

Elijah French

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SUMMARY

PhD student at the University of Toronto in Statistics under the supervision of Sebastian Jaimungal and Leonard Wong. Completed a Bachelor of Science in Economics and Mathematics at the University of Toronto in 2024. Has completed technical and rigorous mathematics, statistics, and economics courses. Dual UK-Canadian citizen.

EDUCATION

University of Toronto, Toronto, Canada 2024 - Present
PhD in Statistics

- Courses: Graduate Probability I, Advanced Theory of Statistics, Applied Probability in Mathematical Finance
- Awards: Ontario Graduate Scholarship (OGS), Faculty of Arts and Science Top Doctoral Fellowship (FAST), Doctoral Recruitment Award
- Other: Internal VP for the Statistics Graduate Student Union

University of Toronto, Toronto, Canada 2019 - 2024
Economics and Mathematics Specialist, Statistics Minor (cGPA: 3.76, Course Average: 89%)

- Courses: Partial Differential Equations, Non-Linear Differential Equations, Real Analysis, Probability, Stochastic Processes, Game Theory, Data Analysis, Time Series Analysis, Applied Econometrics I/II, Topology, Linear Algebra, Advanced Calculus, Advanced Real Analysis I/II, Deep Learning: Theory and Data Science
- Awards: George Roderick Fraser Scholarship (UC), First Norman McLarty Scholarship (UC), Dean's List Scholar (UofT), Research Award (Department of Statistics, supervised by Sebastian Jaimungal)

EXPERIENCE

Research Assistant *University of Toronto, Department of Statistics* April 2023 - April 2024

- Simulated a fully implicit fluid flow PDE solver using a convolutional neural network to decrease environment transition time in a reinforcement learning setting
- Implemented the DDPG reinforcement learning algorithm in a geo-physical model environment and optimized learning through varying actor and critic learning rates, buffer sampling techniques, and network hyper-parameters
- Applied double deep Q-network learning to a scenario involving the trading of a mean-reverting asset

Seminar Speaker *University of Toronto, Graduate Applied Mathematics Seminar* April 2023 - April 2024

- Attended and contributed to weekly seminars led by PhD students in the mathematics department. Topics presented include Optimal Transport Theory, Monte Carlo methods for Sampling, and Adjoint Methods for parameter estimation
- Presented the actor-critic algorithm DDPG to the group. Introduced reinforcement learning, deep neural networks, and their applications to geological carbon storage over three separate presentations

Vice President *University of Toronto Investment Banking Club* September 2022 - September 2023

- Contributed towards the planning and execution of the investment banking training program. Executed a stock pitch competition involving 10 pitches from 3 different universities
- Assisted in the creation of interactive modules and activities for 40+ club members and 16 analysts
- Performed recruitment for the 2022-2023 session. Filled roles for our 25+ analysts and executives

Teaching Assistant *University of Toronto* September 2021 - April 2023

- Taught Calculus, Linear Algebra, and Probability courses
- Ran tutorials for up to 30 students at a time and provided regular office hours
- Marked and gave thoughtful feedback to up to 1600 students on assignments, worksheets, and examinations

- Worked in a team looking over other staff. Taught beginner level windsurfing to a variety of age groups.

PROJECTS

Optimizing Geological Carbon Storage With Reinforcement Learning

[Link](#)

In this project, we performed research into the implementation of the deep reinforcement learning algorithm DDPG to geological carbon storage. Rewards were based off of carbon offset credits received, cost of brine extracted, and pressure build-up. Slow iteration speed as a result of the geo-physical modeller was a major concern. The fine-tuning of learning rates, network size, and the training algorithm allowed the agent to find a schedule of injection and extraction rates that beat an optimal constant schedule. This work was presented at the Department of Statistics undergraduate research showcase.

Work in Real Analysis: Are All Convergences Topological?

[Link](#)

This project answers whether all convergences can be described topologically. I present and prove that convergence almost everywhere, which is fundamental in probability theory, is not a topological convergence. Furthermore, I show the equivalence of limit-point, sequential, and regular compactness in metric spaces.

Hamiltonian Monte Carlo Sampling: An Introduction and Applications

[Link](#)

Monte Carlo integration and Markov chains are presented. The Metropolis Hasting algorithm and its issues exploring the typical sets of distributions are shown. The curse of high-dimensionality is discussed, the Hamiltonian Monte Carlo algorithm, and the discretized non-linear ODEs behind it are presented. Lastly the efficacy of HMC is discussed in reference to its ability to sample from high-dimensional empirical distributions.

SKILLS

- **Languages:** Python, LaTeX, R, Stata
- **Packages:** Matplotlib, ggplot, Pytorch
- **Software:** Linux, Git, GitHub, OPM Flow