Actuarial and Financial Mathematics Conference

Interplay between Finance and Insurance

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Lunches and coffee breaks : Marble room

Conference dinner : University foundation (Egmontstraat 11, 1000 Brussel)

Map with important locations : available on

http://www.afmathconf.ugent.be/index.php?page=practicalinfo

Wireless internet

There is wireless internet available in the main building and throne building.

- SSID = academie.
- This is an open network, no password is needed.

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15h15 - 15h45	CONTRIBUTED TALK - Philipp Möller, University of Göttingen, Germany **Drawdown measures and return moments**
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16h15 - 17h00	CONTRIBUTED TALK - Markus Michaelsen, Hamburg University, Germany **Information flow dependence in financial markets**
17h00 – 17h30	INVITED SPEAKER - Katrien Antonio, KU Leuven, B & University of Amsterdam, NL PRACTITIONERS LECTURE **Data analytics for claims reserving**
18h30 - 22h00	Conference Dinner at University Foundation

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09h45 - 10h15	CONTRIBUTED TALK - Nathan Lassance, Université catholique de Louvain, Belgium **Minimum Rényi entropy portfolios**
10h15 - 10h45	Coffee break
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10h45 - 11h30	INVITED SPEAKER - Christa Cuchiero, University of Vienna, Austria **Rough volatility from an affine point of view**
11h30 - 12h00	CONTRIBUTED TALK - Sander Willems, EPFL and Swiss Finance Institute, Switzerland **A term-structure model for dividends and interest rates**
12h00 – 13h30	Sandwich lunch combined with **Poster session**
	Chair: Ludger Rüschendorf
13h30 - 14h15	INVITED SPEAKER - Frédéric Vrins, Université catholique de Louvain, Belgium PRACTITIONERS LECTURE **CVA wrong-way risk via change of measure: theory, implementation and performance analysis**
14h15 - 14h45	CONTRIBUTED TALK - Jiang Ye, Vrije Universiteit Brussel, Belgium **Optimal strategy under omega ratio**
14h45 - 15h15	Coffee break
	Chair: Steven Vanduffel
15h15 - 16h00	INVITED SPEAKER - Łukasz Delong, Warsaw School of Economics, Poland **Time-inconsistent optimization problems in finance and insurance**
16h00 - 16h15	Closing

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  Text mining and ruin theory: A case study of research on risk models with dependence

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ABSTRACTS – Presentations

Joint Modeling of Customer Loyalty and Risk in Personal Insurance

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Joint work with: Catalina Bolance, Montserrat Guillen, Emiliano Valdez

This work connects two strands of research of modeling personal (automobile and homeowners) insurance. One strand involves understanding the joint outcomes of separate personal insurance contracts, e.g., do higher automobile claims suggest more severe homeowner claims? Joint modeling of personal insurance is complicated by the fact that the outcomes typically have a mass at zero, corresponding to no claims, and when there are claims, distributions tend to be right-skewed and long-tailed. Moreover, it is important to account for insured personal characteristics as well as characteristics of the contract and, in the case of auto and homeowners, features of the automobile and the house. A second strand of the literature involves understanding determinants of customer loyalty. For example, we now know that when a customer cancels one insurance contract, he or she is likely to cancel all other contracts soon after.

This paper examines longitudinal data from a major Spanish insurance company that offers automobile and homeowners insurance. The dataset tracks 890,542 clients over five years, many of whom subscribed to both automobile and homeowners insurance (75,536, or approximately 8.5%). To represent this data, we use copula regression to model the joint outcomes of auto and home claims as well as customer loyalty. Including customer loyalty, or duration with the company, is complicated because of the censoring of this time variable as well as the discreteness. Although customers may cancel the contract at any time, cancelation typically occurs at contract renewal, making this variable essentially a discrete outcome. Composite likelihood and generalized method of moments techniques allow us to address the special features of this data structure.

Consistent with findings from other studies, we find that intertemporal dependencies are important, e.g., high auto claims from one year signal high auto claims for the following year. Work is ongoing to develop strategies that will allow the insurance manager to identify profitable portfolios through measurement of a customer loyalty index.

Long-Term Care Models and Dependence Probability Tables by Acuity Level: New Empirical Evidence from Switzerland

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Joint work with: Michel Fuino

Due to the demographic changes and population aging occurring in many countries, the financing of long-term care (LTC) poses a systemic threat. The scarcity of knowledge about the probability of an elderly person needing help with activities of daily living has hindered the development of insurance solutions that complement existing social systems. In this paper, we consider two models: a frailty level model that studies the evolution of a dependent person through mild, moderate and severe dependency states to death and a type of care model that distinguishes between care received at home and care received in an institution. We develop and interpret the expressions for the state- and time-dependent transition probabilities in a semi-Markov framework. Then, we empirically assess these probabilities using a novel longitudinal dataset covering all LTC needs in Switzerland over a 20-year period. As a key result, we are the first to derive dependence probability tables by acuity level, gender and age for the Swiss population. We find that the transition probabilities differ significantly by gender, age and duration.

Tonuity: A Novel Individual-Oriented Retirement Plan

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Joint work with: Peter Hieber, Jakob Klein

For insurance companies in Europe, the introduction of Solvency II leads to a tightening of rules for solvency capital provision. In life insurance, this especially affects retirement products that contain a significant portion of longevity risk (for example conventional annuities). Insurance companies might react by price increases for those products, and, at the same time, might think of alternatives that shift longevity risk (at least partially) to policyholders. In the extreme case, this leads to so-called tontine products where the insurance company's role is merely administrative and longevity risk is shared within a pool of policyholders. From the policyholder's viewpoint, such products are, however, not desirable as they lead to a high uncertainty of retirement income at old ages. In this article, we alternatively suggest a so-called tonuity that combines the appealing features of tontine and conventional annuity. Until some fixed age (the switching time), a tonuity's payoff is tontine-like, afterwards the policyholder receives a secure payment of a (deferred) annuity. A tonuity is attractive for both the retiree (who benefits from a secure income at old ages) and the insurance company (whose capital requirements are reduced compared to conventional annuities). The tonuity is a possibility to offer tailor-made retirement products: using risk capital charges linked to Solvency II, we show that retirees with very low or very high risk aversion prefer a tontine or conventional annuity, respectively. Retirees with medium risk aversion, however, prefer a tonuity. In a utility-based framework, we therefore determine the optimal tonuity characterized by the critical switching time that maximizes the policyholder's lifetime utility.

Optimal Stopping at Random Intervention Times

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Joint work with: Alexander Szimayer

We propose a Markovian model to value American-style complete contracts of agents who are temporarily inattentive. Exercise decisions maximizing the contract's payoff are not admissible continuously but at random intervention times. Further, premature forced exercises events can occur randomly accounting for e.g. liquidity needs or mortality. Exercise events are modeled with possibly market and time dependent arrival intensities. We state the fair contract value in terms of an optimal stopping problem. It is converted to optimal control which, further, provides a characterisation in terms of a partial integro differential equation. We suggest the three numerical approaches, forward improvement iteration, least squares Monte-Carlo and finite differences, each corresponding one particular characterization of the value. Our adapted least squares Monte-Carlo method can treat complex and possibly multi-dimensional settings.

Utility-Consistent Valuation Schemes for the Own Risk and Solvency Assessment of Life Insurance Companies

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Joint work with: Mohamed MAJRI and Li SHEN

In this paper, we construct new valuation schemes for the liabilities and economic capital of insurance companies. Specifically, we first build a valuation framework based on SAHARA utility functions, and second we construct a framework based on the cumulative prospect theory that incorporates the SAHARA utility function as a value function. The process used for assessing a life insurance company's own funds consists in replacing the market-consistent parametrization with a utility-consistent parametrization that accounts for the risk aversion of the market and the long-term duration of the company's commitments. Our illustrations show that this approach leads to a lower value of the own risk and solvency assessment, or ORSA, overall solvency needs and to a lower volatility of own funds. The SAHARA-CPT framework has the advantage over a pure SAHARA framework that it considers a precautionary overweighting of extreme events, as a tradeoff for additional model complexity.

Reverse sensitivity testing

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Joint work with: Pietro Millossovich, Andreas Tsanakas

Sensitivity and uncertainty analyses are important components of model building, interpretation and validation. We propose a model-independent framework for sensitivity analysis that reflects sensitivity in the whole input and output distribution. A model comprises a vector of random input factors and an aggregation function, mapping risk factors to a random output. A typical example is that of an internal model used by an insurer to calculate capital requirements. Our reverse sensitivity testing method proceeds as follows. First, a stress on the model output distribution is specified, for example an increase in output VaR and/or Expected Shortfall. Second, a stressed model is identified, as a new probability measure that minimises the Kullback-Leibler divergence with respect to the baseline model, subject to constraints (stresses) on the output. Third, changes of the distribution of the inputs under the stressed model are assessed, thus identifying the key drivers of the stressed output. Implementation in a Monte-Carlo simulation setting is akin to importance sampling and thus numerically efficient, circumventing the need for the computationally expensive repeated evaluations of the aggregation function that are common in standard sensitivity analyses. We illustrate our approach through a numerical example of a simple insurance portfolio.

Drawdown Measures and Return Moments

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Drawdown risk measures constitute the most prominent class of path-dependent risk measures. However, fundamental properties like their relation to the risky asset's return moments remain unexplored. Intuition about these relationships is easily flawed since the drawdown measures' path dependence adds significantly to their complexity. This paper provides a thorough investigation of the effects of an investment's return moments on most drawdown-based measures studied in the literature, including Maximum Drawdown, Conditional Drawdown (CDD) and Conditional Expected Drawdown (CED). Additionally, a new end-of-period drawdown measure is introduced, which incorporates a psychological aspect about risk perception which previous drawdown measures are unable to capture. While simulation results indicate many similarities for the 1st and 2nd moments, skewness and kurtosis affect different drawdown measures in radically different ways. Thus, users should ask themselves whether their choice of drawdown measure accurately reflects what kind of risk they want to measure. The related question, which risk measure best captures the well-established notion that high odd moments are desirable and high even moments are not, is also addressed.

Information Flow Dependence in Financial Markets

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In response to empirical evidence we propose a continuous-time model for multivariate asset returns providing a two-layered dependence structure. The price process is subject to multivariate information arrivals driving the market activity modeled by non-decreasing pure-jump Lévy processes. The jump dependence is determined by a Lévy copula allowing for a generic multivariate information flow and flexible dependence beyond the conditional aspects of the return distribution. Assuming that conditioning on the information flow asset returns are jointly normal, their dependence is modeled by a Brownian motion allowing for correlation. Furthermore, we provide an estimation framework based on maximum simulated likelihood. We apply novel multivariate models to equity data and obtain estimates which meet an economic intuition with respect to the two-layered dependence structure.

Data analytics for claims reserving

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Joint work with: Jonas Crevecoeur and Roel Verbelen

To be able to fulfill future liabilities insurance companies will hold sufficient capital reserves. Loss reserving deals with the prediction of the remaining development of reported, open claims (the reported but not settled reserve) and unreported claims (the incurred but not reported reserve). Accurate, reliable and robust reserving methods for a wide range of products and lines of business are a key factor in the stability and solvability of insurance companies. Micro-level reserving approaches the reserving problem by using granular, detailed data on the development of individual claims. In this talk we give an overview of the research on micro-level reserving. We present ongoing developments in this field, highlight their possible strengths but also weaknesses, and formulate current challenges. We pay specific attention to the structure of micro-level data, and the use of statistical modeling and data analytic tools for reserving with granular data. We illustrate our talk with case-studies.

Mean Field Games and Trading with Latent Factors

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Joint work with: Philippe Casgrain

Alpha signals for statistical arbitrage strategies are often driven by latent factors. This talk analyses how to optimally trade in such environments and accounts forthe impact trading has on prices. Under fairly general assumptions, we demonstrate how the trader can learn from the flow of orders, and explicitly solve the latent optimal trading problem. We also investigate the large population limit of heterogeneous agents by developing the theory of mean field games with latent factors. By using methods of convex analysis, we are able to analytically demonstrate how trading actions are modified in the presence of competing agents.

Minimum Rényi Entropy Portfolios

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Joint work with: Frédéric Vrins

Accounting for the non-normality of asset returns remains challenging in robust portfolio optimization. In this article, we tackle this problem by assessing the risk of the portfolio through the "amount of randomness" conveyed by its returns. We achieve this by using an objective function that relies on *Rényi entropy*, an information-theoretic criterion that precisely quantifies the uncertainty embedded in a distribution, accounting for all moments. Compared to Shannon entropy, Rényi entropy features a parameter that can be tuned to play around the notion of uncertainty. It is shown to control the relative contributions of the central and tail parts of the distribution in the measure. We further rely on a non-parametric estimator of the exponential Rényi entropy that extends a robust sample-spacings estimator initially designed for Shannon entropy. The relevance of Rényi entropy in portfolio selection applications is illustrated with an empirical study: minimizing this cost function yields portfolios that outperform standard minimum risk portfolios along most performance indicators.

Rough volatility from an affine point of view

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Joint work with: Josef Teichmann

We represent Hawkes process and their Volterra long term limits, which have recently been used as rough variance processes, as projections of (infinite dimensional) affine Markov processes. The representations lead to several new views on affine Volterra processes considered by Abi-Jaber, Larsson and Pulido. We also discuss numerical approximation schemes based on these representations. The talk is based on joint work with Josef Teichmann.

A Term-Structure Model for Dividends and Interest Rates

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Joint work with: Damir Filipovic

Over the last decade, dividends have increasingly become a standalone asset class instead of a mere side product of an equity investment. In this paper we present a polynomial framework designed to jointly price the term structure of dividends and interest rates. The framework has desirable features such as: i) seasonal behavior in the dividend dynamics, ii) closed-form prices for dividend futures, bonds, and dividend paying stocks, iii) efficient moment-based approximations for prices of options on interest rates and/or dividends, and iv) a flexible correlation structure between the two term structures. We show that a parsimonious model specification has a remarkably good fit with European data on interest rate swaps, index dividend futures and options, and options on the dividend paying index.

CVA Wrong-Way Risk via change of measure : theory, implementation and performance analysis

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Joint work with: D. Brigo and T. Hvolby

A key driver of Credit Value Adjustment (CVA) is the possible dependency between exposure and counterparty credit risk, known as Wrong-Way Risk (WWR). At this time, addressing WWR in a both sound and tractable way remains challenging: arbitrage-free setups have been proposed by academic research through dynamic models but are computationally intensive and hard to use in practice. Tractable alternatives based on resampling techniques have been proposed by the industry, but they lack mathematical foundations. This perhaps explains why WWR is not explicitly handled in the Basel III framework in spite of its acknowledged importance.

Recently, Brigo & Vrins proposed a new paradigm to deal with WWR, consisting of an appealing compromise. They start with a reduced-form (stochastic intensity) default model and show that WWR can be handled via equivalent measures. In such a framework, it becomes possible to value CVA *as if* there were no WWR, provided that the drift of the exposure process is adjusted. This approach relies on a continuous set of equivalent measures, so that an infinite number of drift adjustment processes need to be computed. Yet, functional approximations can be derived which rend the method very convenient for practical use. For instance, semi-analytical expressions are obtained for CVA with WWR when the exposure is a Gaussian process. Such processes could nicely approximate the dynamics of forward rate agreements (FRA), equity return swaps (ERS) or interest rate swaps (IRS) using drifted Brownian bridges. Moreover, explicit expressions of WWR CVA can be found for European call and put options in the Black-Scholes model. Interestingly, for more general exposure processes, the method still yields a dimensionality reduction compared to the standard Monte-Carlo approach, thereby offering a reduction of both computational cost and time.

In this talk, we shall review the concept of WWR CVA, discuss the change-of-measure approach and derive several drift approximations as well as CVA expressions under WWR. The performance of our approach is illustrated through extensive comparisons of Expected Positive Exposure (EPE) profiles and CVA figures produced either by (i) the standard method relying on a full Monte Carlo framework and (ii) the change-of-measure technique combined with the drift-adjustment approximations. We show that these approximations do not impact the level of accuracy typically required for CVA figures.

Optimal Strategy under Omega Ratio

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Joint work with: Carole Bernard, Steven Vanduffel

We study optimal investment strategies under the objective of maximizing the Omegaratio, proposed by Keating and Shadwick(2002) as an alternative to the Sharpe ratio for performance assessment of investment strategies. We show that in a standard set-up of the financial market the problem is ill-posed, i.e., maximizing the Omega ratio leads to excessive risk taking. By imposing additional restrictions we show that the Omega ratio maximizing strategy is still very risky and may coincide with the choice made by risk neutral investors. We conclude that caution is needed when using the Omega ratio for making asset allocation decisions.

Time-inconsistent optimization problems in finance and insurance

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In this presentation we introduce time-inconsistent optimization problems and we discuss how such problems can be solved. We give examples of time-inconsistent optimization problems in finance and insurance. We focus on exponential utility maximization problem for an insurer with wealth-dependent risk aversion. We assume that the insurer's risk aversion coefficient changes in time and it depends on the insurer's current net asset value (the excess of the assets over the liabilities). Time-varying risk aversion makes the optimization problem time-inconsistent. We use the notion of an equilibrium strategy and we derive the HJB equation. In order to solve our problem, we assume that the insurer's risk aversion coefficient consists of a constant risk aversion which is perturbated by adding a small amount of a wealth-dependent risk aversion. The value function, which solves the HJB equation, is expanded on the parameter controlling the degree of risk aversion depending on wealth. We find the first-order approximation to the optimal equilibrium investment strategy and the first-order approximation to the solution to the HJB equation. We use BSDEs and PDEs to describe the value function and the equilibrium strategy.

ABSTRACTS – Posters

Text mining and ruin theory: A case study of research on risk models with dependence

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Joint work with: Alfredo Duarte Ego dos Reis

This paper aims to analyze unstructured data using a text mining approach. In our study, the subject to be analyzed is composed by 27 published papers of the risk and ruin theory topic, area of actuarial science. They were coded into 32 categories. For the purpose, all data was analyzed and figures were produced using the software *NVivo 11 plus*. Software *NVivo* is a specialized tool in analyzing unstructured data, although it is commonly used just for qualitative research. We used it for Quali-Quant analysis.

Portfolio optimization in Multi-Objective Mean-CVaR framework under VG process

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This study is devoted to evaluate portfolio performance and portfolio optimization by describing the dynamics of assets 'log prices with Variance Gamma (VG) process. Like Markowitz theory in mean-variance framework, we use Conditional Value-at-risk (CVaR) as a risk measure and propose our model in multi objective mean-CVaR framework. Without considering the skewness and kurtosis of assets return rate, optimization with Gaussian underestimate the optimal CVaR and VaR of portfolio. The literature suggests the portfolio efficiency based on multi-objective proportional change in mean-CVaR by VG process. In our study there are some negative data, so our model is based on Range Directional Measure (RDM) model by using Data Envelopment Analysis (DEA) that can take positive and negative data. Finally, a numerical example in Iran's market is presented.

Fair valuation of insurance liabilities via mean-variance hedging

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Joint work with: Jan Dhaene

A general class of fair valuations which are both market-consistent (mark-to-market for any hedgeable part of a claim) and actuarial (mark-to-model for any claim that is independent of financial market evolutions) were introduced in Dhaene et al. (2017) in a single period framework. In particular, the authors considered *mean-variance hedge-based* valuations where the fair valuations of insurance liabilities can be expressed as sums of mean-variance hedges and actuarial valuations. In the current paper, we generalize the approach in a multi-period dynamic hedging setting. We show that the class of fair valuations and mean-variance hedge-based are equivalent. We also consider the fair valuation of equity-linked contracts in which financial and actuarial risks are dependent and quantify the impact in terms of fair value.

Keywords: Market-consistent valuation, actuarial valuation, insurance liabilities, Solvency II, mean-variance hedging.

References:

1. Dhaene J., Stassen B., Barigou K., Linders, D., Chen Z. (2017). Fair valuation of insurance liabilities: merging actuarial judgement and market-consistency. *Insurance: Mathematics and Economics, 76, 14-27.*

2. Barigou K., Dhaene J. (2017). Fair valuation of insurance liabilities via mean-variance hedging. *Work in progress.*

3. Barigou K., Chen Z., Dhaene J. (2017). Fair valuation of insurance liabilities in a dynamic multi-period framework. *Work in progress.*

Maximum Likelihood Estimation of stock volatility using Jump Diffusion Models

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This study investigates whether there are systematic jumps in stock prices using the Brownian motion and Poisson processes to test diffusion risk and jump risk respectively on Johannesburg Stock Exchange and whether these jumps cause asset return volatility. Our hypothesis is that stocks with high positive (negative) slopes are more likely to have large positive (negative) jumps in the future. As such, we expect to observe salient properties of volatility on listed stocks. We also conjecture that it is valid to use maximum likelihood procedures in estimating jumps in stocks over and above the least squares method.

Systematic risk in long term insurance contracts: The need for a dynamic approach

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Joint work with: Jan Dhaene, Michel Denuit and Julien Trufin

The Law of Large Numbers (LLN) is the fundamental concept on which classical insurance business is built. In the framework of this probabilistic law, the realizations of insurance risks in a given portfolio are considered as independent random variables. The independence property implies that the risks are devoid of interaction. The LLN guarantees that the gains and losses of the insurer average out when the portfolio size is sufficiently large. This way of eliminating risk is known as 'diversification'.
In practice, actuaries rely on past data to perform forecasts of actuarial and financial quantities. Very often, the main quantities to be estimated are the probabilities of occurrence of the risk (e.g. death or sickness probabilities), the claim amounts in case they are random (for instance, in health insurance contracts) and the interest rates for discounting future cash flows. These estimated values allow to obtain a fair price, or premium. Thereafter, both the premium and its underlying estimates are used as a basis for other tasks, such as reserving or Asset and Liability Management. Therefore, in order for the insurance company to meet its obligations toward both the client and the regulator, forecasts must be performed with high accuracy.
However, given that the quantities needed in the pricing are stochastic processes, accurate estimates are often very hard to obtain, as they depend on the underlying model and the data. Moreover, errors that occur in the pricing process are magnified when the portfolio size is increased, which can lead to significant losses for the insurer. This form of risk which is stemming from the uncertainty about the actuarial and financial quantities is called 'systematic risk', and cannot be carried out using traditional insurance technics.
In our paper, we do not state that forecasting is a vain exercise. But we suggest to combine forecasting with other tools that can guarantee the solvency of the insurer. In particular, we focus on the systematic risk stemming from the uncertainty on the life table. It is demonstrated that appropriate updating mechanisms allow to cope with both the uncertainty on the estimates and the systematic risk inherent in the insurance business. First, we examine the consequences of working with unknown survival probabilities for which only a prediction is available. Then, we investigate solutions consisting on transferring part of the risk back to clients. Finally, we show that this approach helps to achieve solvency at an affordable cost.

A number of new methods for finding numerical solution of stochastic differential equations arisen in financial mathematics

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Joint work with: Tayebeh Damercheli

In this paper, a number of new convenient techniques is used to solve problems formulated by stochastic Volterra integral equations. Cox-Ingersoll-Ross (CIR) model, Vasicek model and Heston model in financial mathematics can be transformed to a stochastic Volterra integral equation.

Here, we consider homotopy perturbation method which consists in constructing the series whose sum is the solution of the problem considered. The results reveal that the proposed method is very effective and simple, also, computation of presented method is very attractive. The method is applied to a few test examples to illustrate the accuracy and implementation of the method.

Also, it is introduced an efficient method for solving problems formulated by stochastic Volterra integral equations. Triangular functions, block pulse functions and their operational matrix and stochastic operational matrix of integration are considered. This method has several benefits; in addition to validity and good degree of accuracy, arithmetic operations are carried out without the need to derivative or integration. Illustrative examples are included to demonstrate the efficiency and applicability of the operational matrices based on block pulse and triangular functions.

Keywords: Ito Integral; Homotopy perturbation method; Brownian motion process, Stochastic operational matrix, Operational matrix.

Pricing Basket and Spread Options under a Markov-Modulated Lévy Framework with Synchronous Jumps

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This paper considers the valuation of spread and basket options when the risky assets are driven by Markov-modulated Lévy processes (MMLPs) with synchronous jumps. Precisely, the asset prices jump whenever the phase changes, see e.g. Hainaut and Colwell (2016). Besides, we allow the different price dynamics to be dependent. Under this general framework, we provide lower and upper bounds to the exact option prices based on the idea of Caldana et al. (2016) and Caldana and Fusai (2013), but extending to a Markovian set-up. These bounds are obtained via univariate Fourier inversion under the assumption that the joint characteristic function of MMLPs is known. To test our pricing formulas, we focus on the regime switching version of Kou model in which the dependency between the jump components is constructed by means of a stochastic time change, see e.g. Mai et al. (2014). Numerical examples illustrate the application of our model on pricing spread and basket options.

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On optimal periodic dividend strategies for Lévy risk processes

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We revisit the optimal periodic dividend problem where dividend payments can only be made at the jump times of an independent Poisson process. Recent results have shown, in the dual (spectrally positive) model, the optimality of a periodic barrier strategy where dividends are paid at dividend-decision times if and only if the surplus is above some level. In this poster, we show its optimality for a spectrally negative Lévy model with a completely monotone Lévy density. The optimal strategies and the value functions are concisely written in terms of the scale function. Numerical results are also given.

Bonus-malus systems with different claim types and varying deductibles

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One of the main tasks of an actuary is to design a tariff structure that fairly distributes the total risk of potential losses among policyholders. To this end, he often has to grade all policyholders into risk classes such that all policyholders belonging to the same class pay the same premium. Rating systems penalizing policyholders responsible for one or more accidents by premium surcharges (or maluses), and rewarding claim-free policyholders by giving them discounts (or bonuses) are often called bonus-malus systems and aim to assess individual risks better. Traditional bonus-malus systems suffer from two considerable drawbacks. Firstly, the claim amounts are not taken into account and a posteriori corrections depend only on the number of claims. In particular, this breeds bonus hunger. Secondly, traditional bonus-malus systems create the possibility of malus evasion.

We try to eliminate both those drawbacks and deal with bonus-malus systems with different claim types and varying deductibles. The premium relativities are softened for the policyholders who are in the malus zone and these policyholders are subject to per claim deductibles depending on their levels in the bonus-malus scale and the types of the reported claims. Such bonus-malus systems present a number of advantages and seem to be very attractive for policyholders. We introduce such bonus-malus systems and study their basic properties. In particular, we investigate when it is possible to introduce varying deductibles, what restrictions we have and how we can do this. Moreover, we deal with the special case where varying deductibles are applied to the claims reported by policyholders occupying the highest level in the bonus-malus scale and consider two allocation principles for the deductibles. Finally, numerical illustrations are presented, which show that use of both penalty types (premium relativities and varying deductibles) seems to be indeed attractive and fair for policyholders.

Modeling Credit Risk with Hidden Markov Default Intensity

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We investigate the modeling of credit default under an interactive reduced-form intensity-based model with Hidden Markov setting. The intensities of defaults are determined by the hidden economic states which are govern by Markov chain, as well as the past defaults. We estimate the parameters in the default intensity based on Expectation Maximization (EM) algorithm with real-world datasets under three different practical default models. Numerical experiments are conducted to compare the results under our models with real situation. The results demonstrate that our model is able to capture the hidden features and simulate credit default risks which are critical in risk management and the extracted hidden economic states are consistent with the real situation. In addition, we take an important credit derivative application: pricing CDS as an example to illustrate the sensitivity analysis.

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