Mateo Dulce Rubio

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https://mdulcer.github.io/

I am a fourth-year Ph.D. candidate in the Statistics and Public Policy joint program at Carnegie Mellon University, specialized in mathematical reasoning, statistical modeling and coding. My research focuses on non-parametric statistics, causal inference, and responsible machine learning, with a strong emphasis on their applications for good.

EDUCATION

2025 (EXPECTED)	**Carnegie Mellon University** PH.D. IN STATISTICS & PUBLIC POLICY ADVISOR: EDWARD H. KENNEDY
2022	**Carnegie Mellon University** M.SC. STATISTICS
2019	**University of the Andes, Colombia** M.SC. ECONOMICS, *Cum Laude*
2017	**University of the Andes, Colombia** B.S. ECONOMICS
2017	**University of the Andes, Colombia** B.S. MATHEMATICS

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.

Center for Analytics and Public Policy in Colombia
CO-FOUNDER AND MEMBER OF THE BOARD OF DIRECTORS
MAY 2021 – PRESENT

Advisor on statistical modeling and machine learning projects to provide public policy recommendations. Researcher on AI methodologies and tools for social impact.

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.

RESEARCH AND PUBLICATIONS

Journal Articles

- "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. *Under Revision.*

- "Exploring the effect of victimization on future offending among adolescents using nonparametric causal inference tools". **Mateo Dulce Rubio**, Edward Kennedy, Valerio Baćak, Daniel Nagin. Contributed Talk at ICHPS, 2023. *Under Revision.*

- "A Location Discrete Choice Model of Crime: Police Elasticity and Optimal Deployment". Douglas Newball-Ramírez, Álvaro Riascos, Andrés Hoyos, **Mateo Dulce**. *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

- "Inference under constrained distribution shifts". Santiago Cortés-Gómez, **Mateo Dulce**, Bryan Wilder. *Under Revision.*

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

- "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.*

TEACHING

Teaching Assistant, Carnegie Mellon University

- Reasoning with Data, Summer 2023.

- Advanced Methods for Data Analysis, Spring 2022, Spring 2023.

- Critical Analysis of Policy Research, Fall 2021, Fall 2022.

- 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

HONORS AND AWARDS

- Outstanding Teaching Assistant Award, Carnegie Mellon University, Spring 2023.

- Graduated *Cum Laude* M.Sc. in Economics, University of the Andes.

- Selected by the Dean to deliver the Commencement Speech at Master's Graduation.

- Awarded a grant by the Vice-Presidency of Research of the University of the Andes for my Master's thesis. Together with Professor Álvaro Riascos.

SKILLS

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