Thematic cycle on Monte-Carlo Techniques October 2015 - July 2016

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Monte-Carlo methods are widely used by the financial industry to price derivatives, estimate risks, or to calibrate/estimate models. They can also be used to handle big data, in machine learning, to perform online optimization, to study the propagation of uncertainty in fluid mechanics or geophysics. Under the same label Monte-Carlo, one actually finds very different techniques and communities that evolve in different directions. The thematic cycle that we organized from october 2015 to July 2016 aimed at confronting the different viewpoints of these communities and at contributing to a general thinking on how these techniques can be used by the financial industry and the economic world in general. It benefited from the financial support of the Louis Bachelier Institute, the Chaire Risques Financiers, the Chaire Finance et Développement durable, the Chaire Économie des nouvelles données, the Chaire Marchés en mutation, the ANR program ISOTACE ANR-12-MONU-0013 and the Institut Henri Poincaré. Three topics were covered by academic lectures followed by a one-day workshop: propagation of uncertainty, particle methods for the management of risks, stochastic algorithms and big data. We thank Areski Cousin, Virginie Ehrlacher, Romuald Elie, Gersende Fort, Stéphane Gaiffas and Gilles Pagès for having coordinated these workshops. The cycle was concluded by a one week closing conference with twelve plenary talks and sixteen minisymposia: see the website `https://montecarlo16.sciencesconf.org`

Of course the six papers in these proceedings cannot account for all the topics addressed during the cycle. But they give qualitative spotlights on some of the active fields of research on stochastic methods in finance. We thank their authors for these valuable contributions.

To compute by Monte-Carlo methods the price and sensitivities of a financial derivative written on underlyings evolving according to a Stochastic Differential Equation, one has to discretize this SDE in time. Schemes with

high order of weak convergence permit to reduce the discretization bias. The contribution by Anis Al Gerbi, Benjamin Jourdain and Emmanuelle Clément is devoted to the implementation of the Ninomiya-Victoir scheme which exhibits order two of weak convergence and also discusses how this scheme can be combined with the Multi-Level Monte-Carlo method. This variance reduction method introduced by Mike Giles in 2008 permits to recover the complexity of a Monte-Carlo estimator with unbiased samples. Multi-Level Monte Carlo unbiased estimators which are stratified along infinitely many strata have recently been introduced in the literature. Motivated by the asymptotic behaviour of such estimators, Zeyu Zheng and Peter Glynn establish in their contribution a general central limit theorem for stratified Monte-Carlo estimators with an infinite number of strata. Denis Belomestny, Stefan Häfner and Mikhail Urusov present in their article an enhancement of another variance reduction technique called truncated regression-based variance reduction.

The financial crisis of 2008 and the bankruptcy of Lehman Brothers showed the necessity to better understand systemic risk and triggered active research in that direction. The paper by Rui Chen, Andreea Minca and Agnès Sulem suggests that the financial stability is better described in terms of the mechanism of formation of the financial network than in terms of simple statistics of the network topology.

The detection of cointegrated time series is an important issue in portfolio management. The contribution by Maciej Marowka, Gareth Peters, Nikolas Kantas and Guillaume Bagnarosa deals with Markov Chain Monte Carlo approaches for Bayesian inference of parameters determining cointegration.

We last thank Charles-Albert Lehalle for coordinating the writing of the paper on automatic differentiation that he co-authored with the speakers of the minisymposium that he organized on this topic at the closing conference: Sebastien Geeraert, Barak Pearlmutter, Olivier Pironneau and Adil Reghai. The recent interest of market participants for this technique is motivated by the strong increase in regulatory demand for sensitivity computations.

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