Mateo Dulce Rubio

mdulceru@andrew.cmu.edu
https://mdulcer.github.io/

Ph.D. candidate in Statistics and Public Policy at Carnegie Mellon University. My research focuses on nonparametric statistics, causal inference, and responsible machine learning, with a strong emphasis on their applications for good.

Education

2025 (Expected) **Ph.D. Statistics & Public Policy**
Carnegie Mellon University
Advisor: Edward H. Kennedy

2022 **M.Sc. Statistics**
Carnegie Mellon University

2019 **M.Sc. Economics, *Cum Laude***
University of the Andes, Colombia

2017 **B.S. Economics**
University of the Andes, Colombia

2017 **B.S. Mathematics**
University of the Andes, Colombia

Honors and Awards

- JSM 2024 Student Paper Award.
- 2024 K&L Gates Presidential Fellow in Ethics and Computational Technologies
- Outstanding Teaching Assistant Award, Carnegie Mellon University (Advanced Methods for Data Analysis course, Spring 2023).
- *Cum Laude* M.Sc. in Economics, University of the Andes (2019).

Research and Publications

Journal Articles

- "Effects of Adolescent Victimization on Offending: Flexible Methods for Missing Data & Unmeasured Confounding". **Mateo Dulce Rubio**, Edward Kennedy, Valerio Baćak, Daniel Nagin. arXiv:2309.12595. *Major revisions at Annals of Applied Statistics.* Contributed Talk at ICHPS Conference 2023.
- "RELand: Risk Estimation of Landmines via Interpretable Invariant Risk Minimization". **Mateo Dulce Rubio*** , Siqi Zeng*, Qi Wang, Didier Alvarado, Francisco Moreno, Hoda Heidari, Fei Fang. arXiv:2311.03115. *ACM Journal on Computing and Sustainable Societies (Forthcomxing).*
- "A Location Discrete Choice Model of Crime: Police Elasticity and Optimal Deployment". Douglas Newball-Ramírez, Álvaro Riascos, Andrés Hoyos, **Mateo Dulce**. *PLoS One (Forthcoming).*

- "Modelling underreported spatio-temporal crime events". Álvaro J. Riascos Villegas, Jose Sebastian Nungo, Lucas Gómez Tobón, **Mateo Dulce Rubio**, Francisco Gómez. *PLoS One. 18(7):e0287776, 2023.*

- "Spatio Temporal Sparsity in Homicide Prediction Models". Álvaro J. Riascos Villegas, Juan S. Moreno Pabón, **Mateo Dulce**, Sebastián Quintero, Johan García Vargas, Hernán García. *IEEE Access, 10, 14359-14367, 2022.*

- "Efficient Nearest Neighbors Methods for Support Vector Machines in High Dimensional Feature Spaces". Diana C. Montañes, Adolfo J. Quiroz, **Mateo Dulce Rubio**, Álvaro J. Riascos Villegas. *Optimization Letters, 2020.*

- "On the Relationship between the Inhomogeneous Wave and Helmholtz Equations in a Fractional Setting", **Mateo Dulce**, Alexander Getmanenko, *Abstract and Applied Analysis*, vol. 2019, Article ID 1483764, 9 pages, 2019.

Conference Articles

- "Statistical Inference under Constrained Selection Bias". Santiago Cortés-Gómez, **Mateo Dulce**, Carlos Patiño, Bryan Wilder. *Submitted*

- "Optimal Counterfactual Fair Allocation", **Mateo Dulce Rubio**, Edward H. Kennedy. *Submitted.*

- "Self-exciting point processes with image features as covariates for robbery modeling". **Mateo Dulce**, Paula Rodríguez, Juan Moreno, Álvaro Riascos, Jorge Camargo. *Intelligent Computing (pp. 886-898). Springer, Cham, 2022.*

- "Visual Representations to Evaluate the Heterogeneous Effects of Urban Parks Restoration on Crime". Julián Chitiva Bocanegra, Douglas Newball Ramírez, Paula Rodríguez Díaz, Hamadys Benavides Gutiérrez, **Mateo Dulce**, Álvaro Riascos. *ACM SIGCAS Conference on Computing and Sustainable Societies (COMPASS '21). Association for Computing Machinery, New York, NY, USA, 48–54, 2021.*

- "Interpreting a Conditional Generative Adversarial Network Model for Crime Prediction". **Mateo Dulce**, Óscar Gómez, Juan Moreno, Christian Urcuqui, Álvaro Riascos. *In Iberoamerican Congress on Pattern Recognition. Springer, Cham, 2021.*

- "A fair allocation algorithm for predictive police patrolling". Isabella Rodas, **Mateo Dulce**, Álvaro Riascos. *8th International Conference on Artificial Intelligence & Applications (ARIA), 2021.*

- "Dynamic Network Analysis of Spatio- Temporal Crime Incidents in Bogotá - Colombia". Juan Moreno, Hernán García, Sebastián Quintero, Johan García, Alvaro Riascos, **Mateo Dulce**. *8th International Conference on Behavioral and Social Computing (BESC), 2021.*

- "Graph Restrictions for Signal Processing of Homicides Data". Sebastián Quintero, Juan Moreno, **Mateo Dulce**, Álvaro Riascos and Gustavo Nonato. *Proceedings of the International Conference on Applied Artificial Intelligence (ICAPAI), pp. 1-6, 2021.*

- "Zero-Inflated Embeddings to Analyze Homicide Occurrence Patterns". Hamadys Benavides, Óscar Gómez, **Mateo Dulce**, Paula Rodríguez, Juan Moreno, Álvaro Riascos. *2nd International Conference on Computing and Data Science (CDS), 2021.*

- "A Manifold Learning Data Enrichment Methodology for Homicide Prediction". Juan Moreno, **Mateo Dulce**, Álvaro Riascos, Yor Castaño, Paula Rodríguez. *7th International Conference on Behavioural and Social Computing (BESC), 2020.*
- "Accuracy and Fairness in a Conditional Generative Adversarial Model of Crime Prediction", Christian Urcuqui, Juan Moreno, Carlos Montenegro, Álvaro Riascos **Mateo Dulce**. *7th International Conference on Behavioural and Social Computing (BESC), 2020.* **Nominated as best paper**.
- "Predicting criminal behavior with Lévy flights using real data from Bogotá". **Mateo Dulce**, *Documento CEDE No. 2019-11.* Master's thesis. Contributed Talk at LXAI Workshop at Neurips, 2018.
- "Efficient allocation of law enforcement resources using predictive police patrolling", **Mateo Dulce**, Simón Ramírez-Amaya and Álvaro Riascos, *Proceedings of NeurIPS 2018 Workshop on Machine Learning for the Developing World: Achieving Sustainable Impact.* arXiv:1811.12880, 2018.

Book Chapters

- "Randomized Experiments". Amanda Coston, **Mateo Dulce**, Edward Kennedy. Book chapter in *AI for Social Impact. Edited by Milind Tambe, Fei Fang, Bryan Wilder, 2022.*

Work experience

RAND Corporation

Statistics Summer Associate

May 2022 – August 2022

Designed, developed, and implemented a pipeline for monitoring emerging trends in the interaction between society, technology, and the criminal justice system, using NLP and time series methodologies.

Quantil | Applied Mathematics

Associate Researcher

August 2020 – December 2021

Associate Director of Data Mining

May 2019 – July 2020

Data Mining Senior Researcher

August 2018 – April 2019

Data Mining Junior Researcher

May 2017 – July 2018

- Led the development and implementation of crime prediction models in Bogotá, contributing to enhanced public safety measures, such as prioritizing video surveillance systems and optimizing the placement of new police equipment.

- Utilized techniques in text mining and Natural Language Processing to perform information retrieval, sentiment analysis, and algorithmic classification of diverse data sources, including legal documents and social network posts.

- Applied machine learning methodologies in healthcare settings to develop prediction models for diseases and their progression, and to assess the risk profiles of patients.

- Conducted fairness testing of matching algorithms in the context of a ridesharing application and crime prediction models, ensuring equitable outcomes and promoting transparency and ethical considerations in algorithmic decision-making processes.

Service

- Co-founder of the Data Analytics Center for Public Policy, a research initiative dedicated to fostering the advancement of mathematics, data science, and AI for the public sector in Colombia and Latin America (2021-).

Teaching

Teaching Assistant, Carnegie Mellon University

- Critical Analysis of Policy Research, Fall 2021, 2022, 2023.
- Advanced Methods for Data Analysis, Spring 2022, 2023.
- Reasoning with Data, Summer 2023.
- Probability and Statistics, Fall 2022.
- Summer Undergraduate Research Apprenticeship, Summer 2022.
- Statistics for IT Managers, Fall 2021.
- Introduction to Statistical Inference, Summer 2021.
- Basic Mathematics for Management, Summer 2021.
- Data over Space and Time, Fall 2020.

Guest Lecturer, Harvard University

- Randomized Experiments in AI for Social Impact, Fall 2022.

Leading Professor, University of the Andes

- Analytics project management, Fall 2019.
- Machine Learning for Business intelligence, Fall 2019.
- Introduction to data analysis with Python, Fall 2019.

Leading Professor, Del Rosario University

- Unsupervised Learning - Data Science Program, Fall 2018

Skills

Computational	Python, R, Git, SQL, ArcGIS, STATA, LaTex.
Languages	Spanish (Native speaker), English (Full professional proficiency).