

# Fin-ML 5<sup>th</sup> Anniversary Event

November 7<sup>th</sup> and 8<sup>th</sup>, 2023



## Program

## DAY 1: TUESDAY 7 NOVEMBER

8:30 Doors open

9:00 – 9:15

**WELCOME ADDRESS**  
Rheia Khalaf and Prof. Manuel Morales

### ***Data Privacy in Banking***

9:15 – 9:40

Patrick Mesana (HEC Montréal)

*Measuring the residual risks and tradeoffs of anonymization and data synthesis (National Bank of Canada)*

9:40 – 10:05

Mohamed Gueye (Croesus Financesoft)

*Row Conditional Tabular GAN for the generation of relational databases*

10:05 – 10:30

Fabian Bastin (Université de Montréal)

*Generation of synthetic populations preserving anonymity and exploiting dependency structure transfer*

10:30 – 10:50

**BREAK**

### ***Fin-ML ALUMNI: Where are they now?***

10:50 – 11:15

Jérémi Deblois-Beaucage (QuantumBlack)

*AI consulting at QuantumBlack*

**This talk will be presented in French + slides in English**

11:15 – 11:40

Samuel Tremblay (Desjardins)

*How Fin-ML helped me win the 2020 Fintech Challenge and land a job at Desjardins's AI Team*

**This talk will be presented in French**

11:40 – 12:05

Melany Delgado (MoovAI)

*Beakers, business and bytes: embracing change and chartering new territories*

12:05 – 12:30

Marie-Ève Malette (Vention)

*Managing Growth with a Data-Driven Approach*

12:30 – 14:00

LUNCH

***Insurance, Banking & Client Management***

14:00 – 14:30

Jérémy Rieussec (Université de Montréal)

*AI virtual agents for insurance and financial industry* (Koios Intelligence)

14:30 – 14:40

Jotio Joseph Antoine Bell (HEC Montréal)

*Modélisation du comportement de conformité fiscale des individus avec un modèle de Machine Learning* (Revenu Québec)

**This talk will be presented in French**

14:40 – 15:05

Philippe Béliveau (HEC Montréal)

*Prédiction des flux de trésorerie à court terme* (Videns Analytics)

**This talk will be presented in French**

15:05 – 15:25

BREAK

***Fin-ML ALUMNI: Where are they now?***

15:25 – 15:40

Rui Fan (Royal Bank of Canada)

*Knowledge Graph Entity Alignment Dataset Benchmarking Study and Use Cases in Financial Industry*

15:40 – 16:05

Saeed Marzban (Ernst & Young)

*WaveCorr: Deep Reinforcement Learning with Permutation Invariant Convolutional Policy Networks for Portfolio Management*

16:05 – 16:30

Tiguéné Nabassagua (BNP Paribas CIB)

*AI and ML for operational risk management*

## DAY 2: WEDNESDAY 8 NOVEMBER

### *Investments & Risk Management*

- 8:30 – 8:35 *FLASH SESSIONS – Introduction*
- 8:35 – 8:45 Frédéric Godin (Concordia University)  
*Equal risk pricing of derivatives with deep hedging*
- 8:45 – 8:55 Parisa Davar (Concordia University)  
*Risk Averse Policy Gradient Approach for CVaR*
- 8:55 – 9:05 Carlos Octavio Perez (Concordia University)  
*Deep hedging for joint dynamics of the underlying asset and its implied volatility*
- 9:05 – 9:15 Rosnel Sessinou (HEC Montréal)  
*Precision Least Squares: Estimation and Inference in High-Dimensions*
- 9:15 – 9:25 Md Hasib Uddin Molla (University of Calgary)  
*Deep Learning-based Method for Financial Decision-making Problems*
- 9:25 – 9:35 Q&A – Part I
- 9:35 – 9:45 Francis Huot Chantal (Université de Montréal)  
*TSbench: Multivariate time series simulation with applications*
- 9:45 – 9:55 Yaw Asomani (University of Calgary)  
*A Hybrid Modeling and Pricing of Financial Derivatives Using GARCH and Neural Networks*
- 9:55 – 10:05 Ningsheng Zhao (Concordia University)  
*Explaining Machine Learning Model Informatively*
- 10:05 – 10:15 Kirill Golubnichiy (University of Calgary)  
*Forecasting Stock Options Prices via the Solution of an Ill-Posed Problem for the Black-Scholes Equation, Recovering volatility coefficient and Neural Network Machine Learning*
- 10:15 – 10:25 Mamadou Yamar Thioub (HEC Montréal)  
*Regime-Based Dynamic Asset Allocation*
- 10:25 – 10:30 Q&A – Part II

**10:30 – 10:45**

**BREAK**

10:45 – 11:15

*Detecting Anomalies from High Frequency Trading Activity in the Limit Order Book* (Regulatory Division - Montreal Exchange TMX)

- Manuel Morales (Université de Montréal)
- Cédric Poutré (Université de Montréal)

11:15 – 11:45

*High Frequency Market Making and ML Trading in Futures Markets* (Futures First)

- Luca Lalor (University of Calgary)
- Timothy DeLise (Université de Montréal)
- Myles Sjogren (University of Calgary)

### ***Upcoming trends***

11:45 – 12:15

Pierre Rosin (JACOBBS)  
*Finance evolution with generative AI*

12:15 – 12:30

Vincent Racine (University of Waterloo)  
*Learning capacities from data in large universes*

**12:30 – 14:00**

**LUNCH**

### ***Electricity Markets***

14:00 – 14:20

Geneviève Gauthier (HEC Montréal)  
*Foreseeing the worst: Forecasting electricity DART spikes*

14:20 – 14:40

Anthony Forgetta (Concordia University)  
*Distributional forecasting of electricity DART spreads with mixture models*  
(Plant-E Corp)

14:40 – 15:00

Yang Yang (University of Calgary)  
*Stochastic Path-Dependent Volatility Model and the Associated Swing Option Pricing in Natural Gas Market*

**15:00 – 15:20**

**BREAK**

## ***Sustainable investments***

15:20 – 16:00 *Panel discussion: Comment naviguer dans le « Wild West » des crédits carbone.*

Frédéric Rivard (McGill St-Laurent / HEC Montréal)

Daniel Sutherland (McGill St-Laurent Climate Solutions)

Pierre-Luc Lamontagne (McGill St-Laurent)

Luc Baillargeon Nadeau (LCL Environnement)

### **This talk will be bilingual**

16:00 – 16:15 David Ardia (HEC Montréal)

*Climate Change Concerns and the Performance of Green vs. Brown Stocks*

16:15 – 16:30 Elham Kheradmand (Université de Montréal)

*AI Revolution: Unveiling the Power of Technology in ESG Investing*

16:30 – 16:45 Fabrizio Sabelli (Université de Montréal)

*Leveraging Large Language Models for ESG Investing in Finance*

**17:00 – 19:00**

**NETWORKING EVENT**

## ABSTRACTS / BIOGRAPHIES

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### DAY 1: TUESDAY 7 NOVEMBER

#### *Data Privacy in Banking*

**Patrick MESANA**, HEC Montréal, PhD Candidate

[Tuesday November 7, 09:15 A.M]

*Measuring the residual risks and tradeoffs of anonymization and data synthesis*

In this talk, we will first unpack the evolution of data anonymization, examining modern techniques beyond traditional methods to address the intricacies of ensuring privacy. We will introduce the concept of residual privacy risks, focusing on membership attacks. We will discuss the gap between the literature and the practical realities acknowledged in regulatory frameworks.

Furthermore, we will delve into practical aspects by discussing how re-identification risks are measured, particularly emphasizing the 'cost of search' within the realm of tabular data—a common format in the banking industry. We will share insights from the methodology precisely developed in collaboration with National Bank of Canada, shedding light on its practical implications and the compelling need for industries to adopt such thorough measures in the face of ever-evolving digital threats.

**Biography:** Patrick Mesana began his career as a software engineer, gaining experience with consulting companies and startups before transitioning into the field of Data Science. As a former manager in the Data Office of National Bank of Canada (NBC), Patrick encountered numerous data management challenges. He is currently pursuing a PhD in decision science to explore the tradeoffs between data privacy and data value. In addition, Patrick served as a researcher and scientific lead on these topics for the AI Factory at NBC.

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**Mohamed GUEYE**, Croesus Financesoft, AI research developer

[Tuesday November 7, 09:40 A.M]

*Row Conditional Tabular GAN for the generation of relational databases*

Besides reproducing tabular data properties of standalone tables, synthetic relational databases also, require modeling the relationships between related tables. In this paper, we propose the Row Conditional-Tabular Generative Adversarial Network (RC-TGAN), a novel

generative adversarial network (GAN) model that extends the tabular GAN to support modeling and synthesizing relational databases. The RC-TGAN models relationship information between tables by incorporating conditional data of parent rows into the design of the child table's GAN. We further extend the RC-TGAN to model the influence that grandparent table rows may have on their grandchild rows, in order to prevent the loss of this connection when the rows of the parent table fail to transfer this relationship information. The experimental results, using eight real relational databases, show significant improvements in the quality of the synthesized relational databases when compared to the benchmark system, demonstrating the effectiveness of the RC-TGAN in preserving relationships between tables of the original database.

**Biography:** With a master's degree in statistics from the Université de Montréal and a member of Fin-ML program, Mohamed Gueye has always been interested in valuing data in industry. In Senegal, he was a data analyst in the marketing field after training as a statistical engineer. Today, he works at Croesus as a research developer in artificial intelligence, which allowed him to participate in the publication of the article "*Row Conditional Tabular GAN for the generation of relational databases*". He also works on copulas and Bayesian methods as part of my thesis.

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**Fabian BASTIN**, Université de Montréal, Full Professor

[Tuesday November 7, 10:05 A.M]

*Generation of synthetic populations preserving anonymity and exploiting dependency structure transfer*

The generation of synthetic populations consists of producing a realistic representation of a target population for modeling and behavioral simulation purposes, a task that can be tricky when the available multivariate samples are small or when privacy concerns are important. In the first part of the talk, we study to what extent k-anonymity and generative modeling provide useful data relative to the sensitive data they replace. In the second part of the talk, we introduce a new framework based on copulas to generate synthetic data for a population whose only empirical marginal distributions are known, using a sample from another population sharing a similar dependency structure. We compare the proposed scheme to common methods such as Iterative Proportional Fitting and to modern probabilistic approaches such as Bayesian networks, variational auto-encoders and generative adversarial networks and illustrate it on American Community Survey data.

**Biography:** Fabian Bastin has a doctorate in Mathematics from the University of Namur and is Full Professor at the Department of Computer Science and Operations Research, University of Montreal. He is affiliated with CIRRELT, IVADO, and Fin-ML.



## DAY 1: TUESDAY 7 NOVEMBER

### *Fin-ML ALUMNI: Where are they now?*

**Jérémi DEBLOIS-BEAUCAGE**, QuantumBlack, Data Engineer

[Tuesday November 7, 10:50 A.M.]

*AI consulting at QuantumBlack*

1. How Fin-ML impacted my studies & early career
2. Overview of AI projects at QuantumBlack

**Biography:** Jérémi is a Data Engineer at QuantumBlack, AI by McKinsey. He works in various industries such as sustainability, aerospace, financial fraud, and private equity. He graduated from HEC Montréal, where his studies included a Fin-ML supported project at Decathlon, where he specialized in graph neural networks applied to recommender systems.

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**Samuel TREMBLAY**, Desjardins, Agile Project Manager

[Tuesday November 7, 11:15 A.M.]

*How Fin-ML helped me win the 2020 Fintech Challenge and land a job at Desjardins' AI Team*

I will explain my background, current job and the links between Fin-ML and

- a) The Fintech Challenge I won plus
- b) My internship at Desjardins, which translated to a full time job.

**Biography:** Samuel Tremblay is an Agile Project Manager at Desjardins, where he oversees internal projects related to artificial intelligence and cloud migrations. He graduated with honors from a bachelor's degree in aerospace engineering from Polytechnique Montréal as well as a master's degree in business intelligence from HEC Montréal.

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**Melany DELGADO**, MoovAI, AI Delivery Manager

[Tuesday November 7, 11:40 A.M.]

*Beakers, business and bytes: embracing change and chartering new territories*

Join me as I unravel the lessons learned on my journey since I decided to change career path to become a data scientist. From my dream of curing cancer to my work as an AI delivery manager

passing by my entrepreneurship ventures, I will make the case for daring to embrace the unknown with courage and candor.

**Biography:** Though she comes from an atypical background in the life sciences and manufacturing industry, Melany has carved a niche for herself in the ever-evolving world of data science. Starting her journey as a data scientist, she wielded the power of AI to decode intricate problems and provide innovative solutions. Today, as an AI Delivery Manager, Melany empowers data teams to create value powered by AI.

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**Marie-Ève MALETTE**, Vention, Manager Data Science

[Tuesday November 7, 12:05 P.M]

*Managing Growth with a Data-Driven Approach*

This presentation is about Marie-Eve's professional journey leading up to her role as Manager, Data Science at Vention. She will be giving an overview of the challenges and benefits of using data science to promote the growth of a start-up, as well as the place of AI and data-driven strategies in such environments. More specifically, she will delve into the inner workings of making a sales team more efficient with AI-qualified leads.

**Biography:** Marie-Eve Malette is a Montreal-based Manager with a deep passion for innovation. With a strong academic foundation in Computer Science and Financial Engineering, she has over a decade of diverse experience, including AI, data science, and finance. Currently, she manages the data science team at Vention, where she is responsible for building a data infrastructure to increase data visibility company-wide. In previous roles, she worked at JACOBBS, a Montreal-based research center in AI, as the director of AI Project Development and Partnerships, and at National Bank of Canada as an AI Scientist.

## DAY 1: TUESDAY 7 NOVEMBER

### *Insurance, Banking & Client Management*

**Jérémy RIEUSSEC**, Université de Montréal, PhD Candidate in Computer science and Operational Research

[Tuesday November 7, 14:00 P.M]

*AI virtual agents for insurance and financial industry* (Koios Intelligence)

Koios Intelligence's mission is to empower the insurance and financial industry with the next generation of intelligent and customized systems that are supported by Artificial Intelligence, statistics and operational research. Koios is developing new technologies that redefine the interactions between insurers, brokers and customers by engineering solutions in Natural Language Processing at every layer of the AI pipeline, from the architecture and training of models to the optimization methods for efficient learning.

**Biography:** Jeremy Rieussec is a PhD student at the University of Montreal. He has interest in the study and development of optimization methods, especially by extending trust-region methods to stochastic frameworks, for the estimation of statistical models using maximum likelihood or least squares, in a context of big-data.

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**Jotio Joseph Antoine BELL**, HEC Montréal, Masters Student

[Tuesday November 7, 14:30 P.M]

*Modélisation du comportement de conformité fiscale des individus avec un modèle de Machine Learning* (Revenu Québec)

Le projet de connaissance client du Revenu Québec vise à développer la connaissance de la clientèle afin d'améliorer son expérience en adaptant les façons de faire à ses besoins et ainsi mieux l'accompagner dans sa conformité fiscale.

Il s'agit de:

- Personnaliser davantage leurs services en tirant profit du potentiel du numérique.
- Améliorer l'expérience client en prenant en compte ce que nous connaissons de lui afin de prendre les bonnes actions.
- Accroître l'efficacité des activités de recouvrement en mettant davantage les efforts sur des dossiers qui nécessitent un suivi plus rigoureux.

Notre travail consiste en la modélisation de la capacité et de la volonté du client afin de faire une prédiction du risque de défaut de paiement ou autrement dit, de la capacité à s'acquitter

de sa créance, ce qui permettra d'adapter le parcours de son dossier dans les processus de recouvrement afin de prendre les bonnes actions au bon moment.

**Biography:** Jotio est ingénieur de Conception en informatique diplômé de l'École Nationale Supérieure Polytechnique de Yaoundé au Cameroun, et étudiant en maîtrise en ingénierie financière à HEC Montréal. Il est passionné par l'économie, la finance, l'intelligence artificielle et les mathématiques. Il s'intéresse plus particulièrement aux problématiques de création de modèles décisionnels optimaux, mais aussi à l'évaluation et la modélisation de produits dérivés du marché des capitaux, et également à la prédiction des chocs sur les marchés internationaux, faisant appel au calcul stochastique et à l'économétrie des séries temporelles. Il est un homme discipliné, ouvert d'esprit, ordonné, méticuleux, rigoureux et travailleur.

**Philippe BÉLIVEAU**, HEC Montréal, Masters Student

[Tuesday November 7, 14:35 P.M]

*Cash flow forecasting and categorization of banking transactions for treasury management*

In collaboration with Groupe Azur and Datalog Finance, we are developing a cash flow forecasting solution for the cash management system. Our project encompasses two main components: the automated classification of bank transactions and the prediction of cash flows across varying time spans (weekly, monthly, and 13 months). To substantiate our approach, we conducted a proof of concept using authentic data sourced from a prominent European B2B conglomerate. The presentation will delve into the latest strides in machine learning as applied to treasury management, insights garnered from treasury experts regarding the integration of AI in this domain, the functionality of our classification algorithm, and the efficacy of our predictive model across diverse time intervals.

**Biography:** Philippe Béliveau is currently pursuing a Master's degree in Data Science at HEC Montreal, with a keen interest in applying time series analysis within the realm of finance. His focus relies on effectively connecting statistical approaches to practical implications in the business context.

## DAY 1: TUESDAY 7 NOVEMBER

### *Fin-ML ALUMNI: Where are they now?*

**Rui FAN**, Royal Bank of Canada, A.I. and Data Engineer

[Tuesday November 7, 15:25 P.M]

*Knowledge Graph Entity Alignment Dataset Benchmarking Study and Use Cases in Financial Industry*

Real-world knowledge graphs (KGs) are usually constructed independently by different parties from different heterogeneous data sources. This heterogeneity presents a formidable challenge when one attempts to merge and harness the collective knowledge stored in these KGs. Entity alignment serves as the linchpin for overcoming these challenges by identifying and linking equivalent entities across disparate KGs. However, there has been very limited effort devoted to curating domain-specific datasets for entity alignment purposes. We hypothesize that this scarcity is attributable to two primary factors: 1) the privacy and licensing issue of domain-specific data, and 2) the significant effort required for curation. Nonetheless, we maintain our strong belief in the intrinsic value of curating a dataset specific to domain-specific knowledge graphs. These graphs often exhibit distinct characteristics compared to widely adopted general domain ones, thereby posing unique challenges in the realm of entity alignment. To fill this gap, we present a novel Knowledge Graph Entity Alignment Dataset tailored specifically to the finance domain. Our dataset addresses the pressing need for high-quality, domain-specific resources to advance the state of entity alignment techniques in financial knowledge graphs.

**Biography:** Rui Fan is a master's graduate of HEC Montreal and GERAD, and a current A.I. and Data Engineer at the Royal Bank of Canada. Her areas of research include optimization and machine learning. She is particularly interested in risk-aware optimization, integrated machine learning with operation research, and its applications in finance and e-commerce industries.

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**Saeed MARZBAN**, Ernst & Young, Senior Technology Consultant

[Tuesday November 7, 15:40 P.M]

*WaveCorr: Deep Reinforcement Learning with Permutation Invariant Convolutional Policy Networks for Portfolio Management*

We present a new portfolio policy convolutional neural network architecture, WaveCorr, for deep reinforcement learning applied to portfolio optimization. WaveCorr is the first to treat asset correlation while preserving asset invariance property, a new permutation invariance

property that significantly increases the stability of performance in problems where input indexing is done arbitrarily. A general theory is also derived for verifying this property in other fields of application. Our experiments show that WaveCorr consistently outperforms other state-of-the-art convolutional architectures.

**Biography:** I am a technology consultant at EY, specializing in guiding organizations through comprehensive data analytics lifecycle modernization using cutting-edge cloud technologies such as SAS Viya, DataBricks, and Snowflake hosted by main cloud providers (Azure, AWS, GCP). With expertise spanning ETL, modeling, reporting, and AI implementation (Time Series Analysis, Gen-AI), I have led numerous modernization projects, crafting innovative Gen-AI tools to streamline the transition from legacy systems. I graduated from HEC Montreal with a PhD in Financial Engineering, and my thesis has been on reinforcement learning.

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**Tiguéné NABASSAGUA**, BNP Paribas CIB, Vice-Président, Model Validation

[Tuesday November 7, 16:05 P.M]

*AI and ML for operational risk management*

We explore various applications of artificial intelligence (AI) and machine learning (ML) in the quantification and management of operational risk.

**Biography:** Tiguéné Nabassaga has recently joined the Model Validation Team at BNP Paribas CIB. Before joining BNP Paribas, Tiguéné held a managerial role in the EY Data & Analytics practice, where he was involved in diverse projects concerning operational risk modeling, Model Risk Management, and the implementation of technology for financial risk management. Over the course of his career, Tiguéné has worked with a range of clients in different sectors, including banks, insurance companies, and development financial institutions.

## DAY 2: WEDNESDAY 8 NOVEMBER

### *Investments & Risk Management*

**Frédéric GODIN**, Concordia University, Associate Professor

[Wednesday November 8, 08:35 A.M]

*Equal risk pricing of derivatives with deep hedging*

The equal risk pricing methodology for derivatives pricing is introduced. The deep reinforcement learning associated implementation is discussed.

**Biography:** Frédéric Godin is an Associate Professor, Mathematics and Statistics, at Concordia University. He studies financial engineering, risk management and machine learning.

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**Parisa DAVAR**, Concordia University, Masters Student

[Wednesday November 8, 08:45 A.M]

*Risk Averse Policy Gradient Approach for CVaR*

In this work, our focus is on the risk-averse Policy Gradient algorithm in a tail risk optimization problem. Our objective is to find the optimal policy that minimizes tail risk, given a risk measure such as Conditional Value at Risk (CVaR). We employed Extreme Value Theory, along with the automated threshold method to manage risks associated with extreme events. To assess our approach, we applied it to simulated data from heavy-tailed distributions, such as the generalized Pareto distribution (GPD) and the Burr distribution.

**Biography:** Parisa Davar is a master's student in financial mathematics at Concordia University. Her research interest lies in Machine Learning models for finance, risk management, and data analytics. She has experience in modeling limit order book dataset using Deep Learning models.

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**Carlos Octavio PÉREZ**, Concordia University, PhD Candidate

[Wednesday November 8, 08:55 A.M]

*Deep hedging for joint dynamics of the underlying asset and its implied volatility*

Deep hedging (Buehler et al. 2019) is a flexible framework to approximate hedging strategies in incomplete markets. In this work, we use the deep hedging algorithm equipped with a Recurrent Neural Network with a Feedforward Connection (RNN-FNN) to hedge vanilla European options

under the joint dynamics introduced by François et al. 2023. This work contrasts the performance of this framework considering different penalty functions such as conditional value at risk, mean-square-error and semi-mean-square-error and three well known benchmarks (Black-Scholes delta, Smile-implied delta and Leland delta) under several market conditions in the period of 1996–2020. Furthermore, our analysis takes into account market frictions (transaction cost) and different moneyness scenarios such as deep-out and deep-in the money options for short-term and long-term maturities. We also provide explainability of the framework in terms of the implied volatility dynamics using the SAGE methodology for machine learning explainability.

**Biography:** Carlos Pérez, current PhD student at Concordia University, is a science enthusiast with over five years of experience in designing and developing machine learning and probabilistic models to provide solutions to financial problems. His main goal is to contribute to the consolidation of machine learning solutions in finance.

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**Rosnel SESSINOU**, HEC Montreal, Postdoctoral fellow

[Wednesday November 8, 09:05 A.M]

*Precision Least Squares: Estimation and Inference in High-Dimensions*

The least squares estimator can be cast to depend only on the precision matrix. We show that a consistent estimator of the latter can be directly used to obtain a consistent estimator of the former even in high-dimensional regression problems where the number of covariates can be larger than the sample size. We call this the {precision least squares} estimator. We show that it is asymptotically Gaussian and delivers uniformly valid inference irrespective of the sparsity within the data generating process. Since bias can still hinder the estimates when using consistent but regularized precision matrix estimators, we show how to construct a nearly unbiased least squares estimator.

We illustrate the relevance of regularized precision matrices on both simulated and real data. Contrary to the systemic risk literature based on multivariate autoregressive models for stock returns, and more in line with the theory of financial market fragility, we find evidence that returns connectedness of 88 global banks drastically decreases during crisis periods.

**Biography:** Rosnel is a Postdoctoral Researcher in the Department of Decision Sciences at HEC Montréal. He holds a Ph.D in Economics from Aix-Marseille School of Economics, a French research center. His research interests are Finance, Econometrics, Machine Learning and High-dimensional Statistics.



**Md Hasib Uddin MOLLA**, University of Calgary, PhD Candidate

[Wednesday November 8, 09:15 A.M]

*Deep Learning-based Method for Financial Decision-making Problems*

Many strategic decision-making problems in finance may be modeled as stochastic optimal control problems. To solve a stochastic optimal control problem one may solve the associated coupled forward-backward SDE that comes from the maximum principle theorem. We extend Deep learning-based methods for numerical approximations of non-Markovian coupled FBSDEs. Here we explain through an example how portfolio optimization problems may be solved by Deep-learning methods applied to coupled FBSDEs.

**Biography:** Hasib is pursuing a PhD in Financial Mathematics at the University of Calgary. The main area of research is coupled forward-backward stochastic differential equations (FBSDEs) and non-linear SPDEs that may arise from the Stochastic Optimal Control problems and the Mean-Field Game systems.

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**Francis HUOT CHANTAL**, Université de Montréal, PhD Candidate

[Wednesday November 8, 09:35 A.M]

*TSbench : Multivariate time series simulation with applications*

TSbench is a Python package offering a general framework to simulate and forecast multivariate time series models, ensuring reproducibility by allowing the definition of simulation parameters such as random generators, models, data, metrics, etc. TSbench has been tailored to deal with financial problems, for instance option pricing and portfolio selection, but can be used for a variety of other applications. As an illustration, we present the pricing of an American max put option on two underlying assets with no closed-form solution.

**Biography:** Currently pursuing my PhD with a focus on High Frequency Trading and Time Series Analysis, I am passionate about uncovering patterns in financial data that drive market dynamics. Armed with a strong foundation in time series analysis, I apply cutting-edge machine learning techniques to unravel insights from complex financial data.

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**Yaw ASOMANI**, University of Calgary, PhD Candidate

[Wednesday November 8, 09:45 A.M]

*A Hybrid Modeling and Pricing of Financial Derivatives Using GARCH and Neural Networks*

The main subject of this research presentation is to explore a new approach to volatility modeling and subsequently options pricing using a novel hybrid system of econometric models and neural networks. Several empirical studies have been made to study the volatility of returns using discrete volatility models like GARCH-type models and their continuous counterparts in Stochastic Volatility (SV) models. Others have made efforts in the study of volatility using neural networks to varying degrees of success. Empirical evidence shows that a combination of both the econometric models and neural networks tend to offer better predictive performance than pursuing each paradigm individually. This presentation demonstrates several models to model volatility using a hybrid GARCH-type and neural network modeling by varying some of the parameters of the GARCH-type model with respect to time. This time varying dynamic is governed by the neural network.

**Biography:** Yaw Asomani is currently a PhD student with the department of Mathematics and Statistics at the University of Calgary. His main concentration is in the area of Math Finance.

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**Ningsheng ZHAO**, Concordia University, PhD Candidate

[Wednesday November 8, 09:55 A.M]

*Explaining Machine Learning Model Informatively*

1. Explore the informative dependence of model outcomes on each feature, e.g., what elements are associated with certain types of risk;
2. Remedy untenable feature independence or parametric assumptions that cause under-informative explanations;
3. Improve the robustness to data sparsity that easily results in over-informative explanations.

**Biography:** Ningsheng is currently a PHD candidate in Information and Systems Engineering from Concordia University, and obtained his master's diploma in Statistics from the University of Waterloo. His research interests are machine learning and data science. His current research is focusing on machine learning models' diagnostics and explanation techniques and their applications in business.

**Kirill GOLUBNICHY**, University of Calgary, Postdoctoral fellow

[Wednesday November 8, 10:05 A.M]

*Forecasting Stock Options Prices via the Solution of an Ill-Posed Problem for the Black-Scholes Equation, Recovering volatility coefficient and Neural Network Machine Learning.*

In the paper (Inverse Problems, 32, 015010, 2016), a new heuristic mathematical model was proposed for accurate forecasting of prices of stock options for 1-2 trading days ahead of the present one. This new technique uses the Black-Scholes equation supplied by new intervals for the underlying stock and new initial and boundary conditions for option prices. The Black-Scholes equation was solved in the positive direction of the time variable. This ill-posed initial boundary value problem was solved by the so-called Quasi-Reversibility Method (QRM). This approach with an added trading strategy was tested on the market data for 368 stock options and good forecasting results were demonstrated. In the current paper presented here, we use the geometric Brownian motion to provide an explanation of that effectivity using computationally simulated data for European call options. We also provide a convergence analysis for QRM. The key tool of that analysis is a Carleman estimate.

**Biography:** Kirill V. Golubnichiy is a Postdoctoral Associate at the University of Calgary. He obtained his Ph.D from University of Washington in 2022. His research interests are twofold: (1) developing mathematical tools to analyze the partial differential equations (PDEs) that govern pricing financial assets; and (2) developing computational, statistical (GARCH) and machine learning algorithms to analyze the forecasting power of those analytic methods.

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**Mamadou Yamar THIOUB**, HEC Montreal, PhD Candidate

[Wednesday November 8, 10:15 A.M]

*Regime-based Dynamic Asset Allocation*

The objective of this project is to perform tactical deviations from a strategic portfolio using short-term business cycle forecasts. Assets moments are forecasted with HMM, and the portfolio allocation is based on the risk-budgeting strategy.

**Biography:** Mamadou is a quantitative researcher at PSP Investment. His research focuses on factor investing and portfolio management. He is also pursuing a PhD in Data Science at HEC Montreal.

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**Manuel MORALES**, Université de Montréal, Professor

**Cédric POUTRÉ**, Université de Montréal, Recent PhD Graduate

[Wednesday November 8, 10:45 A.M]

*Detecting Anomalies from High Frequency Trading Activity in the Limit Order Book (Regulatory Division - Montreal Exchange TMX)*

The regulatory division of the Montreal Exchange - TMX has the mandate to detect and legally act on activities that are not compliant and that seek to manipulate the market for the benefit of a third party. We explore several deep learning techniques to construct a pipeline that allows the implementation of anomaly detection models in production. We also explore NLP techniques to detect external signals that could help inform models targeting insiders trading.

**Manuel Morales Biography:** Professor at the University of Montreal working in the field of applied Artificial Intelligence in banking and investment. Former Chief AI Scientist at National Bank of Canada, the sixth largest bank in Canada, and former Digital Strategy & Innovation Advisor at PSP Investments, one Canada's largest pension investment funds. Director of the FinML network, whose mandate is to train the next AI-enabled generation of finance and banking professionals while building bridges between the industry sector and the research community in the province of Quebec. Currently working on the impact of AI in measuring and reporting ESG footprint in the context of sustainable finance. Active member of the FinTech community in Montreal where I play different roles as advisor and founder.

**Cédric Poutré Biography:** Cédric is a recent Ph.D. graduate in Financial Mathematics from Université de Montréal under the supervision of professor Manuel Morales. Passionate about statistical arbitrage and algorithmic trading, he joined Fin-ML and IVADO in 2019 as a graduate researcher to explore Machine Learning applications in these fields. Since then, Cédric has published his work on high-frequency statistical arbitrage in top peer-reviewed journals like International Journal of Forecasting, and International Review of Financial Analysis.

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**Luca LALOR**, University of Calgary/Futures First, PhD Candidate /Quantitative Researcher

**Timothy DELISE**, Université de Montréal, PhD Candidate

**Myles SJOGREN**, University of Calgary, Quantitative Researcher

[Wednesday November 8, 11:15 A.M]

*High Frequency Market Making and ML Trading in Futures Markets*

An important type of financial market participant is the market maker (MM). The MM aims to facilitate trades, profit from the spread (best ask-best bid), optimize their trade executions, and adapt to changing market conditions. One can build a stochastic optimal control problem whereby the MMs aim is to maximize terminal wealth by trading in and out of positions using limit orders. We will discuss how MMs are often exposed to adverse selection risk, which we try to incorporate in our model by making short-term alpha predictions. A core aspect of market making is the short-term alpha. We've developed several methods for utilizing cutting edge ML techniques to predict alpha at various time horizons. We have shown ML short-term alpha outperforms more traditional signals like order flow. We also develop medium-term alpha predictions which lead to profitable active-trading strategies. At futures first, we've worked from the ground up to develop our own data mining methodology from the hardware to the software. We have a full ML pipeline in place which harvests real-time tick data from the futures markets, trains models, simulates, and deploys live trading algorithms. Our talk will highlight basic principles for applying ML models in this domain.

**Luca LALOR Biography:** Luca Lalor is a PhD candidate in Mathematical Finance at the University of Calgary and a Quantitative Researcher at Futures First. His main research interests lie in Algorithmic and High Frequency Trading. Prior to his new research role, Luca has 5 years of experience in equity trading.

**Timothy DELISE Biography:** Timothy DeLise is a PhD candidate in Mathematics at University of Montreal. His research of interests are Mathematics, Machine Learning, and Software Development.

**Myles SJOGREN's Biography:** Myles has an MSc in Financial Mathematics from the University of Calgary and now works as a quantitative analyst for Futures First. His research revolves around the goal of finding practical trading applications of machine learning and data science.

## DAY 2: WEDNESDAY 8 NOVEMBER

### *Upcoming trends*

**Pierre ROSIN**, JACOBBS, AI project manager

[Wednesday November 8, 11:45 A.M]

*Finance Evolution with Generative AI*

In our presentation, we will delve deep into the practical application of generative AI, paying special attention to its implications in the financial sector. As the integration of such technologies rapidly progresses, it is imperative to address the pressing ethical challenges they introduce. A central question we aim to explore is: to what extent should we entrust AI with the pivotal role of decision-making and providing nuanced recommendations?

**Biography:** Pierre Rosin holds a master's degree from the University of Montreal in mathematical and computational finance. He is currently working as an artificial intelligence project manager at JACOBBS. He also worked for 3 years in the financial regulation sector.

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**Vincent RACINE**, University of Waterloo, Master's Student

[Wednesday November 8, 12:15 P.M]

*Learning capacities from data in large universes*

Capacities (non-additive set functions, or fuzzy measures) and the associated notion of a Choquet integral provide a flexible class of aggregation operators. In nonparametric settings, such fuzzy measures need to be estimated from available data. For a large number of inputs, the exponential complexity of all the interactions is a major obstacle in learning fuzzy measures from data. We propose a novel neural network-based algorithm that estimates a fuzzy measure by learning the pseudo-Boolean function associated with it. The proposed method allows for efficient learning of fuzzy measures in dimensions up to 100 variables, which is significantly higher than existing methodologies in the literature.

**Biography:** Vincent Racine is a master's student in Computational Mathematics at the University of Waterloo.

## DAY 2: WEDNESDAY 8 NOVEMBER

### *Electricity Markets*

**Geneviève GAUTHIER**, HEC Montréal, Full Professor

[Wednesday November 8, 14:00 P.M]

*Foreseeing the worst: Forecasting electricity DART spikes*

Statistical learning models are proposed for the prediction of the probability of a spike in the electricity DART (day-ahead minus real-time price) spread. Assessing the likelihood of DART spikes is of paramount importance for virtual bidders, among others. The model's performance is evaluated on historical data for the Long Island zone of the New York Independent System Operator (NYISO). A tailored feature set encompassing novel engineered features is designed. Such a set of features makes it possible to achieve excellent predictive performance and discriminatory power. Results are shown to be robust to the choice of the predictive algorithm. Lastly, the benefits of forecasting the spikes are illustrated through a trading exercise, confirming that trading strategies employing the model predicted probabilities as a signal generate consistent profits.

**Biography:** Geneviève Gauthier est professeure à HEC Montréal et se spécialise en ingénierie financière. En recherche, elle s'intéresse à l'économétrie financière appliquée à divers marchés: les actions et les indices, le marché de produits dérivés, le risque de crédit et ses produits dérivés, les matières premières et l'énergie.

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**Anthony FORGETTA**, Concordia University, Ph.D. Candidate

[Wednesday November 8, 14:20 P.M]

*Distributional forecasting of electricity DART spreads with mixture models*

We propose using a dynamic finite mixture model to describe the behavior of electricity DART spreads in Long Island, a single zone in the NYISO (New York Independent System Operator). Three regimes are considered: a regular DART regime, a positive spike regime, and a negative spike regime. We therefore attempt to model both the frequency and severity of DART spread spikes, among other characteristics. The covariates considered include load data, weather data, and fuel price data. Our model can be used to develop a risk management framework for power merchants.

**Biography:** Anthony Forgetta holds a B.Sc. in Actuarial Mathematics, with a Minor in Multidisciplinary Studies in Science. He fast-tracked from his Masters to the Ph.D. program, where his main areas of interest include mathematical finance and statistical modeling.

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**Yang YANG**, University of Calgary, PhD Candidate

[Wednesday November 8, 14:40 P.M]

*Stochastic Path-Dependent Volatility Model and the Associated Swing Option Pricing in Natural Gas Market*

This talk is devoted to the price-storage dynamics in natural gas markets. A novel stochastic path-dependent volatility model is proposed with path-dependence introduced in both price volatility and storage increments. Model calibrations are conducted for both the price and storage dynamics. Further, we discuss a pricing problem of a specific discrete swing option using the dynamic programming principle, and a deep learning-based method is proposed for numerical approximations. A numerical algorithm is provided, followed by a convergence analysis result for the deep-learning approach.

**Biography:** Yang Yang is a PhD student in Mathematics at the University of Calgary. His research of interest is stochastic optimal control theory.



## DAY 2: WEDNESDAY 8 NOVEMBER

### *Sustainable investments*

**Frédéric RIVARD**, HEC Montréal / McGill St Laurent, Carbon Trading and FX Risk Management Analyst

**Daniel SUTHERLAND**, McGill St Laurent, Commercial Lead

**Pierre-Luc LAMONTAGNE**, McGill St Laurent, Carbon Solutions Lead

**Luc BAILLARGEON NADEAU**, LCL Environnement, Directeur du département de Développement Durable

[Wednesday November 8, 15:20 P.M]

*Comment naviguer dans le « Wild West » des crédits carbone.*

Le panel va explorer plusieurs questions, notamment : Quelle est la différence entre les marchés légiférés et volontaires? Quelle est l'importance de la quantification, de la stratégie de réduction, et de la compensation dans une stratégie de décarbonation? Comment identifier des projets et crédits de haute qualité, en examinant les standards reconnus vs les projets autonomes? Comment une réelle diligence raisonnable peut-elle être faite? Comment naviguer les risques de "greenwashing", ainsi que les risques réputationnel liés aux pressions médiatiques? Comment le "big data" et la modélisation jouent-elles un rôle crucial dans la gestion des émissions de carbone?

Prêts à plonger dans le monde complexe mais essentiel des crédits carbone ?

**Frédéric Rivard Biography:** Frédéric est agriculteur de quatrième génération, diplômé en sciences agro environnementales de l'université McGill et termine bientôt sa maîtrise en Ingénierie financière au HEC. Avant de rejoindre McGill St Laurent Solutions Climat en tant qu'Analyste carbone, Frédéric a travaillé en développement international et à la Banque Nationale au sein de l'équipe Commodity Derivatives.

**Daniel Sutherland Biography:** Agriculteur de septième génération, Daniel a grandi sur la ferme familiale à Godmanchester, Québec. Diplômé de la Royal Agricultural University (BSc. Agribusiness) et de l'Université de Genève (MSc. Commodity Trading), Daniel dirige aujourd'hui les divisions de Solutions Climat et de commodités agricoles chez McGill St Laurent.

**Pierre-Luc Lamontagne Biography:** Diplômé de l'UQTR en comptabilité, Pierre-Luc a commencé sa carrière chez en vérification chez PwC. En 2011, il a fondé une entreprise œuvrant dans le développement de projets carbone en foresterie sur le marché volontaire, ayant obtenu la première homologation en Amérique du Nord d'un projet de reboisement certifié Gold Standard. Pierre-Luc est aujourd'hui Lead de solutions carbone chez McGill St Laurent Solutions Climat.

Luc Baillargeon Nadeau Biography: Luc Baillargeon-Nadeau, directeur du département de Développement Durable, est géologue spécialisé en environnement pour LCL. Ses études aux cycles supérieurs et son expérience professionnelle l'ont amené à se spécialiser en développement durable et en lutte contre les changements climatiques pour les entreprises, organismes et municipalités.

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**David ARDIA**, HEC Montréal, Associate Professor

[Wednesday November 8, 16:00 P.M]

*Climate Change Concerns and the Performance of Green vs. Brown Stocks*

We empirically test the prediction of Pastor, Stambaugh, and Taylor (2021) that green firms outperform brown firms when concerns about climate change increase unexpectedly, using data for S&P 500 companies from January 2010 to June 2018. To capture unexpected increases in climate change concerns, we construct a daily Media Climate Change Concerns index using news about climate change published by major U.S. newspapers and newswires. We find that on days with an unexpected increase in climate change concerns, the green firms' stock prices tend to increase while brown firms' prices decrease. Further, using topic modeling, we conclude that this effect holds for concerns about both transition and physical climate change risk. Finally, we decompose returns into cash flow and discount rate news components and find that an unexpected increase in climate change concerns is associated with an increase (decrease) in the discount rate of brown (green) firms.

**Biography:** David Ardia is an IVADO professor in the Department of Decision Sciences at HEC Montréal. Trained in quantitative methods for finance, he has a keen interest in asset allocation, risk management, and text-mining. In 2018, the Swiss Risk Association awarded him "Swiss risk manager of the year". He is a regular member at GERAD, Quantact, and Fin-ML, an associate researcher at OBVIA, and an instructor at DataCamp. When he is not coding, he plays a foodie in downtown Montréal.

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**Elham KHERADMAND**, Université de Montréal, Postdoctoral Researcher

[Wednesday November 8, 16:15 P.M]

*AI Revolution: Unveiling the Power of Technology in ESG Investing*

In the presentation, we explore the revolutionary impact of artificial intelligence in the world of ESG (Environmental, Social, and Governance) investing. We delve into how AI's data-processing prowess enables us to uncover deeper insights into environmental, social, and governance

factors. Additionally, we will explore how natural language processing is helpful in extracting information. Discover how AI-driven analytics, coupled with NLP capabilities, can enhance decision-making, promote sustainable investing, and drive positive change.

**Biography:** Elham, a postdoctoral researcher at the University of Montreal, specializes in machine learning for sustainable finance, with a focus on climate change. She has rich experience, having worked as a lead AI scientist at Clearsum and R&D Scientist at Axionable as a Fin-ML postdoc fellow. With a Ph.D. in Mathematics, she champions AI for social good, mentoring students and supporting women in AI through her involvement in organizations like Mila and Women in AI. Her dedication earned her a “*2022 Women in Artificial Intelligence award in North America*”.

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**Fabrizio SABELLI**, Université de Montréal, Masters Student

[Wednesday November 8, 16:30 P.M]

*Leveraging Large Language Models for ESG Investing in Finance*

In the finance sector, large language models are reshaping ESG (Environmental, Social, and Governance) investment decision making. These models play a pivotal role in accelerating document scoring pipelines and enabling more informed and efficient ESG investment choices. However, the automation of data extraction from financial documents remains a multifaceted and resource-intensive challenge. The crux of this challenge lies in the critical need for precise and accurate data annotation, which remains a primary bottleneck. Consequently, there is an urgent imperative to construct robust prompt engineering and optimization frameworks. These frameworks serve to enhance the scalability of data pipelines, effectively mitigating costs and facilitating the development of efficient, high-precision data annotation pipelines.

This presentation will delve into the realm of prompt engineering and optimization as a strategic approach to harness the potential of large-language models in automating this process.

**Biography:** Fabrizio is currently a Master's student in Applied Mathematics at the Université de Montréal. He completed his Bachelor's degree in Mathematics and Computer Science at McGill University. His research interests primarily lie at the intersection of stochastic processes, machine learning, and sustainable finance.