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COLUMN:
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INSURANCE

AND THE CLIMATE AND BIODIVERSITY CRISIS

Insurance and the climate are opposite matters, so it seems. What could be the role of innovation to bridge these two opposites? We asked Regula Hess, Senior Advisor Sustainable Finance at WWF Switzerland.

On 13 September 2023, 29 scientists published the study 'Earth beyond six of nine planetary boundaries' in the magazine Science Advances. According to the study, six of the nine planetary boundaries have already been exceeded. How big and how acute do you think the threat to the everyday life of people in Europe is?

'The threat is urgent and enormous. This year, Spain experienced the worst drought in 500 years; water had to be rationed and crop failures are driving up food prices. The price of olive oil has more than doubled since 2022. At the same time, studies show many links between air and water pollution and cancer

and other diseases. In 2020, an estimated 238,000 people died prematurely due to air pollution in the EU alone. Or a study from France concludes that children living near vineyards are more likely to develop leukaemia - grapes require large amounts of pesticides.'

Do we still need new technical solutions to solve the climate and biodiversity crisis or is the challenge more one of implementation?

'There are already many good solutions that are not being implemented and scaled at the speed necessary. Let's think of solar systems on roofs. There are so many suitable surfaces that can be used

without encroaching on nature. Nevertheless, such systems are being built far too slowly. Or the most efficient electric vehicle: the train. There is immense potential in the expansion of public transport instead of motorised individual mobility and air travel.

However, even better and more efficient (technological) solutions often help to displace unsustainable alternatives. It is therefore crucial that insurance companies support both existing green technologies in scaling up and new or improved approaches in development. After all, there are also win-win situations in our behaviour - completely without technology. We can eat healthier and more sustainably to the benefit of ourselves and the planet.' >

‘Better and more efficient (technological) solutions often help to displace unsustainable alternatives.’

Also on 13 September 2023, the WWF published the report ‘Underwriting our planet: How insurers can help address the crises in climate and biodiversity’ together with Deloitte Switzerland, for which you were a co-author. What does the report deal with?

‘The report discusses the interactions between the insurance business on the one hand and the climate and nature on the other. For example, the climate and biodiversity crisis are having an impact on insured risks, while at the same time insurance companies are underwriting economic activities that exacerbate precisely this crisis. Losses due to natural disasters are continuously increasing globally and it is assumed that insured losses will once again exceed the USD 100 billion threshold this year. At the same time, the growing unpredictability of these events is making the pricing of insurance products more difficult. Accordingly, the report argues that it is essential for insurance companies to achieve global climate and biodiversity goals and makes recommendations on how insurance companies can contribute to these goals.’ >



REGULA HESS is Senior
Advisor Sustainable Finance
at WWF Switzerland

‘It is assumed that insured losses will once again exceed the USD 100 billion threshold this year.’

How can insurance companies make a concrete contribution to the global climate and biodiversity goals in their core business?

‘We have identified 11 levers in three categories that insurance companies can use for this purpose. Firstly, it is crucial ‘what’ is insured. Insurance products and risk management support should be expanded for green technologies, but also for landscapes and their restoration (nature-based solution). Simultaneously, economic activities that destroy our livelihoods should no longer be supported, and the associated companies should be supported in their green transformation. Secondly, insurance can provide incentives for sustainable practices by companies or behaviour by private customers for example through insurance conditions and claims management. Thirdly, insurance companies are important stakeholders for their customers and politicians. They can use this position to

highlight to politicians the risks of the growing climate and biodiversity crisis and the need for reliable framework conditions for the insurance sector.’

Which opportunities are opening up for insurance companies in connection to decarbonisation?

‘As already mentioned, sustainable technologies and companies are growing. Insurance companies that position themselves early on as partners to these up-and-coming economic sectors will have a larger market share in the future. Moreover, we believe that insuring transition risks is a business area that is still underdeveloped. For example, numerous agricultural businesses must switch to more environmentally friendly production. This is associated with risks that they can hardly bear alone and that could be efficiently distributed by insurance companies.’

One problem in the field of insurance in general, but particularly when it comes to climate change, is that of so-called ‘moral hazard’ How can insurers ensure that their insurance products do not lead to riskier behaviour on the part of policyholders with view to environmental and climate protection?

‘The report discusses moral hazard related to environmental liability insurance. This insurance cover can tempt insureds to act more carelessly when handling toxic and environmentally hazardous substances. The literature draws the conclusion that insurance products that combine a high deductible with safety and environmental standards and also check these with inspections can effectively counteract these false incentives. In addition, a high level of cover is important to ensure that nature is restored and injured parties are compensated. >

Numerous agricultural businesses must switch to more environmentally friendly production. These risks could be efficiently distributed by insurance companies.

More specifically, climate liability is quickly becoming a topic of interest. Around 2,000 court cases are pending globally and the Bank of England has pointed out the risks for insurance companies, particularly regarding D&O liability insurance. To ensure that the incentives for companies and their managers to combat the climate crisis are not distorted, the report proposes that climate liability should only be covered for those companies that have aligned their entire business with the Paris climate goals.'

The long-term affordability of insurance products is a core actuarial task. Prevention is inextricably linked to this, particularly in the context of climate change and biodiversity. How can prevention look like worldwide and for society as a whole?

'Prevention and adaptation are key to prosperity, but will not be sufficient without consistent mitigation efforts, i.e. stopping the climate and biodiversity crisis. We see a particular opportunity in the combination of prevention and mitigation, for example through increased

investment in nature-based solutions. The reforestation of mangroves or the restoration of peat land can offer protection against flooding and absorb greenhouse gas emissions in the long run. At a global level, there is a clear need for politicians and supervisory authorities to act. It is therefore crucial that insurance companies proactively support ambitious and stringent climate and environmental policy.'

This interview also appeared in the German magazine Aktuar Aktuell. <

CLOUD COMPUTING AS A DRIVER FOR INNOVATION IN INSURANCE

BY **MARCEL SMITH** AND **DAAN TE RIELE**

The insurance industry keeps changing, and cloud computing enables innovation and efficiency. Its scalability and computational power unlocks new capabilities for Balance Sheet Management and General Insurance Pricing. Let's explore the benefits and advancements of cloud computing.

USE CASE 1: BALANCE SHEET MANAGEMENT THROUGH SCENARIO ANALYSES

Balance sheet management is a cornerstone of financial risk management in the insurance industry. Regulatory processes such as Own Risk and Solvency Assessment (ORSA) and Asset Liability Management (ALM) studies necessitate insurers to conduct diverse scenario analyses. These assessments involve complex mathematical models, extensive datasets, and laborious calculations, demanding significant resources and time.

In the past, insurers heavily relied on traditional computing resources for scenario analyses. Modern insurers seek stochastic balance sheet projections, involving a vast amount of scenarios, each marked by variable parameters and complex interrelationships.

This is where the computation power and capacity to parallelize with GPUs of cloud computing becomes a game-changer. Stochastic projections entail running thousands, or even millions, of simulations to investigate potential outcomes across various conditions.

- **Accelerated Scenario Analyses:** Cloud computing with GPU-accelerated simulations allows insurers to execute thousands of stochastic balance sheet projections within minutes, significantly shortening time and resource investments.
- **Enhanced Collaboration:** Cloud solutions cultivate multidisciplinary collaboration, facilitating efficient iterative scenario analyses and encouraging a culture of 'what-if' thinking.
- **Deeper Understanding:** The computational powers of the cloud permits the analysis and visualization of numerous scenarios, resulting in a more profound comprehension of risk exposure and potential financial impacts, both for specialists and decision makers.
- **Informed Decision-Making:** The combination of cloud computing and GPU-accelerated simulations equips insurers to make more informed decisions concerning risk management and balance sheet optimization, enabling the identification of issues and opportunities with unprecedented accuracy and speed. >

MARCEL SMITH is a principal consultant and one of the founding partners of MavenBlue.

He has a background in econometrics and is a certified FRM from GARP. Marcel is an expert in financial risk management, asset liability management, investment management, product development, operations research, quantitative modelling and parallel computing.



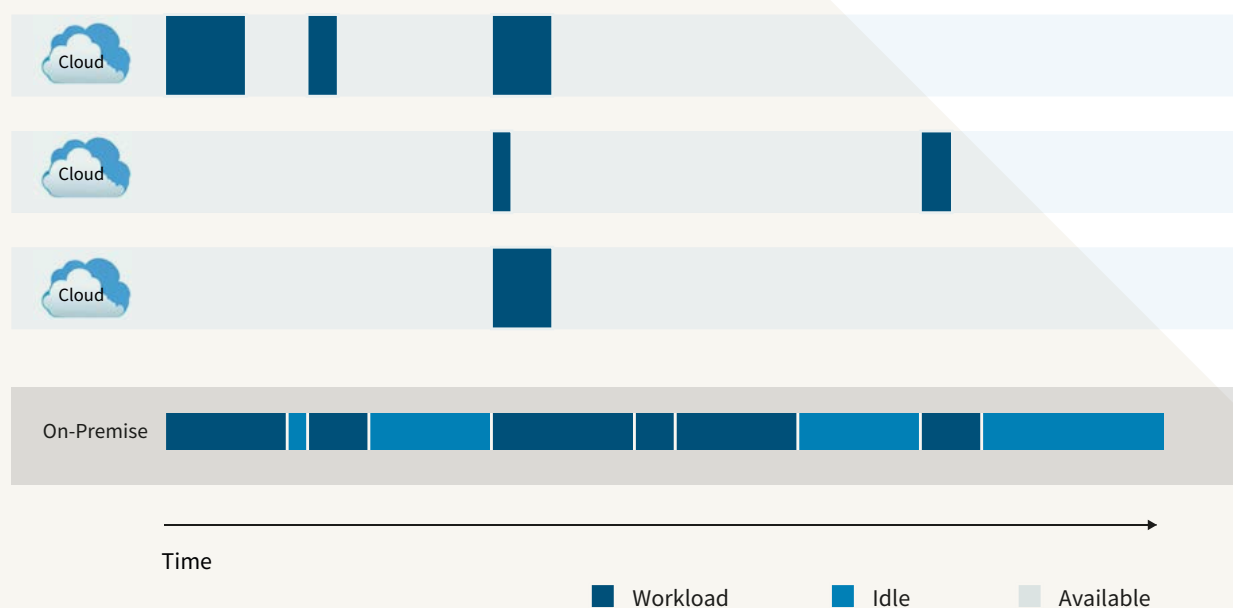
- **Streamlined Operations:** Beyond elevating risk management practices, it streamlines operations, ensuring both financial stability and regulatory compliance.

USE CASE 2: PRICING OF GENERAL INSURANCE

Pricing is very important to the general insurance sector. Not only does it drive profits, but it is a good marketing tool. The pricing process is a combination of data processing, advanced statistical modelling, domain expertise, intuition, and seamless integration with systems like data warehouses and core administration systems. In this intensely competitive and data-rich landscape, effective pricing hinges on several pivotal factors. Insurers must execute these tasks with speed and accuracy to stay competitive and align with evolving customer demands.

- **Accurate Modelling:** Pricing models must accurately capture the risks associated with different policies to ensure that premiums strike the right balance between competitiveness and profitability.
- **Collaboration Across Disciplines:** Effective pricing strategies often necessitate collaboration across diverse disciplines. Actuaries, underwriters, and data scientists must collaborate to craft accurate models.
- **Agile Tariff Updates:** The insurance realm is dynamic, marked by shifting regulations, market conditions, and customer preferences. Pricing models and tariffs must adapt to remain competitive.
- **Data Processing:** General insurance companies have access to massive data volumes, encompassing customer information, claims histories, and external market data. Efficient data processing is essential for accurate pricing. >

FIGURE 1: CLOUD VS ON PREMISE



- **Automation:** Historically, tasks like feature selection, model building, and model testing were manual and time-intensive. Automation streamlines these processes, optimizing pricing efficiency.
- **Machine Learning:** Cloud solutions provide the computational power needed to implement machine learning in pricing, empowering insurers to construct more accurate models in shorter lead times and make better-informed risk assessments.
- **Cloud-Native APIs:** Insurers can publish their tariff models via cloud-native APIs, ensuring precise control over how pricing information is shared. Instead of pushing tariff definitions to third parties like websites and aggregators, these entities can access pricing information as needed, safeguarding insurance companies' intellectual property.

CLOUD COMPUTING PROVIDES INSURANCE COMPANIES WITH AN ARRAY OF BENEFITS

Cloud computing has emerged as the linchpin of enhanced efficiency, competitiveness, and risk management. This technology gives insurers superior data analytics, predictive modelling capabilities, scalability, and streamlined collaboration. By embracing cloud solutions, insurance companies are well-positioned to lead in a data-driven, efficient, and competitive future, where innovation, agility, and collaboration take centre stage.

- **Scalability:** The capacity to scale computing resources as needed ensures efficient workload management, a valuable asset in the insurance sector marked by fluctuating workloads.
- **Cost Efficiency:** Cloud computing eliminates the necessity for hefty upfront investments in physical infrastructure. Insurers can embrace a pay-as-you-go model, substantially reducing overall costs and capital expenditures. ➤

- **Flexibility and Development Speed:**

The dynamic nature of the insurance industry demands adaptability. Cloud solutions offer the agility to swiftly adjust operations, introduce new services, and explore innovations without the confines of traditional on-premises setups.

- **Data Management:** Insurance firms contend with vast data volumes, from policyholder information to historical claims data. Cloud computing provides the infrastructure and tools essential for efficient data processing, storage, and management.

- **Computational Power:** Actuarial science, risk modelling, and underwriting rely on substantial computational power. Cloud platforms offer the resources required to perform complex calculations and simulations with speed and precision.

- **Data Security:** Cloud service providers heavily invest in security measures and compliance certifications, ensuring the safeguarding of sensitive policyholder information and helping companies adhere to data protection regulations.

- **Accessibility and Collaboration:** Cloud solutions enable convenient access to data and tools from any location with an internet connection, fostering seamless collaboration and facilitating remote work capabilities.

- **Disaster Recovery:** Cloud-based backup and disaster recovery solutions help insurers secure critical data and maintain business continuity, even in the face of unexpected crises.

CONCLUSION

Cloud computing is the catalyst for transformation, reshaping how the industry operates and innovates.^{1,2,3} Cloud technology matches very well with the insurance sector, as seen in the case studies on Balance Sheet Management and General Insurance Pricing. Cloud computing delivers accelerated scenario analyses, profound insights, and streamlined operations. <



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¹ <https://www.pwc.com/us/en/tech-effect/cloud/cloud-business-survey.html#four-ways-cloud-powered-companies-are-driving-value>

² <https://hbr.org/sponsored/2022/02/accelerating-forward-the-state-of-cloud-driven-transformation>

³ <https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/what-every-insurance-leader-should-know-about-cloud>

THE ROLE OF MATHEMATICS IN COMPUTATIONAL EFFICIENCY

BEST FRIEND - WORST ENEMY

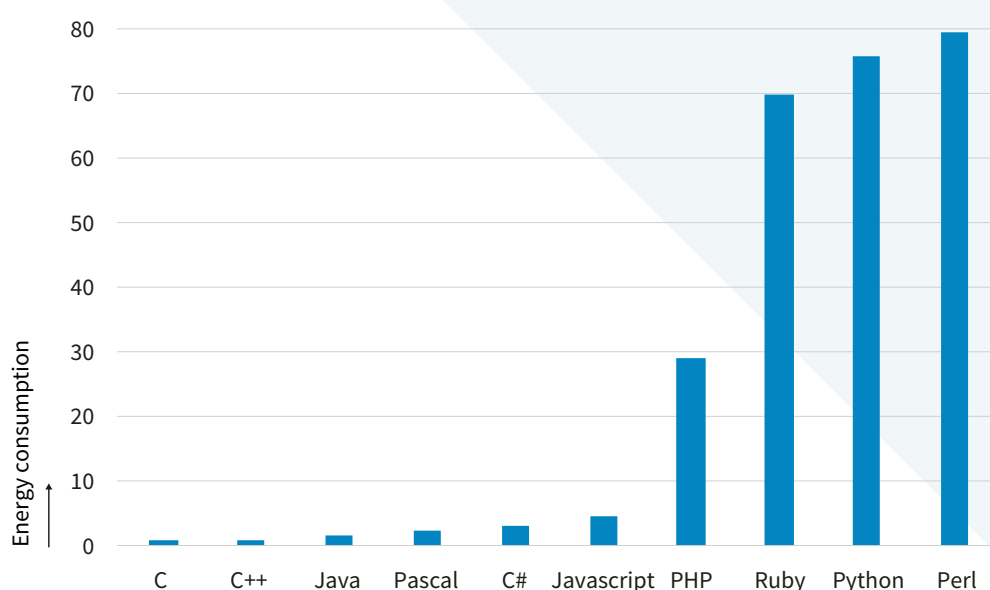
BY **ALEXANDRE BOUMEZOUED**

Although actuaries have a longstanding relationship with stochastic simulations, insurance portfolio valuations and economic capital calculations are still viewed as a computational burden. In the context of an increasing need for computational resources to facilitate improved understanding of financial and insurance risks, and to achieve shortened timelines for financial disclosure, large investments are made – now increasingly in the cloud – to allow for heavier and parallelised computations.

To better manage computational expenses and, of equal importance, to start to measure and control the carbon footprint of computing resources, attention needs to be paid to the energy consumption of different computing languages¹ and libraries² for a given task.

Different coding optimisation techniques can be used to make computations more efficient, for example using vectorization as an alternative to loops. Hardware configurations for large scale computations are also now evaluated in terms of CO2 emissions³. >

FIGURE 1: NORMALIZED ENERGY CONSUMPTION OF SELECTED LANGUAGES¹



¹ Pereira, R., Couto, M., Ribeiro, F., Rua, R., Cunha, J., Fernandes, J. P., & Saraiva, J. (2017). Energy efficiency across programming languages: how do energy, time, and memory relate? In Proceedings of the 10th ACM SIGPLAN international conference on software language engineering (pp. 256-267).

² <https://fr.milliman.com/fr-fr/insight/building-in-house-projection-alm-model-python>

³ Lannelongue, L., Grealey, J., & Inouye, M. (2021). Green algorithms: quantifying the carbon footprint of computation. Advanced science, 8(12), 2100707.

FRUGAL INNOVATION, OR HOW TO DO BETTER WITH LESS

Advances in actuarial science have brought means of improving the accuracy and speed of simulation methods. Closed-form formulae deliver instantaneous results, which are used in areas such as in Property & Casualty reserving to efficiently estimate the variance of the reserve risk distribution⁴, hence avoiding the need for simulations from a bootstrap procedure. To value life insurance portfolios from a stochastic set of risk-neutral economic scenarios, different methods can be considered for variance reduction and faster convergence, including low discrepancy random sequences⁵, antithetic variables, or ‘on-the-fly’ economic scenario generation at policy level.⁶ As another example, Nested Stochastic (NS) simulations do appear in a variety of case studies, among them Solvency II Internal models.

To achieve an accuracy of order ϵ (a very small value) to compute a Value-at-Risk using a NS approach, it is required to perform ϵ^{-3} simulations in total, and the optimal allocation – proved in 2011⁷ – is in the order of ϵ^{-2} outer scenarios, each followed by ϵ^{-1} inner simulations. For example, to target an accuracy of order $\epsilon = 10^{-3}$, a typical split of a one billion simulation budget would be one million outer scenarios, each followed by one thousand inner scenarios. Since this is out of reach in most operational contexts,

a variety of approximation methods have been developed to reduce the computational complexity of NS simulations by, for example, using polynomial approximations (Least Squares Monte Carlo⁸), that require fewer paths in comparison to a full NS approach for their calibration. Still, the polynomial representation is sometimes restrictive, and the calibration step can lead to deficiencies. Also, the validation process can be computationally heavy, especially when iterations are required to further improve the specification of the polynomial function.

THINK TWICE BEFORE YOU RUN

Going back to fundamentals, one can resort to different statistical estimators for a given calculation of interest. At the core of statistical inference is the split of the so-called mean squared error into a squared bias term and a variance term. Then, the objective is to build an optimal estimator in the sense of bias-variance minimization. Although the mathematical methods may seem different for each problem being solved, acceleration techniques tend to share a common ingredient: adding more degrees of freedom. By introducing more flexible statistical estimators, and new parameters in the simulation process, one can achieve better efficiency. ➤

⁴ Mack, T. (1993).

Distribution-free calculation of the standard error of chain ladder reserve estimates. ASTIN Bulletin: The Journal of the IAA, 23(2), 213-225.

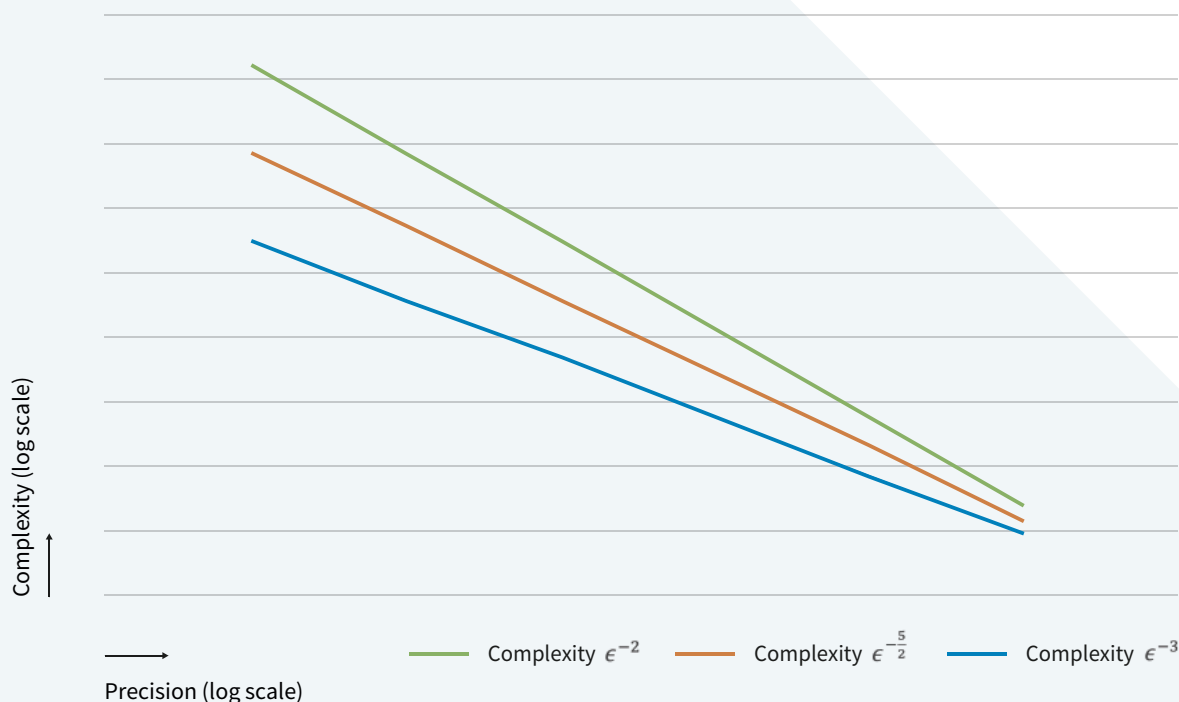
⁵ <https://www.milliman.com/en/insight/hybrid-rng-for-accurate-valuation-of-insurance-liabilities>

⁶ <https://www.soa.org/49383b/globalassets/assets/files/research/projects/research-2011-11-model-eff-report.pdf>

⁷ Gordy, M. B., & Juneja, S. (2010). Nested simulation in portfolio risk measurement. Management Science, 56(10), 1833-1848.

⁸ Bauer, D., Bergmann, D., & Reuss, A. (2010). Solvency II and nested simulations—a least-squares Monte Carlo approach. In Proceedings of the 2010 ICA congress.

FIGURE 2: COMPLEXITY COMPARISON – COMPUTATIONAL COST AS A FUNCTION OF ACCURACY



An approach to further improve Best Estimate valuation accuracy is to introduce weights under the framework of the so-called Weighted Monte Carlo methods.⁹ Beyond expected values, a key example of improvement in percentile estimation using weighted Monte Carlo simulations is the Harrell Davis estimator.¹⁰ Back to NS, new methods leveraging the so-called Multi-Level Monte Carlo theory have been developed¹¹ to improve the computational cost of the Value at Risk calculation from ϵ^{-3} down to $\epsilon^{-\frac{5}{2}}$, then recently¹² even closer to ϵ^{-2} , which is equivalent to the complexity of a standard Monte Carlo estimate (non-nested).

In theory, this would mean using 1 million simulations instead of 1 billion to reach the same accuracy – it is worth mentioning that this holds in the ‘asymptotic’, i.e. for large computational budgets, and practical estimates need to be assessed for each use case.¹¹ Complexity graphs are key tools to compare the efficiency of methods, as they depict the computational effort in the log scale (y-axis) as a function of the targeted accuracy (x-axis), allowing us to measure their asymptotic behaviour for large computations. ➤

⁹ <https://fr.milliman.com/fr-fr/insight/reducing-the-number-of-scenarios-stochastic-alm-valuation>

¹⁰ Harrell, F. E., & Davis, C. E. (1982). A new distribution-free quantile estimator. *Biometrika*, 69(3), 635-640.

¹¹ <https://fr.milliman.com/fr-fr/insight/Efficient-computation-of-SCR-computation-using-MLMC>

¹² Lemaire, V., & Pagès, G. (2017). Multilevel Richardson-Romberg extrapolation. *Bernoulli*, 20(3), 1029-1067.

With the Multi-Level Monte Carlo method, the greater flexibility comes from the use of multiple levels, where a first (rough) standard NS estimator at the initial level is augmented progressively at the next levels by reducing the number of outer scenarios while increasing the number of inner scenarios, with the aim to reduce the bias, while preserving the variance.

AN EFFICIENT FUTURE

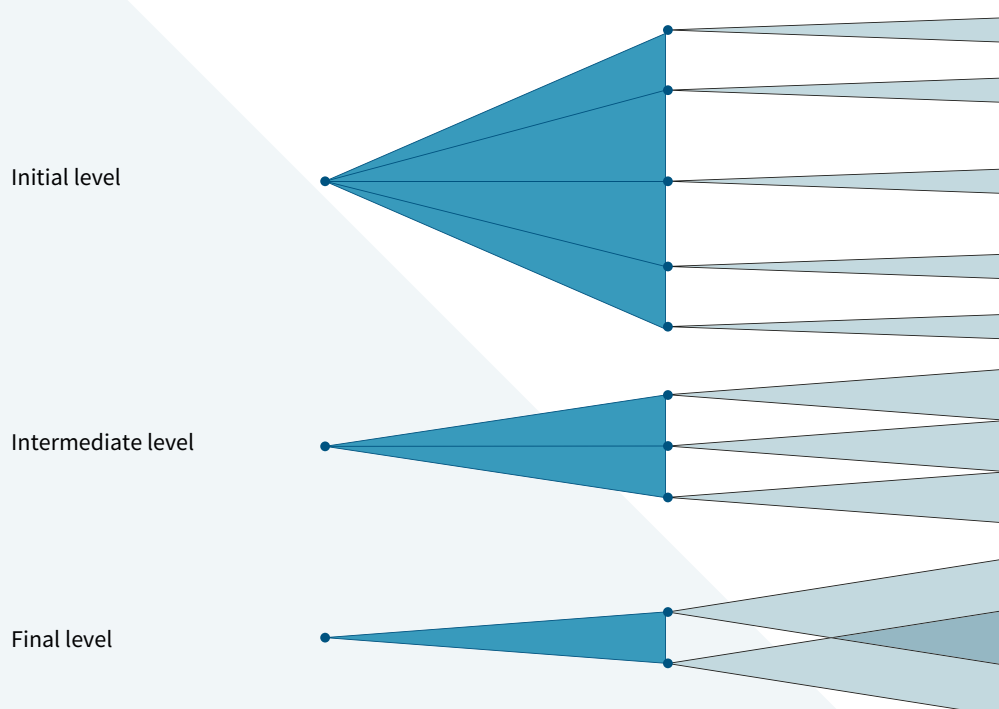
Given the speed at which the research in numerical probability is evolving, one could argue that actuarial science underexploits the available and up-to-date methods in mathematics. When stochastic simulations are involved, mathematics can

lead the way to more direct simulation methods, based on smarter estimators, skipping the unnecessary calibration and validation steps of approximation methods. The computational needs of the insurance industry are not expected to slow down given new accounting standards and developments in risk management. Hence it is now time for actuaries to get on the mathematical train again. This can be achieved by adapting more of the numerical probability research to insurance use cases, while convincing insurance companies and supervisors that it is worth the effort of implementing improved processes for Monte Carlo calculations, even if some model changes are required. <



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Milliman.

FIGURE 3: MULTI-LEVEL MONTE CARLO



SHOWCASING BANKING EXPERTISE TO ACTUARIAL SOCIETIES IN THE AMERICAS

BY **RONALD KOZLOWSKI** AND **MICHAEL TICHAREVA**

Actuaries are increasingly involved in banking practice in various jurisdictions around the world. South Africa and Australia currently lead, with banking practice for actuaries being well established. In South Africa, about 12% of actuarial professionals, roughly about 560 members of the Actuarial Society of South Africa, are involved in banking practice. In North America and Europe, the involvement of actuaries is still at its infancy, although there are also a number of individual actuarial professionals already involved in banking in those jurisdictions.

SHOWCASING BANKING EXPERTISE

We initially met in early December 2022, while attending the 32nd Caribbean Actuarial Association Conference in Barbados, where Michael presented in three different sessions on actuaries working in banking practice. Ron attended all three sessions where, in one of the sessions, Michael used South African banking case studies to highlight professionalism issues that actuaries need to consider in banking.

As Ron sat through Michael's sessions on banking, he heard him say that property & casualty (or general insurance) actuaries are naturals for entry into banking. With Ron having worked on a variety of industries such as construction, retail, food services, health care, pharmaceuticals, transportation, energy,

manufacturing, and public entities on risks, applying actuarial skills in a wide range of risk areas resonated well with him.

One concept Ron learnt from his catastrophe modelling days was that of contagion risks, where multiple risks can have losses at the same time. In that same realm, banks are exposed to many risks, including credit, market, and operational risks, that they need to look at on an individual basis as well as in aggregate. This scenario is a natural fit for actuaries as risk management professionals. Actuaries already have risk management and modelling skills relevant to banking, and they only need to understand banks' business models, products, markets, and regulations to understand the underlying risks that they need to model. >

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of the Casualty Actuarial Society,
and the CAS International
Ambassador.



Ron was impressed with Michael's pitch for actuaries to move into banking that he asked him to present at the 2023 Casualty Actuarial Society (CAS) Spring Meetings, that took place between May 7th and 10th in Boston. Michael came to Boston in May 2023 and presented on banking practice for actuaries. His talk resonated well with a few initiatives that CAS is pushing, the first of which is having actuaries work in different industries given their risk management expertise.

THE BANK FAILURES OF 2023

The bank failures of 2023, with the failure of Silicon Valley Bank, Signature Bank of New York, First Republic Bank in North America, and the rescue of Credit Suisse in Europe, present great opportunities for the involvement of actuaries in banking.

The Basel Committee on Banking Supervision (BCBS) published a report in October 2023 on the banking turmoil, grouping recurring themes into three broad categories as outlined below.

1. Faulty risk management practices and governance arrangements of banks

The following fault-lines were highlighted in this area:

- fundamental shortcomings in basic risk management of traditional banking risks such as interest rate risk, liquidity risk, and various forms of concentration risk;
- a failure to appreciate how the build-up of various individual risks were interrelated and could compound one another;

- inadequate and unsustainable business models, including an excessive focus on growth and short-term profitability at the expense of appropriate risk management;
- a poor risk culture, as well as ineffective senior management and board oversight; and
- a failure to adequately respond to supervisory feedback and recommendations.

2. Importance of strong and effective supervision across various dimensions

The following issues were highlighted in this area:

- the ability and willingness of supervisors to not only actively identify weaknesses in banks, but to also take and enforce prompt actions;
- the need to ensure supervisory teams have the appropriate quantity and quality of resources;
- the need to continuously monitor exogenous and structural changes to the banking system and adapt supervisory approaches to overseeing risks; and
- maintaining effective and timely cross-border supervisory cooperation across a wide network. >

3. Importance of prudent and robust regulatory standards

The following initial lessons were highlighted:

- the importance of a full and consistent implementation of Basel standards;
- the importance of a robust design and calibration of global standards for internationally active banks given that banks can be vulnerable to rapid changes in market sentiment;
- the need for a balanced approach between Pillar 1 regulation and Pillar 2 supervision, with robust and rigorous Pillar 2 approaches pursued as complements, and not substitutes, to Pillar 1 requirements;
- the potential for banks that are deemed to be not internationally active in a jurisdiction to pose cross-border financial stability risks;

- the need for proportionate regulatory frameworks to reflect the BCBS' expectations that any proportionate approaches are commensurate with a bank's risk profile and systemic importance.

IMPLICATIONS FOR ACTUARIES

As the global banking industry considers areas that may require attention following these bank failures, actuaries can bring complementary skills to multi-disciplinary teams in banking.

A key issue for such teams is understanding and judgement versus 'tick box compliance'. Actuaries across jurisdictions can, therefore, be involved in designing enhanced solutions that help banks, supervisors, and regulators in understanding banking risks, and how banks can manage such risks in a more holistic manner.

Actuaries can, for example, add value in asset-liability management, liquidity risk management, and in stress testing allowing for interactions between risks. These are areas that require understanding and judgement in setting assumptions, choosing appropriate methodologies, and designing appropriate banking risk management frameworks, which are key areas in which actuaries are well trained in applying judgement. <



MICHAEL TICHAREVA is the Executive Chairman and Senior Actuary at South Africa's Claxon Actuaries International. He is a Fellow of the Actuarial Society of South Africa and a Fellow of the Institute of Actuaries. Michael is also the Chair of the IAA Banking Virtual Forum.

ACTUARIAL MODELLING IN THE DIGITAL AGE

BY **ZUZANNA CHMIELEWSKA**

In the insurance industry, we face the challenges of uncertainty and unpredictability, and actuaries are focused on managing them. Actuaries have a powerful tool in their arsenal: actuarial models. These models provide a methodical and data-driven approach to assessing and predicting future financial outcomes. As technology keeps getting better, it offers opportunities to enhance our actuarial models further.

In this article, we will explore the impact of technological developments on actuarial models. We will delve into cloud computing, which is offering new possibilities and efficiency in managing IT resources. We will also discuss the importance of version control which brings significant improvements in model management and consistency. Furthermore, we will shed light on the collaborative potential of open-source solutions. >



CLOUD COMPUTING

Cloud computing is a service that delivers IT resources, such as servers, computing power, networking and databases, via the internet on an 'on-demand' basis. It shifts the responsibility of setting up, maintaining and scaling IT resources from companies to providers. Leading cloud infrastructure providers include Amazon Web Services (AWS), Microsoft Azure and Google Cloud.

Scalability

In the actuarial profession, the demand for the IT resources can vary due to both external and internal factors.

Externally, insurers might be compelled to expand their actuarial calculations due to regulatory changes, such as the introduction of IFRS17. These new regulations may require assessing new risks or presenting results on another level of aggregation.

Internally, insurers may choose to broaden their actuarial calculations by analyzing existing data more extensively or incorporating new data. This expanded analysis could aim to delve deeper into significant factors, like the impact of various inflation scenarios on their portfolios due to recent market fluctuations. Insurers may also find themselves working with entirely new data related to policyholders, events, or claims, especially in the field of pricing, which benefits from big data analysis to identify trends and correlations.

Cloud platforms with their 'on-demand' approach can accommodate these increased demands and help adapt to ongoing changes. They allow for the addition of more resources like virtual machines, storage, or database instances. Nevertheless, factors like cost, resource availability, and the specific service in use affect when and how resource scaling can take place.

Cost-effectiveness

Cloud computing enables actuaries to efficiently handle large datasets and run computationally intensive models without the need for costly in-house infrastructure. Cloud providers operate at a massive scale, spreading infrastructure and operational costs across many customers, resulting in lower individual costs. They offer a flexible pricing model, often referred to as 'pay-as-you-go', which promotes cost-effective solutions.

But in terms of cost predictability, on-premises solutions offer a consistent advantage. They maintain stable expenses, while cloud costs can be less predictable and asymmetrical, potentially leading to unexpected higher costs when scaling up and less significant savings when scaling down.

Data security

Ensuring data security is a major concern for insurers. Reputable cloud providers invest heavily in security measures and have dedicated teams to protect their infrastructure. It's important to note that both the cloud provider and the insurance company share responsibility for data security. While the cloud provider is responsible for the security of the cloud infrastructure, the insurance company is responsible for securing the data within that infrastructure, such as ensuring GDPR compliance.

VERSION CONTROL SYSTEMS

Auditability is pivotal in actuarial models, enabling easy identification of the primary model version and maintaining a clear record of modifications, their authors and timestamps. This information is valuable not only to developers but also to users and supervisors.

One widely favoured version control system is Git, known for its distributed nature and compatibility with command-line usage. >



Git seamlessly supports project management, both in local and remote settings and offers its full capabilities when working with models developed in programming languages.

Reproducibility

Actuaries are obliged to reproduce historical results, yet actuarial models evolve continuously. The changes can occur for various reasons. New products might be added to the portfolio after their launch. New regulations may require the calculation of additional components, such as Coverage Units in IFRS17. Actuaries might also create different model versions for pricing research. Version control system provides a historical record of changes, allowing actuaries to review, compare, and understand the model's development. This ensures precise recreation of any past model version.

Collaboration

Actuarial work often involves team collaboration and version control systems enable multiple actuaries to work on a single model

simultaneously. Git's use of branches permits the development of new features without affecting the main model. A fundamental operation in Git is a 'commit', which records changes to the files in the repository. Each commit includes a unique identifier, author information, timestamp, commit message and corresponding modifications. Version control systems can enhance project management for actuarial teams by integrating with project management tools to track tasks, milestones, and project progress.

OPEN SOURCE

Open-source software is reshaping the landscape of actuarial modelling. Traditionally, actuaries relied on proprietary software, but the emergence of open-source tools brings forth a wave of innovation.

Community and knowledge sharing

Open-source platforms foster communities of passionate users and developers. Actuaries can tap into this collective wisdom, share knowledge and collaborate on projects. This dynamic >

environment encourages the rapid evolution of best practices. To get started, you can explore groups like the 'Actuarial Open Source Community' on LinkedIn to discover various projects that you can both utilize and contribute to.

However, it's worth noting that traditional actuarial education often lacks coverage of programming languages like R and Python. If insurance companies adopt open-source solutions, they may face a risk associated with relying on a few key individuals with this knowledge, as it may not be widespread across all team members compared to more widely-known tools like spreadsheets. Moreover, models created in programming languages may appear less transparent than those in spreadsheets and could be seen as 'black boxes', especially by higher management.

Integration

Programming languages like R and Python lean on open-source packages as fundamental building blocks. These packages contain pre-written code modules for various tasks. Programmers use them to execute complex operations without starting from scratch. For instance, in Python, 'NumPy' and 'pandas' offer robust data manipulation capabilities, while 'cashflower' provides a comprehensive framework for actuarial cash flow models.

These open-source packages can often be used together and integrate with each other. When combined, they can achieve even better results, working together integrally to enhance actuarial modelling capabilities.

Cost reduction

Open-source software is freely available, significantly reducing software-related expenses for actuarial teams. This cost-effectiveness frees up resources that can be redirected toward other critical areas, such as data analysis and interpretation. But it's essential to bear in mind that open-source software does not guarantee support in case of issues, a service typically offered with proprietary software.

CONCLUSION

In conclusion, the actuarial field is experiencing a transformative era driven by technological advancements. Cloud computing has revolutionized data storage and processing, making it more efficient and accessible. Version control ensures the integrity of models and fosters collaboration. Open-source tools empower actuaries with a wealth of resources and drive innovation.

Navigating this evolving landscape is essential but it's equally important to carefully assess how these new opportunities align with the unique needs of each insurer. Actuaries who adapt to these technological shifts will find themselves better equipped to address complex challenges and deliver more accurate insights. <

CATASTROPHE BONDS

AS AN IMPORTANT SEGMENT OF INSURANCE-LINKED SECURITIES

BY **KRZYSZTOF BURNECKI** AND **GRZEGORZ KUKLA**

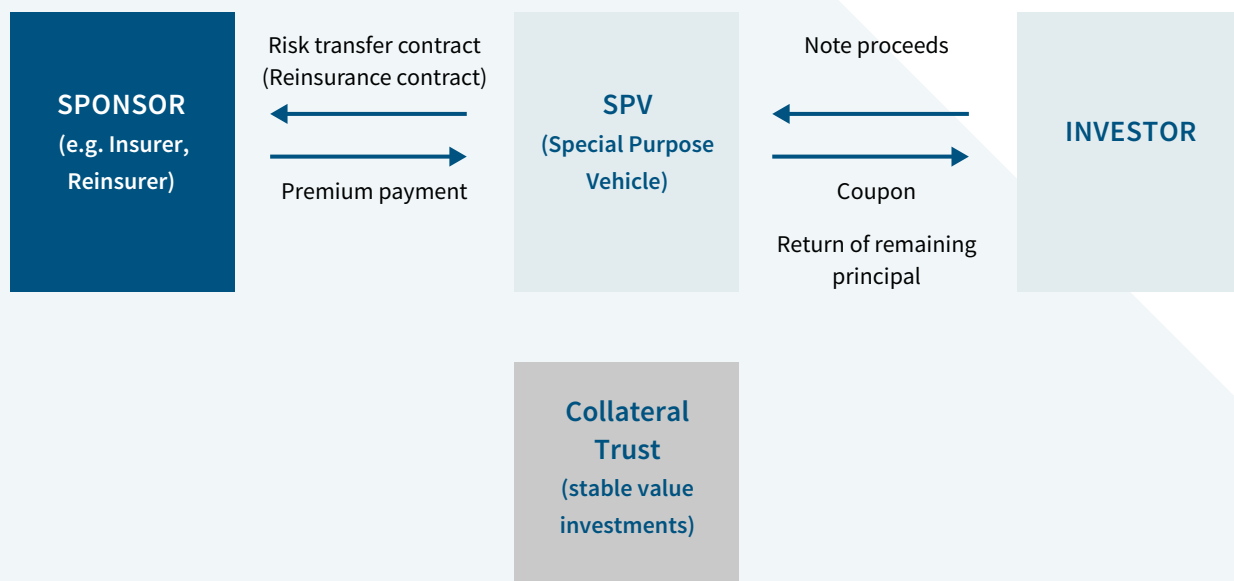
Innovative risk-transfer solutions can help to close identified protection gaps and increase personal and societal resilience. In this context, the insurance-linked securities (ILS) market, as a form of alternative risk transfer, has been at the forefront. The actuarial techniques play a key role in the valuation of catastrophe instruments.

According to the Swiss Re Institute's sigma report No. 1/2023, natural disasters resulted in global economic losses of USD 275 billion in 2022, of which only USD 125 billion were covered by insurance, the fourth highest one-year total. In Europe the economic and insured losses amounted to approx. USD 20 and 11 billion, respectively. With climate change, environmental devastation, global inflation and ever more people concentrated in high-risk areas, natural catastrophes such as earthquakes, floods, hurricanes, wildfires and winter storms have become more intense and frequent in recent years, posing a threat to people and economies worldwide. The financial burden of such events is enormous, but despite this threat many people and businesses remain uninsured leaving them vulnerable when a natural catastrophe does strike. A large protection gap weakens the financial resilience of economies as lack of insurance makes it more difficult for businesses and people to recover from disasters. >



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FIGURE 1: TYPICAL ILS STRUCTURE



ILS are investment assets linked to insurance-related, non-financial risks such as natural disasters, life and health insurance risks including mortality or longevity, but also newly present in other risks such as mortgage, casualty and cyber. They are generally thought to have little to no correlation with the wider financial markets.

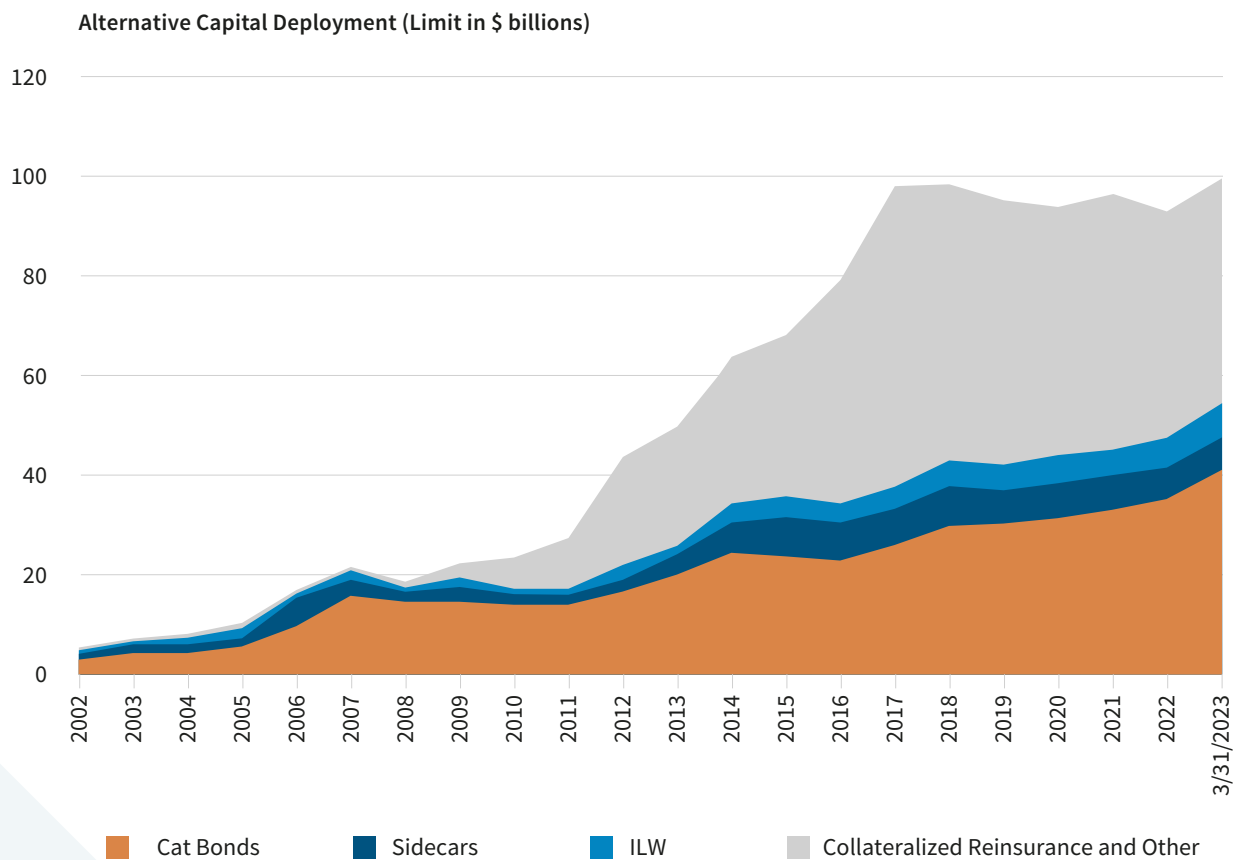
The ILS operating pattern is as follows (see Figure 1):

- A sponsor (usually an insurer or reinsurer looking to get protection but also large corporations, public authorities, and even sovereign nations) enters into a risk transfer contract (reinsurance or derivative) with a special purpose vehicle (SPV) set up by the sponsor. A risk transfer contract is established and the sponsor pays a premium to the SPV.
- The SPV capitalises itself by issuing notes (e.g. catastrophe bond) to investors in the capital markets in an amount equal to the limit of the risk transfer contract.

- Proceeds from the securities offering are transferred into a collateral trust account and invested to provide a stable return.
- If no covered event occurs during the risk period, the securities will be redeemed at 100% of face value. In case of a covered event meeting the thresholds set forth in the risk transfer contract, funds will be withdrawn from the collateral account to make an event payment to the sponsor. The redemption price of the securities is reduced accordingly.

The first ILS were issued in the mid-1990s. To date, most ILS issues have been collateralized reinsurance and catastrophe bonds (see Figure 2 from Aon Securities LLC). We can observe that the catastrophe bond market now stands for almost half of the whole ILS market and is steadily growing. Let us now concentrate on that market, which is also important for an actuary as involved person in the crucial pricing process. ➤

FIGURE 2: EVOLUTION OF ILS MARKET (2002 - Q1 2023), CUMULATIVE



Source: Aon Securities, LLC

Four broad types of catastrophe bond triggers exist, with the first three being more traditional, namely:

- 1 indemnity triggers, where the trigger is based on the actual losses of the issuer/sponsor;
- 2 parametric triggers, where the trigger is based on the occurrence of pre-specified characteristics or criteria of a pre-specified natural disaster;
- 3 industry index triggers, where the trigger is based on insurance-industry catastrophe loss indices;
- 4 modelled loss triggers, wherein a risk-modelling firm provides an evaluation of the catastrophe risk.

Most catastrophe bonds rely on a single trigger. However, in some cases, multiple triggers are used. In Europe, European windstorms, earthquakes and multi-peril risks are covered.

The vast majority of catastrophe bond transactions issued are rule 144a bonds. Rule 144a allows institutions to trade these securities before any public offering or sale, thereby increasing its liquidity. 144a property catastrophe bond issuance at the end of third quarter of 2023 exceeded USD 10 billion with the market on track to break all records this year (see Artemis Deal Directory). >

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In 2020, the government of Mexico with the help of the World Bank and its International Bank for Reconstruction and Development (IBRD), issued an innovative USD 485 million bond that provides insurance protection against both earthquakes and hurricanes, all on a parametric trigger basis. It is the first catastrophe bond in which the proceeds from the sale of the notes can be used by the IBRD to finance sustainable development projects in its member countries. It is a hybrid structure that incorporates elements of a sustainable development bond alongside a catastrophe bond, a concept that has been broadly discussed around the market as one way to tap into investor appetite for ESG assets.

The issuance of a catastrophe bond typically requires engaging a specialised modelling firm to quantify the catastrophe risk.

The modelling companies develop probabilistic models that help to assess financial impacts of catastrophes. In practice, advanced software is used to mathematically represent the physical characteristics of natural catastrophes.

The pricing, which involves experts including actuaries, is based on those analyses and the competing financial environment and the catastrophe market. It is a challenging task especially in the context of multi-peril triggers and it involves the usage of innovative

techniques like machine learning. It is worth mentioning that the developed techniques can also be used in modelling and pricing different risks such as terrorism, pandemics, extreme casualty events, and cyber incidents. The standardisation and the adequate modelling and valuation (including actuarial techniques) are the key to the success and development of the innovative catastrophe bond market which is the essential part of the ILS market. Actuarial pricing techniques are becoming an important complement to the standard catastrophe models as the character and frequency of natural events is becoming ever more unpredictable with the acceleration of the climate change dynamics. <

THE CHALLENGES FACING SOCIAL SECURITY IN OUR TIMES

BY **MARIA ECONOMOU**

Which are the ageing challenges and opportunities? How we can defend the public pension systems? How (and Why) peoples' awareness on pensions issues should be raised?

With these questions, the Social Security Sub Committee (SSSC) addressed to the distinguished speakers who participated in the Social Security Forum in November to discuss the future of Social Security¹.

Following a series of successful webinars regarding the role of actuary in Social Security, the SSSC of the Actuarial Association of Europe (AAE) decided to organize a Forum and invite the interested actuaries and stakeholders to an open discussion on the challenges facing Social Security in our times.

This initiative of the Social Security Sub Committee was targeting to enhance communication with all involved parties in Social

Security area in order a) to make them aware about the view of the Actuarial Association of Europe, 'to contribute to the wellbeing of society' and b) to highlight the valuable role the actuaries can play in this field.

In that light, the aim of the Forum was to bring together stakeholders from the European institutions and the countries of AAEs member associations for a comprehensive discussion on Social Security. >

¹ For the forum discussion it was proposed the SSSC paper from 'From Labour Supply to Labour Productivity'; an article about this paper is presented in TEA in June 2022.



Francisco de Borja Suárez Corujo
Secretary of State of Social Security and Pensions
Ministry of Inclusion, Social Security and Migration



Valdis Zagorskis
Deputy Head Social Protection Unit, DG Employment,
Social Affairs and Inclusion
European Commission



Giampaolo Crenca
Chairperson
Actuarial Association of Europe

The AAE Social Security Forum brought together stakeholders from European institutions and countries of AAE's member associations.

The program included high-class keynote sessions and comprehensive panel discussions.

The AAE had the honour to host high positioned speakers. Among them were:

- The Secretary of State of Social Security and Pensions from the Spanish Ministry of Inclusion, Social Security and Migrations, **Mr Francisco de Borja Suárez Corujo**.

Mr Suárez presented the Recent Pension Reforms Undertaken in Spain. Among these reforms are included:

- a) Pensioners have recovered the right to maintain the purchasing power of their pensions. Since 2022, all pensions are linked to the inflation of the previous year. This corrects the anomaly that was created in 2013, when Spain became the only country in the European Union (EU) whose pension was not linked to the evolution of prices or salaries.
- b) A new approach characterized by combining measures aimed at reducing pension spending with a specific

consideration of revenue measures as a tool to guarantee fiscal sustainability.

- c) The Substitution of the Sustainability Factor by the Intergenerational Equity Mechanism IEM. The IEM addresses the creation of a final contribution, exclusively dedicated to fill the Social Security Reserve Fund. In parallel, in case it is needed, a disbursement payment schedule has been designed to use these funds in order to cope with potential deficits derived from the spending pressured caused by the demographic challenges.
- The Deputy Head of the Social Protection unit at DG Employment, Social Affairs and Inclusion of the European Commission, **Mr Valdis Zagorskis**.

Mr Zagorskis made a detailed analysis on the four 'Megatrends' impacting Social Security Social Protection: Demographic changes, Changing world of work, Digitalisation and technological change, Climate change and green transition. ➤

He also referred to the High-Level Group on the future of social protection and of the welfare state in the EU set up in the framework of the Action Plan on the implementation of the European Pillar of Social Rights. The aim of the High-Level group is to develop a vision on how to reinforce social protection and the welfare state in a medium to long-term perspective. The Report of the High-Level Group released in February 2023. Among its recommendations addressed to the EU, Member States, social partners & stakeholders, are: Ensuring inclusive social protection and lifelong learning and supporting adequate income and high-quality care in old age.

- Colleagues, actuaries and non-actuaries, from the International Labour Organization (ILO), Organisation for Economic Co-operation and Development (OECD), Research advisors, Government Actuaries, Chief Actuaries, Academics. Each one, provided from his/her own perspective his/her view on the range of challenges we need to face in the next years for supporting the public pension systems. Challenges, which are not necessarily 'actuarial' in a narrow sense, but which do impact on the objectives which actuaries seek to address.

The AAE had also the honour to host a high-level audience including colleagues, actuaries and non-actuaries, who work in ministries, governmental organizations and institutions, universities but also in insurance companies and pension funds. It is worth noting their interest in attending the Forum and providing feedback after each panel discussion. Based on the received feedback the following priorities are set:

- To address the challenges of ageing: Consider innovative forms of employment that use technology, when necessary, of the transition to jobs suited to older workers.

- To achieve and maintain support for pension systems, Key action: Cater for the diversity of profiles amongst individuals protected under social security when designing policy.
- To raise people awareness: Seeking to explain issues around balancing the concerns of different generations.

The Social Security Forum was a successful event well supported by the figures; *both the number of registrants and the number of attendees was high.*

Even though at this stage it is quite early to evaluate the outcome of this event, we couldn't miss highlighting the eagerness from all stakeholders with different backgrounds to participate in this discussion organized by the Actuarial Association of Europe. A feeling that seems to reflect a growing perception that the actuary's opinion in the domain of Social Security counts. The audience which the Social Security Actuary seeks to address, becomes larger and more open to hear. <



MARIA ECONOMOU

is Chairperson of the Social Security sub Committee of the Actuarial Association of Europe (AAE), Senior Consultant & Actuary at Aon Solutions Greece.

THE HORIZON FOR ACTUARIES

‘The horizon for actuaries is vast, and with passion, enthusiasm and courage, we are moving towards an evolution of the actuary capable of assisting decision-makers in evaluating risks from a global perspective.’

As the new Chairperson of the Actuarial Association of Europe, I am honoured to be representing all actuaries in Europe – around 29,000 of them. My own words quoted above give a sense of how I intend to navigate the road ahead, and in my first speech as Chair I further outlined my main goal: ‘To develop the actuarial profession from all points of view, from a global perspective.’

The ambition for actuaries is that their scope of activity broadens to the extent that they can support any decision-maker evaluating any quantifiable risk. I use the word ‘any’ here to make it clear that we need to embrace further development of the traditional fields but also significantly develop our presence in wider fields. This encapsulates the global view which we must take in order to ultimately move towards the idea of a global actuary. I would add that actuaries must never forget that one of their missions is to support the wellbeing of society.

Wider fields refer to technological innovations and new data processing approaches such as artificial intelligence, machine learning, digitalization, data science and big data; but it also includes enterprise risk management (non-financial firms), supplementary health private funds in the welfare context, topics such as the right to be forgotten, value for money, sustainability, governance roles and much more – like operational risks, project management, water utilization.

But it is important not to limit our focus. Other important considerations for the actuarial profession include professionalism, education, communication, relationships with institutional and non-institutional stakeholders, public opinion, and much more that arises from experience, suggestions, ideas, solutions. The AAE strategic plan has all these issues at its core, while also including a project concerning economic and human resources.

The main message is that actuaries are essential for providing any decision-maker with accurate information for the right decisions. This is an important mission, as understanding the function in this way clarifies why actuaries need to be fully involved in governance processes.

Another thing I want actuaries to understand is that developing the actuarial profession will result in many new points of view! In my maiden speech I reflected about the profound significance of being an actuary. This proud vocation is characterised by a relentless passion to endow value on something which was previously without value, by taking that value from unknown to known. Doesn't this process make the actuary something like an artist?

My hope and wish is that actuaries will continue to be full of inspiration in their art, and in taking forward the development of the profession together!

Giampaolo Crenca

Chairperson of Actuarial Association of Europe

COLOPHON

The European Actuary (TEA) is the quarterly magazine about international actuarial developments. TEA is written for European actuaries, financial specialists and board members. It will be released primarily as e-mail newsletter. The views and opinions expressed in TEA are those of the authors and do not necessarily reflect the official policy or position of the Editorial Board and/or the AAE. The Editorial Board welcomes comments and reactions on this edition under info@theeuropeanactuary.org.

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Suggestions can be e-mailed to info@theeuropeanactuary.org
The deadline is 1 February 2024.

EUROPEAN AGENDA

Please check
<http://actuary.eu/event-calendar/>
for the most actual forthcoming events.

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