TECHNISCHE UNIVERSITÄT MÜNCHEN

VFVW Verein zur Förderung der Versicherungswissenschaft in München e.V.

Munich Risk and Insurance Days 2024

October 10 – 11, 2024

Thursday, October 10, 2024	
09:55 – 10:00	Welcome (Matthias Scherer)
10:00 – 10:40	**Werner, Ralf:** A Review of Economic Scenario Generation by (Variational) Autoencoders
10:40 – 11:20	**Schmidt, Jan-Philipp:** Dynamic Pricing in the Insurance Industry: A Supply and Demand-Oriented Approach
11:20 – 12:00	**Bauer, Daniel:** Asset and Liability Risks in Financial Institutions
12:00 – 13:00	Lunch Break
13:00 – 13:40	**Kratz, Marie:** Comparing Multivariate Distributions: A Novel Approach Using Optimal Transport-based Plots
13:40 – 14:20	**Hieber, Peter:** Modern Tontine-Schemes in Retirement Decumulation
14:20 – 15:00	**Müller, Alfred:** Stochastic orders under uncertainty
15:00 – 15:30	Coffee Break
15:30 – 16:10	**Chen, An**: Optimal Payoffs under Smooth Ambiguity
16:10 – 16:50	**Mai, Jan-Frederik:** Bond-CDS basis: where does it come from and what is a mathematically rigorous definition?
16:50 – 17:30	**Schmidli, Hanspeter:** Stabilizing the surplus process through the control of Drawdowns
17:30 – 17:35	Closing (Matthias Scherer)
18:00	Speakers Dinner

Friday, October 11, 2024	
08:55 – 09:00	Welcome (Matthias Scherer)
09:00 – 09:40	**De Vecchi, Corrado:** Some remarks on almost stochastic dominance
09:40 – 10:20	**Zähle, Henryk:** Copula robustness in quantitative risk management
10:20 – 10:40	Coffee Break
10:40 – 11:20	**Eling, Martin:** The Supply of Cyber Risk Insurance
11:20 – 12:00	**Weber, Stefan:** Multinomial Backtesting of Distortion Risk Measures
12:00 – 13:00	Lunch Break
13:00 – 13:40	**Christiansen, Marcus:** The stochastic Thiele equation
13:40 – 14:20	**Korn, Ralf:** Optimal Investment with Sustainable Assets with Applications for Life Insurers
14:20 – 14:40	Coffee Break
14:40 – 15:00	**Fermanian, Jean-David**: Latent Factor models with functional loadings
15:00 – 15:40	**Detering, Nils:** Solving optimal execution problems via in-context operator networks
15:40 – 15:45	Closing (Matthias Scherer)

Prof. Dr. Daniel Bauer
University of Wisconsin-Madison
Asset and Liability Risks in Financial Institutions
(with George Zanjani) We analyze economic models of financial institutions with risky assets and liabilities. Markets are incomplete, firm counter-parties are risk-averse, and risk capital is costly. In such a setting, profit-maximizing firms hold risk capital and incur costs associated with different positions. We investigate how institutions measure, allocate, and price asset and liability risks. While we find that risk margins and allocation can be represented by risk measures as they are used in practice, we find that it is not appropriate to focus on the net portfolio position of assets minus liabilities as is common practice. Rather, we show that asset and liability risks should be assessed separately with different risk measures and different associated costs.

Prof. Dr. An Chen
University Ulm
Optimal Payoffs under Smooth Ambiguity
(joint work with Steven Vanduffel and Morten Wilke) We study optimal payoff choice for an investor in a one-period model under smooth ambiguity preferences, also called KMM preferences as proposed by (Klibanoff, P., Marinacci, M., & Mukerji, S. (2005). A smooth model of decision making under ambiguity. Econometrica, 73 (6), 1849–1892). In contrast to the existing literature on optimal asset allocation for a KMM investor in a one-period model, we also allow payoffs that are non-linear in the
stock price. Our contribution is threefold. First, we characterize and derive the optimal payoff under KMM preferences. Second, we demonstrate that a KMM investor solves an equivalent problem to an investor under classical subjective expected utility (CSEU) with adjusted second-order probabilities. Third, in a setting of a log-normal market asset under drift and volatility uncertainty, we reveal that ambiguity leads to optimal payoffs that are no longer necessarily strictly increasing in the market asset.

Prof. Dr. Marcus Christiansen
University of Oldenburg
The stochastic Thiele equation
In 1992, Ragnar Norberg generalised the classical Thiele equation to non-Markovian modelling by introducing a so-called stochastic Thiele equation. The classical Thiele equation is a key tool in life insurance, not only for numerical calculations, but also for sensitivity analyses, safe-side calculations, surplus calculations and contract modifications. The stochastic Thiele equation makes it possible to generalise these risk management techniques beyond the limited world of Markov modelling, so it is surprising that this generalisation has not yet found its way into life insurance textbooks. Indeed, there have been a number of unresolved technical issues with the stochastic Thiele equation, and we show how they can be overcome. As a result, we are finally able to present the basic concepts of risk management in life insurance without the usual restrictive Markov assumptions.

Prof. Dr. Nils Detering
Heinrich Heine University
Solving optimal execution problems via in-context operator networks
Computing optimal order execution strategies is a fundamental problem in financial mathematics. The optimal execution strategy balances the trade-off between the cost of executing the order and market risk. A prominent approach proposed by practitioners is the propagator model, which employs an optimal control framework to derive these strategies. Yet, enhancing the speed of computing these strategies remains a vital area of research. Concurrently, in-context learning has proven effective in addressing large-scale practical problems. Within the domain of scientific computing, In-Context Operator Networks (ICONs) have emerged. These networks facilitate the learning of operators by merging offline pre-training with online inference, where the operator is approximated using a limited dataset provided as context. This approach eliminates the need for retraining when new contexts arise, offering benefits like rapid inference and reduced data demands. In our study, we apply ICONs to tackle optimal execution

problems. Utilizing price dynamics as the context, ICONs establish a connection between market prices and execution strategies. Subsequently, the optimal strategy is determined by solving the optimal control problem using the operator learned through this process.

Prof. Dr. Martin Eling
University of St. Gallen
The Supply of Cyber Risk Insurance
Cyber risk economic losses are large and growing, yet the insurance market for cyber risk is tiny, amounting to 0.4% ($2.8 billion) of premiums in the US propertycasualty insurance market in 2020. In this paper, we analyze the constraints that the insurance industry faces in providing larger capacity. We argue that cyber risk is special in that it combines (i) heavy-tailedness, (ii) uncertain loss distribution, and (iii) asymmetric information in underwriting. The combination of factors (i)-(iii) creates a tension between a need to raise substantial amounts of capital to finance heavytailed and uncertain risks and an expensive compensation demanded by investors due to information frictions. To circumvent asymmetric information costs, insurers can use internal capital. Hence, suppliers of cyber insurance are large insurance groups with a deep internal capital market. However, their capacity is constrained by the group's size. We document stylized facts about the US cyber risk insurance market. We then establish the causal inference that insurers primarily rely on the internal capital market to supply cyber risk insurance using an exogenous shock of the non- US affiliated reinsurance tax treatment in 2017. Finally, we test which of the three features (i)–(iii) of cyber risk contribute to the cost of external capital and confirm that all of them play a significant role. [Martin Eling, Anastasia Kartasheva, Dingchen Ning]

Prof. Dr. Jean-David Fermanian
ENSAE Crest/ Institut Polytechnique de Paris
Latent Factor models with functional loadings
We extend static linear factor models in a semiparametric framework, by assuming the loadings are unknown functions that depend on some exogeneous covariates. Since the latter covariates may be possibly numerous, their effect is summarized through individual univariate indices. We state the consistency and the asymptotic normality of our estimated factors and loading functions, when the number of individuals and their history length go to the infinity (large N, large T asymptotics). By simulation and a real data experiment, the relevance of this approach is empirically shown.

Prof. Dr. Peter Hieber
Université de Lausanne
Modern Tontine-Schemes in Retirement Decumulation
The 2019 introduction of the pan-European personal pension product (PEPP) regulation responds to demographic challenges in Europe and aims to support the introduction of transparent and cost-efficient voluntary pension products. Decentralized insurance like tontines are a promising way to implement such schemes. This talk introduces modern tontines and shows how mortality risk is shared within a pool of individuals of different age and risk characteristics. We specifically discuss actuarial fairness, the choice and update of mortality tables and the possibility of individuals to later join the scheme. We also demonstrate how the tontine can be complemented by a long-term care rider that provides higher payments in case of dependency (= life-care tontine).

Prof. Dr. Ralf Korn
University Kaiserslautern
Optimal Investment with Sustainable Assets with Applications for Life Insurers
Due to their ability of taking long-term positions, life insurers can invest in sustainable (and often illiquid) assets such as wind parks, solar parks or real estate. We will solve portfolio problems containing sustainable assets and will particular focus on the actuarial reserve fund of a life insurer. Further, we will indicate suitable actions (such as taxations) that governments that automatically direct investors to sustainable investments. Finally, some open problems for future studies will also be presented.

Prof. Dr. Marie Kratz
ESSEC Business School
Comparing Multivariate Distributions: A Novel Approach Using Optimal Transport-based Plots
Quantile-Quantile (Q-Q) plots are commonly used to assess the distributional similarity between two datasets. Traditionally designed for univariate distributions, Q-Q plots are ineffective at capturing the complex dependencies present in multivariate data. In this study developed with S. Singha and S. Vadlamani, we propose a novel approach for constructing multivariate Q-Q plots that extend the traditional methodology to handle high-dimensional data, crucial in modern risk management. Our approach utilizes optimal transport (OT) and entropy-regularized optimal transport (EOT) to align the empirical quantiles of the two datasets. Additionally, we introduce a technique based on OT and EOT potentials that can effectively compare two multivariate datasets using a single bivariate plot, regardless of the distribution's dimension. Through extensive simulations and real data examples, we demonstrate the effectiveness of our proposed approach in capturing multivariate dependencies and identifying distributional differences such as tail behaviour. We also propose two test statistics based on the Q-Q and potential plots to rigorously compare two distributions. Illustrations are provided in the context of risk management.

Dr. Jan-Frederik Mai
XAIA Investment
Bond-CDS basis: where does it come from and what is a mathematically rigorous definition?
The spread which a bond pays on top of a reference discounting rate is explained by the implied credit risk in usual pricing models. Buying credit risk insurance via a credit default swap (CDS), one thus expects the package of bond and CDS to earn the reference rate. If such package earns more (less) than the reference rate, one speaks of a negative (positive) bond-CDS basis, which can be an interesting trading opportunity that is typically categorized as an “alternative investment”. This talk provides an overview on reasons for the existence of this discrepancy between bond and CDS. Furthermore, a mathematically rigorous measurement of the bond-CDS basis is (maybe surprisingly) challenging. The talk recalls the methodology invented in [1] for this task.
[1]: J.-F. Mai: “Pricing-hedging duality for credit default swaps and the negative basis arbitrage”, International Journal of Theoretical and Applied Finance 22:6 (2019) 1950032.

Prof. Dr. Alfred Müller
University Siegen
Stochastic orders under uncertainty
LWe study stochastic order relations under uncertainty. There is an enormous amount of literature on stochastic order relations as a tool to compare probability distributions under only partial information on the preference relation of the decision maker. There is also a growing literature on robust decisions under uncertainty when there is only partial knowledge of distributions. However, the combination of these two topics has hardly been considered in the literature so far. It is shown that we cannot expect any reasonable robustness of classical first order stochastic dominance, whereas such properties hold for some versions of almost stochastic dominance, as almost stochastic dominance is naturally related to robustness with respect to the Wasserstein distance. We also review other recent results on almost stochastic dominance under uncertainty where the uncertainty sets are either described by knowing only mean and variance or by knowing only the marginal distribution in a multivariate context.

Prof. Dr. Dr. Hanspeter Schmidli
University Köln
Stabilizing the surplus process through the control of Drawdowns
The drawdown is the loss of the surplus process compared its historical maximum. In order to stabilize the surplus one tries to keep the surplus close the its maximum; that is, keeping the drawdown small. We use proportional reinsurance to control the drawdown and measure the time the drawdown spends below

a predefined barrier. If the time in drawdown is the only criterion, the maximum will never increase under the optimal strategy, see Brinker and Schmidli (2022). To avoid this, we maximise simultaneously the increase of the maximum. Dependent on how we weight the two contradicting
criteria, we obtain different strategies, of which some are surprising. The talk is based on joint work with Leonie Brinker and Kira Hoffmann.

Prof. Dr. Jan-Philipp Schmidt
TH Köln
Dynamic Pricing in the Insurance Industry: A Supply and Demand-Oriented Approach
In the insurance sector, risk has traditionally been the main factor in pricing. This presentation expands this perspective by integrating the dynamics of supply and demand on insurance markets. It illustrates how considering these market mechanisms can develop effective pricing strategies that are not solely based on risk assessments but also enhance competitiveness in a changing market environment. By analyzing the interactions between market conditions and pricing, new insights are gained into optimizing pricing strategies in the insurance industry.

Dr. Corrado De Vecchi
Technische Universität München
Some remarks on almost stochastic dominance
We study how to describe the set of sure payoffs that dominate a given random payoff in the sense of almost first-order stochastic dominance. Such results have interesting consequences for risk management decisions. Many financial and insurance operations involve the notion of expected utility, but the utility (or preference) elicitation of a decision maker is indeed a complicated task. In the actuarial context, one clear example is given by the zero-utility principle adopted to compute the premium of an insurance contract. We show how to apply the methodological results that we have obtained in order to deal with such an issue, extending the analysis also to the case of shortfall risk measures. Applications to portfolio optimization problems are also illustrated.

Prof. Dr. Stefan Weber
University Hannover
Multinomial Backtesting of Distortion Risk Measures
We extend the scope of risk measures for which backtesting methods are available by proposing a new approach for general distortion risk measures. The method relies on a stratification and randomization of risk levels. We illustrate the performance of our method in numerical case studies. This is joint work with Sören Bettels and Sojung Kim

Prof. Dr. Ralf Werner
University Augsburg
A Review of Economic Scenario Generation by (Variational) Autoencoders
In this talk, we discuss a few recent approaches how (variational) autoencoders might be used for the generation of economic scenarios. After illustrating the main principles, we discuss the pros and cons of such approaches. We especially analyse the quality of interest rate and FX scenarios generated with these tools and highlight important pitfalls.

Prof. Dr. Henryk Zähle
Saarland University
Copula robustness in quantitative risk management
Characteristics of d-variate risks, such as downside risk measures of aggregate positions or optimal portfolio values, play a central role in financial and actuarial applications. This talk addresses the question of when such characteristics are robust to (small) misspecifications in the copula.