

9<sup>ème</sup> SEMINAIRE ACTUARIAT – FINANCE  
ISFA Lyon & IRA LE MANS  
Vendredi 9 novembre 2018  
ISFA Lyon, amphithéâtre G1

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9h00 – 9h30 : ACCUEIL – CAFÉ

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**9h30 – 10h10** : Alexandre POPIER (IRA, Le Mans Université)  
*A Mean Field Game of Optimal Portfolio Liquidation*

**10h10 – 10h50** : Didier RULLIERE (ISFA, Université Lyon 1)  
*On aggregation of submodels with a large number of observations.*

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10h50 – 11h15 : PAUSE CAFÉ

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**11h15 – 11h55** : Sarah KAAKAI (IRA, Le Mans Université)  
*A pathwise construction of Birth-Death-Swap systems leading to an averaging result in the presence of two timescales.*

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12h00 – 13h45 : DÉJEUNER (Restaurant La Rive Gauche)

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**14h00 – 14h40** : Etienne MARCEAU (ISFA, Université Lyon 1)  
*Composite likelihood estimation method for hierarchical Archimedean copulas defined with multivariate compound distributions*

**14h40 – 15h20** : Marius SOLTANE (IRA, Le Mans Université)  
*An autoregressive process with correlated random coefficients*

**15h20 – 16h00** : Morgane PLANTIER (ISFA, Université Lyon 1)  
*Advantageous selection and risk aversion: an econometric analysis in the French health insurance market*

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16h00 : CLOTURE DE LA JOURNEE

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## **ABSTRACTS**

**Alexandre POPIER (IRA, Le Mans Université), Guanxing FU, Paulwin GRAEWE, Ulrich HORST**

Title : *A Mean Field Game of Optimal Portfolio Liquidation.*

Abstract : We consider a mean field game (MFG) of optimal portfolio liquidation under asymmetric information. In the first part we recall the link between optimal liquidation and a (F)BSDE with singular terminal value, when there is only one player ([1], [2] and [3])

Then we will explain how the solution to the MFG can be characterized in terms of a mean-field FBSDE with possibly singular terminal condition on the backward component or, equivalently, in terms of a mean-field FBSDE with finite terminal value, yet singular driver. Extending the method of continuation to linear-quadratic FBSDE with singular driver we prove that this FBSDE has a unique solution. This solution provides an optimal control for the MFG and we also obtain a  $\varepsilon$ -Nash equilibrium when the number of players is increasing.

Finally, our existence and uniqueness result allows to prove that the MFG with possibly singular terminal condition can be approximated by a sequence of MFGs with finite terminal values. Here contrary to the "classical" case and surprisingly, the penalized scheme does not directly give the solution of the initial FBSDE.

**Didier RULLIERE (ISFA, Université Lyon 1), François BACHOC, Clément CHEVALIER, Nicolas DURRANDE**

Title: *On aggregation of submodels with a large number of observations.*

Abstract : Actuarial studies often make use of expensive simulators, so that predicting the value of a simulator given some input values may ease some computations as Solvency II, Solvency Capital Requirement and Nested Simulations problems. The presented work falls within the context of predicting the value of a real function at some input locations given observations of this function. The Kriging interpolation technique (or Gaussian process regression) is often considered to tackle such a problem, but the method suffers from its computational burden when the number of observation points is large. We introduce here nested Kriging predictors which are constructed by aggregating sub-models based on subsets of observation points. This approach is proven to have better theoretical properties than other aggregation methods that can be found in the literature. Contrarily to some other methods it can be shown that the proposed aggregation method is consistent. Some illustrations with a large number of observations are provided.

**Sarah KAKAI (IRA, Le Mans Université), Nicole EL KAROUI**

Title : *A pathwise construction of Birth-Death-Swap systems leading to an averaging result in the presence of two timescales.*

Abstract : In this talk, I will present a general class of stochastic population dynamics structured by discrete subgroups, called Birth-Death-Swap (BDS) systems. Such processes generalize classical multitype Birth-Death processes by allowing swap events, i.e. transfers from one subgroup to another. The variability of the environment is also taken into account.

I will first prove a general result, on the construction by strong domination of multivariate counting processes solutions of stochastic differential equations driven by Poisson measures. The existence of BDS systems is then obtained under weaker assumptions than usual.

In a second part, I will then study the evolution of the population in the presence of two timescales, when swap events occur at a faster timescale than demographic events. A general averaging result for the demographic counting process is first proven. Finally, I will show that at the limit, the aggregated population become a Birth-Death process with averaged intensities. In particular, the population heterogeneity generates non linearities of mortality rates at the aggregated level.

**Etienne MARCEAU (École d'actuariat, Faculté des sciences et de génie, Université Laval), Hélène COSSETTE, Simon-Pierre GADOURY, Christian ROBERT**

Title : *Composite likelihood estimation method for hierarchical Archimedean copulas defined with multivariate compound distributions.*

Abstract : We consider the family of hierarchical Archimedean copulas whose imbrication technique is derived via the construction of a multivariate exponential mixture distribution through compounding, as introduced in Cossette et al. (2017). We investigate the structure determination and the estimation of these copulas. A complete-linkage clustering technique based on the Spearman's rho matrix combined with a bootstrap procedure is used to identify the tree structure. The parameter estimation is done through a top-down composite likelihood method. The validity of the proposed approach is illustrated through two simulation studies in which the procedure is explained step by step. The composite likelihood method is also compared to the full likelihood method in a simple case where the full likelihood is computable.

**Marius SOLTANE (IRA, Le Mans Université), Frédéric PROÏA**

Title : *An autoregressive process with correlated random coefficients.*

Abstract : Time series are now widely used in different fields for modeling, especially in economics and econometrics. The RCAR ( $\rho$ ) processes were introduced and studied in the 1980's and their great flexibility is based on the lack of correlation between two successive random coefficients. In a time series context this is counter-intuitive and we show that the usual OLS estimate may not be consistent in this case, leading to unfortunate interpretation when the coefficients are correlated. We propose in this talk to study an extension of the RCAR(1) process by introducing a short memory in the random coefficients. We will study the properties of the OLS and we will propose a strongly consistent estimate of the autoregressive parameter. At the end of the talk we will see the construction of a test to detect the presence of memory in the coefficients.

**Morgane PLANTIER (ISFA, Université Lyon 1), Nathalie HAVET, Jean-Louis RULLIERE**

Title : *Advantageous selection and risk aversion : an econometric analysis in the French health insurance market.*

Abstract : The theoretical model of de Meza et al. (2001) reverses the positive correlation between risk and insurance predicted by the standard model of asymmetric information (Rothschild and Stiglitz, 1976), based on the hypothesis of multidimensional private information. In this model, the insured have private information about their risk type but also about their risk aversion, which could conduct to an *advantageous selection*. This prediction has been tested and confirmed in the health context by two empirical works (Fang et al., 2008 ; Finkelstein et al., 2006), but the role of risk tolerance remains ambiguous. We propose an empirical study to test and analyze the presence of *advantageous selection* in the French health insurance market. We use the data from the *French Health, Health Care and Insurance survey* ('Enquête sur la santé et la protection sociale (ESPS)'), enriched with health care consumption data from the National Health Insurance Database ('Système National d'Information Inter-régimes de l'assurance maladie (Sniiram)'), in 2012. Assuming that the level of premiums paid by individuals largely reflects the level of coverage chosen, we test the correlation between the insurance coverage and health expenditures of policyholders, including the role of individual preferences. At first, the simultaneous estimation of both insurance and health expenditure equations confirms the prediction of advantageous selection in the French health insurance market: a more comprehensive coverage implies a decrease of health care expenditures. Moreover, the results highlight the central role of risk aversion because the advantageous selection is observed only for the risk-averse assured.