

### Contact details

Address Department of Statistics and Operations Research, Faculty of Mathematics, University of Seville  
Av. Reina Mercedes, s/n, 41012, Seville, Spain

Birth June 6, 1994

Telephone +34 678 321 938

E-mail mmolero@us.es

Others GoogleScholar | LinkedIn | ResearchGate | Twitter

### Education

Since Oct 2017 **Ph.D. Studies in Mathematics**  
Title: "Enhancing Classification and Regression Tree-Based Models by Means of Mathematical Optimization".  
Supervisors: R. Blanquero, E. Carrizosa and D. Romero Morales. Expected date of graduation: Mid 2022

2016–2017 **Master's Degree in Mathematics (60 ECTS Credits)**, *University of Seville*

2012 –2016 **Bachelor's Degree in Mathematics (240 ECTS Credits)**, *University of Seville*  
Bachelor's thesis with honors

### Grants and Scholarships

Mar 2020 **IFORS/EURO double grant to attend XIX ELAVIO 2020 XXIV Latin-American Summer School on Operations Research (ELAVIO2020)**  
Selected candidate by the Spanish Society of Statistics and Operations Research (SEIO), and among the European Statistics and Operations Research Societies (EURO)  
Funding Body: EURO and IFORS

Jan 2020 **Grant to attend EURO PhD School Data Driven Decision Making and Optimization**  
Funding Body: IMUS and NeEDS project

Feb 2020 – Feb 2024 **University of Seville Ph.D. Fellowship (VI Plan Propio de Investigación y Transferencia de la Universidad de Sevilla) in the Department of Statistics and Operations Research**  
Funding Body: *University of Seville*

Feb 2017 – Apr 2017 **Research initiation grant for MSc students at IMUS**, *University of Seville*  
Funding Body: *Fundación de Investigación de la Universidad de Sevilla (FIUS)*

Oct 2015 – Jun 2016 **Research collaboration grant for BSc students in the Department of Statistics and Operations Research**, *University of Seville*  
Funding Body: *Spanish Ministry of Education, Science and Sports*

### Professional activities

Since Feb 2020 **Doctoral Candidate at the Department of Statistics and Operations Research**, *University of Seville*

Feb 2019 - Feb 2020 **Interim Professor at the Department of Statistics and Operations Research**, *University of Seville*

Nov 2018 - Feb 2019 **Interim Professor at Escuela Universitaria de Osuna**, *University of Seville*

Oct 2018 - Feb 2019 **Researcher under contract in project Mathematical Optimization for Data Visualization and Decision Making (MTM2015-65915-R)**, *University of Seville*

- Jul 2017 - **Researcher under contract in project Cost-sensitive classification. A mathematical optimization approach. COSECLA. (FUNDBBVA/016/005), University of Seville**  
Sep 2018
- Dec 2016 - **Researcher under contract in project Metaheuristics for model selection in the context of portfolio optimization, University of Edinburgh**  
Jan 2017 &
- Aug 2015 -  
Sep 2015

## Transfer of knowledge

- Since Apr 2020 **Researcher in project entitled “Situación vacunal e inmunogenicidad a largo plazo en una cohorte de pacientes con enfermedades reumáticas en un hospital terciario de España”, Instituto de Investigación Sanitaria La Fe - Fundación de Investigación de la Universidad de Sevilla (FIUS) - IMUS, with Principal Investigators: Dr. Rafael Blanquero and Dr. Inmaculada Barranco-Chamorro**
- Mar 2020 - **Researcher in project entitled “Acción matemática contra el coronavirus”, Spanish Committee for Mathematics (CEMat)**  
May 2020
- Jul 2016 - **Researcher in project entitled “Ciencia de los Datos en Universal Diagnostics”, UNIVERSAL DX - Fundación de Investigación de la Universidad de Sevilla (FIUS) - IMUS. University of Seville, with Principal Investigator: Dr. Emilio Carrizosa**  
Sep 2016

## Research

### Publications

- On sparse optimal regression trees**, *Rafael Blanquero, Emilio Carrizosa, Cristina Molero-Río, Dolores Romero Morales*, *European Journal of Operational Research*, 299 (3), pp. 1045-1054 (2022)
- Mathematical optimization in classification and regression trees**, *Emilio Carrizosa, Cristina Molero-Río, Dolores Romero Morales*, *TOP*, 29 (1), pp. 5-33 (2021)
- On Sparse Ensemble Methods: An Application to Short-Term Predictions of the Evolution of COVID-19**, *Sandra Benítez-Peña, Emilio Carrizosa, Vanesa Guerrero, M. Dolores Jiménez-Gamero, Belén Martín-Barragán, Cristina Molero-Río, Pepa Ramírez Cobo, Dolores Romero Morales, M. Remedios Sillero-Denamiel*, *European Journal of Operational Research*, 295 (2), pp. 648-663 (2021)
- Optimal randomized classification trees**, *Rafael Blanquero, Emilio Carrizosa, Cristina Molero-Río, Dolores Romero Morales*, *Computers & Operations Research*, 132, pp. 105281 (2021)
- Sparsity in Optimal Randomized Classification Trees**, *Rafael Blanquero, Emilio Carrizosa, Cristina Molero-Río, Dolores Romero Morales*, *European Journal of Operational Research*, 284 (1), pp. 255-272 (2020)

### Preprints

- On optimal regression trees to detect critical intervals for multivariate functional data**, *Rafael Blanquero, Emilio Carrizosa, Cristina Molero-Río, Dolores Romero Morales*

### Working papers

- Optimized Rule Sets**, *Cristina Molero-Río, Cynthia Rudin, Tong Wang*

## Invited & contributed talks presented

- Mar 2022 **On fair and explainable optimal regression trees**  
Data Science and Optimization Webinar - EURO WISDOM FORUM (virtual)
- Nov 2021 **Optimal Decision Trees for Complex Data**  
New Bridges between Mathematics and Data Science (NBMDs2021), Valladolid, Spain
- Jul 2021 **Optimal Decision Trees at the service of Functional Data Analysis**  
31st European Conference on Operational Research (EURO2021), Athens, Greece (virtual)
- Jun 2021 **On the optimization of classification and regression trees**  
ECON Brown Bag Seminar - Copenhagen Business School, Copenhagen, Denmark (virtual)
- Apr 2021 **Fair Optimal Randomized Regression Trees**  
3rd IMA and OR Society Conference on Mathematics of Operational Research, Essex, United Kingdom (virtual)

- Feb 2021 **Mathematical optimization in classification and regression trees**  
YOUNG Online Seminar Series Machine Learning NeEDS Mathematical Optimization, IMUS, Seville, Spain (virtual)
- May 2020 **On Sparse Ensemble Methods: An Application to Short-Term Predictions of the Evolution of COVID-19**  
Online seminar *Matemáticas y la COVID*, IMUS, Sevilla, Spain (virtual)
- Sep 2019 **On the Optimization of Regression Trees**  
NeEDS Workshop “On the Latest Advances in Machine Learning to Deal with Complex Data”, Copenhagen Business School, Frederiksberg, Denmark
- Sep 2019 **Optimal Regression Trees**  
XXXVIII Congreso Nacional de Estadística e Investigación Operativa (SEIO), University of Oviedo, Alcoi, Spain
- Jun 2019 **On the construction of Optimal Randomized Regression Trees**  
30th European Conference on Operational Research (EURO2019), Dublin, Ireland
- Jun 2019 **Optimal Randomized Decision Trees**  
2nd Young Statisticians and Operational Researchers Meeting (SYSORM), Real Centro Universitario Escorial - María Cristina (UCM), San Lorenzo de El Escorial, Madrid, Spain
- May 2019 **On the construction of decision trees via mathematical optimization**  
The First EUROYoung Workshop, IMUS, Seville, Spain
- Mar 2019 **Optimal and flexible classification trees**  
Ph.D. Seminar organized by the Mathematical Research Institute of the University of Seville (IMUS), Seville, Spain
- Nov 2018 **Optimal classification trees**  
Escuela de Invierno de la Red de Métodos Inteligentes en Optimización Heurística, Universitat de València (UV), Valencia, Spain
- Sep 2018 **Sparsity on Optimal Randomized Classification Trees**  
Workshop on Data Science, Mathematical Research Institute of the University of Seville (IMUS), Seville, Spain
- Jul 2018 **Continuous Optimization for Randomized Classification Trees**  
16th EUROPT Workshop on Advances in Continuous Optimization (EUROPT2018), Almería, Spain
- Jul 2018 **On the construction of optimal randomized classification trees**  
29th European Conference on Operational Research (EURO2018), Valencia, Spain
- Jul 2018 **Optimizing classification trees via non-linear continuous optimization**  
International Symposium in Mathematical Programming, Bordeaux, France
- Jun 2018 **Optimal Randomized Classification Trees**  
Summer School on “Operations Research and Machine Learning”, La Villa Clythia - CAES du CNRS, Fréjus, France
- May 2018 **Optimal Oblique Classification Trees**  
XXXVII Congreso Nacional de Estadística e Investigación Operativa (SEIO), University of Oviedo, Oviedo, Spain
- Oct 2017 **Supervised Classification: Random Forests**  
Ph.D. Seminar organized by the Mathematical Research Institute of the University of Seville (IMUS), Seville, Spain

## Workshops and courses attended

- Sep 2021 **Optimización al servicio de la Transparencia: Abriendo cajas negras en Inteligencia Artificial**  
Speaker: Dolores Romero Morales - Doctoral Program Mathematics and the Mathematical Research Institute of the University of Seville (IMUS), Seville, Spain (virtual)
- Jun 2021 **Jornadas SEIO 2021 de la Sociedad de Estadística e Investigación Operativa**  
University of Granada (UGR), Granada, Spain (virtual)
- Oct 2020 **Workshop Análisis Estructural de Redes Complejas: Teoría y aplicaciones**  
Speaker: Miguel Romance del Río - Doctoral Program of Mathematics and the Institute of Mathematics of the University of Seville (IMUS), Seville, Spain (virtual)
- Oct 2020 **Autumn School on Bilevel Optimization**  
University of Trier, Trier, Germany (virtual)
- Dec 2019 **Jornada de Optimización Matemática y Ciencias de los Datos: modelos y aplicaciones**  
Doctoral Program Mathematics and the Mathematical Research Institute of the University of Seville (IMUS), Seville, Spain

- Jul 2019 **ECMI Postgraduate/VI Iberian/NeEDS MODELLING WEEK**  
Mathematical Research Institute of the University of Seville (IMUS), Seville, Spain
- Nov 2018 **Escuela de Invierno de la Red de Métodos Inteligentes en Optimización Heurística**  
Speakers: Rafa Martí, Óscar Cordón, Jesús Sánchez-Oro and Rubén Ruiz - UV, Valencia, Spain
- Oct 2018 - **Optimization: Stochastic programming and decomposition techniques**  
Nov 2018 Speakers: Francisco Saldanha and Ivana Ljubic - IMUS, Seville, Spain
- Sep 2018 **An introduction on Arc Routing**  
Speaker: Gilbert Laporte - IMUS, Seville, Spain
- Sep 2018 **Modeling Week on Data Driven Decision Making and Optimization**  
Copenhagen Business School, COST Action MI-NET (TD1409), The Association of European Operational Research Societies (EURO), Copenhagen, Denmark
- Jun 2018 **Summer School on “Operations Research and Machine Learning”**  
Speakers: Sébastien Bubeck, Andrea Lodi and Yinyu Ye - La Villa Clythia - CAES du CNRS, Fréjus, France
- Mar 2018 **Version Control Systems for Mathematical Researchers**  
Speaker: Pedro Vicente Gómez Sánchez (KARUMI) - Doctoral Program Mathematics and the Mathematical Research Institute of the University of Seville (IMUS), Seville, Spain
- Feb 2018 **Modelado y Programación en SCIP**  
Speakers: Stefano Benati and Diego Ponce - IMUS, Seville, Spain
- Nov 2017 **Optimization**  
Speaker: Stefano Benati - IMUS, Seville, Spain
- Oct 2017 **Methods and Algorithms for Optimization in Public Transport**  
Speakers: Raymond Kwan, Miguel A. Pozo, Alicia De los Santos, Martine Labbé, David de Almeida, Matthias Mülller-Hanneman, Mozart Menezes and Laureano Escudero - IMUS, Seville, Spain
- May 2017 **Un algoritmo para la reposición y redistribución de inventarios**  
Speaker: Julio González Díaz - IMUS, Seville, Spain
- Apr 2017 **The complexity of simple models - a study of worst and typical hard cases of the StQP**  
Speaker: Immanuel Bomze - IMUS, Seville, Spain
- Jan 2017 **Avances en problemas de logística y problemas de rutas. Modelos con uno o varios objetivos**  
Speakers: Vladimir Marianov, Martin Gairing and Daniele Vigo - IMUS, Seville, Spain
- Dec 2016 **Optimization**  
Speakers: Ángel Corberán Salvador, Alfredo Norberto Marín Pérez, Antonio Manuel Rodríguez Chía, Juan Francisco Monge Ivars and Víctor Blanco Izquierdo - IMUS, Seville, Spain
- Nov 2016 **Lifetime Regression Models**  
Speaker: Chrysseis Caroni - IMUS, Seville, Spain
- Nov 2016 **Análisis de Big Data: retos y oportunidades**  
Speaker: Daniel Peña Sánchez de Rivera - IMUS, Seville, Spain
- Oct 2016 **Técnicas estadísticas en bioinformática**  
Speaker: Sonia Tarazona Campos - IMUS, Seville, Spain
- Oct 2015 **Técnicas Predictivas en Estadística: Aplicaciones en Kaggle**  
Speaker: José Antonio Guerrero Durán - IMUS, Seville, Spain

## Research projects

- Jan 2022 - **Mathematical Optimization in Data Science: Towards Interpretability in Classification, Regression and Dimensionality Reduction (US-1381178)**  
Dec 2022 Funded by: Junta de Andalucía, Andalusian Government  
Principal Investigator: Dr. Emilio Carrizosa
- Jan 2020 - **Mathematical Optimization for Data-Driven Decision-Making (PID2019-110886RB-I00)**  
Dec 2022 Funded by: Ministry of Science and Innovation, Spanish Government  
Principal Investigators: Dr. Emilio Carrizosa and Dr. Rafael Blanquero
- Jan 2020 - **Data Science: from mathematical modelling to mathematical optimization (P18-FR-2369)**  
Dec 2022 Funded by: Junta de Andalucía, Andalusian Government  
Principal Investigators: Dr. Emilio Carrizosa and Dr. Rafael Blanquero

- Jan 2019 - **Research and Innovation Staff Exchange Network of European Data Scientists - NeEDS (H2020-822214)**, *Member of the Steering Board as Early Career Researcher*  
 Dec 2022  
 Funded by: Marie Skłodowska-Curie Actions, European Union's Horizon 2020  
 Project Coordinator: Dr. Dolores Romero Morales
- Sep 2016 - **Cost-sensitive classification. A mathematical optimization approach. COSECLA. (FUNDBBVA/016/005)**  
 Aug 2018  
 Funded by: BBVA Foundation  
 Principal Investigator: Dr. Emilio Carrizosa
- Jan 2016 - **Mathematical Optimization for Data Visualization and Decision Making (MTM2015-65915-R)**  
 Dec 2019  
 Funded by: Ministry of Economy and Competitiveness, Spanish Government  
 Principal Investigators: Dr. Emilio Carrizosa and Dr. Rafael Blanquero
- Aug 2015 - **Metaheuristics for model selection in the context of portfolio optimization**  
 Jun 2017  
 Funded by: The University of Edinburgh Business School  
 Principal Investigator: Belén Martín-Barragán

## Teaching experience

- 2021/2022 **International University of Andalusia (UNIA)**  
 Fundamentals of Quantitative Methods, 13 hours (MSc in Big Data, virtual)
- University of Seville**  
 Statistical Methods in Criminology Research, 30 hours (BSc in Criminology)  
 Statistics applied to Biology, 30 hours (BSc in Biology)
- 2020/2021 **University of Granada**  
 Árboles de decisión: de lo clásico a lo óptimo in *Optimization days* seminar, 2 hours (MSc in Mathematics, virtual)
- International University of Andalusia (UNIA)**  
 Fundamentals of Quantitative Methods, 13 hours (MSc in Big Data, virtual)
- University of Seville**  
 Statistical Methods in Criminology Research, 30 hours (BSc in Criminology, virtual)
- 2019/2020 **University of Seville**  
 Statistical Methods in Criminology Research, 30 hours (BSc in Criminology, virtual)  
 Statistical Inference, 12 hours (Double BSc in Physics and Mathematics/Double BSc in Mathematics and Statistics/BSc in Mathematics)  
 Statistics applied to Biology, 32 hours (BSc in Biology)  
 Statistics, 30 hours (BSc in Computer Sciences)
- 2018/2019 **University of Seville**  
 Statistics, 68 hours (Double BSc in Physiotherapy and Sports Science/BSc in Sports Science)  
 Statistics, 30 hours (BSc in Computer Sciences)  
 Quantitative and Qualitative Data Analysis, 30 hours (BSc in Criminology)
- Escuela Universitaria de Osuna, University of Seville**  
 Statistics, 60 hours (BSc in Labor Relations and Human Resources)
- University of Granada**  
 Optimal Decision Trees in *Alternative fitting models to Ordinary Least Squares* activity, 2 hours (Ph.D. Program in Economics and Business)

## Dissemination and outreach

- Since Mar 2022 **Participant at the outreach activity Una científica en tu cole andaluz**  
 Organized by AMIT Andalucía, Seville, Spain
- Feb 2022 **Participant at the outreach activity Mujeres en la Ciencia**  
 Organized by IES Virgen de Valme, Seville, Spain
- Nov 2021 **Participant at the outreach activity Three Minute Thesis Competition**  
 Organized by the International Doctoral School of the University of Seville (EIDUS), Seville, Spain
- Nov 2021 **Participant at the outreach activity Science is wonderful!**  
 Organized by Marie Skłodowska-Curie Actions, European Union's Horizon 2020 (virtual).

- Since Aug 2021 **Co-organizer of the stream Machine Learning and Mathematical Optimization within the area of Data Science and Analytics at EURO2022 Conference**
- May 2021 **Participant at XXV Salón de Estudiantes y Ferisport and III Salón de Posgrado**  
Organized by Área de Orientación Universitaria y Participación Estudiantil del Vicerrectorado de Estudiantes de la Universidad de Sevilla, Seville, Spain (virtual)
- Mar 2021 **Dissemination lecture “¿Quién quiere ser millonario?”**  
Mujeres Matemáticas Martes de Marzo M<sup>4</sup>, Organized by IMUS and Ciencia en Bulebar, Seville, Spain
- Since Jan 2021 **Co-organizer of the IMUS Online Seminars Series Machine Learning NeEDS Mathematical Optimization**
- Oct 2020 - Sep 2021 **Co-organizer of Ph.D. Seminar at IMUS**
- Nov 2018 **Volunteer in dissemination activities during the Science Week at IMUS**

## Academic visits

- Since Mar 2022 **Duke University**, Visiting Ph.D. Student at the Department of Computer Science, Durham, NC, United States, with Prof. Cynthia Rudin
- Jun 2021 - Jul 2021 **Copenhagen Business School**, Visiting Ph.D. Student (virtual) at the Department of Economics, Frederiksberg, Denmark, with Prof. Dolores Romero Morales - 31 days
- Aug 2019 - Oct 2019 **Copenhagen Business School**, Visiting Ph.D. Student at the Department of Economics, Frederiksberg, Denmark, with Prof. Dolores Romero Morales - 68 days

## Awards

- Nov 2021 **Runner-up Prize of the Three Minute Thesis Competition**
- Oct 2021 **YoungWomen4OR 2021**, *EURO WISDOM Forum*
- Jun 2020 **Special Fellow of the Week**, *Marie Skłodowska-Curie Actions fellows, European Union's Horizon 2020*

## Editorial work

- Since 2021 Ad-hoc reviewer in *Advances in Data Analysis and Classification*, *Computers and Operations Research*, *European Journal of Operational Research* and *INFORMS Journal on Computing*

## Memberships

- Since 2019 Member of EUROYoung, a Forum of the European Association of Operational Research Societies (EURO)
- Since 2018 Member of the Spanish Society of Statistics and Operations Research (SEIO), belonging to the working groups Multivariate Analysis and Classification (AMyC) and Functional Data Analysis (FDA)
- Since 2017 Member of the research group FQM - 329 of the University of Seville
- Since 2017 Member of the Red Española Matemática-Industria (math-in)

## Languages

Spanish (native), English (B2 level) and French (B1 level)

## Computational skills

Python, R, Matlab, SPSS, IPOPT, CPLEX, Mathematica, Sage, Haskell, Isabelle, Maple, Geogebra, LaTeX, MS Office