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## Chaire Risques Financiers

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**Partenaires** : Ecole Polytechnique - Ecole des ponts - Sorbonne Université – Société Générale

**Responsables Scientifiques** : Nicole El Karoui (Sorbonne Université), Nizar Touzi (Ecole Polytechnique)

**Site internet** : <https://www.institutlouisbachelier.org/programme/risques-financiers/>

### DESCRIPTION DU PROGRAMME DE RECHERCHE

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Les grandes thématiques de la Chaire pour 2022 sont :

- Nouveaux enjeux de modélisation : modélisation de la contagion et du risque systémique ; modélisation de la dépendance ; valorisation, couverture et robustesse ; le risque de crédit ; risque à long terme et risque de longévité.
- Méthodes numériques et simulations : risques extrêmes ; imperfections du marché et équations non linéaires ; techniques de simulation efficaces.
- Haute fréquence : statistiques et gestion optimale, connexion à la régulation

Elles tiennent compte des évolutions majeures ayant eu lieu dans les marchés financiers durant ces années de crise financières, tant que sur le plan de la modélisation que sur celui de l'implémentation numérique.

Les résultats de ces recherches sont d'un niveau académique d'excellence et donnent lieu à des publications internationales dans les journaux de premier rang du domaine. Parallèlement, un effort pédagogique de valorisation de la recherche est mis en œuvre vers les praticiens et les étudiants.

### EQUIPE DE RECHERCHE

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- Aurélien Alfonsi, ENPC
- Benjamin Jourdain, ENPC
- Eduardo Abi Jaber, Ecole Polytechnique
- Charles Bertucci, Ecole Polytechnique
- Stefano De Marco, Ecole Polytechnique
- Fabrice Djete, Ecole Polytechnique
- Emmanuel Gobet, Ecole Polytechnique
- Nizar Touzi, Ecole Polytechnique
- Lokman Abbas-Turki, Sorbonne University
- Nicole El Karoui, Ecole Polytechnique,
- Idris Kharroubi, Sorbonne University
- Daphné Giorgi, Chaire Risques financiers,
- Vincent Lemaire, Sorbonne University
- Gilles Pagès, Sorbonne University

### **Chercheurs Associés**

- Sergio Pulido, Université d'Evry
- Claudio Fontana, University of Padova
- Ahmed Kebaier, Université d'Evry

### **Post doctorants**

- Alekos Cecchin, Ecole Polytechnique
- Haoyang Cao, Ecole Polytechnique
- Guillaume Szulda, ENPC

### **Chercheurs ingénieurs**

- Nicolas Baradel, Ecole Polytechnique

### **Doctorants**

- Joffrey DERCHU
- Bowen SHENG
- Mehdi TALBI
- Mehdi TOMAS
- Leila BASSOU
- Mouna BEN DEROUICHE
- Anas BENTALEB
- Guillaume BOUTOILLE
- Pierre BRAS
- Marcos CARREIRA
- Jérémy CHICHEPORTICHE
- Edoardo LOMBARDO
- Alexandre PREVOT
- Djibril SARR
- Nerea VADILLO FERNANDEZ
- Hervé ANDRES
- Roberta FLENGHI
- Assil Fadle
- Kexin SHAO
- Songbo Wang
- Nathan Sauldubois

### **PUBLICATIONS DE L'ANNEE**

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- E. Abi Jaber, The characteristic function of Gaussian stochastic volatility models: an analytic expression, *Finance and Stochastics* 26 (2022), no. 4, 733–769.
- The Laplace transform of the integrated Volterra Wishart process, *Mathematical Finance* 32 (2022), no. 1, 309–348.
- Y. Achdou, C. Bertucci, J.M. Lasry, P.L. Lions, A. Rostand, and J.A. Scheinkman, A class of short-term models for the oil industry that accounts for speculative oil storage, *Finance and Stochastics* 26 (2022), no. 3, 631–669.
- A. Bondu Y. Achenchabe A. Cornuéjols and V. Lemaire, Early and revocable time series classification, 2022 International Joint Conference on Neural Networks (IJCNN), 2022, pp. 1–8.

- R. Aïd, D. Possamaï, and N. Touzi, Optimal electricity demand response contracting with responsiveness incentives, *Mathematics of Operations Research*.
- A. Alfonsi, R. Coyaud, and V. Ehrlacher, Constrained overdamped Langevin dynamics for symmetric multi-marginal optimal transportation, *Mathematical Models and Methods in Applied Sciences* 32 (2022), no. 03, 403–455.
- M. Allouche, S. Girard, and E. Gobet, EV-GAN: Simulation of extreme events with ReLU neural networks, *Journal of Machine Learning Research* 23 (2022), no. 150, 1–39.
- A. Barrasso and N. Touzi, Controlled diffusion Mean Field Games with common noise, and McKean-Vlasov second order backward SDEs, *Journal of Theoretical Probability*.
- M. Beiglbořek, B. Jourdain, W. Margheriti, and G. Pammer, Approximation of martingale couplings on the line in the adapted weak topology, *Probability Theory and Related Fields* 183 (2022), no. 1-2, 359–413.
- O. Bencheikh and B. Jourdain, Approximation rate in Wasserstein distance of probability measures on the real line by deterministic empirical measures, *Journal of Approximation Theory* 274 (2022), 105684.
- Weak and strong error analysis for mean-field rank-based particle approximations of one-dimensional viscous scalar conservation laws, *The Annals of Applied Probability* 32 (2022), no. 6, 4143–4185.
- Convergence in Total Variation of the Euler–Maruyama Scheme Applied to Diffusion Processes with Measurable Drift Coefficient and Additive Noise, *SIAM Journal on Numerical Analysis* 60 (2022), no. 4, 1701–1740.
- C. Bertucci, M. Debbah, J.M. Lasry, and P.L. Lions, A spectral dominance approach to large random matrices, *Journal de Mathématiques Pures et Appliquées* 164 (2022), 27–56.
- Y. Achenchabe A. Bondu A. Bifet, V. Lemaire, and P.-F. Marteau, Open challenges for machine learning based early decision-making research, *ACM SIGKDD Explorations Newsletter* 24 (2022), no. 2, 12–31.
- R. El Nmeir, H. Luschgy, and G. Pagès, New approach to greedy vector quantization, *Bernoulli* 28 (2022), no. 1, 424–452.
- B. Jourdain and E. Kahn, Strong solutions to a beta-Wishart particle system, *Journal of Theoretical Probability* 35 (2022), no. 3, 1574–1613.
- B. Jourdain and G. Pagès, Quantization and martingale couplings, *Latin American Journal of Probability and Mathematical Statistics* 19 (2022), 1–22.
- Convex order, quantization and monotone approximations of ARCH models, *Journal of Theoretical Probability* 35 (2022), no. 4, 2480–2517.
- B. Jourdain and W. Margheriti, Martingale Wasserstein inequality for probability measures in the convex order, *Bernoulli* 28 (2022), no. 2, 830–858.
- One-dimensional martingale rearrangement couplings, *ESAIM:P&S* 26 (2022), 495–527.
- Y. Lin, Z. Ren, N. Touzi, and J. Yang, Random horizon principal-agent problem, *SIAM Journal on Control and Optimization* 60 (2022), no. 1, 355–384.
- Z. Ren, N. Touzi, and J. Yang, Nonlinear predictable representation, and L1-solutions of second-order backward SDEs, *Annales de l’Institut Henri Poincaré (B) Probabilités et statistiques*, 2022, pp. 639–666.
- F. Djete, D. Possamaï, and X. Tan, McKean–Vlasov optimal control: the dynamic programming principle, *The Annals of Probability* 50 (2022), no. 2, 791–833.
- McKean–Vlasov optimal control: limit theory and equivalence between different formulations, *Mathematics of Operations Research* 47 (2022), no. 4, 2891–2930.
- F. Djete, Extended mean field control problem: a propagation of chaos result, *Electronic Journal of Probability* 27 (2022), 1–53.
- F. Bourgey, E. Gobet, and C. Rey, A comparative study of polynomial-type chaos expansions for indicator functions, *SIAM/ASA Journal on Uncertainty Quantification* 10 (2022), no. 4, 1350–1383.
- F. Bourgey, E. Gobet, and Y. Jiao, Bridging socioeconomic pathways of CO<sub>2</sub> emission and credit risk, *Annals of Operations Research* (2022), 1–22.

- E. Gobet and M. Grangereau, Newton method for stochastic control problems, SIAM Journal on Control and Optimization 60 (2022), no. 5, 2996–3025.
- Extended McKean-Vlasov optimal stochastic control applied to smart grid management, ESAIM: Control, Optimisation and Calculus of Variations 28 (2022), 40.
- M. Allouche, S. Girard, and E. Gobet, A generative model for fBm with deep ReLU neural networks, Journal of Complexity 73 (2022), 101667.
- P.-E. Arrouy, A. Boumezoued, B. Jourdain, and S. Mehalla, Jacobi stochastic volatility factor for the LIBOR market model, Finance and Stochastics 26 (2022), no. 4, 771–823.
- M. Gaïgi, I. Kharroubi, and T. Lim, Optimal management and valuation of a natural resource: the case of optimal harvesting, Probability in the Engineering and Informational Sciences (2022), 1–21.
- V. Lemaire, T. Montes, and G. Pagès, Stationary Heston model: calibration and pricing of exotics using product recursive quantization, Quantitative Finance 22 (2022), no. 4, 611–629.
- Y. Liu and G. Pagès, Monotone convex order for the McKean–Vlasov processes, Stochastic Processes and their Applications 152 (2022), 312–338.
- Functional convex order for the scaled McKean-Vlasov processes, Annals of Applied Probability (2022).
- P. Bras, G. Pagès, and F. Panloup, Total variation distance between two diffusions in small time with un- bounded drift: application to the Euler-Maruyama scheme, Electronic Journal of Probability 27 (2022), 1–19.

## **RESTITUTION DES TRAVAUX LORS DE MANIFESTATIONS SCIENTIFIQUES**

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### **Conférences et écoles d'été**

Advances in Financial Mathematics, 14-17 janvier 2020, Paris. Web site : [https:// fin-risks2020.sciencesconf.org/](https://fin-risks2020.sciencesconf.org/)

13th European Summer School in Financial Mathematics, Vienna University, Septembre 2020. Site Web: [https://www.univie.ac.at/summer\\_school\\_MathFinance/index.htm](https://www.univie.ac.at/summer_school_MathFinance/index.htm)

### **Séminaires et groupes de travail**

A. Alfonsi et A. Kebaier co-organisent le séminaire hebdomadaire “numerical methods and finance” qui a lieu à Marne la Vallée et INRIA Paris, <https://cermics.enpc.fr/~alfonsi/GTMSF.html>.

A. Barrasso et T. Mastrolia co-organisent le séminaire hebdomadaire “mathematical finance” à Ecole Polytechnique, organisé avec Ensta ParisTech et ENSAE. <http://www.cmap.polytechnique.fr/spip.php?page=semfi>.

N. El Karoui, C. Hillairet et S. Kaakai co-organisent un groupe de travail sur “Longevity risk” à UPMC, <https://sites.google.com/site/gtlongevitelpma/home>, dans le frame-work de l’ANR Lolita.

I. Kharroubi et G. Pagès co-organisent le séminaire hebdomadaire “Financial mathematics, Actuarial Sciences and Numerical Probability”, <https://www.lpsm.paris/mathfipronum/gt>.

A. Alfonsi, N. El Karoui, G. Pagès et N. Touzi co-organisent le séminaire hebdomadaire Bachelier, <https://sites.google.com/site/seminairebachelierparis/>.

A. Kebaier co-organise le séminaire sur « probability and statistics » qui a lieu 2 fois par mois à l’Université Paris 13, <https://www.math.univ-paris13.fr/laga/index.php/fr/ps/seminaires>.

## AUTRES FAITS MARQUANTS

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La chaire intervient dans les Masters suivant :

- Probability and Finance of Sorbonne Université-X: <http://www.masterfinance.proba.jussieu.fr>. Co-headed by N. El Karoui, E. Gobet, G. Pagès and M. Rosenbaum.
- Mathematics and applications, finance track of UPEM: <http://www.u-pem.fr/formations/loffre-de-formationen/les-masters/domaine-sciences-technologies-sante/mention-mathematiques/master-ingenierie-mathematiques-informatique-et-statistique/>.
- IFMA of UPMC: <http://www.proba.jussieu.fr/IFMA/>. Headed by V. Lemaire.
- MSC International Finance of HEC, Paris: <http://www.hec.edu/Masters-programs/Master-s-Programs/One-Year-MSc-MS-Programs/MSc-International-Finance/Program-Details>