EURO PHD SCHOOL ON MCDM

Multiple Criteria Decision Making:

Methodologies and Applications to the Sustainable Development Goals

FINAL REPORT

CONTENTS OF THE REPORT

01. Background

Multicriteria Decision Making is a branch of Operations Research that studies the mathematical treatment of decision problems, in which several objectives that conflict with each other must be considered simultaneously. Although it is a relatively young discipline (its beginnings date back to the 1960s), it has experienced spectacular growth in recent decades and its techniques have been used in real applications in a multitude of scientific fields. One of the fields in which it is being applied the most is Sustainable Development, due to the conflicting nature of the economic, social and environmental criteria that usually must be considered in this area.

The Spanish Multicriteria decision community has long been one of the world leaders, currently occupying the fourth place in terms of the number of members, according to data from the International Multicriteria Decision Society (www.mcdmsociety.org). The Spanish Multicriteria Decision Group (GEDM, www.multicriterio.es) was founded in 1997, with Professor Rafael Caballero, from the University of Malaga, as its first coordinator, together with Professor Sixto Ríos-Insúa from the Technical University of Madrid. From 2015 to 2018, Professor Francisco Ruiz, from the University of Malaga, was the coordinator of this group. Since then, the group has been growing, currently having 248 members distributed in 30 nodes.

As part of its activity, GEDM applied for a Thematic Network in 2022, within the framework of the National Plan for Scientific, Technical and Innovation Research 2021-2023, which was finally granted for the period 01/06/2023 - 31/05/2025 (RED2022-134540-T). This Thematic Network attempts to respond to the current needs of the Spanish scientific community in Multicriteria Decision Making, which are identified in four main objectives:

1. Increase the cohesion of the Spanish Multicriteria Decision Group;
2. Increase the visibility of the Spanish Multicriteria Decision Group internationally;
3. Increase national and international collaborations of the groups that make up the network, and in particular, the development of research and fundraising;
4. Disseminate and publicize the methodology and its applications, as well as train younger generations, promoting the creation of national and international networks among peers.

One of the activities planned in the Multicriteria Decision Thematic Network is the organization of a Doctoral School in Malaga.

The Multicriteria Decision Group was also established as a Working Group within the Spanish Society of Statistics and Operations Research (SEIO, www.seio.es), which is part of the Association of European Operational Research Societies (EURO, www.euro-online.org).

Thus, an application was made to EURO in June 2023 to organize a EURO PhD School at the University of Malaga in November 2024, a request that was accepted in July 2023. Therefore, the EURO PhD School on Multiple Criteria Decision Making: Methodologies and Applications to the Sustainable Development Goals is a joint activity of the European EURO Society and the Thematic Network on Multiple Criteria Decision Making.

The scientific objective of this meeting is to put reputable researchers in the field of Multicriteria Decision Making in contact with young researchers who are in the period of doctoral studies, with a triple purpose:

1. To make doctoral students aware of the latest advances in various fields of Multicriteria Decision Making, with the help of leading researchers in each of the topics covered.
2. To bring PhD students into contact with real problems in which multi-criteria decision techniques have been applied in the field of sustainable development.
3. Allow PhD students to present their PhD thesis projects, so that they can receive quality feedback from the researchers participating in the meeting.

02. Committees and faculty

The Scientific Committee of the EURO PhD School was responsible for supervising the development of the teaching program and monitoring the admission procedure for applications. It was composed of the following professors:

- AMELIA MARÍA BILBAO. Co-chair. University of Oviedo, Spain
- ALESSIO ISHIZAKA. NEOMA Business School, France
- ANTONIO JIMÉNEZ. Co-chair. Technical University of Madrid, Spain
- AMPARO MÁRMOL. University of Seville, Spain
- KAISA MIETTINEN. University of Jyväskylä, Finland
- JOSÉ MARÍA MORENO. University of Zaragoza, Spain
- FRANCISCO RUIZ. University of Málaga, Spain
- BEGOÑA VITORIANO. University Complutense of Madrid, Spain

On the other hand, the local organizing committee was made up of staff from the University of Malaga, belonging to the Departments of Applied Economics (Mathematics) and Mathematical Analysis, Statistics and Operational Research:

- RAFAEL CABALLERO.
- LAURA DELGADO.
- SAMIRA EL GIBARI.
- SANDRA GONZÁLEZ.
- MÓNICA HERNÁNDEZ.
- MARIANO LUQUE.
- FRANCISCO MARTOS.
- ANA BELÉN RUIZ.
- FRANCISCO RUIZ. Chair.

Finally, the list of teachers who participated in the different training sessions of the School is as follows:

- GABRIELA FERNÁNDEZ BARBERIS. University San Pablo CEU, Spain
- TRINIDAD GÓMEZ. University of Málaga, Spain
- ALESSIO ISHIZAKA. NEOMA Business School, France
- ANTONIO JIMÉNEZ. Technical University of Madrid, Spain
- DYLAN JONES. University of Portsmouth, UK
- KAISA MIETTINEN. University of Jyväskylä, Finland
- JOSÉ MARÍA MORENO. University of Zaragoza, Spain
- RUBÉN SABORIDO. University of Málaga, Spain

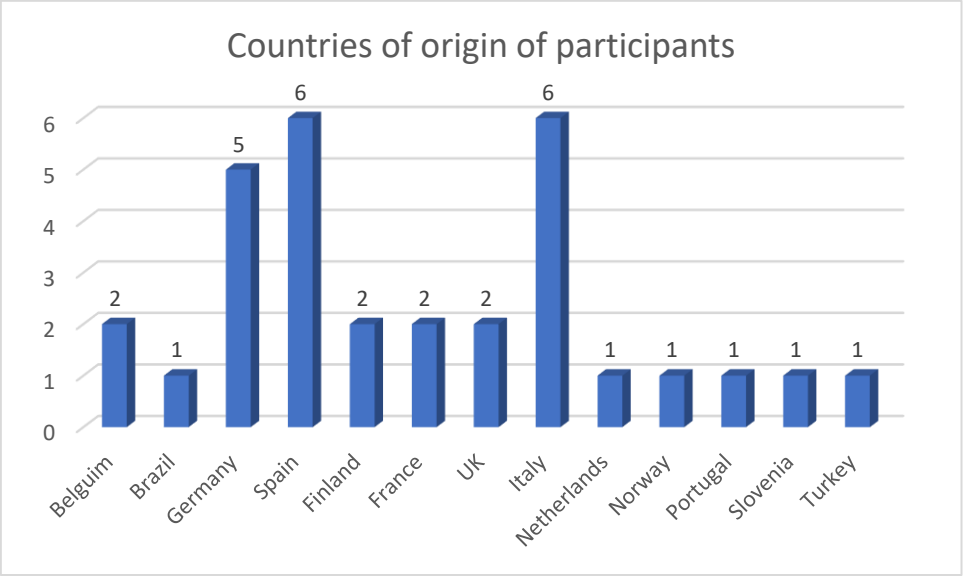
Likewise, all members of the local organizing committee participated as instructors in the supervised practice sessions of the School.

03. Development of the School

03.1.- Student Admission Process

The application period for participating in the School opened on April 22nd, 2024 and was extended until July 17th. By the end of this period, 44 applications had been received. The scientific committee decided to give priority to students who were pursuing their PhD studies in EURO Society member countries, and also to those who were still PhD students (since some applicants had already defended their PhD theses). As a result, applications from 32 students were initially accepted on September 13th, for whom the registration period was open from 16 to 29 September. By the end of this period, 31 students had registered, and these were the ones who finally attended the School. These students come from 13 different countries, according to the distribution shown in Figure 1.

Fig 1. Countries of Origin of Participants



The venue of the School was the Faculty of Marketing and Management of the University of Málaga. Students paid a registration fee of €200, which covered the scientific and social programs, half-board accommodation in a shared double room, at the Albergue Inturjoven of Málaga, lunches and coffees at the School's venue during all school days and transport from the hostel to the venue and vice versa. Those students who preferred to opt for a single room in the hostel had to pay an additional fee of €104. 22 students opted for this option.

03.2.- Planned program and incidents

The program initially planned for the EURO PhD School is detailed in Figures 2 (first week) and 3 (second week).

Fig 2. PhD School Program. Week 1

	Monday 4/11	Tuesday 5/11	Wednesday 6/11	Thursday 7/11	Friday 8/11	Saturday 9/11
9:00 - 9:30	Opening	Theoretical AHP/ANP J.M. Moreno	Theoretical MAUT 1 A. Jiménez	Theoretical Outranking G. Fernández		Outing
9:30 - 10:00	Theoretical Global Introduction A. Ishizaka				Posters Session	
10:00 - 10:30						
10:30 - 11:00						
11:00 - 11:30		Coffee Break	Coffee Break	Coffee Break	Coffee Break	
11:30 - 12:00	Coffee Break	Supervised Training	Theoretical MAUT 2 A. Jiménez	Supervised Training	Supervised Training	
12:00 - 12:30	Groups and Problems					
12:30 - 13:00						
13:00 - 13:30	Lunch	Lunch	Lunch	Lunch	Lunch	
13:30 - 14:00						
14:00 - 14:30						
14:30 - 15:00	Problems and software	Supervised Training	Supervised Training	Supervised Training		
15:00 - 15:30						
15:30 - 16:00						
16:00 - 16:30		Personal Work	Personal Work	Personal Work		
16:30 - 17:00	Personal Work					
17:00 - 17:30						
17:30 - 18:00						
18:00 - 18:30						
18:30 - 19:00						
19:00 - 19-30						

The first week went by without incident. However, on the afternoon of Tuesday 12th, the local authorities declared a red alert in anticipation of torrential rain on Wednesday 13th, which led the rectorate of the University of Malaga to suspend all face-to-face activities on that day. The School's organization reacted by postponing the activity planned for Wednesday 13th to Thursday 14th. On Wednesday 13th, the students worked in their accommodation, having the members of the local committee at their disposal to resolve any queries that might arise. The effects of the rains on the 13th were severe in the city of Malaga and caused damage to some buildings at the University, which led the academic authorities to suspend face-to-face activity on Thursday the 14th as well. Consequently, the organization of the Doctoral School arranged for Professor Miettinen's presentation and the supervised practice sessions to be held online, through the Google Meet platform, on Thursday the 14th. The guided tour of the city was possible in the afternoon on Thursday and on Friday the 15th, face-to-face activity was resumed at the School's venue.

Fig 3. PhD School Program. Week 2

	Monday 11/11	Tuesday 12/11	Wednesday 13/11	Thursday 14/11	Friday 15/11
9:00 - 9:30	Theoretical Efficient Set R. Saborido		Theoretical Ref & Int K. Miettinen		
9:30 - 10:00		Theoretical Goal Progr 1 D. Jones		Supervised Training	Presentations Discrete 1
10:00 - 10:30					
10:30 - 11:00					
11:00 - 11:30	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break
11:30 - 12:00	Problems	Theoretical Goal Progr 2 D. Jones	Supervised Training	Supervised Training	Presentations Discrete 2
12:00 - 12:30					
12:30 - 13:00					
13:00 - 13:30	Lunch	Lunch	Lunch	Lunch	Lunch
13:30 - 14:00					
14:00 - 14:30					Presentations Continuous 1
14:30 - 15:00	Supervised Training	Supervised Training	Supervised Training	Supervised Training	
15:00 - 15:30					
15:30 - 16:00					Coffee Break
16:00 - 16:30	Personal Work	Personal Work	Personal Work	Personal Work	Presentations Continuous 2
16:30 - 17:00					
17:00 - 17:30					
17:30 - 18:00					Closing
18:00 - 18:30			Guided tour of the city of Málaga		
18:30 - 19:00					
19:00 - 19-30					

03.3.- Detailed development of academic activity

Below is a list of the academic activities carried out during each day at the EURO PhD School.

WEEK 1

Monday 04/11

The first day began with the delivery of materials and accreditations to the participants in the school. The opening session was chaired by the Vice-Rector for Doctoral and Postgraduate Studies at the UMA, Professor Rocío Ponce Ortiz, and also attended by Professor Francisco Ruiz de la Rúa, as Chair of the Organizing Committee of the event, Professor Begoña Vitoriano Villanueva, from Complutense University of Madrid, President of the Spanish Society of Statistics and Operations Research and Coordinator of the National Thematic Network on Multicriteria Decision Making, Mr. Gerardo Lerones Martín, Head of the

Education and Financial Education Area of the Unicaja Foundation and Professor Benjamín del Alcázar Martínez, Dean of the Faculty of Marketing and Management at the UMA.

Fig 4. Collection of Material and Accreditations

Fig 5. Speakers at the Opening Session

Fig 6. Opening Session

Following the opening session, Professor Alessio Ishizaka delivered his theoretical session, entitled *"Introduction to Multiple Criteria Decision Making"*, in which he showed the basics of multicriteria decision making, talked about preference elicitation in decision models, and discussed compensatory and non-compensatory approaches in multicriteria techniques.

Fig 7. Alessio Ishizaka

The remaining two sessions of the day were devoted to forming the working groups and assigning problems. For the first, a classroom dynamic was carried out in which each student introduced themselves and discussed the line of research of their doctoral thesis. Based on this, groups were formed in which their members shared common or similar interests. Subsequently, 7 discrete problems related to sustainability and the Sustainable Development Goals (SDG) were described to the students and each group chose one to work on during the week. The groups began to work on their problems, selecting the alternatives and criteria to consider and collecting the necessary data.

Fig 8. Beginning of the Groups' Work

Tuesday 05/11

Professor José María Moreno's theoretical session was entitled *"The Analytic Hierarchy Process (AHP)"*. In it, the AHP method was presented, referring to the cognitive approach; the basic concepts of this methodology were introduced, and the methodology and some extensions were described in detail, such as the multi-actor case or ANP. In the second session, Professor Moreno described the Expert Choice and Superdecisions software, based on an example of application to the SDG indicators.

Fig 9. José María Moreno

All the supervised training sessions were held in a room where students could sit in groups more easily. In them, they worked on the assigned problems, applying what they had seen in each day's sessions, with the support of the professor who taught the theoretical session and members of the local committee.

Fig 10. Supervised Training in the Study Room

Wednesday 06/11

On the third day, Professor Antonio Jiménez gave the theoretical session entitled *"Multi-Attribute Utility Theory (MAUT)"*. In it, he studied the decision analysis cycle, consisting of problem structuring, determination of alternatives and performances, quantification of preferences, according to utility theory, evaluation of alternatives and sensitivity analysis. The second session was dedicated to the description of the WEB-MAUT-DSS software, developed by researchers from the Technical University of Madrid, and Professor Jiménez provided the students with 8 additional problems to work on with the software described. The groups devoted the afternoon supervised training session to this.

Fig 11. Antonio Jiménez

Thursday 07/11

The fourth day was dedicated to outranking methods, led by Professor Gabriela Fernández, who gave the theoretical session entitled *"The PROMETHEE Methods for Multiple Criteria Decision Aid"*. In it, she discussed the basic principles of our PROMETHEE methods, the extension of the concept of criteria and the improvement relationship and graph, applied to decision making. She also examined the partial and total rankings of PROMETHEE I and II, respectively. In addition, she instructed the students in the use of the Visual Promethee software, using several examples from the field of the SDGs. In the supervised practice sessions, the groups were able to apply PROMETHEE to their respective problems.

Fig 12. Gabriela Fernández

Friday 08/11

The academic activity of the first week concluded on Friday with a poster session, in which the students presented the research topics of their respective doctoral theses. This session was attended by professors Mariano Luque, Laura Delgado and Francisco Martos, all members of the local committee, who provided the students with valuable feedback on their presentations. In addition, an interesting dynamic was created among the students themselves, who were able to observe each other's work and discuss it.

The activity on this day concluded with supervised training sessions in which students were able to review the concepts learned during the week and complete the work on the assigned problems.

Fig 13. Posters Session

WEEK 2

Monday 11/11

The second week of the School was dedicated to the resolution of continuous problems in Multiobjective Programming. In the theoretical session on Monday, Professor Rubén Saborido gave a presentation entitled *"Theoretical Efficient Set – Multiobjective Optimization"*. In it, he presented the basic aspects of the modelling of continuous problems and addressed the problem of generating efficient solutions (posteriori methods). He studied the classical weighting and epsilon constraint methods and went through the main evolutionary multiobjective methods (EMO).

The following session was devoted to the description of the continuous problems that the groups would have to work on during this second week. Afterwards, each group chose its problem, and the supervised training work began with an analysis of the approximation of the efficient frontier, generated by means of evolutionary algorithms.

Fig 14. Rubén Saborido

Tuesday 12/11

The sessions on Tuesday 12th were led by Professor Dylan Jones, who gave the lecture *"Goal Programming: Theory and Applications"*. In it, he outlined the basics of Goal Programming, as well as the traditional approaches: weighted, Chebyshev and lexicographic. In addition, he referred to the most recent extended version and presented applications in the fields of

renewable energy and Arctic security. The supervised training sessions of the day were dedicated to the groups working on their problems using Goal Programming, with the help of the LINGO software.

Fig 15. Dylan Jones

Wednesday 13/11

On Tuesday 11th at night, faced with the threat of torrential rain in Malaga the following day, the rector of the University of Malaga decided to suspend face-to-face activities in all centers. In this situation, the students had to stay in their accommodation, so the organizers decided to change the activities planned for Wednesday to group practice sessions (initially

planned for Thursday 14th). During the hours allocated for the supervised training sessions, the instructors remained available to resolve online any questions that might arise for the work groups. The decision made by the rector of the university turned out to be correct, as the heavy rain caused flooding in many parts of the city.

Fig 16. Floods in Málaga

Thursday 14/11

Unfortunately, the disruption of activity caused by the rain did not end on Wednesday 13th. Given that the alert extended until early Thursday morning, and given the doubts about the state of the buildings at the University of Malaga, the rector decided to suspend face-to-face activity on Thursday as well. For this reason, the School's organization decided that the sessions on the 14th would be held online. In the theoretical session, Professor Kaisa Miettinen gave the talk *"Some Interactive Multiobjective Optimization Methods and the Open Source Software Framework DEDEO"*. In it, she introduced the basic aspects of interactive methods and commented on their classification according to the preferential information requested from the decision-maker. She then studied the reference point methods, Synchronous NIMBUS, Pareto Navigator, NAUTILUS and NAUTILUS Navigator. The talk ended with a series of applications and experiences and the presentation of the DEDEO software. In the first supervised training session, a live demonstration of the use of DEDEO was performed with two of the methods described: NAUTILUS Navigator and Synchronous NUMBUS. During the remainder of this session and the entire second supervised training session, the groups worked on their problems using the interactive methods implemented in DEDEO.

Fig 17. Kaisa Miettinen. Online session.

Friday 15/11

Fortunately, face-to-face activities were able to resume normally on the last day of the School. This day was dedicated to presentations, by the groups, of the work carried out on the different problems assigned, using the different multicriteria techniques learned throughout the two weeks of activity. During the first two sessions (before lunch), the groups presented the discrete problems which they worked on during the first week. This session was chaired by professors Trinidad Gómez and Francisco Ruiz. During the last two sessions (after lunch), the continuous problems were presented, which the groups worked on during the second week. This session was chaired by professors Kaisa Miettinen and Francisco Ruiz.

Fig 18. Presentations. Discrete Problems

Fig 19. Presentations. Continuous Problems

In both cases, each group had 15 minutes to present their presentations and then received feedback from the instructors who chaired the session. In these presentations, the students demonstrated a very satisfactory knowledge of the concepts and techniques learned during the School.

The activities of the Doctoral School ended on Friday 15th with a short closing session in which students and organizers thanked all the parties involved for their effort and dedication during the two intense weeks of work and social activities that made up the program.

Fig 20. Closing Session

03.4.- Social Program

The School's social program consisted of three main activities. During these activities, the students were able to interact and get to know each other better and formed a very friendly group among themselves. The school's organization values these events positively, as they fostered the creation of relationships and networks between the participating students.

Sunday 3/11. Welcome cocktail

The School's social activity began the day before the start of the academic sessions, with a welcome cocktail served at the facilities of the Real Club Mediterráneo in Málaga, where participants were able to taste a variety of classic local gastronomic products. The activity began at 8:00 p.m. and lasted for two hours, during which the students were able to get to know each other and meet some members of the local committee and some of the School's instructors.

Fig 21. Welcome Cocktail

Saturday 9/11. Excursion to Nerja

Probably the most notable event of the social program was the full-day excursion to the town of Nerja in Malaga. A bus took the students directly to the Nerja Cave, one of the most spectacular caves in Spain, a natural geological wonder declared a Site of Cultural Interest in 2006. In addition, the visit was complemented by an immersive visit through a 360º video made using virtual reality glasses. Afterwards, the organizers had planned a lunch served at the Cueva de Nerja Restaurant, on a terrace with sea views.

Fig 22. Visit to the Nerja Cave

Fig 23. Lunch

After lunch, all attendees were able to enjoy a 45-minute Spanish Dance show, performed by a local group of professionals.

Fig 24. Spanish Dance Show

Once the show was over, the students were taken on a tourist train to the city center of Nerja, where they had 90 minutes of free time during which they could visit the main attractions of the town, such as the Balcón de Europa or its beaches. After the visit, the bus took the students back to Málaga.

Fig 25. Tourist train and free time in Nerja

Thursday 14/11. Guided tour of Malaga

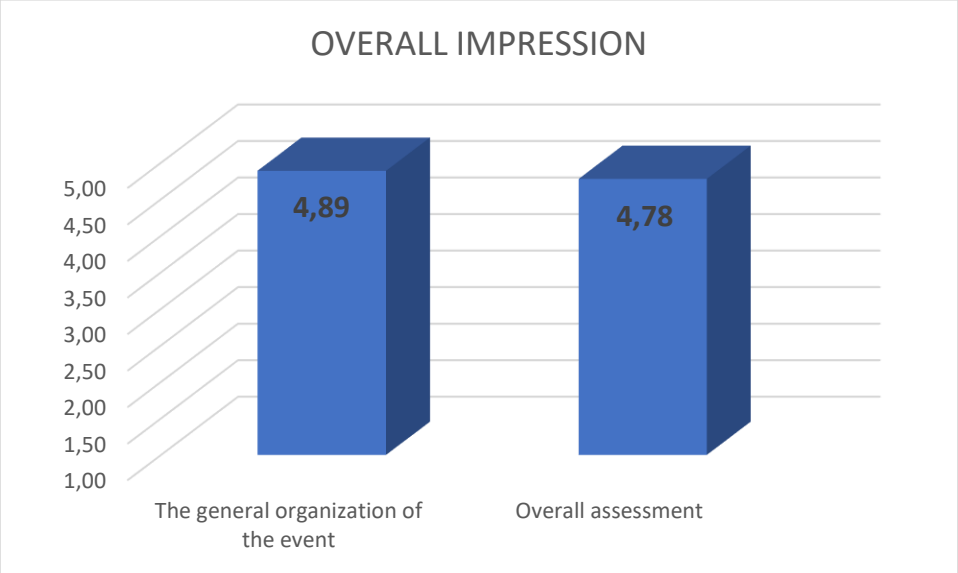
With a day's delay from the initially planned schedule due to rain, the guided walking tour of the center of Malaga took place normally on Thursday 14th. During the visit, the students were able to visit and receive explanations about the main attractions of the city, such as Calle Larios, the Carmen Thyssen Museum, the Cathedral, the Roman Theatre, the Alcazaba or some landmarks related to the Malaga painter Picasso, such as his Birthplace, the Church of Santiago (where he was baptized) or the Picasso Museum.

Fig 26. Guided tour of the center of Malaga

04. Participants' satisfaction

Once the School was over, the participating students were asked to answer a short survey in which they rated its main aspects. Most of the questions were answered using a Likert scale from 1 to 5, with 1 being the worst score and 5 being the best. 27 of the 31 students answered the survey, and these are the average results obtained.

Fig 26. Survey: Overall impression



Two questions were devoted to establishing the students' general impression of the school (Figure 26). The question that asked to rate the general organization of the event obtained an average score of 4.89 out of 5. The general opinion of the PhD School, on the other hand, yielded an average score of 4.78. The answers to these two items reveal a high degree of student satisfaction with the PhD School.

Besides, five questions were asked about the school's scientific and academic program (Figure 27). Students gave the highest scores to the general structure of the scientific program and to the instructors' mastery of the topics covered (4.74 and 4.70, respectively). They also gave high scores to the content of the lectures and the material used in them (4.15 and 4.19, respectively). The lowest score was given to the item that assessed the ease of following the lectures, which still received a high score of almost 4. The different origins and backgrounds of the students may explain this slightly lower score than the others.

Fig 27. Survey: Scientific Program

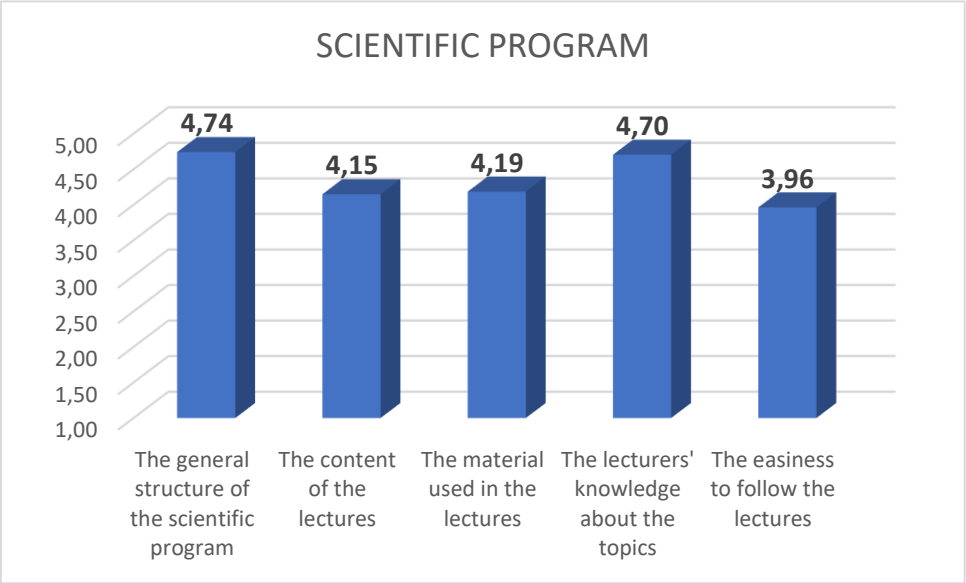
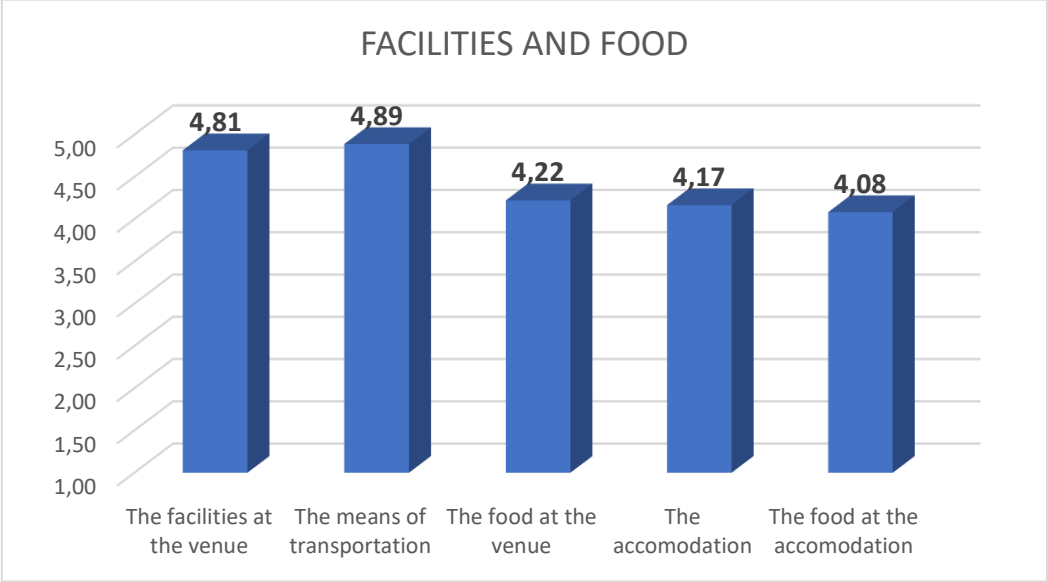


Fig 28. Survey: Facilities and food

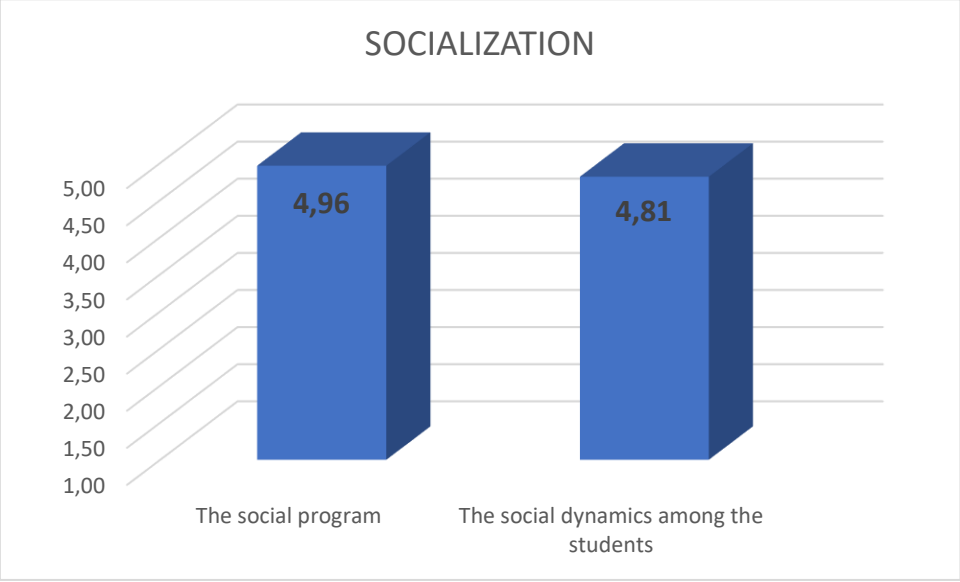


Another block of 5 questions was devoted to the evaluation of the various facilities and services received (Figure 28). The students gave a very high score to the facilities at the venue, at the Faculty of Marketing and Management and to the means of transport provided by the organization (4.81 and 4.89, respectively). The food (lunches and coffees) served at the venue

received an average score of 4.22. The accommodation was rated with a score of 4.17 and the food served there (breakfasts and dinners) obtained a score of 4.08. Considering that it is a hostel, the organization values these scores very positively.

Finally, students rated the aspects related to socialization during the School (Figure 29). The social program received the highest score obtained in all the questions (4.96) and the students also rated very positively (4.81) the social dynamics that arose among the students.

Fig 29. Survey: Socialization



The survey was completed with two open questions. One of them asked the students to say what was the most important piece of knowledge acquired during the School. The answers covered a wide range of topics. While some students valued all the information received on different multicriteria techniques and the different software used, others focused more on specific techniques more oriented to their specific fields of research. In general, all the students stated that they had learned concepts and techniques useful for the development of their doctoral theses. A final question was dedicated to any additional comments that the students wanted to make. Only 13 students answered it, but the answers obtained were extremely satisfactory. Comments such as *"it was an excellent experience, both professional and personal"*, *"I rate this experience with a 10 out of 10… I will never forget it"*, *"the organization was perfect"* or *"there was not a single day or moment when I felt that I should not have come"* make us, the organizers, feel very satisfied. There were also some suggestions for improvement, such as providing the hostel rooms with air conditioning (despite it being November, some students were hot), or using software that allowed data to be imported from spreadsheets. In this regard, the

organization opted for free and easy-to-use software, which did not require prior knowledge or programming skills. In any case, the design of specific software remains an issue to be taken into account. Another student suggested the documentation (material and presentations) to be sent before the start of the School, in order to make better use of the instructors' sessions. This is an interesting suggestion for other editions, although it requires the commitment of all instructors to have the material available in advance.

05. Diffusion

The event organizers have made an effort to publicize the school's activities, which began prior to the event, with the distribution of the flyer through various channels and distribution lists (EURO, International Society for Multicriteria Decision Making, Spanish Society of Statistics and Operational Research, other national societies, etc.). This document (Figure 30) contained basic information on the structure of the school, faculty, activities, dates and sponsors. On the other hand, during the event, an advertising poster was used, which was displayed in different places in the venues (Figure 31), as well as a roll-up, with a very similar design, which was visible in all the sessions of the event. In addition, all the School's material, such as certificates (Figure 32) and accreditations (Figure 33), were designed in a homogeneous way to the poster, including the main sponsors.

Fig 30. School Flyer

EURO PhD SCHOOL on Multiple Criteria Decision Making Methodologies and Applications to the Sustainable Development Goals

Practical information

- Web page: http://eventos.uma.es/go/EUROPhD2024
- Dates: November 4 - 15, 2024
- Location: Facultad de Marketing y Gestión, Universidad de Malaga - Campus de Teatinos. 29071, Malaga (Spain)
- Application deadline: July 17, 2024
- Notification of acceptance: September 13, 2024
- Maximum number of participants: 30
- ECTS Credits: 3 → 75 hours
  - Classes: 2-3 hours/day; Supervised training: 2-3 hours/day; Personal work: 2.5 hours/day
- An activity of the PhD Programme in Economics and Business, University of Malaga (Spain)

Contents

The aim of the PhD School is to introduce students in discrete and continous Multiple Criteria Decision Making problems and their applications. To this end, contents are as follows:

1. Basic Concepts on Multiple Criteria Decision Making
2. Discrete Multicriteria methods: MAUT, AHP and outranking methods
3. Group Decision Making
4. Continuous problems: generating the efficient set
5. Goal Programming
6. Interactive methods

Provisional timetable

- Classes: 9:30h - 11:30h
- Supervised training: 12:00h - 13:30h & 15:00h - 16:30h
- Personal work: 16:30h - 19:30h

Week 1 - Discrete MCDM methods	
Day 1	Opening session.Introduction to MCDM problems
Day 2	Analytic Hierarchy Process
Day 3	Multi-Attribute Utility/Value Theory
Day 4	Outranking methods
Day 5	Posters Session

Week 2 - Continuous MCDM methods

Day 1	Efficiency analysis
Day 2	Goal Programming
Day 3	Reference point and interactive Methods
Day 4	Caseworks
Day 5	Presentations of discrete and continuous caseworks

Sponsors

- Theme Net on Multiple Criteria Decision Making (RED2022-134540-T), financed by MICIU/AEI/10.13039/501100011033
- Fundación Unicaja
- Sociedad Española de Estadística e Investigación Operativa (SEIO)
- Research projects PID2020-115429GB-I00 & PID2022-139543OB-C42, financed by MICIU/AEI/10.13039/501100011033
- Asociación Española de Profesores Universitarios de Matemáticas para la Economía y la Empresa (ASEPUMA)
- Málaga Convention Bureau
- Metro Málaga
- PhD Program in economy and Business, University of Málaga

Contact

- Chair: FRANCISCO RUIZ
  - Address: FACULTAD DE MARKETING Y GESTIÓN. UNIVERSIDAD DE MÁLAGA CAMPUS DE TEATINOS. 29071 MÁLAGA (SPAIN)
  - Phone: +34 951952020
  - E-mail: rua@uma.es

Scientific Committee

- AMELIA MARÍA BILBAO. Co-chair. (University of Oviedo, Spain)
- ANTONIO JIMÉNEZ. Co-chair. (Technical University of Madrid, Spain)
- ALESSIO ISHIZAKA (NEOMA Business School, France)
- AMPARO MÁRMOL (University of Sevilla, Spain)
- KAISA MIETTINEN (University of Jyväskylä, Finland)
- JOSÉ MARÍA MORENO (University of Zaragoza, Spain)
- FRANCISCO RUIZ (University of Málaga, Spain)
- BEGOÑA VITORIANO (University Complutense of Madrid, Spain)

Instructors

- LAURA DELGADO ANTEQUERA - University of Malaga, Spain
- SAMIRA EL GIBARI BEN SAID - University of Malaga, Spain
- GABRIELA FERNÁNDEZ BARBERIS – University San Pablo CEU, Spain
- SANDRA GONZALEZ GALLARDO - University of Malaga, Spain
- ALESSIO ISHIZAKA - NEOMA Business School, France
- ANTONIO JIMÉNEZ - Technical University of Madrid, Spain
- DYLAN JONES - University of Portsmouth, UK
- KAISA MIETTINEN - University of Jyväskylä, Finland
- JOSÉ MARÍA MORENO - University of Zaragoza, Spain
- FRANCISCO RUIZ - University of Malaga, Spain

Methodology

- Students will work in groups
- Two different problems (caseworks) will be assigned to each group on Day 1
- Students will work on the assigned problems throughout the course, following each day this scheme:
  - 2-3 hours of theoretical classes where new concepts and methods are introduced
  - 2-3 hours of supervised training in a computing classroom
  - 2.5 hours of personal work
- The problems will belong to different fields, especially focused on sustainability problems

Terms & conditions

1. **Admission**: To apply to the EPS, candidates from a EURO member society country, or studying in a EURO member society country, should submit the following information to rua@uma.es:
   - curriculum vitae (including their academic track record)
   - a letter outlining their motivation to attend
   - a letter of recommendation from their supervisor
2. **Financial arrangements**: Registration fee → 200 €
   - All living costs (accommodation, meals, and travel within school activities) are supported by the EPS. No insurance will cover the participants
   - Travel costs should be covered by the participants
3. **Accomodation**:
   - Accommodation is provided in Albergue Inturjoven Málaga (Address: Plaza Pío XII, 6, 29007 Málaga)
4. **Social activities**:
   - Activities such as meals, tourist visits etc. will be organised for the participants (free of charge) in order to stimulate friendly relations

Fig 31. Poster and roll-up design

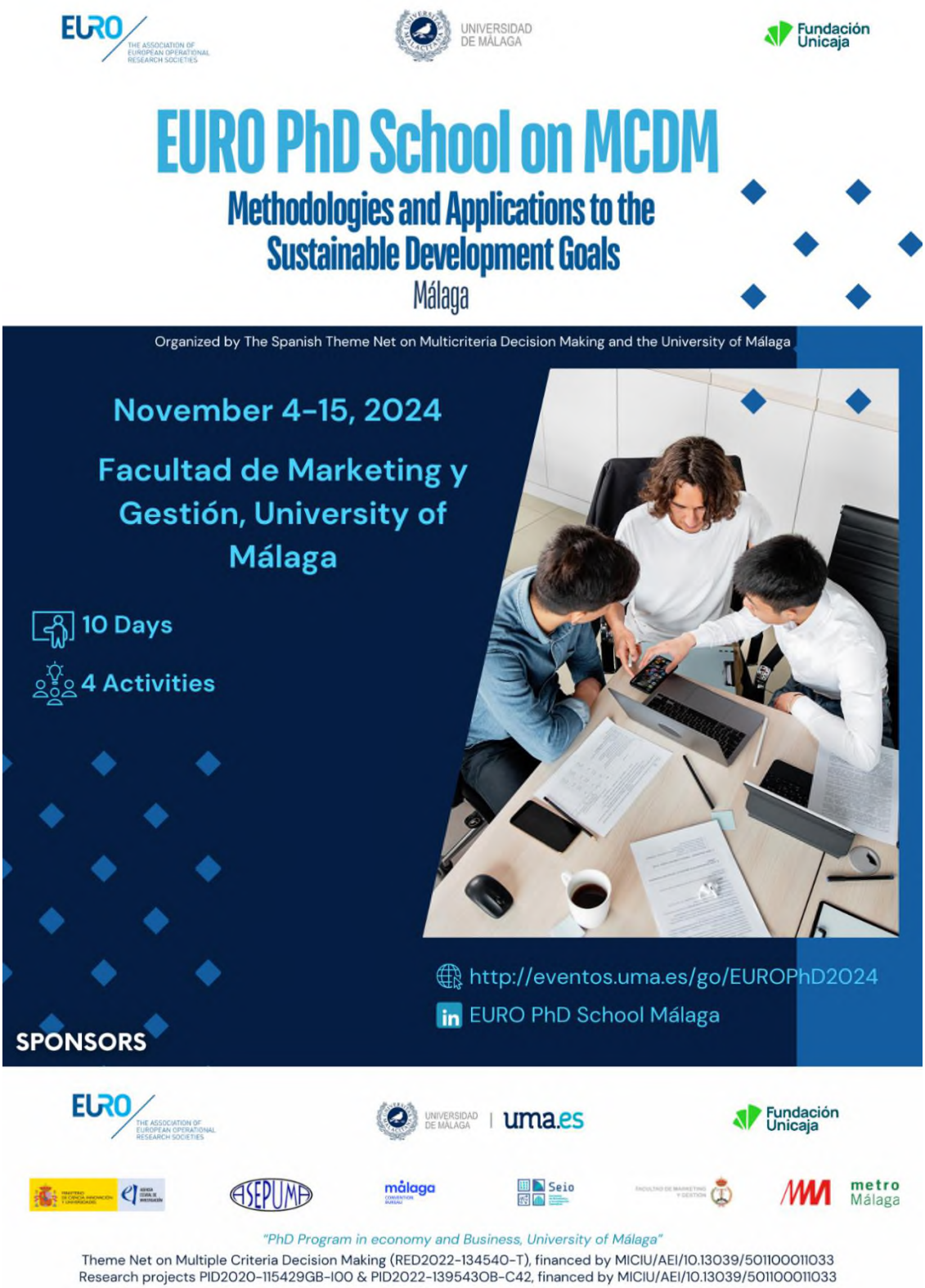


Fig 32. Certificate template

Fig 33. Accreditation model.

The news about the opening session of the School appeared published both on the main page of the University of Malaga (Figure 34), and on the page of the Faculty of Marketing and Management (Figure 35).

Fig 34. News on the main page of the UMA

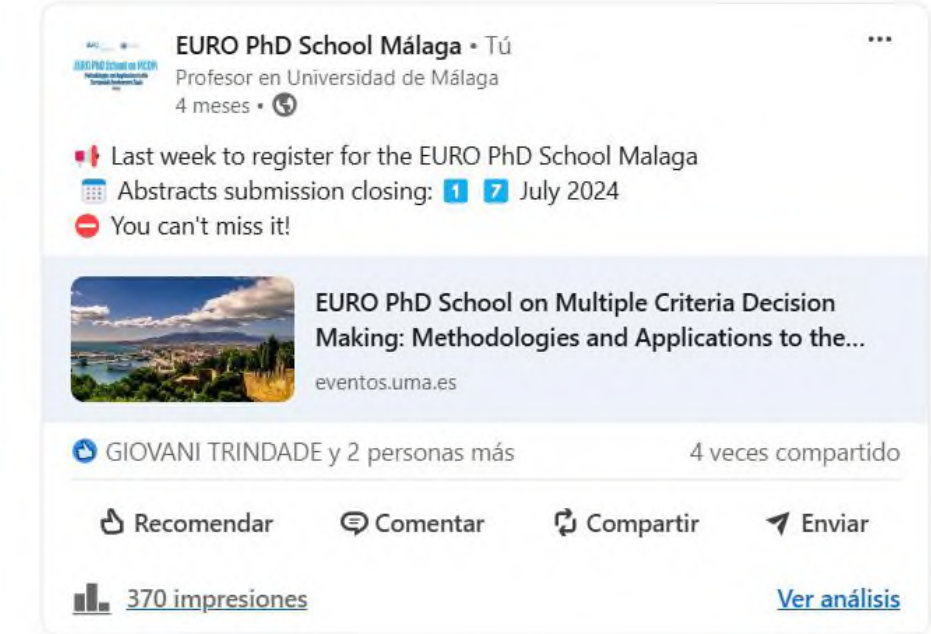
https://www.uma.es/sala-de-prensa/noticias/31-estudiantes-de-doctorado-de-toda-europa-participan-en-la-uma-en-un-encuentro/

Fig 35. News on the Faculty of Marketing and Management website

https://www.uma.es/facultadmarketing/noticias/sesion-de-apertura-de-la-euro-phd-school-celebrada-en-la-facultad-de-marketing-y-gestion/

All the activity of the Doctoral School has been disseminated through the School's LinkedIn account (EURO PhD School Malaga). Below are some screenshots of posts on this social network, as well as posts by some students on their LinkedIn profiles.

Fig 36. LinkedIn Activity (1/8)



	WEEK 2				
	Monday 11/11	Tuesday 12/11	Wednesday 13/11	Thursday 14/11	Friday 15/11
9:00 - 9:30	Theoretical Efficient Set (A.B. Ruiz)	Theoretical Goal Programming 1 (D. Jones)	Theoretical Reference Point & Interactive M. (K. Miettinen)	Supervised Training	Presentations Discrete 1
9:30 - 10:00					
10:00 - 10:30					
10:30 - 11:00					
11:00 - 11:30	Coffee Break	Coffee Break	Coffee Break	Coffee Break	Coffee Break
11:30 - 12:00		Theoretical Goal	Supervised	Supervised	Presentations

Fig 38. LinkedIn Activity (2/8)

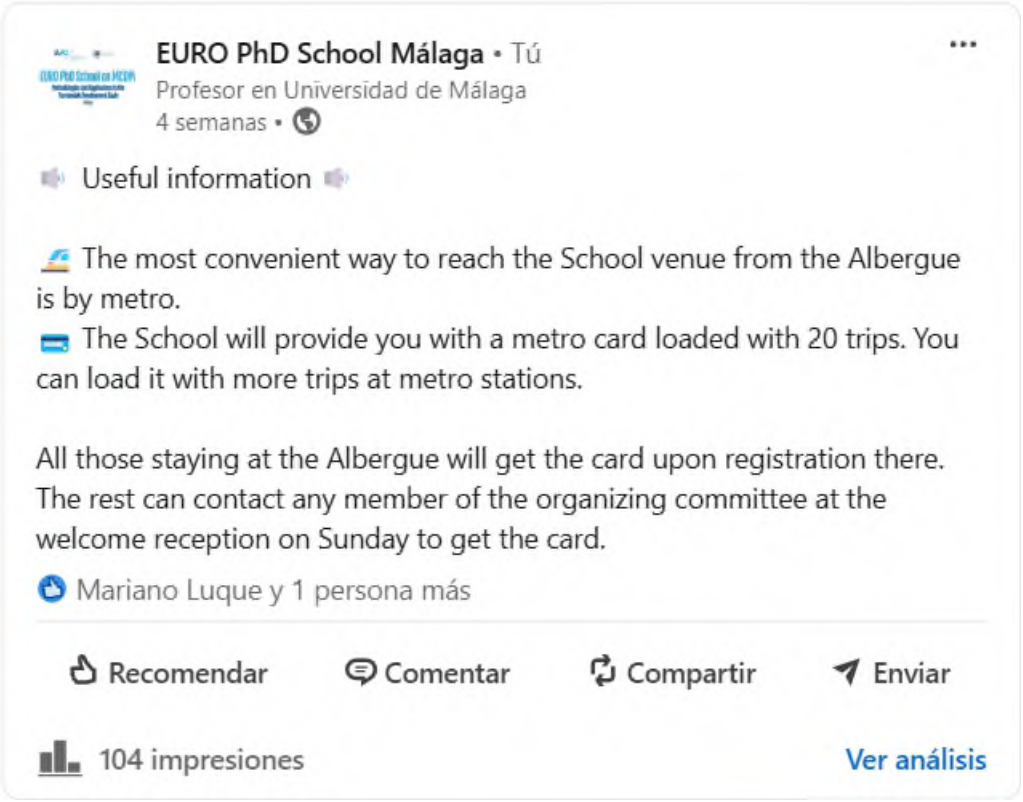


Fig 39. LinkedIn Activity (3/8)

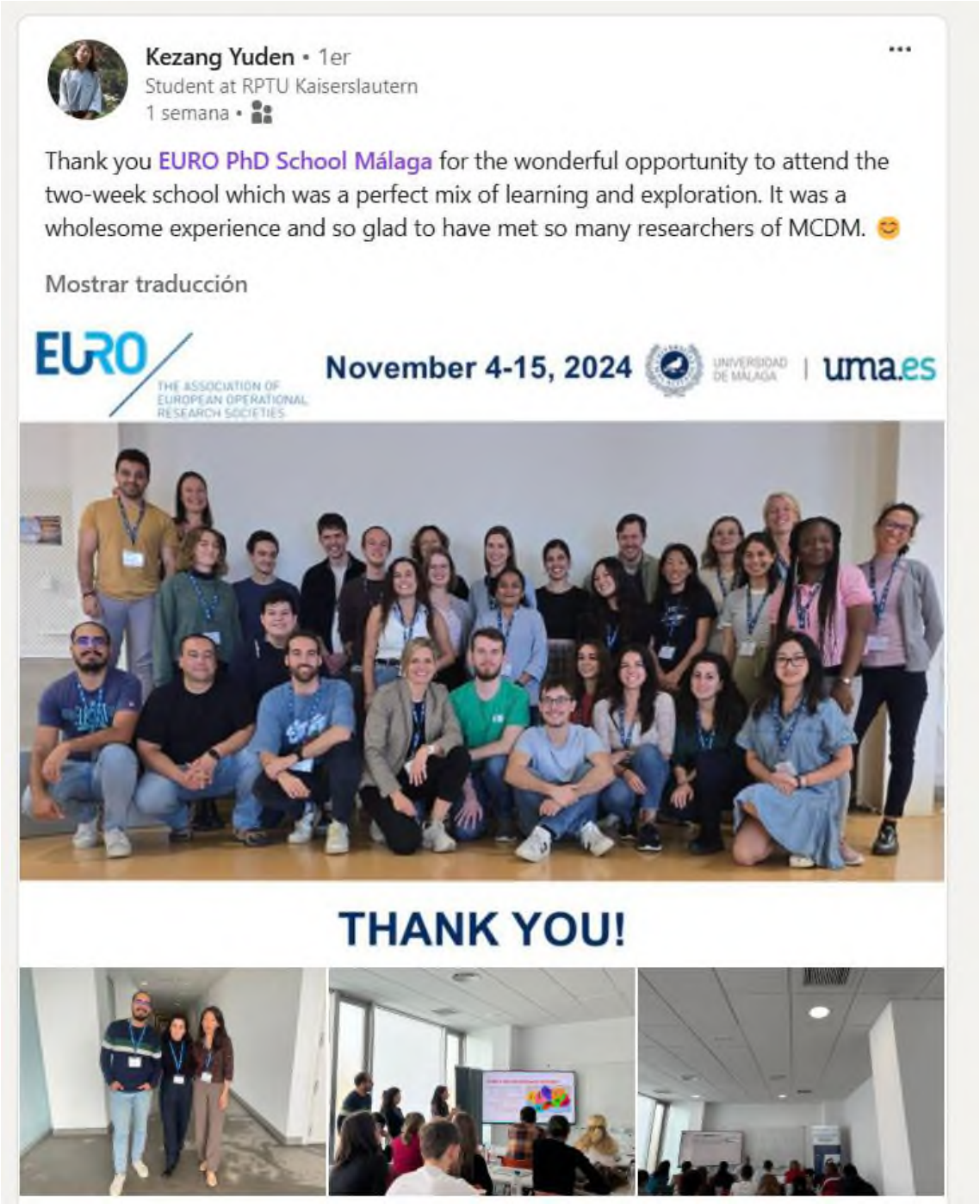
Fig 40. LinkedIn Activity (4/8)

Fig 41. LinkedIn Activity (5/8)

Fig 42. LinkedIn Activity (6/8)

Fig 43. LinkedIn Activity (7/8)

Fig 44. LinkedIn Activity (8/8)



06. Economic report

In addition to EURO's contribution to the realization of this PhD School, the organization has received financial support from the Spanish Thematic Network of Multicriteria Decision Making, the Unicaja Foundation, the University of Malaga, the Spanish Society of Statistics and Operations Research (SEIO) and the Spanish Association of University Professors of Mathematics for Economics and Business (ASEPUMA). In addition, there has been collaboration from the Faculty of Marketing and Management, which has provided the spaces and infrastructure necessary for the organization of the event, as well as from the Malaga Convention Bureau, which has provided details for the speakers and discounts for visits to monuments and attractions in the city, Metro Malaga, which has subsidized transportation costs, and the Doctoral Program in Economics and Business of the UMA, which has contributed with some material costs. This has allowed us to provide various services to those attending the meeting and to design an attractive social program. The following two tables show, respectively, the expenses and income of the School, classified by concept.

Table 1. EURO PhD School Expenses

EXPENSES	
Concept	**Amount**
Accommodation for students in half board	14.882,00
Luches and Coffee-breaks	5.074,20
Teachers' trips	3.460,68
Accommodation for teachers	2.886,25
Daily allowances for teachers	1.500,00
Payments of teachers' talks	3.000,00
Material, printing and signage	987,26
Social Program	6.622,42
Photographer	600,00
Transportation	1.520,00
Representation expenses	1.532,80
Technical Secretariat	1.630,00
TOTAL	43.695,61

Table 2. EURO PhD School Income

INCOME	
Concept	**Amount**
EURO	15.000,00
Thematic Network on MCDM	7.336,61
University of Málaga	4.000,00
Registration Fees	8.384,00
Spanish Society of Statistics and OR	2.500,00
Unicaja Foundation	5.675,00
ASEPUMA	800,00
TOTAL	43.695,61

07. Sponsors

The EURO PhD School has had the privilege of having the following sponsors, to whom the organization would like to express its most sincere gratitude:

Tabla 3. Sponsors of the EURO PhD School

LOGO	SPONSOR	WEBSITE
	EURO. The Association of European Operational Research Societies	www.euro-online.org
	Spanish Thematic Network in Multicriteria Decision Making	http://multicriterio.es/redMCDM.html
	University of Málaga	www.uma.es
	Unicaja Foundation	https://www.fundacionunicaja.com
	Faculty of Marketing and Management	www.uma.es/facultadmarketing

Seio	Spanish Society of Statistics and Operations Research (through Working Group on Multicriteria Decision Making)	www.seio.es
ASEPUMA	Spanish Association of University Professors of Mathematics for Economics and Business	www.asepuma.org
málaga CONVENTION BUREAU	Malaga Convention Bureau	https://visita.malaga.eu/convention-bureau
metro Málaga	Metro Málaga	https://metromalaga.es/
E&B uma.es	PhD Program in Economics and Business at the University of Malaga	https://www.uma.es/doctorado-economia/

Málaga, December 9th, 2024

Francisco Ruiz

Chair of the Local Organizing Committee