Agathe **Fernandes Machado**

PhD student · Department of Mathematics

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Research topics

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

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

Development of 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.

Academic project of machine learning (1 month) — *Brest (France)*

IMT Atlantique — *2021*

- Process automation consisting of the following steps: pre-processing, training of classification models (Random Forest, decision tree, SVM, neural networks) and performance calculation;
- Applying the process to datsets *Chronic Kidney Disease* and *Bank Note Authentication*;
- Python code: `https://github.com/fer-agathe/ML-Project-Classification.git`.

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

Work in progress

1. Patrón Piñerez, A., Fernandes Machado, A., Charpentier, A. & Gallic, E. *Probabilistic Scoring for Unbalanced Multi-Class Classifiers: Enhancing Calibration with Nested Dichotomies*. [*Submitted, Actuarial and Financial Mathematics Conference 2025*]
2. Fernandes Machado, A., Charpentier, A., Flachaire, E., Gallic, E. & Hu, F. *Post-Calibration Techniques: Balancing Calibration and Score Distribution Alignment*. [*Submitted, NeurIPS 2024 Workshop BDU*]
3. Fernandes Machado, A., Charpentier, A., Flachaire, E., Gallic, E., & Hu, F. *Probabilistic scores of classifiers, calibration is not enough*. https://doi.org/10.48550/arXiv.2408.03421 [*Submitted, AAAI 2025 Conference*]
4. Fernandes Machado, A., Charpentier, A., & Gallic, E. *Sequential conditional transport on probabilistic graphs for interpretable counterfactual fairness*. https://doi.org/10.48550/arXiv.2408.03425 [*Submitted, AAAI 2025 Conference*]
5. Hu, F., Ratz P., Charpentier, A., Grondin, S. & Fernandes Machado, A. *EquiPy: Sequential Fairness using Optimal Transport in Python*. [*Writing, Journal of Statistical Software*]

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

Other scientific publications

1. Python package `EquiPy`. https://github.com/equilibration/equipy.git

Conferences, Workgroups, Seminars

1. 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.
2. 08/2024 Seminar *Seminario de Matemáticas Aplicadas* (Quantil, Colombia, remote): package `EquiPy`, https://github.com/fer-agathe/quantil_seminar.git.
3. 06/2024 Insurance Data Science Conference (Stockholm University): *Probabilistic scores of classifiers, calibration is not enough.*, https://github.com/fer-agathe/IDSC_2024.git.

4. 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.
5. 05/2024 Workshop on Fairness and Discrimination in Insurance 2024 (Université Laval, Québec): package `EquiPy`.
6. 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.
7. 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

Ana-Maria Patrón Piñerez (Research internship of 3 months)
Université du Québec à Montréal
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. 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.
2. 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).

Langues

English:	Fluent
Spanish:	Intermediate
French:	Native

Computer Skills

Programming Languages:	R (advanced), Python (advanced), SAS (advanced), SQL (advanced), PyTorch (basics), MATLAB (basics), Java (basics), JavaScript (basics), C++ (basics)
Markup Languages:	LaTeX, Markdown
Office software:	Ms Office (Word, Excel, PowerPoint, Access), LibreOffice