ML/FIN

ML/FIN EXCHANGE RATE:

MATHEMATICAL INSIGHTS FROM MARKETS, CONTROL, AND LEARNING.

Abstract

Despite their undeniable success in recent decades, conventional models in financial mathematics require knowledge of the parameters of a model which is often lacking in practice. The use of machine learning (ML) offers immense potential to address this gap by enabling more accurate modelling of financial markets and more informed decision-making.

On the other hand, the wide range of problems studied in financial mathematics, such as optimal execution and portfolio management, has begun attracting the interest of researchers in learning theory. Furthermore, the advanced mathematical tools traditionally used in financial mathematics are now contributing to several notable advances in learning theory and its recent applications, such as *diffusion models*.

Therefore, it is evident that these two communities are complementary in many respects, and interdisciplinary collaborations between them should be promoted. This workshop aims to bring together young researchers from these two fields to share their ideas, challenges, and methods, thereby building interdisciplinary bridges that will open exciting new perspectives in the fields of mathematical finance and machine learning.

CONFERENCE DETAILS

The workshop will take place over one work week (Monday-Friday) in September or October of 2024, depending on venue availability. We aim to welcome approximately 30 participants at an early stage of their academic career (PhD, Postdoc, and young permanent researchers) from a range of backgrounds.

Conference Venue

The workshop will be organised at one of the CNRS conference centres (CIRM, CAES, etc.), based on availability. Care will be taken for the practicality of access to ensure travelling costs for young researchers are kept down.

Applications

To ensure the scientific excellence of the workshop, we will take applications from prospective attendees. The organisation committee will shortlist applications based on relevance of work to

the conference, under the supervision of the scientific committee. Places will be allocated according to the shortlist with priority given to selected speakers.

CONFERENCE ORGANISATION

Organisation Committee

- Lorenzo Croissant. Postdoc, CREST, ENSAE, and Inria, FairPlay team.
- Antonio Ocello. Postdoc, CMAP, Ecole Polytechnique.
- Grégoire Szymanski. Ph.D. student, CMAP, Ecole Polytechnique.

Scientific Committee

- Huyên Pham. Professor, LPSM, Université Paris Cité.
- To be announced
- To be announced
- To be announced
- To be announced
- Éric/Mathieu? (éviter de mettre trop d'X)
- CA Lehalle / O guéant?
- Stephane Crepey, Julien Guyon

Finances

To be able to welcome Ph.D. students regardless of funding situation, we aim to finance the fees of the stay of all attendees. Any further funding will be used to support further participants, up to the limit imposed by accommodation (50) and to support travel expenses of students in need.

We solicit funding from interested sponsors, both academic and private to cover these expenses. Finances will be managed by Justine Viaud at CREST.

Sponsorships will be recognised in the advertising materials to attendees, including recognition during the opening of the conference. A report summarizing all the talks and events of the conference will be produced and distributed to sponsors after the workshop. We will also support and participate in other outreach efforts of sponsors, for instance with photographs of the event. Further, we welcome participants from our sponsors to give talks on topics (theoretical or practical) of interest to them.

Budget plan

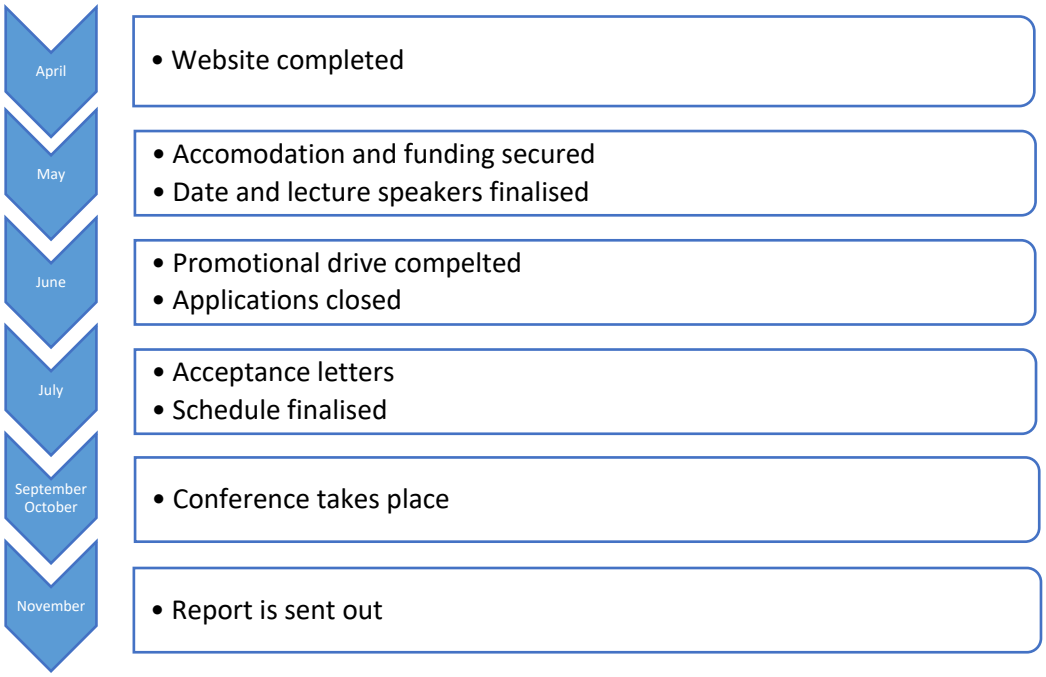
Below is a list of expected expenditure and funding sources of the conference, to be revised as organisation progresses. Its finalised version will be made available after the conference.

Expense	Number of units	Unit cost	Total cost
Accommodation at CIRM	30	555,00 €	16.650,00 €
Total			16.650,00 €

Funding	Source	Value
BOUM Project grant	SMAI	1000,00 €
Total		1000,00 €

Timeline

Below is an estimated organizational timeline, indicating milestones to be reached by the end of the corresponding month.



SCIENTIFIC PROGRAM

Overview

The workshop focuses on interdisciplinary contributions at the intersection of Applied and Financial Mathematics, Statistics, Economics, and Computer Science, welcoming both theoretical and empirical work. The objective is to build bridges between these communities at the level of young researchers to forge connections that will drive interdisciplinary research forward in the future.

We hope theorists can recognise tools and problems of shared interest across disciplinary boundaries as well as draw on real-world problems to inspire their work. Conversely, we hope applied researchers can find theoretical guidance and practical expertise for their problems and propose new problems which spur the theoretical fields forwards. To realise this vision, we have centred the scientific program around 5 sessions each of which straddles disciplinary boundaries while also engaging in a dialogue with other sessions.

Economic theory of markets

This session delves into the foundational theories underpinning market dynamics, including auction theory, market design, and matching algorithms. Researchers will explore the theoretical frameworks governing market equilibrium, price discovery mechanisms, and allocation efficiency in various market structures. Discussions will encompass the intricacies of auction mechanisms, the design of market platforms, and the role of matching algorithms in optimizing resource allocation. Through mathematical analyses of theoretical models, participants will uncover insights into market efficiency, liquidity provision, and the impact of market microstructure on price formation. These theoretical insights, leveraging mostly Economics and Computer Science tools should provide the basis of comparison with real-world market situations.

Markets in the real world

This session focuses on the empirical realities and statistical phenomena observed in real-world markets, encompassing diverse financial instruments as well as markets lying outside traditional financial domains. Topics include market microstructure dynamics, statistical properties of asset returns, and the influence of exogenous factors on market behaviour. Case studies will explore the intricacies of trading in non-financial markets, such as commodities, energy, and advertising, and shed light on the challenges posed by various aspects of market structure (auction format, regulatory environments, etc.). Traditional mathematical finance will find new, exotic markets which welcome its mature tools, while also shedding new light on the influence of the market format via comparative analysis.

Learning to Control

This session, dedicated to control problems, explores innovative approaches to resolving control problems in dynamic environments with imperfect knowledge or uncertain models. Researchers will discuss advancements in control theory, reinforcement learning theory, and adaptive control strategies. Topics range from theory to applications within the context of financial decision-making and may include the resolution of control problems under model uncertainty, reinforcement learning techniques for trading algorithms, and the development of robust control policies in uncertain market conditions. This session aims for the mutually beneficial convergence of expertise between theoreticians and practitioners of both control theory and reinforcement learning.

Integrating ML in decision problems

This session focuses on machine learning techniques which, unlike in reinforcement learning, do not learn from interactions with the decision problem but, instead, learn from prior data to predict key variables of interest in the decision problem.

Many practical approaches to integrating ML in decision problems involve using available data to learn to predict important variables of the decision problem, which are then fed to a (non-ML) decision maker. This session is dedicated to this perspective, sometimes known as *algorithms with predictions* and is a counter point to the session on learning to control. Researchers will present case studies showcasing the use of machine learning algorithms to forecast market parameters and inform investment decisions, as well as learning-theoretic explorations of this problem. Practitioners will be exposed to the key concepts of the budding theoretical basis for this approach, while theorists will be presented with a range of new problems to guide their study.

Fairness, privacy, and transparency in markets

Ensuring fairness, privacy, and transparency in financial markets is paramount for maintaining market integrity and public trust. This session examines the ethical, policy, and regulatory considerations surrounding data privacy, algorithmic bias, and market transparency in financial markets, in both theoretical and real-world markets. Researchers will discuss methodologies for detecting and mitigating biases in algorithmic decision-making, safeguarding sensitive financial information, and promoting equitable market access. Through interdisciplinary discussions, participants will explore the implications of emerging technologies on market fairness and transparency, and the role of regulatory frameworks in fostering trust and accountability in financial markets.

Program

To foster collaboration and discussion, we will host three types of talks broken up by many short breaks, namely:

- 5 Introductory courses (one for each thematic session) each consisting of 3 lectures of 45 minutes each.
- 7 Spotlight talks dedicated to exemplary interdisciplinary work or industry relevant problems lasting 45 minutes each (35m talk, 10m questions).
- 20 Short talks with posters encouraged, lasting 20 minutes each (15m talk, 5m questions).

Below is a draft schedule of the arrangement of the talks. Specific talks will be placed in the schedule based on speaker constraints, and wherever possible lectures in a session will precede the spotlights and short talks associated.

	Monday	Tuesday	Wednesday	Thursday	Friday
8:30-9:15	Opening Course 1 Lecture 1	Course 2 Lecture 1	Course 3 Lecture 2	Course 4 Lecture 2	Course 5 Lecture 3
9:15-9:30	Break				
9:30-10:15	Course 1 Lecture 2	Course 2 Lecture 2	Course 3 Lecture 3	Course 4 Lecture 3	Spotlight
10:15-10:45	Break				
10:45-11:30	Spotlight	Spotlight	Short Talks	Spotlight	Short Talks
11:30-11:45	Break				
11:45-12:30	Short Talks	Short Talks	Course 4 Lecture 1	Short Talks	Short Talks Closing
12:30-14:00	Lunch				
14:00-14:45	Course 1 Lecture 3	Course 2 Lecture 3		Course 5 Lecture 1	
14:45-15:00	Break			Break	

15:00-15:45	Spotlight	Spotlight	Left free for activities	Course 5 Lecture 2	Left free for return travel
15:45-16:15	Break			Break	
16:15-17:00	Short Talks	Short Talks		Spotlight	
17:00-17:15	Break			Break	
17:15-18:00	Short Talks	Course 3 Lecture 1		Short Talks	

POTENTIAL SPEAKERS LIST

Introductory courses

1. Economic theory of markets,

Simon Mauras is a permanent researcher at INRIA, in the FAIRPLAY team, working on topics of Mechanism Design, auctions and Fairness. Prior to this position, he was a postdoctoral Fellow at Tel Aviv University, working on algorithmic Mechanism Design. He holds a Ph.D. in Computer Science from IRIF and Université Paris Cité, under the supervision of Claire Mathieu.

2. Markets in the real-world,

To be announced.

3. Learning to control,

Lorenzo Croissant is currently a postdoc researcher at ENSAE working on topics in control and learning theory, as part of the FAIRPLAY INRIA team. He holds a Ph.D. in Mathematics from Université Paris-Dauphine, under the supervision of Bruno Bouchard and Marc Abeille.

4. ML in decision problems,

To be announced.

5. Fairness, privacy, transparency in markets,

Felipe Garrido-Lucero is currently a postdoc researcher in Market design & Fairness at FAIRPLAY, joint team between INRIA, IP Paris (ENSAE and Ecole Polytechnique), and Criteo. He defended his Ph.D. in Computer Science in 2022 at Université Paris-Dauphine, under the supervision of Rida Laraki.

Potential Attendees

A non-exhaustive list of researchers which fall within the purview of the conference and will be invited to apply.

Name	Affiliation	Name	Affiliation
Morgane Goibert	CFM	Shaun Li	Université Paris-Dauphine, AXA
Solenne Gaucher	ENSAE	Louis Armand Gerard	Université Paris I, GEFIP
Matilde Tullii	ENSAE	Songbo Wang	Ecole Polytechnique
Maria Cherifa	ENSAE, Criteo	Assil Fadle	Ecole Polytechnique
Emanouil Sfendourakis	Ecole Polytechnique	Redouane Silvente	Ecole Polytechnique
Alexander Merkel	TU Berlin	Fanny Cartellier	ENSAE
Timothée Fabre	École Centrale, Sun Zu Lab	Alicia Bassière	ENSAE
Vincent Ragel	Ecole Centrale	Jodi Dianetti	Universität Bielefeld
Nathan De carvalho	Université Paris-Cité, Engie	Maximilien Germain	Morgan Stanley
Jules Delemotte	Ecole Polytechnique	Alessio Brini	Duke University
Siu Hin Tang	NUS	Felix Prenzel	University of Oxford

Adele Ravagnani	SNS Pisa	Chao Zhang	University of Oxford
Paul Hager	Humboldt Universität	Ioannis Gasteratos	Imperial College London
Florin Suciu	Université Paris-Dauphine	Carl Remlinger	EPFL
Janka Möller	Universität Wien	Melih İşeri	University of Michigan
Steven A. Campbell	Columbia University	Jiacheng Zhang	University of California at Berkely
Purba Das	King's College London	Antoine Heranval	ENSAE
Gökce Dayanikli	University of Illinois Urbana-Champaign	Victor Le Coz	Ecole Polytechnique, Quant AI Lab
Claire Vallade	Université Paris-Dauphine Banque de France	Wei Xiong	University of Oxford
Flore Sentenac	HEC	Simon Mauras	INRIA
Simon Finster	INRIA	Felipe Garrido-Lucero	INRIA
Entienne Boursier	Université Paris-Saclay	Giovanni Montanari	ENSAE
Giulia Romano	Politechnico di Milano	Hugo Richard	Criteo
Mathieu Molina	INRIA	Ziyad Benomar	ENSAE