# The 1st International Online Conference on Risks

6–7 July 2026 | Online

MDPI

# Organizing Committee

## Conference Chair

Prof. Dr. Steven Haberman

## Session Chairs

Dr. Young Shin Aaron Kim
Prof. Dr. Annamaria Olivieri
Prof. Dr. Corina Constantinescu
Prof. Dr. Hailiang Yang
Prof. Dr. Mercedes Ayuso
Prof. Dr. Paolo Giudici
Prof. Dr. Rüdiger Kiesel

## Scientific Committee

Dr. Guojun Gan
Dr. Kai Li
Dr. Katarzyna Czech
Dr. Shengkun Xie
Dr. Syed Shams
Dr. Tianyang Wang
Prof. Dr. Alexander Melnikov
Prof. Dr. Alexandru Valentin Asimit
Prof. Dr. Andrea Consiglio
Prof. Dr. Andrei Badescu
Prof. Dr. Arthur Charpentier
Prof. Dr. Byeongyong Paul Choi
Prof. Dr. Chengguo Weng
Prof. Dr. Emilia di Lorenzo
Prof. Dr. Ioannis Kyriakou
Prof. Dr. Jorge Miguel Bravo
Prof. Dr. José Garrido
Prof. Dr. Luca Regis
Prof. Dr. Massimiliano Menzietti
Prof. Dr. Pasquale Cirillo
Prof. Dr. Pavel Shevchenko
Prof. Dr. Rolf Poulsen
Prof. Dr. Séverine Arnold
Prof. Dr. Tak Kuen Ken Siu
Prof. Dr. Ying Yuan

## Organised by

MDPI

## Conference Secretariat

Email: iocr2026@mdpi.com

# Table of Contents

# Welcome from the Chair

Dear Colleagues,

We are delighted to invite you to the upcoming conference, organised by the MDPI journal *Risks* (ISSN: 2227-9091, Impact Factor 1.8). This **online** conference will take place from **6-7 July 2026**, breaking down geographical barriers and enabling global participation.

At a time characterised by intensifying market volatility, rapidly evolving regulatory landscapes, and a proliferation of emerging threats—ranging from climate-related disruptions to cyber vulnerabilities—this conference aims to be a pivotal forum for interdisciplinary dialogue. In a world where risks intertwine and impact every aspect of business, society, and the global economy, the need for collaborative and innovative approaches to risk management has never been more pressing.

Our conference offers a prestigious international platform. Here, you will have the invaluable opportunity to engage in cutting-edge research discussions, exchange insights with renowned academics and experienced industry practitioners, and play an active role in shaping a resilient risk management framework for the future. This framework is not only essential for withstanding the current challenges but also for anticipating and adapting to future uncertainties.

The five curated topics of our conference serve as the cornerstones for bridging theoretical innovation with practical applications. By exploring these areas, we aim to develop collaborative strategies that will enable us to navigate the complex web of uncertainties ahead.

S1. Insurance;
S2. Actuarial Science;
S3. Financial Risk Management;
S4. Asset Pricing and Investment Strategies;
S5. Emerging Risks and Interdisciplinary Topics.

We are committed to ensuring inclusive participation in our conference. All interested attendees are invited to register free of charge for our online sessions, providing access to a wealth of knowledge and networking opportunities, regardless of geographical location or financial constraints. Additionally, all submitted abstracts will undergo a rigorous review process by our esteemed scientific committee, ensuring the highest quality of research and discussions at the conference.

We would like to express our deepest gratitude to the *Risks* journal for its unwavering support in promoting open access. Their support has been instrumental in making this conference a reality and in facilitating the dissemination of knowledge and ideas across the global academic and practitioner communities.

As we embark on this exciting journey of exploration and collaboration, we look forward to engaging in lively discussions, forging new partnerships, and collectively contributing to the advancement of risk management. We sincerely hope that your participation in this conference will be both fruitful and enlightening, and we wish you a rewarding and memorable experience.

**Prof. Dr. Steven Haberman**
**Conference Chair**
Faculty of Actuarial Science and Insurance, Bayes Business School, City George's, University of London, London, UK


*Risks* (ISSN 2227-9091) is an international, peer-reviewed scholarly open access journal of research and studies on insurance and financial risk management. It publishes reviews, regular research papers, and communications; there is no restriction on the maximum length of the papers. Our aim is to encourage scientists to publish their experimental and theoretical research in as much detail as possible. Full experimental and/or methodical details must be provided for research articles.

**Impact Factor:** 1.8 (2025); 5-Year Impact Factor: 1.8 (2025)

# Keynote Speakers

**Dr. Guojun Gan**

**Department of Mathematics, University of Connecticut, Storrs, CT, USA**
Dr. Guojun Gan is an Associate Professor in the Department of Mathematics at the University of Connecticut, where he joined the actuarial science program in August 2014. His research interests lie in the interdisciplinary fields of actuarial science and data science. From April 2008 to April 2014, he worked in the Global Variable Annuity Hedging Department at Manulife Financial, an international life insurance company headquartered in Toronto, Canada. In this role, his primary responsibility was to improve, develop, and implement mathematical models supporting the company's global hedging programs. Prior to that, he worked for approximately one year at a hedge fund in Oakville, Ontario, Canada. Dr. Guojun Gan is passionate about both research and teaching. During his time in industry, he published two books focused on teaching clustering algorithms and mathematical finance to students and practitioners.

**Prof. Dr. Alexandru Valentin Asimit**

**Department of Actuarial Studies and Business Analytics, Macquarie Business School, Macquarie University, Sydney, Australia**
Tak Kuen Siu is a Professor in the Department of Actuarial Studies and Business Analytics, Macquarie Business School, Macquarie University. He received a B.S. degree from the Hong Kong University of Science and Technology and a Ph.D. degree from the University of Hong Kong. He serves as a member of the editorial boards of several journals, such as Stochastics, the IMA Journal of Management Mathematics, Risks and Journal of Industrial and Management Optimization. His research interests include mathematical finance, actuarial science and quantitative risk management. He has published more than 200 papers.

**Prof. Dr. Tak Kuen Ken Siu**

**Faculty of Actuarial Science and Insurance, University of London, London, UK**
Vali Asimit is a Professor of Actuarial Analytics at Bayes Business School (formerly Cass), City St George's, University of London. His work bridges academic research and practical applications in actuarial science, risk modelling, and data analytics. He has been serving as Associate Editor of Insurance: Mathematics and Economics and sits on the editorial boards of Risks and Investment. His research has received international recognition, including the Fortis Award for the best paper presented at the International Congress of Insurance: Mathematics and Economics. Vali is actively engaged with professional education through the Institute and Faculty of Actuaries, where he has been serving as Module Leader for CS2 Subject (Risk Modelling and Survival Analysis). He is also the Founding Programme Director of the MSc Business Analytics Programme, contributing to the development of future professionals at the interface of analytics and decision-making. In addition to his academic career, Vali brings substantial industry and policy experience. He began his career as a non-life actuary with Allianz and Vienna Insurance Group, working on pricing, portfolio management, and risk assessment. He has since provided consulting support to public sector bodies, including the UK Government Actuary's Department and NHS Resolution, where he developed models to forecast medical malpractice liabilities and assess long-term risk. Vali also leads impactful industry collaborations. As Academic Lead Consultant with Moody's RMS, he contributed to the development of Climate on Demand Pro, a global platform for assessing physical climate risks. He was Principal Investigator on an Innovate UK-funded project (£310,845) focused on developing a digital financial advisory system using AI to improve access to financial advice.

# Invited Speakers

**Dr. Evangelos Vasileiou**

Department of Accounting and Finance, Hellenic Mediterranean University, Heraklion, Greece

**Dr. Katarzyna Czech**

Department of Econometrics and Statistics, Institute of Economics and Finance, Warsaw University of Life Sciences, Warsaw, Poland

**Dr. Kwangmin Jung**

Department of Industrial and Management Engineering, Pohang University of Science and Technology, Pohang, Republic of Korea

**Ms. Sharon Cilia Tortell**

Insurance and Risk Management Department within the Faculty of Economics, Management and Accountancy, University of Malta, Msida, Malta

**Prof. Dr. Andrea Macrina**

Department of Mathematics, University College London (UCL), London, United Kingdom

**Prof. Dr. Ying Yuan**

National Frontiers Science Center for Industrial Intelligence and Systems Optimization, Northeastern University, Shenyang, China & School of Business Administration, Northeastern University, Shenyang, China

# Program at a Glance

| | Day 1 | Day 2 |
|---|---|---|
| **Morning** | **Session 3.** Financial Risk Management | **Session 1.** Insurance |
| **Afternoon** | **Session 5.** Emerging Risks and Interdisciplinary Topics | **Session 2.** Actuarial Science<br>**Session 4.** Asset Pricing and Investment Strategies |

# IOCR 2026 Program

## 6th July 2026 (Monday)

### *Session 3. Financial Risk Management*

*Time: 9:00 (CEST, Basel) | 03:00 (EDT, New York) | 15:00 (CST Asia, Beijing)*

| CEST Time | Speaker | Title |
|---|---|---|
| 09:00-09:10 | ***Opening Remarks from the Event Chair<br>Prof. Dr. Steven Haberman*** | |
| 09:10-09:20 | ***Welcome from the Session Chair<br>Prof. Dr. Rüdiger Kiesel*** | |
| 09:20-09:45 | **Prof. Dr. Ying Yuan**<br>Invited Speaker | From Weather to Wall Street: Climate Risk and the Endogenous Formation of Tail Risk |
| 09:45-10:10 | **Dr. Katarzyna Czech**<br>Invited Speaker | Risk-Off or Policy Shock? Regime-Switching Evidence on CHF and JPY Safe-Haven Behaviour |
| 10:10-10:25 | **Arief Rahman Hakim**<br>Selected Speaker | Directional Predictability of Financial Instability Under Climate Transition Scenarios |
| 10:25-10:40 | **Modisane Seitshiro**<br>Selected Speaker | Analysis of a Long-Memory GARCH-Type Model of Stock Returns and Their Risk Measures |
| 10:40-10:55 | **Vincenzo Di Sauro**<br>Selected Speaker | Assessing Spatial Risk Dependence in Temperature Portfolios: A Spatially Continuous Neural Network Framework |
| 10:55-11:10 | **Serena Gallo**<br>Selected Speaker | Life Expectancy as a Driver of Pension Fund Equity Allocation: Evidence from Cross-Country Data |
| 11:10-11:25 | **Christian Laudagé**<br>Selected Speaker | Towards a Unified Theory of Return Risk Measures |
| 11:25-11:40 | **Natavan Safikhanova**<br>Selected Speaker | On Minimization of Shortfall Risk in Tradable and Non-Tradable Assets |
| 11:40-14:00 | **Break** | |

### *Session 5. Emerging Risks and Interdisciplinary Topics*

*Time: 14:00 (CEST, Basel) | 08:00 (EDT, New York) | 20:00 (CST Asia, Beijing)*

| CEST Time | Speaker | Title |
|---|---|---|
| 14:00-14:10 | ***Welcome from the Session Chair<br>Prof. Dr. Paolo Giudici*** | |
| 14:10-14:35 | **Dr. Kwangmin Jung**<br>Invited Speaker | Systemic Cyber Risks and Insurance Regulatory Capital |
| 14:35-15:00 | **Ms. Sharon Cilia Tortell**<br>Invited Speaker | AI Risk Governance in EU Insurance: From Emerging Risk to Board-Level Accountability |
| 15:00-15:15 | **Abid Ullah**<br>Selected Speaker | Emerging Risks and Interdisciplinary Frontiers: Integrative Approaches for a Complex and Uncertain World |
| 15:15-15:30 | **Diana Andreea Ujică**<br>Selected Speaker | The Impact of ESG Reporting Quality on Operational and Reputational Risk Factors at European Companies in Different Risk Sectors |
| 15:30-15:45 | **Susana Herrero Olarte**<br>Selected Speaker | Financial Literacy for the Mitigation of Credit Risk and Default Probability |
| 15:45-16:00 | **Abdullah Azeem**<br>Selected Speaker | CIRIS: A Multi-Project Risk Intelligence Framework for Operational Risk Mitigation and Supply Chain Resilience |
| 16:00-16:15 | **Claude Valery Essimi Ayissi**<br>Selected Speaker | The Asymmetric Effect of Life Insurance on Longevity: An Analysis of the Cameroonian Case |
| 16:15-16:30 | **Edit Rroji**<br>Selected Speaker | Market-Implied Time to Transition to a Low-Carbon Economy |
| 16:30-16:45 | **Puneet Redu**<br>Selected Speaker | From Model Performance Signals to Risk Decisions: A Framework for Consistent Model Risk Governance at Model and Aggregate Levels in Financial Institutions |

## 7th July 2026 (Tuesday)

### *Session 1. Insurance*

*Time: 9:00 (CEST, Basel) | 03:00 (EDT, New York) | 15:00 (CST Asia, Beijing)*

| CEST Time | Speaker | Title |
|---|---|---|
| 09:00-09:10 | ***Welcome from the Session Chairs<br>Prof. Dr. Annamaria Olivieri<br>Prof. Dr. Mercedes Ayuso*** | |
| 09:10-09:40 | **Prof. Dr. Alexandru Valentin Asimit**<br>Keynote Speaker | Distribution-Free Shrinkage of High-Dimensional Mean Vector |
| 09:40-10:05 | **Prof. Dr. Andrea Macrina**<br>Invited Speaker | Optimal Insurance for Index Risk |
| 10:05-10:20 | **Debbie Kusch Falden**<br>Selected Speaker | When Indemnity Insurance Fails: Parametric Coverage under Binding Budget and Risk Constraints |
| 10:20-10:35 | **Massimiliano Menzietti**<br>Selected Speaker | A Multi-State Actuarial Framework for Health-Contingent NDC Pensions |
| 10:35-10:50 | **Alba Roviello**<br>Selected Speaker | Reverse Mortgage in Italy: Life-Cycle Theoretical Approach vs Empirical Evidences |
| 10:50-11:05 | **Miguel Santolino**<br>Selected Speaker | Population Density, Traffic Injury Severity, and Their Monetary Valuation: Evidence and Policy Implications for Insurers |
| 11:05-11:20 | **Alberto Piscitelli**<br>Selected Speaker | Optimal Risk Transfer with Imperfect Hedging: A Framework for Insurers |
| 11:20-11:35 | **Brayan Felipe Parra Martínez**<br>Selected Speaker | Economic Loss Distribution Conditional on Extreme Meteorological Events: An Actuarial Copula–Extreme Value Approach |
| 11:35-14:00 | **Break** | |

### *Session 2. Actuarial Science*

*Time: 14:00 (CEST, Basel) | 08:00 (EDT, New York) | 20:00 (CST Asia, Beijing)*

| CEST Time | Speaker | Title |
|---|---|---|
| 14:00-14:10 | ***Welcome from the Session Chairs<br>Prof. Dr. Hailiang Yang<br>Prof. Dr. Corina Constantinescu*** | |
| 14:10-14:40 | **Prof. Dr. Tak Kuen Ken Siu**<br>Keynote Speaker | Bayesian Lower and Upper Estimates for Ether Option Prices with Conditional Heteroscedasticity and Model Uncertainty |
| 14:40-15:10 | **Dr. Guojun Gan**<br>Keynote Speaker | Beyond Structured Data: Large Language Models in Modern Actuarial Analytics |
| 15:10-15:25 | **Ziwei Chen**<br>Selected Speaker | GLM Solutions via Shrinkage |
| 15:25-15:40 | **Francesco Strati**<br>Selected Speaker | Time-Consistent Dynamic Risk Measures on State-Dependent Musielak–Orlicz Hearts |
| 15:40-15:55 | **Carlos Matos**<br>Selected Speaker | Climate-Adjusted Ruin under Finite Horizons: Extending the Cramér–Lundberg Model with Covariate-Dependent Claims |

### *Session 4. Asset Pricing and Investment Strategies*

*Time: 15:55 (CEST, Basel) | 09:55 (EDT, New York) | 21:55 (CST Asia, Beijing)*

| CEST Time | Speaker | Title |
|---|---|---|
| 15:55-16:05 | ***Welcome from the Session Chair<br>Dr. Young Shin Aaron Kim*** | |
| 16:05-16:30 | **Prof. Dr. Evangelos Vasileiou**<br>Invited Speaker | Local Panic or Global Attention? Filtered Internet Searches and Tel Aviv Stock Exchange Performance during the Israel–Hamas War |
| 16:30-16:45 | **David-Jacob Economides**<br>Selected Speaker | Perpetual American Knock-Out Barrier Options in a Random Inspection Scheme |
| 16:45-17:00 | **Davide Sandretto**<br>Selected Speaker | Corporate Bond Factor Momentum |
| 17:00-17:10 | ***Closing Remarks from the Event Chair<br>Prof. Dr. Steven Haberman*** | |

# Session 1. Insurance

# sciforum-176395: Climate Parametric Risk Transfer Across Insurance and Capital Markets: A Framework-Guided Thematic Synthesis of Governance, Principles, and Risk Allocation

**Reza Hajipour Farsangi [1], Sirus Sharifi [2], Vahid Mahmoudi [3], Pouria Goodarz [3], Baharan Jaber [4] and Sina Borzooei [5]**

[1] Department of Mathematics and Computer Science, Amirkabir University of Technology, Tehran 1591634311, Iran
[2] Faculty of Management, Kharazmi University, Tehran 15719-14911, Iran
[3] Faculty of Accounting and Finance, University of Tehran, Tehran 1417935838, Iran
[4] Faculty of Management, Kharazmi University, Tehran 1571914911, Iran
[5] Process Modelling and Digitalization Group, IVL Swedish Environmental Research Institute Valhallavägen 81, 114 27 Stockholm, Sweden

Parametric and index-based risk transfer mechanisms are increasingly promoted as scalable solutions to climate-related losses across insurance and capital markets. However, the rapidly expanding literature on these instruments remains fragmented across disciplinary, institutional, and regulatory domains, obscuring how risk is governed and allocated under conditions of climate non-stationarity. This study conducts a concept-driven umbrella review of peer-reviewed reviews and synthesis studies to examine how parametric risk transfer is theorized, designed, and governed across insurance and capital market regimes. Using a structured search of the Scopus database and guided by the PRISMA framework, twenty-one review studies published between 1991 and 2026 were synthesized through a thematic analysis informed by core insurance principles and governance theory. An adapted AMSTAR 2 appraisal was employed to assess confidence in the evidence base. The synthesis reveals that parametric instruments operate under fundamentally different governance logics across market regimes, despite shared reliance on index-based triggers. In insurance-centered applications, trigger design is closely tied to principles of indemnification, insurable interest, and legitimacy, with basis risk framed as a social and contractual concern. In capital-market-based structures, including catastrophe bonds and insurance-linked securities, trigger design functions primarily as a risk allocation mechanism, shifting model uncertainty, basis risk, and climate non-stationarity from sponsors to investors. Across both regimes, the increasing reliance on complex models and externally produced data reconfigures traditional insurance principles, relocating key governance functions from underwriting and claims settlement to model governance and index calibration. These findings suggest that parametric risk transfer should not be understood solely as a technical innovation but as a governance arrangement that redistributes climate risk, uncertainty, and accountability across actors. The paper contributes a unifying conceptual framework that links trigger design, insurance principles, and regulatory boundaries, highlighting implications for climate risk governance, market regulation, and the future role of insurance under accelerating climate change.

# sciforum-182139: A Comparative Study of Logistic Regression, Random Forest, and Gradient Boosting for Motor Insurance Lapse Prediction

**Alfiyyah Hasanah**

Secondary School, Regents School Bali, Denpasar 80237, Indonesia

This study examines the application of machine learning techniques to predict policyholder renewal behavior in motor vehicle insurance. Accurately identifying customers likely to lapse is crucial for pricing strategies and customer retention in actuarial practice. Using a dataset of motor insurance policies, three classification models, Logistic Regression, Random Forest, and LightGBM, were developed and compared. Exploratory analysis revealed a moderate class imbalance, with approximately 79.6% renewal and 20.4% lapse observations. Feature engineering was performed to construct variables such as age and driving experience. The models were evaluated using multiple performance metrics, including accuracy, precision, recall, specificity, F1-score, and the area under the ROC curve (AUC). The results show that Logistic Regression achieved the highest accuracy (79.4%) and recall (99.5%), but exhibited extremely low specificity (2.1%), indicating poor performance in identifying lapse cases. Random Forest provided a more balanced performance, with an AUC of 0.663 and improved specificity (7.1%), though still limited. LightGBM achieved the best overall discrimination ability, with the highest AUC (0.683) and a more balanced trade-off between recall (63.0%) and specificity (63.3%), despite lower overall accuracy. These findings suggest that while traditional models, such as Logistic Regression, may perform well on aggregate metrics, they can be misleading in imbalanced insurance datasets. Ensemble methods, particularly gradient boosting, offer superior capability in capturing complex patterns and improving classification balance. The study highlights the importance of using appropriate evaluation metrics beyond accuracy and demonstrates the practical relevance of machine learning methods in actuarial modeling and policyholder retention analysis.

# sciforum-176952: A Multi-State Actuarial Framework for Health-Contingent NDC Pensions

**Domenico De Giovanni [1], Massimiliano Menzietti [2], Marco Pirra [1] and Fabio Viviano [1]**

[1] Department of Economics, Statistics and Finance, University of Calabria, Cosenza, Italy
[2] Department of Economics and Statistics, University of Salerno, Fisciano, Italy

**Introduction**

In ageing populations, pension and long-term care are increasingly affected by the joint evolution of longevity, morbidity, and disability. Standard NDC pensions do not explicitly account for changing health conditions after retirement, even though health-related heterogeneity affects both life expectancies and economic needs.

**Methods**

We propose a health-coningent NDC framework in which benefits can vary with retirees' current health and disability status. A continuous-time five-state Markov model is used to represent transitions among health, disability, and death. Transition intensities are estimated on U.S. Health and Retirement Study longitudinal data from 1998 to 2020, with states defined using multimorbidity and Activities of Daily Living limitations. Alternative pension designs are evaluated with respect to four evaluation criteria: financial sustainability, actuarial fairness, consistency with health-related economic needs, and homogeneity of benefits within current health states.

**Results**

The analysis shows that these four criteria cannot, in general, be simultaneously satisfied. A standard NDC design is financially sustainable but generates actuarial unfairness by redistributing pension wealth from shorter-lived, fragile retirees to healthier and longer-lived individuals. Conditioning benefits only on health at retirement restores actuarial fairness at retirement, but creates benefit inhomogeneity over time. Dynamic health-contingent schemes mitigate these shortcomings, but only through explicit trade-offs among redistribution, benefit uniformity, and needs-based protection.

**Conclusions**

The proposed framework provides a quantitative basis for assessing how NDC pensions can incorporate health- and disability-contingent protection during retirement. It shows that stronger protection for fragile retirees can be financed within the cohort without increasing aggregate expected pension expenditure. However, this implementation requires explicit choices over the trade-off between actuarial fairness, benefit homogeneity, and needs-based redistribution.

# sciforum-181795: Adverse Risk Selection in the Russian Health Insurance Model: Evidence from Cardiovascular Surgery

**Alexander Shatskiy**

Faculty of Fundamental Medicine, Chelyabinsk State University, Chelyabinsk 454001, Russia

**Introduction**

Adverse selection typically destabilizes voluntary insurance markets. In Russia, mandatory health insurance (MHI) dominates, but its dual structure—insurance medical organizations (IMOs) and territorial funds (TFMIFs)—shifts risk selection from insurers to providers. Cardiovascular surgery (CVS), a high-cost, high-risk field, reveals hidden mechanisms. This study examines provider-driven adverse selection in Russian MHI and high-tech medical care (HTMC), using evidence from cardiac surgery.

**Methods**

We analyzed Russian MHI regulations, payment models (capitation for primary care; clinical-statistical groups (CSG/DRG) for inpatient care; fixed tariffs for HTMC) using standard reporting of TFMIFs. Additionally, a quasi-experimental design was used, comparing two centers: a regional center and a single federal center. Four groups were formed based on insurance type (MHI vs. VHI) and care level (regional vs. federal). Clinical risk stratification was assessed using the EuroSCORE II and compared across groups.

**Results**

HTMC, fixed episode tariffs ignore age and comorbidity. To test this empirically, we employed a quasi-experimental design comparing regional (Chelyabinsk) and federal (Bakoulev, Moscow) cardiac centers. Distributions were compared via Mann–Whitney U test. Consequently, CVS centers avoid complex cases through formal refusal or informal barriers (excessive preoperative requirements). High-risk patients are redirected to a few "unavoidable" hospitals, worsening their unadjusted mortality statistics. Regional disparities push severe cases to federal centers, which further select low-risk patients to protect performance ratings.

**Conclusions**

Adverse selection in Russia is provider-driven, amplified by unadjusted capitation, incomplete CSG risk adjustment, and flat HTMC tariffs. In cardiovascular surgery, this results in hidden denial of care to high-risk patients. Transition to value-based healthcare (VBHC) with bundled payments, systematic risk adjustment (DCG/ACG), and outcomes measurement is necessary to align financial and clinical incentives.

# sciforum-177939: Do Traffic Crashes Change Driver Behaviour?

**Montserrat Guillen, Catalina Bolancé and Ana M. Pérez-Marín**

Econometrics RISKcenter-IREA, Universitat de Barcelona, 08034 Barcelona, Spain

This study estimates the causal effects of traffic crashes on subsequent driving behaviour, focusing on total annual kilometres driven, the proportion of kilometres driven above the posted speed limit, and the share of driving in urban areas and at night. The analysis relies on weekly data provided by an insurtech company, collected over a two-year period.

We implement a difference-in-differences (DiD) quasi-experimental design that evaluates changes in driving outcomes in the weeks following a crash. The treatment group consists of individuals who experienced an at-fault crash during the overall observation period and for whom complete information is available for the design's observational window, which spans over 25 weeks. The treatment period corresponds to the week in which the crash occurs (week 13), preceded by a 12-week pre-treatment period and followed by a 12-week post-treatment period. The control group comprises individuals who did not experience a crash during the observation period. The causal effects are estimated using a two-way fixed effects (TWFE) panel model that incorporates both additive and multiplicative control covariates. A semiparametric approach based on inverse probability weighted estimation is employed to assess the robustness of the results.

We conclude that being at fault in a crash has a statistically significant negative effect on the four driving outcomes. The largest negative effects one week after the crash are observed in the share of urban and night-time driving. For all four outcomes, these effects gradually diminish and approach zero after twelve weeks. The decline is faster for the share of urban driving. Different driver and vehicle characteristics are associated with distinct behaviour. The effects for young women and men differ with respect to speed outcomes: while the effect for women is more negative one week after the crash, it decreases more rapidly than the corresponding effect for men.

# sciforum-176815: Economic Loss Distribution Conditional on Extreme Meteorological Events: An Actuarial Copula–Extreme Value Approach

**Brayan Felipe Parra Martínez [1], Catalina Bolance Losilla [2] and Miguel Santolino [2]**

[1] MSc in Actuarial and Financial Sciences, University of Barcelona, Barcelona, Spain
[2] Department of Econometrics, Statistics and Applied Economics, University of Barcelona, Barcelona, Spain

**Introduction**

The increasing frequency and severity of extreme precipitation events pose significant challenges for the insurance industry in quantifying and managing climate-related economic losses. This study develops a statistical–actuarial framework to estimate the distribution of economic losses conditional on extreme precipitation levels. The approach integrates heavy-tailed marginal modeling with copula-based dependence structures, allowing the joint behavior of meteorological extremes and disaster losses to be analyzed within a coherent probabilistic setting.

**Methods**

To model the marginal behavior of precipitation and loss variables, we assess a range of right-skewed candidate distributions, including those with heavy fat tails. Dependence between precipitation and losses is captured using Gaussian, t-Student, and Gumbel copulas. Conditional loss quantiles, including Value at Risk (VaR), are estimated under different precipitation scenarios. Weekly maximum precipitation data from Spain (2018–2025) and economic loss records from the Emergency Events Database (EM-DAT) for selected European countries and the NOAA Storm Events Database for the United States are used for empirical illustration.

**Results**

The results show that specifications incorporating upper-tail dependence generate substantially higher conditional Value at Risk estimates than symmetric Gaussian dependence, particularly in the United States, where extreme losses dominate the distribution.

**Conclusions**

The proposed framework provides a flexible and robust tool for climate risk assessment, supporting insurers and policymakers in capital allocation, pricing, and disaster risk management under extreme weather conditions.

# sciforum-173408: From Engineering Risk to Insurance Decisions: A Risk-Based Premium Model for Energy Assets

**Barathkumar Krishnan**

Asset Integrity & Process Safety (AIPS), Abu Dhabi National Oil Company (ADNOC), Abu Dhabi P.O. Box 898, United Arab Emirates

The energy sector depends on high-value, safety-critical assets where failures can result in severe human, environmental, and financial consequences. Although insurance provides financial risk transfer, current underwriting practices largely rely on historical loss data and regional benchmarks, often overlooking asset-specific integrity conditions and management effectiveness. Risk-Based Inspection (RBI) offers a structured engineering approach to quantify probability and consequence of failure at the asset level, yet its outputs are rarely integrated into insurance premium determination.

This study introduces a Risk-Based Premium Model (RBPM) framework that embeds RBI outputs and integrity management data directly into insurance pricing. The framework prioritizes inspection confidence and documented integrity management practices as primary premium drivers, with remaining asset life applied as a secondary modifier. Aboveground Storage Tank datasets from prior integrity studies, including inspection histories, condition assessments, and management plans, were used to test the model and compare premium outcomes across differing risk profiles.

Application of RBPM demonstrated clear differentiation between well-managed and poorly managed assets. Tanks with low remaining life but high inspection confidence and active integrity management plans were rated comparably to lower-risk assets, reflecting reduced uncertainty. Conversely, assets with unknown condition, limited inspection coverage, or absent management strategies attracted significant premium loadings. The model replaced generic actuarial assumptions with transparent, evidence-based engineering risk indicators.

RBPM establishes a direct link between integrity risk reduction and financial reward, promoting proactive asset management while reducing insurer uncertainty. By aligning engineering reliability with insurance economics, the framework enables fairer, condition-based premiums and incentivizes continuous integrity improvement. Future work includes integration with digital twins, real-time analytics, and standardized RBI–insurance protocols to further enhance risk-responsive underwriting.

# sciforum-180770: Hey Judge: Don’t Let Me Down! A Mechanism for Optimal Capital Allocation to Fund Judicialization of Claims in Insurance Companies

**Amanda Ganzer de Lima, Thiago Dutra de Araújo and João Vinícius de França Carvalho**

School of Economics, Business, Accounting and Actuarial Science, University of São Paulo, São Paulo, Brazil

Litigation has become an increasingly relevant source of financial pressure for insurers, affecting both operational performance and long-term solvency. Although prior studies have shown that litigation raises operating costs and contributes to premium increases, the literature still lacks a technical, quantitatively grounded study to measure its joint impact on pricing and solvency capital. This study fills this gap by developing an analytical model, based on classical Risk Theory and the exponential premium principle, that derives the optimal sharing of litigation costs between policyholders and shareholders. The model incorporates litigation as an explicit operational cost, links it to the insurer’s adjustment coefficient and ruin probability, and derives closed-form solutions for (i) the optimal solvency capital that minimizes premiums, and (ii) the corresponding minimum premium that ensures technical and economic equilibrium. Using data from the Brazilian insurance market, we calibrate the model across multiple scenarios and quantify both the absolute and percentage effects of litigation on premium loadings and equity-capital requirements. The results show that litigation impacts premiums more strongly than solvency capital, although this effect varies across market segments. Larger insurers are able to absorb litigation costs more effectively through equity capital, partially shielding policyholders from premium increases, while smaller insurers tend to pass on a greater share of these costs via premiums. Beyond offering numerical evidence, this study introduces a formal actuarial criterion for the measurement of judicial provisions, addressing a longstanding gap in both regulation and accounting practice. The model provides insurers and regulators with an objective, replicable, and prudentially consistent tool for allocating litigation costs and managing related liabilities. By quantifying litigation’s dual impact on pricing and solvency, this study contributes to more efficient market functioning, enhanced transparency, and improved alignment between actuarial, accounting, and managerial perspectives.

# sciforum-181907: How Can Catastrophe Insurance Policies Reduce Direct Economic Losses from Natural Disasters under Extreme Climate Events?

**Zhang Li**

School of Public Administration, Jiangxi University of Finance and Economics, Jiangxi 330029, China

Catastrophe insurance, as a financial tool for disaster prevention and mitigation, provides significant support for the risk governance of China's modernization. This paper employs the difference-in-difference method and text analysis method, based on the panel data of 31 provinces in China from 2012 to 2023, to investigate the impact of catastrophe insurance policies on the direct economic losses caused by natural disasters and the pathways through which they operate. The findings indicate that catastrophe insurance policies significantly reduce the economic losses caused by natural disasters. The results of the mechanism analysis show that the attention of local governments to climate risks has a positive moderating effect on the impact of catastrophe insurance policies on direct economic losses from natural disasters. The heterogeneous analysis reveals that the policy effects are better in the eastern region than in the central and western regions, and better in the south than in the north. Accordingly, it is suggested that regional differentiated implementation strategies be combined to further explore new models of insurance policies for disaster prevention and mitigation, in order to serve the high-quality development of China's modernization. This study enriches the empirical research on the governance effect of catastrophe insurance and provides a practical reference for improving the national disaster risk prevention and control system.

# sciforum-179120: Life Insurance Market Development and Economic Growth in Cameroon: Evidence of a Nonlinear and Feedback Relationship

**Claude Valery Essimi Ayissi and Desire Avom**

Department of Monetary, Banking and Financial Economics, Faculty of Economics and Management, University of Yaoundé 2 SOA, Yaoundé, Cameroon

This study examines the impact of life insurance market development on economic growth in Cameroon, the second-largest market in the FANAF zone in terms of premiums issued in 2021. Despite the notable growth of the Cameroonian life insurance sector, its potential impact on economic growth remains largely unexplored, as national empirical research has primarily focused on banking institutions. This study addresses a significant empirical and methodological gap in the existing literature by investigating two fundamental questions: the direction of causality between life insurance development and economic growth (supply-leading, demand-following, or feedback hypothesis), and whether this relationship is symmetric or asymmetric. Using annual data covering the period from 1992 to 2020 and advanced econometric methods (ARDL, NARDL, FMOLS, DOLS, and CCR), we establish the existence of a positive and significant long-run relationship between life insurance penetration and GDP per capita. Our results reveal an intrinsic asymmetry: the expansion of the life insurance market generates a greater positive impact on economic growth compared to contraction periods. The Granger causality test, adapted to asymmetric modeling, confirms the existence of a feedback relationship: economic growth initially stimulates sector development, which in turn influences growth asymmetrically. These findings underscore the need for proactive regulation and targeted awareness policies to maximize the stabilizing role and catalytic effect of life insurance in the Cameroonian economy.

# sciforum-176767: Optimal Risk Transfer with Imperfect Hedging: A Framework for Insurers

**Alberto Piscitelli [1], Emilia Di Lorenzo [2], Massimiliano Menzietti [2] and Marilena Sibillo [2]**

[1] Department of Statistical Sciences, Sapienza University of Rome, 00185 Rome, Italy
[2] Department of Economics and Statistical Sciences, University of Naples Federico II, 80126 Naples, Italy

Risk transfer mechanisms increasingly rely on instruments whose payoffs are imperfectly aligned with the underlying exposures they are intended to hedge.

This misalignment generates basis risk and complicates the evaluation of optimal coverage decisions for insurers. Understanding how insurers determine the appropriate level of coverage when hedging effectiveness is limited therefore represents a relevant problem in insurance risk management.

This work develops a stylized analytical framework to study the insurer's optimal risk transfer decision in the presence of imperfect hedging.

The insurer faces a stochastic loss process and can transfer risk through an external instrument whose payoff is only partially correlated with the underlying exposure. The effectiveness of the hedge is therefore driven by the statistical relationship between the loss process and the hedging instrument.

The insurer's decision problem is modeled as a trade-off between risk reduction and expected profitability. Risk mitigation is achieved by transferring part of the exposure, while expected profitability is constrained by an endogenous minimum profit requirement reflecting managerial preferences and business sustainability considerations.

Within this setting, the model characterizes the optimal level of coverage as a function of hedge effectiveness, pricing conditions, and the insurer's tolerance for residual risk. The analysis highlights how imperfect hedging generates distinct coverage regimes and may lead insurers to adopt partial risk transfer even when hedging instruments are available.

The framework provides a simple analytical structure that helps interpret heterogeneous coverage choices observed in practice.

# sciforum-181050: Population Density, Traffic Injury Severity, and Their Monetary Valuation: Evidence and Policy Implications for Insurers

**Luis Cespedes, Mercedes Ayuso and Miguel Santolino**

Department of Econometrics, Statistics and Applied Economics, University of Barcelona, Barcelona 08034, Spain

**Introduction:** Differences in crash severity driven by geography and population density are highly relevant not only for traffic authorities, but also for insurance companies. In European countries, populations are concentrated in high-density areas, while the most severe injuries and fatalities occur in low-density regions. This study quantifies how much of the severity gap between high- and low-density areas is explained by differences in the distribution of observable risk factors (composition effect) versus differences in how these factors influence outcomes (structure effect).

**Methods:** Crash severity is measured using a novel monetary approach based on the aggregate Value of a Statistical Life (VSL) for all casualties. The analysis evaluates differences across the full distribution of crash severity. A counterfactual regression method is applied to decompose differences into composition and structure components.

**Results:** Using Spanish crash data from 2021 to 2023, results show that differences across density regions in road type, collision type, age, sex, and the involvement of two-wheelers explain a substantial share of the severity gap up to the median. At higher severity levels, differences in the impact of these factors become increasingly important. Summarizing, the composition effect dominates up to the 60th–70th percentiles of the severity distribution, indicating that differences in the distribution of observable characteristics account for most moderate severity gaps. Beyond these percentiles, the structure effect becomes more influential, suggesting a growing role for unobserved factors in the most severe crashes.

**Conclusions:** The findings indicate that insurers should integrate population density into premium design to better reflect heterogeneous risk profiles and ongoing demographic trends such as population ageing and geographic relocation in Europe. Counterfactual analysis provides insurers with a valuable tool for identifying the specific sources of the observed severity differences between high- and low-density areas, thereby enabling more accurate risk assessment and more efficient pricing strategies.

# sciforum-176713: Reverse Mortgage in Italy: Life-Cycle Theoretical Approach vs. Empirical Evidences

**Emilia Di Lorenzo [1], Gabriella Piscopo [1], Alba Roviello [1] and Marilena Sibillo [2]**

[1] Department of Economics and Statistics, University of Naples Federico II, 80126 Naples, Italy
[2] Department of Economics and Statistics, University of Salerno, 84084 Fisciano, Italy

**Introduction**

The recent increase in life expectancy, while reflecting improvements in living standards, implies long retirement periods, high long-term care expenses and pressure on the pension system. The elderly often hold valuable real estate assets but lack the liquidity to face the demands of consumption needs and medical expenses (house-rich and cash-poor). In this framework, Reverse Mortgage (RM) may constitute a valid financial support: it allows elder homeowners to borrow money against their home while maintaining the right to live in it. Upon the borrower's death, heirs must repay the debt, and the non-negative equity guarantee ensures that the exceed of the proceeds of the sale of the property is transferred to the heirs. Despite its availability in Italy, RM remains relatively underutilized. In this study, we provide useful insights into the Italian RM market and investigate the reasons behind its limited adoption.

**Methods**

We present a twofold analysis. First, we construct a life-cycle model to evaluate the borrower's decision problem, taking into account long-term care expenses and house maintenance costs. Exploiting a dynamic programming technique, we establish the optimal saving streams with and without RM. We then perform a comprehensive quantitative analysis conducted among potential Italian subscribers to assess current levels of awareness and to identify the factors hindering access to this credit line.

**Results**

The life-cycle model approach shows that elders receive higher utility gains when using RM. Under three different health scenarios, the liquid wealth available in the case of RM was shown to alleviate the pressure on the elders' savings. The survey results underline elders' trust issues with respect to the institutions that offer RM. Product complexity and emotional attachment to the property are among the main factors hindering the development in the uptake of this option.

**Conclusions**

Our work highlights the main criticalities affecting RM in the Italian market and provides relevant policy indications to enhance the potentiality of this product.

# sciforum-176441: Short-Term Mortality Modelling via Explainable Deep Learning

**Raffaele Clemente Petrella**

Department of Economic and Legal Studies, University of Naples “Parthenope”, Generale Parisi Street, 80132 Naples, Italy

Short-term mortality fluctuations are traditionally estimated using Serfling models [2], which capture trend and seasonality through Fourier harmonic components. Recent studies have highlighted the importance of climate in explaining mortality dynamics. Robben et al. (2024) [1] show that climate variables significantly improve weekly mortality prediction using machine learning techniques. This evidence suggests that climate contains relevant information for seasonal mortality dynamics. However, many approaches impose rigid seasonal structures or rely on black-box models, limiting interpretability. Moreover, spatial mortality models typically require the explicit specification of geographic dependence through spatial weight matrices. Motivated by these considerations, we introduce an interpretable deep-learning extension of the Serfling model in which climate effects are structurally incorporated into the seasonal dynamics. Our framework allows spatial heterogeneity to emerge directly from the learning architecture without requiring external spatial regularization. Specifically, we introduce feedforward neural networks that dynamically model the amplitudes of seasonal oscillations as a function of climate variables. This extension preserves the interpretability of the baseline framework while enabling nonlinear climate modulation. We use weekly mortality data for NUTS3 regions in Europe; models are estimated over 2014–2022 and evaluated out-of-sample in 2023. Across multiple evaluation metrics, these extensions reveal consistent improvements in predictive performance over the baseline, with gains observed in more than half of the analyzed regions. These findings confirm the models’ ability to capture spatial heterogeneity and demonstrate the robustness of the proposed specification. The framework therefore provides an interpretable advancement for climate-sensitive risk analysis in actuarial applications.

## References

[1] Robben, J., Antonio, K., & Kleinow, T. (2025). The short-term association between environmental variables and mortality: evidence from Europe. Journal of the Royal Statistical Society Series A: Statistics in Society, qnaf052.
[2] Serfling, R. E. (1963). Methods for current statistical analysis of excess pneumonia-influenza deaths. Public health reports, 78(6), 494.

# sciforum-181519: When Indemnity Insurance Fails: Parametric Coverage under Binding Budget and Risk Constraints

**Benjamin Avanzi [1], Debbie Kusch Falden [2] and Mogens Steffensen [3]**

[1] Department of Economics, Faculty of Business and Economics, University of Melbourne, Parkville, Australia
[2] Department of Mathematical Sciences, University of Liverpool, Liverpool, UK
[3] Department of Mathematical Sciences, University of Copenhagen, Copenhagen, Denmark

In high-risk environments, traditional indemnity insurance is often unaffordable or ineffective, despite its well-known optimality under expected utility. We compare excess-of-loss indemnity insurance with parametric insurance within a common mean–variance framework, allowing for fixed costs, heterogeneous premium loadings, and binding budget constraints. Motivated by the disaster insurance and risk-sharing literature, we show that, once these realistic frictions are introduced, parametric insurance can yield higher welfare for risk-averse individuals, even under the same utility objective and without relying on behavioral assumptions.

The key factor is that indemnity insurance, typically written on a full-value basis, is difficult to scale down: affordability is restored only by increasing deductibles, which can render coverage economically irrelevant. By contrast, parametric insurance allows for explicitly bounded, first-dollar protection that remains feasible even under tight budget constraints. As a result, small but timely payouts can meaningfully improve welfare by alleviating liquidity constraints and supporting early recovery, even when they cover only a fraction of total losses.

We characterize the conditions under which parametric insurance dominates indemnity insurance and show that this advantage is non-monotonic in the available premium budget. It emerges when indemnity insurance becomes impractical, weakens as affordability improves, and disappears once both contracts are unconstrained. Our results reconcile classical insurance theory with the growing use of parametric risk transfer in high-risk settings, highlighting its role as a welfare-enhancing instrument when full indemnification is no longer feasible.

# Session 2. Actuarial Science

# sciforum-180292: Back to the Future: Prospective Solvency Capital Allocation Using Predictive Dynamic Mixture of Copulas-Wavelet Combinations

**Thiago Dutra de Araújo and João Vinícius de França Carvalho**

School of Economics, Business, Accounting and Actuarial Science, University of São Paulo, São Paulo, Brazil

In this study, we propose a dynamic and forward-looking model for solvency capital allocation in insurance companies, combining convex dynamic mixtures of dynamic copulas with multiresolution analysis through wavelets. Our model simultaneously captures the temporal variation of both dependence parameters and copula weights, while also enabling forecasts of the Solvency Capital Requirement (SCR) over different time horizons. This approach overcomes the limitations of standard models, which assume static dependence structures, by incorporating complex, time-varying dynamics that are sensitive to market shocks and extreme events. We apply the model to real data from a large Brazilian insurer, using publicly available microdata from SUSEP. The analysis focuses on the “pricing” submodule of the “non-life underwriting” module, accounting for dependence among incurred claims across major business lines. The results show that the standard model tends to overestimate capital requirements by approximately 13%, whereas our dynamic model provides more parsimonious and risk-aligned estimates. Moreover, the proposed framework reacts prospectively to systemic shocks, adjusting required capital during periods of heightened claims severity. The contribution of this study is two-fold. Methodologically, it advances the theory of dynamic copulas by allowing simultaneous variation in parameters and weights. Practically, we offer a quantitative tool that improves capital calibration, strengthens prudential resilience, and supports strategic decision-making by managers, regulators, and insurers, serving as technical basis for insurers to develop internal models.

# sciforum-173322: Assessing Regional Mortality Risks in Algeria Under Data Sparsity: A Bayesian Relational Approach

**Amina Boukhalfa [1] and Farid Flici [2]**

[1] National Higher School of Statistics and Applied Economics (ENSSEA, Algiers)
[2] Research Center in Applied Economics for Development (CREAD, Algiers)

Producing reliable regional life tables is essential for capturing the disparities in mortality and life expectancy at the regional scale. These disparities provide critical insight for assessing demographic and actuarial risks that influence public health systems, social security, and financial institution schemes. In Algeria, the absence of regional life tables published by the Office for National Statistics (ONS) constrains the analysis and understanding of mortality patterns and life expectancy differences across regions. To address this gap, this study estimates mortality rates across seven Algerian regions (North Central Region, Northeast Region, Northwest Region, Central Highlands, Eastern Highlands, Western Highlands, and Great South) using data from the latest Multiple Indicator Cluster Surveys (MICS4 and MICS6), combined with official national mortality data from the ONS. However, the raw mortality rates derived from MICSs are sparse and noisy and require adjustment to ensure smoothness and completeness of mortality curves using a Bayesian relational model. Our results indicate the existence of substantial disparities in mortality and life expectancy across regions. The Great South exhibits the highest mortality levels and the lowest life expectancy for both sexes, while the Western Highlands show the most favourable profiles. These findings identify regions facing elevated demographic and actuarial risk, providing insights for insurance modelling, pension planning, and public health design. By combining survey data with statistical modelling, this study provides a practical framework for measuring and managing demographic risks in data-limited contexts.

# sciforum-182132: Risk Perception vs. Actuarial Reality: Examining Insurance Gaps and Social Security Stability During Prolonged Conflict

**Itamar David Damari [1], Rami Yosef [1] and Shenhav Malul [2]**

[1] Department of Management, Guilford Glazer Faculty of Business and Management, Ben-Gurion University of the Negev, Beer-Sheva, Israel
[2] Faculty of Business Administration, Ono Academic College, Kiryat Ono, Israel

This research investigates the divergence between subjective risk perception and objective actuarial risk during the "Iron Swords" war in Israel. As life expectancy continues to rise and demographic structures shift, the financial resilience of individuals and the stability of national social security systems depend heavily on accurate risk assessment and adequate insurance coverage.

The study utilizes a quantitative analysis of survey data (N=442) categorized into three cohorts: combat reservists, their immediate family circles, and the general public. We employed logistic regression models to identify predictors of life insurance purchase intentions and evaluated financial literacy levels across these groups.

The results reveal a significant "Knowledge Illusion" among high-risk populations. Combat reservists demonstrated a profound gap between their perceived and actual insurance literacy (P 0.01), suggesting that those at the highest objective risk are the most prone to behavioral biases. Furthermore, the findings identify a "Neighbor Effect," where purchase intentions are driven more by social proximity to risk than by individual exposure.

Significance: From an actuarial and policy perspective, these behavioral gaps represent a systemic risk to the National Insurance Institute (NII) and the broader pension system. When high-risk cohorts remain under-insured due to cognitive biases, the long-term financial burden shifts to state-funded safety nets. We propose that addressing these gaps requires the integration of Automatic Adjustment Mechanisms (AAMs) and default enrollment schemes. Such interventions are essential to ensure the actuarial stability of the social security framework, especially as the system faces the dual challenges of prolonged geopolitical instability and an aging population.

# sciforum-182144: Time-Consistent Dynamic Risk Measures on State-Dependent Musielak–Orlicz Hearts

**Francesco Strati**

Actuarial Department, PricewaterhouseCoopers Srl, 20145 Milan, Italy

Dynamic risk evaluation in insurance and finance is typically formulated on fixed integrability classes, such as $L^p$ spaces or Orlicz hearts generated by a single Young function. A uniform tail regime is thereby imposed across scenarios, which is difficult to reconcile with actuarial portfolios in which loss severity and admissible model perturbations depend on observable risk factors. Regional catastrophe exposures and lapse or surrender behaviour under stress are concrete instances in which tail control should vary locally with the realised state. Admissible terminal payoffs at time $t$ are modelled on a conditional Musielak–Orlicz heart $M^{\Phi_{S_{t}}}(\mathcal{F}_{T}\mid\mathcal{F}_{t})$ generated by an $\mathcal{F}_{t}$-measurable random Young function driven by an adapted state process $S$. Dynamic evaluation is developed in the stopping-time two-parameter sense on adapted càdlàg processes, using the $L^{0}$-module viewpoint and the conditional expectation pairing to handle scalarisation cleanly in conditional duality. A robust dual representation is obtained on state-dependent hearts as an essential supremum of penalised conditional expectations over a state-indexed dual family. Time consistency is characterised by pasting the stability of the dual classes and, in the convex case, by a cocycle property of the minimal penalty. The $\sigma$-order continuous conditional Köthe dual is identified and supports a stable weak topology under which attainment of a worst-case measure is obtained. A discrete-time Snell envelope on varying hearts follows from a backward-admissibility mechanism controlled by a conditional modular bound; it yields a minimal dominating $\mathcal{E}$-supermartingale and a first-hitting optimal exercise rule. The construction integrates state-dependent tail control with time-consistent dynamic programming for unbounded rewards, providing a rigorous foundation for actuarial and financial evaluation under heterogeneous tail regimes. It covers situations where classical fixed-integrability frameworks are restrictive, and it supports explicit dynamic-programming implementations on the admissible state-dependent domain.

# sciforum-176897: A Hybrid Framework to Model Insurance Mortality Rates: Graduation and Ensemble Models

**Lobna Sayed Ahmed [1,2], María Isabel Martínez Torre-Enciso [1] and Oscar Valdemar De la Torre-Torres [3]**

[1] Department of Finance and Commercial Research, UDI of Finance, Faculty of Economics and Business, Universidad Autónoma de Madrid (UAM), 28049 Madrid, Spain
[2] Insurance and Actuarial Science Department, Faculty of Commerce, Cairo University, Giza 12613, Egypt
[3] School of Accounting and Management Sciences, Universidad Michoacana de San Nicolás de Hidalgo (UMSNH), Morelia 58090, México

Accurate modeling of mortality rates is crucial for effective risk management. It affects product pricing, reserving, and capital estimation. Modeling mortality experience for insurance portfolios is particularly challenging in emerging markets, where data is often limited and inconsistent.

This research introduces a hybrid modeling framework that integrates actuarial graduation with tree-based machine learning models to enhance the modeling and forecasting of insurance mortality rates.

The proposed framework first applies graduation models, including the Makeham law and P-splines, to smooth crude mortality rates and capture underlying patterns. Tree-based machine learning models, including decision trees, random forests, and gradient boosting, are then utilized with two splitting approaches, random splitting and year-based splitting, to estimate and forecast graduated mortality rates, capturing nonlinear dependencies across age, year, and gender.

The methodology is applied to Egyptian life insurance data covering ages 16 to 60 for the period 2013 to 2019. The empirical results showed that the Makeham model provides a better fit and higher predictive accuracy for graduating mortality rates. Among machine learning models, gradient boosting with both random and year-based splitting achieves the highest predictive accuracy and supports reliable prediction of future mortality rates.

By combining the interpretability of actuarial graduation methods with the predictive capability of machine learning, the proposed framework provides a robust approach for modeling and forecasting insurance mortality rates in life insurance applications.

# sciforum-176124: A Stochastic Gordon–Loeb Framework for Outcome-Based Cyber Insurance

**Maria Carannante [1] and Alessandro Mazzoccoli [2]**

[1] Department of Human Science, Link Campus University, via del casale di San Pio V, 00165 Rome, Italy
[2] Department of Economics, Roma Tre University, Via Silvio D'Amico 77, 00145 Rome, Italy

**Introduction**

Cyber insurance markets are fertile ground for outcome-based contracts (OBCs), in which premiums depend on observable security performance. While these contracts aim to align incentives between policyholders and insurance companies, they also introduce additional solvency risk due to the stochastic interaction between security investments, loss frequency, and premium variability. Therefore, we propose a stochastic framework to model the trade-off between policyholders' security investments and insurer liability and to assess the solvency implications of performance-related pricing in cyber insurance.

**Methods**

We extend a stochastic Gordon–Loeb framework with aggregate losses dependent on the stochastic breach probability determined by security investments. The policyholder's investment dynamics are modeled as an exogenous mean-reverting diffusion, which captures operational uncertainty. The insurance company offers a premium adjustment based on expected outcomes, linked to vulnerability over the contractual horizon. The insurance company's profit and loss distribution is derived by combining the frequency of stochastic attacks, their severity, vulnerability dynamics, and performance-related premium variability. This also allows for the effects on capital requirements.

**Expected Results**

The model reveals a nonlinear relationship between incentive intensity and capital requirements. Performance-based pricing reduces expected losses but increases profit volatility due to premium variability. The net solvency effect depends on the covariance between aggregate losses and vulnerability-based premium adjustments. An optimal incentive intensity emerges that minimizes required capital while preserving risk mitigation benefits.

**Conclusions**

Outcome-based cyber insurance contracts create a measurable trade-off between security investment incentives and the insurer's solvency risk. The proposed framework enables dynamic performance-based pricing, consistent with risk-sensitive capital valuation, providing a quantitative basis for prudentially sound cyber OBC design.

# sciforum-177988: A Two‑Split, Three‑Peak Fourier Extension of the Lee–Carter Mortality Model

**Aimi Syairah Md Sa'at [1], Syazreen Niza Shair [2] and Norazliani Md Lazam [2]**

[1] Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA (UiTM), Darul Ehsan, Malaysia
[2] Research Interest Group of Actuarial Risk and Takaful, Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA (UiTM), Darul Ehsan, Malaysia

Longevity risk has become increasingly significant in actuarial and financial applications due to improvements in life expectancy and demographic changes. The uncertainty of future mortality trends motivates the use of stochastic mortality models to capture mortality randomness. Building on the foundational Lee−Carter (LC) model and a recent Fourier-based extension for modelling time-varying age patterns, this study proposes an enhanced LC−Fourier model tailored to Malaysian mortality dynamics. Mortality data disaggregated by age and gender from 1980 to 2023 were obtained from the Department of Statistics Malaysia (DOSM). The proposed model decomposes the age-sensitivity parameter of the LC model into a Fourier series of three sinusoidal components with time-varying amplitude and phase parameters. This flexible structure reflects the presence of two splitting ages and three peak-age effects, enabling the model to capture multiple age-specific mortality patterns observed in the Malaysian population. Model performance for both the LC and LC−Fourier frameworks is evaluated using the Mean Absolute Percentage Error (MAPE) for fitted mortality rates and life expectancy at birth across male and female groups. Empirical results demonstrate that the two-split, three-peak LC−Fourier model achieves a superior fit and yields improved mortality projections compared with the baseline LC model, particularly at older ages. The enhancements are most notable for females. These findings highlight the model's ability to capture structural changes in age-dependent mortality patterns that are not adequately represented by the original LC model.

# sciforum-181393: Accounting for Temporal and Spatial Dependencies in Multi-Population Mortality Forecasts: The *Transformer* Approach

**Abiodun Jean-Luc Gouthon [1], Xavier Milhaud [1] and José Garrido [2]**

[1] Aix Marseille Univ, CNRS, I2M, Marseille, France, 3, Place Victor Hugo, 13331 Marseille, France
[2] Concordia University, Department of Mathematics and Statistics, 1455 De Maisonneuve Blvd W, Montreal, QC H3G 1M8, Canada

Mortality modelling has advanced significantly in recent years, partly thanks to the development of machine learning and data science. The introduction of the “transformer” model by Wang et al. (2024), highly effective in processing long sequences of information, has greatly improved the precision of mortality forecasts, at least in comparison to parametric mortality models such as Li and Lee or more recent benchmarks.

We propose an innovative approach that integrates the dependence between countries, in terms of mortality, directly into the transformer model. This involves constructing a similarity matrix that combines mortality data and exogenous variables that impact mortality, such as GDP or alcohol consumption, using the method proposed in Gouthon and Milhaud (2025). This matrix helps quantify the degree of similarity between countries, based on their mortality data and related covariates. The proposed Transformer architecture uses the encoder to process temporal dependence between series and the decoder to address inter-country dependence via the similarity matrix. Hence, the proposed model simultaneously captures the long-term temporal dependencies specific to each country and the structural correlations between them.

This new approach performs well in a comprehensive comparative study against classical benchmarks such as Li and Lee, and against more recent deep learning-based models such as the long short-term memory network, the convolutional neural network, or the basic transformer model.

# sciforum-178897: Bayesian Neural Networks for Robust Reserve Decisions under Lévy Mortality Shocks

**Antonio Nazzaro [1] and Paola Festa [2]**

[1] REPRISE – Register of Expert Peer Reviewers for Italian Scientific Evaluation, Ministry of University and Research (MUR), 00153 Rome, Italy
[2] Department of Mathematics and Applications "R. Caccioppoli" University of Naples Federico II, 80126 Naples, Italy

This paper addresses the critical decision-making problem of valuing life insurance reserves under extreme demographic uncertainty, such as pandemics, climate-induced shifts, and economic crises. We introduce a novel framework that integrates Bayesian deep learning with measure-theoretic actuarial science to overcome the limitations of classical models. By modeling financial and demographic risks through product measures ($\mu \otimes \nu$) and incorporating Lévy processes for mortality shocks, our approach captures the complex interaction between stochastic discounting and discontinuous demographic dynamics. The neural architecture, a stochastic multilayer perceptron with Bayesian Bernoulli dropout and Lévy-distributed noise injection ($\varepsilon \sim$ Levy(1.7)), ensures Radon-Nikodym compatibility via a measure-preserving neural operator, guaranteeing actuarial interpretability and decision robustness under Solvency II regulatory standards.

We validate the framework empirically using EIOPA mortality data across multiple stress scenarios, including a simulated COVID-19-style pandemic shock with tripled arrival rates. Results demonstrate significant improvements: a 63% reduction in mean absolute error (MAE) and a 77% decrease in Kullback–Leibler (KL) divergence compared to classical models. Under pandemic stress, our model achieves a 64% error reduction, requiring 22% less economic capital under the 99.5% Value-at-Risk (VaR) Solvency II requirement. Additionally, we integrate fairness metrics via Pearl's do-calculus, achieving a fairness score of $\varepsilon = 0.0031$—well below the EIOPA regulatory threshold (0.005)—with an adjusted average treatment effect (ATE) for gender of $-0.0031 \pm 0.0004$, eliminating demographic bias.

The framework offers a scalable, transparent, and ethically-aware solution for reserve modeling and decision-making in volatile demographic environments, with projected quantum-inspired complexity of $O(\sqrt{N})$ for large portfolios.

# sciforum-180786: Climate-Adjusted Ruin Under Finite Horizons: Extending the Cramér–Lundberg Model with Covariate-Dependent Claims

**Carlos Matos**

Faculty of Actuarial Science, Faculdades Metropolitanas Unidas (FMU), São Paulo, Brazil

**Introduction**

Climate change has intensified the frequency and severity of weather-related insurance losses, particularly in portfolios exposed to flood and hydrological risk. Classical ruin models generally assume stationary claim dynamics and therefore do not explicitly account for environmental drivers of risk. This study develops a Climate-Adjusted Ruin framework for non-life insurance in which claim frequency and claim severity are modeled as functions of exogenous climate covariates.

**Methods**

We consider a collective risk model and extend the classical Cramér–Lundberg framework by introducing climate-dependent claim frequency and severity components. The aggregate loss process is driven by a covariate-dependent counting distribution for claim arrivals and a conditional severity distribution linked to rainfall and temperature through regression-based specifications. The premium rate is fixed at the technical level calibrated under a baseline scenario, allowing an isolated assessment of the impact of climate deterioration on the insurer's surplus. Finite-horizon ruin probabilities are evaluated via Monte Carlo simulation under alternative climate stress scenarios. Additionally, we construct risk maps and climate-adjusted capital maps describing, respectively, the sensitivity of ruin probabilities and required initial capital to varying environmental conditions.

**Results**

The numerical analysis indicates that adverse climate conditions lead to simultaneous increases in expected claim frequency and loss severity, producing a nonlinear amplification of aggregate losses. This effect weakens surplus accumulation and results in a material increase in ruin probabilities over the planning horizon. The corresponding capital maps show a systematic upward shift in the minimum capital required to satisfy a fixed solvency target under joint precipitation–temperature stress scenarios.

**Conclusions**

These findings suggest that solvency assessments based on stationary assumptions may significantly underestimate ruin risk in climate-sensitive portfolios. The proposed framework provides an actuarially interpretable and operational approach for integrating environmental covariates into ruin theory, supporting enhanced stress testing, capital adequacy assessment, and climate-aware risk management.

# sciforum-182153: Dynamic EVT–Copula Models with Endogenous Linkage Between Extreme Losses and Dependence Structure

**Basavaraj Talawar and A S Talawar**

Department of Statistics, Karnatak University, Dharwad 580003, India

This paper proposes a novel dynamic extreme value theory (EVT)–Copula modelling framework with endogenous linkage to model systemic risk arising from extreme losses and evolving dependence structures. The marginal distributions of asset losses are modelled using a peak-over-threshold approach. Then, exceedances follow generalized Pareto distributions with time-varying parameters and adaptive thresholds to capture non-stationary tail behavior. The dependence structure is specified through copula modelling of non-linear and asymmetric tail dependence across multiple financial entities. The endogenizing of the dependence copula parameters evolves according to score-driven mechanism augmented by extreme loss feedback. Specifically, the dependence parameter is modelled as a function of past dependence, score information, and aggregated magnitudes. Its captures the co-evaluation between marginal extremes and systemic independence. The estimation is carried out using inference functions for margins and canonical maximum likelihood for copula parameters exposed the computational tractability and efficiency. The proposed modelling enables the computation of systemic risk measures including value at risk, expected shortfall, conditional value at risk, marginal expected shortfall, and tail dependence coefficients. The empirical and simulation analyses demonstrate that the model effectively captures contagion effects and dynamic tail risk. The model provides a robust tool for actuarial risk management and financial stability assessment under extreme conditions.

# sciforum-176908: Dynamic Principal Component Analysis for Syndemic Factors in an Extended Lee–Carter Mortality Model

**Maria Carannante [1], Valeria D'Amato [2], Steven Haberman [3] and Massimiliano Menzietti [4]**

[1] Department of Human Science, Link Campus University, 00165 Rome, Italy
[2] Memotef Department, Sapienza University of Rome, 00161 Rome, Italy
[3] Faculty of Actuarial Science and Insurance, Bayes Business School, City St. George's, University of London, London EC1Y 8TZ, UK
[4] Department of Economical and Statistical Sciences, University of Salerno, 84084 Fisciano, Italy

**Introduction**

The interaction between socioeconomic conditions, lifestyle factors, and mortality is a crucial issue for improving mortality modeling and forecasting. The traditional Lee–Carter family models capture long-term mortality dynamics through a latent time index but do not explicitly incorporate exogenous determinants. This study proposes an extension of the Lee–Carter framework that integrates a composite syndemic index derived from multiple socioeconomic and health-related variables. To address multicollinearity and preserve temporal dependence among covariates, a dynamic dimensionality-reduction approach based on Dynamic Principal Component Analysis (dPCA) is introduced.

**Methods**

Central mortality rates are modeled as a function of age-specific parameters, a latent mortality trend, and an additional exogenous component representing a syndemic index. Identification constraints ensure the uniqueness of the model parameters. A set of socioeconomic, behavioral, and healthcare indicators for Italy and its regions from 1995 to 2023 is used to determine the multidimensional index. Standard Principal Component Analysis (PCA) and dPCA are applied to reduce the dimensionality of the covariates. While PCA identifies latent factors based on variance maximization, dPCA explicitly accounts for temporal dependence by extracting orthogonal dynamic components from lagged data matrices.

**Results**

Exploratory analysis reveals a strong clustering of economic and health expenditure variables, with obesity and alcohol consumption associated with higher income levels, while smoking and hospital-based healthcare structures are linked to more traditional socioeconomic contexts. The dPCA-based specification further enhances the robustness of the index by preserving temporal relationships among variables.

**Conclusions**

Integrating a dynamically derived syndemic index into the Lee–Carter framework improves the representation of mortality dynamics by explicitly linking mortality trends to evolving socioeconomic and health environments. The dPCA approach offers a more robust method for dimensionality reduction, thanks to the preservation of the temporal structure, leading to more stable parameter estimations and a more in-depth interpretation of mortality drivers.

# sciforum-183843: GLM Solutions via Shrinkage

**Vali Asimit [1], Ziwei Chen [1], Oana Avramescu [2], Diego Rivas [2] and Claudio Senatore [2]**

[1] Bayes Business School, City St George's, University of London, London, UK
[2] SAS Institute, Cary, United States

Generalised Linear Models are a core tool for modelling non-normal data and are routinely fitted via the Iteratively Reweighted Least Squares algorithm. While this algorithm is computationally attractive, its performance can be hindered by convergence issues, sensitivity to starting values, and substantial estimation error. This paper develops a practical enhancement of the Iteratively Reweighted Least Squares algorithm by replacing the standard least squares step with Stein-type shrinkage estimators. These estimators reduce the theoretical mean squared error by introducing a controlled bias that leads to a significant variance reduction, without requiring cross-validation or increasing computational complexity. As a result, the proposed approach provides a scalable and efficient alternative to commonly used penalised generalised linear modelling. In addition, we propose an optimisation-based strategy for selecting starting values, which improves the stability and convergence of both standard and shrinkage-based Iteratively Reweighted Least Squares implementations. The paper is not primarily methodological; instead, it focuses on the practical deployment of generalised linear modelling. Extensive numerical experiments, covering a wide range of settings relevant to practitioners, together with real-data applications, demonstrate consistent improvements in accuracy, stability, and computational efficiency over the industry standard benchmarks.

# sciforum-155578: Impact of Hedging on the Cost of Capital Rate for Hybrid Life Insurance

**Oussama Belhouari, Pierre Devolder and Karim Barigou**

Institute of Statistics, Biostatistics and Actuarial Science, UCLouvain, Louvain-la-Neuve, Belgium

In the Solvency II framework for insurance, the cost of capital rate is a critical metric that encapsulates the cost of holding capital to meet regulatory solvency requirements, while also reflecting the investor's opportunity cost of capital allocation. It is therefore essential for insurers to rigorously justify the magnitude of this rate, particularly from the perspective of investors who perceive it as a required rate of return on capital. In the literature, they investigated the magnitude of this rate in the economic triangle of the policyholder, the shareholder, and the regulator. This paper seeks to extend that analysis by incorporating access to the financial market and focusing on hybrid life liabilities, which combine financial and mortality risks, thereby affording an asset-liability management perspective that insurers can employ to optimize business run-off. Furthermore, by incorporating partial hedging strategies, we show how hedging can affect both the numerator (i.e., the risk margin) and the denominator (i.e., the solvency capital requirement) of the cost of capital ratio. We focus precisely on when the hedging operation is considered effective. In particular, we demonstrate that, depending on its cost, effective hedging may not necessarily reduce the policyholder's risk margin. Our results provide insights into the practical limitations and regulatory implications of the cost of capital methodology in partially replicable environments.

# sciforum-175105: Optimal Stochastic Control of Pension Asset Sustainability for Ghana's Basic National Social Security Scheme

**Dominic Owusu Abeyie and Gabriel Asare Okyere**

Department of Statistics and Actuarial Science, Kwame Nkrumah University of Science and Technology, PMB, Ghana

Ghana's Basic National Social Security Scheme (Tier 1), managed by the Social Security and National Insurance Trust (SSNIT), faces sustainability challenges due to shifting pension demographics and macro-financial volatility. Using optimal control theory, our paper formulates a continuous-time stochastic control problem for a social planner (SSNIT) to determine optimal policies of investment and benefit indexation that maximize discounted expected utility of aggregate retiree benefits over a finite horizon, subject to ruin probability constraint with a solvency floor. The dynamics of the pension fund's asset under management combine risky and risk-free investment returns with stochastic net cashflows driven by a CEV salary process and deterministic contributor and retiree population flows. Using the principle of dynamic programming (Bellman's optimality condition), we derive the associated Hamilton–Jacobi–Bellman PDE and obtain feedback characterizations of the optimal portfolio and indexation policies under Karush–Kuhn–Tucker (KKT) control bounds. We couple the optimal feedback policy with a backward Kolmogorov survival probability to enforce the chance constraint. The numerical results, calibrated using the trustee's (SSNIT) data and Ghana's financial market inputs over a 30-year planning horizon, yielded an optimal asset allocation mix of 19.5% equity exposure and 9.9% benefit indexation at 96.7% survival probability for sustainability. The results further show that a 0.5% increase in the contribution rate as a policy modification doubles benefit adequacy at 10% equity exposure and 15% benefit indexation with 99% sustainability. Similarly, a 1% increase in contribution rate yielded no additional adequacy gains beyond the 0.5% increment but improved survival probability to 99.9%. These findings suggest that modest, targeted contribution-rate adjustments combined with disciplined asset allocation provide a quantitatively superior pathway to restoring long-term sustainability without sacrificing intergenerational benefit adequacy.

# sciforum-176680: Period vs. Cohort Longevity: SRE-Based Forecasts for Fair Pensions

**Ivan Gallo [1], Giovanna Bimonte [2] and Maria Russolillo [2]**

[1] DICAM, Alma MaterSstudiorum- University of Bologna, Bologna, Italy
[2] DISES-University of Salerno, Fisciano, Italy

Longevity risk represents a structural source of uncertainty for modern pension systems and longevity-linked financial arrangements. Under persistent mortality improvements, period life expectancy evaluated at retirement age systematically understates the effective lifetime of real cohorts, generating a wedge between period and cohort measures. The magnitude and dynamics of this Life Expectancy Gap (LEG) depend critically on how future mortality rates are projected, since cohort life expectancy aggregates mortality along the diagonal of the Lexis surface and is therefore inherently forward-looking.

This paper investigates how model uncertainty and forecast combination design affect the measurement of cohort-based longevity indicators and the implied intergenerational transfers embedded in pension rules. Rather than proposing a new structural mortality specification, we focus on the aggregation layer within the class of generalized age–period–cohort (GAPC) mortality models. We implement a horizon-specific stacked regression ensemble (SRE), where combination weights are estimated via blocked time-series cross-validation and allowed to vary across forecasting horizons. This approach explicitly targets multi-step predictive risk and accounts for the instability of model performance across horizons.

To interpret the sources of predictive gains, we introduce a cooperative game–theoretic attribution based on the Shapley value. For each forecasting horizon, Shapley values provide an axiomatically grounded decomposition of out-of-sample risk reduction relative to an equal-weight benchmark, linking ensemble weights to the marginal informational contribution of each mortality specification.

Using Italian mortality data from the Human Mortality Database for ages 60–100 over 1960–2022, we construct extended mortality surfaces to compute period and cohort life expectancy at retirement age and the associated longevity gap. Results show that while a positive cohort–period wedge is robust across aggregation schemes, its magnitude and long-run dynamics differ materially between horizon-adaptive stacking and static forecast averaging, implying non-trivial consequences for the measurement of intergenerational transfers and actuarial fairness in pension systems.

# sciforum-172249: Postcode-Level Longevity Risk Heterogeneity in the UK: Implications for Pension Buyouts and Annuity Pricing

**Luba Orlovsky**

Earnix, London, United Kingdom

**Introduction**

The UK pension buyout market exceeded £50 billion in 2024, yet current industry mortality tables (S3PA, SAPS) aggregate data at the postcode sector level, potentially masking significant within-sector heterogeneity. Building on the Renshaw–Haberman cohort mortality framework, this work-in-progress examines whether finer postal district granularity (average 2,500 residents vs. 7,000 for sectors) improves longevity risk assessment and pricing accuracy in bulk annuity transactions.

**Methods**

We analyze ONS mortality data (2015-2023) across UK postal districts, linked to Index of Multiple Deprivation scores and geodemographic classifications. Using Lee–Carter models with geographic random effects and stratified Cox proportional hazards with frailty terms, we quantify life expectancy differentials controlling for socioeconomic factors, with validation against recent mortality experience. We apply postal district mortality rates to representative defined benefit pension scheme portfolios, comparing reserve adequacy against S3PA baseline assumptions through Monte Carlo simulation under various geographic concentration scenarios.

**Results**

Preliminary findings indicate substantial life expectancy variation across postal districts, exceeding current sector-level adjustments in industry tables. Geographic concentration of scheme membership appears to drive material pricing divergence from standard assumptions, with implications varying by deprivation profile and regional mortality patterns. Both positive and negative pricing adjustments emerge depending on membership characteristics. Results demonstrate robustness across alternative deprivation indices and sensitivity analyses on mortality improvement assumptions. Statistical significance testing and quantification of financial impacts are ongoing.

**Conclusions**

Postal district granularity shows promise for materially improving bulk annuity pricing accuracy, directly addressing FCA fair value assessment requirements. The transparent methodology using publicly available ONS data offers insurers enhanced risk selection capabilities while providing pension trustees with tools for better membership longevity profiling. This approach is generalizable to other countries with fine-grained mortality statistics and supports enhanced regulatory capital modeling under Solvency II. We will present completed quantitative findings and practical implementation frameworks at the conference.

# sciforum-176212: Serial Risk Sharing

**Tim J. Boonen and Ka Long Chiu**

Department of Statistics and Actuarial Science, School of Computing and Data Science, The University of Hong Kong, Hong Kong, China

**Introduction**

This work introduces a novel risk-sharing rule called serial risk sharing (SRS), inspired by the serial cost-sharing method of Moulin and Shenker (1992, *Econometrica 60*(5), 1009–1037). Using a serial mechanism, which involves a quantile-based decomposition of initial losses, and a uniform allocation of the resulting components to the relevant agents, we develop an equitable and intuitive risk allocation tailored for heterogeneous losses, serving as a computationally efficient alternative to other risk-sharing rules like conditional mean risk sharing (CMRS) due to the availability of a closed-form formula. In addition to numerical illustrations, the analytical properties of SRS are shown to consolidate its theoretical foundation.

**Methods**

The quantile-based decomposition of losses is constructed via a novel concept of quantile equivalent loss, defined via the probability levels of agents' initial losses. By probability and quantile transformations, the distributional properties of the resulting components remain tractable, enabling theoretical analysis of the behavior of SRS. Particularly, when the losses are ordered by first-order stochastic dominance, substantial simplification of the rule is available, further facilitating the analysis of the rule and improving its transparency.

**Results**

Various theoretical properties of SRS are shown, such as actuarial fairness, full allocation, scale invariance, monotonicity, risk fairness, and convex-order improvement, under suitable assumptions. Additionally, through numerical studies, we demonstrate that SRS exhibits good properties and performs well relative to other risk-sharing rules. The numerical results also reinforce our theoretical findings.

**Conclusions**

By adapting the serial cost-sharing method put forward by Moulin and Shenker (1992) to the risk-sharing context, we design a novel risk-sharing rule known as serial risk sharing, where losses are decomposed into components based on quantiles. It carries a clear and interpretable structure, with favorable theoretical properties and supportive numerical results.

# sciforum-161946: Starting Off on the Wrong Foot: Pitfalls in Data Preparation

**Jiayi Guo, Panyi Dong and Zhiyu Quan**

Actuarial and Risk Management Sciences, University of Illinois Urbana-Champaign, 1409 W. Green Street (MC-382), Urbana, IL 61801, USA

In applied insurance data science, practitioners routinely face critical challenges during the data preparation stage that can undermine the statistical validity and reliability of subsequent actuarial modeling. This study addresses a fundamental issue: demonstrating that conventional data preparation procedures, particularly random train–test partitioning, often yield unreliable and unstable results when confronted with highly imbalanced insurance loss data. Such naive splitting fails to maintain representativeness, especially of rare high-loss events, compromising the validity of model evaluation. To mitigate these limitations and establish a foundation for more robust modeling, we propose a novel data preparation framework leveraging two recent statistical advancements. First, we employ Support Points to achieve data splitting that is demonstrably more representative of the underlying data distribution than simple random sampling. Second, we utilize the Chatterjee Correlation Coefficient for an initial, non-parametric screening of feature relevance and dependence structure. We integrate these theoretical methods into a unified, efficient framework that also incorporates advanced handling of missing data, and we further embed the framework within our custom InsurAutoML\footnote{ \href{https://github.com/PanyiDong/InsurAutoML}{https://github.com/PanyiDong/InsurAutoML}.} pipeline. The performance of this proposed approach is rigorously evaluated using both simulated datasets and datasets often cited in the academic literature. The empirical assessment focuses on quantifying the gains in computational efficiency and model stability—key concerns in industry-scale workflows. Our findings definitively demonstrate that incorporating statistically rigorous data preparation methods not only significantly enhances model robustness and interpretability but also substantially reduces computational resource requirements across diverse insurance loss modeling tasks. This work provides a crucial methodological upgrade for achieving reliable results in high-stakes insurance applications.

# Session 3. Financial Risk Management

# sciforum-176933: Decentralized Finance (DeFi) and Anti-Money Laundering: Challenges and Risk Management Strategies

**Marta Spyra [1] and Łukasz Spyra [2]**

[1] Department of Finance, Warsaw University of Life Sciences (SGGW), Warsaw, Poland
[2] Extramural Mode, Warsaw School of Economics, Warsaw, Poland

Anti-Money Laundering (AML) and regulatory compliance are critical components of financial risk management, aimed at preventing financial crimes such as money laundering, fraud, and terrorist financing. The rapid emergence of Decentralized Finance (DeFi) introduces new challenges for AML due to its pseudonymous, borderless, and intermediary-free nature. Traditional monitoring and compliance mechanisms are often insufficient to detect illicit activity in decentralized networks, creating potential vulnerabilities for financial institutions and regulators.

This paper examines AML risks in the context of DeFi, with a focus on staking and other decentralized financial services. DeFi platforms utilize smart contracts and decentralized applications (Dapps) to provide lending, trading, and investment opportunities without central intermediaries. While these systems offer transparency and innovative financial models, they also complicate transaction monitoring, identity verification, and regulatory oversight. Different staking methods, including on-chain staking, liquid staking, and exchange-based staking, illustrate both the operational opportunities and compliance challenges within DeFi networks.

The paper further discusses risk mitigation strategies, including enhanced due diligence, transaction monitoring tools, and integration of regulatory frameworks tailored to decentralized systems. By bridging AML practices with emerging DeFi technologies, this study highlights approaches to ensure financial integrity while leveraging the benefits of decentralized finance.

# sciforum-180294: It Moves in Mysterious Ways! Analysis of Contagion Risk Dynamics Using Asymmetric Dependence Measures Within a Wavelet-Copula-Based Framework

**Thiago Dutra de Araújo and João Vinícius de França Carvalho**

School of Economics, Business, Accounting and Actuarial Science, University of São Paulo, São Paulo, Brazil

Contagion risk refers to the propagation of shocks originating in a specific economic sector (or country) to other sectors or regions. During periods of crisis, this risk tends to intensify, such that a localized adverse event can generate significant losses throughout the system. Traditionally, contagion has been measured through intersectoral dependence, usually assessed using correlations. However, although correlations capture the intensity of dependence, they present important limitations, particularly their symmetry, which prevents the identification of contagion direction. To overcome these limitations, this study proposes a robust approach to identify and measure contagion risk by combining asymmetric dependence measures, causal inference via vine copulas, and wavelet coherence analysis. This combination allows for the following: (i) capturing nonlinear coherences through the flexibility of vine copulas; (ii) incorporating causal and temporal relationships into contagion dynamics; (iii) measuring contagion intensity while removing dependence symmetry; and (iv) analyzing contagion direction across multiple time scales. The methodology was applied to intraday data from various segments of the U.S. economy between 2005 and 2025, focusing on the interactions between the banking and insurance sectors, which are central to the propagation of financial shocks. The results indicate that the banking sector tends to transmit long-term shocks to the insurance sector during crises, whereas in stable periods, both sectors jointly absorb shocks from other parts of the system. In the short term, both sectors respond to shocks originating in areas directly associated with the epicenters of crises, such as the real estate sector during the subprime crisis and the pharmaceutical sector during the COVID-19 pandemic.

# sciforum-176896: Life Expectancy as a Driver of Pension Fund Equity Allocation: Evidence from Cross-Country Data

**Serena Gallo, Rosa Cocozza and Domenico Curcio**

Department of Economics, Management, Institutions; University of Naples Federico II; Naples (IT); 80126 Napoli; Italy

Rising life expectancy is reshaping retirement systems and may have important implications for pension funds' long-term investment strategies. While traditional life-cycle models predict a gradual reduction in equity exposure as plan members age, rising life expectancy may instead extend investment horizons and increase the resources required to finance retirement consumption. As individuals live longer and spend more years in retirement, pension funds may face stronger incentives to seek higher long-term returns in order to sustain future pension liabilities. This paper explores the relationship between longevity and pension funds' asset allocation, focusing on the share of financial assets invested in equities. Using cross-country data for a sample of OECD countries, we examine whether improvements in life expectancy are associated with changes in pension funds' investment behavior. The analysis also considers the role of demographic dynamics, macroeconomic conditions, and differences in financial systems in shaping this relationship. Our findings suggest that longevity trends may influence pension funds' willingness to allocate a larger share of their portfolios to return-seeking assets. At the same time, the strength of this relationship appears to depend on institutional features and market conditions, highlighting the importance of the broader financial environment in shaping long-term investment strategies. Overall, the study contributes to the growing debate on how demographic change affects institutional investors and long-term capital allocation. The results also provide relevant insights for pension system design and regulatory frameworks, as well as for policies aimed at supporting long-horizon investment and capital market development.

# sciforum-183325: Local Panic or Global Attention? Filtered Internet Searches and Tel Aviv Stock Exchange Performance during the Israel–Hamas War

**Papanikolaou Nikolaos and Vasileiou Evangelos**

Department of Accounting and Finance, Hellenic Mediterranean University, Heraklion, Crete, Greece

This study investigates how conflict-related public attention, measured through Google Trends search data, shaped equity market dynamics in Israel during the 2023–2025 Israel–Hamas war. Search activity is disaggregated along two dimensions, the language of the query (English vs. Hebrew) and the geographic origin of the search (worldwide vs. domestic), producing eight attention indicators constructed from the terms "War in Israel" and "Hamas". The analysis employs an EGARCH(1,1) framework to capture asymmetric volatility responses and Granger causality tests to assess the predictive content of search-based attention at varying time horizons. The results reveal a clear linguistic asymmetry in how conflict-related information reaches asset prices. Hebrew-language searches exert a statistically significant negative contemporaneous effect on TA-35 returns, consistent with the rapid pricing of localized anxiety among domestic investors. English-language searches, by contrast, produce no significant same-week market response but carry robust predictive power at a two-week horizon, particularly domestic English searches for "War in Israel", which reject the null hypothesis of no Granger causality at the 1% level. In every specification, causality runs strictly from public attention to market returns, with no evidence of the reverse. A robustness check based on PCA-derived composite indices confirms both findings: the contemporaneous Hebrew war-specific effect and the lagged English predictive effect survive the compression of each linguistic channel into a single index. These findings suggest that the same conflict generates two distinct information transmission paths, one fast and local, driven by immediate threat perception, and one slow and global, reflecting the gradual accumulation of geopolitical awareness among internationally oriented investors. The results highlight that what moves markets during geopolitical crises is not simply the volume of public attention, but its linguistic and geographic origin.

# sciforum-181963: A Normalizing Flow Approach in Portfolio Optimization with NTS Model with Volatility Clustering

**Aaron Young Shin Kim [1] and Jeongyeon Park [2]**

[1] College of Business, Stony Brook University, New York, USA
[2] Applied Mathematics and Statistics, Stony Brook University, New York, USA

We propose a novel portfolio optimization framework that integrates linear factor modeling, non-Gaussian innovations, and generative artificial intelligence to construct portfolios with superior risk-return trade-offs. The success of portfolio optimization critically depends on accurately capturing the joint dependence structure among asset returns. However, traditional covariance measures fail to describe asymmetric tail dependence, and widely used parametric copulas are often too restrictive for complex financial regimes. To overcome these limitations, we introduce a generative framework utilizing Real NVP, a subclass of normalizing flows, to flexibly learn and represent complex dependence structures among latent financial factors. Our approach builds on the tradition of CAPM and Fama–French models but departs by extracting factors statistically via Principal Component Analysis (PCA). Each factor is filtered through ARMA-GARCH dynamics, with residuals modeled using the Normal Tempered Stable (NTS) distribution to account for fat tails and asymmetry. Empirical results from a 10-year backtest (2015–2024) demonstrate that our NTS-MLCopula method achieves superior statistical fidelity, evidenced by a lower Maximum Mean Discrepancy (MMD) as a non-parametric metric for goodness-of-fit compared to traditional multivariate models. Furthermore, the framework consistently produces portfolios with enhanced Conditional Value at Risk (CVaR) protection and higher Sharpe ratios, proving its robustness in mitigating extreme tail risks during catastrophic market events.

# sciforum-176993: Beyond the Hype: Dynamic Connectedness and Portfolio Implications of ReFi and AI Tokens with Energy Markets and Uncertainty Indices

**Khadija Hafdhi, Asma Abdallah and Ahmed Ghorbel**

Department of Quantitative Methods, University of Sfax, Sfax 3018, Tunisia

This paper investigates dynamic connectedness between emerging digital assets, Regenerative Finance (ReFi) and AI tokens, and energy markets from 2021 to 2025. Utilizing a DCC-GARCH model with $R^2$ decomposition, we analyze time-varying shock transmission among these assets, renewable energy, fossil fuels, and key fear indices (VIX, OVX, GVIZ). This framework captures evolving interdependencies and volatility spillovers across traditional and digital financial ecosystems, providing a comprehensive understanding of cross-market linkages during a period characterized by significant technological advancement and energy transition dynamics.

Our results reveal that ReFi and AI tokens consistently act as net transmitters of volatility shocks to energy markets, with transmission intensity increasing markedly during geopolitical crises and periods of macroeconomic uncertainty. This finding challenges conventional assumptions about digital assets as isolated speculative vehicles and underscores their growing systemic importance. Conversely, fossil fuels remain net receivers throughout the sample period, suggesting their susceptibility to external shocks originating from digital and renewable energy sectors. The total connectedness index surges significantly during market stress, substantially eroding traditional portfolio diversification benefits and highlighting the limitations of conventional risk management frameworks in contemporary financial markets.

Comparative portfolio analysis demonstrates that minimum variance strategies consistently outperform both naive and correlation-based approaches in turbulent market conditions, offering superior capital preservation and enhanced risk-adjusted returns for investors. These findings provide critical insights for institutional investors, portfolio managers, and policymakers navigating the complex intersection of digital finance, technological innovation, and the ongoing energy transition. Understanding these dynamic relationships enables more effective hedging strategies, improved asset allocation decisions, and better regulatory frameworks in an increasingly interconnected financial landscape where digital and traditional assets increasingly coexist and interact.

# sciforum-182030: On Minimization of Shortfall Risk in Tradable and Non-Tradable Assets

**Alexander Melnikov and Natavan Safikhanova**

Mathematics and Statistical Sciences Department, Faculty of Science, University of Alberta, Edmonton, Canada

This work studies the problem of shortfall risk minimization in incomplete financial markets where the payoff of a contingent claim depends on a non-tradable asset. The trading is allowed only in a correlated tradable asset. This setting naturally leads to market incompleteness and makes perfect hedging impossible.

We study the problem in a continuous-time Brownian framework under different informational structures. First, we consider the case where the non-tradable asset is fully observable. In this setting, the optimal trading strategy is derived using stochastic calculus techniques, including Itô's formula and a change of probability measure. The resulting strategy incorporates a term depending on the market price of risk and a term reflecting the dependence of the payoff on the non-tradable asset.

Second, we study the case where the non-tradable asset is unobservable until the terminal time. Thus, the problem is reformulated by conditioning on the hidden factor. As a result, an optimal strategy is expressed in terms of conditional expectations with respect to this hidden factor. The conclusions demonstrate the impact of information availability on hedging performance.

The approach is further extended to a mixed model driven by both Brownian motion and fractional Brownian motion, with the Hurst parameter $H>3/4$, ensuring that the model remains within the semi-martingale framework.

# sciforum-176551: Analysis of a Long-Memory Garch-Type Model of Stock Returns and Their Risk Measures

**Modisane Seitshiro**

Centre for Business Mathematics and Informatics, North-West University, Potchefstroom 2531, South Africa

The purpose of this article is to investigate whether considering stylized facts in financial time series leads to better estimation of risk measures. This study focuses on long-memory GARCH-type models chosen for their ability to capture characteristics of financial time series like long memory and volatility clustering. There are periods of high and low volatility in financial markets. One of the most important ways to reduce risk is to use a time-series model to manage market risk. In comparison to long-memory GARCH-type models, such as fractionally integrated generalised autoregressive conditional heteroskedasticity and hyperbolic generalised autoregressive conditional heteroskedasticity, this research study aims to determine how effective the fractionally integrated asymmetric power autoregressive conditional heteroskedasticity is at producing competitive risk measures. The stock returns are assumed to follow a family of extreme parametric distributions in long-memory GARCH-type models. The historical closing price time series for both short and long trading positions on the various confidence levels correspond to the left and right quantiles of the return distributions, respectively. The findings show that FIAPARCH with Student's-t distribution has a high chance of becoming a suitable model for generating reliable risk measures. However, FIGARCH fits the data well to generate risk measures when using the presumptive skewed Student's-t distribution model.

# sciforum-176080: Assessing Spatial Risk Dependence in Temperature Portfolios: A Spatially Continuous Neural Network Framework

**Stefania Corsaro [1], Vincenzo Di Sauro [2], Zelda Marino [1] and Salvatore Scognamiglio [1]**

[1] Department of Management and Quantitative Studies, Parthenope University of Naples, Naples, Italy
[2] Department of Economics and Legal Studies, Parthenope University of Naples, Naples, Italy

The increasing frequency of anomalous climatic events exposes energy utilities to significant volumetric risk, particularly through revenue shortfalls during mild winters. To hedge this exposure, firms rely on Over-the-Counter weather derivatives, such as Heating Degree Day (HDD) options, structured as weighted spatial baskets that reflect distributed customer loads. Pricing and risk-managing these multi-site contracts remains challenging due to spatial dependence structures in temperature dynamics. Existing pricing frameworks fall into two categories. First, modelling each geographical location independently ignores the spatial correlation of weather phenomena. This creates a false sense of portfolio diversification, cancelling out local shocks and underestimating portfolio risk. Second, to manage spatial dependence, the literature relies on linear techniques driven by empirical covariance matrices. While mathematically convenient, these linear transformations struggle to capture asymmetric tail dependencies and climatic extremes, implying theoretical hedging baskets that are untradable in illiquid weather markets. These frameworks are bound to discrete meteorological stations or fixed grids, inducing basis risk when evaluating portfolios tied to off-grid locations, highlighting an unmet need for continuous spatial representations. To address these limitations, we propose a neural network framework designed to price temperature derivatives under interdependent risks. Our network architecture performs non-linear dimensionality reduction, compressing the high-dimensional field into latent risk factors. By utilising a continuous spatial approach, we map these latent factors to any geographic coordinate, solving the spatial discretisation problem. This design preserves explainability essential for risk management, while capturing asymmetric spatial interactions and tail dependencies that linear covariance models miss. Empirical analysis on NASA MERRA-2 temperature data demonstrates that our interpretable approach captures spatial risk dependence more accurately than linear models. This leads to improved pricing stability, reliable portfolio Value-at-Risk estimates, and hedging performance for multi-site HDD options, highlighting the critical role of explainable non-linear spatial modelling in climate-related financial risk.

# sciforum-168230: Bank Credit Risk and Macroeconomic Performance: Evidence from Sub-Saharan Africa

**Elfy Deba Bangagnan Yanga**

Faculty of economics science, Marien Ngouabi University, Brazzaville 69, Republic of Congo

This study explores the relationship between macroeconomic performance and bank credit risk across Sub-Saharan Africa (SSA), a region where financial institutions operate amid persistent structural vulnerabilities, limited diversification, and exposure to both domestic and global shocks. While substantial research has analyzed how macroeconomic instability impacts credit risk in advanced and emerging markets (Beck et al., 2013; Louzis et al., 2012), empirical evidence from SSA remains fragmented, often lacking region-specific modeling that captures institutional weaknesses and external dependencies.

The central research question asks the following: To what extent do macroeconomic variables such as inflation, GDP growth, exchange rate volatility, and fiscal balance affect non-performing loan (NPL) ratios across SSA banking systems? The study hypothesizes that poor macroeconomic performance exacerbates credit risk, with more severe effects observed in low-income countries where monetary policy tools and supervisory mechanisms are weaker (Khemraj & Pasha, 2009; Nkusu, 2011).

Using a panel dataset from 25 SSA countries between 2005 and 2023, the study applies a system GMM estimator to address endogeneity and cross-country heterogeneity. Additional controls include institutional quality, regulatory strength, and bank-specific indicators.

Findings are expected to generate actionable insights for regional central banks and financial regulators, helping to design macroprudential tools suited to SSA economies. The paper contributes to the growing literature on financial stability by emphasizing the role of macroeconomic context in shaping bank risk across structurally diverse low- and middle-income countries.

# sciforum-176816: Bubbles, Crashes and Contagion: Evidence on Volatility Forecasting in Cryptocurrencies and Stablecoins

**Andrea Montanino [1] and Giovanni De Luca [2]**

[1] Economics, Statistics and Sustainability, University of Naples Parthenope, 80132 Naples, Italy
[2] Department of Management and Quantitative Studies, University of Naples Parthenope, 80132 Naples, Italy

Extreme price episodes such as bubbles and crashes are pervasive in cryptocurrency markets. While a growing body of literature has examined these phenomena in major cryptocurrencies, relatively few studies have investigated their presence and implications for stablecoins, whose prices are designed to maintain a relatively stable value compared to other cryptocurrencies. Moreover, the role of extreme events in volatility modeling and their spillover effects across digital assets remain relatively underexplored. To address this gap, this study employs the Bubble Crash-GARCH (BC-GARCH) model, which allows us to explicitly incorporate extreme price events into volatility modeling through the Phillips, Shi, and Yu (PSY) test. The detected bubble and crash episodes are included as dummy variables in the conditional mean equation of returns. The empirical analysis considers major cryptocurrencies such as Bitcoin and Ethereum together with the stablecoin Tether, and is conducted under several GARCH-type volatility specifications. Contagion effects are also investigated by incorporating Bitcoin bubble and crash signals into the volatility models of other digital assets. The BC-GARCH specification reduces the latent component of the data generating process and enhances volatility forecast accuracy relative to standard GARCH benchmarks. Moreover, extreme events in Bitcoin provide informative signals for the volatility dynamics of other cryptocurrencies.

# sciforum-172938: Change-Point Detection in Volatility of Stock Indices Based on Asymptotic and Finite-Sample Distributions of Empirical Relative Entropy

**Matthieu Garcin [1] and Louis Perot [2]**

[1] ESILV, De Vinci Higher Education, 92000 Nanterre, France
[2] Department of Applied Mathematics, Ecole Normale Supérieure, 75005 Paris, France

Relative entropy, as a divergence metric between two distributions, can be used for offline change-point detection and extends classical methods that mainly rely on moment-based discrepancies. To build a statistical test suitable for this context, we study the distribution of empirical relative entropy and derive several types of approximations: concentration inequalities for finite samples, asymptotic distributions, and Berry--Esseen bounds in a pre-asymptotic regime. For the latter, we introduce a new approach to obtain Berry--Esseen inequalities for nonlinear functions of sum statistics under some convexity assumptions. Our theoretical contributions cover both one- and two-sample empirical relative entropies. We then detail a change-point detection procedure built on relative entropy and compare it, through extensive simulations, with classical methods based on moments or on information criteria. In particular, we show that our method has a high power for many types of change-points. Finally, we illustrate the practical relevance of our method on a real dataset involving time series of volatility of stock indices, namely several realized volatility series as well as the VIX. In this application, we define the change-point as a modification of the multivariate distribution of successive increments of volatility. Therefore, every detection of a change-point highlights a modification of the serial dependence of volatility and thus a modification of the way people should predict this risk measure.

# sciforum-181603: Corporate Social Disclosure, Ownership Concentration, and Firm Risk: Evidence from Saudi Arabia

**Ilyes Charchafa and Salaheddine Boulares**

Department of Finance and Accounting, Ferhat Abbas Sétif 1 University, Setif 19000, Algeria

**Introduction**

Growing scholarly interest in the governance–risk nexus has yet to produce consensus on whether voluntary social disclosure meaningfully reduces firm-level risk, particularly in emerging markets where ownership structures differ markedly from Western contexts. This study examines whether corporate social disclosure reduces firm risk in Saudi Arabia and whether concentrated ownership moderates this relationship.

**Methods**

Using a balanced panel of 86 non-financial firms listed on the Tadawul over 2019–2024 (N = 516 firm-year observations), we constructed a 48-item Social Disclosure Index hand-collected from annual reports and aligned with GRI standards and Saudi CMA guidelines. Firm risk was captured through annualised stock return volatility, systematic risk (beta), and idiosyncratic volatility. Fixed-effects regressions with cluster-robust standard errors address within-firm heterogeneity, while Two-Step System GMM estimation accounts for potential endogeneity of disclosure decisions.

**Results**

Greater social disclosure is associated with significantly lower total and idiosyncratic risk, with weaker but directionally consistent effects on systematic risk. Ownership concentration attenuates this risk-reducing benefit: the interaction between disclosure and block-holding is positive and significant, and the disclosure effect becomes statistically indistinguishable from zero only at approximately 93% ownership concentration. Subsample analyses show that the disclosure–risk association is substantially stronger among firms with below-median ownership concentration.

**Conclusions**

The findings demonstrate that the risk-reduction benefits of corporate social disclosure are conditional on ownership structure. In highly concentrated environments, disclosure becomes less effective, providing evidence that transparency outcomes are fundamentally governance-contingent in emerging markets.

# sciforum-176928: Directional Predictability of Financial Instability Under Climate Transition Scenarios

**Arief Rahman Hakim [1], Atina Ahdika [2], Daniel Wei-Chung Miao [3] and Agus Widarjono [4]**

[1] Research Center for Computing, National Research and Innovation Agency (BRIN), Cibinong, Bogor 16911, Indonesia
[2] Department of Statistics, Universitas Islam Indonesia, Yogyakarta 55584, Indonesia
[3] Graduate Institute of Finance, National Taiwan University of Science and Technology, Taipei 106, Taiwan
[4] Department of Economics, Universitas Islam Indonesia, Yogyakarta 55584, Indonesia

Global warming and climate change have become critical issues for all countries, prompting them to transition from brown (fossil) energy resources to green (clean) energy resources with the aim of achieving a low-carbon economy. However, if financial actors cannot fully anticipate changes in climate policies and regulations, then this situation can trigger climate transition risk. Under certain climate transition scenarios, this new type of financial risk implies a downturn or an upturn in both brown and green stock markets, thereby potentially leading to financial instability in a country.

In this study, we aim to examine whether financial instability is directionally predictable under certain market scenarios related to climate transitions. Financial instability is reflected by a low value of so-called financial stability index (FSI), constructed by integrating financial stability proxies, such as interest rates, exchange rates, yield curves, inflation, and money supply. The FSI construction is carried out using nonlinear principal component analysis (PCA) through some kernel functions. The directional predictability of financial instability is assessed across some quantile levels under climate transition scenarios by proposing some modified versions of the cross-quantilogram. Using data for some selected Asian countries, we reveal significantly positive directional predictability effects, particularly in developed countries.

# sciforum-181826: Evaluating Dynamic Hedging Strategies for American Options in Markets with Jumps

**Shima Jalili and Patrice Gaillardetz**

Mathematics and Statistics, Concordia University, Montreal, Canada

This study investigates and compares dynamic hedging strategies for American put options in financial markets governed by jump diffusion dynamics. Since closed-form continuous-time hedging solutions are generally unavailable in this setting, we approximate the underlying continuous-time models by using a discrete-time lattice framework. By focusing on the challenges posed by continuous-time hedging, we utilize a discrete-time and discrete-outcome stochastic framework with backward dynamic programming to optimize hedging under jump risk. The strategies include global quadratic hedging, local risk minimization, and Delta-Gamma hedging. We also examine an internal exercise specification in which the exercise decision is linked to the current hedging portfolio value, and compare it with the standard externally imposed exercise rule. Through numerical experiments, we compare the hedging error distributions across these methodologies, particularly highlighting how the inclusion of jump risk affects hedging outcomes. Moreover, we investigate and compare the Kou and Merton jump-diffusion models calibrated to S$\&$P 500 and Bitcoin (BTC) data. Our results indicate that while all strategies effectively manage standard market risks, local risk minimization offers superior performance in extreme market conditions. Additionally, incorporating a third hedging asset does not lead to a consistent improvement in the performance of the global hedging strategy. Although the additional option enlarges the hedge set and may reduce the required initial investment, it does not deliver a robust reduction in tail-risk measures under the jump diffusion setting considered here.

# sciforum-182158: Implicit Autocorrelation Diversification in Mean Reverting Processes

**Giacomo Maugeri [1] and Simon Margetts [2]**

[1] Independent Researcher - FIA & CERA, Chur 7000, Switzerland
[2] Financial Modeling Product Management team, Moody's RMS, St Dennis PL26 8BS, Great Britain

**Introduction**

Since the Morris review (2004) in the UK, and the MAAA/SOA/CAS ESGs towards the turn of the century, mean-reverting stochastic processes have been widely used to model inflation, interest rates, and other macroeconomic risk drivers in actuarial cashflow projections and financial risk models. In most practical implementations, autocorrelation is seldomly looked at and assumed to be flat. However, this is only asymptotically valid and can conceal a transient implicit diversification effect at finite horizons.

**Methods**

Looking at the class of mean-reverting diffusions based on Ornstein–Uhlenbeck specification (Vasicek, CIR, Hull–White), where finite-horizon lag-Δ autocorrelation is available in closed form, this paper aims to prove monotonic convergence to the stationary limit and analyze sensitivity to mean-reversion speed and horizon length. For practical materiality, Monte Carlo experiments across parameter grids for mean reversion and volatility on two representative use cases have been designed: inflation-linked liability cashflows and interest-rate-driven discounting distributions, comparing simulations with two stationary-imposition implementations (assuming a deterministic start different from the reverted mean): (i) empirical copula reordering of existing simulated paths and (ii) recursive reconstruction with a fixed flat-$\rho$ target

**Results**

Across mean-reverting specifications, finite-horizon autocorrelation exhibits a pre-stationary term structure that converges to the long-run lag structure. In the Ornstein–Uhlenbeck benchmark with $\kappa>0$, the finite-horizon autocorrelation is increasing in t, and is independent of the initial level and reversion direction. Relative to stationary assumptions, early-horizon paths display weaker serial dependence and therefore stronger implicit diversification, leading to potentially material differences in aggregate variance and tail-risk metrics, especially for slow mean reversion and short-to-medium horizons.

**Conclusions**

Pre-stationary autocorrelation should be treated as an explicit modelling assumption in mean-reverting models. For deterministic starts, practical stationary-imposition overlays described before are shown and benchmarked against the baseline. This framework makes diversification effects measurable and provides a practical decision toolkit for model developers and validators.

# sciforum-182122: Measuring Investors' Sensitivity to Systemic Financial Risks: Development and Validation of a Rigorous Assessment Scale

**Zhibin Tao**

Department of Accountancy and Finance, University of Otago, Dunedin 9054, New Zealand

Systemic financial risks, arising from macroeconomic fluctuations, market volatility, policy shifts, and international economic events, present significant challenges for investors, particularly in rapidly evolving and highly interconnected markets such as China. Despite substantial research on risk perception and investor behavior, a comprehensive and psychometrically rigorous instrument specifically designed to measure investors' sensitivity to systemic risks has been lacking. This study aims to fill this gap by developing the systemic risk sensitivity scale for Chinese investors, grounded in financial theory and designed to assess the impact of systemic risks on investment behavior. An empirical study was conducted using structural equation modeling method, which demonstrated the scale's methodological rigor, high reliability, and strong internal consistency. Moreover, the scale exhibited excellent cross-group consistency across different types of investors, suggesting its applicability across diverse investment populations. Robustness tests further confirmed the stability and validity of the results, highlighting the practical and theoretical soundness of the instrument. This study thus develops the systemic risk sensitivity scale for Chinese investors, grounded in financial theory and behavioral finance principles, aimed at assessing how systemic risks affect investment decisions. The scale not only provides valuable insights for portfolio management, investor risk assessment, and financial policy formulation but also contributes to the behavioral finance literature by offering a validated framework for understanding investor decision-making under systemic risk conditions in China's dynamic financial market.

# sciforum-166597: Multi-Objective Stochastic Market-Oriented Optimal Power Flow for Day-Ahead Electricity Price Forecasting in Sustainable Electricity Markets

**Abhishek Bajirao Katkar**

Electrical Engineering, Government Polytechnic, An Autonomous Institute of Government of Maharashtra, Kolhapur, Maharashtra, India

The large-scale integration of renewable energy sources into deregulated power systems introduces significant stochasticity in generation, network congestion, and market operations, leading to pronounced volatility and financial risk in day-ahead electricity prices. Accurate and risk-aware price forecasting is therefore essential for market participants to optimize bidding strategies, manage exposure to price uncertainty, and support sustainable electricity market operation. This paper proposes a **multi-objective stochastic market-oriented optimal power flow (MO-SMOOPF) framework** for **day-ahead electricity price forecasting**, explicitly embedding economic efficiency, price formation, congestion effects, and risk management within the physical constraints of the power flow problem.

The proposed framework formulates electricity market clearing as a **many-objective optimization problem**, simultaneously considering social welfare maximization, producer profit, consumer payment minimization, congestion rent allocation, reserve procurement cost, locational marginal price (LMP) volatility reduction, and conditional value-at-risk (CVaR)-based financial risk mitigation. These objectives are optimized subject to AC power flow equations, transmission capacity limits, generator operating constraints, reserve adequacy requirements, and market settlement balance conditions, ensuring both physical feasibility and financial consistency.

To solve the resulting high-dimensional and nonlinear optimization problem, an **improved non-dominated sorting genetic algorithm II (NSGA-II)** is integrated with a **radial basis function (RBF) neural network**. The enhanced NSGA-II incorporates adaptive crossover and mutation strategies, dynamic crowding distance evaluation, and elite retention mechanisms to effectively balance convergence, diversity, and robustness. The RBF neural network is employed to capture the nonlinear and stochastic dependencies between market prices and system states, enabling accurate day-ahead price forecasting under uncertainty.

The proposed approach is validated on the **IEEE-118 bus system** under stochastic renewable and load scenarios. Numerical results demonstrate superior forecasting accuracy, improved risk-adjusted market outcomes, and enhanced price stability compared with conventional methods. The developed framework provides a robust decision-support tool for **financial risk management and sustainable operation of future electricity markets**.

# sciforum-175695: Predicting Bank Defaults with AI: An Improvement over Statistical and Machine Learning Methods

**Alexandru Monahov**

Research Department, National Bank of Moldova, Chisinau MD-2005, Moldova

Accurately forecasting bankruptcies within the financial sector is an essential objective for prudential regulators tasked with maintaining financial stability. While Machine Learning techniques, in particular the more advanced ensemble methods, and neural networks have been proven to perform well in forecasting loan defaults, these methods have yet to be integrated into workflows for assessing the risk and predicting the failure of financial institutions.

To identify the most effective approach to predicting the default of banks and NBFIs, this study investigates the performance of eight leading predictive modeling techniques of varying complexity—from traditional statistical models to advanced Machine Learning methods against Large Language Models (LLMs), a rapidly growing area of Artificial Intelligence.

The paper develops a new workflow that uses LLMs to analyze the risk exposure of financial institutions and determine their probability of default. A new PD metric, that LLMs are capable of generating accurately, is created as the joint outcome of risk and profitability, whose impacts are separately estimated by the model. To further improve the analysis, the paper proposes a new financial performance indicator and adaptations for traditional ratios to enable their usage in both going concern and failure contexts.

The results of the study reveal that while traditional methods like regression models and Random Forests can provide very good predictive capabilities, the best performance is achieved with the Large Language Model, which significantly surpasses all other methods in the majority of evaluation metrics. The LLM's ability to capture complex patterns and contextual nuances within financial data results in superior predictive accuracy and robustness. This highlights the potential of incorporating advanced language-based modeling approaches into financial risk management systems, paving the way for more intelligent and adaptive frameworks that enhance decision-making and regulatory policy in the financial industry.

# sciforum-175584: Regime-Adaptive Volatility Forecasting in Equity Markets

**Chigozie Andy Ngwaba**

Department of Economics and Finance, Bradley University, Peoria, IL 61625, USA

**Background**

Accurate forecasting of realized volatility (RV) remains a cornerstone of risk management and option pricing. Hybrid volatility models, such as the HAR-RV-CARMA framework, have proven effective at fusing discrete-time persistence with continuous-time dynamics, utilizing the standard Kalman Filter for weight allocation. The model operates on a reactive feedback loop that relies on past residuals, often leading to a "tracking lag" during rapid market transitions, in which the model fails to shift weights quickly enough among its constituent components.

**Methods**

This study introduces a novel architectural enhancement to the HAR-RV-CARMA model by adding an Entropy-Conditioned State-Space Layer. We utilize Sample Entropy as an external complexity indicator to track the information regularity of the volatility series in real time. By linking entropy fluctuations to the noise covariance system in the Kalman Filter, we create a proactive regime-switching mechanism. This enables the model to identify breakdowns in structural persistence and speed up weight re-adjustments before prediction errors accumulate in full.

**Results**

Using daily realized volatility for major U.S. equity ETFs (SPY, QQQ, and IWM), the models are estimated over a training period from 2015 to 2022 and a test period covering 2023 to 2024. The proposed entropy-conditioned hybrid model is assessed against the base HAR-RV-CARMA model. Forecast performance is evaluated using MAE, MSE, QLIKE, and directional accuracy. The results show that the entropy-enhanced model consistently outperforms the base hybrid model across all evaluation metrics.

**Conclusions**

Overall, the proposed framework offers a flexible and econometrically sound approach to volatility forecasting that balances model simplicity with regime-sensitive learning. The Entropy-Conditioned HAR-RV-CARMA model effectively reduces the lag present in standard dynamic weighting, providing a more robust forecasting tool for highly volatile markets.

# sciforum-176964: Statistical Modelling of Systemic Financial Risk Using Random Matrix Theory and Neural Stochastic Dynamics

**Harsh Choudhary**

Department of Mechanical Engineering, KIIT University, Bhubaneswar 751024, India

The increasing interconnectedness and high dimensionality of modern financial markets have significantly increased the complexity of modelling systemic financial risk. Traditional econometric and volatility models often fail to capture nonlinear dependencies, structural instability, and noise contamination present in large financial datasets. This study proposes an advanced statistical modelling framework that combines spectral methods from Random Matrix Theory with data-driven dynamic modelling using Neural Stochastic Differential Equations to analyze systemic risk in high-dimensional financial systems.

Random Matrix Theory is applied to extract meaningful correlation structures from empirical covariance matrices of financial returns and to distinguish genuine market information from noise arising in large asset universes. This spectral filtering enables more stable estimation of correlation networks and improves the detection of systemic dependencies across financial institutions and assets. To capture the nonlinear stochastic evolution of market dynamics, neural stochastic differential equations are employed to learn drift and diffusion processes governing asset interactions and volatility propagation over time.

The integration of spectral statistical methods with neural stochastic modelling provides a flexible framework for identifying early warning signals of systemic instability and extreme financial events. Empirical experiments on high-dimensional financial datasets demonstrate that the proposed approach improves risk estimation and enhances the detection of emerging systemic vulnerabilities compared with conventional statistical models. By bridging tools from Applied Mathematics, Statistical Modelling, and Quantitative Finance, this research contributes to the development of robust analytical frameworks for systemic financial risk management.

# sciforum-167657: Stochastic Firm Valuation with Dependent Cash Flows: Analytical Results for Random Walk and ARMA Models

**Karl-Heinz Jöckel [1] and Peter Pflaumer [2]**

[1] Department Biometry, University Medicine Essen, University of Essen-Duisburg, Essen 45141, Germany
[2] Department of Statistics, Technical University of Dortmund, Dortmund 87435, Germany

**Introduction**

Discounted cash flow (DCF) valuation is a standard method for estimating firm value, yet many applications implicitly assume independent cash flows. In practice, however, financial cash flows frequently exhibit temporal dependence, which may substantially affect valuation risk.

**Methods**

This study derives analytical expressions for the expectation and variance of discounted cash flows under three stochastic processes: white noise, ARMA(1,1), and random walk (ARIMA(0,1,0)). The formulas are obtained for finite and infinite planning horizons and also include limiting cases of discounting structures.

**Results**

The results show that autocorrelation increases valuation uncertainty while leaving expected firm value unchanged. For ARMA(1,1) processes, valuation risk depends on both innovation variance and the induced covariance structure. In the random walk case, shocks are fully persistent, leading to a strong accumulation of uncertainty over time and a more than proportional growth of valuation variance.

**Conclusions**

The analysis demonstrates that ignoring temporal dependence can lead to a substantial underestimation of valuation risk in DCF models. The derived closed-form expressions provide a tractable framework for incorporating dependence structures into firm valuation. Future research may extend the framework to long-memory ARFIMA processes, which allow for gradually decaying dependence between the short-memory ARMA structure and the fully persistent random walk case, offering a more flexible description of persistence in cash-flow dynamics.

# sciforum-176137: The Economics of Piracy: Pricing Maritime Security in Risk Portfolios

**Sonia Rozbiewska**

Doctoral School, Maritime University of Szczecin, 70-500 Szczecin, Poland

Maritime piracy remains a persistent and geographically shifting threat to international shipping, generating direct losses (ransom payments, cargo theft, vessel damage) as well as substantial indirect costs related to delays, rerouting, insurance premiums, and private security measures. Despite a decline in high-profile incidents in some regions, the economic exposure of global supply chains to piracy risk remains significant, particularly along strategic chokepoints and in emerging high-risk zones. This study examines how piracy risk is identified, quantified, and incorporated into maritime risk portfolios by shipowners, insurers, and logistics operators. The paper develops an integrated economic framework for pricing maritime security under uncertainty. First, piracy risk is modeled using frequency–severity approaches commonly applied in actuarial science, incorporating spatial concentration, seasonal variation, and clustering effects. Second, cost components associated with preventive and reactive measures—armed guards, vessel hardening, convoy participation, rerouting, and kidnap and ransom (K&R) insurance—are analyzed as portfolio hedging instruments. Third, the study evaluates how piracy risk premiums are transferred along the value chain, affecting freight rates, charter agreements, and trade competitiveness. Using scenario analysis and sensitivity testing, the research compares optimal security investment strategies under varying attack probabilities and loss distributions. Results indicate that maritime security expenditures function as a hybrid financial–operational hedge, reducing tail risk while influencing overall portfolio volatility. Furthermore, diversification across routes and contract structures can mitigate concentrated exposure to piracy-prone areas. The findings contribute to financial risk management by positioning piracy not merely as a security issue but as a measurable economic variable that reshapes cost allocation and asset valuation in maritime transport. The study provides decision-support insights for insurers, shipowners, and policymakers seeking to balance security investments with capital efficiency in an evolving global risk environment.

# sciforum-177271: Towards a Unified Theory of Return Risk Measures

**Christian Laudagé**

Department of Mathematics, RPTU Kaiserslautern-Landau, Kaiserslautern, Germany

Classical risk measures are designed to evaluate the risk of uncertain monetary payoffs (or losses), whereas in time series analysis, risk is typically assessed for logarithmic returns. An axiomatic foundation for this latter perspective has recently been developed under the umbrella of so-called return risk measures (RRMs). In this theory, the positive cone of the linear space of essentially bounded random variables, or subsets of this cone, such as its interior, plays a key role.

Our contribution consists of extending the RRM definition to general ordered vector spaces and characterizing positive homogeneity in terms of the geometric epigraph. Then, to study geometric convexity and establish connections to classical risk measures, we specialize to AM-algebras admitting an order unit. Geometric convexity is also characterized via the geometric epigraph. This setting encompasses a variety of domains, including Euclidean spaces and spaces of multidimensional and essentially bounded random variables. The latter is new in the RRM literature and enables us to study several novel classes of RRMs, including multivariate RRMs, systemic RRMs, and their set-valued versions. We present results regarding standard properties; for example, finiteness, separability and dual representations. Finally, we introduce and discuss concrete kinds of multivariate RRMs and illustrate their performances numerically.

# Session 4. Asset Pricing and Investment Strategies

# sciforum-176594: Diagnosing Cryptocurrency Security Vulnerability Through Time-Series Decomposition

**Julien Chevallier**

Economics Department (LED), Université Paris 8, Saint-Denis 93526, France

Cryptocurrency markets have experienced repeated systemic breakdowns over the past decade, exposing structural fragilities within digital asset ecosystems. Prominent examples include the Mt. Gox collapses (2011–2014), the COVID-19-driven “312” flash crash, the “519” crash in 2021 following environmental concerns, the 2017–2018 crypto winter, the collapse of the Terra/Luna ecosystem and the FTX exchange in 2022, and the combined effects of Grayscale ETF outflows and tariff conflicts in early 2025. These disruptions were driven by regulatory shocks, exchange failures, excessive leverage, macroeconomic instability, and automated liquidation cascades, often producing billions in losses within hours and erasing trillions in market capitalization. This study proposes a mathematical framework for diagnosing cryptocurrency market failures through the decomposition of financial time-series data. The approach integrates nonlinear signal analysis with regime-shift detection techniques to identify critical transitions preceding major breakdown events. Empirical examination of multiple crisis episodes reveals consistent precursory signatures, including structural changes in volatility dynamics, distortions in trading flows, and abnormal amplitude fluctuations in price signals. These indicators provide insight into latent systemic instability and suggest the feasibility of early diagnostic signals for emerging market stress. The proposed framework contributes a quantitative perspective for analyzing crypto-market fragility and offers analytical tools for examining complex, chaotic behaviors that remain inadequately captured by conventional financial risk metrics.

# sciforum-182134: Corporate Bond Factor Momentum

**Davide Sandretto**

Department of Management, University of Turin, Turin 10134, Italy

Factor momentum has attracted significant attention in the recent asset pricing literature, as it has been proposed as one of the potential mechanisms through which the empirical puzzle of the momentum anomaly manifests itself in financial markets. Factor momentum exploits the tendency of anomalies that have recently exhibited strong performance to continue outperforming, and of anomalies that have recently underperformed to continue doing so, in a manner analogous to cross-sectional price momentum. While the literature has devoted considerable effort to examining this phenomenon in equity markets, the question of whether a similar mechanism operates in the corporate bond market remains largely unexplored. This market represents a particularly relevant testing ground, as it has been at the center of a broader debate regarding the replicability of anomalies proposed to explain the cross-sectional variation in corporate bond returns.

Leveraging a novel, manually cleaned, and error-free dataset that consolidates information from the most widely used databases in the literature, including TRACE among others, we investigate whether a factor momentum premium exists in the corporate bond market, examining both its cross-sectional and time-series manifestations across factor subsamples comprising up to more than 140 corporate bond anomalies.

Our results show the following: (i) for certain factor subsamples, both cross-sectional and time-series factor momentum generate positive and statistically significant raw payoffs with modest economic magnitude of approximately 2.60% per year; (ii) these payoffs survive transaction cost adjustments and standard factor model risk exposures; (iii) they are not subsumed by traditional price momentum, suggesting they capture a distinct source of return variation.

This study contributes to the corporate bond literature by providing evidence of a factor momentum effect, challenging the notion that momentum is a pervasive feature of all cross-sectional anomalies, and contributing to the growing literature on factor momentum.

# sciforum-182173: Do Politicians' Stock Trades Signal Market Movements? Evidence from U.S. Congressional Trading Data

**Minh Tam Tammy Schlosky**

College of Business and Management University of Illinois Springfield Springfield, IL, USA

Abstract: Members of the United States Congress buy and sell stocks and options when writing laws that shape the economy. This has prompted debate over fairness and information. In this paper, I exploit transaction-level STOCK Act disclosures from 2012 to 2025 and daily market data to check whether trades by Congress members convey valuable information about asset prices. Event-study regressions indicate that negative short sales, puts, or inverse funds make between 1 to 1.5 percent more money than usual in a week after the trade. Likewise, good trades do not earn any more money. Committee assignments amplify this effect: lawmakers who oversee an industry see larger price changes when they trade, but longer reporting delays mean that the information is less valuable. These portfolios that mimic Congress members' positions generate profits while contrarian strategies do not compared with four and six factor models. A probit analysis of reactions on the market demonstrates that negative trades tend to lead to larger price shifts than positive ones. These patterns remain valid across many different event windows, return models, subsamples, and placebo tests. The results indicate political trades are a helpful if small source of information, but they also raise questions about insider knowledge and public trust.

# sciforum-182015: Dynamic Portfolio Choice with Stochastic ESG Scores

**Rafael Serrano**

Faculty of Economics, Universidad del Rosario, Bogotá 111711, Colombia

**Introduction**

The integration of ESG criteria into portfolio management has grown substantially, yet the theoretical literature remains largely static: ESG scores are treated as deterministic or single-period random variables. In practice, scores evolve as firms change their environmental practices and governance structures, exposing multi-year investors to ESG score risk. This paper addresses this gap by extending the ESG portfolio problem to continuous time.

**Methods**

We derive the optimal dynamic investment strategy for a CARA investor with warm-glow preferences over portfolio ESG quality, where scores follow a multivariate Ornstein–Uhlenbeck process correlated with asset returns. The solution to the associated Hamilton–Jacobi–Bellman equation can be characterized explicitly. We further extend the model to incorporate ambiguity aversion about ESG dynamics using a Hansen–Sargent robust control formulation.

**Results**

The optimal portfolio decomposes into four components, two of which correspond to intertemporal hedging demands against ESG score risk. Closed-form solutions are derived in the scalar case, with comparative statics showing that the hedging demand grows quadratically in ESG preference intensity, depends critically on the return–ESG correlation, and saturates with the investment horizon. We extend the model to incorporate ambiguity aversion about ESG dynamics. The model nests the static frameworks of Pástor et al. (2021), Pedersen et al. (2021), and Avramov et al. (2022) as limiting cases.

**Conclusions**

Dynamic ESG investing generates hedging demands absent from static frameworks, whose magnitude depends on horizon, persistence, and return–ESG correlation. Ambiguity surroundng ESG dynamics attenuates but does not eliminate these demands, providing a tractable bridge between static and fully dynamic approaches.

# sciforum-168645: Money-Based Financial Products and Their Effects on Systemic Resilience

**Nikolaos A. Kyriazis**

Department of Accounting and Finance, University of Thessaly, Larissa 41334, Greece

This research examines the primary factors contributing to financial system instability, with an emphasis on leveraged ETFs that involve long and short positions in alternative forms of currency. Utilizing the sophisticated approach of network connectedness and daily data from the inception of ETFs for digital, fiat, and metal currencies, our findings show that while precious metal-based ETFs shield investors from variations in fiat or digital investments, cryptocurrency ETFs provide better protection against both metal and fiat ETFs during bear markets but lose stability during bull markets. The primary stabilizer against short positions is gold, as these positions destabilize other forms of currency during bull markets, while sub-leading currencies such as silver and Ether heighten systemic risk. If national currencies were absent during bull markets, it would lead to bubbles in gold and silver and cause serious systemic instability down the line. These findings offer new insights into the intricate dynamics of alternative monetary tools and demonstrate how they contribute to systemic risk within the current fragile monetary system. Moreover, this paper provides a compass to interested investors and policymakers by shedding light on how systemic resilience can be amplified or mitigated depending on the type of assets considered. Leverage being a protagonistic phenomenon for the outbreak of crises makes leveraged ETFs function as fuel for over-enthusiasm but potentially for abrupt turmoil.

# sciforum-181892: Perpetual American Knock-Out Barrier Options in a Random Inspection Scheme

**Michael V. Boutsikas and David-Jacob Economides**

Department of Statistics & Insurance Science, University of Piraeus, Piraeus, Greece

Karatzas and Wang (2000) study an extension of the perpetual American put option by introducing a knock-out barrier for the price of the underlying asset that deactivates the option. We revisit the problem of pricing perpetual American barrier-type options studied by Karatzas, I., & Wang, H. (2000), but this time with the additional assumption that the holder has the opportunity to exercise the option only at random epochs occurring according to an exogenous Poisson process with constant intensity. In contrast, the barrier-triggered deactivation of the option occurs under continuous monitoring, e.g., by an automated system. By employing a constant optimal exercise boundary strategy and assuming geometric Brownian motion dynamics for the underlying asset price process, we provide closed form formulas for the expected present value of the options payoff, the probability of exercising the option and the Laplace transform of the time until exercising the option for both put and call option cases. The determination of the optimal exercise boundary and the fair price of the option is achieved by maximizing the option's expected present value. The impact of the random exercise opportunities on the optimal expected present value, the optimal exercise threshold and the probability of the optimal exercise before the option is knocked-out is numerically investigated for the put and call option case.

# sciforum-182175: Politicians' Portfolios and Firm-Level Political Risk

**Minh Tam Tammy Schlosky and Serkan Karadas**

College of Business and Management University of Illinois Springfield Springfield, IL, USA

In an era of increasing political salience, firm-level political risk, including policy uncertainty, regulatory threats and partisan favoritism has a significant effect on asset pricing, capital structure and investment decisions. Path-breaking research by scholars attests to these effects—yet they treat risk as exogenous, ignoring its responsiveness to changes in party identification(s). We fill this gap by looking at risk changing endogenously when firms enter and exit U.S. politicians' stock portfolios, using lawmakers' trades as natural experiments both in the formation of alliances and their subsequent dissolution.

In our analysis, we rely on granular transaction-level openness from congressional traders as well as common firm fundamentals and known measures of political risk. This results in a monitoring of events at firm-level frequency from open diary data, recording both entry (new positions or increases) and exit (reductions or complete disposals) for public firms. We leverage intra-firm variation before and after events, as initiations or increases represent an endorsement (e.g., increased visibility to committees), while reductions or sales serve as severed connections (e.g., divestitures post-scandals).

We contribute to political finance by bridging ownership and risk channels systematically, thus deepening studies of congressional trading benefits and crony capitalism. Robustness to alternative specifications indicates one's ability to be applied to a broader set of contexts. Implications protect investors from this type of policy-induced volatility, assist regulators in deciding how to craft disclosure laws such as the STOCK Act, and guide researchers on how to structurally represent endogenous policy uncertainty within an asset pricing framework.

# Session 5. Emerging Risks and Interdisciplinary Topics

# sciforum-171634: Assessing the Risk of Maritime Piracy for Global Shipping: An Interdisciplinary Risk Framework

**Sonia Rozbiewska**

Doctoral School , Maritime University of Szczecin, 70-500 Szczecin, Poland

Maritime piracy remains a persistent and evolving threat to global shipping networks, international trade, and supply chain stability. Despite significant advances in maritime security practices, piracy incidents continue to generate substantial operational, financial, and insurance-related risks for shipping companies and associated stakeholders. This paper proposes an interdisciplinary framework for assessing the risk of maritime piracy by integrating quantitative risk modeling with qualitative operational analysis. The study examines historical piracy data, regional risk patterns, and contributing socio-economic and geopolitical factors that influence the frequency and severity of piracy incidents.

The research develops a structured risk assessment model that combines statistical techniques, including probabilistic risk analysis and scenario-based modeling, with expert-based evaluation methods such as multi-criteria decision analysis. This approach enables the identification of key risk drivers, interdependencies, and potential escalation pathways. Particular attention is given to the impact of piracy on shipping operations, insurance costs, and logistical disruptions, as well as to the effectiveness of existing mitigation strategies such as onboard security measures, routing optimization, and international cooperative initiatives. The proposed framework is further positioned within the context of operational risk modeling and is designed to be compatible with emerging explainable artificial intelligence approaches in cyber and hybrid risk management.

The framework considers emerging challenges, including the increasing technological sophistication of maritime operations and the interaction between physical and cyber risks. The findings highlight the necessity of incorporating maritime piracy into comprehensive enterprise risk management and insurance decision-making processes. By treating piracy as an interdisciplinary risk that intersects operational, financial, and geopolitical domains, stakeholders can develop more resilient strategies to protect assets and maintain continuity of global trade. The proposed approach contributes to a broader understanding of emerging risks in maritime contexts and offers practical insights for policymakers, insurers, and shipping operators seeking to enhance risk preparedness and adaptive response capabilities.

# sciforum-171286: Balancing Efficiency and Responsibility: Artificial Intelligence Risk Management for Sustainable Operations and Supply Chains

**Alok Bihari Singh**

School of Business, UPES Dehradun, Uttarakhand 248007, India

The rapid adoption of artificial intelligence (AI) in operations and supply chain management has transformed decision-making related to demand forecasting, inventory optimization, supplier selection, and logistics planning. While AI-driven systems offer substantial efficiency and cost advantages, they also introduce emerging risks related to system reliability, bias, over-automation, and unintended sustainability trade-offs. This study develops an interdisciplinary framework that examines how AI-enabled operational decisions influence performance, risk exposure, and sustainability outcomes in operations and supply chains. Drawing on the responsible AI, risk management, and sustainability literature, the paper conceptualizes AI as both an operational capability and a source of systemic risk. Using secondary evidence and illustrative operational scenarios, the study identifies key AI-related risks, such as model opacity, data bias, and reduced human oversight, and analyzes how these risks affect operational resilience, environmental efficiency, and social responsibility across supply chains. The framework highlights the moderating role of human-centered AI governance mechanisms, including transparency, accountability, and decision oversight, in mitigating risk while preserving performance gains. The study contributes to operations and supply chain management research by integrating AI risk management with sustainability objectives. Managerially, it provides guidance on designing responsible and safe AI systems that balance efficiency, resilience, and long-term sustainable value creation.

# sciforum-173371: CIRIS: A Multi-Project Risk Intelligence Framework for Operational Risk Mitigation and Supply Chain Resilience

**Abdullah Azeem**

Department of Electrical Engineering, FAST National University of Computer and Emerging Sciences (FAST-NUCES), Lahore, Pakistan

Organizations executing multiple concurrent projects frequently face operational risks due to material shortages, idle inventory, emergency procurement, and fragmented decision-making. While traditional ERP systems optimize procurement within individual projects, they offer limited support for structured cross-project redistribution under uncertainty. This study proposes CIRIS (Cross-Inventory Reallocation & Intelligence System), a risk-aware framework designed to enhance supply chain resilience and reduce capital inefficiencies through structured decision modeling.

CIRIS is implemented as a hybrid desktop–cloud architecture with offline-first capability and centralized synchronization. The framework is built on a configurable multi-factor reallocation model, where candidate resource transfers are evaluated using weighted parameters including urgency, item criticality, historical usage trends, geographical proximity, transfer cost, and expected risk reduction. These parameters are normalized and aggregated into a composite priority score to rank feasible redistribution actions. The system further integrates three analytical components: a Shortage Probability Predictor, an Idle Capital Risk Index, and a Cross-Project Resilience Indicator. An event-driven workflow with QR-enabled chain-of-custody tracking ensures traceability and auditability.

Prototype validation is conducted using synthetic multi-project datasets under simulated disruption scenarios, including demand spikes and supply delays. The results indicate that CIRIS effectively identifies surplus–shortage relationships, prioritizes reallocation decisions, and improves internal resource utilization while reducing dependency on emergency procurement.

CIRIS extends conventional inventory systems into a structured risk intelligence framework for multi-project environments, providing a scalable foundation for enterprise deployment and future empirical validation.

# sciforum-155349: Emerging Risks and Interdisciplinary Frontiers: Integrative Approaches for a Complex and Uncertain World

**Abid Ullah [1], Muhammad Humayun [2] and Muhammad Waqar [3]**

[1] Department of Advanced energy and System Engineering, University of Science and Technology (UST), Daejeon 34113, South Korea
[2] Department of Chemistry, UET Peshswar, Peshswar 25000, Pakistan
[3] Department of Chemistry, Malakand University, Khyber Pakhtunkhwa 18800, Pakistan

The rapid pace of technological innovation, globalization, and environmental change is generating a new class of *emerging risks* that are complex, uncertain, and cross-sectoral. These risks, ranging from climate–energy transitions and digital vulnerabilities to biosecurity and resource scarcity, cannot be understood through single-disciplinary lenses. Addressing them requires integrated and collaborative approaches that combine insights from science, engineering, data analytics, and social sciences. This paper explores how interdisciplinary frameworks enhance our ability to identify, assess, and manage emerging risks in dynamic systems. It highlights critical intersections such as the climate–energy–infrastructure nexus, artificial intelligence and ethics, and health environment interactions, where risks evolve through interlinked feedbacks. By connecting technical innovation with socio-economic and governance perspectives, interdisciplinary research promotes holistic understanding and more adaptive policy responses. We argue that resilience in modern societies depends on bridging disciplinary boundaries to anticipate systemic vulnerabilities before they escalate. Emerging tools such as machine learning, network modeling, and systems analysis can support this transition by revealing hidden dependencies and cascading effects. Strengthening cross-sectoral collaboration, transparent data exchange, and adaptive governance will be vital for transforming risk management from reactive control to proactive foresight. In summary, managing emerging risks demands a shift toward integrative, interdisciplinary thinking that transforms uncertainty into knowledge and builds sustainable, resilient futures.

# sciforum-177084: Financial Literacy for the Mitigation of Credit Risk and Default Probability

**Susana Herrero Olarte**

Faculty of Economics and Business (Diagonal Campus), University of Barcelona (UB), Barcelona 08034, Spain

The central hypothesis of this research posits that enhancing literacy regarding debt obligations significantly attenuates the probability of systemic over-indebtedness and personal insolvency. By bolstering borrower creditworthiness and strategic financial foresight, such literacy reduces the asymmetric information and credit risk perceived by financial institutions, thereby facilitating a substantive and measurable reduction in applied interest rates. This structural mechanism is particularly critical for low-income households, who remain the most susceptible to predatory lending, debt traps, and the compounding effects of escalating financing costs.

To rigorously evaluate this hypothesis, we examine the empirical relationship between targeted financial literacy interventions—specifically those designed to incentivize disciplined debt repayment—and their subsequent longitudinal outcomes on household leverage levels and institutional credit risk metrics. Utilizing a comprehensive dataset from Ecuador encompassing nearly 2,000 individuals tracked between 2023 and 2024, this study employs a quantitative approach to assess the efficacy of financial education in fostering long-term economic stability and inclusive growth. The findings suggest that educational proficiency in financial management acts as a non-traditional collateral, lowering default probabilities and optimizing the credit market's efficiency. Consequently, the study advocates for the integration of financial literacy into public policy as a primary tool for poverty alleviation and the strengthening of the national financial architecture.

# sciforum-179646: From Model Performance Signals to Risk Decisions: A Framework for Consistent Model Risk Governance at Model and Aggregate Levels in Financial Institutions

**Puneet Redu**

Barclays, New York, United States

Model performance monitoring is a well-established component of model risk management in financial institutions; however, a critical gap remains in translating monitoring outputs into consistent and defensible risk decisions. While existing practices generate signals such as performance degradation, data drift, and override activity, responses are often fragmented, judgment-driven, and inconsistently applied. Current approaches also remain largely model-centric and do not adequately address aggregate model risk, where multiple models respond simultaneously to shared macroeconomic conditions.

This paper proposes a structured decision framework for converting model performance signals into consistent governance actions at both model and aggregate levels. At the model level, the framework defines a rule-based decision layer comprising predefined thresholds, escalation logic, and action-mapping rules that translate observed signal patterns into actions such as continued monitoring, targeted validation, recalibration, or model redevelopment, reducing reliance on subjective judgment. Machine learning techniques, including supervised classification, unsupervised anomaly detection, and explainable attribution methods, are applied to support signal interpretation and root-cause identification, including changes arising from data distribution shifts, population variations, or macroeconomic transitions.

At the aggregate level, the framework introduces a multi-model signal aggregation approach that integrates internal performance indicators with macroeconomic and event-driven context to identify systemic risk drivers affecting multiple models. Given the complexity of cross-model dependencies, machine learning techniques support detection of correlated deterioration patterns and interpretation of aggregate model risk, allowing institutions to distinguish isolated issues from broader regime shifts across key financial risk domains, including credit risk, IFRS 9 impairment, stress testing, market risk, and broader balance sheet and regulatory capital models.

The key contribution is the formalization of a decision layer within model risk governance that bridges signal detection and governance response. The framework incorporates explainable decision pathways, human-in-the-loop oversight, and an audit structure to ensure traceability and regulatory defensibility under SR 26-2 and PRA SS1/23.

# sciforum-182140: Market-Implied Time to Transition to a Low-Carbon Economy

**Lorenzo Mercuri [1], Andrea Perchiazzo [2], Edit Rroji [3] and Ilaria Stefani [4]**

[1] Department of Economics and Quantitative Method, University of Milan, Milan, Italy
[2] Department of Economics and Business Studies, Eastern Piedmont University, Vercelli, Italy
[3] Department of Statistics and Quantitative Methods, University of Milano-Bicocca, Milano, Italy
[4] Faculty of Mathematics and Economics, University of Ulm, Ulm, Germany

In the transition to a low-carbon economy, the difference in greenium between twin bonds with different maturities is expected to vanish, or at least to decline in both level and volatility. This motivates the introduction of stochastic models for the greenium term-structure slope subject to a terminal transition constraint. Empirically, this slope exhibits mean-reverting behavior together with substantial changes across volatility regimes. To capture these features, we introduce two related models.

The first one is a Regulatory Deadline-Constrained Model (RDCM), namely a linear mean-reverting diffusion with a deterministic terminal date at which the greenium difference is forced to vanish. The second is a Switching Regulatory Deadline-Constrained Model (SRDCM), where the perceived transition deadline is regime-dependent and evolves according to a discrete-time latent Markov structure. In both cases, the model is formulated so that the transition date affects not only the terminal condition, but also the pre-terminal behavior of the drift target and diffusion coefficient through the time remaining to transition.

For the RDCM, we derive the exact Gaussian bridge likelihood and study its calibration on fixed observation grids. We then show that, under a fixed-horizon infill asymptotic scheme, the diffusion block can be consistently identified on the part of the observation interval where it is asymptotically visible. This result yields a structurally grounded local temporal discrimination rule between competing transition labels in the switching framework. The models are calibrated using data from twin German government bonds. In the empirical analysis, the evidence suggests that, in the most recent period, market perception has shifted toward a slower transition path and a delayed convergence of the greenium term structure.

# sciforum-176849: Prospect Theory and Decision-Making Under Risk: A Cross-Disciplinary Systematic Review of Its Reception and Applications

**Mohammad Behroyan**

Ted Rogers School of Management, Toronto Metropolitan University, Toronto, ON, Canada

**Introduction**

This systematic review examines the influence of Prospect Theory (PT) across finance, management, and psychology. By analyzing literature along two dimensions—scholarly stance toward the theory and its functional contributions—this study provides a novel, common framework to measure and compare PT's impact across diverse academic fields.

**Methods**

Following PRISMA 2020 guidelines, the Web of Science database was searched for "prospect theory" or "loss aversion" (1979–2024). To assess methodological quality and perform a high-impact synthesis, a purposive sampling strategy was employed—inspired by Holmes et al. (2011)—where only the top 25 most-cited articles from predetermined prestigious journals were screened to reflect scholarly consensus. Eligibility required a direct application of PT or Cumulative Prospect Theory. Google Scholar identified additional records. For the first dimension (scholarly stance), a standardized coding protocol was used: studies fully affirming PT received 1 point, while partial affirmations received 0.5 points. For the second dimension (contributions), studies were categorized as "theory building" or "explanation of a concept." A qualitative and quantitative synthesis was performed. This review was not registered.

**Results**

The final review included 55 articles: 27 in management, 16 in finance, and 12 in psychology. Scholarly affirmation scores were 16.5 for management, 10 for finance, and 7 for psychology, while rejection scores were 4.5, 5, and 2, respectively. Regarding functional contributions, PT was utilized for theory building in 12 management, 6 finance, and 6 psychology studies. Conversely, PT was used for conceptual explanation in 12 management, 7 finance, and 4 psychology studies.

**Conclusions**

This review demonstrates a predominantly affirmative scholarly stance toward PT, ranging from 66.67% to 78.57% across disciplines. Furthermore, PT's contributions are nearly equally distributed between theory building and conceptual explanation across all three fields.

# sciforum-179115: The Asymmetric Effect of Life Insurance on Longevity: An Analysis of the Cameroonian Case

**Claude Valery Essimi Ayissi and Desire Avom**

Department of Monetary, Banking and Financial Economics / Faculty of Economics and Management / University of Yaoundé 2 SOA / Cameroon

This study provides the first empirical evidence of an asymmetric effect of life insurance development on life expectancy in Cameroon, a country where life expectancy at birth remains at 63.8 years in 2023, significantly below international standards. Drawing on the theory of human capital and the health production function developed by Grossman (1972), we posit that the relationship between life insurance market development and longevity is nonlinear, characterized by a ratchet effect where gains in health capital are partially irreversible. To test this hypothesis, we employ the autoregressive distributed lag (ARDL) approach and the nonlinear ARDL (NARDL) model developed by Shin et al. (2014), using annual data covering the period 1992–2020. The analysis is complemented by the fully modified ordinary least squares (FMOLS) method to ensure structural robustness of the long-run estimates. The empirical results reveal a significant long-run cointegrating relationship: only expansions of the life insurance market significantly improve longevity, while contractions have no statistically detectable effect. This fundamental asymmetry suggests that life insurance development creates permanent improvements in health outcomes that persist even during subsequent economic downturns. These findings definitively reject the conventional symmetry hypothesis and highlight the structural and stabilizing role of life insurance in protecting human capital. The policy implications call for differentiated interventions according to the economic cycle and a targeted market penetration strategy to maximize sustainable health gains in emerging economies, particularly in Sub-Saharan Africa where insurance markets remain largely underdeveloped.

# sciforum-182155: The Impact of ESG Reporting Quality on Operational and Reputational Risk Factors at European Companies in Different Risk Sectors

**Diana Andreea Ujică [1] and Tatiana Dănescu [2]**

[1] Doctoral School of Accounting, 1 December 1918 University of Alba Iulia, Alba Iulia 510009, Romania
[2] George Emil Palade University of Medicine, Pharmacy, Science, and Technology of Targu Mures

Over the past decade, there has been growing interest in the dissemination of non-financial information in corporate reporting. Its relevance stems from the significant influence it has on investor decisions, consumer behavior, and public policy orientation. Organizations are facing increasing pressure to present quality information in terms of ESG reporting and to take responsibility for their impact on society and the environment. In order to respond to the obligations of new regulations, companies are placing great emphasis on ESG risk management. This study aims to analyze the readability and transparency of non-financial reports in companies in different risk sectors to determine the impact of ESG reporting quality on operational and reputational risk. The case study is based on the sustainability reports of European companies in the oil and gas sectors (very high-risk), chemical and mining sectors (high-risk), the energy sector (medium-risk), and retail (low-risk) from 2019-2024 and the GRI Sustainability Disclosure Database. By including the four sectors with different risk profiles, readability and transparency will be systematically compared both within and between sectors. For the analysis of readability and transparency, an index calculated using the R package was built. Through this case study on a multi-sector comparative design that allows us to draw cross-industry generality and enabling sector-level risk comparisons, we have a sample size for panel regression and for robust statistical testing. Within the results obtained, we want to identify whether companies in sectors with high environmental risk use more opaque language in sustainability reports as a strategy for managing operational and reputational risk and to what extent the information is correlated with documented environmental incidents.

MDPI AG
Grosspeteranlage 5
4052 Basel
Switzerland
Tel.: +41 61 683 77 34

*Risks* Editorial Office
E-mail: risks@mdpi.com
www.mdpi.com/journal/risks