Insurance Data Science Conference 9 - 10 June 2026

Programme and Abstract Booklet

Scientific Committee

4 June 2026

Contents

Leibniz Universität Hannover

house of insurance

Scientific Committee

Academic	Industry
Andreas Tsanakas (Bayes Business School)	Andreas Märkert (Hannover Re, Hanover)
Arthur Charpentier (Université du Québec à Montréal)	Can Baysal (Munich Re, Munich)
Bernard Wong (UNSW Sydney)	Claudio Giancaterino (Towards Innovation Lab, Italy)
Despoina Makariou (University of St.Gallen)	Davide de March (Markel, London)
Filip Lindskog (Stockholm University)	Dylan Liew (Bupa, London)
Gregor Svindland (House of Insurance, University of Hanover)	Giorgio Alfredo Spedicato (Unipol Group, Milan)
Ioannis Kyriakou (Bayes Business School)	Grainne McGuire (Optum)
Mario Wüthrich (RiskLab, ETH Zurich)	Jürgen Bierbaum (Alte Leipziger-Hallesche, Oberursel)
Mathias Lindholm (Stockholm University)	Jürg Schelldorfer (Swiss Re, Zurich)
Matthias Fahrenwaldt (RPTU, University of Copenhagen)	Luca Baldassarre (Swiss Re, Zurich)
Matthias Scherer (TU Munich)	Marcela Granados (Databricks, New York)
Mike Ludkovski (UC Santa Barbara)	Markus Gesmann (ICMR, London)
Montserrat Guillén (Universitat de Barcelona)	Markus Senn (Partner Re, Zurich)
Munir Hiabu (University of Copenhagen)	Mick Cooney (Describe Data, Dublin)
Pietro Millossovich (Bayes Business School)	Ronald Richman (Johannesburg, South Africa)
Rui Zhu (Bayes Business School)	Thomas Schmidt (HDI Global SE, Hanover)
Salvatore Scognamiglio (University of Naples)	Wui Hua (John) Ng (Zurich Financial Services, Melbourne)
Silvana Pesenti (University of Toronto)	
Stefan Weber (House of Insurance, University of Hanover)	

Keynotes

- **Frank Chang** (Vice President of Applied Science, Uber)
- **Silvana Pesenti** (Associate Professor, Department of Statistical Sciences, University of Toronto)
- **Thomas Kuhnt** (Chief Operating Officer, Chief Information Officer, HDI Global SE)

Panel discussion

The Future of Insurance: Data, AI, and Emerging Risk

Chair: Stefan Weber, House of Insurance, University of Hanover

Panelists:

- **Frank Chang** (Uber)
- **Marius Lindauer** (University of Hanover)
- **Silvana Pesenti** (University of Toronto)
- **Silke Sehm** (Hannover Re)

Programme

Venue

- HDI Platz 1, 30659, Hannover

9 June 2026

12:30 - 13:30 Lunch + registration

13:30 - 14:15 Keynote 1 (Atrium)

- **Frank Chang** (Uber)

14:15 - 14:25 Short break

14:25 - 15:45 Contributed sessions 1

Stream 1 Room Montevideo: Climate (Chair: Hirbod Assa)

- **Xun Wang** (Hannover Re): Assessing Tropical Cyclone Risk for Offshore Wind Farms in the Northwest Pacific Basin
- **Fabian Transchel** (Harz University of Applied Sciences): Estimation of hail-induced property damage modeling via German weather agency now-casting radar data in high definition spatial resolution
- **Luba Orlovsky** (Earnix): Enriching Motor Insurance Risk Models with Satellite Weather Reanalysis Data: Evidence from UK Road Accidents
- **Hirbod Assa** (University College Dublin and Model Library LTD): NatPar: Natural Parametric Modeling

Stream 2 Room Chicago: Mortality (Chair: Mick Cooney)

- **Dion Krisnadi** (University of Lausanne): Forecasting cause-specific mortality: Exploration with neural network and data augmentation
- **Francesco Ungolo** (UNSW Sydney): Robust estimation and projection of portfolio-specific mortality rates leveraging larger population data
- **David Atance** (Universidad de Alcalá): LEDecomp. Life Expectancy Decomposition R package
- **Mick Cooney** (describedata.com): Bayesian Survival Analysis for Life Insurance Lapse Modelling: From Posterior Inference to Cashflow Projection

15:45 - 16:15 Coffee break

16:15 - 17:35 Contributed sessions 2

Stream 1 Room Chicago: AI in Practice (Chair: Vincent Goulet)

- **Carlos Arocha** (Arocha & Associates GmbH): Practical Integration of Feed-Forward Networks into Core Actuarial Workflows
- **Andreas Hofmann** (Harz University of Applied Sciences): Automation of risk modelling of wildlife vehicle collisions
- **Sumesh Sheth** (National Insurance Academy): Analysing the impact of India Stack on Indian Life Insurance
- **Vincent Goulet** (Université Laval): APIculture

Stream 2 Room Montevideo: Advanced Risk Analytics (Chair: Thomas (Yew Sing) Lee)

- **Mulugeta Tilahun Bekele** (University of Gondar): A Distributed Geospatial–AI and Computer Vision Framework for Real-Time Risk Assessment, Automated Claims Verification, and Catastrophe Loss Prediction in Smart Insurance Ecosystems Using Edge-Cloud Communication Networks
- **Muhsin Tamturk** (Antares Global): Insurance Claim Prediction With Quantum Machine Learning
- **Rajiv Krishnakumar** (University of Basel): Quantum-classical meta-models and time series forecasts
- **Thomas (Yew Sing) Lee** (University of Illinois): A Novel Integrated Framework for Multi-Period Cyber Security Risk Management

17:35 - 18:00 Coffee break

18:00 - 18:45 Panel discussion (Atrium)

The Future of Insurance: Data, AI, and Emerging Risk (Chair: Stefan Weber)

- Frank Chang (Uber)
- Marius Lindauer (University of Hanover)
- Silvana Pesenti (University of Toronto)
- Silke Sehm (Hannover Re)

18:45 - 19:00 Transition to dinner

19:00 - 21:00 Conference dinner

10 June 2026

08:15 - 08:45 Welcome coffee

08:45 - 09:30 Keynote 2 (Atrium)

- **Silvana Pesenti** (University of Toronto)

09:30 - 09:40 Short break

09:40 - 11:00 Contributed sessions 3

Stream 1 Room Chicago: Climate (Chair: Grace Rigamonti Osorno)

- **Annine Duclaire Kenne** (University of Manchester): xLSTM-Based Forecast Coupled with Bayesian Online Changepoint Detection for Climate Indices
- **Daniel Nkameni** (Institut Polytechnique, Paris): A GAN-based climate scenario generator for risk management and insurance: the case of drought
- **Saeid Safarveisi** (KU Leuven): CATNet: A geometric deep learning approach for CAT bond spread prediction in the primary market
- **Grace Rigamonti Osorno** (University of Macerata): Physics-Guided Open-Data CAT Bond Trigger Design for European Earthquake and Flood Risk (EuroCatFM)

Stream 2 Room Montevideo: Fairness (Chair: Wiebke Hansen)

- **Andreas Tsanakas** (City St George's University Of London): Measuring proxy discrimination through model distortions
- **Manuel Caccone** (Italian Society of Actuaries): From Predictive Pricing to Fair Pricing: A Causal Fairness Audit Framework for Insurance Models
- **Viktor Kessler** (Vakamo inc): Governing AI at Scale: Trust, Access, and Open Standards Beyond Vendor Lock-In
- **Wiebke Hansen** (University of Hanover, HDI AG): A Robust Framework to Balance Anti-Discrimination and Risk-Adequacy in Insurance Pricing

11:00 - 11:30 Coffee break

11:30 - 12:50 Contributed sessions 4

Stream 1 Room Chicago: Portfolio Management (Chair: Nneka Umeorah)

- **Davide Rolfi** (City St George's University Of London): A Continuous-Time Framework for ESG-Constrained Investment Decisions in DC Plans
- **Linh Ha** (University of Luxembourg): Set-Valued Expectiles as Risk Measures for Multi-Numéraire Portfolios
- **Prashant De**: Optimal XS and Reinsurance portfolio coverage selection through convex optimization of coherent risk measures
- **Nneka Umeorah** (Cardiff University): Forecasting Market Volatility Through Dynamic Financial Networks

Stream 2 Room Montevideo: AI in Practice (Chair: Michael Leitschkis)

- **Marco Kemmerling** (ControlExpert GmbH): From Prototypes to Production: Engineering Agentic AI for End-to-End Motor Claims & Repair Automation
- **Mohamed El Fodil Ihaddaden** (HDI Global SE): mini007: Designing, Managing, and Orchestrating AI Agents in R
- **Katrin Kröger** (AXA Switzerland): Early Intervention, Maximum Impact: An AI Approach for Case Management Triage
- **Michael Leitschkis, Abdal Chaudhry** (Kynesis): From traditional proxy modelling to generative machine learning

12:50 - 14:00 Lunch break

14:00 - 15:20 Contributed sessions 5

Stream 1 Room Chicago: ML and Uncertainty (Chair: Karol Gawlowski)

- **Raúl Alonso Cancino Reyes** (Universidad Carlos III de Madrid): Early Warning Systems: Optimizing Default Prediction through Advanced Gradient Boosting Architectures
- **Dominik Chevalier** (Laval University): Quantifying epistemic uncertainty in gradient boosting via spectral decomposition of staged predictions
- **Samuel Asante Gyamerah** (Toronto Metropolitan University): An Enhanced Focal Loss Function to Mitigate Class Imbalance in Auto Insurance Fraud Detection with Explainable AI
- **Karol Gawlowski** (EY): Glassbox Models: Closing the Gap Between Transparency and Performance

Stream 2 Room Montevideo: Advanced Risk Analytics (Chair: Jake Morris)

- **Artak Kamalyan, Natali Gzraryan** (Plat.ai): Redefining Claim Severity: A Data-Driven Approach to Measuring the True Impact of Vehicle Accidents
- **Fallou Niakh** (ENSAE IP Paris): Federated Learning for the Design of Parametric Insurance Indices under Heterogeneous Renewable Production Losses
- **Kevin Brendler** (Hannover Re): Data Science in Parametric Insurance
- **Jake Morris** (Allianz Commercial): Experience Credibility from Account Characteristics: A Logistic Extension of Bühlmann-Straub with Temporal Adaptation

15:20 - 15:45 Coffee break

15:45 - 16:30 Keynote 3 (Atrium)

- **Thomas Kuhnt** (HDI Global SE)

16:30 - 17:00 Coffee break

17:00 - 17:40 Contributed sessions 6

Stream 1 Room Chicago: Mortality (Chair: Sascha Günther)

- **Jean-Luc Gouthon** (Aix Marseille University): Accounting for temporal and spatial dependencies in multi-population mortality forecasts: the Transformers approach
- **Sascha Günther** (ETH Zürich): Efficiently computing annuity conversion factors via feed-forward neural networks

Stream 2 Room Montevideo: Motor Insurance Pricing and Risk Analytics (Chair: Mohamed Hanafy Kotb Ibrahim)

- **Christopher Blier-Wong** (University of Toronto): Semantic representational insurance pricing
- **Mohamed Hanafy Kotb Ibrahim** (UNSW Sydney): Driving Behavior Bonus–Malus System: Enhanced Risk Classification Through Telematics and Neural Modeling

18:00 - 19:00 Reception with dinner buffet / informal closing

Abstracts of contributed talks

Practical Integration of Feed-Forward Networks into Core Actuarial Workflows

Carlos Arocha, Arocha & Associates GmbH (presenter)

Abstract: Feed-forward neural networks (FFNNs) are often viewed in actuarial teams as powerful yet hard to govern, explain, and operationalise in pricing or reserving. This presentation demonstrates a pragmatic path to adopting FFNNs responsibly by treating them as structured extensions to familiar GLM workflows rather than as black-box replacements. From an actuarial consulting perspective, we cover design choices that preserve auditability (model structure, constraints, documentation), validation aligned to actuarial standards (out-of-sample deviance, calibration, stability and sensitivity checks), and deployment patterns that integrate with existing production processes (versioning, monitoring, challenger frameworks). Python-based examples illustrate how incremental predictive lift can be achieved while maintaining interpretability and regulatory credibility through transparent reporting and model risk controls.

Keywords: Feed-forward neural networks; GLM extensions; actuarial pricing; model governance, interpretability; auditability

References

1. Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning: MIT Press https://doi.org/10.1007/s10710-017-9314-z
2. Holvoet, F., Antonio, K., & Henckaerts, R. (2025). Neural Networks for Insurance Pricing with Frequency and Severity Data: A Benchmark Study from Data Preprocessing to Technical Tariff. North American Actuarial Journal, 29(3), 519–562. https://doi.org/10.1080/10920277.2025.2451860
3. Richman, R. (2022). Mind the gap – safely incorporating deep learning models into the actuarial toolkit. British Actuarial Journal, 27, e21. https://doi.org/10.1017/S1357321722000162
4. Samek, W., Montavon, G., Vedaldi, A., Hansen, L. K., & Müller, K.-R. (Eds.). (2019). Explainable AI: Interpreting, explaining and visualizing deep learning. Springer. https://doi.org/10.1007/978-3-030-28954-6
5. Wuthrich, M. V., Richman, R., Avanzi, B., Lindholm, M., Maggi, Marco, Mayer, M., Schelldorfer, J„ and Scognamiglio, S. AI Tools for Actuaries (January 20, 2026). http://dx.doi.org/10.2139/ssrn.5162304

Contact details

- Email: ca@ArochaAndAssociates.ch
- Homepage: https://ArochaAndAssociates.ch
- Repository: https://github.com/Arocha-Associates/ffns
- Social media: https://linkedin.com/in/carocha/

NatPar: Natural Parametric Modeling

Hirbod Assa, University College Dublin and Model Library LTD (presenter)

Abstract: This paper proposes a minimum viable reporting template for natural parametric insurance. The framework is motivated by prevailing industry practice: under intensifying climate volatility, rapidly evolving exposures, and binding solvency constraints, natural catastrophe (NatCat) teams increasingly re-purpose the hazard–exposure–vulnerability–finance (HEVF) stack to engineer index-linked liabilities that are verifiable, bounded, and more capital-tractable. We refer to this supply-side design class as Natural Parametric (NatPar) modelling.

NatPar retains the NatCat architecture but alters what becomes contractual. Hazard modelling specifies observable indices and trigger logic; exposure and vulnerability are re-tasked into a basis-risk engine that quantifies mismatch between indemnity loss and parametric payout; and the finance block is adapted to short-tailed liabilities with limited development risk. Standard portfolio outputs carry over directly, including AAL, EP/AEP/OEP curves, return-period levels, and one-year tail metrics, enabling like-for-like comparison between indemnity and parametric programmes on a common hazard and exposure base.

We then introduce a minimal reporting standard that complements these familiar tail objects with basis-risk governance diagnostics: average basis shortfall and overpayment, parametric–indemnity dependence, basis-exceedance probability curves, and portfolio-level basis AEP and OEP. A frost laboratory illustrates the framework and shows that payout shape is a first-order determinant of tail capital.

Keywords: natural parametric insurance, parametric insurance, natural catastrophe modelling, basis risk, solvency capital, catastrophe risk

Contact details

- Email: assa.hirbod@gmail.com; hirbod.assa@ucd.ie
- Homepage: https://www.modelibrary.com/
- Personal website: http://hirbod-assa.com/index.html
- Social media: https://www.linkedin.com/in/hirbod-assa-a8a75237/

LEDecomp. Life Expectancy Decomposition R package

David Atance, Universidad de Alcalá, Alcalá de Henares, Spain (presenter)

Josep Lledó, Universidad de Valencia, Valencia, Spain.

Timothy Riffe, OPiK, Department of Sociology and Social Work, Universidad del País Vasco (UPV/EHU), Leioa, Spain; Ikerbasque (Basque Foundation for Science), Bilbao, Spain; Laboratory of Population Health, Max Planck Institute for Demographic Research, Rostock, Germany

Abstract: Differences in life expectancy across populations are often analyzed using age-specific decomposition methods, yet these approaches remain scattered and inconsistently applied. This paper introduces *LEdecomp*, a user-friendly tool available as an R package, designed to standardize decomposition analyses by age group and cause of death. We implement widely used decomposition techniques and extend them to incorporate sensitivity analyses and cause-specific mortality analysis. Our package collects the principal decomposition methods in the literature, providing a systematic comparison and highlighting their key properties. Empirical illustrations from the US population between 2010 and 2020 demonstrate how these approaches explain disparities and temporal changes in life expectancy. All methods are fully operational within LEdecomp, enabling researchers and practitioners to perform robust analyses without advanced programming skills. By integrating decomposition analysis into a single R package (*LEdecomp*), it becomes easier to carry out evidence-based interventions aimed at reducing health disparities and improving population longevity.

Keywords: Life expectancy; Mortality; Decomposition; Demography.

Contact details

- Email: david.atance@uah.es
- Social media: https://www.linkedin.com/in/david-atance-1a687499/

A Distributed Geospatial–AI and Computer Vision Framework for Real-Time Risk Assessment, Automated Claims Verification, and Catastrophe Loss Prediction in Smart Insurance Ecosystems Using Edge-Cloud Communication Networks

Mulugeta Tilahun Bekele, University of Gondar, College of Informatics, Department of Information Technology (presenter)

Abstract: The increasing frequency of natural catastrophes and the rapid growth of digital insurance ecosystems demand advanced data-driven methodologies for accurate risk assessment, efficient claims management, and predictive loss modeling. This study proposes a Distributed Geospatial–Artificial Intelligence (AI) and Computer Vision framework designed to enable real-time risk assessment, automated claims verification, and catastrophe loss prediction within smart insurance ecosystems using edge–cloud communication networks. The proposed architecture integrates distributed computing infrastructures, geospatial analytics, and multimodal machine learning models to process heterogeneous insurance data sources, including satellite imagery, drone-based inspection images, IoT sensor data, and geospatial environmental datasets.

Computer vision and advanced image processing techniques are employed to automatically detect and classify property damage from high-resolution imagery, enabling rapid and objective claims verification. Simultaneously, geospatial deep learning models analyze spatial risk patterns associated with floods, wildfires, earthquakes, and other climate-driven hazards to enhance actuarial risk estimation and underwriting accuracy. The framework leverages edge computing to perform localized inference and preliminary image processing near data sources, thereby reducing latency and communication overhead, while cloud-based distributed systems perform large-scale model training, catastrophe simulation, and predictive analytics.

A communication-aware architecture is developed to ensure secure and efficient data exchange across distributed insurance platforms, enabling scalable deployment in smart cities and digital insurance infrastructures. Experimental evaluations using multimodal geospatial datasets demonstrate improvements in risk prediction accuracy, claim processing time, and catastrophe loss estimation compared with conventional centralized insurance analytics systems.

The proposed framework contributes to the emerging field of insurance data science by combining geospatial AI, distributed systems, and computer vision into a unified intelligent decision-support system. This research offers practical implications for insurers, regulators, and disaster management agencies seeking to build resilient, technology-driven insurance services capable of responding effectively to climate-related risks and large-scale catastrophic events.

Keywords: Insurance Data Science; Geospatial Artificial Intelligence; Computer Vision; Distributed Systems; Catastrophe Risk Prediction; Edge–Cloud Computing; Automated Claims Verification; Image Processing

References

1. Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press.
2. Kshetri, N. (2018). 1 Blockchain's roles in meeting key supply chain management objectives. International Journal of Information Management, 39, 80–89.
3. Reichstein, M., Camps-Valls, G., Stevens, B., et al. (2019). Deep learning and process understanding for data-driven Earth system science. Nature, 566(7743), 195–204.
4. Zhang, C., & Zhang, Z. (2020). Geospatial artificial intelligence (GeoAI): A new frontier for spatial data science. Annals of GIS, 26(2), 89–95.
5. Shi, W., Cao, J., Zhang, Q., Li, Y., & Xu, L. (2016). Edge computing: Vision and challenges. IEEE Internet of Things Journal, 3(5), 637–646.

Contact details

- Email: mulugeta.tilahun@uog.edu.et

Semantic representational insurance pricing

Christopher Blier-Wong, University of Toronto (presenter)

Derek Kusmenko, University of Toronto

Abstract: Insurance pricing models rely on structured covariates such as driver age, vehicle type, and region, which are typically modelled in a generalized linear model using additive or low-order interaction effects; higher-order interactions and contextual associations among risk factors are difficult to capture through explicit feature engineering. We propose replacing hand-crafted features with semantic embeddings produced by a pre-trained large language model (LLM). Each policyholder's covariate vector is serialized into a natural-language prompt, encoded by an embedding model, and reduced via principal component analysis to a fixed-length feature vector that serves as input to a standard Poisson GLM. The embedding step enables the model to exploit latent relationships between covariates, such as the compounded risk of a young driver operating a high-powered vehicle in a dense urban area, that the LLM has learned from vast text corpora. We fine-tune the embedding model on an insurance-specific objective using low-rank adaptation and a ranking-based contrastive loss, thereby aligning the embedding geometry with claim-frequency similarity. Experiments on a French motor third-party liability dataset show that the embedding-based GLM outperforms the traditional GLM.

Keywords: Insurance pricing, representation models, artificial intelligence, large language models, embeddings

References

1. Blier-Wong et al. (2021). Rethinking representations in P&C actuarial science with deep neural networks. arXiv preprint arXiv:2102.05784
2. Vaswani et al. (2017). Attention is all you need. In 31st Conference on Neural Information Processing Systems
3. Lee et al. (2025). Gemini embedding: Generalizable embeddings from Gemini. arXiv preprint arXiv:2503.07891
4. Zhang et al. (2025). Qwen3 embedding: Advancing text embedding and reranking through foundation models. arXiv preprint arXiv:2506.05176

Contact details

- Email: christopher.blierwong@utoronto.ca
- Homepage: chrisbw.ca

Data Science in Parametric Insurance

Kevin Brendler, Hannover Re

Abstract: Parametric insurance enables fast and transparent risk transfer by linking payouts to predefined, measurable indices rather than observed losses. While individual contracts are highly bespoke, the underlying analytics follow structured and repeatable modelling approaches. This creates a fundamental tension between tailored deal design and the need for scalable, standardised analysis.

This presentation introduces an evolving, human-centric data science framework that addresses this challenge through modular modelling pipelines and AI-supported workflow orchestration. The system standardises core analytical routes across different hazard classes — ranging from extreme value modelling to systemic risk analysis — while preserving flexibility at the contract level.

A key component is the integration of AI-driven support in early-stage submission screening and pipeline orchestration. AI tools assist in structuring unstructured input data, identifying modelling pathways, and automating routine tasks, while human experts retain full control over validation, interpretation, and underwriting decisions. This ensures both efficiency gains and governance compliance.

The resulting setup connects data gathering, modelling, and advisory functions into a coherent and scalable workflow. It significantly reduces turnaround times, improves consistency in reporting, and enhances decision-making capabilities in parametric insurance. The system is presented as a prototype, following an iterative build, validate, formalise approach.

Keywords: Parametric Insurance, Data Science, Climate Risk Modelling, AI Workflows, Pipeline Automation, Risk Analytics, Human-in-the-loop

Contact details

- Email: Kevin.Brendler@hannover-re.com
- LinkedIn: www.linkedin.com/in/kevin-brendler

From Predictive Pricing to Fair Pricing: A Causal Fairness Audit Framework for Insurance Models

Manuel Caccone, AI Task Force, Italian Society of Actuaries (presenter)

Abstract: The pervasive adoption of Machine Learning in insurance pricing raises fundamental questions: when does a predictive variable become discriminatory? How can we distinguish spurious correlations from legitimate causal relationships? The EU AI Act classifies credit scoring—and implicitly insurance pricing—as a high-risk system, imposing stringent transparency and non-discrimination requirements.

We propose an operational audit framework enabling actuaries to systematically assess predictive model fairness, distinguishing between variables with legitimate causal links to risk and discriminatory proxies masquerading as predictors. Using the French Motor Third-Party Liability dataset (freMTPL2freq), we develop a three-phase structured audit: (1) a *Calibration Audit* based on statistical sufficiency tests verifying that, for a given predicted premium, expected risk is uniform across demographic groups (age, gender, geographic area); (2) *Proxy Detection via XAI*, using SHAP analysis to quantify each variable's contribution and identify potential proxies for protected attributes through residual correlations; (3) a *Counterfactual Fairness Check* simulating counterfactual scenarios to distinguish "option luck" (modifiable behaviors such as vehicle type, coverage choice) from "brute luck" (immutable or semi-immutable characteristics).

The framework produces a replicable audit protocol yielding group-stratified calibration metrics, stratified SHAP attribution maps, and operational recommendations for mitigating identified biases, with documentation compliant with EU AI Act requirements. In doing so, it evolves the actuary's role from loss ratio optimizer to "causal nexus curator," providing concrete tools to balance technical sustainability, social equity, and regulatory compliance.

Keywords: Algorithmic fairness, Insurance pricing, Machine Learning, Explainable AI, SHAP, Counterfactual fairness, EU AI Act, Actuarial science

References

1. Pearl, J., Mackenzie, D. (2018). *The Book of Why: The New Science of Cause and Effect.* Basic Books.
2. Lundberg, S. M., Lee, S.-I. (2017). A unified approach to interpreting model predictions. *Advances in Neural Information Processing Systems* **30**, 4765–4774.
3. Dwork, C., Hardt, M., Pitassi, T., Reingold, O., Zemel, R. (2012). Fairness through awareness. *Proceedings of the 3rd Innovations in Theoretical Computer Science Conference*, 214–226.
4. Kusner, M. J., Loftus, J., Russell, C., Silva, R. (2017). Counterfactual fairness. *Advances in Neural Information Processing Systems* **30**, 4066–4076.
5. European Parliament and Council (2024). Regulation (EU) 2024/1689 laying down harmonised rules on artificial intelligence (AI Act). *Official Journal of the European Union*.

Contact details

- Email: manuel.caccone@actuaries.it
- Social media: https://www.linkedin.com/in/manuelcaccone/
- Repository: https://github.com/manuelcaccone

Quantifying epistemic uncertainty in gradient boosting via spectral decomposition of staged predictions

Dominik Chevalier, Laval University (presenter)

Marie-Pier Côté, Laval University

Abstract: Gradient boosting for decision tree (GBDT) models are widespread in the insurance industry as they achieve state-of-the-art performance for tabular data. A limitation of GBDT models is the absence of a measure of predictive uncertainty, an element readily available in generalised linear models and essential in many high-stakes applications. Aleatoric uncertainty can be quantified with probabilistic predictions, mainly through probabilistic GBDT algorithms, as illustrated by Chevalier and Côté (2025). Yet, the epistemic uncertainty component still needs investigation. In this work, we shift the perspective of existing propositions by leveraging the sequential nature of GBDT to construct a consistent model variance estimator and valid prediction intervals.We exploit the spectral decomposition of a GBDT staged prediction discrete-time stochastic process. After proving the consistency properties of our estimator,we dive into numerical results through simulation and real data actuarial applications, comparing the performance of our epistemic uncertainty quantification method against model-agnostic benchmarks: ensembling and conformal prediction.

Keywords: Gradient boosting for decision trees, uncertainty quantification,epistemic uncertainty, prediction intervals, model variance estimation,actuarial science, machine learning.

References

1. Chevalier, D., Côté, MP. From point to probabilistic gradient boosting for claim frequency and severity prediction. Eur.Actuar. J. 15, 707–752 (2025).

Contact details

- Email: dominik.chevalier.1@ulaval.ca
- Homepage: https://www.linkedin.com/in/dominik-chevalier/
- Repository: https://github.com/doche15
- Social media: Linkedin, GitHub

Bayesian Survival Analysis for Life Insurance Lapse Modelling: From Posterior Inference to Cashflow Projection

Mick Cooney, describedata.com

Abstract: Lapse modelling is central to life insurance pricing, reserving, and in-force portfolio management, and survival analysis provides a natural framework for this problem. Classical approaches such as the Kaplan-Meier estimator and the Cox Proportional Hazards model are well established in actuarial practice, but they produce point estimates of survival curves without propagating parameter uncertainty to downstream quantities such as projected cashflows.

In this talk we demonstrate a fully Bayesian treatment of survival analysis applied to a portfolio of individual life protection policies. Using Stan as the MCMC engine — accessed via the `brms` and `rstanarm` R packages — we fit Cox-PH models with flexible M-spline baseline hazards and weakly informative priors on regression coefficients. We discuss model specification choices, MCMC convergence diagnostics (R-hat, effective sample size, trace plots), and the use of Schoenfeld residuals to assess the proportional hazards assumption.

The central practical contribution is a workflow that propagates posterior uncertainty through to monthly cashflow projections, yielding a full predictive distribution over portfolio premium income. We compare this Bayesian fan chart against classical point estimates and observed out-of-sample cashflows, and discuss the operational benefits of communicating projection uncertainty to business stakeholders. All code is written in R with reproducible Quarto notebooks and is available in a public repository.

Keywords: Bayesian inference, survival analysis, lapse modelling, life insurance, Stan, MCMC, cashflow projection

References

1. Cox, D. R. (1972). Regression models and life-tables. *Journal of the Royal Statistical Society, Series B* **34**(2), 187–220.
2. Gelman, A., Carlin, J. B., Stern, H. S., Dunson, D. B., Vehtari, A., & Rubin, D. B. (2013). *Bayesian Data Analysis* (3rd ed.). CRC Press.
3. Carpenter, B., Gelman, A., Hoffman, M. D., Lee, D., Goodrich, B., et al. (2017). Stan: A probabilistic programming language. *Journal of Statistical Software* **76**(1), 1–32.
4. Bürkner, P.-C. (2017). brms: An R package for Bayesian multilevel models using Stan. *Journal of Statistical Software* **80**(1), 1–28.
5. Goodrich, B., Gabry, J., Ali, I., & Brilleman, S. (2023). rstanarm: Bayesian applied regression modeling via Stan. R package version 2.21.4. https://mc-stan.org/rstanarm

Contact details

- Email: mcooney@describedata.com
- Homepage: describedata.com
- Social media: LinkedIn

Optimal XS and Reinsurance portfolio coverage selection through convex optimization of coherent risk measures

Prashant De (presenter)

Abstract: Artzner et al. (1999) proposed criteria for coherent risk measures

Homogeneity : $\varrho(\lambda X) = \lambda\varrho(X)$

Monotonicity : $X \leq Y \implies \varrho(X) \leq \varrho(Y)$

Translation Invariance: $\varrho(X + c) = \varrho(X) + c$

Subadditivity : $\varrho(X + Y) \leq \varrho(X) + \varrho(Y)$.

A commonly used risk measure in financial services for required regulatory capital is Value at Risk(V@R/VaR). For Economic losses, VaR at percentile a is the minimum loss to exceed the percentile. Value at Risk (VaR) satisfies the first three requirements, but fails 4) Subadditivity.

The failure of subadditivity implies that the minimum loss to exceed a given probability of the sum of two or more independent variables can be found to be greater than the sum of the individual losses.

The implications of the failure, can indicate that the overall risk capital needs for a risk carrier may be greater than is currently assumed if aggregate VAR is relied on, especially for highly skewed distributions of actual losses.

Solutions : I Vary risk measures based on identifying the lightness or heaviness of tails of the expected net loss distributions in the portfolio II Consider the greater of the sum of the individual percentile risk measures and the percentile risk measure of the sum of losses

We choose solution I as solution II results in a loss of diversification benefits for the portfolio: However solution I requires careful analysis of loss distributions.

Consequently the analysis method is also considered in aggregate for a portfolio. Simulation approaches using Monte Carlo methods are useful but time and cost inefficient. Analytical approaches require strong assumptions for the distributions' parameters in aggregate which is challenging to prove in some cases. Finally statistical inference may require both a priori information or beliefs, and repeated sampling to estimate the correct posterior conclusion.

Finally, a risk carrier may want to use the analysis to make decisions on available reinsurance structures for an objective. This paper demonstrates that reinsurance structure optimization based on the convex optimization of key risk metrics can be achieved with efficiency; which may give risk carriers greater decision making insight during risk capital discussions, decisions on capital exposure on certain risk towers, and reinsurance purchasing during renewals.

Keywords: Reinsurance, Optimisation, Heavy Tails, Risk Measures

References

1. P Artzner. (1999) Coherent Measures of Risk. Mathematical Finance, Vol. 9, No. 3, 203-228
2. Boyd, S. & Vandenberghe, L. (2004) Convex Optimization. Cambridge University Press
3. Daníelsson, J., et al. (2005) Subadditivity Re–Examined: the Case for Value–at–Risk. LSE Financial Market Group Discussion Paper Series Volume 549
4. Daníelsson, J., et al. (2012) Fat tails,VaR and Subadditivity. Journal of Econometrics (2012), doi:10.1016/j.jeconom.2012.08.011
5. R. T. Rockafellar and S. Uryasev. (2000) Optimization of conditional value-at-risk. Journal of Risk, 2(3):21–41

Contact details

- Email: prashant.de@gmail.com
- Quant leader across Casualty Lines across Pricing, Claims, Reserving, Capital; in Primary and Surplus XS markets
- Social media: https://www.linkedin.com/in/prashantde/

Glassbox Models: Closing the Gap Between Transparency and Performance

Karol Gawlowski, Manager, EY (presenter)

William Flaherty, Actuarial Analyst, Benefact Group

Abstract: Model interpretability remains a critical challenge in predictive analytics, particularly in highly regulated industries like insurance, where model performance often ends up being outweighed by the need for its transparency. A new frontier of glassbox architectures - models that are interpretable by design yet performant out of the box, promises to close this gap without the traditional trade-off.

We present results of a comprehensive benchmarking exercise evaluating both predictive power and interpretability across a set of glassbox architectures, including IBLM, PIN, LocalGLMnet, distill-trees and EBMs, beyond GBM with SHAP. Our findings aim to equip the modern modelling actuary and financial data scientist with practical guidance on selecting architectures that satisfy both transparency requirements and predictive performance demands.

Keywords: Glassbox models, Predictive Modelling, IML, XAI

References

1. Ronald Richman, Salvatore Scognamiglio, Mario V. Wüthrich (2024) Tree-like Pairwise Interaction Networks. *arXiv preprint*
2. Yin Lou, Rich Caruana, Johannes Gehrke, Giles Hooker (2013) Accurate Intelligible Models with Pairwise Interactions. *19th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*
3. Karol Gawlowski, Patricia Wang (2025) Interpretable Boosted GLM *IFoA GIRO*
4. Cynthia Rudin (2019) Stop Explaining Black Box Machine Learning Models for High Stakes Decisions and Use Interpretable Models Instead. *Nature Machine Intelligence*

Contact details

- Email: karol.gawlowski1@uk.ey.com, kg.actuarial@gmail.com
- Repository: github.com/IFoA-ADSWP/
- Social media: linkedin.com/in/karol-gawlowski/

APIculture

Vincent Goulet, Université Laval

Abstract: In an outstanding keynote address at Insurance Data Science 2023, Mark Sellors urged us data scientists to explore the power of APIs to disseminate our results and foster collaboration. As a professor who was already training students on the lower levels of Mark's "hierarchy of data science communication" (automated reports, apps, packages), I immediately felt compelled to look into this subject. And guess what? It's not that complicated (and I got help). In this talk, I will outline my experience in developing a training course on the usage of APIs, the development of an API using *plumber* in R, and its deployment on a Linux server.

Keywords: API, R, plumber, curl

References

1. Sellors, M. (2023). APIs and the Future of Data Science, *Insurance Data Science 2023*.
2. Goulet, V. (2025). Utilisation et conception d'interfaces API. Open educational resource (in French). https://vigou3.gitlab.io/utilisation-et-conception-interfaces-api/

Contact details

- Email: vincent.goulet@act.ulaval.ca
- Homepage: vigou3.gitlab.io
- Repository: gitlab.com/vigou3

Accounting for temporal and spatial dependencies in multi-population mortality forecasts: the Transformers approach

Jean-Luc Gouthon, Aix Marseille University, France (presenter)

Xavier Milhaud, Aix Marseille University, France

José Garrido, Concordia University, Canada

Abstract: Thanks to the development of machine learning, there have been significant advances in mortality modelling. The introduction of the Transformer model by "Wang et al. 2024", which is highly effective in processing long sequences of information, has notably enhanced the precision of mortality forecasts. Our work aims to extend the Transformer architecture by incorporating structural dependencies between countries. This involves constructing a similarity matrix that combines death data and exogenous variables impacting mortality, using the method proposed in "Gouthon and Milhaud 2025". This architecture allows the model to capture long-term temporal dependencies specific to each country. It also allows for the modeling of structural correlations between countries using a modified version of the Transformer's encoding and decoding mechanisms. This new approach performs well in a comprehensive comparative study.

Keywords: mortality, deep learning, similarity matrix, clustering

References

1. Wang, Jun, Lihong Wen, Lu Xiao, and Chaojie Wang. 2024. Time-series forecasting of mortality rates using transformer. *Scandinavian Actuarial Journal* 2024 (2): 109–123. https://doi.org/10.1080/03461238.2023.2218859.640
2. Gouthon, Abiodun Jean-Luc, and Xavier Milhaud. 2025. A spatiotemporal clustering algorithm combining multiple data sources: application to mortality, hal.science/hal-05225632v1.

Contact details

- Email: abiodun-jean-luc.GOUTHON@univ-amu.fr

Efficiently computing annuity conversion factors via feed-forward neural networks

Sascha Günther, ETH Zürich (presenter)

Peter Hieber, University of Lausanne

Maria Aragona, University of Torino and Collegio Carlo Alberto

Abstract: Many pension plans and private retirement products contain annuity factors, converting the funds at some future time into lifelong income. In general model settings like, for example, the Li-Lee mortality model, analytical values for the annuity factors are not available and one has to rely on numerical techniques. Their computation typically requires nested simulations as they depend on the interest rate level and the mortality tables at the time of retirement. We exploit the flexibility and efficiency of feed-forward neural networks (NNs) to value the annuity factors at the time of retirement. In a numerical study, we compare our deep learning approach to (least-squares) Monte-Carlo, which can be represented as a special case of the NN.

Keywords: deep learning, feed-forward neural networks, least-squares Monte-Carlo, annuity factor, Li-Lee model

References

1. Aragona, M., Günther, S., Hieber, P. (2025). Efficiently computing annuity conversion factors via feed-forward neural networks. *Annals of Actuarial Science* **19**(2):304–316.

Contact details

- Email: sascha.guenther@math.ethz.ch
- Homepage: https://sites.google.com/view/saschaguenther
- Social media: https://www.linkedin.com/in/gnthr96/

An Enhanced Focal Loss Function to Mitigate Class Imbalance in Auto Insurance Fraud Detection with Explainable AI

Francis Boabang, Toronto Metropolitan University

Samuel Asante Gyamerah, Toronto Metropolitan University (presenter)

Abstract: Detecting fraudulent auto-insurance claims remains a challenging classification problem, largely due to the extreme imbalance between legitimate and fraudulent cases. Standard learning algorithms tend to overfit to the majority class, resulting in poor detection of economically significant minority events. This paper proposes a structured three-stage training framework that integrates a convex surrogate of focal loss for stable initialization, a controlled non-convex intermediate loss to improve feature discrimination, and the standard focal loss to refine minority-class sensitivity. We derive conditions under which the surrogate retains convexity in the prediction space and show how this facilitates more reliable optimization when combined with deep sequential models. Using a proprietary auto-insurance dataset, the proposed method improves minority-class F1-scores and AUC relative to conventional focal-loss training and resampling baselines. The approach also provides interpretable feature-attribution patterns through SHAP analysis, offering transparency for actuarial and fraud-analytics applications.

Keywords: automobile insurance fraud prediction; class imbalance; explainable AI; multistage focal loss function; machine learning.

References

1. Debener, J., Heinke, V., & Kriebel, J. (2023). Detecting insurance fraud using supervised and unsupervised machine learning. Journal of Risk and Insurance, 90(3), 743-768.
2. Ding, N., Ruan, X., Wang, H., & Liu, Y. (2025). Automobile insurance fraud detection based on PSO-XGBoost model and interpretable machine learning method. Insurance: Mathematics and Economics, 120, 51-60.
3. Gheysarbeigi, A., Rakhshaninejad, M., Fathian, M., & Barzinpour, F. (2025). An Ensemble-Based Auto Insurance Fraud Detection Using BQANA Hyperparameter Tuning. IEEE Access.

Contact details

- Email: asante.gyamerah@torontomu.ca
- Homepage: https://www.torontomu.ca/math/our-people/samuel-asante-gyamerah/
- Social media: www.linkedin.com/in/samuelasantegyamerah

Set-Valued Expectiles as Risk Measures for Multi-Numéraire Portfolios

(Thi Khanh) Linh Ha, University of Luxembourg (presenter)

Andreas H. Hamel, Free University of Bozen-Bolzano

Abstract: Expectile regions–like depth regions in general–capture the idea of centrality of multivariate distributions. If an order relation is present for the values of random vectors and a decision maker is interested in dominant/best points with respect to this order, centrality is not a useful concept. Therefore, cone expectile sets are introduced which depend on a vector preorder generated by a convex cone. This provides a way of describing and clustering a multivariate distribution/data cloud with respect to an order relation. Fundamental properties of cone expectiles are established including dual representations of both expectile regions and cone expectile sets. It is shown that set-valued sublinear risk measures can be constructed from cone expectile sets in the same way as in the univariate case. Examples are provided to relate this set-valued risk measure to the solvency cone in finance for multi-numéraire portfolios.

Keywords: Risk measures, expectiles, solvency cone

References

1. Bellini, F., Klar, B., Müller, A., Rosazza Gianin, E. (2014). Generalized quantiles as risk measures. Insurance: Mathematics and Economics 54, 41-48.
2. Hamel, A. H., Ha, T. K. L. (2025). Set-valued expectiles for ordered data analysis. Journal of Multivariate Analysis 208, 105425.
3. Hamel, A. H., Heyde, F. (2021). Set-valued T-translative functions and their applications in finance. Mathematics 9, online.
4. Newey, W., Powell, J. (1987). Asymmetric least squares estimation and testing. Econometrica 55, 819-847.
5. Schachermayer, W. (2004). The fundamental theorem of asset pricing under proportional transaction costs in finite discrete time. Mathematical Finance 14, 19-48.

Contact details

- Email: hikhanhlinh.ha@uni.lu
- Homepage: https://sites.google.com/view/linh-ha-ecomath/
- Social media: https://www.linkedin.com/in/linh-h-0130a57b/

A Robust Framework to Balance Anti-Discrimination and Risk-Adequacy in Insurance Pricing

Wiebke Hansen, University of Hanover, HDI AG (presenter)

Stefan Weber, University of Hanover

Mario V. Wüthrich, ETH Zurich

Abstract: Private insurance premiums earned in a portfolio must cover its aggregated risk while being individually risk-adequate to mitigate moral hazard and adverse selection. Protected information, such as gender, may be relevant for risk differentiation, yet its use can conflict with anti-discrimination regulations. The trade-off between risk-adequacy and anti-discrimination is well recognized in the literature. However, risk-adequacy focuses on pure risk pricing; additional risk loadings included in commercial premiums may distort the risk-adequacy offered to policyholders. Anti-discrimination seeks to avoid prohibited disadvantages based on protected information, e.g., through gender-neutral pricing. Thereby, policyholders are typically forced to systematically cross-subsidize. The discriminatory implications of which have received limited attention. Pricing decisions are typically further complicated by model uncertainty arising from inflation and changing portfolio compositions.

This paper conceptualizes a robust vector optimization problem to identify Pareto-optimal pricing compromises between three main pricing objectives: portfolio risk coverage, risk-adequacy, and anti-discrimination. We use an extended hierarchical Bühlmann model to propose a notion of risk-adequacy and a characterization of discrimination that also addresses disadvantages arising from systematic cross-subsidization. Each objective is accompanied with a suitable quantification and applicable to general premiums. As discrimination omits no uniform definition, our framework is designed to accommodate alternative notions. The contributions are conceptual and real-world applications are subject to future work.

Keywords: Insurance pricing, Risk differentiation, Anti-discrimination, Robust Vector Optimization, Systematic Cross-Subsidization

References

1. Lindholm, M., Richman, R., Tsanakas, A., Wüthrich, M. V. (2024). What is fair? Proxy discrimination vs. demographic disparities in insurance pricing. *Scandinavian Actuarial Journal*, **2024**(9), 935-970.
2. Dwork, C., Hardt, M., Pitassi, T. (2012). Fairness through Awareness. *Proceedings of the 3rd Innovations in Theoretical Computer Science Conference*, 214-226.
3. Ehrgott, M., Ide, J., Schöbel, A. (2014). Minmax Robustness for Multi-Objective Optimization Problems. *European Journal of Operational Research*, **2014**, 17-31.

Contact details

- Email: wiebke.hansen@insurance.uni-hannover.de

Automation of risk modelling of wildlife vehicle collisions

Andreas Hofmann, Harz University of Applied Sciences (presenter)

Fabian Transchel, Harz University of Applied Sciences

Abstract: Wildlife–vehicle collisions (WVCs) represent a significant risk to traffic safety and wildlife conservation and lead to high insurance claims each year. In Germany alone, several hundred thousand WVCs are reported annually, resulting in personal injuries and substantial financial damage. In this work, we explore the feasibility of automated risk modelling for wildlife–vehicle collisions using heterogeneous spatial and temporal data sources. Such a system would allow the estimation, and therefore the quantitative assessment, of accident risk for each individual trip independently of the driver. For such a system, we propose combining accident, land use, weather, traffic volume, topological, and temporal data to model the risk exposure of road segments. This, however, comes with a particular challenge: the quality and structure of the available data. For this reason, we explored the use of geospatial feature engineering, traffic simulations, and synthetic data generation in order to approximate missing exposure information. With our proof-of-concept hotspot analysis, we demonstrate how spatial risk surfaces can be generated and combined with temporal predictors to estimate dynamic collision probabilities. The results indicate that explainable machine learning models can be used not only to identify key drivers of wildlife–vehicle collisions but also to estimate accident risks for each individual trip, which could enable applications in insurance risk modelling, infrastructure planning, and telematics-supported dynamic warning systems aimed at reducing collision rates.

Keywords: wildlife–vehicle collisions, risk modelling, spatial data science, traffic safety, telematics

References

1. Wildlife vehicle collisions Influencing factors, data collection and research methods , S. 16, 11.2020, Pagany R., Biological Conservation Volume 251, November 2020, 108758, doi: https://doi.org/10.1016/j.biocon.2020.108758
2. On reliable identification of factors influencing wildlife vehicle collisions along roads , 2019, Bíl , M. et al., Journal of Environmental Management 21.02.2022 https://doi.org/10.1016/j.jenvman.2019.02.076
3. The Toll of the Automobile: Wildlife and Roads in Sweden , 2003, Seiler, A., Doctoral Thesis, Swedish University of Agricultural Sciences, Sweden.
4. Wildlife Vehicle Collision Reduction Study , 08.2008, U.S. Department of Transportation 10.10.2021 | https://www.fhwa.dot.gov/publications/research/safety/08034/08034.pdf
5. Wil d un fälle errei chen Rekord hoch , 19.10.2020, GDV 10.10.2021 | https://www.gdv.de/de/medien/aktuell/wildunfaelle erreichen rekordhoch 63692

Contact details

- Email: Andreas.Hofmann.MA@gmail.com
- Homepage: https://www.hs-harz.de/en/

Driving Behavior Bonus–Malus System: Enhanced Risk Classification Through Telematics and Neural Modeling

Mohamed Hanafy Kotb Ibrahim, UNSW Sydney (presenter)

Eric C.K. Cheung, UNSW Sydney

Andrés Villegas Ramirez, UNSW Sydney

Jae-Kyung Woo, UNSW Sydney

Abstract: Traditional automobile insurance pricing relies on demographic and vehicle characteristics that serve as indirect proxies for driving risk. This paper proposes a Driving-behavior Bonus–Malus System (DBBMS) that incorporates telematics data into the premium adjustment mechanism through three integrated components. First, K-means clustering segments policyholders into behavioral risk profiles based on telematics features, and a multinomial-logit CANN estimates soft cluster membership probabilities via a softmax classifier. Second, a Hurdle–Tweedie model decomposes the loss distribution into a binary claim-occurrence stage and a zero-truncated Tweedie severity stage, providing accurate loss predictions in a zero-inflated portfolio. Third, a joint Gaussian random-effects structure links the loss model and the cluster classifier, capturing residual policyholder-level heterogeneity.

Four transition rules of increasing complexity, ranging from classical claim-frequency adjustments to integrated behavioral-severity designs, are each equipped with optimal Bonus–Malus relativities derived under a financial equilibrium constraint. Empirically, the Hurdle–Tweedie achieves near-perfect calibration on positive claims (predicted-to-observed loss ratio of 1.002), with the predicted cluster membership identified as the single most informative covariate in both the occurrence and severity stages. Without cluster information, over 97% of policyholders concentrate at the two lowest BM levels; cluster-based transitions disperse the portfolio across all five levels while keeping relativities within a commercially practical range.

Keywords: Usage-Based Insurance, Unsupervised Clustering, Bonus–Malus System, Hurdle–Tweedie Model, Optimal Relativities

Contact details

- Email: mohamed_hanafy.ibrahim@student.unsw.edu.au
- Homepage: https://www.unsw.edu.au/hdr/mohamed-hanafy-kotb-ibrahim
- Personal page: https://mohamedhanafykotbibrahim14.github.io/Mohamed-Hanafy-Kotb-Ibrahim/

mini007: Designing, Managing, and Orchestrating AI Agents in R

Mohamed El Fodil Ihaddaden, HDI Global SE

Abstract: mini007 is an R package designed to create, manage, and orchestrate AI agents in a structured and reproducible way. It provides a lightweight yet expressive framework for modeling agents as autonomous components with clearly defined roles, goals, tools, and interaction rules. Rather than treating agents as opaque black boxes, mini007 emphasizes explicit workflows, traceability, and control.

The package introduces abstractions for agent definition, task delegation, and coordination, making it possible to build multi-agent systems that collaborate, specialize, and exchange information in a predictable manner. Agents can be composed into pipelines, monitored throughout execution, and reused across different contexts, supporting both experimentation and production-oriented use cases.

mini007 integrates naturally into the R ecosystem, aligning with functional programming principles and familiar data science workflows. It supports agentic patterns such as planning, reflection, and iterative refinement while maintaining reproducibility and debuggability, two aspects often missing from agent-based systems.

By focusing on clarity, modularity, and engineering discipline, mini007 enables practitioners to move beyond single-prompt interactions toward scalable, maintainable AI agent architectures built entirely in R.

Keywords: AI, R, Agents

References

1. Mohamed El Fodil Ihaddaden (2025). mini007: Lightweight Framework for Orchestrating Multi-Agent Large Language Models

Contact details

- Email: mohamedelfodil.ihaddaden@hdi.de
- Repository: https://github.com/feddelegrand7/mini007
- Social media: https://www.linkedin.com/in/dr-mohamed-el-fodil-ihaddaden-ph-d-730796159/

Redefining Claim Severity: A Data-Driven Approach to Measuring the True Impact of Vehicle Accidents

Artak Kamalyan, Lead Deep Learning Scientist, Plat.ai (presenter)

Natali Gzraryan, Deep Learning Scientist, Plat.ai (presenter)

Abstract: A novel approach (for liability car insurance) to measuring claim severity in vehicle accidents by addressing the limitations of traditional severity definitions, which rely solely on compensation amounts. Standard metrics fail to capture the true impact of accidents, as identical compensation amounts may signify drastically different levels of damage depending on the vehicle's value. To overcome this, we propose a "transformed severity" metric that normalizes compensation by dividing it by an estimated average compensation for cars with similar characteristics. This normalization leverages historical claim data and tree-based groupings, which cluster vehicles using features like make, model, body type, and age. The resulting metric provides a more accurate, data-driven reflection of accident severity, independent of vehicle price disparities. This innovative method offers insurers deeper insights into accident impacts while creating a new type of target and features for algorithms.

Keywords: Car Insurance, Claim Severity, Tree based algorithms, Severity Prediction

References

1. Avanzi, B., Taylor, G., Wu, W., & Wong, B. (2016). Generalized linear models for dependent frequency and severity of insurance claims. Insurance: Mathematics and Economics, 70, 205–215.
2. Wüthrich, M. V. Multivariate frequency-severity regression models in insurance

Contact details

- Email: natali.g@plat.ai
- Homepage: plat.ai

From Prototypes to Production: Engineering Agentic AI for End-to-End Motor Claims & Repair Automation

Dr. Sebastian Schoenen, Director of Innovation & Technology at ControlExpert GmbH | Head of Data & AI Center of Excellence at Solvd Group, ControlExpert GmbH

Dr. Marco Kemmerling, ControlExpert GmbH (presenter)

Abstract: Agentic systems are increasingly discussed as a foundation for automating complex insurance processes. While early prototypes demonstrate promising capabilities, many approaches struggle to translate into stable, auditable production systems within regulated environments.

This presentation examines end-to-end motor claims automation as a sequential decision problem rather than a collection of isolated prediction tasks. Traditional architectures typically combine predictive models with rule-based workflow engines. In practice, such designs often break down when confronted with heterogeneous data sources, multimodal claimant interaction, and dynamically evolving process states.

We report on the design and operation of a production-grade agentic AI system that automates the process from first notice of loss to payout. The system replaces static workflow logic with a structured multi-agent architecture coordinating predictive models, external services, and explicit process knowledge through a persistent state representation. A central design principle is full multi-tenancy and configurability: agent composition, process logic, prompts, and tool availability can be dynamically adapted across insurers, markets, and regulatory contexts without modifying the core architecture. This enables controlled variation of decision behavior while preserving auditability and governance requirements.

Particular attention is given to multimodal claimant interaction using voice-based models, orchestration of decoupled sub-agents, and the formalization of communication via emerging standards such as the Model Context Protocol (MCP). We further discuss persistence, memory modeling, traceability, and systematic, trace-agnostic end-to-end evaluation via automated agent-based simulation, combining analytical metrics with LLM-as-a-judge scoring to characterize robustness and failure modes under realistic process scenarios.

Drawing on live deployment experience and operational claims data from first customer implementations, we derive concrete design trade-offs and transferable principles for building configurable and robust agentic decision systems in motor insurance and related domains.

Keywords: Agentic AI, Automation, Multi-Agent Systems, End-to-End Claims Automation, Motor Insurance, Claims & Repair Automation

References

1. Plaat, Aske, et al. "Agentic large language models, a survey." *Journal of Artificial Intelligence Research* 84 (2025).
2. Wang, Lei, et al. "A survey on large language model based autonomous agents." *Frontiers of Computer Science* 18.6 (2024): 186345.
3. Zhu, Kunlun, et al. "Multiagentbench: Evaluating the collaboration and competition of llm agents." *Proceedings of the 63rd Annual Meeting of the Association for Computational Linguistics* (Volume 1: Long Papers). 2025.
4. Bhattacharya, Sukriti, et al. "AI revolution in insurance: bridging research and reality." *Frontiers in Artificial Intelligence* 8 (2025): 1568266.

Contact details

- Email: ce-marketing@controlexpert.com
- Homepage: https://www.controlexpert.com/de-de
- LinkedIn: https://www.linkedin.com/company/controlexpert-gmbh/

xLSTM-Based Forecast Coupled with Bayesian Online Changepoint Detection for Climate Indices

Annine Duclaire Kenne, The University of Manchester (presenter)

Olatunji Johnson, The University of Manchester

Rendani Mbuvha, The University of Manchester & University of Witwatersrand

Abstract: Climate indices are key indicators for understanding climate variability and detecting shifts in climate regimes. Reliable identification of structural changes in these indices is essential for monitoring evolving climate patterns and supporting risk-informed decision-making. Traditional changepoint detection methods often rely on assumptions such as stationarity or linearity, limiting their ability to capture the multiscale and nonlinear dynamics of climate systems. In this study, we use a unified framework that combines an Extended Long Short-Term Memory (xLSTM) architecture with Bayesian Online Changepoint Detection (BOCPD) to forecast climate indices and identify regime shifts. The xLSTM model improves classical LSTM networks through exponential gating and improved memory mechanisms, enabling better representation of long-range dependencies. BOCPD is applied to both model forecasts and residual series to detect abrupt and gradual distributional changes. Using a 45-year dataset (1981–2025) of temperature, precipitation, and Niño indices, we benchmark xLSTM against the persistence model, tConvLSTM, the Temporal Fusion Transformer, and XGBoost. Results show that xLSTM achieves superior predictive skill across indices ($0.73 < NSE < 0.98$; $0.86 < Pearson' r < 0.997$). The coupled xLSTM–BOCPD framework also identifies major ENSO phase transitions and hydroclimatic extremes. Changepoints detected in residuals align closely with documented disaster years, highlighting clearer signals of event-related structural changes. This hybrid deep learning–Bayesian approach provides a promising pathway for improved climate monitoring, early warning systems, and data-driven climate services.

Keywords: xLSTM, Bayesian, Changepoint detection, Climate index

References

1. Hochreiter, S., & Schmidhuber, J. (1997). Long Short-Term Memory. Neural Computation.
2. Adams, R., & MacKay, D. (2007). Bayesian Online Changepoint Detection.
3. Lim, B. et al. (2021). Temporal Fusion Transformers for Interpretable Multi-horizon Time Series Forecasting. International Journal of Forecasting.
4. Beck, M., Pöppel, K., Spanring, M., Auer, A., Prudnikova, O., Kopp, M., … & Hochreiter, S. (2024). xlstm: Extended long short-term memory. Advances in Neural Information Processing Systems, 37, 107547-107603.

Governing AI at Scale: Trust, Access, and Open Standards Beyond Vendor Lock-In

Viktor Kessler, Vakamo inc

Abstract: You've shipped your model to production. Now it needs access to sensitive customer data spread across hundreds of Apache Iceberg tables—each owned by different teams, governed by different approval processes. Weeks later, access is still pending. Meanwhile, security and compliance teams lack visibility into who can access what, under which conditions, and why.

As organizations scale from a handful of analytical models to hundreds of AI systems—and from batch processing to autonomous, real-time agents—traditional governance approaches break down. We are moving from human-to-data access toward agent-to-agent data sharing, yet most governance frameworks were not designed for this shift.

This talk explores how governance and trust in AI can be rethought using open, interoperable architectural patterns rather than proprietary control planes. Drawing on practical lessons from building Lakekeeper, an open-source Iceberg catalog and control plane, the session focuses on principles that work across teams, clouds, and execution engines.

Key topics include:

- Permissions as Code: replacing slow, manual access workflows with auditable, reviewable policies.
- Data and AI Contracts: enforcing schema, quality, and policy guarantees before AI systems fail in production.
- Agent-era governance: managing access, accountability, and trust when AI systems act autonomously.

The session is aimed at data leaders, architects, and insurance practitioners looking to build trustworthy AI systems without surrendering control of data and governance to vendor-specific platforms—solutions that can be used anywhere, by anyone.

Keywords: AI Governance, Data Governance, Open Standards, Apache Iceberg, Trustworthy AI

References

1. Big Data Europe https://youtu.be/uUhataqFUVc?si=uazsqyrxQzEOfkfW
2. My newsletter https://www.linkedin.com/newsletters/agnostic-data-7329781616556273664/
3. Apache Iceberg Europe Community https://luma.com/vakamo

Contact details

- Email: viktor@vakamo.com
- Homepage: https://vakamo.com
- Repository: https://github.com/lakekeeper
- Social media: https://www.linkedin.com/in/viktor-kessler/

Quantum-classical meta-models and time series forecasts

Frederik F. Flöther, QuantumBasel, University of Basel

Rajiv Krishnakumar, QuantumBasel, University of Basel (presenter)

Abstract: There is a wide range of applications in insurance that would benefit from enhanced pattern detection algorithms, for example in spotting anomalies and in forecasting. Quantum computing, while still a very young technology, provides algorithms that address problems in novel ways, enabling solutions that may be more accurate or efficient than their classical counterparts. One of the most promising application areas is quantum machine learning.

In this presentation, quantum-classical meta-models are presented, which include both classical and quantum machine learning models. These are applied to computational problems in insurance such as fraud detection and time series prediction. Breakdowns of the contribution of individual models are shown and comparisons with purely classical benchmarks are made. Finally, open research challenges are discussed and ways to accelerate the progress of such hybrid approaches towards broader use in insurance, financial services, and beyond.

Keywords: AI, Quantum Algorithms, Time Series

References

1. Cerezo, Marco, et al. "Challenges and opportunities in quantum machine learning." Nature Computational Science 2.9 (2022): 567-576.
2. Grossi, Michele, et al. "Mixed quantum-classical method for fraud detection with quantum feature selection." IEEE Transactions on Quantum Engineering 3 (2022): 1-12.

Contact details

- Email: frederik.floether@quantumbasel.com
- Homepage: https://www.quantumbasel.com
- Social media: https://www.linkedin.com/in/frederikfloether

Forecasting cause-specific mortality: Exploration with neural network and data augmentation

Dion Krisnadi, University of Lausanne (presenter)

Séverine Arnold, University of Lausanne

Michael Rockinger, University of Lausanne

Andrés M. Villegas, University of New South Wales

Katja Hanewald, University of New South Wales

Abstract: Although the utilization of richer mortality data, including multi-country datasets and socio-economic factors, has been explored to improve mortality modeling, cause-of-death (CoD) data remains a valuable yet underexplored source of information. Poor data quality and complex inter-cause dependencies pose significant challenges that hinder direct modeling. This study leverages neural networks and data augmentation to address these challenges in CoD mortality forecasting.

We utilize single-year-of-age U.S. CoD data from 1959 to 2017, categorized into six primary groups: circulatory, neoplasm, respiratory, digestive, external, and others. Our primary approach is based on feed-forward neural networks (FFNN) for multi-country setting, adjusting them to the multi-cause dataset. Empirical analysis across twelve cause-gender groups demonstrates that the adjusted FFNN performs competitively against classical Lee-Carter (LC), Age-Period-Cohort (APC), and Renshaw-Haberman (RH) models applied independently to each cause. To further enhance performance, we propose an alternative to hyperparameter tuning by combining simple data augmentation with model pretraining. Preliminary results indicate that while this method reduces Mean Squared Error (MSE) for all-cause mortality forecasts, its efficacy across individual causes varies, though the cause-specific MSE remains comparable. Finally, using network attribution methods, we highlight the networks' capacity to capture complex cause-age interactions and identify the limitations of current architectures in capturing temporal dynamics.

Keywords: Mortality forecasting, Cause-of-death, Neural networks

References

1. Richman, R. (2022). Mind the gap - safely incorporating deep learning models into the actuarial toolkit. *British Actuarial Journal* **27**, e21.
2. Richman, R., &Wüthrich, M. V. (2021). A neural network extension of the Lee-Carter model to multiple populations. *Annals of Actuarial Science* **15**, 346–366.
3. Villegas, A. M., Bajekal, M., Haberman, S., & Zhou, L. (2021, September). *Analysis of historical u. s. population mortality improvement drivers 1959-2016*. SOA.

Contact details

- Email: dion.krisnadi@unil.ch
- Social media: linkedin.com/in/dionkrisnadi

Early Intervention, Maximum Impact: An AI Approach for Case Management Triage

Katrin Kröger, AXA Switzerland (presenter)

Sven Kohler, AXA Switzerland

Bruno Jordan, AXA Switzerland

Gennaro Chirico, AXA Switzerland

David Meier, AXA Switzerland

Abstract: AXA Switzerland provides comprehensive protection against accidents, illnesses, and disabilities. Our specialist case managers play a vital role in supporting severely injured or ill claimants' workplace reintegration, a process crucial for reducing long-term disability costs. To enhance this effort, we developed an AI application designed to identify high-impact cases at an earlier stage. This system leverages document extraction and analysis, applying tailored triage criteria to streamline case prioritization. Since its implementation, we have observed a significant improvement in detection speed, triage review, and effectiveness of our case management process, ultimately leading to better outcomes for claimants and the company.

Keywords: AI, claims processing, document processing, text extraction, recovery potential

Contact details

- Email: katrin.kroeger@axa.ch

A Novel Integrated Framework for Multi-Period Cyber Security Risk Management

Thomas (Yew Sing) Lee, Department of Information and Decision Sciences, University of Illinois

Abstract: Several firms face attacks by multiple types of hackers with type dependent losses during a multiperiod planning horizon. A hacker that failed to breach the system in a period can try breaching the system again in the next period. Each firm decides on the level of investment for cyber security counter measures at the beginning of the planning horizon. An insurer offers multiperiod cyber insurance coverage where premium depends on the cyber security implemented at the firm. Two types of cyber security interdependence breaching process due to the correlated software monoculture risk were analyzed. We derive the mean and variance for several performance measures of interest, including the number of breaches and develop the cyber insurance pricing model. We show that the mean and variance for the number of breaches and our pricing formula converge to the long run averages geometrically. The usefulness of our model demonstrated through numerical examples.

Keywords: Multiperiod Cyber Insurance, Hacker, Number of Breaches, Breaching Probability, Cyber Security, Correlated Risks, Software Monoculture Risk, Multiperiod Integrated Risk Management Strategy

Contact details

- Email: yslee@uic.edu

From traditional proxy modelling to generative machine learning

Dr. Michael Leitschkis, Kynesis (presenter)

Abdal Chaudhry, Kynesis (presenter)

Abstract: Traditional proxy modelling for SCR calculations often fails to capture extreme scenarios and non-differentiable responses, introducing fitting errors that can result in regulatory capital add-ons. In our talk, we will demonstrate how machine learning models can deliver superior fitting quality around the 99.5th percentile and biting scenarios. We will also show how Generative AI can be embedded into the proxy modelling workflow to automate narrative generation, turning model outputs into clear, audit-ready commentary.

By virtue of our case study using a realistic actuarial dataset, attendees will see how this combined approach can enhance model accuracy, reduce capital add-on risk, and streamline internal model processes.

Keywords: Solvency II, Proxy Modelling, non-differentiable responses, automated narrative generation.

Contact details

- E-Mail: michael.leitschkis@kynesis-consulting.com
- Website: www.kynesis-consulting.com

Experience Credibility from Account Characteristics: A Logistic Extension of Bühlmann-Straub with Temporal Adaptation

Jake Morris FIA CSPA, Head of Global Pricing & Portfolio Analytics, Allianz Commercial

Abstract: A core pricing problem for underwriters is to decide how much weight to give an account's own claims history relative to an expected rate. Classical Bühlmann-Straub (B-S) credibility provides an elegant solution but applies a single pooled signal-to-noise ratio, so credibility is determined by exposure volume alone.

I propose a framework in which the credibility weight is modelled as a logistic function of account characteristics (including exposure volume, years of claims history, industry class, or any other observable account or experience feature), and estimated jointly within a single likelihood fit for claim counts or pure premium. This approach has three structural properties:

- *Generalises Bühlmann-Straub*: nests classical credibility exactly, so any performance gain is attributable to the added flexibility, not a change of method
- *Temporal adaptation*: the decay rate on older experience is estimated from data, freeing the practitioner from specifying it in advance and providing a structural correction for drift rather than an ad hoc adjustment
- *Uncertainty quantification*: a Bayesian posterior over the credibility weight reveals where account history can and cannot be trusted

In commercial lines, new accounts often arrive with known loss histories that pre-date the pricing portfolio – falling outside the reach of GLMM-based experience rating, which requires accounts to have been observed during model training. The proposed framework scores any submission from account data alone and produces transparent debits and credits that underwriters and brokers can interrogate.

Simulation scenarios validate the first two structural claims; uncertainty quantification is illustrated on a single run. Under stable risk, the proposed framework performs comparably to B-S. Under drift, temporal-adaptation variants consistently outperform B-S, which applies no temporal discounting to historical experience. Under heterogeneous credibility, an industry-augmented specification consistently outperforms a pooled B-S across simulation seeds.

Keywords: Credibility Theory, Experience Rating, Bühlmann-Straub, Commercial Insurance, Bayesian Inference, Logistic Credibility, Temporal Decay

References

1. Bühlmann, H. & Straub, E. (1970). Glaubwürdigkeit für Schadensätze. *Mitteilungen der Vereinigung Schweizerischer Versicherungsmathematiker* **70**, 111–133.
2. Nelder, J.A. & Verrall, R.J. (1997). Credibility theory and generalised linear models. *ASTIN Bulletin* **27/1**, 71–82.
3. Bühlmann, H. & Gisler, A. (2005). *A Course in Credibility Theory and its Applications*. Springer.
4. Antonio, K. & Beirlant, J. (2007). Actuarial statistics with generalized linear mixed models. *Insurance: Mathematics and Economics* **40/1**, 58–76.
5. Wüthrich, M.V. & Merz, M. (2023). *Statistical Foundations of Actuarial Learning and its Applications*. Springer Open.

Contact details

- Email: jake.morris@allianz.com
- Social media: LinkedIn

Federated Learning for the Design of Parametric Insurance Indices under Heterogeneous Renewable Production Losses

Fallou Niakh, Center for Research in Economics and Statistics, ENSAE IP Paris (presenter)

Abstract: We propose a federated learning framework for the calibration of parametric insurance indices under heterogeneous renewable energy production losses. Producers locally model their losses using Tweedie generalized linear models and private data, while a common index is learned through federated optimization without sharing raw observations. The approach accommodates heterogeneity in variance and link functions and directly minimizes a global deviance objective in a distributed setting. We implement and compare FedAvg, FedProx and FedOpt, and benchmark them against an existing approximation-based aggregation method. An empirical application to solar power production in Germany shows that federated learning recovers comparable index coefficients under moderate heterogeneity, while providing a more general and scalable framework.

Keywords: Federated learning, Parametric insurance, Tweedie GLMs, Renewable energy insurance

References

1. F. Niakh, A. Bassière, M. Denuit, and C. Y. Robert. Peer-to-peer basis risk management for renewable production parametric insurance. Annals of Operations Research, 1-47, 2025.
2. H. Gupta, D. Patel, A. Makade, K. Gupta, O. Vyas, and A. Puliafito. Risk prediction in the life insurance industry using federated learning approach. In 2022 IEEE 21st Mediterranean Electrotechnical Conference (MELECON), 948-953.
3. T. Yin, C. Peng,W. Tan, D. Xu, and H. Tang. Federated learning model for auto insurance rate setting based on tweedie distribution. CMES-Computer Modeling in Engineering & Sciences, 138(1), 2024.

Contact details

- Email: fallou.niakh@ensae.fr
- Homepage: https://fniakh.github.io/
- Social media: https://www.linkedin.com/in/fallouniakh

A GAN-based climate scenario generator for risk management and insurance: the case of drought

Daniel Nkameni, CREST Laboratory, Institut Polytechnique, Paris, France (presenter)

Antoine Heranval, Biostatistiques et Processus Spatiaux (BioSP), INRAE, Avignon, France

Olivier Lopez, CREST Laboratory, Institut Polytechnique, Paris, France

Didier Ngatcha, Independent researcher, Paris, France

Abstract: According to the United Nations Office for Disaster Risk Reduction (2025), the average annual cost of natural catastrophes increased from 70–80 billion USD between 1970 and 2000 to 180–200 billion USD between 2001 and 2020. Reports from organizations such as the IFOA and the WWF highlight the need for the insurance sector to adapt to this rapidly evolving context by developing medium- to long-term strategies that go beyond the one-year horizon of prudential regulations such as Solvency II. This paper introduces an artificial intelligence framework based on Conditional Generative Adversarial Networks (Conditional GANs) to generate future spatio-temporal trajectories of climatic indices. The approach focuses on the Soil Wetness Index (SWI), a key indicator used in France to assess drought severity. Drought accounts for approximately 30% of the indemnities paid under the French natural catastrophe insurance scheme. The proposed model, SwiGAN, simulates plausible drought propagation patterns up to 2050 for a region of France particularly exposed to this hazard. By generating realistic sequences of SWI maps, SwiGAN provides insights into drought dynamics under climate change scenarios and supports the design of adaptive risk management and insurance strategies. The methodology is also generalizable to other climate-related perils and actuarial applications such as economic scenario generation.

Keywords: Artificial intelligence, generative adversarial networks, climate risk, drought, risk management

References

1. R. Belhajjam, A. Chaqdid, N. Yebari, M. Seaid, N. El Mocayd (2024). Climate-informed flood risk mapping using a gan-based approach (exgan). *Journal of Hydrology* **638:131487**.
2. D. Chakraborty, D. Sharma, A. Mitra, B. N. Goswami (2025). Cv-gan-a generative model to simulate global climate variability. *Authorea Preprints*.
3. A. Ferchichi, M. Chihaoui, A. Ferchichi (2024). Spatio-temporal modeling of climate change impacts on drought forecast using generative adversarial network: A case study in africa. *Expert Systems with Applications* **238:122211**.

Contact details

- Email: daniel.nkameni@ensae.fr
- Linkedin: https://www.linkedin.com/in/daniel-nkameni-9590141b4/

Enriching Motor Insurance Risk Models with Satellite Weather Reanalysis Data: Evidence from UK Road Accidents

Luba Orlovsky, Earnix (presenter)

Abstract: Motor insurers traditionally rely on police-reported weather conditions in accident databases for pricing and claims analysis. However, these subjective assessments may be incomplete or inaccurate. This study investigates whether objective satellite-based weather reanalysis data can enhance motor insurance risk modelling.

We enrich the UK STATS19 road accident database with Copernicus ERA5 climate reanalysis data, providing precise measurements of temperature, precipitation, wind speed, and derived risk indicators (fog likelihood, ice risk) matched to each accident's location and time. Comparing ERA5 measurements against police-reported weather conditions reveals significant discrepancies: ERA5 detects 59% more fog conditions than police reports, suggesting systematic underreporting affecting traditional risk assessment. When police report "rain," ERA5 confirms precipitation in approximately 70% of cases, while identifying unreported precipitation in 15% of "fine weather" accidents.

We develop and compare predictive models for accident severity using: (1) police-reported weather only, (2) ERA5 weather features only, and (3) combined features from both sources. Results indicate that each source captures different risk information, with combined models potentially offering improved predictive performance. We discuss practical insurance applications including weather-adjusted territorial rating, claims validation and fraud detection through independent weather verification, severity-based reserving, and climate change scenario modelling.

The methodology uses open data sources (STATS19, ERA5) and Python, enabling insurers to implement weather enrichment at scale.

Keywords: Motor insurance, Weather risk, ERA5 reanalysis, Pricing models, Fraud detection

References

1. Copernicus Climate Change Service (2023). ERA5 hourly data on single levels from 1940 to present. *ECMWF*. https://cds.climate.copernicus.eu
2. Department for Transport (2024). STATS19 Road Safety Data. https://data.gov.uk
3. Abdel-Aty M, Pande A. Identifying crash propensity using specific traffic speed conditions. J Safety Res. 2005;36(1):97-108. doi: 10.1016/j.jsr.2004.11.002. Epub 2005 Jan 26. PMID: 15752487.
4. Brijs T, Karlis D, Wets G. Studying the effect of weather conditions on daily crash counts using a discrete time-series model. Accid Anal Prev. 2008 May;40(3):1180-90. doi: 10.1016/j.aap.2008.01.001. Epub 2008 Feb 4. PMID: 18460387.
5. Wuthrich, Mario V. and Merz, Michael, Statistical Foundations of Actuarial Learning and its Applications (June 3, 2022). Springer Actuarial, Open Access, https://link.springer.com/book/10.1007/978-3-031-12409-9, Available at SSRN: https://ssrn.com/abstract=3822407 or http://dx.doi.org/10.2139/ssrn.3822407

Contact details

- Email: lubao@earnix.com
- Homepage: earnix.com
- Social media: https://www.linkedin.com/in/luba-orlovsky-18a8881/

Physics-Guided Open-Data CAT Bond Trigger Design for European Earthquake and Flood Risk (EuroCatFM)

Grace Rigamonti Osorno, University of Macerata, Department of Economics and Law (presenter)

Abstract: EuroCatFM is proposed as a physics-guided, open-data framework for exploratory CAT bond trigger design for European earthquake and flood risk, designed to operate without proprietary policy-level or claims microdata and without proprietary catastrophe-model outputs. For flood risk, the framework combines ERA5 meteorological forcing with EFAS hydrological information. For earthquake risk, it uses ESHM20 and ESRM20 resources for hazard, exposure, vulnerability, and scenario-based loss analysis. Synthetic insurer portfolios and event-loss books are generated from public spatial data and calibrated to observable geographic and supervisory aggregates, without claiming replication of proprietary insurer microdata. Hazard-index, loss-proxy, and hybrid trigger structures are evaluated through expected loss, attachment and exhaustion probabilities, tranche loss distributions, payout timeliness, and basis-risk diagnostics. The framework is intended as an auditable and transferable prototyping environment for analyzing physically coherent and explainable trigger designs across European jurisdictions under open-data constraints.

Keywords: catastrophe bonds, open data, basis risk, flood risk, earthquake risk

References

1. Hersbach, H., Bell, B., Berrisford, P., et al. (2020). The ERA5 global reanalysis. *Quarterly Journal of the Royal Meteorological Society* **146**(730), 1999–2049. DOI: 10.1002/qj.3803.
2. Thielen, J., Bartholmes, J., Ramos, M.-H., and de Roo, A. (2009). The European Flood Alert System – Part 1: Concept and development. *Hydrology and Earth System Sciences* **13**(2), 125–140. DOI: 10.5194/hess-13-125-2009.
3. Danciu, L., Giardini, D., Weatherill, G., et al. (2024). The 2020 European Seismic Hazard Model: overview and results. *Natural Hazards and Earth System Sciences* **24**, 3049–3073. DOI: 10.5194/nhess-24-3049-2024.
4. Crowley, H., Dabbeek, J., Despotaki, V., Rodrigues, D., Martins, L., Silva, V., Romão, X., Pereira, N., Weatherill, G., and Danciu, L. (2021). *European Seismic Risk Model (ESRM20).* EFEHR Technical Report 002, V1.0.1, 84 pp. DOI: 10.7414/EUC-EFEHR-TR002-ESRM20.
5. Cummins, J. D., Lalonde, D., and Phillips, R. D. (2004). The basis risk of catastrophic-loss index securities. *Journal of Financial Economics* **71**(1), 77–111. DOI: 10.1016/S0304-405X(03)00172-7.

Contact details

- Email: g1.rigamontiosorno@unimc.it

Early Warning Systems: Optimizing Default Prediction through Advanced Gradient Boosting Architectures

Raúl Alonso Cancino Reyes, Universidad Carlos III de Madrid (presenter) - Actuary at AXA

Abstract: This research presents the development of an advanced Early Warning System (EWS) for Probability of Default (PD) prediction, addressing key limitations of traditional risk modeling approaches in both banking and insurance contexts. Conventional credit scoring methods often fail to capture non-linear interactions and complex feature structures, particularly in high-dimensional and categorical datasets.

To overcome these challenges, this study proposes a robust and scalable machine learning framework combining supervised and unsupervised techniques, with a particular focus on Gradient Boosting Decision Trees. Among the evaluated models, the CatBoost architecture demonstrates superior performance, achieving lower prediction error (MAE ≈ 18%) and explaining over 96% of variance in default prediction tasks.

The proposed pipeline integrates data preprocessing, feature transformation, and model optimization, and is validated on a large-scale portfolio dataset with more than 300,000 observations and 40+ variables. Results highlight not only improved predictive accuracy compared to benchmark models such as XGBoost, but also enhanced stability and robustness in risk segmentation.

From an industry perspective, this approach enables earlier detection of high-risk profiles, significantly reducing Type II errors, one of the most critical challenges in credit insurance and financial risk management. This improvement directly supports more effective underwriting, portfolio monitoring, and capital allocation under regulatory frameworks such as Solvency II and Basel III.

This work contributes to bridging the gap between advanced machine learning techniques and their practical implementation in insurance analytics, offering a replicable framework for next-generation risk modeling systems. The paper has been awarded by SCOR, the Spanish Institute of Actuaries, and the Portuguese Institute of Actuaries.

Keywords: Early Warning Systems, CatBoost, Probability of Default, Credit Insurance, Machine Learning.

References

1. Hastie, T., Tibshirani, R., & Friedman, J. (2009). The Elements of Statistical Learning: Data Mining, Inference, and Prediction. Springer.
2. Prokhorenkova, L., Gusev, G., Vorobev, A., Dorogush, A. V., & Gulin, A. (2018). CatBoost: unbiased boosting with categorical features. Advances in Neural Information Processing Systems, 31.
3. Chen, T., & Guestrin, C. (2016). XGBoost: A Scalable Tree Boosting System. Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining.
4. Baesens, B., Van Gestel, T., Stepanova, M., Van den Poel, D., & Vanthienen, J. (2003). Neural network survival analysis for personal loan data. Journal of the Operational Research Society, 54(12), 1289–1298.
5. PwC & GalytiX (2024). The Future of Early Warning Systems in Financial Services.

Contact details

- Email: rcancino1996@gmail.com
- Linkedin: https://www.linkedin.com/in/ra%C3%BAl-alonso-cancino-09175b103/
- Full publication: https://documentacion.fundacionmapfre.org/documentacion/publico/es/bib/187347.do
- Rewards: https://www.linkedin.com/posts/scor_scor-is-proud-to-recognize-outstanding-actuarial-activity-7388617779580559360-9pCS

A Continuous-Time Framework for ESG-Constrained Investment Decisions in DC Plans

Steven Haberman, Bayes Business School, City St George's University Of London

Iqbal Owadally, Bayes Business School, City St George's University Of London

Davide Rolfi, Bayes Business School, City St George's University Of London (presenter)

Abstract: We study the optimal investment problem of a defined-contribution (DC) pension fund operating under a binding sustainability mandate. The fund allocates its wealth across a risk-free asset, a tradable ESG index, and multiple risky securities while receiving labour-income inflows. A defining feature of the setting is that the portfolio's ESG score is required to remain aligned with a fixed target. This condition narrows the set of feasible allocations and naturally gives rise to a synthetic risky asset that summarises the relevant investment opportunities.

Within a continuous-time framework and assuming exponential utility, we derive tractable expressions for the optimal strategy in two environments. In a benchmark case with deterministic labour income, the optimal allocation cleanly decomposes into a speculative position in the synthetic risky asset and a systematic adjustment that enforces the ESG requirement. We then allow labour income to be stochastic, introducing a non-tradable source of risk and generating intertemporal hedging motives. We characterise the resulting policy and show how labour-income uncertainty interacts with the sustainability mandate, reshaping both the speculative and hedging components of the portfolio.

The results highlight how binding ESG constraints alter the structure of dynamic portfolio choice and affect risk-taking and hedging capacity. The framework offers a transparent and tractable benchmark for analysing sustainability requirements in long-horizon investment settings such as DC pension funds.

Keywords: Sustainability, Dynamic Portfolio Optimization, ESG, DC Pension Funds.

Contact details

- Email: davide.rolfi@bayes.city.ac.uk
- Social media: https://www.linkedin.com/in/davide-rolfi-3b9128211/

CATNet: A geometric deep learning approach for CAT bond spread prediction in the primary market

Saeid Safarveisi, Actuarial Research Group, AFI, Faculty of Economics and Business, KU Leuven, Leuven, Belgium (presenter)

Dixon Domfeh, College of Computing, Georgia Institute of Technology, Atlanta, United States

Abstract: Traditional models for pricing catastrophe (CAT) bonds struggle to capture the complex relational structure inherent in these instruments. This paper introduces CATNet, a novel framework that applies geometric deep learning through a Relational Graph Convolutional Network (R-GCN) to model the CAT bond primary market as a graph. By representing deals and their attributes within a relational network, CATNet leverages the underlying connectivity of the market to predict issuance spreads. Our analysis shows that the CAT bond market exhibits characteristics of a scale-free network, where a small number of highly connected and influential hubs dominate the structure. Exploiting this topology, CATNet achieves strong predictive performance and significantly outperforms benchmark machine learning models, including Random Forest and XGBoost. These results highlight the importance of network connectivity in spread formation and provide new evidence that structural relationships across deals contain valuable pricing information. The proposed framework therefore offers a new paradigm for CAT bond risk assessment, demonstrating that graph-based models can deliver both state-of-the-art predictive accuracy and deeper, quantifiable insights into the structure of the market.

Keywords: climate risk, catastrophe bonds, Graph Neural Networks (GNNs), network topology, scale-free networks, systemic risk.

References

1. Makariou, D., Barrieu, P., & Chen, Y. (2021). A random forest based approach for predicting spreads in the primary catastrophe bond market. Insurance: Mathematics and Economics, 101, Part B 140-162. https://doi.org/10.1016/j.insmatheco.2021.07.003
2. Götze, T., Gürtler, M., & Witowski, E. (2020). Improving CAT bond pricing models via machine learning. Journal of Asset Management, 21 (5), 428–446. https://doi.org/10 .1057/s41260-020-00167-0
3. Götze, T., Gürtler, M., & Witowski, E. (2023). Forecasting accuracy of machine learning and linear regression: evidence from the secondary CAT bond market. Journal of Business Economics, 93(9), 1629-1660. https://doi.org/10.1007/s11573-023-01138-8
4. Chen, X., Li, H., Lu, Y., & Zhou, R. (2024). Pricing Catastrophe Bonds–A Probabilistic Machine Learning Approach. arXiv preprint arXiv:2405.00697. https://arxiv.org/abs/2405.00697
5. Bronstein, M. M., Bruna, J., LeCun, Y., Szlam, A., & Vandergheynst, P. (2017). Geometric Deep Learning: Going beyond Euclidean data. IEEE Signal Processing Magazine, 34 (4), 18–42. 10.1109/MSP.2017.2693418

Contact details

- Email: saeid.safarveisi@kuleuven.be

Analysing the impact of India Stack on Indian Life Insurance

Sumesh Sheth, National Insurance Academy (presenter)

Abstract: India has taken number of steps to build its digital infrastructure which is referred to as, 'India Stack'. This is the largest set of open APIs in the world. Its impact is all pervasive on Indian society. It has transformed the business with a digital payment ecosystem at a cost per transaction which is among the lowest in the world. Historically the Insurance penetration in India is much lower with Life Insurance faring slightly better than non-life, despite being a competitive Insurance market since the year 2001. This has started changing, especially after the covid-pandemic. On one hand demand for Life and health Insurance is increasing and on the other hand India stack is being explored to advantage by traditional Life and health Insurer as well as host of InsurTech's. This has led to a number of unique solutions which are attempting to reduce cost and increase penetration. This short paper from a practitioner with over three decades of working in Indian Life Insurance Industry tries to answer a fundamental question, Whether India Stack and its application by the insurance sector has resulted in any meaningful impact on life and health Insurance penetration in India. It also analyses the innovations utilising this digital infrastructure for sell and service of life Insurance at a competitive pricing. This analysis is done using the public domain secondary data and a qualitative analysis by interacting with senior managers from the insurance industry and other players. This is combined with an insight of the author to answer these questions and look at the evolving future scenarios.

Keywords: Motor insurance, Weather risk, ERA5 reanalysis, Pricing models, Fraud detection

References

1. IRDAI Annual Reports at https://irdai.gov.in/annual-reports
2. Data from https://www.pib.gov.in
3. Data from The India InsurTech Association at https://www.indiainsurtech.com/
4. Data from https://www.fintechcouncil.in/
5. Data from National Payments Corporation of India (NPCI) https://www.npci.org.in

Contact details

- Email: sumesh@niapune.org.in
- Homepage: https://niapune.org.in

Insurance Claim Prediction With Quantum Machine Learning

Muhsin Tamturk, Antares Global

Abstract: This talk presents a newly developed quantum machine learning algorithm that outperforms not only traditional methods such as generalized linear models, but also advanced classical machine learning approaches like XGBoost and CatBoost, in motor and medical insurance claim prediction. Recent developments in quantum computing and their implications for the insurance industry are also discussed.

Keywords: Quantum Machine Learning, Insurance, QuantumBoosting, Motor Insurance, Medical Insurance

References

1. Tamturk, M., Ginossar, E., Carenzo, M. et al. Motor insurance data analysis by quantum machine learning. Discover Quantum Science 2, 3 (2026). https://doi.org/10.1007/s44464-026-00007-x

Contact details

- Email: mtamturk@antaresglobal.com
- Homepage: https://muhsintamturk.academia.edu/
- Linkedin: https://www.linkedin.com/in/muhsintamturk/

Estimation of hail-induced property damage modeling via German weather agency now-casting radar data in high definition spatial resolution (working title)

Fabian Transchel, Harz University of Applied Sciences (presenter)

Johannes Bühl, Harz University of Applied Sciences (co-author)

Abstract: We propose a novel approach for estimation of hail-induced property damage modeling via German weather agency now-casting radar data on spatial resolutions up to 1x1 km grids.

Previous approaches estimate property claim severity from hail size and volume. Our approach not only circumvents estimation of physical hail properties by using observations from the European Severe Weather Database to directly link property claims with observed radar data, it also potentially works in or near real-time, where standard methods require delayed post-processed weather observations.

The approach is consequently validated by comparing ESWD observations with sidelined hail property predictions. It allows for both real-time monitoring of exposure sets (and reservation requirements thereof) as well as enabling partial or fully automated and/or parametric claims handling.

Possible extensions to the approach are the inclusion of other types of extreme weather damages like windfall and intense rain. Additionally, post-hoc analysis of severe hail events could enable more granular programmatic prevention programs.

Keywords: severe weather analysis, machine learning, hail estimation, real-time claims monitoring, bulk risk treatments

Contact details

- Email: ftranschel@hs-harz.de
- Homepage: https://www.hs-harz.de/en/

Measuring proxy discrimination through model distortions

Mathias Lindholm, Stockholm University

Andreas Tsanakas, City St George's, University of London (presenter)

Rui Zhu, City St George's, University of London

Abstract: In insurance pricing there are typically prohibitions on the use of certain sensitive attributes as inputs to the pricing process. A concern then remains about policyholder information leakage, through the statistical association between sensitive attributes and other covariates that can act as proxies (Lindholm et al., 2022; Côté et al., 2025). We conceptualise proxy discrimination in line with Lindholm et al. (2024) and Steensgaard et al. (2026), as the extent to which, for a given claims generating process, prices in a portfolio vary in the conditional distribution of the sensitive attribute. This gives rise to a simple scheme for evaluating proxy discrimination, by which a classifier for the sensitive attribute is distorted, pseudo-data are generated, and prices are recalculated on the new dataset. Then, proxy discrimination is measured as a distance between the distorted and baseline price vectors, or their distributions.

This process generalises current approaches in two ways. First, much of the literature equates prices with model predictions. However, our proposed approach is applicable to any algorithm mapping data to pricing decisions, including, e.g., price optimisation. Second, metrics based on the discrimination-free pricing of Lindholm et al. (2022) rely on the comparison of prices to an alternative scenario where sensitive attributes are independent of other covariates. The proposed method explores more fully the space of dependence structures, e.g., also considering the effect of increasing (rather then reducing) dependence. We apply these ideas to measuring proxy discrimination effects and attributing them to individual covariates, using the synthetic motor insurance data set of So et al. (2021).

Keywords: Insurance pricing, Proxy discrimination, Algorithmic fairness

References

1. So, B., Boucher, J. P., Valdez, E. A. (2021). Synthetic dataset generation of driver telematics. *Risks*, **9**(4), 58.
2. Lindholm, M., Richman, R., Tsanakas, A., Wüthrich, M. V. (2022). Discrimination-free insurance pricing. *ASTIN Bulletin: The Journal of the IAA*, **52**(1), 55-89.
3. Côté, O., Côté, M. P., & Charpentier, A. (2025). A fair price to pay: Exploiting causal graphs for fairness in insurance. *Journal of Risk and Insurance*, **92**(1), 33-75.
4. Lindholm, M., Richman, R., Tsanakas, A., Wüthrich, M. V. (2024). What is fair? Proxy discrimination vs. demographic disparities in insurance pricing. *Scandinavian Actuarial Journal*, **2024**(9), 935-970.
5. Steensgaard, T., Hiabu, M., Pfister, N. (2026). Invariance in the presence of protected features. Presented at the *1st ASTIN Bulletin Conference*, Zurich, January 2026.

Contact details

- Email: a.tsanakas.1@citystgeorges.ac.uk
- Homepage: https://www.bayes.citystgeorges.ac.uk/faculties-and-research/experts/andreas-tsanakas
- Repository: https://openaccess.city.ac.uk/view/creators_id/a=2Etsanakas=2E1.html
- Social media: https://www.linkedin.com/in/andreas-tsanakas-22356824/

Forecasting Market Volatility Through Dynamic Financial Networks

Nneka Umeorah, Cardiff University, United Kingdom (presenter)

Pulikandala Nithish Kumar, Cardiff University

Alex Alochukwu, Albany State University, USA

Abstract: Volatility dynamics exhibit strong nonlinearities and time-varying cross-market dependencies, challenging traditional econometric models. Capturing volatility spillovers and network effects requires frameworks capable of jointly modelling temporal evolution and dynamic interconnections. We propose a Temporal Graph Neural Network (TemporalGNN) that represents global equity markets as time-evolving graphs. Market indices are treated as nodes, while edges encode dynamic dependence structures derived from correlation networks and Diebold–Yilmaz spillover measures. The architecture combines graph convolutions, attention mechanisms, and temporal learning to capture volatility persistence and heterogeneous cross-market influence. Using 15 years of daily data from eight major equity indices, the model consistently outperforms GARCH-type and machine learning benchmarks across forecasting horizons. Robustness analyses confirm stable performance under varying specifications and market regimes.

Keywords: Volatility dynamics; Volatility spillovers; Temporal GNN; Financial networks; Time-varying interconnectedness; Global equity markets.

References

1. Diebold, F. X., & Mariano, R. S. (2002). Comparing predictive accuracy. *Journal of Business & economic statistics*, 20(1), 134–144.
2. Diebold, F. X., & Yilmaz, K. (2009). Measuring financial asset return and volatility spillovers, with application to global equity markets. *The Economic Journal*, 119(534), 158–171.
3. Kumar, P. N., Umeorah, N., & Alochukwu, A. (2026). Regime-dependent graph neural networks for enhanced volatility prediction in financial markets. *Mathematics*, 14(2), 289.
4. Son, B., Lee, Y., Park, S., & Lee, J. (2023). Forecasting global stock market volatility: The impact of volatility spillover index in spatial-temporal graph-based model. *Journal of Forecasting*, 42(7), 1539–1559.

Contact details

- Email: umeorahn@cardiff.ac.uk
- Homepage: https://profiles.cardiff.ac.uk/staff/umeorahn
- Social media: https://www.linkedin.com/in/nneka-umeorah/

Robust estimation and projection of portfolio-specific mortality rates leveraging larger population data

Francesco Ungolo, School of Risk and Actuarial Studies, UNSW Sydney (presenter)

Abstract: The estimation and projection of mortality rates for pension scheme annuity portfolios is a fundamental task for annuity providers for the calculation of the value of the liabilities. These are normally observed over short observation windows and a comparably smaller number of lives compared to national population or actuarial associations data. When mortality rates are estimated using the scheme data alone, these can be characterized by a higher statistical uncertainty and unstable long-term projections. Therefore, it is proposed to improve the estimation and the projection of portfolio-specific mortality rates (the target) through a L1-regularized approach which adaptively borrows information from larger datasets (the source), as the data suggest. The method is illustrated through the analysis of regression models for the force of mortality, used to characterize the distribution of the individual future lifetime, as well as to stochastic mortality models for the analysis of the death rates and their projection. The proposed method yields substantial gains in terms of reduced uncertainty in the evaluation of the liabilities and actuarial pricing, and turns out particularly useful in situations of covariate shift or small target sample sizes. Overall, the approach provides a principled and practical way to enhance portfolio-specific mortality analysis by leveraging larger population data while respecting scheme-specific characteristics.

Keywords: Longevity risk management, Life Insurance, Pensions, Mortality projection, Survival analysis, Transfer learning

References

1. Ungolo, F. (2026). Robust estimation and projection of portfolio-specific mortality rates leveraging larger population data. *Working paper*.

Contact details

- Email: f.ungolo@unsw.edu.au
- Homepage: https://scholar.google.com/citations?user=Ty_f1dgAAAAJ&hl=it
- Repository: https://github.com/ungolof/AVDPM
- Twitter: f_ungolo

Assessing Tropical Cyclone Risk for Offshore Wind Farms in the Northwest Pacific Basin

Xun Wang, Hannover Re

Abstract: Rapid development of offshore wind farms in the Northwest Pacific – led by China with over 40 GW of installed capacity – has concentrated high-value infrastructure in one of the world's most tropical cyclone (TC) active basins. However, widely used vendor natural catastrophe models are primarily designed for land-based exposure and do not adequately represent offshore TC hazard.

In this study, we introduce a framework for assessing TC risk for offshore wind farms. Using stochastic TC track sets, we generate hazard footprints representing maximum wind speeds across offshore sites. These footprints are integrated with industry exposure data to estimate potential damage and financial loss distributions. We further evaluate uncertainty in hazard representation through sensitivity analysis using different TC track sets. Finally, we assess the impact of climate change by incorporating projected shifts in TC intensity and frequency under warming scenarios, highlighting how future climate conditions may alter offshore wind risk profiles.

Keywords: offshore wind, tropical cyclone, natural catastrophe modelling

Contact details

- Email: xun.wang@hannover-re.com

Index of presenters