

ASTIN - Articles

Paris, May 11th-14th 2020

ASTIN - Articles 1/4

- ASTIN – 001: [CORT, the COpula Recursive Tree](#)
- ASTIN – 002: [Understanding driver's behavior with telematics for usage based insurance](#)
- ASTIN – 003: [Can Long-Term Care Insurance Emerge in Switzerland? A Depiction of Potential Buyers to Understand Overall Demand](#)
- ASTIN – 004: [Practical application of statistical models in the activities of Insurance Guarantee Fund](#)
- ASTIN – 005: [Cyber claim analysis through Generalized Pareto Regression Trees with applications to insurance pricing and reserving](#)
- ASTIN – 006: [Application of machine learning methods for cost prediction of natural hazard in France](#)
- ASTIN – 007: [Optimal reinsurance with multiple dependent Risks](#)
- ASTIN – 008: [The effect of Disruption in Insurance Industry: Instant Policy Pricing and Cyber Risk Evaluation](#)
- ASTIN – 009: [On fitting dependent non homogeneous loss models to unearned premium risk](#)
- ASTIN – 010: [Les catastrophes naturelles à l'épreuve du 21 siècle](#)
- ASTIN – 011: [How to improve the performance of a neural network with unbalanced data for text classification in insurance application](#)
- ASTIN – 012: [Actuarial Science and Deep Learning: Orthogonal Viewpoints on Uncertainty](#)
- ASTIN – 013: [Accumulation scenarios for cyber insurance based on epidemiological models](#)

ASTIN - Articles 2/4

- ASTIN – 014: [How do Health, Care Services Consumption and Lifestyle Factors Affect the Choice of Health Insurance Plans in Switzerland?](#)
- ASTIN – 015: [Regression models for the joint development of individual payments and claims incurred](#)
- ASTIN – 016: [Medium-term Risk Appetite and Capital Management for Non-Life Insurance](#)
- ASTIN – 017: [Generalized Pareto Regression Trees for extreme claims prediction](#)
- ASTIN – 018: [The key role of actuaries in steering IFRS 17 KPIs](#)
- ASTIN – 019: [A longitudinal analysis of the impact of distance driven on the probability of car accident](#)
- ASTIN – 020: [The Skewness of Bornhuetter-Ferguson](#)
- ASTIN – 021: [Asymptotic tail probability of the discounted aggregate claims under homogeneous, non homogeneous and mixed Poisson risk model](#)
- ASTIN – 022: [Can machine learning algorithms outperform traditional pricing methods?](#)
- ASTIN – 023: [From Generalized Linear Models to Neural Networks and Back](#)
- ASTIN – 024: [Best Estimate\(s\), qui se réservera la meilleure estimation ? – Biais cognitifs et jugement d'expert en provisionnement non-vie](#)
- ASTIN – 025: [A tree-based algorithm adapted to microlevel reserving and long development claims](#)

ASTIN - Articles 3/4

- ASTIN – 026: [An Estimation of a Hybrid Log-Poisson Regression using an Optimization Program for Optimal Loss Reserving in Insurance](#)
- ASTIN – 027: [Silent Cyber assessment Framework](#)
- ASTIN – 028: [Actuaries Climate Risk Index: Research Update Abstract](#)
- ASTIN – 029: [Boosting Forest](#)
- ASTIN – 030: [Scenario Testing for Flatrated Fleets during the yearly Price Adjustment Process – a practical example](#)
- ASTIN – 031: [Moral hazard in supplementary health insurance: modelling of the insured's behaviour and the optimal contract](#)
- ASTIN – 032: [Solvency 2 Non-Life Future Premiums: modelization and impacts](#)
- ASTIN – 033: [Multivariate Hawkes process for Cyber Risk Insurance](#)
- ASTIN – 034: [Generative Synthesis of Insurance Datasets](#)
- ASTIN – 035: [Agent Based Models: Dynamics, Stochastics and Rule based Decisions - A Model Study](#)
- ASTIN – 036: [Spatial aspects of insurance risk in automobile insurance](#)
- ASTIN – 037: [Believing the Bot - Model Risk in the Era of Deep Learning](#)
- ASTIN – 038: [On the difference between pairwise and mutual independence, and why we should care](#)
- ASTIN – 039: [Risk measures derived from a regulator's perspective on the regulatory capital requirements for insurers](#)

ASTIN - Articles 4/4

- ASTIN – 040: [One-year premium risk and emergence pattern of ultimate loss based on conditional distribution](#)
- ASTIN – 041: [Premium rating without losses – how to estimate the loss frequency of loss-free risks](#)
- ASTIN – 042: [How do Risk attitudes and Homeowners Insurance Literacy Impact Default Behavior?](#)
- ASTIN – 043: [Does policyholder consider P2P insurance as a fair substitute to stock insurance? An experimental study](#)
- ASTIN – 044: [Exploitation des ressources dans un horizon stochastique sous deux interprétations](#)
- ASTIN – 045: [AGLM, A Hybrid Modeling Method of GLM and Data Science Techniques](#)
- ASTIN – 046: [How to build a risk-factors model for a Non-Life Insurance portfolio: calibration and implementation](#)
- ASTIN – 047: [Joint model prediction and application to individual-level loss reserving](#)
- ASTIN – 048: [Detection of data anomalies](#)
- ASTIN – 049: [Pertinence du catalogue d'événements CATNAT d'un logiciel sur des données réelles enregistrées au Maroc](#)
- ASTIN – 050: [Measuring the Value of Risk Cost Models](#)
- ASTIN – 051: [Goodness-of-t tests for compound distributions with applications in insurance](#)
- ASTIN – 052: [Renewal Weibull risk model with dependence, with an application to earthquake risk](#)
- ASTIN/IACA – 001: [Social inclusion in the world of modern predictive analytics](#)

CORT, the COpula Recursive Tree

Author(s): Oskar Laverny (Scor), Véronique Maume-Deschamps (Université Claude Bernard Lyon 1), Didier Rullière (Université Claude Bernard Lyon 1), Esterina Masiello (Université Claude Bernard Lyon 1)

Abstract: We construct a flexible, consistent, piecewise linear estimator for a copula, leveraging the patchwork copula formalization and various piecewise constant density estimators. While the patchwork structure imposes the grid, our estimator is data-driven and construct the (possibly irregular) grid recursively from the data, minimizing a chosen distance on the copula space. Furthermore, while the addition of the copula constraints makes the available solutions for density estimation unusable, our estimator is only concerned with dependence and guaranties the uniformity of margins. Refinements such as localized dimension reduction, bagging and boosting are developed, analyzed, and tested through application on simulated data.

Understanding driver's behavior with telematics for usage based insurance

Author(s): Emiliano Valdez (University of Connecticut), Banghee So (University of Connecticut), Jean-Philippe Boucher (UQAM)

Abstract: The evolving and rapid development of technology is revolutionizing the auto insurance market. Powered with telematics technology, insurers are able to capture a wide range of data, such as distance traveled, how drivers brake or make turns and frequency of travel during each day of the week, to better decode driver's behavior. Such additional information helped insurers introduce an innovative product called usage-based insurance (UBI). UBI has long been in the market, but in this presentation, we discuss the advantages and drawbacks of UBI to both insurers and the policyholders, and explore how we can integrate telematics information to better predict the frequency and cost of claims. We use empirical data collected from a telematics program in Canada to investigate how the information can be used to assess the frequency of claims. To comparably understand the improvement in predictions using traditional and telematics risk variables, we calibrated various classification models: logistic regression, penalized logistic regression (LASSO), trees with random forests and adaptive boosting. For training, we use a sampled data drawn from year 2015 with 25,829 observations; for testing, we use a sampled data drawn from year 2016 with 24,419 observations. We find that broadly speaking, the additional information derived from vehicle telematics help refine risk classification of drivers of UBI.

Can Long-Term Care Insurance Emerge in Switzerland? A Depiction of Potential Buyers to Understand Overall Demand

Author(s): Andrey Ugarte (Université de Lausanne), Michel Fuino (Université de Lausanne), Joël Wagner (Université de Lausanne)

Abstract: As the risks associated to aging start to materialize, societies become more aware of their financial and social consequences, and the importance of Long-Term Care Insurance (LTCI) becomes evident. In this context, although this type of coverage is already developed in some countries, in the case of Switzerland barely no offer of such products exists, and the lack of knowledge about their potential persists. To tackle this issue, this research aims to identify the main determinants that could trigger the interest of individuals to purchase LTCI. Through the development of models that combine both a Classical Statistical Framework and more recent Machine Learning techniques, and in order to better comprehend the possible market characteristics of such a product, the paper attempts to present a depiction of a potential purchaser of LTCI based on economic, social, demographic, and political factors, among others. To achieve this, the main information source consists of a unique survey specially designed to shed some light on what Swiss residents think about aging, and their experiences dealing with dependency. As it will be shown, specific factors related to their experience and understanding about LTCI coverage turn out to be very relevant when discarding or not the purchase of these products, as the socio-economic factors play a second role in their decision-making process.

Practical application of statistical models in the activities of Insurance Guarantee Fund

Author(s): Piotr Dziel (Ubezpieczeniowy Fundusz Gwarancyjny), Wojciech Bijak (Insurance Guarantee Fund - Warsaw School of Economics), Kamil Gala (Insurance Guarantee Fund)

Abstract: Insurance Guarantee Fund (IGF) has the largest, market-wide insurance database in Poland which holds the detailed information on Motor Third Party Liability and Motor Own Damage policies. Along with insurance contracts Information Center database includes information about claims and payments arising from those claims. To implement the statutory tasks imposed by national law the Fund has applied the so-called data-driven approach. The possibility to process data for internal purposes gives the opportunity to detect uninsured vehicle's owners as well as identify and counteract motor insurance fraud phenomenon. This approach uses machine learning algorithms to spot patterns in data. Statistical models and detection rules embedded in the aforementioned processes enable IGF and insurance companies to increase their operational efficiency. The paper will present the processes as well as the utilisation of variety predictive models that were used during training phase to show the significant role they play. For the better differentiation of objects a bunch of models and techniques were verified: GLM, random forests, decision trees, detection rules, fuzzy logic, gradient boosting, neural networks, segmentation. The most important variables that influence models are also going to be considered.

Cyber claim analysis through Generalized Pareto Regression Trees with applications to insurance pricing and reserving

Author(s): Sébastien Farkas (Sorbonne Université - LPSM), Olivier Lopez (UPMC), Maud Thomas (UPMC)

Abstract: In this paper we propose an actuarial framework and a statistical methodology allowing the quantification of Cyber claims resulting from data breaches events even when applied on few and heterogeneous data. Indeed, for now, just a few Cyber insurance claims occurred and in the same time some public databases gathered Cyber events. We propose to take advantage of the Privacy Right Clearinghouse database, paying attention firstly on the heterogeneity caused by the evolution of both the underlying Cyber risk and the data collection process through time, secondly on the extreme events and thirdly on the uncertainty on the exposure. We investigate the heterogeneity of the reported data breaches using regression trees customized with a splitting criterion based on Generalized Pareto likelihood in order to track different behaviors of the tail of the distribution. Combining this analysis with an assessment of the frequency of the claims and a cost formula for data breaches, we compute median and extreme quantile loss estimations of a virtual Cyber insurance portfolio.

Application of machine learning methods for cost prediction of natural hazard in France

Author(s): Antoine Heranval (Sorbonne Université / Mission Risques Naturels), Olivier Lopez (Sorbonne Université), Maud Thomas (ISUP/Sorbonne Université)

Abstract: In this work, we propose a methodology to predict the total cost of a natural catastrophe shortly after its occurrence. Thanks to a large database provided through a partnership with Fédération Française d'Assurance, we manage to have access to a very large volume of claims (our database covers over 70% of the market). Using meteorological data, we measure the intensity of an event. Socioeconomic data provided by INSEE (French public statistical organization) allow to combine this information with a better knowledge of the exposure. In this work we propose the application of different machine learning methods to handle this big volume of data, from sparse Generalized Linear Models (Lasso and Elastic-Net penalties) to Random Forests. We also take into account the unbalanced nature of our data and discussed the use of data augmentation to improve our results.

Optimal reinsurance with multiple dependent Risks

Author(s): Islem Kedidi (University of Sousse), Faysal Mansouri (Doha Institute for Graduate Studies; University of Sousse), Rihab Bedoui (University of Sousse)

Abstract: We provide model minimizing total capital requirement using the VaR and CVaRs risk measures in order to find optimal reinsurance policies for insurance companies with multiple business lines. Numerical examples are provided in order to illustrate the effects of marginal distributions and risk dependence structure on the optimal reinsurance policies.

The effect of Disruption in Insurance Industry: Instant Policy Pricing and Cyber Risk Evaluation

Author(s): Valeria D'Amato (University of Salerno), Paola Fersini (Luiss Guido Carli University), Salvatore Forte (Università Telematica Giustino Fortunato), Giuseppe Melisi (University of Sannio)

Abstract: The insurance industry are embracing innovation and technology where are not only Millennials and Generation Y customers accounted for the majority of online insurance sales. The InsurTech is breaking the paradigms affecting the insurance market by introducing digitalization, big data, chatbots, artificial intelligence. They are all testaments of an ongoing revolution that is changing traditional ways of doing things, and impact in particular the insurance market – from risk estimation, tariff assessment, and insurance distribution to customer engagement. Instant Insurance represents one of the most interesting developments of InsurTech. It is a digital insurance model which offers flexibility in policy terms and pricing. Indeed, through technological platforms, it is possible to deliver/offer, directly on the customers' smartphones, short-term, low-cost micro-insurance to be activated instantly as the insurance need arises and only for the time required. The aim of the paper is twofold: an internal model for pricing the instant policy is proposed and the correlated cyber risk is measured by the vine copula model in a multivariate dependence modeling perspective.

On fitting dependent non homogeneous loss models to unearned premium risk

Author(s): Mathieu Pigeon (UQAM), Jean-Philippe Boucher (UQAM), Sebastien Jessup (Concordia University)

Abstract: Unearned premium, or more particularly the risk associated to it, has only recently received regulatory attention. Unearned losses occur after the evaluation date for policies written before the evaluation date. Given that an inadequate acquisition pattern of premium and approximate modelling of premium liability can lead to an inaccurate reserve around unearned premium risk, an individual nonhomogeneous loss model including cross-coverage dependence is proposed to provide an alternative method of evaluating this risk. Claim occurrence is analysed in terms of both claim seasonality and multiple coverage frequency. Homogeneous and heterogeneous distributions are fitted to marginals. Copulas are fitted to pairs of coverages using rank-based methods and a tail function. This approach is used on a recent Ontario auto database.

Les catastrophes naturelles à l'épreuve du 21 siècle

Author(s): Laurence Barry (Chaire PARI), Anne-Charlotte Bongard (Addactis), Thierry Cohignac (CCR), Barbara Zucconi (Groupama)

Abstract: Le régime d'indemnisation des catastrophes naturelles (« catnat ») mis en place par le législateur en 1982 est un régime hybride : d'un côté il affirme une solidarité très large en imposant une surprime unique fixée par décret, de l'autre il s'appuie sur l'assurance pour notamment maintenir une responsabilité des assurés. Mais, si cette double assise était viable en 1982, les deux objectifs de solidarité et de responsabilité semblent aujourd'hui de plus en plus difficiles à concilier. En effet, une part croissante des sinistres couverts en DAB sont dus aux risques climatiques. Par voie de conséquence, les compagnies d'assurances sont amenées à revoir leur tarification pour tenir compte de ces risques, et mettent en place des mécanismes devenus classiques de gestion de portefeuille. Cette pratique va dans le sens d'une segmentation croissante des primes. Va-t-on vers une "individualisation" de la prime catnat ? Les catastrophes naturelles diffèrent fondamentalement des autres produits d'assurance pour lesquels il serait possible d'imaginer l'individualisation de la prime comme une autre technique de mutualisation. En effet, ce que montrent aussi les modèles c'est la très grande disparité des situations. Les primes deviennent très vite inabordables ; c'est ce que reconnaît le législateur britannique en mettant en place Flood Re en 2016. De plus, la transition climatique vient renforcer les aléas sur l'évolution des catastrophes naturelles tant en type et en fréquence qu'en impacts potentiels, alimentant l'imaginaire collectif depuis des générations (exemples illustratifs extraits de l'industrie cinématographique). Jusqu'où aller finalement dans la mutualisation ? Pourra-t-on assurer tous les risques et leurs impacts dans des scénarios de changements climatiques dits de « worst case » ? Ou est-ce finalement de formidables opportunités, et même une responsabilité sociétale, pour les assureurs ?

[Back to the list](#)

How to improve the performance of a neural network with unbalanced data for text classification in insurance application

Author(s): Isaac Cohen Sabban (Sorbonne/Pacifica), Olivier Lopez (Sorbonne Université), Yann Mercuzot (Pacifica)

Abstract: Prediction of the evolution of a claim is a challenging problem in insurance, especially for guarantees associated with high volatility of the cost such as third-party insurance. Identifying, soon after occurrence, the claims that require more attention, is particularly interesting for the company since it allows to better adapt its response to the specificity of a claim. With the increase of available data on a claim in order to analyze its severity, artificial intelligence techniques are a promising direction to deal with this problem. In this paper, we propose an ensemble method using Neural Networks as an early warning system for predicting the cost which is not directly observed due to censoring. The model is fed by information of various types (such as texts reports about the circumstances of claims and nature of the damage) obtained at the opening of the claim. A particular attention is devoted to deal with the unbalanced characteristic of our data, with minority classes representing 2% of our observations. We combine bagging with a rebalancing method to improve our results and reduce the variance of the estimator. We illustrate our methodology on one applications. The first concerns the gravity of the accident.

Actuarial Science and Deep Learning: Orthogonal Viewpoints on Uncertainty

Author(s): Laurence Barry (Chaire PARI), Arthur Charpentier (UQAM)

Abstract: The aim of this paper is to measure the disruptive potential of big data technologies for insurance, with a special focus on motor products. The first part shows how statistics imposed a vertical viewpoint, that enabled insurance mechanisms by making visible regularities that remained invisible at the individual level. Despite a very granular segmentation in motor insurance, the approach has remained classificatory, with the assumption that all members of a class are identical risks. The second part focuses on the reversal of perspective implied by big data. This tremendous volume of data, served by new algorithms such as deep learning, indeed shakes the vertical approach in a wide range of domains: the homogeneity hypothesis becomes difficult to maintain, the more so as predictive analytics claim to accurately predict individual results. Onboard devices that collect continuous driving behavioural data could import this new paradigm into automobile insurance. An examination of the current state of research on models with telematics data shows however that the epistemological leap, for now, has not happened. This comes as a surprise; insurance rates seem to resist the widespread trend towards personalization. This might be explained by the very specific and collective approach to risk at the heart of actuarial science.

Accumulation scenarios for cyber insurance based on epidemiological models

Author(s): Olivier Lopez (UPMC), Caroline Hillairet (Ensaë Paris, Crest)

Abstract: In this paper, we develop stochastic models to determine the impact of a massive cyber attack on an insurance portfolio. The model is based on the classical SIR framework (Susceptible - Infected - Recovered) of epidemiological models. For a given type of attack, we provide a general framework to quantify the impact on the portfolio of such an event, and calibrate response policies for the insurance company (such as prevention and reaction time to the attack). We also consider the possibility of a « collapse » of the response system. Such a collapse could happen if too many policyholders are affected simultaneously. In which case, the insurance company is unable to bring assistance to its policyholder. We provide sharp bounds for the probability that such an event occur.

How do Health, Care Services Consumption and Lifestyle Factors Affect the Choice of Health Insurance Plans in Switzerland?

Author(s): Veronika Kalouguina (UNIL), Joël Wagner (University of Lausanne)

Abstract: In compulsory health insurance in Switzerland, policyholders can choose two main features, the level of deductible and the type of plan. Deductibles can be chosen among six levels between CHF 300 and 2 500. While the coverage and benefits are identical, insurers propose several plans where policyholders, when requiring medical help, must first call a medical hotline, consult their family doctor or visit a doctor from a defined network. Higher deductibles and insurance plans with limitations come with lower premiums. The insureds' decisions to opt for a specific cover depend on observed and unobserved characteristics. The aim of this research is to understand the correlation between insurance plan choices and lifestyle, state of health and medical care consumption in the setting of Swiss mandatory health insurance. To do so, we account for individual health and medical health care consumption as unobserved variables employing structural equation modeling. Our empirical analysis is based on data from the Swiss Health Survey wherein lifestyle factors like the body mass index, diet, physical activity and commuting mode are available. From the 9 301 recorded observations, we find a positive relationship between having a "healthy" lifestyle, a low consumption of doctors' services and choosing a high deductible as well as an insurance plan with restrictions.

Regression models for the joint development of individual payments and claims incurred

Author(s): Łukasz Delong (SGH Warsaw School of Economics), Mario Wüthrich (RiskLab, ETH Zurich)

Abstract: The goal of this paper is to develop regression models and postulate distributions which can be used in practice to describe the joint development process of individual claim payments and claim incurred. We apply neural networks to estimate our regression models. As regressors we use the whole claim history of incremental payments and claim incurred, as well as any relevant feature information which is available to describe individual claims and their development characteristics. Our models are calibrated and tested on a real data set, and the results are benchmarked with the Chain-Ladder method.

Medium-term Risk Appetite and Capital Management for Non-Life Insurance

Author(s): Antonio Pallaria (Università di Roma La Sapienza), Nino Savelli (Catholic University of Sacred Heart, Milan)

Abstract: Solvency II is widely considered the most important regulatory change of the insurance sector in the last decade, introducing new challenges and opportunities for actuarial and quantitative risk management. In particular, the new regime is based not only on new risk-based solvency capital requirements, but it also relies on several governance and disclosure obligation European insurers must comply with. In insurance risk management it is now required to define a Risk Appetite Framework (RAF) with a target level and possibly lower and upper limits to be respected during the company's industrial plan, where solvency ratio is usually used for benchmarking. Following our last published research on a medium-term risk analysis regarding non-life underwriting risk, in this paper it is analysed the development of a dynamic RAF based on a multi-years approach, where the impacts of capital management strategies as either reinsurance or a change on portfolio mix or claims settlement speed are assessed on medium-term solvency position. For this aim, the structure of a stochastic model at this regard is presented for a multi-line Non-Life insurer, and the impact of some different strategies is investigated. As numerical results show, business and underwriting risk strategy may have a huge impact on the assessment of financial position of non-life insurers under the new prudential regime and the risk appetite may be more.

Generalized Pareto Regression Trees for extreme claims prediction

Author(s): Maud Thomas (UPMC), Olivier Lopez (UPMC)

Abstract: Tree-based methods are convenient and powerful machine learning tools that can be seen as alternatives to classical regression and prediction models such as generalized linear models, see for example. The most standard procedures are designed to estimate the expectation of a random variable, that is, when it comes to risk, a central scenario (or a best estimate using the Solvency II terminology). In this work, we propose an extension of these tree methods to the study of extreme events, which are of particular interest when it comes to investigate the tail of the distribution and design reinsurance policies. We propose a detailed description of our adaptation of decision trees and support the methodology with new consistency results on these topics. We illustrate the performance of the procedure on non-life insurance databases. Extension to random forest is also discussed.

The key role of actuaries in steering IFRS 17 KPIs

Author(s): Baptiste Brechot (Deloitte), Redouan Hmami (Deloitte)

Abstract: The international IFRS 17 standard will have a major impact on the valuation and accounting of insurance contracts and therefore on the profit signature of insurance companies. Actuaries have a central role in new standard implementation. They are strongly involved in topics such as transition, financial impact assessments, measurement of risk adjustment as well as valuation of future cash flows and contractual service margin. Through the selection of options offered by IFRS 17, the determination of actuarial methodologies and the use of expert judgment in many areas, actuaries are heavily involved in the performance and KPIs outlook of insurance companies in the new world. We present in this paper how decisions taken by actuaries can influence the insurance financial reporting metrics, with a focus on the expert judgment required in several parts of the IFRS 17 liabilities valuation process. This analysis is enriched by an international benchmark showing the diversity of practices and bringing key considerations regarding the role of actuaries within the IFRS 17 framework.

A longitudinal analysis of the impact of distance driven on the probability of car accident

Author(s): Jean-Philippe Boucher (UQAM), Roxanne Turcotte (UQAM)

Abstract: The use of driven distance as an exposure variable has already been studied (see for example Boucher et al, 2017). However, one can argue that the driven distance is not uncorrelated with other driving habits. Hence, if the model does not take this property into account, the resulting relation between claim frequency and the driven distance does not give an appropriate representation of the evolution of claim frequency regarding the driven distance for a single insured whom would change its habits. This is precisely this aspect that is tackled in the present work. By using additive models with a panel data structure for the number of claims, we focus on the marginal effect of the driven distance for its use as an exposure variable. The objective is to understand how the distance impact the exposure to the risk for an individual when every externalities have been removed. A pay-as-you-drive premium plan can be defined using the model. Numerical applications with real insurance data is presented.

The Skewness of Bornhuetter-Ferguson

Author(s): Eric Dal Moro (Scor)

Abstract: The Bornhuetter-Ferguson method is among the most popular methods used to project non-life paid or incurred triangles. For this method, T. Mack (2008) developed a stochastic model allowing the estimation of the prediction error resulting from such projections. This stochastic model involves a parametrization of the Bornhuetter-Ferguson method based on incremental triangles of incurred or paid. Hence, this parametrized method differs from the usual way in which the Bornhuetter-Ferguson is usually applied on cumulative triangles of incurred or paid. Based on this proposed stochastic model, this article provides a first approach for the estimation of the third moment, i.e. the skewness, of the resulting reserving distribution. An estimate of the third moment is useful in the context of IFRS 17 where the quantile corresponding to the addition of a risk margin on top of the best estimate will have to be disclosed. In order to apply the proposed method, a few numerical examples are provided.

Asymptotic tail probability of the discounted aggregate claims under homogeneous, non homogeneous and mixed Poisson risk model

Author(s): Franck Adekambi (University of Johannesburg)

Abstract: In this paper, we derive a closed form-expression of the tail probability of the aggregate discounted claims under homogenous, non-homogenous and mixed Poisson risk model with constant force of interest using a general dependence structure between the Inter-arrival claims times and the claim amounts. This dependence is relevant since it is well known that under catastrophic or extreme events inter-arrival claims times and the claim severities are dependent.

Can machine learning algorithms outperform traditional pricing methods?

Author(s): Harej Bor (PRS)

Abstract: The comparison of different algorithms for insurance pricing exercise is a task that relies on the available information in data sample used. Real policy and claim data are missing useful information about the true underlying rate of each policy that we want to estimate. An easy trick to avoid this issue is to generate synthetic data where exact claim probability distributions are known for each individual policy. We generate synthetic data sample in a way to reflect non-linear relation of individual factors to claim exposure, non-additive contribution of individual factors and non-trivial dependency among the rating factors. Several different machine-learning algorithms are calibrated to estimate the appropriate basic premium rate to cover expected claims: Generalized Linear Models, Generalized Additive Models, Random Forests, Gradient Boosting and Neural Networks. We compare the predictions with the true underlying rates and try to find the best fit. Finally, we find remarkable results evaluating the profit of the insurers that would use a particular algorithm in comparison with others and the effect of the winner's curse.

From Generalized Linear Models to Neural Networks and Back

Author(s): Mario Wüthrich (RiskLab, ETH Zurich)

Abstract: We present how to enhance classical generalized linear models by neural network features. On this way to get there, we highlight the traps and pitfalls that need to be avoided to get good statistical models. This includes the non-uniqueness of "sufficiently good" regression models, the balance property, and representation learning, which brings us back to the concepts of the good old generalized linear models.

Best Estimate(s) : qui se réservera la meilleure estimation ? – Biais cognitifs et jugement d'expert en provisionnement non-vie

Author(s): Simon Robert (Deloitte)

Abstract: De prudent, le provisionnement des sinistres à payer est désormais bien souvent Best Estimate, se devant de fournir la meilleure estimation du coût qu'auront les sinistres encore en développement, connus ou inconnus de l'assureur. Malgré l'essor de nouvelles méthodes, les méthodes déterministes standards comme Chain Ladder ou Bornhuetter-Ferguson, demeurent très largement les plus plébiscitées à travers le monde. Choix de la méthode, des hypothèses ou de la granularité des données relèvent souvent du jugement d'expert de l'actuaire. La place prépondérante qu'il occupe peut expliquer les différences entre les Best Estimate de deux actuaires à partir des mêmes données. L'assurance d'un jugement d'expert de qualité est donc primordiale afin de garantir celle de l'estimation elle-même. Comme tout un chacun, l'actuaire et son jugement n'est pas immunisé face aux biais cognitifs, inconscients influenceurs de la décision. Biais d'ancrage, de statu quo ou de représentativité sont autant de menaces à la garantie d'avoir le meilleur jugement et donc la meilleure estimation. Identification et mise en situation de ces derniers est donc nécessaire. Cet article vise à présenter et à montrer les résultats d'une étude statistique menée en confrontant un groupe varié d'actuaires à ces biais cognitifs dans des cas pratiques simplifiés de provisionnement. Ses résultats ont pour objectif de vérifier si effet notable de ces biais il y a, et de le quantifier en termes d'impact sur le Best Estimate.

A tree-based algorithm adapted to microlevel reserving and long development claims

Author(s): Xavier Milhaud (UNIV-LYON)

Abstract: In non-life insurance, business sustainability requires accurate and robust predictions of reserves related to unpaid claims. To this aim, two different approaches have historically been developed: aggregated loss triangles and individual claim reserving. The former has reached operational great success in the past decades, whereas the use of the latter still remains limited. Through two illustrative examples and introducing an appropriate tree-based algorithm, we show that individual claim reserving can be really promising, especially in the context of long-term risks.

An Estimation of a Hybrid Log-Poisson Regression using an Optimization Program for Optimal Loss Reserving in Insurance

Author(s): Apollinaire Woundjiague (University of Maroua)

Abstract: In this paper, we provide an alternative estimation method of our hybrid model using a quadratic optimization program and the optimized h-value. We perform the hybrid model with the alternative estimation we are suggesting on two different numerical data to predict incremental payments in loss reserving. From the mean square error prediction, we prove that the alternative estimation of the new Hybrid Model with an optimized h-value predict incremental payments better than the classical log-Poisson regression model as well as the same hybrid model with analytical estimation of parameters. Hence, we have optimized the outstanding loss reserves.

Silent Cyber assessment Framework

Author(s): Simon Cartagena (Scor)

Abstract: The (re)insurance industry is faced with a growing risk related to the development of information technology (IT). This growth is creating an increasingly digitally interconnected world with more and more dependence being placed on IT systems to manage processes. This is generating opportunities for new insurance products and coverages to directly address the risks that companies face. However, it is also changing the risk landscape of existing classes of business within non-life insurance where there is inherent risk of loss as a result of IT events that cannot be excluded in policy wordings or are changing the risk profile of traditional risks. This risk of losses to classes of business resulting from cyber as a peril is defined as non-affirmative cyber risk and is currently not very well understood by the market. In contract wordings, the market has remained relatively "silent" across most lines of business about potential losses resulting from IT related events, either by not addressing the potential issue or exclude via exclusions. Some classes of business recognise the exposure by use of write-backs. Depending on the line of business the approach will vary as to how best to turn any "silent" exposure into a known quantity either by robust exclusionary language, pricing or exposure monitoring. This paper proposes a framework to help insurance companies address the issue of non-affirmative cyber risk across their portfolios.

Actuaries Climate Risk Index: Research Update Abstract

Author(s): Steve Jackson (American Academy of Actuaries)

Abstract: The American Academy of Actuaries (Academy) would be pleased to present Actuaries Climate Risk Index (ACRI): Research Update. The ACRI is derived from a model of the statistical relationship between the weather components of the Actuaries Climate Index (ACI) and property damage caused by severe weather. Several years ago, four actuarial organization in North America (the Academy, the Canadian Institute of Actuaries, the Casualty Actuarial Society, and the Society of Actuaries) launched the ACI. The ACI provides an objective indicator of the frequency of extreme weather events and the extent of sea level change for twelve regions in the United States and Canada. Our work on the ACI led us to our work on the ACRI. This paper describes the methods used and results produced for this new index, the ACRI, which measures the economic losses resulting from changes in environmental conditions since the end of a reference period, 1961 -1990, as measured by the ACI. The ACRI distinguishes the losses due to changes in weather from the larger set of losses due to increases in risk exposure. The resulting ACRI for the United States totals \$24 billion during the post-reference period, 1991 -2016, equal to approximately 5% of weather-related losses during that period.

Boosting Forest

Author(s): Simon Lee (AXA Partners Asia)

Abstract: A new architecture combining boosting and the random forest is proposed. Through a more systematic arrangement of trees, the boosting forest can produce stable improvement of the validation metric as iteration increases, contrasting to the relatively noisy phenomenon in DART. Besides, due to the increased variance introduced in the architecture, the boosting forest in general exhibits lower training metric curve improvement and can even have reversals, giving early signals on over-fitting before even investigating validation data. Using the optimal hyper-parameters for baseline gradient boosting for benchmark data, boosting forest generally exhibits better performance in standard metrics. The performance further improves if hyper-parameters are further tuned for boosting forest.

[Back to the list](#)

Scenario Testing for Flatrated Fleets during the yearly Price Adjustment Process – a practical example

Author(s): Michael Klamser (Allianz)

Abstract: The presentation (in the area of flat rated fleets) will start from the calculation of the (actuarially correct) technical premium and will then deal with the commercial premium which is directly derived from the former one and subsequently adjusted in order to fit the needs of the fleet insurance market. Both will be required to determine the adjustment factor during the yearly premium adjustment process whilst determining the profitability of the future flat rated fleet portfolio (i.e. the bottom line) and at the same time ensuring an optimal growth in gross written premium (i. e. the top line). In this context the lapse analysis plays a crucial role to identify the segments which are more or less price-sensitive, thus giving the portfolio manager an effective tool to optimize the premiums without neglecting the profitability of the whole big fleet portfolio. There the technical premium (or TP) comes into play. It guarantees that the effect of a client's reaction (renewal or lapse) can be quantified, thus preventing an unnecessary lapse of a (highly) profitable account respectively a suboptimal premium increase. Of course, legal restrictions have to be considered in this context, prohibiting an arbitrary or unjustified premium increase. The relation between the offered premium and the technical premium is here of paramount importance.

Moral hazard in supplementary health insurance: modelling of the insured's behaviour and the optimal contract

Author(s): Costin Oarda (CSS Insurance)

Abstract: The goal of this study was to model the behaviour of supplementary health insurance policyholders in a context of moral hazard and build an optimal contract resolution algorithm. The optimal contract maximizes the insurer's expected profit under participation and incentive constraints: the insured remains in such a contract and chooses the effort to limit risk exposure that maximizes its expected utility. Moral hazard is a situation of information asymmetry where the insurer cannot observe the effort but only an imperfect signal from it, called "output". The expected utility of the insured is here the difference between the expected utility of wealth and the cost of the effort. We developed a theoretical framework based on contract theory for health insurance. Based on French supplementary health insurance data, we constructed effort indicators to model the insured's behaviour (frequency and intensity of use of cover) for each risk class. The algorithm calibrates the moral hazard model, in particular the utility of wealth according to the degree of risk-aversion and the cost of effort according to the participation and incentive conditions of the initial contract. The numerical resolution of the model finally identifies the characteristics of the optimal contract (premium, deductible, and limit of indemnity) as well as the insured's behaviour (effort). The algorithm provides an innovative approach to insurance companies wishing to develop competitive and sustainable insurance products.

Solvency 2 Non-Life Future Premiums: modelization and impacts

Author(s): Alberto Girardo (Europ Assistance)

Abstract: This research assesses from a mathematical and actuarial point of view the Future Premium (FP) calculation for Non-Life business under Solvency 2 directive. This is one of the most overlooked part of the Standard Formula calculation in Non-Life business. As verifiable from public SFCRs many non-life insurance companies do not fully calculate FP for the assessment of both Best Estimate Liabilities and Solvency Capital Requirement (SCR) and many use unrefined proxies. In this paper a simple model for a Non-Life insurer is provided as well as the mapping of many particular contract cases. On the one hand, the normative framework, as well as the European market situation for FP, is presented. Particular attention will be given to the definition of Contract Boundaries. On the other hand, the mapping of the great majority of insurance contract types is given, as well as pragmatic example of how an Insurance company can build a database useful for the calculation. Finally, the impact in terms of profitability and risk is assessed by means of two classical indicators (SCR ratio and the RoRaC). While a proper quantification of the FP can yield a positive, neutral or negative result on the SCR ratio, it always deteriorate the RoRaC making it more accurate.

Multivariate Hawkes process for Cyber Risk Insurance

Author(s): Caroline Hillairet (ENSAE)

Abstract: Among the several features of cyber-attacks one wants to reproduce, those related to the memory of events and self-exciting behavior is of major importance, as it underlies the clustering and auto-correlation of times of cyber-attacks. In this paper, we propose a multivariate Hawkes framework for modelling and predicting cyber-attacks frequency. The inference is based on a public dataset containing features of data-breaches targeting the US industry. As a main output of this paper, we demonstrate the supremacy of Hawkes models over Poisson models. We also develop a penalized inference procedure to capture the relevant interactions between different classes of attacks, and detail prediction results providing the full distribution of future cyber-attacks times of occurrence. In addition we shows that a non-instantaneous excitation, which is not the classical framework of the exponential kernel, better fit with our data. In an insurance framework, this study allows to determine quantiles for an internal model as well as the frequency component for a data breach guarantee. In this occasion we provide the computation of the expectation of a multivariate non-stationary Hawkes process.

Generative Synthesis of Insurance Datasets

Author(s): Kevin Kuo (RStudio / Kasa AI)

Abstract: One of the impediments in advancing actuarial research and developing open source assets for insurance analytics is the lack of realistic publicly available datasets. In this work, we develop a workflow for synthesizing insurance datasets leveraging state-of-the-art neural network techniques. We evaluate the predictive modeling efficacy of datasets synthesized from publicly available data in the domains of general insurance pricing and life insurance shock lapse modeling. The trained synthesizers are able to capture representative characteristics of the real datasets. This workflow is implemented via an R interface to promote adoption by researchers and data owners. One of the impediments in advancing actuarial research and developing open source assets for insurance analytics is the lack of realistic publicly available datasets. In this work, we develop a workflow for synthesizing insurance datasets leveraging state-of-the-art neural network techniques. We evaluate the predictive modeling efficacy of datasets synthesized from publicly available data in the domains of general insurance pricing and life insurance shock lapse modeling. The trained synthesizers are able to capture representative characteristics of the real datasets. This workflow is implemented via an R interface to promote adoption by researchers and data owners. One of the impediments in advancing actuarial research and developing open source assets for insurance analytics is the lack of realistic publicly available datasets. In this work, we develop a workflow for synthesizing insurance datasets leveraging state-of-the-art neural network techniques. We evaluate the predictive modeling efficacy of datasets synthesized from publicly available data in the domains of general insurance pricing and life insurance shock lapse modeling. The trained synthesizers are able to capture representative characteristics of the real datasets. This workflow is implemented via an R interface to promote adoption by researchers and data owners. One of the impediments in advancing actuarial research and developing open source assets for insurance analytics is the lack of realistic publicly available datasets. In this work, we develop a workflow for synthesizing insurance datasets leveraging state-of-the-art neural network techniques. We evaluate the predictive modeling efficacy of datasets synthesized from publicly available data in the domains of general insurance pricing and life insurance shock lapse modeling. The trained synthesizers are able to capture representative characteristics of the real datasets. This workflow is implemented via an R interface to promote adoption by researchers and data owners.

Agent Based Models: Dynamics, Stochastics and Rule based Decisions - A Model Study

Author(s): Magda Schiegl (University of Applied Sciences Landshut)

Abstract: One of the first in the actuarial literature published agent-based models (ABM) is by Ingram et al. The paper describes a model of a competitive (insurance) market that shows cyclical behavior. The authors put their focus on the model's theoretic foundation within the theory of plural rationality and on a brief tabulated code-like description of the model. We reformulate the above cited model in a form that makes it accessible for analytical as well as numerical treatment and discussion. We find three interacting components of the model: the dynamics, the stochastics and the rule-based decisions. The agents, insurance companies, play a rule based strategic game, competing with each other. The actions of the agents depend on both, the statistics of the single agent and the statistics of the market as a whole. We analyse the dynamics of the model being responsible for a parameter dependent, periodic behavior and investigate its stochastic and rule-based components. We implemented the model as a Monte Carlo simulation. Therefore we are able to examine the interactions of the model's different components. Finally, we discuss the result of the model as well as possible applications.

Spatial aspects of insurance risk in automobile insurance

Author(s): Kamil Gala (Insurance Guarantee Fund)

Abstract: The standard market practice in automobile insurance is to include information on the place of residence of the insured as one of the rating factors. In such a situation geographic area is used as a proxy for various risk factors associated with this area, e.g. traffic intensity and commuting patterns. The subject of this work is to describe the spatial aspects of insurance risk in Motor Third-Party Liability and Motor Own Damage insurance, such as spatial autocorrelation and spatial heterogeneity, and to examine their possible impact on risk classification. The main tool used to achieve this goal is generalized linear model (GLM) extended with random component, which allows to combine standard actuarial a priori ratemaking methods with complex spatial autocorrelation structures. The models which are considered for the random component include multi-level factor model, Bühlmann-Straub credibility model with correlated latent variables and spatial Markov process. The presented models are built and validated on the basis of the data from the Polish Insurance Guarantee Fund's database, which contains complete market-wide data from the Polish automobile insurance market. These data provide unique opportunity to assess the accuracy and effectiveness of spatial modeling in actuarial context.

Believing the Bot - Model Risk in the Era of Deep Learning

Author(s): Ronald Richman (QED)

Abstract: Deep Learning models are currently being introduced into business processes to support decision-making in insurance companies. At the same time model risk is recognized as an increasingly relevant field within the management of operational risk that tries to mitigate the risk of poor business decisions because of flawed models or inappropriate model use. In this paper we try to determine how Deep Learning models are different from established actuarial models currently in use in insurance companies and how these differences might necessitate changes in the model risk management framework. We analyse operational risk in the development and implementation of Deep Learning models using examples from pricing and mortality forecasting to illustrate specific model risks and controls to mitigate those risks. We discuss changes in model governance and the role that model risk managers could play in providing assurance on the appropriate use of Deep Learning models.

On the difference between pairwise and mutual independence, and why we should care

Author(s): Guillaume Boglioni Beaulieu (UNSW Business School)

Abstract: The modelling of dependence is a central research topic in the actuarial field. To that end, it has long been recognized that the sole use of correlations between pairs of risks can be inadequate. However, dependence is still usually conceived as a pairwise concept. This paper investigates the common fallacy of mistaking pairwise independence of random variables with the stronger assumption of mutual independence. Especially, we study the consequences of this fallacy in an insurance setting featuring dependent risks.

Risk measures derived from a regulator's perspective on the regulatory capital requirements for insurers

Author(s): Jun Cai (University of Waterloo)

Abstract: In this study, we propose new risk measures from a regulator's perspective on the regulatory capital requirements. The proposed risk measures possess many desired properties, including monotonicity, translation-invariance, positive homogeneity, subadditivity, nonnegative loading, and stop-loss order preserving. The new risk measures not only generalize the existing, well-known risk measures in the literature, including the Dutch, tail value-at-risk (TVaR), and expectile measures, but also provide new approaches to generate feasible and practical coherent risk measures. As examples of the new risk measures, TVaR-type generalized expectiles are investigated in detail. In particular, we present the Dual and Kusuoka representations of the TVaR-type generalized expectiles and discuss their robustness with respect to the Wasserstein distance.

One-year premium risk and emergence pattern of ultimate loss based on conditional distribution

Author(s): Marcin Szatkowski (ERGO Hestia), Łukasz Delong (SGH Warsaw School of Economics)

Abstract: We study the relation between one-year premium risk and ultimate premium risk. In practice, the one-year risk is sometimes related to the ultimate risk by using a so-called emergence pattern formula introduced by England et al. (2012) and Bird, Cairns (2011). We postulate to define the true emergence pattern of the ultimate loss X_n for the one-year premium risk based on the conditional distribution of the best estimate of the ultimate loss given the ultimate loss $BE_1 | X_n$ where the conditional distribution is derived from the multivariate distribution of the claims development process (X_1, \dots, X_n) and the definition of the best estimate of the ultimate loss after the first year BE_1 . We investigate three claims development models commonly used in claims reserving. We derive the true emergence pattern formulas in these models and prove that they are different from the emergence pattern postulated by England et al. (2012), Bird, Cairns (2011). We identify that the true one-year premium risk, when measured with Value-at-Risk, can be under and overestimated if the emergence pattern formula from England et al. (2012), Bird, Cairns (2011) is applied. We present two modifications of the emergence pattern formula from England et al. (2012), Bird, Cairns (2011). These modifications allow us to go beyond the claims development models investigated in the first part and work with an arbitrary distribution of the ultimate loss.

Premium rating without losses – how to estimate the loss frequency of loss-free risks

Author(s): Michael Fackler (Consulting Actuary)

Abstract: In insurance and even more in reinsurance it occurs that about a risk you only know that it has suffered no losses in the past say seven years. Some of these risks are furthermore such particular or novel that there are no similar risks to infer the loss frequency from. In this paper we propose a loss frequency estimator that copes with such situations, by just relying on the information coming from the risk itself: the “amended sample mean”. It is derived from a number of reasonable mathematical first principles and turns out to have desirable statistical properties. Some variants are possible, which enables insurers to align the method to their preferred business strategy, by trading off between low initial premiums for new business and moderate premium increases for renewal business after a loss. We further give examples where it is possible to assess also the average loss, from some market or portfolio information, such that overall one has an estimator of the risk premium.

How do Risk attitudes and Homeowners Insurance Literacy Impact Default Behavior?

Author(s): Sebastain Awondo (University of Alabama)

Abstract: We investigate the joint effects of higher order risk attitudes and insurance literacy on homeowner's insurance shopping and switching behaviors for coastal homeowners in the U.S, and the implications on premiums and windstorm mitigation up take using survey and experimental data. To elicit risk attitudes, we employ 50-50 model-free risk apportionment lotteries. Results reveal significant association between HORA, insurance literacy and default behavior in homeowner's insurance. We find a strong association between second order risk attitudes and homeowners' propensity to shop for insurance. However, switching insurance policy is strongly associated with homeowners' third order risk attitudes. Overall, risk-loving and prudent homeowners are most likely to shop for and switch to a new policy. The benefits of switching are highly heterogeneous across risk attitude and insurance literacy subgroups.

Does policyholder consider P2P insurance as a fair substitute to stock insurance? An experimental study

Author(s): Charles Davenne (University Paris Ouest Nanterre (EconomiX) / Yakman)

Abstract: This paper investigates through the prism of behavioral economics the impact of transparency and peer effects on a consumer's choice between an individual insurance contract (stock insurance) and a peer-to-peer risk sharing pool contract (mutual insurance) in an experimental setup. Both dimensions are treated separately through specific treatment. In the transparency treatment, participants are clearly informed of the probability of failure of the risk sharing pool. While in the peer effect treatment, participants are invited to reveal individual preferences in order to build up a sense of belonging in the risk sharing pool. In parallel, we also test how consumer demand for mutual insurance varies inside each treatment in function of risk's characteristics (frequency and loss) and of the competitiveness of mutual insurance compared to individual insurance. Our results show that while some people always prefer individual insurance, a substantial share of participants choose mutual insurance. We show that this preference for peer-to-peer insurance relies importantly on social preferences, but risk aversion is also a non-negligible factor. It is also shown that the transparency treatment positively affects the probability for mutual insurance to be chosen. We explain the largest part of this effect through ambiguity aversion. Finally, peer effect treatment, contrary to what was expected, doesn't seem to have a real positive impact on the preference for mutual insurance. Indeed, experimental results show that peer effects can have either a positive or a negative impact on the preference for mutual insurance depending on the group's characteristics in which it was implemented.

Exploitation des ressources dans un horizon stochastique sous deux interprétations paramétriques

Author(s): Jose Daniel Lopez Barrientos (Universidad Anahuac Mexico)

Abstract: Dans cet exposé, nous présentons un jeu d'extraction à deux joueurs où les temps terminaux aléatoires suivent des distributions (différentes) avec des queues lourdes. En outre, nous nous penchons sur les implications de travailler avec des fonctions logarithmiques d'utilité / paiement terminal. À cette fin, nous utilisons des résultats et de la notation actuariels standards, et nous établissons un lien entre le principe d'équivalence actuarielle, et les contrôleurs de rétroaction trouvés au moyen de la technique de programmation dynamique. Nos conclusions incluent une conjecture sur la forme de la récompense optimale pour assurer les tâches d'extraction; et une comparaison des intensités d'extraction pour chaque joueur sous différentes phases des durées de vie de leurs machines respectives.

AGLM, A Hybrid Modeling Method of GLM and Data Science Techniques

Author(s): Hirokazu Iwasawa (Self Employed)

Abstract: In recent years, one of the most critical tasks for actuaries is to adopt data science techniques in predictive modeling practice. However, due to the peculiarity of insurance data as well as the priorities taken by actuaries in decision-making, such as the interpretability of models and regulatory requirements, most actuaries may find difficulties in applying them. We believe some original modeling methods with a good balance of high predictive accuracy and strong explanatory power is what is required. We propose, from this standpoint, AGLM (Accurate GLM), a simple modeling method with a desirable good balance accomplished by combining data science techniques and conventional Generalized Linear Models. For practitioners' convenience, we have also developed an R package named `aglm` (<https://github.com/kkondo1981/aglm>). Since the first version released in January 2019, the `aglm` can make numeric features segmented optimally exactly as Fused LASSO does when the L1 regularization is designated. In addition, the current version can, alternatively if preferable, change them from linear variables to the optimal piecewise linear variables. Those functions make the constructed predictive model much more flexible than a conventional GLM hopefully still keeping sufficient explanatory power.

[Back to the list](#)

How to build a risk-factors model for a Non-Life Insurance portfolio: calibration and implementation

Author(s): Alessandro Ferriero (Universidad Autónoma de Madrid)

Abstract: The Quantitative Risk Management for a Non-Life insurance company deals with a vector of random variables, which represent the profit-and-loss of different portfolios, its aggregate position and a risk measure that quantifies the total risk. How the dependencies between the different portfolios are modelled has a big impact on the aggregate position and, therefore, on the total risk. It is thus of fundamental importance for the model to be as transparent as possible so that all the stakeholders, notably regulators, have the possibility to validate and challenge its appropriateness. A dependencies model based on risk-factors, similarly to those for the Life insurance risks or for the Asset risks, would be ideal in providing such transparency. Unfortunately, differently to the Life insurance and Asset cases, it is extremely complex to build a risk-factor model for the Non-Life insurance risks in practice, firstly, because the stochasticity of relevant risk-factors are almost impossible to estimate (e.g. social inflation or changes in the legal environment in a jurisdiction) and, secondly, because the impact of the risk-factors on the losses of a portfolio are complex to determine. In this paper we present a model overcoming these difficulties so to build a risk-factors model for a Non-Life insurance portfolio. We discuss how to calibrate and implement this model in practice.

Joint model prediction and application to individual-level loss reserving

Author(s): Peng Shi (Wisconsin School of Business)

Abstract: In non-life insurance, the payment history can be predictive of the timing of a settlement for individual claims. Ignoring the association between the payment process and the settlement process could bias the prediction of outstanding payments. To address this issue, we introduce into the literature of microlevel loss reserving a joint modeling framework that incorporates longitudinal payments of a claim into the intensity process of claim settlement. We discuss statistical inference and focus on the prediction aspects of the model. We demonstrate applications of the proposed model in the reserving practice and identify scenarios where the joint model outperforms macro-level reserving methods.

Detection of data anomalies

Author(s): Alexandre Boumezoued (Milliman)

Abstract: In this presentation, we will review and detail case studies of the use of anomaly detection techniques to solve practical issues in the actuarial field. Multiple operational contexts require a fast and efficient detection of abnormal observations, also called outliers. These may be data errors to be fixed, extreme points caused by exceptional conditions, or atypical observations which may contain valuable information. Among anomaly detection techniques, the so-called Isolation Forest algorithm has been successfully applied in many areas to provide anomaly scores to observations. The advantage of this unsupervised classification technique relies on the fact that it can be trained without labels, and without relying on expert opinion or model to profile the abnormal points. The presentation will focus on case studies related to claims reserving, mortality data correction, and Solvency 2 Internal Model data quality processes.

Pertinence du catalogue d'événements CATNAT d'un logiciel sur des données réelles enregistrées au Maroc

Author(s): Sabrina Mrabti (Forsides)

Abstract: Le régime des couvertures de conséquences d'événements catastrophiques sera obligatoire et applicable dès le 1^{er} janvier 2020 au Maroc (Loi 110-14 venant modifier et compléter la loi 17-99 des Codes des Assurances). La nouvelle loi prévoit deux régimes de couverture : l'un dédié aux personnes déjà couvertes par des polices d'assurance qui seront élargies par la loi aux catastrophes naturelles, et le second dédié à la prise en charge des personnes non couvertes par des polices d'assurance. Au Maroc, l'événement catastrophique qui engendre le plus de perte économique et humaine est le tremblement de terre. La tarification de ce risque se base soit sur des logiciels de modélisation commercialisés par des entreprises spécialisées comme RMS, AIR et EQCAT, soit sur des logiciels libres en open source comme Oasis et GEM. Plusieurs assureurs marocains ont opté pour le logiciel GEM pour la modélisation des engagements et pour la tarification. Ce logiciel comporte un catalogue d'environ 20.000 événements. L'objet de ce travail est de mesurer la pertinence de ce catalogue au vu des derniers tremblements de terre survenus au Maroc.

Measuring the Value of Risk Cost Models

Author(s): Dimitri Semenovich (Insurance Australia Group)

Abstract: Following innovations in machine learning and computational statistics, a large variety of new modeling techniques are being applied to premium rating. In order to carry out model comparison and selection in this regime it is particularly valuable to develop metrics that allow us to evaluate predictive power of candidate models with respect to the insurance outcome without relying on the knowledge of their internal structure. Common diagnostics used today include calibration plots, quantile charts, double lift or loss ratio plots, Lorenz curves and the Gini index (Berry et al., 2009; Goldburd et al., 2016). The relationships between these tools and the potential economic value of the models are not necessarily well understood (Meyers, 2008; Meyers and Cummings, 2009). In this paper we establish a precise connection between the traditional diagnostics and the economic value and take advantage of the resulting intuition to motivate a new family of model-agnostic performance metrics and draw links to established literature on forecast evaluation.

Goodness-of-t tests for compound distributions with applications in insurance

Author(s): Pierre-Olivier Goffard (Université Claude Bernard Lyon 1 - ISFA)

Abstract: Goodness of fit procedures are provided to test the validity of compound models for the total claims, involving specific laws for the constituent components, namely the claim frequency distribution and the distribution of individual claim sizes. This is done without the need for observations on these two component variables. Goodness-of-fit tests that utilize the Laplace transform as well as classical tools based on the distribution function, are proposed and compared. These methods are validated by simulations and then applied to insurance data.

Renewal Weibull risk model with dependence, with an application to earthquake risk

Author(s): Etienne Marceau (Université de Laval)

Abstract: In the seismological and geophysics literature, it is suggested by numerous authors that the elapsed time between two earthquakes at a given location should be represented by either an exponential or Weibull distribution. In addition, the seismic gap hypothesis states that large waiting times could provoke larger earthquakes. This will create a statistical dependence relationship between the frequency and magnitude components of any earthquake risk model. This paper investigates the actuarial, statistical and risk management implications of these two characteristics of earthquake risk. To do so, we introduce the conditional Weibull renewal process to count the number of earthquakes over a given time period and we introduce statistical dependence between the interarrival times and the force of each earthquake. An actuarial earthquake risk model based on these elements is presented and applied to Montreal (Quebec) earthquake data.

Social inclusion in the world of modern predictive analytics

Author(s): Esko Kivisaari (Finance Finland)

Abstract: The volume of digital data is increasing by around 61 % annually. The rapidly developing techniques of predictive analytics make it possible to use this data in underwriting and pricing of insurers. These novel technologies present huge opportunities for societies to utilize pooling of risks better and better. For insurers better techniques help not only to cover risks more efficiently but also to better manage adverse selection and moral hazard, and also to combat insurance fraud. With these benefits we also have threats. Does increasingly exact risk-based underwriting lead to a decrease in the inherent solidarity, existing not only in mandatory or social insurance but also in voluntary insurance? Do we end up in a situation where lack of insurance leads to a larger part of the population being socially excluded (recognizing that modern techniques, when used responsibly, can also reduce exclusion)? The paper looks at the problem of avoiding social exclusion in the context of evolving techniques. It is connected to the thinking of the Consultative Expert Group on Digital Ethics set up by EIOPA, where the author is chairing one of the three workstreams.

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