



# ISFA Lyon et DSA-HEC Lausanne

**Mardi 2 juillet 2019**

**à l'UNIL**  
Extranef 109

- ≡ 9 h 30 WELCOME
- ≡ 10 h 00 Benjamin Avanzi (University of New South Wales, Sydney)  
*A multivariate evolutionary generalised linear model framework with adaptive estimation for claims reserving*
- ≡ 10 h 45 Discussion by Stéphane Loisel (ISFA)
- ≡ 11 h 00 Phd talk #1: Romain Gauchon (ISFA)  
*Health policyholder clustering using health consumption*
- ≡ 11 h 20 Q&A's (including 2 questions by UNIL PhD students)
- ≡ 11 h 30 Networking Time
- ≡ 12 h 00 LUNCH
- ≡ 13 h 30 Han Li (Macquarie University, Sydney)  
*A forecast reconciliation approach to cause-of-death mortality modeling*
- ≡ 14 h 15 Discussion by Viktoriya Glushko (UNIL)
- ≡ 14 h 30 Phd talk #2: Dalit Daily-Amir (UNIL)  
*Lapse analysis and game-theoretical pricing models for the Swiss mandatory health insurance market*
- ≡ 14 h 50 Q&A's (including 2 questions by ISFA PhD students)
- ≡ 15 h 00 Phd talk #3: Pierre Montesinos (ISFA)  
*Bounding Basis-Risk Using S-convex Orders on Beta-unimodal Distributions*
- ≡ 15 h 20 Q&A's (including 2 questions by UNIL PhD students)
- ≡ 15 h 30 Phd talk #4: Charbel Mirza (UNIL)  
*On the Landscape of Insurtech Companies Using Blockchain Technology*
- ≡ 15 h 50 Q&A's (including 2 questions by ISFA PhD students)
- ≡ 16h00 APERO
- ≡ 16h30 DEPARTURE



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## Abstracts:

**Benjamin Avanzi:** A multivariate evolutionary generalised linear model framework with adaptive estimation for claims reserving

Abstract: In loss reserving, claim activity typically changes across accident years. As a result, actuarial judgements or changes to the algebraic structures of models with deterministic factors are often required. An insurer also typically operates in multiple lines or segments whose risks are not perfectly dependent. This results in "diversification benefits", the consideration of which is crucial due to their effects on the aggregate reserves and capital. We propose a multivariate evolutionary generalised linear model (GLM) framework which can capture these features. This framework extends the traditional GLM reserving framework on two fronts. Firstly, we allow factors of the traditional GLM framework to evolve, hence enabling changes in claim experience to be captured naturally in an elegant manner. Secondly, we introduce dependence across business lines using a common shock approach with an explicit and easy-to-interpret dependence structure. We also contribute to the literature with the formulation of a particle filtering with parameter learning procedure. This is an adaptive estimation approach which updates evolving factors of the framework recursively over time. Theoretical developments are illustrated using both a simulated data set and a real data set from a Canadian insurer.

**Romain Gauchon:** Health policyholder clustering using health consumption

Abstract: On paper, prevention appears to be a good complement to health insurance. However, its implementation is often costly. To maximize the impact and efficiency of prevention plans, these should target particular groups of policyholders. We propose a general way of clustering policyholders that could be a starting point for the targeting of prevention plans. This two-step method mainly classifies using policyholder health consumption. The dimension is first reduced using a Nonnegative Matrix Factorization (NMF) algorithm, producing intermediate health-product clusters. We then cluster using Kohonen's map algorithm.

**Han Li:** A forecast reconciliation approach to cause-of-death mortality modeling

Abstract: Life expectancy has been increasing sharply around the globe since the second half of the 20th century. Mortality modeling and forecasting have therefore attracted increasing attention from various areas, such as the public pension systems, commercial insurance sectors, as well as actuarial, demographic and epidemiological research. Compared to the aggregate mortality experience, cause-specific mortality rates contain more detailed information, and can help us better understand the ongoing mortality improvements. However, when conducting cause-of-death mortality modeling, it is important to ensure coherence in the forecasts. That is, the forecasts of cause-specific mortality rates should add up to the forecasts of the aggregate mortality rates. In this paper, we propose a novel forecast reconciliation approach to achieve this



goal. We use the age-specific mortality experience in the U.S. during 1970–2015 as a case study. Seven major causes of death are considered in this paper. By incorporating both the disaggregate cause-specific data and the aggregate total-level data, we achieve better forecasting results at both levels and coherence across forecasts. Moreover, we perform a cluster analysis on the cause-specific mortality data. It is shown that combining mortality experience from causes with similar mortality patterns can provide additional useful information, and thus further improve forecast accuracy. Finally, based on the proposed reconciliation approach, we conduct a scenario-based analysis to project future mortality rates under the assumption of certain causes being eliminated.

**Dalit Daily-Amir:** Lapse analysis and game-theoretical pricing models for the Swiss mandatory health insurance market

**Abstract:** In the mandatory health insurance market in Switzerland, a range of insurers offer policies that differ in characteristics like premium and service level. We analyse the relationship between these characteristics and the changes of the insurers' market shares using publicly available data on this market. The results suggest that market share changes are particularly linked to the difference between the insurer's premium and the market premium. The difference to the previous year's premium also has an impact on the market share, while the service level as well as group affiliation turn out not to be significant in explaining annual market share changes.

We then present and compare two non-cooperative games as pricing models for the Swiss health insurance companies. We apply the models to the same dataset to determine price elasticity coefficients for each insurer and analyze the resulting Nash equilibrium solutions for the premiums. We also consider a Stackelberg solution where a few companies dominate the market. We evaluate the influence of the model parameters on the equilibrium premiums through a set of sensitivity tests. The calculated price elasticity parameters demonstrate the low switching rates in the health insurance market in Switzerland and consequently the estimated equilibrium premiums often equal the largest allowed value.

**Pierre Montesinos:** Bounding Basis-Risk Using S-convex Orders on Beta-unimodal Distributions

In this paper, we characterize s-convex ordering relations for Beta-unimodal random variables thanks to Weyl integrals. We compare s-convex extrema for different values of s, show that some ordering on the sharpness of s-convex bounds is ensured for s-increasing convex functions and provide some counter-example where this is not the case. We obtain s-convex extrema for Beta-unimodal random variables, as well as for a class of random scaling distributions. We then define a framework for "model-free" basis risk management. We introduce several different measures of basis risk. We identify the worst-case scenarios using the results on s-convex extrema and measure the associated basis risk with closed-form formulas. In our framework, we introduce a concept of risk limit for basis risk and explain how to compute it as well as its main properties. Numerical illustrations are provided in several case studies. This is a joint work with C. Lefèvre and S. Loisel.



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**Charbel Mirza:** On the Landscape of Insurtech Companies Using Blockchain Technology

Abstract: We study the evolution of the insurance industry in an environment where the role of technologies grows exponentially. In this context the concept of insurers technology enablers emerged, known as insurtech, becoming today one of the main sources of disruption in the insurance markets. While competition becomes fiercer and insurtech startups hold state-of-the-art technologies, (re)insurers and insurance brokers revalue their position by renovating their business models. Worldwide cooperation of all kinds is being established between newcomers and established insurance firms. In this paper, we study the aspects of collaborations between companies and the potential impact on the involved parties. Moreover, we take a particular interest in the disruption that blockchain technology can bring if implemented in the insurance market. Many speculate blockchain to be a major disruptive tool, however many sectors and in particular the insurance sector are still unsure how to apply it.