Opinion Makers Section

About the 94th Meeting of the EWG on MCDA in Elounda, Crete, Greece

On September 15-16, 2022, at the Porto Elounda Hotel in Elounda, in Agios Nikolaos, Crete, the 94th Meeting of the Euro Working Group on Multicriteria Decision Aiding was held with success. The main theme of the 94th meeting of the EURO working group on Multiple Criteria Decision Aiding (EWG-MCDA 94) aimed to pinpoint the potential of multiple criteria decision aiding methods as an ideal support methodology for the environmental risk management.

Organized by the Faculty of Management Sciences and Technology of the Hellenic Mediterranean University in collaboration with the School of Production Engineering and Management of the Technical University of Crete, the Meeting was a real opportunity to present groundbreaking research on topics covering all theoretical and practical aspects of MCDA specified on the environmental risk management.

The event presented papers on decision support systems, environmental, economic, and social impacts of technological decisions related to carbon emissions to the atmosphere, risks, and uncertainties of climate change mitigation portfolios, and managing risks and uncertainties in climate and energy policies.

Group Picture 94th EWG-MCDA meeting

More than 50 scholars from Europe, North Africa and Canada attended the Meeting, and about 25 research papers were submitted for regular communication, while 16 research papers were also submitted as discussion papers.

During this Meeting, the new volume entitled: Intelligent Decision Support Systems - Combining Operations Research and Artificial Intelligence – Essays (see also the Book Section later in the newsletter), was presented by the Springer Editorial Board in honor of Professor Roman Słowiński (https://link.springer.com/book/10.1007/978-3-030-96318-7). The book provides a comprehensive overview of Roman Słowiński's scientific contributions and includes recent research papers in the area of operations research as well as in the areas of multi-criteria decision aiding and intelligent systems. Editors: Salvatore Greco, Vincent Mousseau, Jerzy Stefanowski, and Constantin Zopounidis.

Also, during the Gala dinner there was an event where five (5) Professors were honored for their work at MCDA, by the Department of Management Science and Technology of the Hellenic Mediterranean University (HMU), which hosted the Meeting.

From left to right: Roman Słowiński, Constantin Zopounidis, Yannis Siskos, Stelios Papadakis, Salvatore Greco, Michalis Doumpos, Christos Lemonakis

In detail, the following five (5) Professors were honored:

- **Prof. Roman Słowiński**
  Poznan University of Technology, Poland
- **Prof. Constantin Zopounidis**
  Technical University of Crete, Greece and Audencia Business School, France
- **Prof. Yannis Siskos**
  University of Pireaus, Greece
- **Prof. Salvatore Greco**
  University of Catania, Italy
- **Prof. Michalis Doumpos**
  Technical University of Crete, Greece

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The five (5) awarded Professors were honored by the Dean of the Faculty of Management and Economic Sciences, Prof. Stelios Papadakis, and Assist. Prof. Christos Lemonakis, co-organizer of the Conference.

CONFERENCE PROGRAMME

Session 1
Chair: Yannis Siskos

The first session on Thursday was devoted to the Bernard Roy Award, where the laureate Dr *Banu Lokman* presented a 45min lecture on current issues in MCDA.

Session 2
Chair: Salvatore Greco

Intelligent Decision Support Systems Combining Operations Research and Artificial Intelligence
S. Greco, V. Mousseau, J. Stefanowski, C. Zopounidis

Active learning with additive value models
Grzegorz Miebs, Matteo Brunelli, Jonas Gehrlein, Miłosz Kadziński

Regularization and Aggregation of Multiple Recommendations in Multicriteria Decision Problems with Reference Sets
Andrzej M.J. Skulimowski

Session 3
Chair: Andrej M.J Skulimowski

Modelling optimism and pessimism in Stochastic Multicriteria Acceptability Analysis
Salvatore Greco, Sally Giuseppe Arcidiacono, Salvatore Corrente

Consistent approximations of pairwise comparisons
Jacek Szybowski, Waldemar W. Koczkodaj, Ryszard Smarzewski

Session 4
Chair: Francis Macary

Parametric and non-parametric models to induce a probability distribution in the space of compatible value functions
Salvatore Corrente, Sally Giuseppe Arcidiacono, Salvatore Greco

Determinants of Foreign Direct Investments: Empirical Evidence from the Global Developing Economies
Manolis I. Skouloudakis

Applying MCDA Disaggregation – Aggregation Approaches to the assessment of a global Products Environmental footprint Index: The case study of Refractory products
Athanasios Spyridakos, Nikolaos Tsotsolas, Dimitrios Alexakos, Isaak Vryzidis, George Varelidis, Euthimios Kagiaras, Spyros Aggellis

Session 5
Chair: Salvatore Corrente

Location of radioactive waste deposit according to ministerial directives
Antonino Scarelli, Vincenzo Piscopo

Is random pricing useful for policy aiding process for Health
Christine C Huttin

A decision-making toolbox for climate mitigation and adaptation at municipal level in Greece
George Stravodimos, Apostolos Arsenopoulos, Nektarios Matsagkos, Anastasia Spanou, Sofoklis Strompolas, Ioannis Georgizas, Savvas Louizidis, Andrinopoulou Theodora

Session 6
Chair: Evangelos Grigoroudis

Multicriteria evaluation of new agricultural practices scenarios in field crops to reduce pesticide use and associated risks
Francis Macary, Elisa Jurine

Programs for optimal development of disadvantaged young children: Vulnerability evaluation and budget allocation using MCDA
Irène Abi-Zeid, Roxane Lavoie, Jérôme Cerutti, Morgane Bousquet, Sophie Métivier

Christos Lemonakis and Constantin Zopounidis
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About SYM-OP-IS: Symposium on Operational Research, Vrnjačka Banja, Serbia

From September 19 to September 22, 2022, we had the opportunity to organize and host participants at the annual Serbian operational research conference (*Sym-Op-Is: Symposium on Operational Research*). The conference took place in Vrnjačka Banja, Serbia. The tradition behind the

From left to right: Salvatore Greco, Mladen Stamenkovic, Miłosz Kadziński

conference is apparent – this was the 49th meeting, as the conference has been regularly held since 1974. The Proceedings of the 49th Sym-Op-Is contains 91 papers and 23 abstracts, with 265 authors and coauthors from 11 countries. Like all general OR conferences, Sym-Op-Is had a wide range of topics grouped into 23 thematic sections. However, this year's special focus was on the multiple criteria decision aiding. We had two keynote speakers from this area, Salvatore Corrente from the University of Catania and Miłosz Kadziński

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from the Poznań University of Technology. We had the opportunity during the opening ceremony to address our idea to promote the MCDA as a field. We introduced the participants to EURO goals and activities and elaborated more on the EURO Working Group on Multiple Criteria Decision Aiding.

We are confident that this year's Sym-Op-Is was a center of an intensive and valuable exchange of scientific ideas among operational researchers from Serbia and abroad. We hope that the interest from researchers outside Serbia that we had this year will only increase in the years to come. Finally, to end in a more personal manner, we hope to see many publications of researchers from Serbia in the field of MCDA and in the "*Recent contributions in brief* " section of this newsletter.

Zorica Mladenović, Mladen Stamenković
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MCDA Research Groups

Politecnico di Torino – DIST research group: Multiple Criteria Decision Analysis to assess urban and territorial transformations

The research group of Politecnico di Torino, InterUniversity Department DIST (hereinafter Polito-Dist) has been doing research for more than twenty years in the field of MCDA to provide answers to decision-making problems in urban and territorial planning realms, toward a sustainable development. The group, curiously almost entirely female, is currently led by three professors (Marta Bottero, Isabella Lami and Patrizia Lombardi) and consists of around 20 people, including associate professors, young researchers and many doctoral students.

Research

It is possible to highlight an evolution in the research pathway of the group: in the past the research in this field was mainly focused on the relationship between the urban plan/architectural project and the real estate market, analysed above all in terms of the economic feasibility of the projects, subsequently the increasingly uncertain outcome of urban and territorial transformations gave rise to more articulated reflections on the type of evaluative question.

In the last 30 years in Italy - and partially in Europe - the following have changed:

- The ways of regulating urban and territorial transformations;

- The approaches to stimulate urban renewal;

- The reactions of the community;

- The modus operandi in the real estate sector;

- The increasing importance of environmental issues;

- The concept of sustainable development.

The last point is particularly significant, because in this milieu, the "sustainability question" takes on a socio-technical character, challenging the experts to provide the most appropriate methodology to support the Decision Makers (DMs). Urban transformation, architecture, is no longer just conceived and perceived as a 'bricks and mortar' issue; but rather present a dual nature: i) a technical identity linked to the redesign of existing buildings, the reclamation and redevelopment of brownfields, the technological challenges of new transport infrastructures, etc.; ii) a social identity, which refers to social equity, well-being and quality of life. Within this context, it is important to support decision analysis and decision-making by means of methodologies for which the information required as input and the recommendation supplied as output could be rigorous and accurate on one hand, but also as simple and understandable as possible on the other hand.

In this respect, the contribution of the Polito -DIST research group to the international MCDA debate concerns the ability to focus on critical points within an evaluation process in the urban and architectural context that require a more formalised approach, without ever losing sight of the objective of providing effective support to DMs concretely engaged in the operational reality of the problems analysed.

To the call to improve our ability to respond to the objectives of sustainable development, and in particular to Sustainable Development Goal 11 (SDG11 - Sustainable cities and communities), the Polito research group – DIST reacted by developing theoretical and applicative lines of research mainly in the following areas: i) strategic urban planning; ii) environmental systems; iii) adaptive reuse of abandoned buildings; iv) infrastructural transport planning strategies; v) location of undesirable facilities; vi) urban energy retrofitting operations and vii) real estate investments.

Dealing with the decisional problems that arise in these contexts means to tackle issues such as the management of a large number of criteria; the consideration of different types of interaction effects between criteria; the management of imprecise preference information provided by the DMs; the possibility of the presence of a huge number of alternatives; the complexity of some aspects of the field, such as the quantification of purely qualitative aesthetic and spatial aspects in numerical variable and, most of all, the need to reduce the commitment, in terms of cognitive effort and time, of the DM. Of course, one has to accept that if a systematic decision aiding methodology has to be applied, it requires a certain commitment by the DMs, because, otherwise, only inaccurate, misleading and shallow results will be obtained that have to be considered definitely unreliable. But mention has to be made to the fact that most of the MCDA's application in this field request several meetings with the DMs, with

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individuals who are often mayors, public administrators, councillors, etc., with rather limited time availability, and frequently with a partial preparation in OR.

On the basis of these remarks, the Polito research group – DIST has introduced several innovations in the procedures to reduce the number of interactions and, most of all, cognitive effort, in order to allow the DM feels comfortable when required information that appears clear and understandable, so that the cognitive effort is strongly reduced and more solid and safer results are obtained from the elicitation procedure. Citing one as an example, the parsimonious Analytic Hierarchy Process (AHP) was introduced, that was conceived to tackle a portfolio issue, to make choices with respect to the realisation of social housing.

The aforementioned areas of application cover different geographical scales of intervention (local, national and transnational) offering the opportunity to reflect around the use of MCDA including: Analytic Network Process (ANP); ANP and Spatial Decision Support Systems (SDSS); Dominance Based Rough-Sets Approach (DRSA), Measuring Attractiveness by a Categorical Based Evaluation Technique (MACBETH), Preference Ranking Organization METHod for Enrichment of Evaluations (PROMETHEE), CATegorization by Similarity–Dissimilarity (CAT-SD), Elimination Et Choix Traduisant La Realité (ELECTRE), parsimonious AHP, Multiple Criteria Hierarchy Process (MCHP), SRF-II method, Stochastic Multicriteria Acceptability Analysis (SMAA), Non Additive Robust Ordinal Regression (NAROR), Multi-Attribute Value Theory (MAVT), AHPSort and ANPSort, Fuzzy AHP, ELECTRE III with interaction between criteria, ELECTRE TRI.

Teaching

At the Politecnico di Torino, the Polito-Dist research group holds courses where the theoretical foundations and application aspects of MCDA are taught at undergraduate level in the following degree courses:

- Bachelor's Degree in Territorial, Urban and Environmental Planning

- Bachelor in Engineering

At master's degree level in the following degree courses:

- Master's Degree in Architecture, Construction and the City

- Master's Degree in Digital Skills

- Master's Degree in Geography and Territorial Sciences

At doctoral level, in the International Doctorate in Urban and Regional Development, there are specifically two courses:

- Multicriteria analysis and strategic assessment (Prof. Bottero)

- Problem Structuring Methods for facing urban uncertainty (Prof. Lami)

Most of the courses are structured as a Problem-Based Learning (PBL): a real case study is proposed to be tackled with the MCDA. Learning on the basis of real problems can be a motivating context for students, who are asked to find feasible solutions through teamwork. Working in co-operative groups following a directed learning scheme not only encourages students to engage in dialogue and teamwork for the development of communication skills, but also enables them to effectively learn strategies based on the development of critical thinking, the integration of theory and practice and the ability to analyse and solve a real complex problem.

Software

Directly connected to the research strands above mentioned, a decision support tool has been designed by Isabella Lami, Matteo Bassan and Davide Di Nicoli, called MuVAM (Multi-Values Appraisal Methodology). MuVAM (https://www.knowledge-share.eu/en/patent/muvam-decision-support-software/) is a web application designed to support decision-making processes related to complex problems, equipped with a very effective online graphical interface. The methodology is based on a combination of Strategic Choice Approach and Analytic Hierarchy Process. MuVAM works with a series of algorithms and mathematical methods in the background to guide participants through five steps aimed at: representing the problem, identifying possible solutions, identifying decision criteria and their weights, comparing solutions and illustrating results. Attachments, links and map representations can be included to support the process. Lastly, it can be used by groups working in real time, in presence or remotely, or in asynchronous mode, allowing them to participate in the same workshop from anywhere, even deferred.

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Example of the software MuVAM

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Books

Salvatore Greco, Vincent Mousseau, Jerzy Stefanowski, and Constantin Zopounidis (Editors) (2022). *Intelligent Decision Support Systems - Combining Operations Research and Artificial Intelligence - Essays in Honor of Roman Słowiński*, **Springer Cham, 1922. ISBN 978-3-030-96317-0.**

This volume is a Festschrift in honor of Roman Slowiski for his 70th birthday. The aim of the book is to shed light on the whole life scientific project of Roman Slowinski that is combining Operations Research and Artificial Intelligence into Intelligent Decision Support Systems. This vision became the scientific program of Roman Slowinski through his meeting, acquaintance, collaboration, and friendship with three scholars who shaped operations research, decision aiding, and computer science: Jan Weglarz, Bernard Roy, and Zdzisław Pawlak, that introduced Roman Slowinski to operations research with a special focus on scheduling, multiple criteria decision aiding and artificial intelligence through rough set theory, respectively. The 21 chapters of the book cover various issues related to research interests and contributions of Roman Slowinski to such fields as multiple criteria decision aiding, multi-objective optimization methods, intelligent decision support systems, and uncertainty managing in artificial intelligence. The authors of the contributions in the book are renowned colleagues coming from laboratories from all over the world that had collaborations with Roman Slowinski or were influenced by his works. The book was presented to Roman Slowinski in the last meeting of the EURO Working Group on Multiple Criteria Decision Aiding held in Elounda Town, Agios Nikolaos on September 15-17, 2022.

The chapters are as follows:
1. **Salvatore Greco, Vincent Mousseau, Jerzy Stefanowski, and Constantin Zopounidis**. Roman Słowiński and His Research Program: Intelligent Decision Support Systems Between Operations Research and Artificial Intelligence;
2. **Jan Węglarz**. Roman's Scientific Trajectory: A Retrospective with an Emphasis on the Beginning;
3. **Salvatore Corrente, José Rui Figueira, and Salvatore Greco.** ELECTRE Methods: A Survey on Roman Słowiński Contributions.
4. **Hannele Wallenius, and Jyrki Wallenius.** How Can Decision Sciences and MCDM Help Solve Challenging World Problems?
5. **Michalis Doumpos, Evangelos Grigoroudis, Nikolaos F. Matsatsinis, and Constantin Zopounidis.** Preference Disaggregation Analysis: An Overview of Methodological Advances and Applications.

6. **Eyke Hüllermeier, and Christophe Labreuche.** Modeling and Learning of Hierarchical Decision Models: The Case of the Choquet Integral.
7. **Adiel Teixeira de Almeida Filho, Julio Cezar Soares Silva, Diogo Ferreira de Lima Silva, and Luciano Ferreira.** Preference Learning Applied to Credit Rating: Applications and Perspectives.
8. **Eduardo Fernández, Jorge Navarro, and Efrain Solares.** USort-nB and USort-nC: Two Multi-criteria Ordinal Classification Methods Using Interval Value Functions.
9. **Aida Valls, and Antonio Moreno.** Constructing an Outranking Relation from Semantic Criteria and Ordinal Criteria for the ELECTRE Method.
10. **Miłosz Kadziński.** Robust Ordinal Regression for Multiple Criteria Decision Aiding.
11. **Yves Meinard, and Alexis Tsoukiàs.** What Is Legitimate Decision Support?
12. **Philippe Fortemps, and Marc Pirlot.** MR-Sort with Partial Information to Decide Whether to Invest in Innovation Projects.
13. **Luis C. Dias, and Miłosz Kadziński.** Meta-Rankings of Journals Publishing Multiple Criteria Decision Aiding Research: Benefit-of-Doubt Composite Indicators for Heterogeneous Qualitative Scales.
14. **Eleftherios Siskos, and Yannis Siskos.** Interactive Multicriteria Methodology Based on a Synergy of PROMETHEE II and Robust Simos Methods: Application to the Evaluation of E-government in Europe.
15. **Juergen Branke, Andrzej Jaszkiewicz, and Piotr Zielniewicz.** The Use of Decision Maker's Preferences in Multiobjective Metaheuristics.

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16. **Margaret M. Wiecek, and Philip J. de Castro.** Decomposition and Coordination for Many-Objective Optimization.
17. **Masahiro Inuiguchi.** Fuzzy Linear Programming with General Necessity Measures.
18. **Jerzy Błaszczyński, Salvatore Greco, Benedetto Matarazzo, and Marcin Szeląg.** Dominance-Based Rough Set Approach: Basic Ideas and Main Trends.
19. **Patrick G. Clark, Jerzy W. Grzymala-Busse, Zdzislaw S. Hippe, and Teresa Mroczek.** Rule Set Complexity for Mining Incomplete Data Using Probabilistic Approximations Based on Generalized Maximal Consistent Blocks.
20. **Izabela Szczech, Robert Susmaga, Dariusz Brzezinski, and Jerzy Stefanowski.** Rule Confirmation Measures: Properties, Visual Analysis and Applications.
21. **Dympna O'Sullivan, Szymon Wilk, Martin Michalowski, Hugh O'Sullivan, Marc Carrier, and Wojtek Michalowski.** An Approach to Combining Adherence-to-Therapy and Patient Preference Models for Evaluation of Therapies in Patient-Centered Care.

We like to conclude this presentation of the book with some words from its introduction: "*While the characteristics of this multi-author monograph correspond to the German term Festschrift, i.e., a special book published on the occasion of the significant birthday, we do not regard it retrospectively as a summary of Roman Slowinski's long and fruitful career. Knowing him personally, we think prospectively and expect his further work proposing many original ideas to contribute to the development of many areas of research continuing to inspire the work of a rich network of researchers*".

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Software

A short announcement of a new software based on Potential Method.

The software is written in C++ and compiled for linux operating system. There are several procedures available for download on https://web.math.pmf.unizg.hr/~caklovic/software.html with examples and references to the existing theory.

1. *pmflow* – a basic ranking procedure. Input data are in the form of weighted preference multigraph. An arc is pointed to the more preferred node and a preference intensity is a non-negative real number.

2. *pmtable* – aggregation of input data in table form. There are several possibilities: (a) aggregation of columns with given weights, (b) aggregation of rows with given weights, (c) aggregation of both, rows and columns simultaneously (duality), (d) self-duality (the names of rows and columns are the same).

3. *pmrmatrix* – aggregation of input data in the form of reciprocal matrix (R-matrix approach). Eigenvalue method (EVM) and geometric mean methods (GMM) are available as options. A group decision is also possible in several forms.

4. *pmhier* – aggregation of data in a hierarchical structure. Criteria are given in the top level, sub criteria and their sub criteria are in the lower levels and the alternatives are at the bottom level. The weights of the elements in the top level should be given. Self duality of hierarchical data is also possible without apriori given weights. In that case the top level and bottom level have the same elements. A group decision of hierarchical data are also possible.

5. *pmchoice* – aggregation of ratios (choice model). For example, if R:=A:B:C=4:3:1 and Q:=A:B=3:2 then R+Q is a network defined as an aggregation of an appropriate R-network and Q-network. This approach is a generalization of R-matrix approach.

At his moment I am working on the several applications of Potential Method which are already tested in *python* and *Mathematica*. They are:

– Ordinal Potential Method.

– Missing Data - a proxy approach.

– Machine learning and prediction by PM.

– PM Score Matching in observational studies.

– Input-Output models (DEA vs. PM).

Any suggestions are welcome and will be incorporated in a future version of the software.

Lavoslav Čaklović
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Announcements

**Call for the "Bernard Roy Award 2023"
of the EURO Working Group on Multiple Criteria
Decision Aiding (Bernard Roy Award 2022 of EWG
MCDA)**

Policy
-The Bernard Roy Award of EWG MCDA (http://www.cs.put.poznan.pl/ewgmcda/) is a recognition conferred to a researcher under 40 years old for an outstanding contribution to the methodology and/or applications of Multiple Criteria Decision Aiding (MCDA).
-The award will be officially bestowed at the opening session of the 96th EWG MCDA meeting, September 2023, ESSCA School of Management, Paris Campus, France, if there is a suitable candidate. In this case, following a presentation of the competition by the chair of the Jury, the laureate will be invited to give a talk.

Award
The laureate then will receive the financial award (1000 EUR) and the diploma.

Eligibility
-The Bernard Roy Award of EWG MCDA shall be awarded for a body of work in MCDA, preferably published over the last decade. Although recent work will not be excluded, care shall be taken to allow the contribution to stand the test of time.
-The potential award recipient shall have a recognized stature in the MCDA community. Significance, innovation, depth, and scientific excellence shall be emphasized.

Nominations
-Candidates can be nominated by any three members of the EWG MCDA. Becoming a member is free (http://www.cs.put.poznan.pl/ewgmcda/index.php/members).
-A candidature for the Bernard Roy Award of EWG MCDA is composed of the nomination letter along with a recent and detailed CV, up to 5 best publications, as well as a self-description of the achievements up to 3 page long in a standard manuscript format. The nominations must be sent to the Jury chair by the due date of June 30, 2023.

Selection process
-Only one award may be assigned on each occasion.
-One person may receive the award at most once in her/his lifetime.
-The jury evaluates the nominees essentially on the basis of their scientific activities (papers in top journals, editorials, relevance of methodological proposals and/or applications, ...).

Jury

-The jury for the current edition is composed of Professors Roman Słowiński (chair), Maria Franca Norese, Salvatore Greco, Constantin Zopounidis, and Nicolas Matsatsinis

Timing
-Deadline for nominations: June 30, 2023.
-The Jury chair informs the EWG coordinators who invite the laureate to the meeting: July 31, 2023.
-Preparation of the diploma by the EWG coordinators. Presentation of the laureate and her/his talk during the EWG MCDA 96th EWG MCDA meeting, September 2023, ESSCA School of Management, Paris Campus, France. An electronic copy of the laureate's presentation handed over to the EWG coordinators will be made available on the EWG on MCDA Web Site.

Applications should be sent to Professor Roman Słowiński at: roman.slowinski@cs.put.poznan.pl.

Call for Papers
MCDM Track of EMO2023
**12th International Conference on Evolutionary Multi-Criterion Optimization
March 20-24, 2023, Leiden, Netherlands. Link**

Submission deadline: October 12, 2022

Final paper submission: November 30, 2022

The Multiple Criteria Decision Making (MCDM) track is an integral part of the 12th edition of the International Conference on Evolutionary Multi-Criterion Optimization (EMO). We will bring together EMO and MCDM communities to emphasize the importance of the topics on the intersection of EMO and MCDM areas of research and their practical value in solving real-world problems in various fields, including government, business, and industry.

Papers are welcome to the MCDM track on theory, methods, applications, and/or software related to any aspects relevant to multiple criteria decision making, multiobjective and many-objective optimization, modeling and incorporating preferences, interactive methods, hybrids of EMO and MCDM approaches, software development, indicators, performance evaluation, challenges of various real applications, consideration of data-driven and simulation-based problems, etc.

Reviewed, accepted full papers (max 12 pages) will be published in a proceedings book by Springer (Lecture Notes in Computer Science series).

Find detailed instructions on the webpage.

Please submit your paper via EasyChair to the MCDM Track by October 12, 2022.

When submitting, please indicate in the submission menu that the paper is for the MCDM Track.

The EMO2023 conference and the MCDM Track will be held in a hybrid format.

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For further inquiries about the MCDM Track, contact the MCDM Chairs Kaisa Miettinen (University of Jyvaskyla, Finland, kaisa.miettinen@jyu.fi) and Iryna Yevseyeva (De Montfort University, Leicester, UK, iryna@dmu.ac.uk).

European Journal of Operational Research
Special Issue: Feature Cluster of the European Journal of Operational Research on Explainable Analytics in Operational Research

We invite high-quality submissions addressing theoretical and algorithmic developments advancing the theory and methodology of explainable analytics within OR, as well as real-world innovative implementations in business and society in areas as marketing and sales, supply chain management, education, production and service operations, medicine, bioinformatics, (financial) risk, and fraud.

Topics for contributions to explainable analytics include (but are not limited to):

- Data representation and pre-processing

- Feature engineering and selection methods

- Model-agnostic interpretability methods

- Inherently interpretable algorithms

- Rule-based methods

- Methods for balancing and optimizing predictive performance and interpretability

- Methods supporting model justifiability and actionability

- Privacy-preserving methods

- Methods related to algorithm fairness and bias avoidance

- Interpretable decision-making methods under uncertainty

- Explainable methods for deep learning

- Model visualizations bridging algorithm outcome with domain knowledge

- New model evaluation metrics

- Field tests and real-life experiments that bring analytics closer to the decision-maker

Prospective authors are asked to follow the EJOR guide for authors. Please submit your paper at: https://www.editorialmanager.com/ejor/

Important Dates

- Opening manuscript submission: September, 1st 2022

- Closing manuscript submission: November, 15th 2022

- Final decisions on all manuscripts: September, 30th 2023

- Expected publication of the Feature Cluster: beginning of 2024

Guest Editors

-Kristof Coussement - IÉSEG School of Management, France – k.coussement@ieseg.fr
-Koen W. De Bock - Audencia Business School, France (Managing Guest Editor) – kdebock@audencia.com
-Arno De Caigny – IÉSEG School of Management, France – a.de-caigny@ieseg.fr
-Roman Słowiński, Poznań University of Technology & Systems Research Institute of the Polish Academy of Sciences, Poland – roman.slowinski@cs.put.poznan.pl

Fuzzy Sets and Systems
Special Issue: Uncertainty and reference involved aggregation model with applications – to celebrate Dr. Ronald R. Yager's 80's birthday

Dear Colleagues,

This Special Issue aims to celebrate Dr. Ronald R. Yager's 80's birthday. Dr. Yager (born in 1941) is a famous pioneer in several study fields including fuzzy systems and intelligent decision-making theory, among others. He is one of the most esteemed and respected researchers in the field of fuzzy theory and computational intelligence. He won several awards including IEEE Computational Intelligence Society Fuzzy Systems Pioneer Award (2004), IEEE Outstanding Contributor Award Granular Computing (2006), IEEE Frank Rosenblatt Award (2016), and Lotfi A. Zadeh Pioneer Award of the IEEE Systems, Man, and Cybernetics Society (2018), etc. Dr. Yager is the founder and former editor in chief (1988–2020) of the International Journal of Intelligent Systems. He was a NASA/Stanford Visiting Fellow and a Research Associate with the University of California, Berkeley. He was a Lecturer with the NATO Advanced Study Institutes. Notably, most of his numerous published papers were written independently by himself.

To honor his contributions, this Special Issue will gather research works and reviews from researchers and scientists mainly working in the research areas most impacted by Dr. Yager's research in uncertainty and preference involved decision making and aggregation operators such as the development of theory and application of Ordered Weighted Averaging (OWA) operator and fuzzy measure. The Special Issue welcomes original contributions that advance the state-of-the-art of aggregation operator theory and models that are focused on uncertainty and preference, which include (but not limited to):

- fuzzy logic;

- aggregation operators;

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- bi-polar preference evaluation models;

- interval handling and aggregation;

- ordered weighted averaging operators;

- preference and uncertainty involved decision making;

- extended fuzzy sets with application;

- information fusion techniques.

Guest editors:

Prof. Dr. Radko Mesiar (Slovak University of Technology)

Dr. LeSheng Jin (Nanjing Normal University)

Dr. Zhen-Song Chen (Wuhan University)

Prof. Dr. Gleb Beliakov (Deakin University)

Prof. Dr. Luis Martínez (University of Jaén)

Manuscript submission information:

December 31, 2022: Submission deadline for initial submission

March 31, 2023: First-round decisions on all submitted manuscripts

May 31, 2023: Submission deadline for invited revisions
September 30, 2023: Final decisions

Annals of Operations Research
Special Issue: New Trends and Recent Developments in OR Techniques for Sustainability, Environment and Social Transition in Economics and Finance

Annals of Operations Research seeks submissions for a special issue on New Trends and Recent Developments in OR Techniques for Sustainability, Environment and Social Transition in Economics and Finance. In this special issue, we expect high-quality and original research papers. We would especially welcome innovative contributions and applications of methods based on OR tools and their combination with computational aspects in real-life problems and specifically, in all areas of economics and finance related to sustainability, environment and social transition. The major acceptance criterion for a submission will be the quality and originality of the contribution.

This is an open call for high-quality and original research papers. We encourage the participants of The International Conference on Sustainability, Environment, and Social Transition in Economics and Finance-2022, jointly organized by Audencia Business School, University of Southampton, University Paris-Saclay, Telfer School of Management (University of Ottawa) and Paris School of Business with the support of Gaia (Audencia Business School) & Center of Research for Energy and Climate Change—CRECC (Paris

School of Business) to be held on December 13–15, 2022 in Paris, to submit their high-quality and original research papers.

We especially welcome innovative contributions related to the main following topics, but are not limited to:

- Mathematical optimization

- Factor identification, timing and forecasting

- Factor optimization

- Feature selection and extraction algorithms

- Optimization models

- Estimating and evaluating asset pricing models

- Climate risk: modelling and assessment

- Network modelling and analysis

- ESG criteria and socially responsible investment

- Computational approaches for classification

- Modelling and classification with big data

- Big data applications

- Green finance and ethical banking

- Artificial intelligence methods for economic and financial modelling

- Machine learning applications for modelling and forecasting

- Ordinal modelling and preference learning

- Multicriteria decision aid

- Applications in sustainability, environment and social transition in Economics and

- Finance

Instructions for authors can be found at:

https://www.springer.com/journal/10479/submission-guidelines

Authors should submit a cover letter and a manuscript by **December 30, 2022**, via the Journal's online submission site. Manuscripts submitted after the deadline may not be considered for the special issue and may be transferred, if accepted, to a regular issue.

Please see the Author instructions on the web site if you have not yet submitted a paper through Springer's web-based system, Editorial Manager. When prompted for the article type, please select **Original Research**. On the Additional Information screen, you will then be asked if the manuscript belongs to a special issue, please choose the special issue's title, **New Trends and Recent Developments in OR Techniques for Sustainability, Environment and Social Transition in Economics and Finance**, to ensure that it will be reviewed for this special issue.

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Series 4, n°5, Fall 2022.

Papers will be subject to a strict review process under the supervision of the Guest Editor, and accepted papers will be published online individually, before print publication.

Guest Editors:

Prof. Ramzi BENKRAIEM
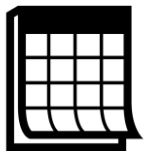Audencia Business School, France
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Forthcoming meetings

(This section is prepared by Carlos Henggeler Antunes ch@deec.uc.pt)

1-3/11/2022
TORS'22: 5th International Conference of the Tunisian Operational Research Society
Sousse, Tunisia
https://torsconference.wixsite.com/tors22

2-4/11/2022
ANTS 2022 13th International Conference on Swarm Intelligence
Malaga, Spain
https://ants2022.uma.es

4/11/2022
Let's SCIP it! A workshop to celebrate 20 years of Solving Constraint Integer Programs
Zuse Institute, Berlin, Germany
https://scipopt.org/20years

6-8/11/2022
XXII Congress of the Portuguese Operational Research Association
University of Évora, Portugal
http://apdio.pt/web/io2022

17-18/11/2022
BIOMA 2022. The 10th International Conference on Bioinspired Optimization Methods and Their Applications.
Maribor, Slovenia
https://bioma2022.um.si/

18-19/11/2022

39th conference Colloquium on Combinatorics (Kolkom 2022)
Paderborn, Germany
https://www.kolkom.de/index.php

24-25/11/2022
International Conference on Business Analytics and Operations Research
Toronto, Canada
https://business.conferenceseries.com/

12-15/12/2022
CLAIO 2022: XXI Latin Ibero-American Conference on Operations Research
Buenos Aires, Argentina
https://claio2022.dc.uba.ar/

9-13/1/2023
XVlll Summer School in Discrete Mathematics
Valparaiso, Chile
https://eventos.cmm.uchile.cl/discretas2023/

15-20/1/2023
Winter School in Data Science, Optimization and Operations Research
Zinal, Switzerland
https://transp-or-academia.epfl.ch/zinal

29/1-2/2/2023
Discrete Choice Analysis: Predicting Individual Behavior and Market Demand
EPFL, Lausanne, Switzerland
https://transp-or-academia.epfl.ch/dca

20-24/3/2023
EMO: Evolutionary Multi-Criterion Optimization
Leiden, Netherlands
https://emo2023.liacs.leidenuniv.nl/

16-18/4/2023
2023 INFORMS Business Analytics Conference
Gaylord Rockies, Colorado, USA
https://meetings.informs.org/wordpress/analytics2023/

April 2023
95th Meeting of EURO Working Group on MCDA
Jaén, Spain
http://www.cs.put.poznan.pl/ewgmcda/

12-14/4/2023
EvoCOP 2023 - The 23nd European Conference on Evolutionary Computation in Combinatorial Optimisation
Brno, Czech Republic
http://www.evostar.org/2023/evocop/

20-21/4/2023
4th conference of the EURO Practitioners´ Forum
Berlin, Germany
https://www.euro-online.org/websites/or-in-practice/epf-conference-2023/

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27-28/4/2023
6th International Conference on Intelligent Computing & Optimization 2023
Hua Hin, Thailand
https://www.icico.info/

3-5/5/2023
OLA'2023: International Conference on Optimization and Learning
Malaga, Spain
http://ola2023.sciencesconf.org/

11-13/5/2023
The ECCO XXXVI European Chapter on Combinatorial Optimization Conference
Chanya, Crete, Greece.
http://

21-23/6/2023
IPCO 2023 - 4th Conference on Integer Programming and Combinatorial Optimization
University of Wisconsin–Madison, USA
https://optimization.discovery.wisc.edu/ipco-2023-madison/

24-26/6/2023
2023 INFORMS Manufacturing and Service Operations Management Conference
McGill University, Montreal, Québec, Canada
https://www.informs.org

3-5/7/2023
29th International Annual EurOMA Conference
Leuven, Belgium
https://euroma2023.org/

10-14/7/2023
IFORS 2023
Santiago, Chile
https://ifors2023.com/

24-28/7/2023
XVI International Conference on Stochastic Programming
California, USA
https://gsm.ucdavis.edu/faculty-and-research/faculty-conferences/xvi-international-conference-stochastic-programming

3-6/9/2023
6th International Conference on Dynamics of Information Systems (DIS 2023)
Prague, Czech Republic
https://dis2023.ujep.cz/

September 2023
96th Meeting of EURO Working Group on MCDA
Paris, France
http://www.cs.put.poznan.pl/ewgmcda/

15-18/10/2023
2023 INFORMS Annual Meeting
Phoenix Convention Center, Arizona, USA
https://www.informs.org

April 2024
97th Meeting of EURO Working Group on MCDA
Madrid, Spain
http://www.cs.put.poznan.pl/ewgmcda/

30/6-3/7/2024
EURO 2024
Copenhagen, Denmark
https://euro2024cph.dk/

Recent contributions in brief

(This section is prepared by Salvatore Corrente
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Alves, M. J., C. H. Antunes (2022). A new exact method for linear bilevel problems with multiple objective functions at the lower level, *European Journal of Operational Research*, **303(1), 312-327.**

https://doi.org/10.1016/j.ejor.2022.02.047

Bilevel optimization models are relevant in problems in which decisions are made sequentially by two decision makers (the leader and the follower), who control different sets of variables aiming to optimize their own objective functions. The leader decides first, and the follower then optimizes his/her objective function within the options restricted by the leader's decision. However, since the follower's decision affects the leader's objective function value and even his/her feasible options, the leader must anticipate the follower's reaction. This type of sequential decision-making processes often appears in the management of decentralized organizations and policy making, namely in pricing and tariff design problems.

The single-objective bilevel problem (BP) is already a difficult problem from theoretical, algorithmic, and computational perspectives. The consideration of multiple objective functions adds further complexities. In practice, multiple, incommensurate and conflicting aspects frequently arise, in particular in the follower's problem, since his/her decisions are often a balance of economic, quality of service, or environmental concerns.

However, dealing with multiple objectives at the lower level is particularly challenging due to the existence of a set of lower-level efficient solutions for each leader's decision. In this work we consider linear BP with multiple objective functions at the lower level. We propose a general-purpose exact method to compute the optimistic optimal solution, which is based on a proposition stating that an optimistic optimal solution to the

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problem is an efficient extreme point of an associated MOLP problem with as many objective functions as the number of lower-level objective functions plus the number of upper-level decision variables plus 1. The optimistic formulation assumes that the follower accepts any efficient solution of the lower-level problem.

We also explore a heuristic procedure relying on the same search principles, which although it cannot ensure the global optimal solution but just a local optimum, it has shown to be quite effective in problems where the global optimum is difficult to obtain within a reasonable timeframe.

The main advantage of the strategy employed by our algorithms (the exact and the heuristic one) is that they can be interrupted at any moment always yielding a feasible solution to the BP, which does not occur with other approaches in the literature. Since the number of efficient extreme points of a MOLP problem grows very quickly with the increase of the number of objective functions, our algorithm is mainly adequate to BP with a small number of upper-level decision variables.

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Angilella, S., & Pappalardo, M. R. (2020). Performance assessment of energy companies employing Hierarchy Stochastic Multi-Attribute Acceptability Analysis. *Operational Research*, 22, 299-370.

https://link.springer.com/article/10.1007/s12351-020-00567-5

During the last decades, the energy sector experienced several deregulation phases that allowed the entrance of new competitors to buy and sell electricity. This renewed competitive structure has led stakeholders (investors, business leaders, policy makers) to face with unprecedent complex problems, such as more alternatives to evaluate, multiple criteria to manage and a higher level of uncertainty to deal with, no longer solvable with traditional models.

Multi Criteria Decision Aid (MCDA) methods, thanks to their multi-dimensional nature, are suitable instruments to assess the multifaceted structure of firms which typically involves a set of conflicting criteria. However, the existing MCDA literature on energy companies' performance evaluation is very often limited to the financial dimension.

To fill this gap, this paper proposes the development of a performance assessment model for twenty worldwide listed companies operating in the energy sector, using a hierarchical structure of criteria based on energy industry assessment. Specifically, conventional financial criteria have been combined with sustainability, technical and market dimensions, and aggregated, in turn, into a composite index to obtain a final ranking for the considered energy companies.

To handle with a hierarchical criteria structure and to account for the space of fluctuations related to the imprecision on criteria weights, we employ the Hierarchy Stochastic Multi-Attribute Acceptability Analysis (HSMAA). Thus, the

proposed model is able to evaluate the performances of energy companies under different uncertainty scenarios, representing the Decision Maker's preferences.

The results indicate that the first and last positions are quite robust in all considered scenarios, while the rankings relative to the intermediate positions vary widely by the chosen set of weights, exemplifying the need to rank companies based on multiple sets of criteria weights.

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L.C. Dias, J. Dias, T. Ventura, H. Rocha, B. Ferreira, L. Khouri, M. do Carmo Lopes (2022). Learning target-based preferences through additive models: an application in radiotherapy treatment planning. *European Journal of Operational Research*, 302(1), 270-279.

https://doi.org/10.1016/j.ejor.2021.12.011

Srinivasan and Shocker's pioneering preference disaggregation model (Psychometrika, 38(3), 337–369, 1973) considers a multiattribute penalty function obtained from a weighted sum of multiple penalties, each one defined as the squared deviation from a target. The weights and the targets are inferred from a set of pairwise comparisons among alternatives, using a linear program (LP) derived from an originally nonlinear formulation. However, a target does not need to represent an ideal value to be achieved. It might instead define a threshold that should, or should not, be surpassed. For instance, in radiotherapy treatment planning, the radiation oncologist has a threshold in terms of minimum dose to be delivered to the volume to be treated, and thresholds defining the maximum allowed dose delivered to healthy organs.

This article presents an asymmetric version of Srinivasan and Shocker's model. Rather than assuming that downward or upward deviations from the target are equally undesirable, only violations above (or under) the target are considered, for each dimension. Considering asymmetry leads to a more complex preference disaggregation problem, for which the linear transformation of Srinivasan and Shocker no longer works. Yet, it was possible to devise an LP model that approximates the penalty functions as much as needed.

The proposed approach was applied to the problem of choosing radiotherapy treatment plans, using a set of retrospective cancer cases treated at the Portuguese Oncology Institute of Coimbra. General monotonic and convex functions were also inferred as benchmarks. Using paired comparison choices made by a radiation oncologist, the preference model was tested with in-sample and out-of-sample data. It is concluded that the model has a good legibility and can represent the radiation oncologist's preferences, with small mean errors and leading, most of the time, to the same treatment plan chosen by the radiation oncologist.

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N.A. Kyriakakis, M. Marinaki, N. Matsatsinis, Y. Marinakis (2022). A cumulative unmanned aerial vehicle routing problem approach for humanitarian coverage path planning. *European Journal of Operational Research*, **300(3), 992-1004.**

https://doi.org/10.1016/j.ejor.2021.09.008.

The paper presents a Cumulative Unmanned Aerial Vehicle Routing Problem (CUAVRP) approach to optimize Humanitarian Coverage Path Planning (HCPP). Search & rescue missions using Unmanned Aerial Vehicles (UAVs) can be considered as HCPP problems in which the goal is to find the routes which cover every point of a certain area of interest in the minimum time possible.

This research approaches such scenarios, by transforming the underlying coverage path planning problem into a vehicle routing problem (VRP). The HCPP problem is transformed into a VRP using an approximate cellular decomposition technique to discretize the area into a grid, where the rectangles represent the UAV sensor's field of view. The center points of the formed rectangles become the nodes used for a UAV routing problem. This transformation allows for different objectives and constraints to be considered in the model. Due to the humanitarian nature of the application, the newly formed CUAVRP uses the Cumulative Capacitated Vehicle Routing Problem (CCVRP) objective, which was originally proposed for routing applications with latency minimization goals. This objective focuses on minimizing the sum of arrival times at customers locations, making it ideal for the scenario at hand.

For solving the CUAVRP, three versions of a Parallel Weighted Greedy Randomized Adaptive Search Procedure - Variable Neighborhood Decent (GRASP-VND) algorithm are implemented. Each of them incorporates a different communication and information exchange strategy between threads, which translates to differences in their exploratory and exploitative properties. The GRASP-VND variants are assessed based on solving the CCVRP benchmark instances, before being applied to the CUAVRP. Two different objective approaches are tested and compared, the original Min-sum, and the Min-max which aims at minimizing the latency at the last visited location. Computational results indicate that the Min-sum objective is the best overall choice for the CUAVRP.

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E.A. Frej, D.C. Morais, A.T. de Almeida (2022). Negotiation Support Through Interactive Dominance Relationship Specification. *Group Decision and Negotiation*, **31(3), 591-620.**

https://doi.org/10.1007/s10726-021-09761-y

In this paper, an innovative protocol for eliciting preferences in multi-issue negotiations considering partial information of preferences is proposed. The proposed approach is based on the Flexible and Interactive Tradeoff (FITradeoff) multicriteria method, which enables negotiators to elicit preferences about negotiation issues in a flexible way,

providing as much information as they are willing to. Preference evaluation is a crucial aspect in multi-issue negotiation support, especially when the set of possible packages is large. Different from previous approaches for negotiation support developed in the literature, the proposed protocol does not require the negotiators to elicit a utility function based on scores and precise values, which may cause errors and inconsistencies. The FITradeoff method allows negotiators to provide incomplete information, which is used to construct a linear programming model to determine the dominance relationship of the alternatives. During the exchange of offers, the models are refined and the packages ranking built based on dominance relationships becomes increasingly more complete. In order to facilitate negotiators to reach an agreement, the proposed negotiation protocol works based on a dynamic set of packages, in such a way that packages that are not interesting for both parties are eliminated from the negotiation. After an agreement is reached, a Pareto-optimality analysis of the final agreement package is conducted in the post-settlement phase, in order to verify whether the agreement package is an efficient solution for the problem. In the paper, the proposed protocol is illustrated with an application to a negotiation between a musician and an entertainment company, showing satisfactory results about the converge speed of the proposed protocol.

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A.C. Marques, E.A. Frej, A.T. de Almeida (2022). Multicriteria decision support for project portfolio selection with the FITradeoff method. *Omega*, **111, 102661.**

https://doi.org/10.1016/j.omega.2022.102661

The need to arrange and deal with limited resources is a permanent challenge for the corporate and social reality, and it pushes us to choose between several options, attempting to find the best and most efficient selection accordingly to multiple coexisting objectives. This paper`s proposition resides in an amplified utilization of the multi-criteria decision support method based on the concepts of flexible elicitation, the FITradeoff (Flexible and Interactive Tradeoff) method, mitigating the energy dispended so far in cognition demanded to solve the project portfolio selection problem. The method distinguishes itself from the others by using the elicitation of scale constants with partial information, maintaining the axiomatic structure of the traditional tradeoff procedure, and with the advantage of the possible use of non-linear marginal value functions. The vanguard challenge faced by this method is how to deal with the combinatorial problem in the portfolio generation process and to do so by considering partial information about preferences. This paper surpasses the mentioned obstacle by offering the use of a search tree combined with the c-optimal and non-dominated portfolios concept, which avoids generating a priori undesirable portfolios. The model is divided into two phases. In the first one, called the preparation phase, an explicit generation of the portfolios is conducted and demands the most significant computational effort. For this, strategies to check the feasibility and efficiency of the generated portfolios are

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implemented and proved effective at reducing the number of possible combinations. It is not demanded interaction with the decision-maker in this primary phase. The second phase elicits the preferences of the decision-maker, in it is possible for the decision-maker to provide partial or incomplete information, demanding less time and cognitive effort in the process of achieving a solution for selecting the best portfolio.

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Parragh, S.N., Tricoire, F., Gutjahr, W.J. (2022). A branch-and-Benders-cut algorithm for a bi-objective stochastic facility location problem. *OR Spectrum* **44, 419– 459.**
doi: 10.1007/s00291-020-00616-7

While both multi-objective optimization and stochastic optimization are currently well-developed and established fields, their interplay has been explored far less intensely up to now. This may be surprising, considering that many decisions in application fields have to be made not only in the presence of multiple objectives, but also under (probabilistically representable) uncertainty. However, dealing with a combination of both features turns out as methodologically challenging. The article addresses a stochastic facility location problem in disaster relief with two objective functions: public facilities, for example shelters or distribution centres for relief items, are to be opened at suitable places, taking the demand of the population into account – and this demand is an uncertain quantity, modelled by random variables. Two objectives are considered: (i) keeping the cost for opening the facilities as low as possible, and (ii) maximizing the expected satisfied demand. A bi-objective, two-stage stochastic optimization problem is obtained.
The proposed solution approach uses a scenario-based approximation of the given stochastic demand model, an adaptation of Benders decomposition for the stochastic optimization aspect of the problem, and, for the bi-objective optimization aspect which aims at the identification of Pareto-optimal solutions, a bi-objective branch-and-bound (BIOBAB) algorithm recently developed in Parragh and Tricoire (2019). The integration of these methodological tools under the requirement that overall runtime remains reasonable needs suitable adjustments in the lower-bound computation of branch-and-bound, valid inequalities to strengthen bounds, appropriate cut generation strategies, a partial decomposition technique etc. The approach is tested at benchmark instances derived from an application case concerning the region Thies in Senegal. Its promising performance suggests the transfer of the method to related problems in other fields.

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F. Liang, M. Brunelli, J. Rezaei (2022). Best-worst Tradeoff method. *Information Sciences*, *610*, 957-976.

https://doi.org/10.1016/j.ins.2022.07.097

Since its inception in 2015, thanks to its simplicity and ease of use, the Best-worst method has gained prominence as a framework for the elicitation of weights. In the recent years, many extensions have been proposed to deal with uncertainty. On the other hand, the questioning system of the methods has remained unchanged.

In this contribution, we present the Best-Worst Tradeoff (BWT) method, which changes the way the preferences are elicited. While retaining the basic scheme for which the best and worst attributes are compared against all the others, the questions asked to the expert are inspired by the well-known Tradeoff method used in Multi-Attribute Value Theory (MAVT), and thus they are significantly different.

In particular, unlike the BWM, the BWT method does not ask direct questions on the intensity of preference, but tradeoffs between attributes are offered by the expert. Then, from these tradeoffs, preferences, in the form of comparisons between weights, are indirectly disclosed.

Notably, unlike the BWM, the BWT has a good capacity of keeping into account the ranges of various attributes and, unlike the tradeoff methods developed in MAVT, it offers a structured way to assess the consistency of preferences.

The paper introduces and justifies the BWT method by means of illustrative examples. Then, thresholds for the consistency are calculated and eventually a case study involving the choice of the seaport is presented.

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G. Xanthos, C. Zopounidis, A. Garefalakis, Ch. Lemonakis, I. Passas (2022). Distinguish regional performance with the use of shift-share analysis and MCDA methods: a gross value-added perspective. *Operational Research* **22, 1363–1376.**

https://doi.org/10.1007/s12351-020-00582-6

This paper aims to take into account regional gross value added, to assess the performance of this macroeconomic component for all thirteen Regions of Greece. Current developments in the international economy, which have a direct impact on the domestic economy, slow down furthermore the economic growth of the Greek Regions. Hadjimichali's study (2011) states that "the Regions of European Countries—and in particular southern Europe including Greece—were heavily affected by the current global economic downturn, increasing the rate of unemployment, such as the social groups within the Regions as and the Regions themselves." Another obstacle is the economic weakening experienced in recent years the Small and Medium-Sized Enterprises. Thus, while the Region's SMEs theoretically have the potential to strengthen the local economy and to make positive growth, the prevailing domestic and international economic conditions do not create a conducive climate for them. Apart from the economic, however, there is also social weakening in the sense that small family businesses in the Region now tend to disappear and this is mainly due to modern life patterns that take away the new generation from its occupation in the primary and secondary

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sectors by pushing it into the services sector (Hadjimichalis 2011).

Moreover, the slowing growth rate of Greek regions is due, among other things, to the fact that the country is mostly lagging in the exploitation of research and development resources. According to a Eurostat study (2011) on innovation, at the country level, Greece ranks in the category with those countries whose R&D expenditure is below average. Moreover, at the regional level, the Greek regions occupy the last positions, while those of the Northern European countries (Germany, Finland, France, Austria) seem to have the lead. Further effort is therefore needed to accelerate the country's growth rate as a whole in order to be able to enter the world market with the appropriate supplies. In addressing this phenomenon, the contribution of the European Union, through Grants, Structural Funds, Regional Development Projects, and other is significant, aiming at the economic and social cohesion of the regions, in order to inequalities both interregional and transnational. Despite these efforts and the fact that the overall economic development of the country can be considered satisfactory over the last twenty years, regional disparities have narrowly decreased (Katsanevas 2009). At this point, it is understood that monitoring this phenomenon is a necessary matter. The objective of state policy should, therefore, be to 'balanced development' of the country as a whole, but also individually or better to mitigate regional disparities. In this way, regions are in a relatively tricky position to develop at a faster rate than the most developed, to improve the relevant indicators of the former, at a rate higher than that of the latter (Polyzos 2012). In our opinion the leading causes of the above problems are attributed to geographical and environmental factors, to the structure of the economy, but also various institutional, political, and cultural factors. In conclusion, the allocation of the state's financial resources should be carried out following the strategic advantages and in the light of the maximum strengthening of the weakest economic regions (Katsanevas 2009).

This effort requires the existence of appropriate scientific tools, such as the methodology of this article, for the long-term monitoring of the regional problem. In this paper, we apply two different methods for the period between 2010 and 2016, (1) the PROMETHEE II Multi-criteria method and (2) Shift and Share Analysis (SHA).

In a nutshell, in nine out of thirteen Regions of Greece, the PROMETHEE II method ranks the regions of Greece in a wholly identical or relatively similar manner to the SHA method, indicating that there is a robust framework considering the joint review for both proposed methods regarding regional performance.

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Hadjimichalis C (2011) Uneven geographical development and socio-spatial justice and solidarity: European

regions after the 2009 financial crisis. Eur Urban Reg Stud 18(3):254–274

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Publications S.A., Athens

Polyzos S (31/6/2012) Greece: the regional problem causes imbalances in production potential, Newspaper

Greek Opinion

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Articles Harvest

(This section is prepared by He Huang
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