30 ans du Laboratoire Manceau de Mathématiques
Probabilités - Statistiques - Risques

May 21-31 2024

Le Mans (France)

https://30ans-lmm.sciencesconf.org

Le Mans University, France

Tuesday, May 21, 2024

========= **10:00 Welcome** =========

========= **10:30 Opening** =========

CHAIR: **Yuri Kutoyants**

11:00 – 11:30	**Nakahiro Yoshida**	Asymptotic expansions for functionals of a fractional Brownian motion
11:30 – 12:00	**Arnak Dalalyan**	Some results on the creativity of Wasserstein GANs

= **Lunch** =

CHAIR: **Marina Klepstyna**

14:00 – 14:30	**Pavel Chigansky**	Asymptotic analysis in some problems with fractional Brownian motion
14:30 – 15:00	**Massaki Fukasawa**	Realized cumulants for martingales
15:00 – 15:30	**Stefano Iacus**	Network Stochastic Differential Equations

= **Coffee Break** =

CHAIR: **Arnak Dalalyan**

16:00 – 16:30	**Sergei Dachian**	On Smooth Change-Point Location Estimation for Poisson Processes and Skorokhod Topologies
16:30 – 17:00	**Azzouz Dermoune**	Forcasting the amplitude, the location and the width of the peak of a time series using the weighted median

========= **Free discussions** =========

========= **19:30 Conference's dinner** =========

Wednesday, May 22, 2024

Chair: **Said Hamadène**

10:30 – 11:00	**Shige Peng**	Space-time white noises in a nonlinear expectation space
11:00 – 11:30	**Etienne Pardoux**	Recent results on epidemic models
11:30 – 12:00	**Nizar Touzi**	Viscosity solution for the HJB on the process space

= **Lunch** =

Chair: **Laurent Denis**

14:00 – 14:30	**Sylvie Méléard**	Exponent dynamics for branching processes
14:30 – 15:00	**Vlad Bally**	CLT in distribution norms and zeros of trigonometric polynomials
15:00 – 15:30	**Jianfeng Zhang**	Set Values and Efficiency of Non-zero Sum Games

= **Coffee Break** =

Chair: **Alexandre Popier**

16:00 – 16:30	**Andrey Piatnitsky**	Large time behaviour of jump Markov process in high contrast media
16:30 – 17:00	**Jaime San Martin**	Pathwise uniqueness for a system of SDE with singular coefficients

========= **Free discussions** =========

Thursday, May 23, 2024

Chair: **Anis Matoussi**

10:30 – 11:00	**Alain Bensoussan**	An Overview of Hawkes Processes
11:00 – 11:30	**Mathieu Rosembaum**	The two square root laws of market impact and the role of sophisticated market participants
11:30 – 12:00	**Nicole El Karoui**	Level set methods in pathwise optimization

= **Lunch** =

Chair: **Nicole El Karoui**

14:00 – 14:30	**Boualem Djehiche**	A quantum computing approach to some health and disability insurance contracts
14:30 – 15:00	**Christian-Yann Robert**	Tail index regression for panel data with unobserved heterogeneity
15:00 – 15:30	**Roxana Dumitrescu**	Energy transition: a mean-field game approach

= **Coffee Break** =

========= **Free discussions** =========

Friday, May 24, 2024

CHAIR: **Alexandre Brouste**

10:30 – 11:00	**Marie Kratz**	OT and EOT QQ-plots. Application in Risk Analysis & Management
11:00 – 11:30	**Lionel Truquet**	Stability Properties of Certain Markov Chain Models in Random Environments
11:30 – 12:00	**Giles Stupfler**	Inference for extremal regression with dependent heavy-tailed data

= **Lunch** =

CHAIR: **Marie Kratz**

14:00 – 14:45	**Olivier Lopez**	Actuarial science and emerging risks: how to push away the frontiers of insurability
15:00 – 16:30	**Round Table**	Scientific Research in Maths in Le Mans

Titles and abstracts

Vlad BALLY (Gustave Eiffel University

CLT in distribution norms and zeros of trigonometric polynomials

Abstract: We prove a CLT in distribution norms and moreover we obtain Edjorth expansions as well. As an application we study the asymptotic behavior of the expectation of the number of roots of trigonomertic polynomials with random coefficients. A more challenging issue concerns the asymptotic behavior of the variance. In this case we obtain a "non universal" result, depending on the fourth moment of the random coefficients. This work is in collaboration with L. Caramellino and G. Poly.

Alain BENSOUSSAN (University of Texas, Dallas)

An Overview of Hawkes Processes

Abstract: Hawkes processes are used for statistical modeling of events in earthquake seismology and other fields in which a random event exhibits self-exciting behavior. Models have been introduced by A. Hawkes for these type of applications in the seventies. Other applications deal with epidemiology. Applications to mathematical finance have been considered by Alan Hawkes himself. It is quite possible that these processes play an important role in considering the impact of climate change in insurance contracts or in modeling risks in supply chains. We present in this work an overview of the theory for the construction of these processes as well as their control. This is a joint work with Benoit Chevalier Roignant.

Pavel CHIGANSKY (The Hebrew University of Jerusalem)

Asymptotic analysis in some problems with fractional Brownian motion

Abstract: Some problems in the theory and applications of stochastic processes reduce to solving integral equations with their covariance operators. Usually, such equations do not have explicit solutions, but useful information can be extracted through asymptotic analysis with respect to relevant parameters. In this talk, I will survey some recent results on such equations for processes related to the fractional Brownian motion: applications include the problem of small deviations, linear filtering, and statistical inference. This is a joint work with M.Kleptsyna.

Serguei DACHIAN (University of Lille)

On Smooth Change-Point Location Estimation for Poisson Processes and Skorokhod Topologies

Abstract: We consider the problem of estimation of the location of what we call "smooth change-point" from n independent observations of an inhomogeneous Poisson process. The "smooth change-point" is a transition of the intensity function of the process from one level to another which happens smoothly, but over such a small interval, that its length δ_n is considered to be decreasing to 0 as n goes to infinity.
We study the maximum likelihood estimator (MLE) and the Bayesian estimators (BEs), and show that there is a "phase transition" in the asymptotic behavior of the estimators depending on the rate at which δ_n goes to 0 ; more precisely, on if it is slower (slow case) or quicker (fast case) than $1/n$.
It should be noted that all these results were obtained using the likelihood ratio analysis method developed by Ibragimov and Khasminskii, which equally yields the convergence of polynomial moments of the considered estimators. On the other hand, for the study of the MLE, this method needs the convergence of the normalized likelihood ratio in some functional space, and up to the best of our knowledge, until now it was only applied using either the space of continuous functions equipped with the topology induced by the supremum norm, or the space of càdlàg functions equipped with the usual Skorokhod topology (called "J_1"by Skorokhod himself). However, we will see that in the fast case of our problem this convergence can not take place in neither of these topologies. So, in order to be able to apply the likelihood ratio analysis method in this case, we first had to extend it to a weaker topology "M_1" (also introduced by Skorokhod).

Arnak DALALYAN (ENSAE-CREST)

Some results on the creativity of Wasserstein GANs

Abstract: Generative modeling aims to simulate diverse examples from an unknown distribution based on observed examples. While recent studies have focused on quantifying the statistical accuracy of popular algorithms, there is a lack of mathematical evaluation regarding their creativity, expressed in terms of non-replication of observed examples. We present theoretical insights into this aspect, demonstrating that the Wasserstein GAN, constrained to left-invertible push-forward maps, generates distributions that not only avoid replication but also significantly deviate from the empirical distribution. Importantly, we show that left-invertibility achieves this without compromising the statistical optimality of the resulting generator.

Azzouz DERMOUNE (University of Lille)

Forcasting the amplitude, the location and the width of the peak of a time series using the weighted median

Abstract: In many signal processing applications, defining and finding peaks is an important part of the pipeline. Peak prediction can be a very challenging endeavor, especially when there is a lot of noise. In this talk, the peak region is considered as a combination of a Gaussian trend with additive and multiplicative noise, and the peak is modeled as the peak of the Gaussian trend. In the case of additive and multiplicative noise, we propose a criterion based on the weighted median which predicts the optimal number of observations necessary for the exact prediction of the peak's location. We analyze the effects of the width, location, and signal-to-noise ratio on our prediction. We show that for small width or a small signal-to-noise ratio (a lot of noise), the prediction becomes inaccurate. In this case, we propose a new idea called the entry time into the region of the peak and the exit time from the region of the peak. We demonstrate how to apply our new idea to real data. As a numerical application, we consider the peak prediction of the daily infections during the first wave of COVID-19 in China, France, and Germany.

Boualem DJEHICHE (KTH-Stockholm)

A quantum computing approach to some health and disability insurance contracts

Abstract: We propose a hybrid classical-quantum approach for modeling transition probabilities in health and disability insurance. The modeling of logistic disability inception probabilities is formulated as a support vector regression problem. Using a quantum feature map, the data are mapped to quantum states belonging to a quantum feature space, where the associated kernel is determined by the inner product between the quantum states. This quantum kernel can be efficiently estimated on a quantum computer. We conduct experiments on the IBM Yorktown quantum computer, fitting the model to disability inception data from a Swedish insurance company.

Roxana DUMITRESCU (King's College London)

Energy transition: a mean-field game approach

Abstract: In this talk, I will first give a panorama of several models developed in the context of energy transition, using as mathematical tools the theory of mean-field games and the principal agent approach. I will then focus on a specific model related to the dynamics of the electric market structure in the long term under possible uncertainty on the scenario, determined by the progressive replacement of conventional power generation with renewable energy sources. The mathematical resolution for this specific model relies on the theory of mean-field games of optimal stopping, using a linear programming approach.

Nicole EL KAROUI (Sorbonne University)

Level set methods in pathwise optimization

Abstract: With AI and Big Data, there is growing interest in results concerning pathwise stochastic processes that can be used directly on the data. This applies in particular to certain optimization problems. Since Whittle (1980), the idea has been to made convex the problems by the introcduction of a new real parameter, and to use classical tools or methods of convex analysis: as level set family, inverse of monotone functions, conjugate of a convex function and the associated optimization results, and so on.
We'll illustrate these ideas with examples related to optimal stopping and different decomposition of supermartingales as in Whittle (1980). Then, we move to problems related to pathwise dynamic utilities. Joint work with El Mrad M. and Hillairet. C.

Masaaki FUKASAWA (Osaka University)

Realized cumulants for martingales

Abstract: Generalizing the realized variance, the realized skewness (Neuberger, 2012) and the realized kurtosis (Bae and Lee, 2020), we construct realized cumulants with the so-called aggregation property. They are unbiased statistics of the cumulants of a martingale marginal based on sub-period increments of the martingale and its lower-order conditional cumulant processes. Our key finding is a relation between the aggregation property and the complete Bell polynomials. For an application we give an alternative proof and an extension of a cumulant recursion formula recently obtained by Lacoin et al. (2019) and Friz et al. (2020).

Stefano IACUS (Harvard University)

Network Stochastic Differential Equations

Abstract: We develop a framework for Network Stochastic Differential Equations (N-SDE) where each node on the network is an SDE that depends on neighbor nodes. The evolution of each node depends on the superposition of three effects: the node?s state (momentum effect), the feedback coming from the node?s neighbors (network effect) and the stochastic volatility term driven by a Brownian motion. Our goal is to estimate the parameters on the N-SDE assuming high-frequency discrete time observations of the system. The main motivation for introducing the N-SDE model, is that its structure allows to analyze very high-dimensional time series by exploiting the sparsity of the corresponding graph. We consider two different scenarios. In the first one the graph representing the network is fully specified. As the dimension of the parameter space grows quadratically with the number of edges on the graph, we establish growth conditions for the identification of the system in terms of the sample size. In the second scenario, the graph structure is not known and has to be discovered from the data. To this aim we propose an iterative procedure based on adaptive Lasso for a particular sub-class of N-SDE models. In this work we assume that the graph representing the network is an oriented one. This new class of models paves the way for new applications of SDEs in the context of causal inference. We show through simulation studies the performance of the estimators for several graph topologies in a very high-dimensional settings as well as some applications to real data.

Marie KRATZ (ESSEC)

OT and EOT QQ-plots. Application in Risk Analysis & Management

Abstract: Univariate Q-Q plot is a very powerful visualisation tool, used to compare two distributions. Turning to multivariate quantiles, various approaches are possible. Considering a similar approach as Easton and McCulloch (1990) and Dhar et al. (2014), we provide component wise QQ plots using (entropy regularized) optimal transport based quantile functions. As for geometric quantiles (Dhar et al., 2014), test statistics for comparing two distributions based on the proposed QQ plots, can also be developed. Turning to applications, we show the attractiveness of (E)OT QQ plots to develop stress scenarios for risk management purpose. This presentation is based on joint works with S. Singha, S. Vadlamani and M. Dacorogna. quantum computer, fitting the model to disability inception data from a Swedish insurance company.

Olivier LOPEZ (ENSAE-CREST)

Actuarial science and emerging risks: how to push away the frontiers of insurability

Abstract: Due to its inverted production cycle, insurance requires anticipation: the premiums are supposed to reflect the future losses, and their amount should be sufficient to protect the portfolio against pessimistic scenarios. From this perspective, emerging risks are very challenging to deal with, due to the lack of experience on these new threats. When this novelty is coupled with high repeated losses (an increase of the catastrophes not only in terms of severity but also of frequency), the insurability of such risks becomes unsure. This is particularly true for natural disasters, which are qualified as emerging risks due to the acceleration of climate change and the difficulty to predict its evolution, or for cyber risk which is the corollary of a society highly dependent on digital tools. In this talk, we will show how actuarial science and its scientific approach can help to respond to these challenges, using modern statistical or AI techniques, and relying on new products like parametric (also called "index-based") insurance.

Sylvie MÉLÉARD (CMAP- Ecole Polytechnique)

Exponent dynamics for branching processes

Etienne PARDOUX (University of Marseille)

Recent results on epidemic models

Shige PENG (Shandong University)

Space-time white noises in a nonlinear expectation space

Abstract: Under the framework of nonlinear expectation, we introduce a new type of random fields, which contains a type of space-time white noise as a special case. Based on this result, we also introduce a space white noise. Different from the case of linear expectation, in which the probability measure are given and fixed. Under the uncertainty of probability measures, space white noises are intrinsically different from the space cases, which is generalized from G-Gaussian processes which are different from a G-Brownian motion (joint work with Xiaojun JI).

Andrey PIATNITSKI (Artic University of Norway)

Large time behaviour of jump Markov process in high contrast media

Abstract: The talk will focus on homogenization of scaled jump Markov processes in high contrast media, both periodic and random stationary cases will be considered. The homogenized dynamics for such processes need not be Markov. However, if we equip the studied process with an additional component that characterized the behaviour of the process in the areas of a small jump intensity, then the limit dynamics of the extended process remains Markov. We will describe the limit dynamics of the extended process.

Mathieu ROSENBAUM (École Polytechnique)

The two square root laws of market impact and the role of sophisticated market participant

Abstract: The goal of this work is to disentangle the roles of volume and participation rate in the price response of the market to a sequence of orders. To do so, we use an approach where price dynamics are derived from the order flow via no arbitrage constraints and make connections with the rough volatility paradigm. We also introduce in the model sophisticated market participants having superior abilities to analyse market dynamics. Our results lead to two square root laws of market impact, with respect to executed volume and with respect to participation rate. This is joint work with Bruno Durin and Grégoire Szymanski.

Jaime SAN MARTIN (University of Chile)

Pathwise uniqueness for a system of SDE with singular coefficients

Abstract: We shall present some techniques to prove pathwise uniqueness for a system of SDE, with singular coefficients, driven by Brownian motion and Poisson processes. This system arises as a limiting of a Bisexual Galton-Watson process.

Giles SUPFLER (University of Angers)

Inference for extremal regression with dependent heavy-tailed data

Abstract: Nonparametric inference on tail conditional quantiles and their least squares analogs, expectiles, remains limited to i.i.d. data. A fully operational inferential theory is developed for extreme conditional quantiles and expectiles in the challenging framework of strong mixing, conditional heavy-tailed data whose tail index may vary with covariate values. It requires a dedicated treatment to deal with data sparsity in the far tail of the response, in addition to handling difficulties inherent to mixing, smoothing, and sparsity associated with covariate localization. The pointwise asymptotic normality of the estimators is proven, and optimal rates of convergence reminiscent of those found in the i.i.d. regression setting are obtained but have not been established in the conditional extreme value literature. The assumptions hold in a wide range of models. Full bias and variance reduction procedures are proposed, and simple but effective data-based rules for selecting tuning hyperparameters are used. The inference strategy is shown to perform well in finite samples and is showcased in applications to stock returns and tornado loss data.

Nizar TOUZI (New York University)

Viscosity solution for the HJB on the process space

Abstract: Motivated by recent applications in optimal control of path-dependent and/or interacting stochastic systems, we investigate a path-dependent optimal control problem on the process space with both drift and diffusion controls, with possibly degenerate volatility. The dynamic value function is characterized by a fully nonlinear second order path dependent HJB equation on the process space, which is by nature infinite dimensional. In particular, our model covers mean field control problems with common noise as a special case. We shall introduce a new notion of viscosity solutions and establish both existence and comparison principle through the doubling variable technique only, and without invoking the Ishii's lemma.

Lionel TRUQUET (ENSAI-CREST, Rennes)

Stability Properties of Certain Markov Chain Models in Random Environments

Abstract: In time series analysis, considerable efforts have been invested in formulating nonlinear models compatible with the concept of stationarity. These models should also allow the application of various limit theorems essential for statistical inference. Markov chain techniques have been extensively employed to investigate the stability properties of numerous autoregressive processes. In this presentation, we aim to explore the feasibility of integrating exogenous covariates into such dynamical systems. Despite their practical significance, the inclusion of exogenous covariates into autoregressive processes is not very well understood mathematically. We will introduce stability criteria applicable to select Markov chain models operating within random environments, offering potential solutions to address these complexities. Our discussion will encompass two primary approaches. The first pertains to extending a classical drift/small set criterion. Notably, in certain observation-driven models detailed in the literature, the small sets theory proves inapplicable. Subsequently, we will introduce a second criterion designed to circumvent this limitation. Both cases rely on appropriate coupling methodologies to manage the loss of memory within chain iterations, measured in terms of either total variation or Wasserstein-type distances. The presentation will feature numerous illustrative examples where this theory can be effectively applied.

Christian-Yann ROBERT (ISFA-Lyon)

Tail index regression for panel data with unobserved heterogeneity

Abstract: Extreme value applications in finance, insurance and risk management need to capture cross-sectional heterogeneity and time-variation while the number of observations for the analysis is inherently small. This paper introduces a method for estimating the tail indices of heavy-tailed distributions for large-scale panel data with tail factor structures. The method also attempts to capture the unobservable heterogeneity of each of the time series based on sensitivity to explanatory variables and to the unobservable factor structure. We propose a multi-step procedure that jointly estimates the parameters of the regression model and modify the thresholds used to define exceedances. The asymptotic consistency of the estimators are studied in an asymptotic framework where both the time series dimension and individual dimension are diverging. Due to the presence of the unobservable common factor structures and the sparsity structure of the exceedances, the development of these results is non-trivial.

Nakahiro YOSHIDA (University of Tokyo)

Asymptotic expansions for functionals of a fractional Brownian motion

Abstract: Recently, the theory of asymptotic expansions is extending to functionals of a fractional Brownian motion. Examples include estimation of the Hurst coefficient, the quadratic variation for a mixed fractional Brownian motion, and a quadratic variation for a stochastic wave equation. We discuss a general scheme provided by Tudor and Yoshida (SPA2023) and an application to estimation for the fractional Ornstein-Uhlenbeck process.

Jianfeng ZHANG (University of Southern California)

Set Values and Efficiency of Non-zero Sum Games

Abstract: A non-zero sum game is typically ill-posed. In this talk we first investigate its efficiency, measured by the ratio between the aggregate payoff at the best equilibrium and that at the social optimal control. Such efficiency operator is very sensitive to small perturbations of the game. This seemingly bad property opens the door for mechanism designs to improve the efficiency dramatically by small perturbations. We next study the set value of the game, which rough speaking is the set of values over all possible equilibria. The set value is by nature unique, and enjoys many nice properties of the value function of the standard control problem, especially the dynamic programming principle. We shall further explore the PDE approach for the set values.

Monday May 27, 2024

10:30 – 12:00	**Gilles Pagès**	Stochastic optimization: when Langevin comes into the game

= **Lunch** =

13:30 – 15:30	**Hiroki Masuda**	Gaussian quasi-likelihood inference for ergodic Lévy driven SDE

Tuesday May 28, 2024

10:30 – 12:00	**Hiroki Masuda**	Gaussian quasi-likelihood inference for ergodic Lévy driven SDE

= **Lunch** =

13:30 – 15:30	**Gilles Pagès**	Stochastic optimization: when Langevin comes into the game
16:00 – 18:00	**Thomas Kruse**	Algorithms for Solving High Dimensional PDEs and BSDEs: From Nonlinear Monte Carlo to Machine Learning

Wednesday May 29, 2024

10:30 – 12:00	**Thomas Kruse**	Algorithms for Solving High Dimensional PDEs and BSDEs: From Nonlinear Monte Carlo to Machine Learning

= **Lunch** =

13:30 – 15:30	**Mathieu Rosenbaum**	A rough volatility tour from market microstructure to complex options
16:00 – 18:00	**Mathieu Rosenbaum**	A rough volatility tour from market microstructure to complex options

Thursday May 30, 2024

= Mont Saint Michel Visit =

Friday May 31, 2024

09:40 – 10:00	**Mohamed Amine Hazzami**	A dynamic colonel Blotto game
10:00 – 10:20	**Marie Badreau**	Consistent model selection in weak FARIMA models
10:20 – 10:40	**Elise Bayraktar**	Estimating the volatility of a stable Cox-Ingersoll-Ross process from high-frequency observations
10:40 – 11:00	**Zakaria Bensaid**	Systemic Shortfall Risk Measures: Different classes and algorithms

= Coffee Break =

11:20 – 11:40	**Guillaume Broux**	Deep learning scheme for forward utilities using ergodic BSDEs
11:40 – 12:00	**Lilit Hovsepyan**	One-step closed-form estimator for generalized linear model with categorical explanatory variables
12:00 –12:20	**Dorian Cacitti-Holland**	Limit behavior of the solution of a backward stochastic differential equation with singular terminal condition

= Lunch =

Mini courses' abstracts

- **H. Masuda**, Graduate School of Mathematical Sciences, University of Tokyo

  Title: Gaussian quasi-likelihood inference for ergodic Lévy driven SDE

  Abstract: This talk will review recent developments in Gaussian quasi-likelihood inference for discrete observed ergodic L'evy-driven stochastic differential equations (SDEs) with parametric drift and scale coefficients. In particular, we present some recent theoretical results on the inference and selection of coefficients based on the fully explicit joint and stepwise Gaussian quasi-likelihood functions (GQLFs). The mixed-rates structure of the joint GQLF, which does not appear in the diffusion case, gives rise to a nonstandard form of the regularization term in the Gaussian information criterion for the coefficients, quantitatively revealing the relationship between estimation accuracy and sampling frequency. After estimating the coefficients, one can proceed to infer the distribution of the driven L'evy process. Several numerical examples are given to illustrate the theoretical findings.

- **M. Rosenbaum**, École Polytechnique

  Title: A rough volatility tour from market microstructure to complex options

  Abstract: In this lecture, we present an overview of recent results in the rough volatility literature. We consider both statistical and option pricing issues in this framework. We notably explain the connection between the behaviour of high frequency prices and that of implied volatility surfaces. This enables us to understand the universal nature of the rough volatility paradigm and to build new financial engineering tools allowing for risk management of complex products such as VIX derivatives.

- **T. Kruse**, University of Wuppertal

  Title: Algorithms for Solving High Dimensional PDEs and BSDEs: From Nonlinear Monte Carlo to Machine Learning

  Abstract: In recent years, tremendous progress has been made in the development of numerical algorithms for solving partial differential equations (PDEs) and backward stochastic differential equations (BSDEs) in high dimensions, using ideas from nonlinear Monte Carlo or deep learning. In this mini course, we review these numerical and theoretical advances. In particular, we analyze algorithms based on stochastic reformulations of the original problem, such as the multilevel Picard iteration and the Deep BSDE method. We revisit selected mathematical results for these algorithms and review the main ideas of their proofs.

- **G. Pagès**, Université Sorbonne

  Title: Stochastic optimization: when Langevin comes into the game

  Abstract: We will describe and analyze the regular Langevin principle for approximating to Gibbs measures associated to a potential function by introducing a mean-reverting Brownian diffusion process having this (normalized) measure as an invariant distribution. We will explain how and why this procedure, properly adapted, has been widely adopted by practitioners in Machine learning to improve the performances of stochastic gradient descent procedures in high dimensional settings, that is getting as close as possible of true minima of the loss/potential function under consideration. This relies on ideas going back to Gelfand and Mitter in the 1990's consists basically in adding an exogenous isotropic noise, namely a small Brownian component to the original procedure to make it close to a Langevin diffusion. These authors were in fact focused on the more sophisticate – but harder to "tune "– simulated annealing procedure where this exogenous noise is slowly fading. Recently this topic (aka ULA algorithm for Unadjusted Langevin Algorithm) gave rise to a very active theoretical and applied literature.

  In a second part we discuss the isotropic assumption made on the noise and show that it is possible to obtain similar theoretical results when the added noise is more general leading to more general Langevin diffusions and new possibilities of approximations of Gibbs measures. This (partially) corresponds in practice to the "pre-conditioning" procedure widely adopted by practitioners, especially in the training of Neural Networks, to "tune' the exogenous noise depending on the value of the gradient and of the loss function.

  This Langevin principle tends to become a paradigm in the sense that it is successfully applied by practitioners to other stochastic optimization procedures like, typically Adam algorithm (for Adaptive Moment Estimation) or its ancestors AdaGrad or RMSProp among others.

Titles and abstracts of Friday

Marie BADREAU (Le Mans University)

Consistent model selection in weak FARIMA models

Abstract: Fractionally integrated autoregressive moving-average (FARIMA) models are still at the heart of many disciplines such as finance, econometrics, and more generally in time series analysis, because of their ability to model long and short memory process thanks to the differentiation parameter d. Commonly used with strong noise assumptions, typically independent and identically distributed (iid), less restrictive hypotheses can extend the generality of the model, for instance by taking non-linear dependancies into account. Thus, we will consider here FARIMA models with uncorrelated but non-independent error terms, which are called *weak FARIMA models*. Estimation and validation procedures have already been established, assuming that p and q ARMA orders are known. The identification of weak FARIMA(p, d, q) models is then at the heart of this work. Minimizing the Kullback-Leibler discrepancy in this context has lead to the construction of a criterion, closely related to the usual BIC, which seems to provide a good selection of the model. The asymptotic consistency of this criterion is currently being established.

Elise BAYRAKTAR (Gustave Eiffel University

Estimating the volatility of a stable Cox-Ingersoll-Ross process from high-frequency observations

Abstract: Our aim is to study the estimation of volatility, scaling and jump activity parameters from high-frequency observations of the process on a fixed time period. We first recall the method of estimating the volatility by the truncated quadratic variation for a diffusion process with jumps. When the jumps have infinite variation, this estimator has a bias. This leads us to use a new estimator based on the characteristic function, for which we establish limit theorems. closely related to the usual BIC, which seems to provide a good selection of the model. The asymptotic consistency of this criterion is currently being established.

Zakaria BEN SAID (Le Mans University)

Systemic Shortfall Risk Measures: Different classes and algorithms

Abstract: In this talk, I present an overview of recent advances in systemic risk measures from both theoretical and numerical perspectives. Specifically, I will discuss stochastic algorithm schemes and deep learning solvers for estimating various classes of Multivariate Shortfall Risk Measures (MSRM) across different settings. Additionally, we test the performance of these algorithms numerically on several examples. I will also present a work in progress on a class of dynamic MSRM via Quadratic Exponential Backward Stochastic Differential Equations which are numerically solved using deep learning solvers.

Guillaume BROUX-QUEMERAIS (Le Mans University)

Deep learning scheme for forward utilities using ergodic BSDEs

Abstract: In this work, we develop a probabilistic numerical method for a class of forward utilities in a stochastic factor model. For this purpose, we use the representation of dynamic utilities using the ergodic Backward Stochastic Differential Equations (eBSDEs) introduced by Liang and Zariphopoulou. We establish a connection between the solution of the ergodic BSDE and the solution of an associated BSDE with random terminal time, defined as the hitting time of the positive recurrent stochastic factor. The viewpoint based on BSDEs with random horizon yields a new characterization of the ergodic cost, which is a part of the solution of the eBSDEs. In particular, for a certain class of eBSDEs with quadratic generator, the Cole-Hopf transformation leads to a semi-explicit representation of the solution as well as a new expression of the ergodic cost. The latter can be estimated with Monte Carlo methods. We also propose two new deep learning numerical schemes for eBSDEs, where the ergodic cost is optimized according either to a global loss function at the random horizon or to the aggregation of local loss functions. Finally, we present numerical results for different examples of eBSDEs and forward utilities together with the associated investment strategies.

Dorian CACITTI HOLLAND(Le Mans University)

Limit behavior of the solution of a backward stochastic differential equation with singular terminal condition

Abstract: The limit behavior of the solution of a backward stochastic differential equation with a singular terminal condition (can be equal to infinity with a positive probability) is different depending on the framework and the assumptions on the coefficients of the BSDE.
If we consider a BSDE driven by a Brownian motion and a balance condition between the growth w.r.t. y and the growth w.r.t. z of the generator then the solution is continuous. This result can be proven by the Malliavin calculus.
However this result cannot be generalized with a BSDE driven by a Poisson random measure. The case of a Poisson process gives us a counter-example and an interesting associated partial differential equation.

Mohamed Amine HAZZAMI (Lorraine University)

A dynamic colonel Blotto game

Abstract: The Colonel Blotto game is a resource allocation game where players decide where to focus their forces between different battlefields. We extend the standard Blotto game to a dynamic stochastic setting, in a time-continuous, two-player, zero-sum game. Using the dynamic programming principle, we explicitly characterize some Nash equilibrium strategies as well as the value of the game through a Hamilton-Jacobi-Bellman equation admitting a smooth solution. We formulate the game generally enough to allow for various rewards, as well as various drivers of randomness.

Lilit HOVSEPYAN (Le Mans University)

One-step closed-form estimator for generalized linear model with categorical explanatory variables

Abstract: The parameters of generalized linear models are generally estimated by the maximum likelihood estimator (MLE), computed using a Newton-Raphson type algorithm that can be time-consuming for a large number of variables or modalities, or a large sample size. Explicit estimators exist for these models but they are not always asymptotically efficient, especially for simple effects models, although they are fast to calculate compared to the MLE. The article proposes a fast and asymptotically efficient estimation of the parameters of generalized linear models with categorical explanatory variables. It is based on a one-step procedure where a single step of the gradient descent is performed on the log-likelihood function initialized from the explicit estimators. This work presents the theoretical results obtained, the simulations carried out and an application to car insurance pricing.