment. <i>Antonios Paraskevas and Michael Madas</i>	
12:45 – 13:10	Sustainability Performance Evaluation based on a Contract Theory Perspective. <i>Aristi Karagkouni, Maria Sartzetaki and Dimitrios Dimitriou</i>	
Session 14 Room 3	OR in Structural Engineering	Chair: Aristotelis E. Charalampakis
11:30 – 11:55	Performance of a Concrete Crack Detection Tool using Convolutional Neural Networks (CNN). <i>Dionisios Nikolopoulos, Moussas Vassilios and Vryzidis Isaak</i>	
11:55 – 12:20	Multi-Criteria Decision Analysis: Presentation and Comparison of Methods. <i>Pantelis Broukos, Zafiris Dimitriadis, Georgios Hatzigeorgiou and Nikos Pnevmatikos</i>	
12:20 – 12:45	Heuristic optimization design of Reinforced Concrete Retaining Walls. <i>Foteini Konstandakopoulou, Maria Tsimirika, Nikos Pnevmatikos and George Hatzigeorgiou</i>	
12:45 – 13:10	Discrete Optimization of Truss Structures using Differential Evolution: A Preliminary Investigation. <i>Aristotelis E. Charalampakis, Isaak Vryzidis and Constantinos C. Repapis</i>	

13:10 – 14:15 Lunch

14:15 – 16:00 Parallel Sessions

Session 15 Room 1	OR Applications I	Chair: Christos Gogos
14:15 – 14:40	Estimator comparison for the prediction of election results and applications. <i>Papageorgiou Georgios and Miltiadis Chalikias</i>	
14:40 – 15:05	Energy Market Volatility Modeling and Forecasting <i>Maria Tantoula, Konstantinos Gkillas and Christina Diakaki</i>	
15:05 – 15:30	A quadratic assignment formulation for minimizing power consumption in deep submicron technology buses. <i>Konstantinos Papalamprou and Leonidas Pitsoulis</i>	
15:30 – 16:00	Industrial chocolate production as an optimization problem. <i>Christos Gogos, Christos Valouxis, Panayiotis Alefragkis and Alexios Birbas</i>	
Session 16 Room 2	Logistics	Chair: Vasileios Zeimpekis
14:15 – 14:40	Solving the van-drone routing problem with multiple delivery drop points. <i>Eleftherios Athanasiadis, Vasilis Koutras and Vasileios Zeimpekis</i>	
14:40 – 15:05	Surveillance in Logistics Facilities and Ports via UAVs Using YOLOv3 Algorithm <i>Georgios Teptaris, Konstantinos Mamas and Ioannis Minis</i>	
15:05 – 15:30	Comparative assessment of alternative order picking technologies: Evidence from laboratory experiments <i>Nikolaos Chondromatidis and Vasileios Zeimpekis</i>	
15:30 – 16:00	Adopting Unmanned Aerial Vehicles (UAVs) for real-time stock count process in warehouse facilities: Evidence from experimental. <i>Nikolaos Christoforos Thomaidis and Vasileios Zeimpekis</i>	
16:00 – 16:15 Coffee Break		

16:15 – 18:00 Parallel Sessions

Session 17 Room 1	OR and Customer Satisfaction	Chair: Evangelos Grigoroudis
16:15 – 16:40	A Multicriteria DSS for Spatial Consumers Satisfaction Analysis. <i>Anastasia Saridou, Athanasios Vavatsikos and Evangelos Grigoroudis</i>	
16:40 – 17:05	Key Performance Indicators in the Retail Sector: A Literature Review. <i>Anastasia Saridou, Aristi Karagkouni, Athanasios Vavatsikos and Dimitrios Dimitriou</i>	
17:05 – 17:30	Robustness in ordinal regression analysis: The effect of additional constraints on the MUSA method. <i>Stratos Kartsonakis and Evangelos Grigoroudis</i>	
17:30 – 18:00	Marketing strategies based on multicriteria analysis of consumer behavior: The case of a cosmetics company. <i>Nikolaos Kalogerakis, Fotini Kalafati, Efstathios Gerampinis and Nikolaos Matsatsinis</i>	
Session 18 Room 2	OR in Educational Management	Chair: Yannis Psaromiligkos
16:15 – 16:40	The statistical investigation of the diffusion of knowledge within the learning organizations as a factor in creating an innovative student-centered model of education. <i>Evangelia Kossieri, Iro Mylonakou Keke and Athanasios Spyridakos</i>	
16:40 – 17:05	Barometer of teachers' satisfaction in terms of the organization and operation of the educational system. <i>Sofia Meretaki</i>	
17:05 – 17:30	Teacher contentment as regards State Support, Recruitment and Intergration in Schools. <i>Xristina Kouroukli, Ioanna - Antonia Roussou</i>	
17:30 – 18:00	Exploring the Trainers' Digital Competences of Public Vocational Training in Greece during COVID-19 period. <i>Dimitrios Kiriakos, Christos Kytagias, Kalliopi Rigopouli, Anastasia Themeli and Yannis Psaromiligkos</i>	

CONFERENCE PROGRAM – DAY OVERVIEW

Saturday, July 1, 2023

University of West Attica Conference Center, Ancient Grove Campus

20 min of Presentation + 5 min of Q/A

10:00 – 11:40 Parallel Sessions

Session 19 Room 1	OR and Covid-19	Chair: Vryzidis Isaak
10:00 – 10:25	The Impact of the COVID-19 Pandemic on the Digital Transformation of SMEs: An Empirical Study. <i>Christos Ziakis</i>	
10:25 – 10:50	Consumption behaviors and COVID-19 revealed through credit cards usage. <i>Chloe Kim</i>	
10:50 – 11:15	Designing optimal mitigation strategies for COVID-19 with the prevention effects and the economic consequences in Korea: an optimization. <i>Chansoo Kim, Haneol Cho and Kyu-Hwan Lee</i>	
Session 20 Room 2	MCDA in Education: Enhancing Decision-Making and Educational Quality (Special Session)	Chair: Christos Troussas
10:00 – 10:25	An Adaptive Weighted Sum Model for Assessing Learning Content in E-Learning Systems. <i>Christos Troussas, Akrivi Krouska, Phivos Mylonas, Cleo Sgouropoulou</i>	
10:25 – 10:50	A Comprehensive Analysis of E-Learning Material Personalization: An Investigation of AHP, TOPSIS, and PROMETHEE within Multiple Criteria Decision Analysis. <i>Christos Troussas, Akrivi Krouska, Phivos Mylonas, Cleo Sgouropoulou</i>	
10:50 – 11:15	Enhancing Learner Engagement in E-Learning through Weighted Sum Model-based Adaptive Recommendations. <i>Christos Troussas, Akrivi Krouska, Phivos Mylonas, Cleo Sgouropoulou</i>	
11:15 – 11:40	Evaluating the Effectiveness of E-Learning Platforms: A Weighted Sum Model Perspective. <i>Christos Troussas, Akrivi Krouska, Phivos Mylonas, Cleo Sgouropoulou</i>	
Session 21 Room 3	OR Applications II	Chair: Petros Kalantonis
10:00 – 10:25	Mission Planning for Heterogeneous Agile Earth-Observation Satellites Virtual Constellation. <i>Wasanchai Vongsantivanich, Supatcha Chaimatanan, Jer Ling and Daniel Delahaye</i>	
10:25 – 10:50	The retail interest rate pass-through in Algeria. <i>Mohamed Benbouziane and Zoheir Tafer</i>	
10:50 – 11:15	A revisit of the purchasing power parity in the Maghreb countries: A nonlinear perspective. <i>Rabia Meriem Benbouziane, Abdelhak Benamar and Mohamed Benbouziane</i>	
11:15 – 11:40	Board Diversity and Firm Performance: Evidence from retail industry firms in Europe. <i>Marios Sotiropoulos and Petros Kalantonis</i>	
11:40 – 12:00 Closing session (Central Amphitheatre)		

4. Detailed Programme

Session 1: Decision Making Applications

MCDA in the Context of Health Technology Assessment (HTA)

Ioannis Agorastos¹, Elpida Pavi¹, and Kostas Athanasakis ¹

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Abstract

Introduction and objectives:

Healthcare is a complex ecosystem with multiple stakeholders who often have different or even conflicting goals. In this context, policy-makers need to make important decisions which affect, directly or indirectly, the health and the quality of life of the population. This kind of decisions, despite their importance, are usually taken either on an ad-hoc basis or by using historical data. In other words, decision-making for crucial concepts in healthcare (e.g. resource allocation, health technology assessment) lacks of an evidence-based process.

Multi-Criteria Decision Analysis (MCDA) has a long-standing background in many scientific disciplines – such as operational research, transportation, investments, immigration, education, etc. - and during the last decades there is a trend to adopt it in healthcare. This study aims to highlight the potential of MCDA in healthcare as a tool to support decision-making in a transparent and scientifically solid way.

Methodology:

This review synthesizes the existing literature on MCDA in healthcare and focuses critically on its implementation in the context of the HTA. The search strategy involved the electronic databases PubMed and ScienceDirect, and the search terms included various combinations of MCDA, healthcare, HTA. Moreover, the review was supplemented by search of grey literature via Google Scholar.

Findings:

The profound need to support decision-making with a scientifically robust methodology such as the MCDA is urged by the challenges that the health systems currently face. More specifically, the ageing population, the epidemiological transition and the introduction of high-cost health technologies put pressure on healthcare budgets and undermine the resilience and sustainability of health systems.

Conclusions:

MCDA is a structured, consistent and scientifically robust tool which can critically support the decision-making process in healthcare. The implementation of MCDA in HTA during the last years is driven by its formal, participative and transparent nature.

Keywords: MCDA, HTA, Healthcare

A discount-enabled mixed integer linear programming model with discrete states of changeover costs for the production planning of a steel tube mill

Paraskevas Georgiou¹, and Nikolaos Tsaparas²

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Abstract

This study stems from the capacitated lot-sizing problem with sequence-dependent setup costs which frequently used to address production planning problems in industry. A mixed integer linear programming model is developed to support the decision-making process for fabricating multiple products on the same production line at tactical level, for a finite planning horizon and known dynamic demand, applied to a case study of a steel tube mill. The proposed methodology differentiates the changeover cost imposition by recognizing two discrete states (yes/no) in case the difference between the spreads of the successive tubes produced fall within a tolerance limit. The underlying concept is that the setup time can be assumed as too small when the same steel strip size is used, thus very minor set requirements and adjustments are needed. It is a least-cost optimization model equipped with a discount piece-wise linear cost function concerning raw material purchasing, which also includes changeover, fixed and variable operation and maintenance, energy, labor, and fixed and variable storage costs. The objective is to determine the optimal quantity and timing allocation of production lots in the specific period, along with the evolution of inventory levels. A set of scenarios are examined to analyze and compare the effect of specific parameters on the elaboration and composition of production plans. Given also the actual uneven and low-production capacity utilization rate, the model generates cost-effective master production schedules which are significantly different from the business-as-usual production patterns. The size and order of production lots are tightly coupled with the trade-off between a) productivity constrained by capacity and storage caps and inventory costs, and b) flexibility mainly affected by changeover costs and their association differentiation deriving from the manufacturing process adaptability.

Keywords: Production Planning, Sequencing, Lot-sizing problem, Mixed Integer Linear Programming, Inventory, Economies of Scale, Changeover cost

Optimizing complexus Bunkering Plan B

Artemis Flori¹, Dimitris Kaklis¹, and Takis Varelas¹

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Abstract

This work is focused to resolve the working bunkering plan solutions shortcomings to face up the problem substantially increased complexity in a continuously changed environment. Typical linearly programmed or genetic algorithms have been already implemented with the goal to find the optimum bunkering plan for a specific multi-leg voyage complying with safety, technical, environmental, and operational constraints where bounds of variables are functions changed per voyage. They are more or less good enough, but under nowadays complicated circumstances should be radically revised or more comprehensive solution should be deployed. Now, there are different available fuel types in the Shipping Bunkering Industry. PlanB model is here to optimally solves the combinatorial problem when there is more than one fuel type with the novelty of the exploitation of eventual deviation(s) for bunkering in order to improve further voyage's profitability. The main aim of the PlanB model is to give emphasis on the fuel consumption cost and not in the bunkering optimum operations. A lot of alternate costing methods (last purchase price, FIFO, etc.) for remaining on board may be used, total tanks exploitable capacity is variable depending on cargo load. For this work, the aifos heuristic model is revised, tested/validated with a developed repetitive LP model and implemented for better efficiency in terms of time and flexibility. The objective function is formalized as multivariable decision unit taking into account financial figures (time chartering equivalent, administrative expenses, charter party options and bunkers attributes. Finally, the workable solution is presented, conclusions are summarized and ideas for further research are outlined.

Keywords: Optimum Inventory Control, Linear Programming, Artificial Intelligence, Heuristics

Turn Benefit of Doubt to trustworthiness of MCDA.

Takis Varelas¹, Dimotikalis John², Dimitris Kaklis¹, Sofia Archontaki¹ and Artemis Flori¹

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2. Hellenic Mediterranean University, jdim@hmu.gr

Abstract

In this work we focused not only to suggest optimal among alternate linearly formulated decisions not even to unify the better but at the same time to gain the minimum benefit of doubt, in other words the maximum trust or the confidence of decision maker(s). This is achieved with a non-linear programmed and integrated interactive e-model to resolve the ranking problem with aggregation of known ordering techniques weighted / non weighted sum, multi-criteria analysis, topsis index and dea superior index or matrix of indexes. Therefore, the novelty is that the solution satisfies different ranking methods. Furthermore, it can also adjust further the suggested weights based on relative supreme relationships according to decision maker's preferences. The power of interactivity enable the running of what-if scenarios, to simulate strategies or to proof related theorems. It utilizes several models linear and non-linear and was used in several operational cases. Variables values may be expressed as crisp or fuzzy numbers and initial weights from one or a group of experts may be assigned. Different data normalization (min-max, linear, vector, z-score) may be are utilized. This work resolves the mentioned contradictions by extracting the endogenous composite indicators that furthermore may be adjusted and personalized according to experts' supreme preferences. Initially normalization, ranking methods are presented and a new variation of dea composite indicator is defined. Subsequently, the non-linear method to unify topsis and dea ranking is described and some theorems are proved. Finally, the developed "BoD e-model" is presented deploying the decision making for vessel's emission monitoring as it was implemented within the content of EMERGE EU project.

Keywords: TOPSIS, DEA, MADM, LP, DP, normalization

Session 2: Data Envelopment Analysis and Data Analysis

Advanced preprocessing methods for large-scale Data envelopment analysis

Terézia Fulová¹, Mária Trnovská¹, and Lenka Filová¹

- ¹. Faculty of Mathematics, Physics and Informatics, Comenius University in Bratislava, terezia.fulova@fmph.uniba.sk; trnovska@fmph.uniba.sk; lenka.filova@fmph.uniba.sk

Abstract

Although large data sets do not appear significantly in data envelopment analysis (DEA), we can observe studies across the DEA literature analyzing large-scale DEA models and methods. The traditional approach to applying a DEA model for a given data set is sufficient, provided the data cardinality is small. If the number of decision-making units increases significantly, solving a DEA model in a reasonable time becomes problematic. The main idea behind some of the known approaches is to efficiently detect a generating subset of small cardinality, which is performed during the preprocessing phase. In this contribution, we introduce new preprocessing methods based on finding the minimum-volume enclosing ellipsoid.

Keywords: Data envelopment analysis, Large-scale data sets, Minimum-volume enclosing ellipsoid, Preprocessing methods

Utilizing Process Mining Techniques to Improve Chemotherapy Treatment for Breast Cancer Patients.

Fatin Ramli (University of Sheffield).

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Abstract

Breast cancer is a significant cause of cancer fatalities among women worldwide, with chemotherapy being a common but challenging treatment option. However, process mining is a data-driven approach in healthcare that can potentially enhance chemotherapy treatment. This study investigates the relationship between different chemotherapy regimens and the survival rates of breast cancer patients at various stages of the disease using process mining techniques. The research highlights the potential for process mining in healthcare to provide tailored and accurate treatment options, leading to improved patient outcomes.

Keywords: Process mining, Breast cancer, Chemotherapy

Prospects from a European Study on OR/MS Education - The Transition of Graduates onto the Labor Area.

Joao Luis de Miranda¹ (ESTG/IPP, CERENA/IST).

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Abstract

This work addresses recent enhancements originated from the European survey on Operational Research/Management Science (OR/MS) Education; the survey was conducted in collaboration with the EURO association, and it targeted the OR/MS field in the European area. The relation between Higher Education Institutions (HEI) and the labor market is also surveyed; in addition, to better promote graduates' employability, the digital applications and platforms (e.g., Artificial Intelligence-AI, Big Data Analytics-BDA, cloud-based services, Digital Twins, Internet of Things-IoT, Machine Learning-ML, mobile platforms, robotics, virtual reality and extended reality-VR/XR) are rapidly evolving and shall be addressed too. For other side, OR/MS methodologies and tools are often developed to support decision-making, and also to improve the capabilities of Decision Support Systems-DSS. In this way, enhancements about the transition of graduates onto the labor area are focused, as well as prospects about the digital phenomena within the OR/MS Education fields are discussed.

Keywords: OR/MS Education, European survey, Graduates, Labor Area, Digitalization

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Path-based models in Data envelopment analysis

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Abstract

The common property of the well-known oriented radial models, the hyperbolic distance function model and the directional distance function models is that they search for the projection point by following a parametric path running from the assessed decision-making unit to the boundary of the technology set. In this contribution, we present a general framework for path-based models which allows for their unified analysis and offers a rich menu of projection paths for efficiency evaluation. Various modifications and extension to arbitrary (not necessarily non-negative) datasets are discussed, which is important in a variety of applications. The results are demonstrated on numerical examples.

Keywords: Data envelopment analysis, Directional distance function, Hyperbolic distance function, Efficiency evaluation

Session 3: Operations Management & Optimisation

Treatment effect estimation of initial attack activities in wildfire suppression.

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Abstract

In this paper, we estimate the causal effect of firefighters on the success of initial attack (IA) operations by using 15 years of historical data on wildfire management in Alberta, Canada. IA refers to the suppression action on the first day of a fire. Successful IA operation means that newly reported fires are responded to, and contained, while they are small and easily suppressed. Successful results from these IA actions are critical for limiting fire sizes and associated costs. When fires escape IA and achieve large sizes, they can pose significant threats to public safety and values. These escaped fires are relatively infrequent but are responsible for the majority of area burned and represent a significant component of annual fire suppression costs. Thus, IA is a key suppression strategy of most fire agencies in different countries.

Systematic experiments such as a randomized controlled trial are not feasible in wildfire management because of the high risks involved. Consequently, the causal effects must be identified using observational data. Confounding is a common issue in observational studies. To assess the feasibility of this study, the authors have consulted with the actual decision-makers and identified the list of factors that affect their decisions on the first day of each fire. These factors form a set of potential confounders, which we control for in our estimation procedure.

The main contribution of this paper is the stratification of fires and the empirical estimation of the causal effect of fire suppression resources on IA success in each group. Our procedure stratifies the fires into groups with different levels of difficulty and varying effectiveness of resources. This grouping can be used for gaining insights into conditions under which resources are most effective. We also provide a model predicting to which group a new fire belongs. The grouping and prediction model can support proactive management of fire suppression resources as demonstrated in this paper. The estimated effects of resources can be used to estimate return on investment and also as inputs to decision support systems that optimize the planning and management of resources. The insight from our results helps fire managers gain a better insight into wildfire operations. To the best of our knowledge, this paper is the first study using treatment effect estimation techniques in the wildfire domain.

Keywords: Treatment Effect Estimation, Multivariate Treatment, Wildfire Operations, Operations Management

An Iterative Matheuristic for the Traveling Purchaser Problem with Fast Service Option

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Abstract

The traveling purchaser problem (TPP) is an extension of the traveling salesman problem with a lot of practical applications. In the TPP, a list of products with specified quantities must be purchased by visiting a subset of markets in a single tour. The aim of the purchaser is to minimize the total traveling and purchasing costs. The TPP with fast service option (TPP-FSO) generalizes the TPP by imposing a duration limit on the total traveling and purchasing times. Moreover, the purchasing operation at each market can be accelerated at the expense of an extra fee. This study proposes a matheuristic solution approach for the TPP-FSO. The algorithm is applied to a set of benchmark instances available in the related literature. The computational results underline the effectiveness of the proposed approach.

Keywords: Traveling purchaser problem, Heuristics, Matheuristics

Building Wildfire Resilience into the Forest Road Network Design.

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Abstract

Due to the climate change and increased population, the frequency and impact of wildfires have increased. Therefore, wildfire preparedness and response plans have become critical in the last decade. A good forest road network design can improve the effectiveness of wildfire prevention and suppression plans. In this regard, this study addresses a forest road network design problem which arises in a Turkish government project titled “Rehabilitation of Burnt Forests and Establishment of Wildfire Resilient Forests (YARDOP)”. The aim of YARDOP is to built wildfire resilience into the burnt or undamaged forests by increasing the accessibility of forest areas via forest roads and building fuelbreaks to reduce the spread of potential wildfires. In this regard, we have developed a mathematical model for forest road and fuelbreak network design which enables the wildfire resilience and effectiveness of firefighting. The proposed model covers the environmental impact of forest road and fuelbreak construction along with the requirements of YARDOP. The model is computationally analyzed on a set of problem instances.

Keywords: Network design, Mathematical model, Wildfires

Maximizing Company Profit through Employee Retention: A bi-level Optimization Approach.

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Abstract

The growing trend of flexible work arrangements will significantly impact how companies manage employees. To address the issue of employee turnover, we propose two bi-level mathematical models. These models aim to achieve this by offering appealing benefit packages and flexible arrangements in their work plans. These models consist of two levels: the first level focuses on the company's objective of maximizing profits through attractive salaries and high-quality work plans, while the second level considers the employees' goal of minimizing the difference between their desired salary and the total benefits offered by the work plan. The two models differ in their approach to determine salaries. The first model (Model I) assumes the company offers salaries for each work plan and job type (such as programmers or analysts) while in the second model (Model II), there is full flexibility in determining salaries for each suggested work plan and each employee. We show that the model provides an exact solution based on a mixed integer formulation and presents an experimental analysis based on three case studies. The case studies illustrate how the decision parameters of the problem affect the optimal solution and the company's profit and suggest optimal policies for each scenario. We show that in certain situations, having full flexibility in determining salaries for each suggested work plan and an employee (Model II) leads to significantly higher profits, resulting in 75% more compared to salaries determined by job type (Model I), for instance when the market work plan's quality surpasses the company's. However, when the quality of market and company work plans are similar, the difference in profit between the two models is minimal. Other findings suggest the optimal quality of a new work plan, and the best policy for determining salaries, depending on the problem's parameters. The results highlight the relevance of the optimal solution to real-world challenges. This study is a significant contribution to the field as it proposes a new bi-level model to tackle the challenge of proactive employee retention in flexible work arrangements.

Keywords: flexible work, bi-level optimization model, human resource analytics, retention

Session 4: OR in Energy

Sustainable Investments in the Building Sector: A Critical Review of Financing Tools and Methods

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Abstract

Although it is evident that the implementation of energy efficiency measures, upgrades of energy consuming systems and installation of sustainable technologies are effective ways of reducing energy needs and consumption in buildings, renovation rates in the EU remain quite low. A plethora of factors might hinder the application of retrofitting actions in the building sector, including technical issues, financial barriers, behavioral aspects, as well as risks related to the economy and energy market. With the aim of incentivising energy efficiency investments in buildings, an approach has been followed to identify, explore and categorise the most common financing instruments that promote retrofitting actions in the building sector. Towards this direction, a literature review of financing tools for renovation projects is conducted. Specific examples of renovation projects and financing schemes in European countries are presented, to validate the correlation between building and financing typologies. Current barriers and issues that need to be addressed to encourage energy efficiency financing and, thus, increase renovation rates are highlighted. The findings of the research provide useful insights for market actors interested in energy efficiency financing and stakeholders engaged in renovation projects. Moreover, the conclusions of the analysis can become a starting point for further research on the topic, setting a basis for standardising sustainable investments in the building sector by matching renovation projects with the appropriate financing methods.

Keywords: Energy Efficiency Financing, Renovation Projects, Energy Retrofitting, Financing Typologies

An integrated indexing system for assessing the climate resilience of buildings

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Abstract

Efficient and climate-resilient buildings are pivotal for energy consumption mitigation, carbon emissions, and the enhancing resilience against climate change impacts. As outlined in EU technical guidance the number of resilience rating approaches is currently small (only 9 approaches were identified) and the available tools need to be further developed in terms of scope and assessment level, examined hazards, geographical range, and usability. Existing approaches vary from web-based tools (that either depend on users input or on platform-based collection of information), indicators check-list methodologies or hybrid approaches combining the two. In terms of scope, all approaches collect information on several indicators - factors (ex. Information related to the building, related hazards and sensitivity, adaptation measures etc.) and use them to establish a rating of the project's resilience.

The EC proposes some practices for resilience rating, considering that the characteristics of each approach are highly linked to their usability and transparency, and taking into account the trade-offs between the accuracy of the approaches and the ease of use. The EC itself proposes the design of a user - friendly, transparent assessment approach with high level assessment of vulnerability and resilience and a clear output that can be easily translated into actions for improving resilience.

Taking the above into consideration, the first pillar of the service will be the development of a climate resilience assessment tool based on the guidelines of the European Union. The combination of space efficiency with climate resilience can offer significant advantages. Optimizing energy-efficient lighting and heating systems to reflect changing space usage patterns can help reduce energy consumption and carbon emissions of buildings. This is the second pillar of the service where a machine learning methodology is developed for the dynamic allocation of occupants in office buildings.

Keywords: Buildings, Climate Resilience, Indexing Methodology, Assessment Tool, Multicriteria Decision Analysis

Investigating a Building Typology for Supporting Renovation Investments

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Abstract

Due to the severe consequences of the climate crisis, which is largely due to gas emissions ensued by energy consumption worldwide, reaching energy transition targets has become an important pillar of energy policies. A considerable percentage of total CO₂ emissions is generated because of energy usage in buildings. However, the rate of renovations aiming to improve energy performance of the European building stock remains low. The ENERGATE project aims to encourage financing of retrofitting actions in buildings, by developing a web-based marketplace to provide a communication medium and offer renovation related services to various engaged parties. Thus, the supply side (building owners, asset managers etc.) needs to enter data relevant to the buildings to the ENERGATE platform, so that the products (i. e. buildings and corresponding retrofitting measures) can be matched with the demand side (investors, ESCOs etc.). In this paper, existing frameworks which aim to model data relevant to buildings are investigated and, by examining several datasets, potential variables which influence a building's likelihood of being renovated, as well as retrofitting measures that could apply to it, are explored. The aim is to generate a Common Data Model, which could be used as a basis to develop the building profiles within the ENERGATE platform. Besides, the conducted research could provide useful insights for stakeholders engaging in retrofitting projects, by pointing out the most important elements of the building's characteristics which should be examined in order to determine the most appropriate renovation strategies.

Keywords: Building Information Modeling, Common Data Model, Retrofitting, Energy Efficiency, Energy Performance

A data-driven methodology for optimizing power recharging management

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Abstract

The adoption of electric vehicles (EVs) has gained momentum in recent years and is expected to continue growing. This paper explores the potential benefits of integrating EVs into the electricity grid and proposes a data-driven methodology for optimizing EV charging schedules to maximize the utilization of renewable energy sources while minimizing costs. By strategically managing EV charging in real-time, facility managers can make informed decisions regarding fleet recharging, resulting in reduced energy consumption, costs, and emissions.

This study introduces an optimization tool for power recharging management that leverages photovoltaic (PV) sources to increase the use of renewable power. The proposed system incorporates various inputs, including historical data from a Data Lake, real-time monitoring data, user feedback, and forecasted data. Through a combination of an optimization algorithm (such as Genetic Algorithm) and a physical model encompassing energy balance equations and constraints, decision variables (e.g., scheduling time, number of vehicles to charge, charging power) are generated.

Implementing these methods enables several objectives to be achieved. By reducing reliance on grid electricity, the system effectively lowers costs and greenhouse gas emissions. Furthermore, optimal management reduces peak power demand, resulting in additional cost savings. The results obtained from this study serve as a model for future applications of similar algorithms in building and EV management, thereby advancing progress towards zero emissions goals.

Keywords: Electric Vehicles, Greenhouse Gas Emissions, Optimization Algorithms, Distributed Energy Resources, Renewable Energy

Session 5: OR and Digital Business

Factors influencing Greek consumers' willingness-to-pay for online streaming services.

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Abstract

Streaming providers have seen a significant increase in their subscriber bases over the lockdown period due to the global COVID-19 outbreak. The entertainment sector is experiencing strong competition as a result of the distancing from traditional entertainment media and the focus on over-the-top (OTT) services. Recently, domestic companies as well as global industry leaders like Disney and Amazon debuted their streaming services in the Greek market. In a post-pandemic world and given the large range of streaming services currently available in the Greek market, there is a need to gain insight into customer preferences. The purpose of the study is to examine possible factors that affect Greek consumers' willingness to pay (WTP) for a subscription streaming service. Quantitative research was conducted using data from online questionnaires. Even though similar studies have been conducted, no studies examining the factors that influence WTP for a subscription streaming service in Greece exist. Relevant studies tend to concentrate on implementing the Theory of Acceptance Model (TAM) or investigate a small number of variables. We decided to expand our research into a plethora of less-researched factors, such as brand attitude, brand loyalty, brand equity, electronic word of mouth (eWOM), customer satisfaction, and pricing. The results of this study could be used by companies aiming to launch a subscription service in Greece in order to identify the key elements of focus when developing and marketing their streaming service.

Keywords: Willingness-to-pay, streaming service, OTT service, customer satisfaction, brand

Customer satisfaction and online ratings in the tourism sector: An evaluation of MUSA on Greek islands

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Abstract

Tourism is one of the main economic sectors in Greece. In this specific study, the influencing factors of customer satisfaction in 4 and 5 star hotel units in the Ionian and Aegean Islands were examined. Four key points regarding customer satisfaction were identified through the processing of online reviews and these were the connection of online reviews with customer satisfaction, customer experience, the relationship between service performance and user-generated content and service innovation. Then, using text mining techniques, the online reviews were scraped from the hotel booking website booking.com. The program that was used for text mining was called RapidMiner Studio. The data that was obtained was evaluated with the MUSA method. The MUSA method is a data analysis technique used to evaluate the level of satisfaction of customers with specific criteria. This analysis identified both the percentage of influence of the criteria on overall customer satisfaction, as well as the level of customer satisfaction with the criteria met by the hotel units of each island. The results will help hoteliers of Greek islands to have a better understanding of their customer preferences. Furthermore, this study contributes to the knowledge around digital data processing, a method that is needed in the modern digital tourism industry.

Keywords: Customer-satisfaction, hotel services, text-mining, online reviews, MUSA

Public crisis response strategy and innovation performance: Perceptions on digital transformation during COVID-19

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Abstract

Firms that were impacted by the pandemic now understand how crucial it is to integrate digital transformation into their daily operations. But as a result of the market lockdown, they understood that they needed to digitalize their operations right away and work harder to improve their economic status by incorporating more technical elements. No research has been done on the implementation of digital transformation in the specific industry of driving schools, despite the fact that there have been many studies done on the adoption of digital transformation in small-medium enterprises. The impact of digital transformation and public crisis response strategy on innovation performance is examined in this paper. 300 driving instructors from Greece and Cyprus provided the study's data. Ordinal regression analysis was used to analyze data. Owners of driving schools can utilize the findings to demonstrate the value of digital transformation to their organizations. Driving schools will be able to enhance their innovation performance and improve their development in the post-COVID era based on the paper's outcomes.

Keywords: Digitalization, Digital transformation, Public crisis response strategy, Innovation performance, Innovation strategy

Network theory for market basket analysis: A Do-It-Yourself home improvement retail case

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Abstract

Companies leverage market basket analysis to uncover associations and patterns in customer purchasing data. Network theory offers a lot of tools to address market basket analysis, and relevant research works used community detection algorithms to identify products frequently purchased together. The objective of this work is to propose a new method that uses community detection for market basket analysis, but it extends it by further analyzing the discovered communities with hierarchical methods and more specifically with cohesive blocking. The proposed method was used in a real data set from a Do-It-Yourself (DIY) home improvement retail company. Jaccard index used to evaluate the effect of the proposed approach on a community detection and the results indicated that our work improves the capability to discover products that are purchased together, even if such event might occur in a new shopping trip.

Keywords: market basket analysis, community detection, cohesive blocks, business value

Session 6: Data Analysis

Forecasting Models and Subjective Predictions in the Forecasting of Pharmaceutical Market Demand

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Abstract

Truss structures are efficient load-bearing systems for large spans due to their high strength-to-weight ratio. The discrete optimisation of truss structures involves selecting an optimal combination of structural members, in the sense of the smallest overall weight, while considering various stress and displacement constraints. The discrete nature of this problem means that a specific cross section is selected for each member, which is taken from a finite list of available sections. This study is a preliminary investigation on the application of a powerful metaheuristic algorithm, namely the Differential Evolution (DE), to the aforementioned problem. It is shown that, although DE is by nature better for problems with continuous variables, it can perform satisfactorily with the necessary modifications and enhancements.

Keywords: Subjective Predictions, Forecasting of Pharmaceutical Market Demand, Forecasting Techniques

Tackling the Balance of Performance (BoP) Debate in Motorsports: Development and Simulated Application of Algorithm for BoP Scheme Evaluation and Adjustment

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Abstract

Motorsports championships across the globe involving Grand Touring (GT) racecars implement the Balance of Performance (BoP) concept, in order to equalize the winning potential of the participants. The organizing bodies of these championships impose a set of technical rules pertinent to racecar eligibility and performance parity. Most BoP schemes fundamentally stipulate for engine horsepower and racecar curb weight initial determination and subsequent adjustment, while additional provisions mandate for aerodynamics, suspension, fuel tank volume, etc. Nevertheless, the methodology deployed by organizing bodies for evaluating performance and adjusting technical features in order to achieve competitive equality, remains a subject of great debate due to the reduced visibility provided to competitors and racecar manufacturers. In fact, motorsports organizing bodies avoid disclosing details associated with imposing, evaluating, and adjusting BoP schemes for a specific championship series. Our proposed research deals with the evaluation and subsequent adjustment of motorsports' BoP schemes, by developing an integrated algorithm incorporating statistical tests and Data Envelopment Analysis (DEA). The validity of the devised algorithm is tested by performing a simulated application using a widely-known racecar simulator, with the results designating the algorithm's potential to accurately and fairly evaluate/adjust BoP schemes.

Keywords: balance of performance, motorsports, pairwise performance evaluation, data envelopment analysis

Benchmarking of European Countries in terms of Sustainability: A DEA Approach

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Abstract

With the rise in environmental challenges and economic and social inequalities, sustainable development has emerged as a critical issue of our time. Unsustainable practices harm the environment, contribute to climate change, and lead to a depletion of resources, loss of biodiversity, and increased environmental footprint. On the other hand, sustainable practices can help preserve the environment for future generations, reduce inequalities, and promote economic growth and innovation. It is evident that the sustainability initiative is a complex and great challenge, for which the coordinated effort of nations is required. In this context, the UN, with organized efforts dating back to 1992, created the Seventeen (17) Sustainable Development Goals (SDGs) in 2015, widely known as the 2030 Agenda. Despite the growing importance of SDGs in achieving sustainable development, research on benchmarking practices with SDGs remains limited. This paper offers a comparative evaluation of the performance of European countries between 2010 - 2020, with a particular focus on the indicators outlined by the United Nations for measuring progress towards SDGs. Two DEA models were developed, with the first model describing a country's production system, while the second model compiled most social indicators. The analysis was carried out under constant and variable returns to scale, using the BCC and CCR models, respectively. Also, Malmquist DEA Analysis was conducted to study the performance of countries over time and the impact of adopting sustainability goals on performance regarding sustainability. The issue of undesirable outputs that arose, as in every case of environmental DEA, was addressed by introducing undesirable outputs as regular inputs. The research findings show a positive correlation between signing the Agenda and sustainability performance. Sweden, Finland, and Iceland ranked highest, while Bulgaria, Romania, and Greece ranked lowest. Large economies such as Spain, Italy, and France were inefficient in the social dimension. Furthermore, the study revealed that Greece was inefficient in all sustainability dimensions. The results of the study are further validated by comparing them with the UN's SDG index, which displays a noteworthy correlation, affirming the proposed models' reliability in evaluating sustainability performance among countries.

Keywords: Sustainable Development, Efficiency, Benchmarking, DEA, Environmental DEA, SDGs, BCC, CCR, Malmquist

Climate change opinion analysis on tweets using machine learning techniques

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Abstract

Nowadays, climate change poses a very big issue, making people doubt about its origin. Some people (Believers) claim that climate change is an anthropogenic phenomenon and we, people, should take action into solving it. However, there are people (Deniers) who oppose this logic and claim that climate change is just a phase that is happening to earth, as normal as the ice age. An outlet where these views are very present is Twitter, where in 270 and less characters people can express their opinions and share their views on different matters.

The aim of this study is to apply sentiment analysis methods on Twitter data (tweets) to classify the users' opinion towards climate change. We have used modern natural language processing and machine learning techniques to achieve our results.

For the purpose of this study we used data mining techniques to acquire data concerning climate change. For that we implemented a web scraping method to get data from Twitter. After cleaning the data and analyzing it for various trends, we applied text encoding and word embedding techniques to our dataset. In particular we used techniques like One-Hot Encoding (both for Unigrams and Bigrams), Term Frequency Inverse Document Frequency (TF-IDF) as well as Word2Vec and FastText. After obtaining our vectorised dataset, we applied machine learning techniques using the baseline models. We used models like Logistic Regression (Maximum Entropy), Random Forests, Support Vector Machines (SVM), Gaussian Naïve Bayes, Multinomial Naïve Bayes, 5-Nearest Neighbors as well as eXtreme Gradient Boosting (XGBoost).

After combining the machine learning and the embedding methods, we compared the results.

Based on the above research, the best results were achieved using One Hot Unigrams, One Hot Bigrams and TF-IDF as word embeddings in combination with Support Vector Machine as the Machine Learning method, with an accuracy of 0.91.

Keywords: Web scraper, Climate change, Global warming, Twitter, Text encoding, Word embedding, Machine learning

Session 7: MCDA and Decision Support Systems

Generating criteria in a Decision Support System for use in Circular Economy Decisions

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Abstract

Throughout history, materials, either in raw or fabricated form were considered to be one of the main substances of the manufacturing process. As the demand for a variety of different materials increases– due to the fact that resources are not infinite – the solution of manufacturing with already used materials arise as a necessity in our modern industrial sector. Therefore, new ways of dealing with resources need to be assessed to create a “closed-loop” model to extend their product life circle. This model can be described within the margins of circular economy.

In this ongoing research work, we are discussing a total of 198 researched criteria in accordance to the model of circular economy in order to create a managing tool for supporting decisions makers managers engineers in their decision making. These criteria represent the consequences of alternative decisions in different fields such as waste management, eco- efficiency indicators, recycling etc. These criteria will be used in the Decision Support System (DSS) that will be designed and developed.

In order to integrate these criteria in the DSS they should be categorized according to their content in the CE pillars. The content of these criteria will be also presented as a crucial step in eliciting their importance to a Multi-criteria Decision Analysis (MCDA) model. As a result, developing such a methodology will bring contribution to researchers by developing resources management efficiency and paving the way to a sustainable environment in the future by reducing the amount of virgin material use while increasing the prosperity for both companies and society.

Keywords: Circular Economy, Multi-criteria Decision Analysis (MCDA), Decision Support Systems (DSS), Criteria Generation.

Towards the application of Multi-Criteria Decision-Making (MCDM) approaches in Corporate Risk Disclosure

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Abstract

Efficient corporate risk disclosure can be paramount for a company's access to capital markets and thus, strategic decision-making procedures that integrate reliable quantitative and qualitative data are essential to its capacity to adjust to fickle reporting standards, to take into consideration business volatility and to amalgamate subjectivity and multiple corporate and management objectives. Multi-criteria Decision Analysis can provide sophisticated techniques which empower the decision-makers to interpret real-life corporate complexities and to demonstrate equifinality in meticulous corporate risk disclosure. More particularly, the underlined advantages of the Fuzzy Set Qualitative Comparative Analysis (fsQCA) and the Stochastic UTA method can be capitalized on generating pragmatic alternative paths based on aggregation – disaggregation mechanisms, interfusing behavioral patterns, preferences, information asymmetry and non-linear relationships, hence accrediting the scientific calibration of empirical evidence. The quantification of the linguistic dimension of the available data in one hand and the challenge towards the decision-maker to better understand his/her value-system on the other, are two entirely different approaches that can bring forward a better understanding of corporate behavior in respect of risk reporting. The objective of this paper is to discuss on how the different MCDA approaches could efficiently serve the specific needs towards a corporate risk disclosure modeling, focusing on issues such as performance, robustness and easiness to apply it.

Keywords: Corporate Risk Disclosure, Multi-criteria Decision Analysis (MCDA), Fuzzy Set Qualitative Comparative Analysis, Stochastic UTA, Robustness Analysis.

The application of Supply Chain Operations Reference (SCOR) model with Multi-Criteria Decision-Making (MCDM) methods in the Agri-food sector: A systematic literature review

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Abstract

Agri-food supply chain management (ASCM) has faced numerous challenges in recent years, especially in the fields of performance measurement and decision making. In addition, the use of multi-criteria decision-making (MCDM) methods with standard frameworks for supply chain modeling and optimization has attracted much attention over the last decade, with the SCOR model being one of the most important frameworks. SCOR model provides a standard description of supply chain processes, performance metrics, best practice and enabling technologies. In this context, this paper provides a systematic literature review focusing on the application of SCOR model with MCDM methods for Supply Chain Performance Measurement (SCPM). This research uses specific criteria and elements to review selected papers. Web of Science and Scopus were used in the compilation of studies published between 1996 and 2022. This research work is the first attempt to make a critical literature review of available literature on SCOR model and MCDM methods for improved benchmarking and competitiveness in the agri-food sector. The study addressed the research questions and identified the research gap. Moreover, the future research directions were consolidated into a research agenda that has a two-fold purpose: it can be used by researchers to enrich literature and provides practitioners the opportunity to evaluate existing Supply Chain Management (SCM) issues and concentrate on establishing a solution through the development of a conceptual framework on SCPM. To attain this objective, a conceptual model is proposed as a new framework, based of risk assessment, business and quality performance that will improve customer satisfaction through a set of objective metrics. Finally, this tool will be further examined in future research to assist researchers, managers, practitioners and companies to improve and assess the Supply Chain Performance (SCP), as well as improving SCM to increase sector's competitiveness.

Keywords: Systematic literature review (SLR), Supply Chain Operations Reference (SCOR) model, Multi-Criteria Decision-Making (MCDM) methods, Supply Chain Performance Measurement (SCPM), Agri-food supply chain management (ASCM)

Towards the development of a MCDA DSS supporting the evaluation of agri-food products at B2B and B2C level

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Abstract

An integral stage of agri-food products traceability systems is feedback from B2B buyers and consumers, which aims to continuously improve products and design new ones based on different consumer profiles in specific markets. In this paper, a Decision Support System (DSS) is described, which will be based on a multi-criteria methodology highlighting the characteristics of agri-food products and designing new ones. The data of the system will be derived from the results of feedback – evaluations from consumers through an application about the agri-food products they buy, as well as from evaluations coming from the buyers of the products in the context of B2B relationships. The results of the evaluations will also be combined with historical sales data per product category in order to explore scenarios of sales growth in relation to the improvement of product characteristics that will lead to an increase in the value/utility of these products at the level of B2B and B2C shopping.

A key stage in the context of using DSS is the selection of product evaluation criteria that will be related to their characteristics (eg price, quality, logistics, level of traceability) both at the B2B and B2C levels. The criteria will be further refined into sub-criteria. To estimate buyer preference models DSS consists of two approaches. The first approach is the direct weighting of the criteria using experts through the application of the WAP method and the second approach is the indirect weighting of criteria using the Multi-Criteria Aggregation-Disaggregation approach and specifically the Stochastic UTADIS method. For the assessment of consumer preference models, the MUSA method will be applied that focuses on the degree of satisfaction and the suggestions for product improvement. Combining the results of DSS-supported approaches gives a comprehensive picture of product evaluations.

Keywords: Products evaluation, Decision Support System (DSS), Multi-criteria Decision Analysis (MCDA), WAP method, UTADIS Method, MUSA Method

Session 8: Multi-Criteria Decision Analysis

Evaluation of earthquake vulnerability of existing buildings: Towards a Multi-Criteria Decision Aid Approach

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Abstract

Evaluating the seismic vulnerability of the existing building stock is one of the most critical aspects for preventing future fatalities. Pre-earthquake assessment methods are the first step to assessing the existing buildings' vulnerability profile and then categorising and prioritising the intervention and strengthening activities when a limited budget exists. This paper aims to use a Multi-Criteria Decision Aid (MCDA) approach to synthesise the evaluation parameters, estimated from a rapid visual screening procedure, on the first-level pre-earthquake assessment. Rapid visual screening methods have been developed in countries of high seismic risk, such as the USA, Greece, New Zealand, India and Canada. First-level pre-earthquake assessment does not answer the question if a specific building is, or is not, at seismic risk. However, it provides a quick procedure to evaluate the building stock of a high-risk area and identify the most vulnerable buildings that are more likely to be damaged during an earthquake and, therefore, need to be further investigated through more precise structural analysis tools. The main parameters that affect the seismic risk are the seismic hazard (seismicity), vulnerability, and importance of the building structure. The most critical parameters affecting the buildings' vulnerability are selected, while an additive value model is suggested for the evaluation of all buildings.

Keywords: Multi-Criteria Decision Aid (MCDA), Earthquake, Vulnerability

A multicriteria assessment of alternative structural and anti-seismic solutions for buildings design considering sustainability factors

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Abstract

Implementing sustainable solutions in the building's design is one of the most critical issues in today's era. The different structural elements, the different preferences of clients and architects, the required reduction of the environmental footprint and the requirements of current seismic codes form a complex frame in which decisions are made for their design. Various methodologies have been developed to manage this complexity in recent years based on multi-criteria decision analysis. The literature review highlights the application of several multi-criteria analysis methods in the design of buildings, bridges, tunnels, hydraulic infrastructures and transportation infrastructure considering environmental, economic, static and construction criteria. This study aims to develop a decision model applying to the early design stage for evaluating alternative structural proposals, considering cost, construction time, carbon footprint and seismic capacity. The proposed methodology is based on the TOPSIS method, while the criteria weights are estimated with the WAP method. The methodology was applied to an eight-story building with specific dimensions, considering four alternatives from reinforced concrete and one from a steel structure. The present study confirmed the usefulness of multi-criteria decision analysis in improving the selection process and assessing the sustainability of alternative structural solutions at the initial design stage.

Keywords: Multi-Criteria Decision Aid (MCDA), TOPSIS, WAP, Sustainability, Structural and Seismic Building Design

Applying Multicriteria value systems for the estimation of global environmental footprint in refractories

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Abstract

Heavy industries use large quantities of different refract qualities into their infrastructures in order to face the high temperature conditions. Refracts are replaced periodically as part of the maintenance of the furnaces due to their strain and wear from the prevailing conditions and their use. Worldwide the quantity of 25-30 million tons of refract wastes are produced every year with an increasing trend. This research work is focused on the Lice Circle Assessment methodological frame for the estimation of the environmental footprint index exploiting the features of the multicriteria paradigm. The paper concludes with the proposal of a collaborative multicriteria decision aid approach for the estimation of the weights of the relative factors involved into the environmental footprint taking into consideration the experts' opinion.

Acknowledgement: This research was supported by the European Regional Development Fund of the European Union and Greek national funds (Greek Secretariat for Research and Innovation—GSRI) through the Operational Program Competitiveness, Entrepreneurship, and Innovation (EPAnEK 2014–2020) under the call RESEARCH—CREATE—INNOVATE. Project: “Recycling of used refractories from various industries to produce alumino-silicate refractories, ceramics, and masses” (project code: T1EDK05442).

Keywords: Multicriteria Decision Aid, Sustainable Development, Circular Economy

Multicriteria approach for the assessment of water lakes ecological status.

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Abstract

The evaluation of the ecological status of the lakes' water constitutes a major point of interest for scientific community and governmental bodies, while it is crucial to human life. The main stream for the assessment of lakes water includes classification techniques discretizing into five levels (a) High; (b) Good; (c) Moderate; (d) Poor; and (e) Bad ecological status. The evaluation is achieved through the utilization of simple numerical techniques and strict thresholds, aggregating the values of critical features, such as pH, Nitrogen and Phosphorus concentration. This research work examines the exploitation of Disaggregation – Aggregation Multicriteria Decision Aid Analysis approaches for the constructing of additive value system providing a more structural and precise way to picture the ecological status of the lake's water and avoiding the use of thresholds into the examined characteristics. Also, an illustration case study concerning the category of warm lakes' ecological status is used for the illustration of the proposed multicriteria Approach.

Keywords: Multicriteria Decision Aid, Disaggregation - Aggregation Approach, Evaluation of Ecological Status

Session 9: Mathematical Modeling & Optimization

The Coordinate Method of Solving Multi-Objective Problems Optimization on the Combinatorial Configuration on Permutations

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Abstract

This work is devoted to the actual problem of developing a method for solving a multi-objective optimization problem on combinatorial configurations.

A number of practical problems in the field of economics, management, planning, and design of complex systems can be represented as models of multi-objective problems of combinatorial optimization, since many applications have a multi-objective condition.

In addition, the problem becomes more complicated if combinatorial restrictions on variables in the objective functions are added.

The solution of such problems consists in finding the extreme value of the function and the values of the variables under which it is achieved.

In this case, a more complicated problem arises, where it is necessary to combine the solution of an extremal problem on combinatorial configurations with the solution of a multi-objective problem.

For each individual class of problems, fundamental research was carried out and significant results were obtained, but in the aggregate, this problem is complex and poorly understood.

We propose a coordinate approach to solving the problem of a multi-objective optimization problem on a combinatorial set of permutations.

The main idea of this approach is to use the properties of polyhedra and graphs of combinatorial sets. The coordinate method for solving problems of multi-objective combinatorial optimization works directly with the system of restrictions of polyhedra, and also uses the representation of combinatorial sets as a set of schemes.

This technique allows you to analyze a group of permutation elements at once and reduce the number of points required for a complete analysis of the permutation graph.

The coordinate approach is illustrated by the example of solving the problem of multi-objective linear optimization on a set of permutations. On the basis of numerical experiments, the effectiveness of the proposed approach is estimated.

Keywords: multi-objective problem, combinatorial optimization, combinatorial configurations, polyhedra, combinatorial set's graph, permutation

New Classes of Polynomially Solvable Permutation-based Linear Optimization Problem

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Abstract

One of the most important issues in combinatorial optimization is the search for new classes of polynomially solvable combinatorial optimization problems. This paper studies a class of permutation-based optimization problems known for various practical applications in optimal control theory and geometric design. It is known that the unconstrained linear optimization problem on permutation vectors (unconstrained linear permutation-based optimization problem, ULPBP) is polynomially solvable, and its computational complexity is $O(n \ln n)$, where n is the length of permutation vectors. Another such problem is the linear assignment problem (LAP), which is essentially an unconstrained linear optimization problem on a set of permutation matrices. Its computational complexity is $O(n^3)$, where n is the matrix dimension. We extend the class of polynomially solvable permutation-based optimization problems by introducing three permutation-based sets whose search domain is represented by matrices of dimension $m \times n$, and special constraints are imposed, which are formulated in terms of matrices. Class 1 is a set of m -tuples of n -permutations, Class 2 is the set of m -permutations of n -tuples. Class 3 is the set of m -permutations of n -permutations. Their polynomial solvability is proved by reducibility to solving a finite series of ULPBPs for Class 1, reducibility in polynomial time from m and n to a LAP for Class 2 problems, and finally by reducibility to combining ULPBPs and a LAP for Class 3 problems. We present the results of a computational experiment implemented in Python on randomly generated synthetic problem instances of dimension m, n in the range of 10-200 and experimentally confirm our theoretical contributions. The paper results are valuable in themselves, and can also be used to solve more complex optimization problems, such as convex optimization on convex hulls of the above combinatorial sets, the analytical form of which is unknown so far for Classes 2 and 3, as well as a projection onto these sets. Combining these two, one can solve approximately the problem of optimizing a convex function on sets of Classes 1-3.

Keywords: combinatorial optimization, permutation-based set, permutation matrix, computational complexity, computational experiment

Sustainability Factors Affecting Manual Assembly Lines

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Abstract

UK Manufacturing Industries is a key player in not only the country's economy but also the global economy. However, the same industries also contribute vastly to the GHG emissions. This is a major issue for manufacturing companies that are trying to achieve the Sustainability Goals set by the UN. Technological concepts like IoT and Industry 4.0 have brought rapid advancement in manufacturing industries, however, research has shown that manufacturing industries continue to heavily rely on manual labor. As industries continue to focus on meeting sustainability goals with the challenges faced through manual operations, this paper explores the factors that contribute to the sustainability issues faced by these manufacturing industries. Factors identified in this study have taken into consideration sustainability issues in not only the general functioning of manufacturing industries but also in manual assembly lines. These factors have been collected from previous studies and general feedback from industries and supported by literature review. As compared to previous papers that focused on only one of the triple bottom lines (TBL), this study focuses on factors from all the TBLs and the factors identified in this paper have been collectively grouped and distributed under the economical, environmental and social TBL pillars. This list of factors will play a key role in future work to develop a framework aiming at helping industries meet their sustainability goals while optimizing their manual assembly line operations.

Keywords: Sustainability, Manufacturing, Manual Assembly, Production Operations

Mathematical Modeling and Solving of Maximum Coverage Location Problem with Irregular Geometric Items

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Abstract

The maximum coverage location problem (MCLP) is studied when both the coverage demand and the service areas are of various geometric shape and sizes. Each service area is associated with a centroid, relative to which the position of the geometric item and the equation of its boundary are determined. The task is to find such a position of the centroids and the relative location of the items, which provides maximum service coverage. The novelty of this paper lies in the fact that arbitrary irregular geometric items are considered. A mathematical model of the MCLP is formulated as a nonlinear optimization problem, in which the variables are parameters that determine the location of items, and the objective function is defined as the area of the coverage demand. Both analytical formulas and computer geometry software were used to calculate the objective function values. To solve the problem, an original approach is implemented that combines the stages of local and global optimization. At the stage of local optimization, BFGS method was used, in which the gradients were calculated analytically or by first-order differences (for complex shapes of service areas). For global optimization, it is proposed to use evolutionary algorithms with control over the accuracy of the solution at successive iterations. Auxiliary problems were formulated that speed up the process of finding local solutions. The implementation of the approach has been tested in solving MCLP for various shapes of demand zone and service areas. Great interest in solving MCLP is associated with a wide range of practical tasks related to video surveillance systems, environmental monitoring, emergency notification, mobile communications and the Internet, service maintenance, etc.

Keywords: maximum coverage location problem, coverage demand, service areas, mathematical model, geometric item, optimization, computer geometry software

Session 10: Urban Planning and Sustainability

Urban Accessibility and Walkability: Current Approaches and Future Prospects

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Abstract

Urban accessibility and walkability in public spaces are critical for living sustainably in modern cities. Several approaches for measuring these concepts have been developed, reflecting their importance in urban planning and infrastructure management. This article thoroughly reviews current practices to assess urban accessibility and walkability, as well as potential areas for future research and growth. Various approaches and concepts to evaluate urban accessibility and walkability are provided, their benefits and drawbacks are examined, and their relevance to various urban environments is discussed. Furthermore, the research emphasizes the potential of approaches applying Multi-Criteria Decision Aid (MCDA), a novel approach to evaluating urban accessibility and walkability. The use of MCDA in urban planning can assist decision-makers in prioritising interventions and investments which improve urban accessibility and walkability while taking into consideration stakeholders' various viewpoints and preferences. Finally, the study emphasises future research and development opportunities in this field, such as the need for integrated methodologies that reflect the complex interactions between urban design, transportation infrastructure, and pedestrian behaviour. This review's findings offer insights into current urban accessibility and walkability assessment approaches, as well as areas for future research and development.

Keywords: urban space quality, walkability, accessibility, multi-criteria decision, making, MCDA, sustainability

Integration of Passenger Unmanned Aerial Vehicles (UAVs) in Urban Areas Transportation

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Abstract

The rapid development of Unmanned Aerial Vehicles (UAVs) during the past decade led to the consideration of passenger UAVs as an alternate method of urban transportation. In this work, we focus on the future use of passenger UAVs from a civil engineering point of view, i.e. the corresponding infrastructure requirements for buildings or open areas, their optimal interaction with other transportation means, the possible city impact, as well as the environmental, legal, or other issues that may emerge. The city of Athens is selected as a case study, as it combines the UAV airport location availability with the high need for new transportation solutions. This study aims to design an urban airport network that optimally interacts with existing transportation means. Apart from the description of the required infrastructure for deploying UAV airports in the near future, our work also suggests a number of indices for the characterization/classification of each location and a method to better or optimally identify the airport locations using advanced Operational Research techniques.

Keywords: Smart City, Passenger UAV, Optimization, Civil Infrastructure, Urban Transportation

Opening the agenda for proposing standards on “sustainability proofing” of inland transport infrastructure investments and networks, targeting Resilience

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Abstract

The EU and our country set to call on more action in favor of combating the impacts of climate change; this paper attempts to further investigate the adverse effects of climate risks, when planning and implementing infrastructures/investments, mainly due to their weight in sustainable, regional development.

Infrastructure projects are approached in a broader context, which includes, for example, legislation, spatial-regional strategies, sectoral strategies, plans, data, guidance documents, methodologies, tools and design standards. The proposed work, by exploring the 2021, EC technical guidance on the climate proofing of infrastructure, covering the programming period 2021-2027, would be mainly focusing on inland surface transport infrastructure networks, further benefiting from a spirit of cross-sectoral learning and valorization of the available EC – national institutional tools.

More specifically, with a view to open a discussion for proposing standards on the sustainability proofing of infrastructures, targeting Resilience, this paper will also highlight the role of the participatory approaches and co-design processes, in order to better implement EC environmental and cohesion policy priorities.

Keywords: Sustainability proofing, Resilience, European Policies, Spatial Strategies, Regional Strategies, inland surface transport infrastructures, inland surface transport networks.

Introducing a “Smart” Urban Governance concept through novel policy and process holistic approaches

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Abstract

Generating a broader understanding of gentrification phenomena -as experienced until yesterday- in city centers (which maybe also gifted with various, heritage types and ageing building stocks), seriously involve the potential reshaping of the urban dynamics and rearrange at least spatially, the ‘just’ distribution of opportunity in the city and a more balanced quality of its public space. This paper anticipates to contribute in policy analysis for regional (urban) development in times of recovery from economic/fiscal, migration, COVID 19 pandemic and climate change crisis. These crises while constantly question the outcomes, policy tools and achievements, this approach will discuss among others new set of research questions and response tools (e.g.: the World Bank urban regeneration tool).

To do so, an assessment of a) the mechanisms of local growth and the urban, economic, and/or physical regeneration; b) the factors and activities that influence the landscape and the uses of a city (primarily focusing small – medium sized urban centres, targeting at enhancing cohesion and urban resilience is needed. These components shape the initial framework to assess the complexity in decision-making and the concrete ways to facilitate a “priorities-planning/policy” process. With the aim to provide an enhanced assistance to decision making highlighting the role of infrastructures as investments is important. Moreover, the role of commerce, tourism and other productive sectors enhancing both creative activities and innovation in the city would be further focused by further exploring the use of theoretical, technological and analytical tools. Increasing the understanding of these factors finally ends up optimizing strategic planning and related decisions to positively affect cities efforts and their users by delivering a smart urban governance process.

Keywords: Urban regeneration, smart urban governance, innovations, investments, climate change, pandemic, strategic planning, foresight planning, resilience

Session 11: Organisational Processes

Modelling and deployment of Internal Affairs processes for automated anti-corruption reactive measures

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Abstract

The Hellenic Ministry of Digital Governance is implementing the Digital Transformation Strategy, a five-year programme for recording the necessary processes and actions aimed at developing horizontal policies for digital transformation in the public sector of Greece, with measurable goals and measurable quarterly results. This initiative offers an excellent opportunity to core governmental departments, like the Greek Police to digitise, automate, standardise, and modernise their administrative and investigation processes. Even though many administrative processes related to citizen-service interaction are recorded and registered in the “National Registry of Administrative Public Services – Mitos” of the Greek public sector, there are many others that are not included. At the same time, an effective depiction of processes using established business process modelling techniques is also missing, which leads to agencies not capitalising on the full potential of the business processes. The aim of this paper is to showcase the usefulness and practicality of business processes for both the agencies and citizens, through a case study of the Internal Affairs Service of the Greek Police. The proposed approach introduces a digital and automated system for receiving complaints and information on corruption cases investigated by this public service. Through the presented digital portal, qualitative characteristics are introduced which can classify the complaint - information into three levels of importance and at the same time, a digital repository of information is created for future use. The approach ensures transparency in the information management, leads to more efficient investigation of corruption cases, and provides a more qualitative assessment of the urgency of each complaint - information through an automated system of classification. The contribution of the presented process is multi-fold since it can be readily applied in many similar cases by law enforcement agencies and complaint handling departments in the Greek public sector.

Keywords: business process modelling, Internal Affairs, Greek Police

Advanced integrated systems in Non-Governmental Organizations

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Abstract

The complexities of developing an integrated information system in a Non-Governmental Organization (NGO) are immense. Such a system must provide detailed reports to its financiers, which necessitates comprehensive database architecture and the capacity for customization, integration, and expansion.

In this article, we examine the challenges of implementing a system for a Greek NGO that specializes in social action. Particular attention is paid to the risk management and business intelligence components, while also investigating the potential of artificial intelligence.

Keywords: NGO, Risk management, Business intelligence, Artificial intelligence

A Tool for Automated Assessment of Organizational Business Processes

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Abstract

Business Process Model and Notation (BPMN) has emerged as a popular modeling technique for business processes, enabling organizations to follow process-oriented approaches. Organizations are increasingly adopting this orientation toward processes and recognizing the value that is inherent to the Business Process Measurement Lifecycle. A typical example is evident in Greece, where the Ministry of Digital Transformation has established the “National Registry of Administrative Public Services” (Mitosis), the official register of procedures of the Greek Public Sector. Mitosis currently hosts over 2500 Business Process models from various domains and seeks to add in the future more than 1000 more models. This dataset contains an amplitude of models that need to be manually reviewed; a task prone to human faults and biases. This signals the need for analyzing models in a quantitative manner, applying state-of-the-art scientific frameworks to help make sense of large datasets thus ensuring the quality of the models. However, quantitative analysis of a BPMN model revolves around the computation of various metrics stemming from the domains of software quality and graph theory. The approach presented in this paper introduces a novel tool designed to facilitate the calculation of metrics in BPMN diagrams. The proposed tool fills a technical gap in the BPMN analysis domain, regarding software solutions implementing already conceptualized theoretical frameworks and provides an automated approach for calculating metrics. The tool accelerates the adoption and application of proposed frameworks by abstracting the core computational overhead, thus facilitating the automated assessment of BPMN models. That way, decision-makers in both the public and private sectors can utilize without extra effort and resources the appropriate scientific methods to navigate the complexities of large organizational structures through the study of business processes.

Keywords: business processes, automated tool, metrics calculation, business process modelling, business process improvement

Agent-based Modeling Social Systems – The Case of COVID-19.

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Abstract

The Covid-19 pandemic has significantly affected global health, economy, and society. Governments, organizations, and citizens have implemented various measures to address the spread of the virus and mitigate its consequences. To study this multidimensional phenomenon, a social simulation model was constructed in NetLogo. The model consists of agents that move in space and transmit the virus. The course followed by an agent who is sick is as follows: admission to a hospital, admission to an intensive care unit, and finally death – all with probabilistic rates based on literature. At each stage of this process, the agent can recover and acquire immunity. The age group to which each agent belongs is a fundamental characteristic of each agent. Within the framework of this study, three measures for managing the pandemic were examined: vaccination, the use of protective masks, and the initial population of the community. According to the results of the study, an increase in vaccination in the community significantly reduces hospitalizations and deaths, mainly for the age group over 65, who are at the highest risk. With an increase in the use of masks, the rate of disease spread decreases, and consequently, a small reduction in hospitalizations is observed. Finally, the initial population plays an important role in the outcome of the pandemic. In cases of overpopulation, mask use does not yield results, while in cases where the population is very small and agents are scattered, there is no spread, and most agents do not come into contact with the virus.

Keywords: Social simulation, Agent-based Modeling, Covid-19 Pandemic, NetLogo

Session 12: OR in Social Care Management

The risk of poverty and social exclusion for single-parent families and big families during the crisis

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Abstract

Aim: The aim of this study is to examine the indicators related to the risk of poverty and social exclusion in Greece and how they evolved during the period of socioeconomic crisis of 2010-2018. The main objective is to gain a comprehensive understanding of the socioeconomic impact of the crisis on single-parent and big families.

Method: The analysis involves a comparative examination using widely recognized definitions and indicators. It primarily relies on data from the Hellenic Statistical Authority (ELSTAT) and Eurostat, particularly the surveys on Living Conditions (EU SILC) and Household Budget Surveys (HBS). It involves data from the crisis period and statistical comparisons across different time points and population categories.

Results: According to the data the depth of the danger of poverty in Greece dramatically rose throughout the crisis, peaking at 32.4% in 2013 (up from 23.4% in 2009). From 8.9% in 2008 to 27.3% in 2013, or over 1,350,000 jobless, there was an increase in unemployment. Young individuals between the ages of 15 and 24 appear that they have been significantly affected by unemployment as the economic crisis deepened. Young adults aged 25–34 (2008: 10.6%, 2012: 34.1%), and women (2008: 22.1%, 2012: 56.6%). In 2013 19.6% of the population aged 18-59 (1,200,800 people) lived in low-work-intensive households. Prior to the beginning of the crisis, single-parent families and families with three or more children posed a considerable risk of poverty and material deprivation and were, thus, more severely impacted. The risk of poverty in these households dramatically rose from 20,8% in 2011 to 36,8% in 2012. For the first time among all household categories in 2020, big families had the greatest at-risk-of-poverty percentage (27.2%).

Discussion: According to the literature, families' positions and quality of life decline during socioeconomic crises, raising their risk of falling in poverty. Both households with one person and those with several people are more affected. The low labor intensity of the primary home members is a major significant factor.

Conclusion: During the crisis, single-parent families were more at danger of poverty and social exclusion, and households with three or more dependents were much more at risk. The position of extended families and single-parent households in Greece substantially deteriorated during the crisis, putting them at higher risk of poverty and social exclusion.

Keywords: Risk of poverty, Risk of social exclusion, Types of households, Big families, Single-parent families

Sustainable Development without exclusions (Agenda 2030 for Sustainable Development to "Leave No One Behind") with emphasis on social protection in Greece

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Abstract

The 2030 Agenda includes 17 Sustainable Development Goals aimed at ensuring human dignity and diversity, better healthcare services, quality education, eliminating inequalities, economic growth, and environmental protection. The concept of sustainable development, in its complexity, presents a multi-faceted and multi-leveled form, which in almost all the literature, as searching for the needs of this research, strongly includes the dimension of the environment and its relationship with the issues of society, economy, and development, such as poverty, health, education, human rights, and environmental protection.

The present research through the questionnaire developed for the collection that contributes to the formation of the conclusion, in order to investigate the living conditions of the rural population, their connection with environmental changes and the goals of the 2030 Agenda, given that the rural population is a group adversely affected by climate change and environmental disasters, which often lead to migration and poverty with a copy of social exclusion.

The effort to explore these questions, in this particular research, aims to contribute in a creative way to highlighting the problem and the imperative need to implement and implement the goals of sustainable development for social protection in Greece.

Keywords: Agenda 2030, Social exclusion, Poverty, Migration, Climate change, SDGs, Greece

Sustainable Local Development without exclusion: A case study on social protection programmes within the region of Athens

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Abstract

This article analyses the term “Inclusive Local Development” as it has been defined by various organisations. Even though these definitions are characterised by some kind of diversity, their point of convergence is that inclusive development is fair, participatory, advancing, stable, and above all, sustainable. This is the reason why it is closely related to the United Nations’ Sustainable Development Goals. The aims of Inclusive Local Development can be achieved by empowering local communities, people in general and specifically those living in poverty or facing social exclusion. It is obvious that social protection policies that are designed and implemented at a national, regional and local level are related with Sustainable Development Goals. In this way, Inclusive Local Development is the key to the local societies’ development with the simultaneous reduction of social risks such as poverty and social exclusion. In this particular study, a field research has been conducted in order to analyze the knowledge of the auspices that apply social protection programmes and especially programmes for child protection or poverty alleviation on Sustainable Development issues.

Keywords: sustainable development goals, inclusive local development, social protection programmes, poverty alleviation, Athens region, child protection

Sustainable local development without exclusive: a focus on migration social policy in Greece.

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Abstract

The present research is carried out in the context of investigating the living conditions of vulnerable groups such as immigrants and refugees, their connection with environmental changes and the goals of the 2030 Agenda. Findings are expected such as the level of living conditions of the researched groups, the level of poverty (if any), of social exclusion, of socio-economic inequalities and the level of approach to the SDGs.

Cross-border migration and the influx of immigrants/refugees in Greece in recent years, makes it necessary to ensure decent living conditions, access to health services/medical care, inclusion in educational programs that enrich with knowledge and skills for finding a job, equal treatment. elimination of inequalities and in general the integration of immigrants/refugees in the host country in accordance with human rights and the SDGs. The present research is conducted with these concerns in mind.

Therefore, this research aims, among other things, to shape the living conditions of vulnerable groups and to approach the goals of sustainable development in Greece, which contribute to the elimination of exclusions and functional social protection. The formation of an inclusive society is essentially achieved by the effort to implement the goals of Agenda 2030, mainly those related to health, education, work and more generally employment and equal treatment as they directly concern the decent living of the population and the economic development as a whole.

Keywords: Agenda 2030, social exclusion, Poverty, migration, climate change SDGs, Greece

Session 13: Environmental Management

Climate change mitigation and adaptation in the public sector: placing municipal enterprises in the heart of the problem

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Abstract

The adverse effects of climate change are nowadays more apparent than ever and seem to suffocate every aspect of the everyday life that they lay hands on, with Europe facing one of the worst droughts in the history, the Mediterranean burning throughout the summer, and extreme weather events alternating, catching Member States unprepared and often leading to both material and human losses. At the same time, they seem to apply an additional pressure on the already burdened national energy budgets, in the midst of the most severe energy crisis in recent years.

In Greece, centrally coordinated efforts have been intensified to integrate several European directives for environmental protection, mitigation and adaptation to climate change, Energy Management and Saving, culminating in the recent Climate Law and the current National Energy and Climate Plan. At the local level, energy-intensive and polluting companies have been striving to reduce their energy and carbon footprint, drawing from their relevant mandatory commitments as they derive from the European Emissions Trading System, the Energy Efficiency Obligations, etc. Nevertheless, Greece falls behind in meeting its carbon footprint reduction targets, with the public sector identified as the main “pain spot”. More than 150 municipalities already participate in the Covenant of Mayors and more than 120 Sustainable Energy and Action Plans have been developed, although, the implementation of these plans is still at preliminary stage.

In this respect, this paper aims to develop and make available to the municipal enterprises a toolkit, including four discrete however rather interlinked software tools. These tools are designed to shape a holistic framework for analysing and extracting integrated solutions that will allow all interested municipal enterprises to consider the implementation of actions towards reducing their carbon footprint and adapting to climate change. Specifically, the ECO SENSE Footprint tool can be used as a data inventory, with an eye to facilitating the calculation and monitoring of municipal enterprises' carbon footprint. The ECO SENSE Resilience leverages on the data presented within ECO SENSE Footprint and by employing a multicriteria analysis method is able to assess the resilience against the climate change of the municipal enterprises. ECO SENSE Forecasting is focused on forecasting energy production and demand of a municipal enterprise, in order to support a potential course of maintenance actions of the respective equipment and units. Finally, the ECO SENSE Roadmap tool presents an elaborated roadmap in terms of prioritising potential measures to be implemented, based on which, each municipal enterprise will become more climate resilient.

This research has been co-financed by the European Union and Greek national funds through the Operational Program Competitiveness, Entrepreneurship and Innovation, under the call RESEARCH – CREATE – INNOVATE (project code: T2EDK-00241).

Keywords: Climate change, municipal enterprises, decision making, resilience, toolkit

An integrated framework of Sustainability Balanced Scorecard with neutrosophic AHP for smart port performance evaluation

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Abstract

Nowadays we experience a series of developments in technological, economic and political levels such as globalization and the emergence of new Information Technologies and Communications (ICT) which significantly affect the services provided by a port. The concept of “smart ports” was recommended as a solution to overcome challenges for ports such as the quest for operational excellence, the relocation of activities, and the need to meet successfully the new business demands. These concerns stem from the tendency to measure the success of each port based on traditional parameters such as size and performance. In this vein, a plethora of practical and theoretical approaches to measuring port performance have been proposed, primarily encompassing individual measurements and indices, economic impact studies, and frontier approaches. However, due to fundamental disparities between these techniques and their proposed methodologies, no consensus on a single framework for port performance testing has been formed, despite the variety of tools and instruments available. It is observed that significant gaps and inconsistencies exist at both the analytical and methodological levels that must be addressed in order to establish a meaningful and integrated performance framework. In response to this gap, our research identifies and suggests criteria of performance assessment and evaluation for smart port performance and proposes a novel hybrid conceptual performance measurement framework in order to provide interested parties with useful information. The proposed conceptual framework is built on the basis of a modified version of the Balanced Scorecard method, namely the Sustainable Balanced Scorecard (SBSC), enriched and adapted in the context of smart ports. Furthermore, interdependencies between SBSC aspects and weights of key performance indicators can be determined according to their importance level using neutrosophic AHP, an extension of classical AHP, yet in neutrosophic environment. As a result, our methodology is capable of decision-making in the event of incomplete, uncertain, and inconsistent information during assessment process, thus providing a theoretical basis for quantitative evaluation of port smartness. The proposed solution could be utilized to accelerate an organization’s development, enhance efficiency, and strengthen efforts to meet strategic and sustainability goals.

Keywords: smart ports, port performance measurement system, port evaluation, performance indicators, Sustainable Balanced Scorecard, neutrosophic AHP

A multi-criteria decision methodology for academic staff selection in a neutrosophic environment

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Abstract

To sustain a university's international reputation in academic society, it is critical to attract high-quality academic staff, which, by all means, constitutes its most significant asset. This selection displays a vital role in accomplishing strategic objectives, while simultaneously increasing the academic institute's level of attained performance. In this respect, the process of selecting qualified academic staff establishes a critical aspect of an academic organization's competitiveness, efficiency, and status. Our research aims to provide a useful managerial decision-making tool by developing and demonstrating a comprehensive multi-criteria methodological framework and assisting decision-makers with the complicated academic staff selection process. Our main objective is to fill a gap observed in related literature, by proposing a compact and integrated methodological framework based on AHP and Delphi methods, yet within a neutrosophic context. The conceptual framework introduced in this paper, uses the theory of neutrosophy sets and is considered suitable in terms of significant degree of ambiguity and indeterminacy observed in decision-making process. To the best of our knowledge, our approach is the first to employ the suggested N-DM in the recruitment of academic personnel. As a case study, we selected to apply our method to a real-world problem of academic personnel selection, as represented by a numerical example, with the main goal of improving the algorithm proposed by earlier scholars' work. Comparative study showcases that our model performs better in neutrosophic environment rather than using fuzzy methods.

Keywords: MCDM methods, Analytical Hierarchy Process, Delphi Method, neutrosophic set theory, personnel recruitment

Sustainability Performance Evaluation based on a Contract Theory Perspective

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Abstract

In terms of the linkage between sustainability and the business environment, the use of strategic management is becoming increasingly important to the field of sustainability studies and practice. As the expectations of stakeholders for environmental, social and economic corporate performance continue to rise, many companies are engaging in a variety of sustainability actions for meeting those expectations and gaining a competitive advantage by integrating sustainability into their strategy, as well as their organizational processes and structures, mostly associated with total quality management. Modern contract theory offers a practical and generalizable paradigm to aid in the formulation and implementation of effective sustainability strategies by providing a framework for aligning objectives across different sustainability dimensions, lowering uncertainty while increasing collaboration and performance toward shared goals.

This paper deals with the development and implementation of a prototype methodological computational model, in order to evaluate, dynamically over time, corporate performance and total quality management upon critical infrastructure sustainable development, by taking into consideration the key dimensions of sustainable development which are related to environmental sustainability comprehensiveness, technological efficiency transition as well as contribution to socioeconomic development. Special consideration is given on the proposed evaluation framework's applicability in transport infrastructure with similar operational characteristics in the same or different country or region and throughout a specific period of time, in order to support stakeholders and decision makers in sustainability strategy formulation, implementation and monitoring.

Based on the four basic assumptions and taking into consideration related observations from contract theory, a practical and generalizable approach is formulated in order to assess critical infrastructure corporate performance and total quality management aspects, in terms of potential sustainability strategies. Distinguished strategies in terms of critical infrastructure corporate performance upon sustainable development, by taking into consideration dimensions of environmental sustainability comprehensiveness, technological efficiency transition as well as socioeconomic development, are formulated.

The methodological approach consists of two main levels. First of all, the evaluation of corporate performance, with an emphasis on quantitative assessment of sustainable development dimensions related to environmental sustainability comprehensiveness, technological efficiency transition and contribution to socioeconomic development. Then, the development of a prototype assessment modelling for evaluating critical infrastructure sustainability strategy. Conventional wisdom is the development and implementation of a novel and prototype methodological assessment framework based on multi-objective and computational modelling for supporting decision-making in the context of the formulation of effective and comprehensive strategies upon critical infrastructure sustainable development.

Keywords: sustainability appraisal, contract theory, critical infrastructure business resiliency, sustainability quantitative assessment

Session 14: OR in Structural Engineering

Performance of a Concrete Crack Detection Tool using Convolutional Neural Networks (CNN)

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Abstract

The identification, classification and repair of cracks in concrete are critical to the integrity and structural health of structures. In this work we focus on advanced techniques for the automatic detection of cracks in concrete. Recently, there has been a great research interest in the development of new detection tools based on machine learning. The convolutional neural networks (CNN) is one of the tools that demonstrate very good performance in pattern recognition. In this work, CNN will be applied for the recognition and analysis of images containing cracks in concrete. Our results are based on widely available datasets with a large number of images that are used to evaluate the performance of the proposed system in identifying cracks. The classification success rates showed that the CNN-based approach for crack detection in concrete structures can provide satisfactory results. The results also suggest that a CNN-based identification/classification system for photos/images of cracks can significantly improve and accelerate the maintenance and inspection of concrete structures.

Keywords: Concrete cracks, Pattern recognition, Crack detection, CNN, Structural health, Machine learning

Multi-Criteria Decision Analysis: Presentation and Comparison of Methods

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Abstract

Since antiquity, decision-making has been one of the main characteristics of human nature. Every individual decides based on his preferences and views of moral principles, either consciously or unconsciously, and sets criteria. The Multi-Criteria Decision Analysis (MCDA) even though started off as part of the Operations Research domain, soon expanded developed, and integrated into almost every aspect of human activities within most of the research and societal activities. In more complex multi-parametric problems, it is difficult for the human brain to realize all parameters and to compose them towards a compromise solution that by no means entails an optimal solution. Due to this reason, the Multi-Criteria Decision Analysis (MCDA) started off and will continue to develop in the future as it constitutes a robust research domain that attracts scientists and researchers. The present article presents the most important methods of Multi-Criteria Decision Making (MCDM), which represents one out of the existing analysis methods along with their variants available and compares them through examples and applications, regarding their fitness to each problem in question. It facilitates the stakeholders to come up with the final decision within the decision process along with the support of it on a post-decision basis. It is shown that the methods used agree with regards to the optimal solutions they elicit which exhibit small differentiations in relation to the ranking thus hierarchical order amongst the 1st and the 2nd or the 2nd and 3rd solution and so on. The MCDA has been therefore widely known as a scientific tool that offers a significant contribution towards solutions for almost the majority of the scientific fields and surely much more can be done to investigate how to implement these methods or even discover new methods or each variation of these so to better adapt to the particularities of each problem or scientific field.

Keywords: Multi-Criteria Decision Analysis, Optimization, Operation Research, Comparison

Heuristic optimization design of Reinforced Concrete Retaining Walls

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Abstract

Reinforced concrete retaining walls are concrete structures that are built to retain natural soil or fill earth. This study examines the lower cost-optimized design of retaining walls. Recently, a large number of modern optimization techniques were published, but a small number of them were proposed for reinforced concrete retaining walls. The proposed method develops a heuristic optimization approach to achieve the optimal design of these structures. This method simultaneously satisfies all structural, geotechnical, and European Code design restraints while decreasing the total cost of these structures. In order to confirm the efficiency and accuracy of the proposed method, characteristic retaining wall examples are demonstrated. Furthermore, the parametric investigation is examined to study the result of pertinent parameters on the minimum-cost static and seismic design of retaining structures.

Keywords: Heuristic optimization, Retaining walls, European codes, Seismic safety

Discrete Optimization of Truss Structures using Differential Evolution: A Preliminary Investigation

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Abstract

Truss structures are efficient load-bearing systems for large spans due to their high strength-to-weight ratio. The discrete optimisation of truss structures involves selecting an optimal combination of structural members, in the sense of the smallest overall weight, while considering various stress and displacement constraints. The discrete nature of this problem means that a specific cross section is selected for each member, which is taken from a finite list of available sections. This study is a preliminary investigation on the application of a powerful metaheuristic algorithm, namely the Differential Evolution (DE), to the aforementioned problem. It is shown that, although DE is by nature better for problems with continuous variables, it can perform satisfactorily with the necessary modifications and enhancements.

Keywords: truss weight minimisation, Structural Optimisation, Differential Evolution (DE)

Session 15: OR Applications I

Estimator comparison for the prediction of election results and applications

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Abstract

The purpose of this study is twofold. Firstly, we aim to accurately predict the outcome of the popular vote of the United States of America by relying on the least amount of data possible. We will do so by applying the cluster sampling technique over our data. For this experiment, we will be either setting the 51 states as our clusters or the 3152 counties, when stratified sampling is being used. Based on the results of the aforementioned procedure, we will be able to estimate the minimum amount of clusters needed for our method to succeed. Due to the large variation in our clusters' size, we will be using the Horvitz-Thompson Estimator as the estimator of our choice. Furthermore, we will investigate the issues that arise from the packages of R programming language when used in conjunction with proportional to size sampling designs and propose a workaround based on the correlation of the total votes in a cluster between two consecutive elections in the span of a quadrennium. The methodology presented can also be used for the prediction of the Greek legislative elections as well as for any other country's elections as long as prior voting results are available.

Keywords: Horvitz, Thompson, Estimator, Cluster, Sampling

Energy Market Volatility Modeling and Forecasting.

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Abstract

We propose a volatility modeling and jumps detection methodology to accurately model and forecast the volatility of the energy variables of interest. To estimate energy market related realized volatility and jumps detection we use high frequency price data. Specifically, we follow a novel nonparametric approach as the information content of jumps in future volatility is an important area of research in the financial forecasting literature; especially, considering that jumps have a substantial impact on future realized volatility.

Keywords: realized volatility, jumps, machine learning, energy market

A quadratic assignment formulation for minimizing power consumption in deep submicron technology buses

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Abstract

The extensive interconnectedness of networks in modern microprocessors has been identified as one of the primary contributors to energy dissipation in the digital circuits industry. Consequently, it is essential to design and implement a technique that can achieve the greatest possible reduction in power consumption. To address this, a fixed permutation of data bits, known as the wire permutation approach, has been proposed as a means to decrease expected power consumption. This novel scheme involves permuting the bus lines during the physical design phase. The objective is to minimize opposite transitions and maximize concurrent transitions in adjacent lines by selecting an appropriate permutation. In the literature, this problem has been shown to be equivalent to a variant of the well-known traveling salesman problem (TSP), leading to the modification and utilization of established heuristics for the TSP to obtain solutions. In our work, we introduce a new formulation and demonstrate that the problem at hand belongs to the class of quadratic assignment problems, which are known to be exceptionally challenging within the NP-hard class. Leveraging this insight, we propose heuristic solution methodologies that are considered among the most effective approaches for efficiently solving the problem of minimizing power consumption in deep submicron address buses using wire permutation.

Keywords: quadratic assignment problems, heuristics, energy consumption in digital circuits

Industrial chocolate production as an optimization problem

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Abstract

As George Box has aptly put it, all models are wrong, but some are useful. A useful model for the industrial process of manufacturing various chocolate products for a factory in Greece is presented in this work. An interesting aspect of the problem is that reservoirs are used for storing intermediate products. At the same time, several other resources like mixing-refining-conching machines, tempering networks, dosage machines, packaging machines, and others must be intelligently shared. The dosage and packaging might be synchronous or asynchronous based on the product type. Synchronous means that the dosage machine casts the pieces of the final product and feeds them directly to the packaging machine, so a production rate in pieces per work shift is given for the combination of the machines. On the other hand, asynchronous means that the intermediate product that the dosage machine produces can be temporarily stored and then sent to the appropriate packaging machine at a convenient time. A further complication is that each mixing-refining-conching machine should process mixtures that will eventually be transformed into final products in a specific order that guarantees minimum costs for cleaning the machine before preparing the following mixture. Even more complications exist, such as that some products (i.e., chocolate pralines) must be stored in refrigerators for specific periods before they are finally ready for the market. Besides providing a feasible schedule that accurately prescribes the production schedule for a horizon of a month, the objective is to minimize energy consumption by exploiting every possible opportunity, such as the simultaneous operation of machines that share air-conditioned spaces, prioritizing the usage of energy generated by the Photovoltaics of the factory and others. Our approach uses a constraint programming model since interval variables and the reservoir constraint are invaluable for modeling the problem. Preliminary results are quite promising.

Keywords: Scheduling, Constraint Programming, Industrial Production, Energy

Session 16: Logistics

Solving the van-drone routing problem with multiple delivery drop points

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Abstract

Express logistics service providers have always been seeking ways for faster, sustainable, and cost-effective deliveries without compromising customer experience. The pandemic of Covid-19 acted as an accelerator for many organizations in order to test and adopt innovative models for parcel delivery in the last mile such as the use of drones in cooperation with vans. To this end, this paper investigates the Van-Drone Routing Problem in Cooperation (VDRPC) for parcel delivery. In this problem we take into consideration a fleet of vans each of which embraces a drone and execute a delivery route in collaboration. The clients of each delivery route are serviced either by the van or by the drone depending on their type and size of order. Drones are serving clients with small size orders whereas clients with large size orders are served by vans. The VDRPC aims at coordinating the two different types of vehicles (i.e. vans and drones) in an optimal way in order to serve all customers and is formulated as a Mixed Integer Linear Programming (MILP) problem. To solve the latter, a heuristic algorithm is developed that takes into consideration constraints such as the maximum flight time of drones and the capacity of vehicles (vans & drones). The proposed algorithm minimizes the time needed for the successful completion of parcel delivery and is tested in a set of clients that are located in two different areas. Seven different scenarios are developed for each area (urban and semi-urban), with 40, 60 and 100 clients respectively to be served. For each scenario, the optimal time to complete clients' service is computed, based on the number of available drones, the operating time with a fully charged battery of a drone and the average speed of the vehicles. The results are encouraging showing that the proposed approach (van-drone collaboration) provides better solutions in terms of total service time (customer service), when compared to the case where a fleet of vans is used to deliver clients' orders.

Keywords: last mile delivery, urban delivery, e-commerce logistics, routing optimization, van-drone in cooperation

Surveillance in Logistics Facilities and Ports via UAVs Using YOLOv3 Algorithm

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Abstract

We are investigating advanced methods for improving security and preventing illegal activities in logistics hubs and ports. In recent years, unmanned aerial vehicles (UAVs) have become an increasingly popular tool for surveillance due to their ability to provide real time video feed from difficult or inaccessible areas. This studies a key issue in employing UAVs in safeguarding expansive logistics environments; that is, how to detect intrusions in such an environment using the related video feeds without human intervention. For this purpose, we use the YOLOv3 algorithm for real time object detection in surveillance images captured by UAVs. We trained the YOLOv3 algorithm using various combinations of three UAV datasets, VisDrone, DAC-SDC and the Stanford Drone Dataset. Post training, the evaluation of the YOLOv3 weight set was performed on a new dataset created by the authors using a UAV in two different locations: a small shipyard and an open space area. The results of the evaluation demonstrated the effectiveness of the the entire set up for automated intrusion detection. Moreover, training the YOLOv3 algorithm with a combination of datasets resulted in improved performance than training it with a single dataset. This suggests that combining different datasets can improve the robustness and the generalizability of the algorithm

Keywords: UAVs, image detection, logistics 4.0, automated surveillance

Comparative assessment of alternative order picking technologies: Evidence from laboratory experiments.

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Abstract

In recent years, the complexity of warehouse operations has significantly increased due to the rise of e-commerce, frequent low-volume order fulfillment requests from customers, and the need for faster response times. Although all warehouse processes are critical and have an impact on both customer service and the total logistics cost, the order picking process is a vital component, accounting for a considerable proportion (55% to 65%) of the total operational warehouse costs and playing a pivotal role in the customer service level. The most widely adopted picking strategy is the picker-to-goods method, which employs a diverse range of information technologies, including RF Scanner, light picking, vision picking, among others. These technologies replace the traditional paper-based picking list and may lead to increased order picking accuracy and efficiency. This article presents evidence obtained through an experimental procedure that assesses 3 different picking technologies (i.e. RF scanning, pick-by-vision and pick-by light) in terms of picking efficiency. For the comparative assessment of the picking technologies a 23x3 full factorial design (Design of Experiment - DoE) has been adopted by taking into consideration certain operational parameters that affect the picking process. The results are encouraging and reveal the picker-to-goods technology that is more efficient under certain laboratory setup.

Keywords: warehouse, logistics, vision picking, light picking, RF-Scanner, order picking

Adopting Unmanned Aerial Vehicles (UAVs) for real-time stock count process in warehouse facilities: Evidence from experimental

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Abstract

E-commerce has skyrocketed since COVID-19 hit, with consumers increasingly ordering items online rather than venturing out to a store, demanding rapid delivery and easy returns. To address customers' requirements, logistics operations and especially warehouse process must be more efficient and cost effective. The use of emerging technologies to manage warehouses in an efficient and timely manner is vital and Unmanned Aerial Vehicles (UAVs) are considered a key technology for that. UAVs may execute repetitive and demanding logistics tasks with minimal human intervention or supervision, making them an economical and safe solution for warehouse operations completion, including stock count. The latter is a critical process since it allows warehouse staff to regularly monitor and increase gross profit, reduce loss, improve control of allowances, and reduce waste. This article presents evidence from experimental results that assess the use of UAVs coupled with RFID technology for real-time stock count execution. The results from laboratory experiments demonstrate the effect of certain operational parameters, such as UAV speed, number of rack levels, and RFID tag location on products, during the execution of the stock count process in terms of RFID reading accuracy and efficiency. A 24 full factorial design (design of experiment) is used to test UAV and RFID technology in a warehouse with products that are stored in ambient environment. The results of the experiments are encouraging showing that the use of UAVs coupled with RFID tags may support faster, cost-effective, and safer stock count in warehouses.

Keywords: drones, logistics, industry 4.0, stock count, warehouse, RFID technology

Session 17: OR and Customer Satisfaction

A Multicriteria DSS for Spatial Consumers Satisfaction Analysis

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Abstract

Consumer satisfaction (CS) is a key performance indicator that businesses have always tried to monitor in an effort to increase their profitability, as it provides valuable information about performance. CS constitutes a multi-criteria problem due to its multi-dimensional character as consumers' preferences are based on a number of evaluation criteria. The MUSA method is a regression-based approach that takes into consideration consumers' partial and overall judgments. As a result it provides satisfaction and demandingness measurements as well as action and improvement diagrams for interpretation. Taking advantage of businesses' databases as well as location-based technologies marketers are provided with geo-referenced information. Geographic Information Systems (GIS) are computerized tools capable of handling and visualizing this spatial information. In that manner, the spatial examination of businesses' data using GIS technologies is known with the term geomarketing. By leveraging location data businesses can gain insights about consumers and further understand consumer behavior. The proposed framework extends the typical MUSA into its spatial context by generating maps representing the method's indices. At first, the examined area is clustered based on a set of characteristics into multiple market areas using k-means algorithm. Results derived from MUSA are now referenced to the market areas formed. Local interpretation of results enables the formation of personalized marketing strategies based on the market areas characteristics. To conclude with a model is developed in QGIS software that takes as inputs shapefiles that consists of consumers answers of the questionnaire formed by the business and demographic data expressed in city blocks to perform the spatial MUSA analysis.

Keywords: MUSA, Market area, Consumer satisfaction, GIS, Geomarketing

Key Performance Indicators in the Retail Sector: A Literature Review

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Abstract

In the continuously changing and competitive today's retail sector, businesses are trying to keep up with the new trends while seeking profitability. They use business intelligence software to monitor various operations within the business over time such as the OnLine Analytical Process in combination with other tools. By doing so retailers are provided with metrics in order to track and measure their performance. Therefore, key performance indicators (KPIs) are widely used in the retail industry to measure and evaluate the performance of retail businesses by combining these metrics. They provide standardization which ensures comparability that allows the implementation of both time series and sectorial analysis. Moreover, KPIs indicators provide retailers with insights into how well their operations are performing and where improvements are needed. Retail KPIs are closely related to supply chain performance KPIs, with the former focusing on measuring business performance from the customer's perspective, whereas the latter measure the performance of a business's supply chain operations. Some of these retail and supply chain KPIs are interdependent as measurements of one may affect the performance of the other. Additionally, they are of a great of importance for the success of a retail business as they are able to assist in data-driven decisions providing a comprehensive view of business's effectiveness. Concluding, the use of KPIs can ultimately lead to increased sales, improved customer satisfaction, and greater profitability for retail businesses when interpreting the indicators results. The current research presents a literature review of the existing KPIs in the retail and supply chain sector. Thus, the evolution of the KPIs is recorded to explore the difference between the business's needs over a period of twenty years. In addition, identified KPIs are classified according to their performance area as it is proposed in the related literature (e.g. sales, inventory, growth, transactions).

Keywords: Retail, Supply chain, KPIs, Performance evaluation

Robustness in ordinal regression analysis: The effect of additional constraints on the MUSA method

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Abstract

Ordinal regression aims at inducing parameters of a preference model (parameters of a value function), which represents some holistic preference comparisons of alternatives given by the Decision Maker (DM). One of the most widely used ordinal regression approaches is the MUSA (Multicriteria Satisfaction Analysis) method. The main objective of the MUSA method is to assess collective global and marginal value functions by aggregating customer's judgments. It uses linear programming (LP) techniques for its solution and, similarly to the additive utility models of the UTA methods, it consists of a post-optimality analysis phase in order to overcome stability issues. Given the LP modelling of the MUSA method, it is possible to add or remove constraints in order to improve the stability of the solution. One of the most intriguing proposals refers to the additional properties for the assessed average indices. However, there is not extended research on how the extra constraints affect the robustness of the MUSA method. Hence, the goal of this study was to conduct a comparative analysis between the basic MUSA method and the extended one under various scenarios. A data generator was created in order to compare the solutions of different and various cases under a simulation process. The results indicate that in certain scenarios, there is indeed an improvement of the stability of the MUSA method, but the main outcome is that it can assist the DM to apply the basic or the extended version of the MUSA depending on the decision variables in order to achieve more reliable feedback on customer satisfaction evaluation and analysis.

Keywords: MUSA method, Robustness, Ordinal regression analysis, Customer Satisfaction, Additional properties, Additional constraints

Marketing strategies based on multicriteria analysis of consumer behavior: The case of a cosmetics company

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Abstract

Market penetration forecasting is crucial to mitigate the high costs associated with commercial failures of new products. This study aims to develop an effective model by analyzing consumer behavior using MUSA-KANO and MUSA multi-criteria methods. Understanding consumer behavior is essential for companies aiming to optimize their product offerings and meet customer preferences. A specialized questionnaire was used to collect consumer data, which was analyzed using descriptive statistics to identify distinct consumer profiles. The MUSA-KANO and MUSA methods were then applied to evaluate La vie en Rose's cosmetic products from the customer's viewpoint. The study findings contribute to reducing commercial failure risks by aligning product offerings with consumer requirements, enhancing customer satisfaction, and improving market penetration. These multicriteria methods empower companies to refine marketing strategies and make informed decisions during product design, fostering success in the competitive cosmetics industry.

Keywords: multi-criteria analysis, customer satisfaction analysis, consumer behavior, marketing strategies

Session 18: OR in Educational Management

The statistical investigation of the diffusion of knowledge within the learning organizations as a factor in creating an innovative student-centered model of education

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Abstract

This research, using statistical approach techniques, tries to examine the ways of knowledge sharing that take place within learning organizations, focusing mainly on the continuous construction of knowledge through innovative educational practices. The enrichment of active learning activities in coordination with the free sharing of knowledge within university institutions leads to the flourishing of interaction between teacher and student, and between students as co-producers of knowledge and as members of the university community.

With the main target the education through experiences and dissemination of knowledge and ideas within trainers, trainees and administration of learning organizations.

Keywords: statistical research, learning organizations, student centered education, social pedagogy

Barometer of teachers' satisfaction in terms of the organization and operation of the educational system

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Abstract

Realizing the educational policy's strategic goals depends on the quality of the educational work provided, which is linked to teachers' satisfaction. Teachers' satisfaction in terms of the way the educational system is organized and operates greatly affects their performance. It is for the first time that such a research has been conducted in Greece in order to measure teachers' satisfaction regarding the organization and operation of the educational system based on the methodology of MUSA (Multicriteria Satisfaction Analysis). The aim of this study is to assess teachers' satisfaction level so as to highlight the critical satisfaction dimensions that need improvement and determine and prioritize the improvement actions in light of the strategic planning of educational policy. The results it provides can contribute to the fulfillment of the strategic objectives of education through the effective management and the strategic reorganization of educational policy.

Keywords: satisfaction barometer, teachers' satisfaction, internal customer, organization & operation of the educational system, multicriteria satisfaction analysis (MUSA), satisfaction measurement

Teacher contentment as regards State Support, Recruitment and Intergration in Schools

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Abstract

It is widely known that the quality of the educational system depends on the effectiveness of the teaching methods, and consequently on the teacher himself. At the same time, effective teaching is in direct correlation with the motivation of the teacher, his professional ability as well as the working conditions in the school unit where the teacher works. At the same time, the method of recruitment as well as the inclusion of teachers in the school unit are inseparable factors for the increase/decrease of their professional satisfaction. This specific research focuses on measuring teachers' satisfaction with state support in their study of education structures. More specifically, the research aims to investigate the satisfaction of teachers from the way they are recruited (recruitment) and in particular with the reception, acceptance, integration and support of the teacher by the state in the new work environment. The bibliographic research proved that the subject of job satisfaction has occupied a multitude of scholars in all professions as well as in the development of employee motivation and the increase of their productivity. However, especially in the last three years when many new teachers were appointed, a gap in research was identified as no studies have been conducted investigating the measurement of teachers' laboratory competence in relation to state support in these areas. The research therefore attempts to fill this gap and is conducted with the MUSA (Multicriteria Satisfaction Analysis) methodology. The sample collected was from 302 people. The results of the survey showed that the educational stuff, in general terms, is not satisfied from the state's support, whereas it indicates a low satisfaction percentage by the recruitment procedure. On the other hand, teachers show that they are more content by their work environment. In addition, factors such as administration and legal frame are issues that need imminent improvement.

Keywords: Professional Satisfaction, Teachers satisfaction, Satisfaction measurement, Recruitment, MUSA (Multicriteria Satisfaction Analysis)

Exploring the Trainers' Digital Competences of Public Vocational Training in Greece during COVID-19 period

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Abstract

The European Union prioritizes, especially after the impact of COVID-19 pandemic on employment and social policy, towards the development of green and digital skills on Vocational Education and Training. In this framework, the teaching profession, which evolves and changes rapidly, require broader and more sophisticated set of competences than before. These competences focus on 6 main areas according to the European Digital Competencies for Education (DigCompEdu) framework, that is professional engagement, digital resources, teaching and learning, assessment, learners' empowerment and learners' digital competence facilitation. The current study constitutes a systematic effort to enhance research on vocational training and presents a repetition of a previous study (Kiriakos et al., 2021) that took place during the pandemic organized by PANEDDIEK (Panhellenic Union of Directors of Public Vocational Training Institutes) in collaboration with the University of West Attica. The Public Vocational Training Institutes (DIEK) offer initial vocational training to persons over the age of 18 in over 72 different occupational specializations that are divided into 8 Orientation Groups. This research aims at capturing the level of the digital competence and digital skills of the trainers of Public Vocational Training Institutes (DIEKs). For this purpose, we designed a questionnaire that has layered questions which allow us to extract simple competence descriptors. From these descriptors we derive indexes for the 6 areas of the European Digital Competencies for Education (DigCompEdu) framework that we cross reference with every vocational orientation group in order to provide an insight into the trainers' digital competence in each group. The research in question involved 68 DIEK, 76 different professional specialties and 655 trainers from dispersed geographical areas of Greece. The value of the research lies in the fact that it is a pioneer effort to track trends in training provided by DIEK during the pandemic period. Other important features are the range of the specialties that are covered, the geographical spread of the sample all over Greece and the fact that it is an ongoing project. Collection of questionnaire answers will be collected on a regular basis, to include even more data that will help us identify patterns in digital proficiency. A preliminary analysis of the results revealed, as expected, that specialties closely tied to technology exhibit higher digital competency indices than those associated to professions that require a more hands-on approach.

Keywords: Vocational Training, Public Vocational Training Institutes, Digital Competences of trainers

Session 19: OR and Covid-19

The Impact of the COVID-19 Pandemic on the Digital Transformation of SMEs: An Empirical Study

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Abstract

Multiple studies indicate that the outbreak of COVID-19 has accelerated the digital transformation of businesses worldwide and has also highlighted the importance of digital capabilities such as e-business, digital marketing, data analytics, automation, and cybersecurity. Many companies have had to rapidly adapt to these changes in order to continue operating during the pandemic. This empirical research examines the impact of the pandemic on the ongoing digital transformation of SMEs across various industries in Greece. It also delves into the implications of digital transformation on employment and the workforce, including the need for reskilling and upskilling. Results from 160 respondents highlight that the pandemic has presented opportunities for companies to innovate and improve their digital capabilities and has led to a rapid increase in digital marketing, e-commerce, remote working, and cloud computing. However, it's important to note that not all companies have been able to adapt to digital transformation equally and some have faced challenges, such as a lack of digital skills, difficulties in implementing new technologies, and security concerns.

Keywords: Digital Transformation, e-Business, Digital Marketing, Information Systems, Covid-19 Pandemic

Consumption behaviors and COVID-19 revealed through credit cards usage

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Abstract

It is required to analyze the behaviors in a society to understand the responses to a pandemic. We have seen enormous impacts of the pandemic COVID-19 as well as social distancing policies (non-pharmaceutical interventions) on our economies. When a society had higher cases of COVID-19, people's consumption via credit cards declined because people did not go out. Higher level of social distancing also reduced social movement, which naturally prevented consumption. Big-data analytics on a set of credit cards data in Korea has been carried out. It cannot include personal and individual-level data for the protection of privacy, but it clearly shows regional and time distributions. The dataset incorporates periods during both COVID-19 as well as normal periods (which spans up to two years). The comparison reveals how the COVID-19 pandemic affects the consumption of a community. Through the analysis, we check a society's consumption by industry and compare this with COVID-19 evolution. It mainly manifests behavioral responses -- effects of the pandemic and social distancing differentiate by consumption types such as malls (markets) or restaurants. The duration in which credit card usages are reduced are made distinct through associations with different industries, because they are related to the daily necessity and foods. The discouraged duration is much shorter for markets for sustenance, compared to restaurants and leisure. This enables us to consider the sustainability and responsiveness to the disease as well as policies.

Keywords: Big Data and Business Analytics, Modeling and Sustainability, Pandemic such as COVID-19

Designing optimal mitigation strategies for COVID-19 with the prevention effects and the economic consequences in Korea: an optimization

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Abstract

It is of importance to consider impacts on the national economy when designing mitigation strategies to fight pandemic diseases. As an example in a field of multiobjective optimization, we suggest optimal policies. As we have witnessed over the years, the COVID-19 pandemic has extensively influenced our lives both in the health and the economy. One of the most important non-pharmaceutical interventions, ‘social distancing’, which seriously asks people to reduce their mobility, has shown its effectiveness in alleviating the spread, but it cannot last for a long time due to the (negative) economic consequences. Increasing infections inevitably induces the social distancing to be tightened, then the decreasing community mobility weakens the national economy. Thus, we have set up a model to find optimal strategies to mitigate the COVID-19 pandemic in Korea with the consideration of their economic impacts. One objective is to reduce the number of new infections, while the other objective focuses on minimizing the economic impacts. Using heuristic methods including AI and machine learnings as well as the Korean dataset such as the reported COVID-19 cases and economic indicators, we construct a model incorporating the disease propagation and the economy. It mainly deals behavioral factors. We show a series of suggested historical instances, which have been discussed with the authorities in Korea during recent years.

Keywords: Complex Social Problems, Decision Making, COVID-19

Session 20: MCDA in Education: Enhancing Decision-Making and Educational Quality (Special Session)

An Adaptive Weighted Sum Model for Assessing Learning Content in E-Learning Systems

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Abstract

The rapid growth of e-learning has necessitated the development of effective methods to assess the quality and suitability of learning content in digital environments. This paper presents an innovative approach, namely the Adaptive Weighted Sum Model (AWSM), for assessing learning content in e-learning systems. The AWSM combines the principles of the Weighted Sum Model (WSM) with adaptive techniques to provide a comprehensive and personalized assessment of learning materials. The proposed AWSM framework incorporates multiple criteria that are essential for evaluating learning content, including relevance, effectiveness, engagement, and adaptability. These criteria are weighted and combined using the WSM, which allows for the incorporation of subjective preferences and priorities of learners and educators. Unlike traditional static weighting methods, the AWSM dynamically adjusts the weights based on learner feedback and performance, resulting in more accurate and personalized assessments. To implement the AWSM, a data-driven approach is employed, leveraging learner interaction data, performance metrics, and feedback. Machine learning techniques, such as clustering and classification algorithms, are utilized to identify patterns in learner preferences and behavior, enabling the system to adaptively update the weights assigned to different criteria. The evaluation of the AWSM framework involved a comprehensive study with a diverse group of learners and educators. The results demonstrate that the adaptive nature of the AWSM enhances the accuracy and relevance of learning content assessments. Learners reported higher satisfaction levels with the personalized assessments, while educators found the AWSM to be a valuable tool for tailoring instructional strategies and improving content selection. Furthermore, the AWSM framework addresses the issue of content adaptability by identifying gaps and recommending modifications to learning materials based on learner preferences and performance. This adaptability promotes continuous improvement in e-learning systems, ensuring that the content remains relevant and effective. In conclusion, the Adaptive Weighted Sum Model (AWSM) presented in this paper offers a robust and personalized approach for assessing learning content in e-learning systems. By dynamically adjusting the weights of evaluation criteria based on learner feedback and performance, the AWSM improves the accuracy, relevance, and adaptability of content assessments. The proposed framework empowers educators with valuable insights for content selection and adaptation, while providing learners with personalized and engaging learning experiences in digital environments. Following, a pseudocode representation of the algorithm for the Adaptive Weighted Sum Model (AWSM) in the context of assessing learning content in e-learning systems is presented:

Initialize:

- Set of learning content items: $L = \{L_1, L_2, \dots, L_n\}$
- Set of criteria weights: $W = \{w_1, w_2, \dots, w_n\}$
- Set of learner performance data: $D = \{d_1, d_2, \dots, d_m\}$

Procedure AWSM(L, W, D):

Compute initial criteria weights based on expert judgment or equal weights

Loop until convergence:

For each learner performance data d in D :

Calculate the relevance score for each learning content item L_i :

$$\text{relevanceScore}_i = W * (d.\text{performance}_i)$$

Normalize the relevance scores to obtain weights:

$$\text{normWeights} = \text{Normalize}(\text{relevanceScore})$$

Update the criteria weights:

$$W = (1 - \alpha) * W + \alpha * \text{normWeights}$$

Return the final criteria weights W

Procedure $\text{Normalize}(\text{scores})$:

$$\text{sumScores} = \text{Sum}(\text{scores})$$

$$\text{normScores} = \text{scores} / \text{sumScores}$$

Return normScores

In the above pseudocode, the AWSM algorithm takes as input the set of learning content items (L), the initial set of criteria weights (W), and the learner performance data (D). It initializes the criteria weights and then iteratively updates them based on the relevance scores calculated for each learning content item. The relevance scores are computed by multiplying the criteria weights with the learner's performance data. The algorithm continues to iterate until convergence, where the convergence condition can be based on a predefined threshold or a maximum number of iterations. Inside the loop, the relevance scores are normalized to obtain weights that represent the relative importance of each criterion. The criteria weights are then updated using a weighted average of the current weights and the normalized weights. Finally, the algorithm returns the final criteria weights (W), which can be used for assessing the learning content in e-learning systems.

A Comprehensive Analysis of E-Learning Material Personalization: An Investigation of AHP, TOPSIS, and PROMETHEE within Multiple Criteria Decision Analysis

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Abstract

In the era of digital education, personalization plays a vital role in enhancing the effectiveness and engagement of e-learning experiences. This paper presents a research study titled "Exploring Multiple Criteria Decision Analysis for E-Learning Material Personalization," which investigates the application of Multiple Criteria Decision Analysis (MCDA) techniques in the context of personalizing e-learning materials. The paper proposes a comprehensive framework that leverages MCDA to make informed decisions regarding the selection and adaptation of learning materials based on multiple criteria. These criteria encompass learner preferences, learning styles, knowledge levels, performance data, and instructional objectives. By considering a diverse range of criteria, the framework aims to provide tailored recommendations that align with individual learners' needs, enhancing their motivation, engagement, and learning outcomes. To implement the framework, data is collected from various sources, including learner profiles, assessment results, interaction logs, and domain knowledge repositories. MCDA techniques, e.g. Analytic Hierarchy Process (AHP), Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), Preference Ranking Organization Method for Enrichment Evaluations (PROMETHEE), are employed to systematically analyze and rank the learning materials based on the identified criteria. The MCDA process allows for the integration of subjective preferences, expert judgments, and quantitative metrics, enabling a more comprehensive and accurate assessment of material suitability for each learner. The effectiveness of the proposed framework is evaluated through a series of experiments and user studies involving a diverse group of learners. The results demonstrate that the MCDA-based personalization approach significantly improves learners' satisfaction, engagement, and learning outcomes compared to non-personalized approaches. Learners reported higher levels of motivation and perceived relevance of the recommended materials, leading to enhanced knowledge acquisition and skill development. Furthermore, the framework's flexibility and adaptability allow for continual refinement and improvement based on learner feedback and evolving needs. The MCDA techniques enable dynamic adjustment of criteria weights, accommodating changes in learner preferences, performance, or instructional goals. This adaptability fosters a personalized and adaptive learning environment that empowers learners to take ownership of their educational journey and fosters a sense of autonomy. In conclusion, the framework presented in this paper offers a robust and systematic approach to personalize e-learning materials based on MCDA techniques. By considering multiple criteria and employing MCDA methodologies, the framework facilitates informed decision-making, ensuring that learning materials align with individual learner characteristics and instructional objectives. The findings of this study contribute to the advancement of personalized e-learning, providing educators, instructional designers, and e-learning platforms with valuable insights and tools to enhance learner experiences, engagement, and learning outcomes in the digital age. Following, a pseudocode representation of the algorithm for exploring Multiple Criteria Decision Analysis (MCDA) for e-learning material personalization is presented:

Initialize:

- Set of learners: $L = \{L1, L2, \dots, Ln\}$

- Set of learning materials: $M = \{M_1, M_2, \dots, M_k\}$
- Set of criteria weights: $W = \{w_1, w_2, \dots, w_m\}$

Procedure PersonalizeMaterials(L, M, W):

```
For each learner  $L_i$  in  $L$ :
    Initialize learner preferences and criteria weights
    For each learning material  $M_j$  in  $M$ :
        Compute the criteria scores for the material  $M_j$ :
             $\text{criteriaScores}_{i,j} = \text{EvaluateCriteria}(L_i, M_j)$ 
        Compute the weighted scores for each criterion:
             $\text{weightedScores}_{i,j} = \text{criteriaScores}_{i,j} * W$ 
        Calculate the overall score for the material  $M_j$ :
             $\text{overallScore}_{i,j} = \text{Sum}(\text{weightedScores}_{i,j})$ 
    Rank the learning materials based on their overall scores:
         $\text{personalizedRanking}_i = \text{Rank}(\text{overallScore}_i)$ 
    Generate personalized recommendations for the learner  $L_i$  based on the ranking
Return the personalized recommendations for all learners
```

Procedure EvaluateCriteria(L_i, M_j):

```
Initialize an empty matrix for pairwise comparisons
For each criterion,  $C_k$  in the set of criteria:
    Perform pairwise comparisons between the criterion and its subcriteria (if applicable) using
    AHP, TOPSIS, PROMETHEE, or other MCDA techniques
    Assign weights or preference values to each criterion and subcriterion based on the MCDA
    results
    Compute the overall criteria scores for the learner  $L_i$  and material  $M_j$  using the weights and
    preference values
Return the criteria scores
```

Procedure Rank(scores):

```
Rank the scores in descending order
Return the ranking
```

The pseudocode outlines the process of personalizing e-learning materials using Multiple Criteria Decision Analysis (MCDA) techniques such as Analytic Hierarchy Process (AHP), Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), or Preference Ranking Organization Method for Enrichment Evaluations (PROMETHEE). The algorithm takes as input a set of learners (L), a set of learning materials (M), and a set of criteria weights (W). The PersonalizeMaterials procedure iterates over each learner in L and computes personalized recommendations for e-learning materials. Within the loop, the EvaluateCriteria procedure is called to evaluate the criteria

scores for each learner-material combination. Here, the MCDA techniques are applied to perform pairwise comparisons and assign weights or preference values to the criteria. This step ensures that the evaluation process incorporates subjective preferences and expert judgments. The criteria scores are then calculated based on the weights and preference values. The learning materials are ranked based on the overall scores, and personalized recommendations are generated for each learner. These recommendations guide learners towards the most suitable and relevant e-learning materials based on their individual characteristics and preferences. The pseudocode provides a flexible framework that allows for the integration of various MCDA techniques. The specific implementation of AHP, TOPSIS, PROMETHEE, or other MCDA methods can be incorporated within the EvaluateCriteria procedure. By utilizing MCDA techniques, the algorithm enables a systematic evaluation and ranking of e-learning materials based on multiple criteria. This approach enhances the personalization of e-learning experiences, as learners receive tailored recommendations that align with their preferences, knowledge levels, and performance data. The pseudocode serves as a foundation for researchers and developers to further customize and implement the MCDA techniques in their e-learning platforms, facilitating effective material selection and personalization for enhanced learner engagement and outcomes.

Enhancing Learner Engagement in E-Learning through Weighted Sum Model-based Adaptive Recommendations

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Abstract

Engaging learners in e-learning environments is crucial for effective knowledge acquisition and retention. This paper proposes a novel approach, which leverages the Weighted Sum Model (WSM) to provide personalized and adaptive recommendations aimed at maximizing learner engagement. The proposed framework employs a multi-faceted approach, taking into account various factors that influence learner engagement, such as learning preferences, interests, performance, and social interactions. These factors are incorporated into the WSM, which serves as a recommendation engine to identify and suggest relevant learning materials, activities, and collaborative opportunities that align with the specific needs and characteristics of individual learners. The adaptive nature of the framework enables continuous learning and refinement of the recommendations based on learner feedback and interactions. By dynamically adjusting the weights assigned to different criteria in the WSM, the system adapts to the changing preferences and learning progress of each learner, ensuring that the recommendations remain tailored and aligned with their evolving needs. To implement the framework, a comprehensive dataset encompassing learner profiles, activity logs, performance metrics, and social interactions is collected. Machine learning techniques, such as clustering and classification algorithms, are applied to analyze and extract meaningful patterns from the dataset. These patterns are then utilized to compute the weighted scores for the learning resources and activities, allowing the system to generate personalized recommendations. The efficacy of the proposed approach was evaluated through an extensive user study involving a diverse group of learners. The results demonstrate that the Weighted Sum Model-based adaptive recommendations significantly enhance learner engagement compared to traditional non-personalized approaches. Learners reported higher levels of motivation, satisfaction, and active participation when exposed to the adaptive recommendations tailored to their individual needs and preferences. Moreover, the adaptive recommendations fostered a sense of autonomy and ownership in the learning process, empowering learners to take control of their educational journey. The collaborative opportunities facilitated by the recommendations further enhanced learner engagement by fostering peer interaction, knowledge sharing, and community building. In conclusion, the framework presented in this paper provides a powerful tool to personalize and optimize learner engagement in e-learning environments. By leveraging the Weighted Sum Model and incorporating adaptive mechanisms, the framework offers tailored recommendations that resonate with learners' preferences, interests, and performance. The adaptive nature of the recommendations ensures continual alignment with learners' evolving needs, fostering motivation, satisfaction, and active participation. The findings of this study contribute to the design and development of more effective and engaging e-learning systems, ultimately enhancing the overall learning experience for learners worldwide. Following, a pseudocode representation of the algorithm for enhancing learner engagement in e-learning through the Weighted Sum Model (WSM)-based adaptive recommendations is presented:

Initialize:

- Set of learners: $L = \{L1, L2, \dots, Ln\}$
- Set of learning resources: $R = \{R1, R2, \dots, Rm\}$
- Set of criteria weights: $W = \{w1, w2, \dots, wn\}$

Procedure AdaptiveRecommendations(L, R, W):

For each learner L_i in L:

Initialize learner preferences based on profile and past interactions

Compute initial criteria weights based on expert judgment or equal weights

Loop until convergence:

For each learning resource R_j in R:

Calculate the relevance score for the learner L_i and resource R_j :

$\text{relevanceScore}_{i,j} = W * (L_i.\text{preferences}_j)$

Normalize the relevance scores to obtain weights:

$\text{normWeights} = \text{Normalize}(\text{relevanceScore})$

Update the criteria weights:

$W = (1 - \alpha) * W + \alpha * \text{normWeights}$

Generate personalized recommendations for the learner L_i based on the updated weights

Return the personalized recommendations for all learners

Procedure Normalize(scores):

$\text{sumScores} = \text{Sum}(\text{scores})$

$\text{normScores} = \text{scores} / \text{sumScores}$

Return normScores

In the above pseudocode, the AdaptiveRecommendations algorithm takes as input the set of learners (L), the set of learning resources (R), and the initial set of criteria weights (W). It iterates over each learner and computes personalized recommendations based on their preferences and past interactions. Inside the loop, the algorithm computes the relevance scores for each learning resource by multiplying the learner's preferences with the criteria weights. The relevance scores are then normalized to obtain weights that represent the relative importance of each criterion. The criteria weights are updated using a weighted average of the current weights and the normalized weights. The algorithm continues to iterate until convergence, where the convergence condition can be based on a predefined threshold or a maximum number of iterations. Finally, the algorithm generates personalized recommendations for each learner based on the updated criteria weights and their preferences.

Evaluating the Effectiveness of E-Learning Platforms: A Weighted Sum Model Perspective

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Abstract

With the widespread adoption of e-learning platforms, there is a growing need to evaluate their effectiveness in facilitating learning outcomes and delivering high-quality educational experiences. This paper proposes a comprehensive framework for assessing the effectiveness of e-learning platforms using the Weighted Sum Model (WSM). The proposed framework considers multiple criteria that are vital for evaluating e-learning platforms, including usability, content quality, interactivity, learner satisfaction, and performance outcomes. These criteria are assigned weights based on their relative importance, reflecting the preferences and priorities of key stakeholders, such as educators, learners, and administrators. The WSM is utilized as an evaluation tool, enabling the integration of subjective judgments with objective metrics to produce a holistic effectiveness score for each e-learning platform under evaluation. To implement the framework, data is collected from various sources, including user surveys, system logs, learning analytics, and performance assessments. Data preprocessing techniques, feature extraction and classification algorithms, are employed to analyze the data and compute the weighted scores for each criterion. The WSM aggregates the weighted scores to generate an overall effectiveness score for each e-learning platform, providing insights into its strengths, weaknesses, and areas for improvement. The evaluation of the proposed framework was conducted on a diverse set of e-learning platforms across different educational contexts. The results demonstrate that the Weighted Sum Model-based evaluation approach yields accurate and meaningful assessments of e-learning platform effectiveness. The framework provides a robust foundation for benchmarking and comparing platforms, enabling educational institutions and stakeholders to make informed decisions regarding platform selection, improvement strategies, and resource allocation. Furthermore, the framework facilitates continuous improvement by identifying specific areas where e-learning platforms can enhance their effectiveness. The evaluation results guide the implementation of targeted interventions, such as content updates, interface enhancements, pedagogical adjustments, and learner support mechanisms, to optimize the learning experience and improve learning outcomes. In conclusion, the framework presented in this paper offers a comprehensive and objective approach for assessing the effectiveness of e-learning platforms. By employing the Weighted Sum Model and considering multiple criteria, the framework provides a holistic view of platform performance and supports evidence-based decision-making in educational settings. The findings of this study contribute to the field of e-learning evaluation, enabling stakeholders to optimize resource allocation, enhance learner experiences, and ultimately improve educational outcomes in the digital era. Following, a pseudocode representation of the algorithm for evaluating the effectiveness of e-learning platforms using the Weighted Sum Model (WSM) perspective is presented:

Initialize:

- Set of e-learning platforms: $P = \{P_1, P_2, \dots, P_n\}$
- Set of evaluation criteria: $C = \{C_1, C_2, \dots, C_m\}$
- Set of criteria weights: $W = \{w_1, w_2, \dots, w_m\}$

Procedure EvaluatePlatforms(P, C, W):

For each e-learning platform P_i in P :

```
Initialize platform effectiveness score to 0
For each criterion Cj in C:
    Compute criterion score for the platform Pi:
        criterionScorei,j = EvaluateCriterion(Pi, Cj)
    Multiply the criterion score by its weight:
        weightedScorei,j = criterionScorei,j * W[j]
    Add the weighted score to the platform's effectiveness score:
        platformScorei = platformScorei + weightedScorei,j
Store the final effectiveness score for the platform Pi
Return the effectiveness scores for all e-learning platforms
Procedure EvaluateCriterion(Pi, Cj):
    Compute the criterion score for the platform Pi and criterion Cj
    Return the criterion score
```

In the above pseudocode, the EvaluatePlatforms algorithm takes as input the set of e-learning platforms (P), the set of evaluation criteria (C), and the set of criteria weights (W). It iterates over each e-learning platform and calculates the effectiveness score based on the weighted sum of criterion scores. Inside the loop, the algorithm calls the EvaluateCriterion procedure to compute the score for each criterion and platform combination. The criterion score represents the performance or evaluation of a specific criterion for a given platform. The criterion score is then multiplied by its weight, and the weighted score is added to the platform's effectiveness score. Finally, the algorithm stores the final effectiveness scores for all e-learning platforms and returns them. The EvaluateCriterion procedure represents the evaluation process for a specific criterion and platform. The details of how each criterion is evaluated can be implemented based on specific metrics, data sources, or evaluation methodologies relevant to the criterion.

Session 21: OR Applications II

Mission Planning for Heterogeneous Agile Earth-Observation Satellites Virtual Constellation

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Abstract

Space-based Earth observation has demonstrated numerous advantages, leading to a growing number of remote-sensing satellites being deployed annually. However, the cost of such missions remains high, and satellite lifetimes are limited. To address these challenges, the concept of sharing Earth Observation satellite resources as a virtual constellation has emerged, aiming to enhance capability, increase flexibility, improve performance and efficiency, and enhance cost-effectiveness.

Consequently, effective management of mission plans and satellite operations is crucial. This paper proposes a graph-based model for addressing the mission planning of a non-homogeneous co-constellation of agile Earth observation satellites. The problem is formulated as a combinatorial optimization problem, and the mathematical formulation of the problem is presented.

A hybrid algorithm integrating dynamic programming and metaheuristic algorithms is implemented to solve it. A real-world numerical test of the model is conducted. The obtained results are discussed, providing insights into the effectiveness and applicability of the proposed approach.

Keywords: Earth Observation Mission, Agile Satellite, Virtual Constellation, Hybrid Algorithm for Mission Planning

The retail interest rate pass-through in Algeria

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Abstract

The aim of this paper is to examine the degree of pass-through in both short and long term of retail interest rates in response to changes in money market rates in ALGERIA during the periode 1990-2010.

Most central banks use a short-term interest rate as their instrument of monetary policy, changes to this short-term interest rate are the first important stage in the transmission of

This first stage between the central bank and the commercial banks is the so called interest rate pass-through. If the commercial banks could completely pass the costs to their consumers then this is the case of complete pass-through and otherwise this is the case of incomplete pass-through.

The motivation of this study is to investigate empirically the relationship between a money market rate and banks retail lending rates, because there is no study which analyse the pass-through in ALGERIA

Keywords: Interest rate Pass through, Monetary policy, Algeria

A revisit of the purchasing power parity in the Maghreb countries: A nonlinear perspective

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Abstract

The main objective of this paper is to test the validity of the purchasing power parity in the Maghreb countries (namely, Algeria, Morocco and Tunisia). We apply the threshold autoregressive non-linear model (TAR) proposed by Caner and Hansen (2001). First, a review of literature on PPP is presented, analysing its empirical validity and the econometric techniques that have been applied. After that, and investigating for the joint hypothesis of nonlinearity and non-stationarity in the exchange rate behaviour, the TAR model is presented and used for the PPP in the Maghreb countries. The results indicate that the RER shows nonlinear behaviour. Moreover, The Moroccan Tunisian (DH/DT) bilateral exchange rate is found to be highly persistent and follows a random walk, whereas the two others (Algerian Moroccan and Algerian Tunisian bilateral real exchange rates) are characterised by partial unit roots. This implies that PPP holds in one threshold regime but not in the other.

Keywords: Purchasing Power Parity (PPP), Real Exchange Rate (RER), Threshold Autoregressive Model (TAR), Non-linearity, Maghreb countries

Board Diversity and Firm Performance: Evidence from retail industry firms in Europe

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Abstract

Board Diversity and Firm Performance is a trending topic examined by the literature for different markets around the globe. In Europe, previous literature approached the topic with data collected mainly from National and International Stock Exchanges, then they statistically analyzed and discussed their results, using the panel data models in order to measure the effect of board diversity on firm financial performance, which in most cases was addressed by profitability ratios. Guided by previous literature, we examined the effect of firm performance, for 213 listed companies from the retail industry in Europe for a five-year period (2016-2020).

Keywords: C1: Econometric and Statistical Methods and Methodology: General, C10 General, C12: Hypothesis Testing: General