2nd European Actuarial Journal (EAJ) Conference & Educational Workshop

TU Vienna, September 8-12, 2014

The **2nd European Actuarial Journal (EAJ) Conference** (September 10-12, 2014) is an international conference in actuarial science and insurance mathematics. The aim is to bring together practicing actuaries and academics to discuss about challenging and current topics in actuarial science. We invite researchers and practitioners to present their scientific work on the topics:

- Life and Pension Insurance Mathematics
- Non-Life Insurance Mathematics
- Risk Management and Solvency II
- Mathematical Finance with Applications in Insurance
- Economics of Insurance

The **EAJ Educational Workshop** (September 8-9, 2014) is a satellite event of the 2nd EAJ Conference, aimed at both academics and practitioners and providing a forum for presenting results and interdisciplinary collaboration.

Organisers

- Actuarial Association of Austria – Aktuarvereinigung Österreichs (AVÖ)
- Vienna University of Technology – Technische Universität Wien (TU Wien)

General Information

Homepage: http://www.fam.tuwien.ac.at/eaj2014/

2nd EAJ Conference 2014: Wednesday, Sept. 10 – Friday, Sept. 12, 2014

EAJ Educational Workshop: Monday, Sept. 8 – Tuesday, Sept. 9, 2014

Venue:
Vienna University of Technology (TU Vienna), Freihaus Building,
Wiedner Hauptstraße 8, 1040 Wien/Vienna, Austria

Conference & Workshop Secretariat:
Ms. Sandra Trenovatz , phone: +43-1-58801-10511, email: eaj2014@fam.tuwien.ac.at

Overview of Talks & Mini Courses

The total duration of talks and mini courses is 29 hours (excluding breaks).

Talks within the 2nd EAJ Conference

Confirmed plenary speakers: Hansjörg **Albrecher** (University of Lausanne, CH) Francesca **Biagini** (LMU Munich, DE) Andrew **Cairns** (Heriot-Watt University, Edinb., UK) Alexander **Dotterweich** (KPMG, Munich, DE) Hansjörg **Furrer** (Swiss FINMA, Berne, CH) Stefan **Jaschke** (Munich Re, DE) Claus **Mischler** (Standard Life, DE) Ragnar **Norberg** (ISFA, Universite Lyon 1, FR) Daniel **Ryan** (Swiss Re, UK) Michael **Schlögl** (Vienna Insurance Group, AT) Hanspeter **Schmidli** (University of Cologne, DE) Mogens **Steffensen** (University of Copenhagen, DK) Nele **Vandaele** (KBC Group, BE)	13 plenary talks, each **50-60 minutes**	**16 hours in total**
Contributed talks within the following sections: Life and Pension Insurance Mathematics Non-Life Insurance Mathematics Risk Management and Solvency II Mathematical Finance with Applications in Insurance Economics of Insurance	12 contributed sessions each: **25 minutes**	

Mini Courses within the EAJ Educational Workshop

Carole **Bernard** (University of Waterloo, CA)	**120 minutes**	**13 hours in total**
Enrico **Biffis** (Imperial College Business School, UK)	**180 minutes**	
Claudia **Czado** (Technische Universität München, DE)	**180 minutes**	
Stéphane **Loisel** (ISFA, Université Lyon 1, FR)	**120 minutes**	
Alfred **Müller** (University of Siegen, DE)	**180 minutes**	

Details to Plenary Speakers and Talks of the 2nd EAJ Conference

Hansjoerg Albrecher

Professor for Insurance Mathematics, Department of Actuarial Science, University of Lausanne, Switzerland, http://www.hec.unil.ch/people/halbrecher

Model choice effects on the volatility of the solvency ratio

An insurance company has an interest in keeping the volatility of its solvency ratio low. In this talk we examine the effects of the choice of model framework and estimation method, and the number of historical data points on the volatility of an insurance company's solvency ratio, and the results are related to the model quality. In a simulation study, where the return on capital follows a GARCH(1,1) process, the performance of the different approaches and the resulting solvency ratio volatility are illustrated.

Francesca Biagini

Professor in applied mathematics, Department of Mathematics, Ludwig-Maximilians-Universität München, Munich, Germany, http://www.fm.math.lmu.de/personen/professors/francesca_biagini/

Risk-minimization for life insurance liabilities with dependent mortality risk

In this talk I present a study on the pricing and hedging of typical life insurance liabilities for an insurance portfolio with dependent mortality risk by means of the well-known risk-minimization approach.

Since the insurance portfolio consists of individuals of different age cohorts, in order to capture the cross-generational dependency structure of the portfolio, in [1] we introduce affine models for the mortality intensities based on Gaussian random fields that deliver analytically tractable results by following an approach of [2] and [3]. We also provide specific examples consistent with historical mortality data and correlation structures. Main novelties of this work are that we provide explicit computations of risk-minimizing strategies for life insurance liabilities written on an insurance portfolio by allowing for investments in the primary financial market (a risky asset and a money market account) and in a family of longevity bonds by considering different age cohorts simultaneously.

(Joint work with Botero, C. and Schreiber, I.)

References:
[1] Biagini, F., Botero, C. and Schreiber, I. (2013), Risk-minimization for life insurance liabilities with dependent mortality risk, preprint LMU.
[2] Biffis, E. (2005), Affine processes for dynamic mortality and actuarial valuations. *Insurance: Mathematics & Economics* 37(3), pp. 443-468.
[3] Biffis, E. and Millossovich, P. (2006), A bidimensional approach to mortality risk. *Decisions in Economics an Finance* 29(2), pp. 71-94.

Andrew Cairns

Professor of financial mathematics at Heriot-Watt University, Edinburgh, United Kingdom, http://www.macs.hw.ac.uk/~andrewc/

Multi-population mortality modelling

There are many situations in life insurance, pensions and elsewhere where we need to model and forecast future rates of mortality for several populations simultaneously. Sometimes this might be at the national population level (different countries; males and females) but often also we wish to model sub-populations that have potentially different characteristics from the national population. We will discuss some different approaches to these problems and outline recent progress in developing new models.

Alexander Dotterweich

Director, KPMG, Munich, Germany, http://de.linkedin.com/pub/alexander-dotterweich/38/b36/296
Member of the KPMG Competence Center for implementation of Solvency II

The importance of actuarial projections in risk management

Actuarial projections, typically designed as projections of future cash-flows, are no unknown territory for insurance companies. They are already established for a wide range of purposes, for example for MCEV calculations, for pricing or for further economic analyses. Now the importance of actuarial projections in risk management increases sustainably, in particular with regard to "good practice" of risk management approaches and with regard to enhanced regulatory requirements.

By reference to practical examples and illustrations, key topics for further development of projection landscape will be examined in the context of this presentation. This concerns for instance questions regarding granularity and quality of projections for a future Forward Looking Assessment of Own Risks and related issues regarding deeper-seated projection principles. In addition, consequences for the projection landscape that result from the required governance framework under Solvency II, e.g. the interaction between the risk management function and the actuarial function, will be addressed.

Hans-Jörg Furrer

Head of Quantitative Risk Management – Division Insurance, Swiss Financial Market Supervisory Authority FINMA, Switzerland, http://www.math.ethz.ch/~hjfurrer/

FINMA's model review approach and future challenges

Switzerland is one of the pioneers in the field of risk-based solvency capital requirements for insurance supervision. The Swiss Solvency Test (SST) has been set into force on 1 January 2011 following a five-year phasing-in period. The SST is based on market-consistent valuation principles and requires the quantification of at least market, credit and insurance risk. Insurance companies are allowed to use internal valuation and risk models for SST purposes provided the models have been approved by the Swiss Financial Market Supervisory Authority (FINMA). In this talk, we first present the main characteristics of the SST and make comparisons with the Solvency II capital requirements. We then present the experiences and challenges FINMA encounters during the review process. A special emphasis is given to some selected mathematical problems that arise in this context.

Stefan Jaschke

Head of Quantitative Methods at Munich Re, Munich, Germany, http://de.linkedin.com/in/stefanjaschke

Challenges in the risk management of life reinsurance

There are numerous challenges for the life insurance industry: a combination of low interest rates, increased competition from the banking and fund industry in savings products, regulatory requirements according to Solvency II (affecting European insurers), additional requirements for large variable annuity writers (to the extent they are classified as globally systemically important insurer), reduced trust in financial institutions and significant changes in the way hedging instruments are collateralized and priced. These require new product designs and new approaches to risk management.

The talk will include

- an overview of the recent developments in the banking and insurance industry regarding valuation and risk assessment
- a description of our general approach to pricing and hedging and
- selected specific questions from the reinsurance business, which entail quantitative challenges.

Claus Mischler

Head of German Product Development, Standard Life, Frankfurt, Germany, http://www.standardlife.de/Ueber_uns/Presse/Bildmaterial/

Guaranties in the stress field between customer needs and financial viability

German insurance clients are well-known for their risk-averse attitude and their preference for life-long guarantees – even if these guarantees are dearly bought at the expense of overall returns. These traditional guarantees, which promise clients a fixed interest rate over the whole lifetime of the contract and a yearly declared total interest, are coming under growing pressure due to their high costs. The on-going low yield environment forces insurance companies to come up with new ideas. While many insurers still haven't dared to change their products, last year a handful of companies introduced new models for the German market: Some are working on the basis of bullet guarantees only, others introduced mechanisms protecting clients against the risks of volatile markets.

Ragnar Norberg

Research Officer (Chercheur) at the University of Lyon 1, Lyon, France (Professor of statistics at London School of Economics, London, UK – emeritus since 2010), http://isfa.univ-lyon1.fr/~norberg/

On marked point processes and their applications in insurance

The talk starts with a friendly introduction to marked point processes and their associated counting processes and martingales. Then it proceeds to three distinct, still intertwined, aspects of the theory: *Modelling* is a matter of specifying the intensities, which are the fundamental model entities with a clear interpretation as instantaneous transition probabilities; *Prediction* is a matter of calculating conditional expected values of functionals of the process, which involves stochastic calculus (can be made simple); *Computation* is a matter of solving *O*rdinary or *P*artial *I*ntegral-*D*ifferential *E*quations, looking for shortcuts (ODE-s replacing PDE-s) and looking out for pitfalls (non-smoothness points that cannot be detected by inspection of the equations). The unifying powers and the versatility of the model framework are demonstrated with examples from risk theory, life insurance, and non-life insurance.

Daniel Ryan

Head of Population Risk & Data Analytics R&D at Swiss Re, London, United Kingdom,
http://uk.linkedin.com/pub/dan-ryan/15/489/996

The future of human longevity

We are all aware of the personal challenges of living longer, and the concern over whether these additional years will be spent in a state of good health. Mortality experience analyses highlight the relative and absolute importance of gender, wealth, the presence of prior disease, adverse risk factors. Insurers and reinsurers are constantly looking for new and better proxies for the underlying risk, as we have seen in recent years through the increased interest in profiling individuals based on where and how they live. In this talk we will look at the future of human longevity and consider some techniques, which enable us to explore relationships in the human life-table data more fully.

Michael Schlögl

Head of Motor Insurance Department and Actuarial Department Non-Life, Wiener Städtische Versicherung AG – Vienna Insurance Group, Vienna, Austria,
http://at.linkedin.com/pub/michael-schlögl/31/b14/b5a

Milestones on the way to an internal model in non-life insurance – experiences out of the dialogue with the surpervisors

Vienna Insurance Group and especially Wiener Städtische want to apply for a (partial) internal model in non-life. The main challenges of the development in the context of Solvency II will be pointed out. Emphasis will be given to the feedback from the supervisors and how it influenced the improvement of the model. The talk will touch the implementation of methods and processes to fulfil the requirements. Furthermore statistical and practical topics like parameterization, validation, automation and documentation will be covered.

Hanspeter Schmidli

Professor for stochastics and actuarial mathematics at the Institute of Mathematics, University of Cologne, Germany, http://www.mi.uni-koeln.de/~schmidli/

On the calculation of risk measures based on dividends and capital injections

The classical measure for the risk in non-life insurance are the ruin probabilities. Because a measure based on ruin probabilities are similar to the VaR in Finance, there are several drawbacks. For example, the time to ruin and the deficit at ruin do not play a role. Therefore, several alternative measures have been introduced in the last few years. Many of these measure are based on dividends and capital injections. For the calculation of such a measure, Gerber-Shiu functions turn out to be helpful. In this talk, we develop a method to calculate Gerber-Shiu functions, and then study the problem of the calculation of the discounted expected value of capital injections.

Mogens Steffensen

Professor in life insurance mathematics at the Department of Mathematical Sciences, University of Copenhagen, Denmark, http://www.math.ku.dk/~mogens/

From utility optimization to good advice and good product design

We discuss three different problems, the structure of their solutions, and their relation to practical challenges concerning pension savings advice and product development. The three problems deal with the optimal consumption-investment plan for an individual or a household in the cases where a) the consumption-investment control in a stochastic framework is constrained to be deterministic, see [1], b) preferences are formulated in terms of growth in smooth consumption rather than consumption itself, see [2], and c) risk aversion and elasticity of intertemporal substitution are separated in presence of uncertain lifetime and access to a life insurance market. The three problems and the structure of their solutions are quite different but they share the ability to shed light on important practical questions in personal finance and insurance and unveil appealing theoretical challenges.

References:
[1] Christiansen, M. and Steffensen, M. (2013). Deterministic mean-variance-optimal consumption and investment. *Stochastics* 85, pp. 620-636.
[2] Bruhn, K. and Steffensen, M. (2013). Optimal smooth consumption and annuity design. *Journal of Banking & Finance* 37 (8), pp. 2693-2701.

Nele Vandaele

Risk Adviser, Group Risk Strategy Support, KBC Group, Brussels, Belgium,
http://be.linkedin.com/pub/nele-vandaele/2/452/585

Solvency II: challenges from a risk perspective

It's a well-known fact that the implementation of Solvency II is a major change for each European insurance company. Not only become the capital requirements risk based, but also the linearity of the capital requirements under Solvency I is abandoned and replaced by an aggregation of requirements based on the Var-Covar method. Furthermore, only calculating the solvency position is not sufficient as additional major importance is given to the risk governance and the risk reporting/disclosure requirements under Pillar II and respectively Pillar III of Solvency II.

Firstly we will zoom in on a number of implications of the Pillar I calculations, amongst other on the governance of an insurance company. Secondly, the implications on risk management due to the ORSA (=Own Risk and Solvency Assessment) requirement are discussed.

Details to Invited Speakers & Mini Courses of the EAJ Educational Workshop

Carole Bernard

Professor at the Department of Statistics and Actuarial Science, University of Waterloo,
http://www.carole.bernard.free.fr/

A new approach to assessing model risk on dependence in high dimensions

(mini course: 120 minutes)

A central problem for regulators and risk managers concerns the risk assessment of an aggregate portfolio defined as the sum of d individual dependent risks X_i. This problem is mainly a numerical issue once the joint distribution of (X_1,X_2,...,X_d) is fully specified. Unfortunately, while the marginal distributions of the risks X_i are often known, their interaction (dependence) is usually either unknown or only partially known, implying that any computed risk measure of the portfolio is subject to model uncertainty.

Previous academic research has focused on the maximum and minimum possible values of a given risk measure of the portfolio, in the case in which only the marginal distributions are known. This approach leads to wide bounds, as all information on the dependence is ignored.

We show how to integrate in a natural way available information on the multivariate dependence and provide easy-to-compute bounds for the risk measure at hand. We observe that incorporating the information of a well-fitted multivariate model may, or may not, lead to much tighter bounds, a feature that also depends on the risk measure used. We illustrate this point by showing that the Value-at-Risk at a very high confidence level (as used in Basel II) is typically prone to very high model risk, even if one knows the multivariate distribution almost completely.

Our results make it possible to determine which risk measures can benefit from adding dependence information (i.e., leading to narrower bounds when used to assess portfolio risk), and, hence, to identify those models for which it would be meaningful to develop accurate multivariate models.

This is joint work with Steven Vanduffel (Vrije Universiteit Brussels).

Enrico Biffis

Professor of actuarial finance at the Imperial College Business School, London, United Kingdom**,**
http://www.imperial.ac.uk/people/e.biffis

Some old and new problems in insurance contract design

(mini course: 180 minutes)

In the first part of the mini course I will consider the design of traditional life insurance contracts and variable annuities in the presence of adverse selection. I will first revisit standard approaches to modelling selective withdrawals, and then outline a model where the policyholders' mortality risk profile can be represented in terms of a frailty process shaped by the relative attractiveness of different contract benefits in different states of the world. I will present some practical examples of optimal contract design and tests for adverse selection.

In the second part of the mini course I will discuss the design of some innovative risk sharing arrangements. I will first look at longevity risk transfers, address the issue of collateralization in

longevity swaps, and discuss the design of longevity linked securities that might appeal to investors more familiar with the catastrophe bond format. I will then look at Value-of-In-Force (VIF) monetization, and outline a model to compare the economic sale and contingent loan format within the Solvency II framework. The results will be illustrated with case studies based on real world portfolios of a large global insurer.

Claudia Czado

Professor for applied mathematical statistics at the Center of Mathematics, Technische Universität München, Munich, Germany, http://www-m4.ma.tum.de/pers/cczado/

Pair-Copula constructions of multivariate copulas with applications

(mini course: 180 minutes)

Copulas are used to characterize dependency among several components and are used to build multivariate models for financial and insurance data. The short course we will introduce the concept of copulas and discuss standard classes such as the elliptical and Archemedian copulas. These are restricted in their dependency pattern such as symmetry, tail independence or ex changeability. In contrast the flexible class of regular vine (R-vine) copula models can accommodate tail asymmetry and allow for different dependency patterns for different pairs of variables. R-vine copulas are based on a pair-copula construction (PCC) using only bivariate copulas as building blocks. Estimation, simulation and model selection are shown with examples using the R-package VineCopula, which contains functions for statistical inference of vine copulas and tools for exploratory data analysis and selection of bivariate copulas.

References:
[1] Aas, K., C. Czado, A. Frigessi and H. Bakken (2009). Pair-copula constructions of multiple dependence. *Insurance: Mathematics and Economics* 44(2), pp. 182-198.
[2] Brechmann, E. C. and U. Schepsmeier (2013). Modeling dependence with C- and D-vine copulas: The R-package CDVine. *Journal of Statistical Software* 52(3), pp. 1-27.
[3] Czado, C. (2010). Pair-copula constructions of multivariate copulas. In P. Jaworski, F. Durante, W. Härdle, and T. Rychlik (Eds.), *Copula Theory and Its Applications*. Berlin: Springer.
[4] Dissmann, J., E. Brechmann, C. Czado, and D. Kurowicka (2013). Selecting and estimating regular vine copulae and application to financial returns. *Computational Statistics and Data Analysis* 59(1), pp. 52-69.
[5] Kurowicka, D. and R. M. Cooke (2006). Uncertainty Analysis with High Dimensional Dependence Modelling. Chichester: John Wiley.
[6] Kurowicka, D. and H. Joe (Eds.) (2011). Dependence Modeling: Vine Copula Handbook. Singapore: World Scientific Publishing Co.
[7] Schepsmeier, U., J. Stoeber, and E. C. Brechmann (2013). VineCopula: Statistical inference of vine copulas. R package version 1.2.

Stéphane Loisel

Professor at Institute of Actuarial Science and Finance, University Claude Bernard of Lyon 1, France, http://isfaserveur.univ-lyon1.fr/~stephane.loisel/

Modeling, monitoring and managing longevity risk

(mini course: 180 minutes)

In this short course, we present classical approaches and new ideas to model longevity risk using population dynamics methods.

We investigate online detection problems: how does one optimally detect changepoints in two-population longevity models under some false alarm constraint? We also discuss some financial risks associated to longevity related contracts as well as simulation issues in a risk management / Solvency II perspective.

Alfred Müller

Professor for Stochastics and Quantitative Methods in Economics at the Department of Mathematics, University of Siegen, Germany, http://www.uni-siegen.de/fb6/src/mueller/

Modeling, measuring and comparing dependent risks

(mini course: 120 minutes)

In this presentation we deal with methods for modeling, measuring and comparing dependent risks. First we deal with the measurement of univariate risks by risk measures, where we follow the axiomatic approach of coherent and convex risk measures, and deal in particular with the relatively new concept of expectiles as a risk measure. Then we look at the comparison of risk measures by stochastic orders like stop-loss order and usual stochastic orders.

The main part, however, will deal with multivariate risks. After introducing the concept of copulas for modeling dependent risks, we look at methods for the comparison of dependent risks. This is an important topic for actuaries, as it helps to understand how dependence between different risks affects the aggregate risk of a business line or a whole company. We will introduce the most relevant concepts of comparing dependence of risks like supermodular ordering and orthant ordering, and we will demonstrate how mass transfer principles can be used to better understand these concepts, and to prove many interesting results.

Literature:
[1] Fabio Bellini, Bernhard Klar, Alfred Müller and Emanuela Rosazza Gianin (2014). Generalized quantiles as risk measures. *Insurance: Mathematics and Economics* 54, pp. 41-48.
[2] Alfred Müller (2013). Duality Theory and Transfers for Stochastic Order Relations. In: *Stochastic Orders in Reliability and Risk*. Lecture Notes in Statistics 208, pp. 41-57.
[3] Alfred Müller and Dietrich Stoyan (2002). *Comparison methods for stochastic models and risks*. John Wiley & Sons, Chichester, xii+330 pages.