Agathe **Fernandes Machado**

PhD student · Department of Mathematics
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Research topics

- Machine Learning;
- Actuarial Science;
- Applied Mathematics.

Work experience

Internship in actuarial science (1 year) - Reinsurance and Natural hazards (Storms) *Nantes (France)*
Generali, Insurance company *2022 – 2023*
- Programming: RMS (natural disaster modeling), Python, R, PySpark.

Internship in actuarial science (3 months) - Drought risk *Paris (France)*
Seabird, Consulting firm in insurance/finance *2023*
- Extreme value theory: analysis of clay shrinkage and swelling risk based on drought index values (KBDI, SSWI) and portfolio claims experience;
- Participation in a mission to merge loan insurance products.

Internship *Data scientist (4 months)* *Vannes (France)*
Crédit Agricole, Bank, Marketing Research and Development Department *2021*
- Optimization of scores from machine learning methods based on tracking and customer profile data (XGBoost, Random Forest, etc.);
- Programming: SAS Guide, Python and Big Data tools.

Internship JavaScript Development (1 month) *Vannes (France)*
Dawizz, Start-up in IT *2019*

Research projects

Visiting researcher (2 months) - Discrimination in Mortality Scores *Paris (France)*
Milliman France - Conservatoire National des Arts et Métiers (CNAM) *2025*
- Theoretical development and implementation of a mitigation technique for a group-fairness criterion, Predictive Parity;
- Writing an article intended for submission within the year 2025.

Development of the Python package `EquiPy` *Montréal (Canada)*
Université du Québec à Montréal *2023*
- Post-processing method to mitigate discrimination in the predictions of a machine learning model, Sequential Fairness;
- Documentation: `https://equilibration.github.io/equipy/`.

Actuarial research thesis (1 year) - Reinsurance and Storm risk *Nantes (France)*
Generali, EURIA (Université de Bretagne Occidentale) *2022 – 2023*
- Thesis title: Marginal contribution of industrial sites to the reinsurance cost of an excess of loss per event treaty;
- Application of reinsurance pricing methods for an excess of loss per event treaty to industrial risks (companies) using the Monte-Carlo method.

Actuarial research project with Sia Partners (1 year) *Paris (France)*
Sia Partners, EURIA (Université de Bretagne Occidentale) *2021 – 2022*
- Projection of drought risk in France, measured by the KBDI index, using temperature and precipitation data (`https://data.nasa.gov`) and IPCC scenarios;
- Implementation of a climate scenario generator with R.

Education

PhD student in Mathematics *Montréal (Canada)*
UNIVERSITÉ DU QUÉBEC À MONTRÉAL *2023 – In progress*
- Thesis title: Algorithmic Fairness and Discrimination;
- Supervisors: Arthur Charpentier, Ewen Gallic.

Master's in Actuarial Science (with High Honors) *Brest (France)*
EURIA, UNIVERSITÉ DE BRETAGNE OCCIDENTALE *2021 – 2023*
Double Degree with IMT Atlantique

Master's from a Generalist Engineering School *Brest (France)*
IMT ATLANTIQUE *2019 – 2023*
Major: Mathematical and Computational Engineering: Statistical Learning, Stochastic Processes and Numerical Optimization

Classes Préparatoires aux Grandes Ecoles, Physics, Chemistry, and Engineering Sciences (Equivalent to a Bachelor's degree) (with Honors) *Rennes (France)*
LYCÉE CHATEAUBRIAND *2017 – 2019*
- Major: Mathematics, Physics, Chemistry;
- Second year in PC*, called "star class".

Publications

Published articles

1. Fernandes Machado, A., Charpentier, A., Flachaire, E., Gallic, E. & Hu, F. (2024). Post-Calibration Techniques: Balancing Calibration and Score Distribution Alignment. *Thirty-Eighth Annual Conference on Neural Information Processing Systems* (NeurIPS 2024) *BDU Workshop*.
2. Fernandes Machado, A., Charpentier, A., & Gallic, E. (2025). Sequential conditional transport on probabilistic graphs for interpretable counterfactual fairness. *The 39th Annual AAAI Conference on Artificial Intelligence* (AAAI 2025).
3. Fernandes Machado, A., Charpentier, A., & Gallic, E. (2025). Optimal Transport on Categorical Data for Counterfactuals using Compositional Data and Dirichlet Transport. *34th International Joint Conference on Artificial Intelligence* (IJCAI 2025).
4. Il Idrissi, M., Fernandes Machado, A., & Charpentier, A. (2025). Beyond Shapley Values: Cooperative Games for the Interpretation of Machine Learning Models. *34th International Joint Conference on Artificial Intelligence* (IJCAI 2025) *Workshop on Explainable Artificial Intelligence (XAI)*.

Preprints

1. Fernandes Machado, A., Hu, F., Ratz, P., Gallic, E., & Charpentier, A. (2024). *Geospatial disparities: A case study on real estate prices in paris*. https://arxiv.org/abs/2401.16197
2. Fernandes Machado, A., Charpentier, A., Flachaire, E., Gallic, E., & Hu, F. (2024). *From uncertainty to precision: Enhancing binary classifier performance through calibration*. https://arxiv.org/abs/2402.07790
3. Fernandes Machado, A., Charpentier, A., Flachaire, E., Gallic, E., & Hu, F. (2024). *Probabilistic scores of classifiers, calibration is not enough*. https://arxiv.org/abs/2408.03421
4. Fernandes Machado, A., Grondin, S., Ratz, P., Charpentier, A., & Hu, F. (2025). *EquiPy: Sequential Fairness using Optimal Transport in Python*. https://arxiv.org/abs/2503.09866
5. Il Idrissi, M., Fernandes Machado, A., Gallic, E., & Charpentier, A. (2025). *Unveil Sources of Uncertainty: Feature Contribution to Conformal Prediction Intervals*. https://arxiv.org/abs/2505.13118

Conferences, Workgroups, Seminars

1. 06/2025 Workshop Calibrating prediction uncertainty, statistics and machine learning perspectives (Isaac Newton Institute, Cambridge): *Beyond Calibration of Probabilistic Classifier Outputs*.
2. 05/2025 STATQAM Research Day (Université du Québec à Montréal, Montréal): *Assessing Counterfactual Fairness via (Marginally) Optimal Transport*, https://github.com/fer-agathe/statqam_research_day.git.

3. 02/2025 Actuarial and Financial Mathematics Conference (AG Campus, Brussels): *Predicting Unobserved Multi-Class Sensitive Attributes: Enhancing Calibration with Nested Dichotomies for Fairness.*, https://github.com/fer-agathe/AFM_2025.git.
4. 01/2025 Workshop (Milliman France, Paris): *Analyzing Discrimination in Mortality Scores.*
5. 01/2025 Seminar PSPP (EDF Lab Chatou, Paris): *Challenging the performance of binary classifiers through the notion of calibration.*
6. 12/2024 NeurIPS 2024 Workshop on Bayesian Decision-making and Uncertainty (Vancouver): *Post-Calibration Techniques: Balancing Calibration and Score Distribution Alignment.*, https://hal.science/hal-04916151/.
7. 08/2024 Actuarial and statistical summer seminar (Université du Québec à Montréal): *Probabilistic scores of classifiers, calibration is not enough.*, https://github.com/TommyMastro/Seminaire_actu_stats_UQAM.git.
8. 08/2024 Seminar *Seminario de Matemáticas Aplicadas* (Quantil, Colombia, remote): package `EquiPy`, https://github.com/fer-agathe/quantil_seminar.git.
9. 06/2024 Insurance Data Science Conference (Stockholm University): *Probabilistic scores of classifiers, calibration is not enough.*, https://github.com/fer-agathe/IDSC_2024.git.
10. 05/2024 Annual Conference *Société Canadienne de Science Economique* 2024 (HEC Montréal): *From uncertainty to precision: Enhancing binary classifier performance through calibration.*, https://github.com/fer-agathe/scse_2024.git.
11. 05/2024 Workshop on Fairness and Discrimination in Insurance 2024 (Université Laval, Québec): package `EquiPy`.
12. 04/2024 Science Research Day 2024 (Université du Québec à Montréal): 4-minute presentation of the research project, https://github.com/fer-agathe/projet_recherche_court.git.
13. 05/2024 Workshop in Insurance Mathematics 2024 (Concordia University, Montréal): poster presentation, package `EquiPy`, https://github.com/fer-agathe/WIM_2024_equipy.git.

Scholarships

PhD scolarship (OBVIA) — *Université du Québec à Montréal*
SUPPORTING THE NEXT GENERATION SCHOLARSHIP PROGRAM 2024, INTERNATIONAL OBSERVATORY ON THE SOCIETAL IMPACTS OF AI AND DIGITAL TECHNOLOGIES — *2024*

Teaching experience

Statistics

Statistical learning (3 hours of lectures and 3 hours of laboratory sessions) — *Université du Québec à Montréal*
FIRST CYCLE (17 STUDENTS) — *2024*
- Linear models, polynomial regression, linear classification (logistic and multinomial regressions), variable selection methods (best subset method, forward, backward, and stepwise), regression regularization methods (Lasso and Ridge), applications using R;
- Website: https://etudier.uqam.ca/STT3030.

IT

Introduction to Python (8 hours of laboratory sessions) — *IMT Atlantique*
SECONDARY STUDENTS — *2021*
As part of an academic project titled “Sustainable Development and Social Engagement,” along with 5 other students, we taught 4 Python classes to Secondary 1 to 3 students, targeting girls to encourage gender equality in technological and IT professions.

Student supervision

Bachelor

Allison Lara Nieva *Université du Québec à Montréal*
Research internship of 3 months *2025*
Combining decision trees and logistic regression models;
Co-supervision of internship with Ewen Gallic and Arthur Charpentier.

Iryna Voitsitska *Université du Québec à Montréal*
Research internship of 3 months *2025*
Using Optimal Transport theory to estimate counterfactuals within causal inference;
Co-supervision of internship with Ewen Gallic and Arthur Charpentier.

Ana-Maria Patrón Piñerez *Université du Québec à Montréal*
Research internship of 3 months *2024*
Algorithmic Fairness: Bayesian methods to predict ethnicity following Colorado legislation SB21-169;
Co-supervision of internship with Arthur Charpentier.

Participating in collective tasks

Research

1. 05/2025 Organization of the 2025 Scientific Day of the OBVIA Community (HEC, Montréal): organization and development of a creative method to present and connect the research work of student members of the OBVIA institute.
2. 09/2024 Organization of the Quantact seminar (Université du Québec à Montréal): Presentation by Adel Cherchali (Milliman, France) on applications of Large Language Models in insurance.
3. 05/2024 Co-organization of Quantact Summer Day (Université de Montréal): A day of presentations by students enrolled in master's or PhD programs in actuarial sciences and financial mathematics, from universities across Quebec (Université de Montréal, Université du Québec à Montréal, HEC Montréal, Université de Sherbrooke, Université Laval and Concordia University).