Philippe Casgrain

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Education

University of Toronto **Toronto, Canada**
Ph.D. in Mathematical Finance *2014–2018*
Thesis Title: Algorithmic Trading with Latent Models and Mean-Field Games
Doctoral Supervisor: Sebastian Jaimungal

University of Toronto **Toronto, Canada**
Bachelors of Science *2010–2014*
Specialist Degree in Actuarial Science with Majors in Statistics and Mathematics

Society of Actuaries
Associate Examinations *2011–2014*
I have completed all five associate-level Actuarial examinations.

Employment

ETH Zürich **Zürich, Switzerland**
Post-Doctoral Research Fellow *April 2020–Present*
Machine Learning, optimization and mathematical finance.

Princeton University **Princeton, USA**
Post-Doctoral Research Fellow *April 2020–Present*
Machine Learning, optimization and mathematical finance.

Citadel LLC. **New York City, USA**
Quantitative Researcher *January 2019–April 2020*
Algorithmic execution and portfolio optimization.

Citadel LLC. **New York City, USA**
Quantitative Research Intern, Algorithmic execution and portfolio optimization. *May 2017–September 2017*

Other..

Optimum Investment Management Inc. *Summer 2013*
Jarislowsky Fraser Ltd. *Summer 2012*
Casgrain & Company Ltd. *Summer 2011*
National Bank Financial *Summer 2009 - 2010*
Canadian Depository for Securities Ltd. *Summer 2008*

Honours

SIAM Financial Mathematics and Engineering Conference Paper Prize *2019*
University of Toronto Department of Statistical Sciences Doctoral Award *2019*
INFORMS Section on Finance Best Student Paper Award *2018*
University of Toronto SGS Conference Grant *2018*
Fields Institute Student Travel Award *2018*

Articles and Preprints

- P. Casgrain, S. Jaimungal. ***Trading Algorithms with Learning in Latent Alpha Models*** (2017)
  Mathematical Finance (2018) – arXiv:1806.04472
  This paper presents a new class of algorithms for optimally trading assets in the event where there is a latent model driving asset returns. We derive a closed form algorithm which is able to learn from midprice and order book information to optimally trade in such situations.

- P. Casgrain, S. Jaimungal. ***Mean Field Games with Partial Information for Algorithmic Trading*** (2018)
  Under Review at *SIAM Journal on Financial Mathematics* – arXiv:1803.04094
  We present trading algorithms for markets in which there is a large body of agents interacting agents with incomplete and asymmetric information, generated by latent processes. We derive an exact Nash equilibrium for this market in the mean-field limit, where the number of agents tends to infinity, which we show to be ϵ-Nash optimal in any finite market.

- P. Casgrain, S. Jaimungal. ***Mean-Field Games with Differing Beliefs for Algorithmic Trading*** (2018)
  Mathematical Finance (2019) – arXiv:1810.06101

  We consider a market with a large number of participants, in which agents have differing beliefs on its stochastic dynamics. We derive a trading algorithm that achieves a mean-field Nash equilibrium amongst all of the participating traders in the mean-field limit by applying techniques from infinite-dimensional convex optimization. We then present an new LSMC-based numerical algorithm for efficiently computing these trading algorithms in a broad class of models.

- P. Casgrain, M. Li, G.K. Dziugaite, D. Roy. ***An Escape-Time Analysis of SGD*** *(2018)*
  Appeared at WiML and Deep Learning Theory Workshops at NeurIPS 2018

  We study the local microscopic behaviour of stochastic gradient descent (SGD) algorithms through the lens of a limiting diffusion model. Through this approach we obtain escape-time bounds on SGD from local minima and saddle points of loss functions, and relate these to various tunable parameters. We pair this a macroscopic empirical analysis of SGD in an attempt to validate its predicted behaviour through these derived bounds.

- P. Casgrain, B. Ning, S. Jaimungal. ***Deep Q-Learning for Nash Equilibria: Nash-DQN*** (2019)
  Pre-print available at arXiv:1904.10554

  We develop a new efficient Deep-Q-learning methodology for model-free learning of Nash equilibria for general-sum multi-agent stochastic games. The algorithm is uses local linear-quadratic expansion of the stochastic games to produce efficient model-free reinforcement learning algorithm. We study the symmetry properties of the algorithm stemming from label-invariant stochastic games and apply our algorithm to learning optimal trading strategies in competitive electronic markets with large numbers of participants.

- P. Casgrain, ***A Latent Variational Framework for Stochastic Optimization*** (2019)
  Advances in Neural Information Processing Systems (2019) arXiv:1905.01707

  Using techniques from stochastic control, the solution to the variational problem is shown to be equivalent to that of a Forward Backward Stochastic Differential Equation (FBSDE). By solving these equations, we recover a variety of existing adaptive stochastic gradient descent methods. This framework establishes a direct connection between stochastic optimization algorithms and a secondary Bayesian inference problem on gradients, where a prior measure on noisy gradient observations determine the resulting algorithm.

Non-Technical Articles

- P. Casgrain ***Algorithmic Trading in Competitive Markets with Mean Field Games*** (2019)
  SIAM News, March 2019

Talks

SIAM Conference on Financial Mathematics & Engineering — **Invited Talk**
Mean-Field Games with Differing Beliefs for Algorithmic Trading — *June 2019*

Institute for Operations Research and the Management Sciences Annual Meeting — **Invited Talk**
Mean Field Games with Partial Information for Algorithmic Trading — *November 2018*

Bachelier Finance Society World Congress — **Contributed Talk**
Mean-Field Games with Differing Beliefs for Algorithmic Trading — *July 2018*

Statistics Graduate Student Research Day — **Contributed Talk**
Algorithmic Trading with Partial Information: A Mean Field Game Approach — *April 2018*

Teaching

Languages: Fluent writer and speaker of English and French (native proficiency)

University of Toronto — **Toronto, ON, Canada**
Instructor and Teaching Assistant — *2014–Present*

Technical Skills

Programming Languages: R, Python (Pytorch, Tensorflow), KDB/Q, MATLAB, C, Mathematica and LaTeX