CONTINGENCIES

INSIGHTS *and* **IDEAS** FROM THE AMERICAN ACADEMY OF ACTUARIES ▲

The Economic Impact of Extreme Cyber Risks

MAR
APR
26

Ezra Penland.

Starting Lineup 2026
Your Actuarial Career Dream Team

Sally Ezra
Years: 30
Sally@EzraPenland.com

Kevin Elliott
Years: 14
Kevin@EzraPenland.com

Jennifer Retford
Years: 18
Jennifer@EzraPenland.com

Lauren Scalzo
Years: 11
Lauren@EzraPenland.com

Liz Ritchie
Years: 6
Liz@EzraPenland.com

Thrishna Samaroo
Years: 3
Thrishna@EzraPenland.com

Lauren McKee
Years: 1
Lauren.McKee@EzraPenland.com

Sarah Kluger
Years: 1
Sarah@EzraPenland.com

Bailey Collins
Years: 10
Bailey@EzraPenland.com

Brea Davis
Support Team
Brea@EzraPenland.com

Leia Ziomek
Support Team
Leia@EzraPenland.com

Diane Vanik
Support Team
Diane@EzraPenland.com

Caitlin Ritch
Support Team
Marketing@EzraPenland.com

Peter Trinh
Support Team
Peter@EzraPenland.com

Gigi Castro
Support Team
Gigi@EzraPenland.com

David Mokaya
Support Team
David@EzraPenland.com

EzraPenland.com | **Actuaries@EzraPenland.com** | **800-580-3972**

IN THIS ISSUE

18

24

32

40

48

DEPARTMENTS

On Risks and Opportunities

ON AVERAGE, I RECEIVE TWO TO THREE TEXT MESSAGES ON MY PHONE EVERY DAY urging me to click on a link to ensure that I receive a package I never ordered or to respond to a fictitious message from my bank asking me to confirm some information. That's just the phone. The spam folder of my email is equally replete with phishing attempts, spoofed messages, and bogus login pages that seem just authentic enough to fool almost anyone.

This experience is hardly unique. According to the Anti-Phishing Working Group's "Phishing Activity Trends Report, Q2 2025," more than 1 million phishing attacks were recorded globally in the second quarter of 2025—up 13% from the first quarter of the year and the highest level observed since mid-2023. Most campaigns were aimed at harvesting individual credentials through email and SMS messages. At this scale, cyber risk has become a constant feature of everyday digital life.

Zoom out, and the terrain becomes even more complex. In the United States alone, these tactics translate into staggering real-world losses. According to the FBI's "2024 Internet Crime Report," U.S. individuals reported nearly 860,000 cybercrime complaints in 2024, resulting in $16.6 billion in losses. Phishing-driven schemes were the most frequently reported category at 193,407 complaints—well more than double the next-closest crime type (extortion, 86,415 complaints).

Internationally, global cybercrime damage was projected to reach $10.5 trillion annually by 2025, according to *Cybercrime Magazine*. From fashion houses guarding customer data to financial firms weathering business-email compromise, cyber risk has become a universal economic vulnerability cutting across industries.

This backdrop of pervasive and accelerating threat helps frame the insights in this month's cover story, "The Economic Impact of Extreme Cyber Risks" (*page 12*). While the largest modeled losses are substantial, author Martin Eling finds that they remain within the bounds of insurability. Using scenarios that range from widespread ransomware outbreaks to multi-sector IT failures, Eling presents a framework for estimating potential losses from extreme cyber events—and underscores why insurers, risk managers, and policymakers must act before these disruptions cascade across the broader economy.

I also want to highlight the job seeker feature, "Breaking Boundaries" (*page 24*), which explores how actuarial rigor, combined with technology, communication, and risk-taking, is opening doors to nontraditional careers. What makes this article worth your time is not just the range of roles it profiles, but how it shows that actuarial thinking travels—rigor, judgment, and comfort with uncertainty remain essential even as the contexts change. Whether these professionals are working in technology firms, startups, academia, or hybrid roles that didn't exist a decade ago, the foundation is familiar: rigorous analysis and the ability to explain risk clearly to decision-makers.

In a similar way, Tricia Maston's President's Message (*page 6*) shows how actuaries are exceptionally well positioned to use their skills to address ethical use of artificial intelligence (AI) in risk assessment, pricing, and risk management.

The issue of where actuarial expertise applies—and how far it extends—comes into focus in William J. Michalisin's CEO Insights, "Why Global Engagement Strengthens the Actuarial Profession" (*page 8*), which considers what a global profession means for an organization such as the Academy that has a clear U.S. mission. He argues that global engagement is essential as the profession navigates common challenges ranging from climate risk to AI.

As you read this issue, one that covers far more ground than I can capture here, consider how both risks and opportunities are showing up in your own work. Where are you seeing cyber risk test existing models—or expose their limits? Which assumptions feel increasingly fragile? And on the opportunities side, how are you applying your actuarial skills in new ways or new settings?

We want to hear from you. Your insights and experiences will help shape future conversations in these pages and highlight not only how the profession is responding to emerging risks, but also how actuaries are creating opportunities by rethinking where and how their expertise can make the greatest impact. Drop us a line at editor@actuary.org. ▲▲

PREETI VASISHTHA is editor-in-chief, *Contingencies*, and the Academy's director of content.

STOCK.ADOBE.COM / GEJSI

Actuarial & Algorithmic Accountability: Setting Ethical Standards for AI

I N LIGHT OF THE EXCELLENT ARTICLE written by Fei Huang and Xi Xin (Xin is the recipient of the 2025 Academy Award for Research) in this issue, I wanted to write about why actuaries are extremely well-positioned to address ethical treatment in use of artificial intelligence (AI) as part of the risk-assessment process in selling, pricing, and managing risk in insurance.

AI and machine learning are transforming the insurance landscape—streamlining underwriting, refining risk assessment, and personalizing customer experiences. But with these advances comes a critical challenge: algorithmic bias. When predictive models inherit bias from historical data or flawed assumptions, the consequences can be profound—unfair pricing, inequitable access, and reputational risk for insurers.

Actuaries are uniquely positioned to lead the conversation on ethical governance for AI in insurance. Our profession has long been grounded in principles of fairness, transparency, and accountability—values that align perfectly with the need for responsible algorithmic design.

Why does this matter?

Algorithms increasingly influence decisions once made by human judgment. If left unchecked, bias can creep in through data selection, feature engineering, or optimization objectives.

For example, a model trained on historical claims data may unintentionally penalize certain demographic groups, perpetuating inequities.

A September 2024 Academy professionalism discussion paper, *Actuarial Professionalism Considerations for Generative AI*, discusses what the actuary should think about when using AI and sets out questions for the actuary to consider, including regarding bias.

Here are some ways in which actuaries are well positioned for ethical applications:

■ **The Code:** Our Code of Professional Conduct deals with certain ethical standards that relate to use of AI. Specifically, the Code states that "actuaries must act honestly, with integrity and competence" and that "[a]n Actuary shall perform actuarial services with skill and care." These general concepts require an actuary to ensure that any AI model used as part of their

actuarial services results in reasonable and appropriate output and does not create unfair bias.

■ **ASOPs:** Actuarial standards of practice (ASOPs) provide guidance for all situations, including working with AI. ASOP No. 56, *Modeling*, which affects all practice areas, provides guidance on any type of model, including related algorithmic approaches such as AI. AI is a model, and as such, ASOP No. 56 applies. Under ASOP No. 56, an actuary designing, developing, selecting, modifying, or using an algorithmic model must meet several requirements, including evaluating the model's appropriateness for its intended use; assessing quality of data, assumptions, and model structure; performing model validation and testing, and ensuring appropriate model governance and controls. Any material limitations or known weaknesses must be disclosed.

■ **Culture of Transparency:** In addition to the specific standards related to use of an AI model referenced above, actuaries are used to meeting requirements for disclosure related to our work products. Every ASOP has disclosure requirements, and ASOP No. 41, *Actuarial Communications,* is focused on ensuring that the final work products and opinions provided by actuaries are accompanied by clear and transparent disclosures to the user.

■ **Experts in Research:** Our profession is known for publishing meaningful and objective research on actuarial topics, including those that are highly relevant to the public at large. Actuaries can leverage these deep skills to develop frameworks for bias detection and correction, leveraging our expertise in risk quantification and uncertainty measurement.

■ **Collaboration across Disciplines:** Ethical AI requires input from data scientists, regulators, and consumer advocates. Actuaries work with all of these stakeholders (and more!) and can serve as the bridge between technical rigor and societal impact.

As algorithms become integral to insurance operations, the actuarial profession has the proper foundation to champion ethical governance. As the above professionalism discussion paper references, integrating AI tools into actuarial work demands thoughtful consideration of two key questions: whether AI is appropriate for the project, and how to meet professionalism responsibilities while using it—along with a longer series of follow-up questions. By embedding fairness into predictive modeling, we not only protect consumers but also uphold the integrity of our profession. ▲▲

TRICIA MATSON is president of the Academy.

Why Global Engagement Strengthens the Actuarial Profession

THE ACADEMY FOCUSES PRIMARILY ON THE UNITED STATES, including policy issues, professionalism topics, and the many actuaries practicing in the U.S. who choose to join as MAAAs. However, the actuarial profession is global, and our work, the issues and topics we cover are all relevant and applicable to the global marketplace. While each country has its own legislative and regulatory environments and unique challenges, the core role of actuaries—to provide expert risk analysis and support financial security systems—remains universal.

This past fall, then President Darrell Knapp and I attended the Actuarial Association of Europe (AAE) Annual Meeting, where this shared purpose was on full display. The meeting brought together volunteer and staff leaders from across Europe, including country-specific actuarial bodies like the Academy, to discuss pressing issues shaping the profession. Those discussions, which included multiple references to Academy work, covered the following key themes.

- **Sustainability and Climate-Related Risks:** Actuaries are increasingly called upon to model and manage the financial implications of climate change, a challenge that transcends borders.
- **Artificial Intelligence (AI):** The impact of AI on actuarial work, including ethical considerations and regulatory developments, continues to be top of mind and critical to the profession's ability to navigate this rapidly evolving technology.
- **Pensions, Social Security, and Public Policy:** Discussions emphasized the actuarial role in ensuring the sustainability of pension systems and social programs. This continues to be relevant here in the U.S. as discussions about the solvency of social programs and potential impact on recipient benefits continue to garner attention and concern.
- **Professionalism and Education:** Reinforcing high standards of qualification and continuous professional development remains a cornerstone of the AAE's work, just as it is for us at the Academy. Given the Academy's solid professionalism structures and experience supporting the profession's self-regulation, our voice is valuable and sought out.
- **Operations and Strategic Focus:** The AAE discussed and voted on a new model to improve operating efficiencies during its General Assembly, including the need and opportunity to define an actuary, and clarify/amplify our value to public stakeholders—topics that resonate here in the U.S. and in stakeholder discussions.

The AAE also reaffirmed its role as an independent voice providing actuarial advice to European institutions on issues like insurance, pensions, financial regulation, and demographic trends, always with the public interest in mind and acting as a unified voice for its many country members. As the professional body focused solely on the U.S., the Academy also maintains its focus on being an objective, independent, and balanced voice for the actuarial profession and public policy stakeholders we serve and engage with in the United States.
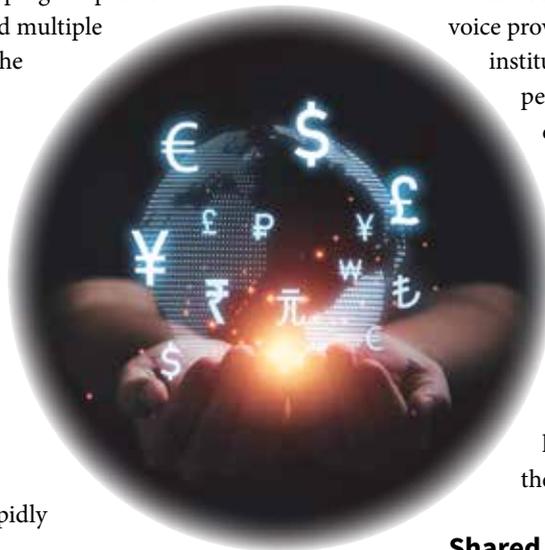
Shared Goals Around the Globe

It's not surprising (maybe it is to some) that there would be so much overlap and relevance between the AAE and its country-focused member organizations and what the Academy is focusing on. Again, our focus is the U.S., but our reach and relevance are far greater, coupled with a profession and membership that transcend borders globally. At the Academy, our mission aligns closely with the AAE and other country organization priorities:

- **Advancing the Profession and Our Members:** We develop, maintain, and promote rigorous standards, a code of conduct, a discipline process, content, publications, and educational tools and resources to ensure actuaries remain trusted experts.

It's not surprising (maybe it is to some) that there would be so much overlap and relevance between the Actuarial Association of Europe and its country-focused member organizations and what the Academy is focusing on. Again, our focus is the U.S., but our reach and relevance are far greater, coupled with a profession and membership that transcend borders globally.

- **Supporting Professionalism and Qualification:** We emphasize ethics, competence, and lifelong learning. A core strength of the Academy is our professionalism structure and approach to maintaining those elements, including the Code of Professional Conduct, actuarial standards of practice, U.S. Qualification Standards, and the counseling and discipline process.
- **Clarifying the Actuarial Role:** We work to ensure policymakers, stakeholders, and the public understand what actuaries do and why our expertise matters to the issues they face. An opportunity is how we achieve this in terms that the public understands and can easily relate to the value we provide, a challenge our staff and volunteers address each day.
- **Serving the Public Good:** Through objective analysis and public policy engagement, we help strengthen systems that millions rely on for financial security. Our ability to amplify this role and the impact we have is another opportunity that the Board is focused on enhancing through the stakeholder strategy and our continued efforts to reinforce the value an actuarial perspective brings to today's pressing issues.
- **Enhancing Operations and Strategic Focus:** We continue to enhance our governance structure through new committees and an ongoing review of governance, along with internal efforts to elevate our impact through new technology, process improvement, and greater investment in and development of our professional staff.

Why Global Engagement Matters to Us

The challenges we face—climate risk, demographic shifts, technological disruption, and organizational effectiveness—are not confined by geography. By engaging with and monitoring the efforts of regional organizations[1] such as the AAE, other country actuarial organizations such as the CIA, IFoA, and DAV, supranational bodies such as the IAIS, ISSB, and OECD, and global organizations such as the IAA, SOA, and CAS, we share knowledge, learn from diverse perspectives, and develop innovative solutions to common problems. These collaborations, and others, can lead to greater creativity, awareness, and opportunities to ensure that the actuarial profession remains relevant and resilient in a rapidly changing world. Whether in Washington, D.C., London, Riyadh, or Beijing, actuaries are united by a common purpose: to apply our expertise for the benefit of society.

Together, we are stronger and better equipped to serve the public good. Our ability to stay connected and aware of each other's efforts can lead to enhanced knowledge and collaboration that ultimately elevates and strengthens the actuarial profession for us all. ▲▲

WILLIAM J. MICHALISIN is the Academy's executive director and CEO.

Endnotes

[1] CIA—Canadian Institute of Actuaries; IFoA—Institute and Faculty of Actuaries (UK); DAV—German Association of Actuaries; IAIS—International Association of Insurance Supervisors; ISSB—International Sustainability Standards Board; OECD—Organisation for Economic Co-operation and Development; IAA—International Actuarial Association; SOA—Society of Actuaries; CAS—Casualty Actuarial Society

COMING SOON!

Here's what we're working on:

- The retirement crisis through multiple actuarial lenses
- Global trade dynamics and their impact on risk and insurance
- Key concepts for understanding long-duration insurance contracts
- The value of Academy membership

Stay tuned for in-depth insights and expert analysis on the issues shaping the actuarial profession.

Have a topic that you would like to see covered? Send your ideas to editor@actuary.org.

A Show of Hands

A PERSON CLOSE TO OUR PROFESSION RECENTLY TOLD ME that when a roomful of actuaries was asked if they could quote Precept 1 of the Code of Professional Conduct, not a single hand was raised. Now, I am guessing that anyone who reads *Contingencies* on a regular basis knows that Precept 1 says, "An Actuary shall act honestly, with integrity and competence, and in a manner to fulfill the profession's responsibility to the public and to uphold the reputation of the actuarial profession."

Some of you would score extra credit by recognizing that Annotation 1-1 adds, "An Actuary shall perform Actuarial Services with skill and care." While the Code contains 14 precepts with multiple annotations, none of the other 13 can be violated easily without also violating Precept 1.

One of my most pleasant volunteer positions within the profession has been to facilitate both the Society of Actuaries (SOA) Fellowship Admissions Course and the SOA Associates Professionalism Course (note: other actuarial organizations have similar courses). I enjoy seeing the new people coming into the profession, with their enthusiasm and excitement (and not a pocket protector in sight). Of course, an important part of these courses is to go through the Code of Professional Conduct, precept by precept. The participants consider real-world situations in which they might confront circumstances that could put them in danger of violating the Code. When these (generally younger) new professionals read Precept 1, they stop just short of

saying "duh" out loud. I'm positive they say it under their breath. After all, why would one study hard, land a great job, and not perform professional duties with "skill and care"?

That was my response to the person who told me that no one could quote Precept 1. It's because we all think it's a no-brainer, or maybe we just don't know the precepts by number. In any case, I'm confident that most actuaries not only know that they should use honesty, integrity, and competence in their work; they actually do it. Certainly the new professionals view it that way. They sometimes have a hard time envisioning why you would ever change an answer, fail to work cooperatively with the former appointed actuary, or be in such a rush to complete a project that you fail to examine the data thoroughly.

One benefit of using the case study method is to have actuaries consider, in a safe environment, how they might respond if they were asked to do something that they viewed as a potential violation of the Code. Members of the

Actuarial Board for Counseling and Discipline (ABCD) frequently speak at local actuarial clubs to give seasoned actuaries a chance to learn from the case study method as well.

Owning Precept 1

Still, actuaries do occasionally violate the Code, some with full knowledge of the Code and others from lack of familiarity. If they didn't, I wouldn't be able to participate in another very rewarding (note that I didn't say pleasant) volunteer experience: being a member of the ABCD. Almost every time the ABCD receives a request for guidance, the person calling actually knows the right answer. The caller is just looking for someone with whom he or she can talk through the situation. It's also telling that when the ABCD receives a complaint, the alleged violation of the Code often begins with a violation of Precept 1. Quite simply, the actuary failed to use "skill and care," did not act honestly with integrity and competence, failed to uphold the profession's responsibility to the public, and/or failed to act professionally. While other precepts generally also will have been violated— such as not being qualified (Precept 2) or not following the applicable actuarial standards of practice (Precept 3)—they all lead back to Precept 1.

A topic that is gaining much more interest these days is continuing education (CE). In particular, members of the ABCD are finding that the

documentation of activities in which an actuary participated in order to fulfill CE requirements can be scanty at best. In many cases, the ABCD is beginning to ask for such documentation from the subject actuary (one against whom a complaint has been made). We also are beginning to ask for such documentation from investigators in order to increase their credibility during the investigation process.

A strong CE requirement is a critical component of being a self-regulating profession. Again, going back to Precept 1, it is part of upholding the reputation of the profession. However, some actuaries may feel that they are doing the same work, in the same way, using the same tools that they have used for decades, and therefore don't need CE. Given the ongoing updates to the actuarial standards of practice, as well as the continually changing regulatory and economic environment, every actuarial specialty is experiencing the need for skills refresher courses.

At the same time, actuaries need to take some type of professionalism course each year to satisfy the three-hour requirement for professionalism in the general qualification standard. All actuarial organizations are making this easy with a wide variety of online, on-demand, and in-person educational events.

Every actuary should read the Code of Professional Conduct at least once a year, paying special attention to Precept 1. It gives you a great measuring stick for every activity you undertake in your professional life.

And if you are ever sitting in a roomful of actuaries and someone asks if you know what Precept 1 says, please raise your hand! ⏶

At the time of publication, **NANCY BEHRENS**, who is a fellow of the Society of Actuaries and a member of the Academy, was a member of the Actuarial Board for Counseling and Discipline and vice president-life/health and mutual funds for State Farm Insurance. She is retired from State Farm and is currently the Academy's Vice President, Professionalism and Education.

Tracking Your CE: Academy Learning

Academy members can track their earned continuing education credits whether earned through Academy programming and publications or through other organizations in Academy Learning: learning.actuary.org.

Up To Code as it appeared in the March/April 2014 edition of *Contingencies*
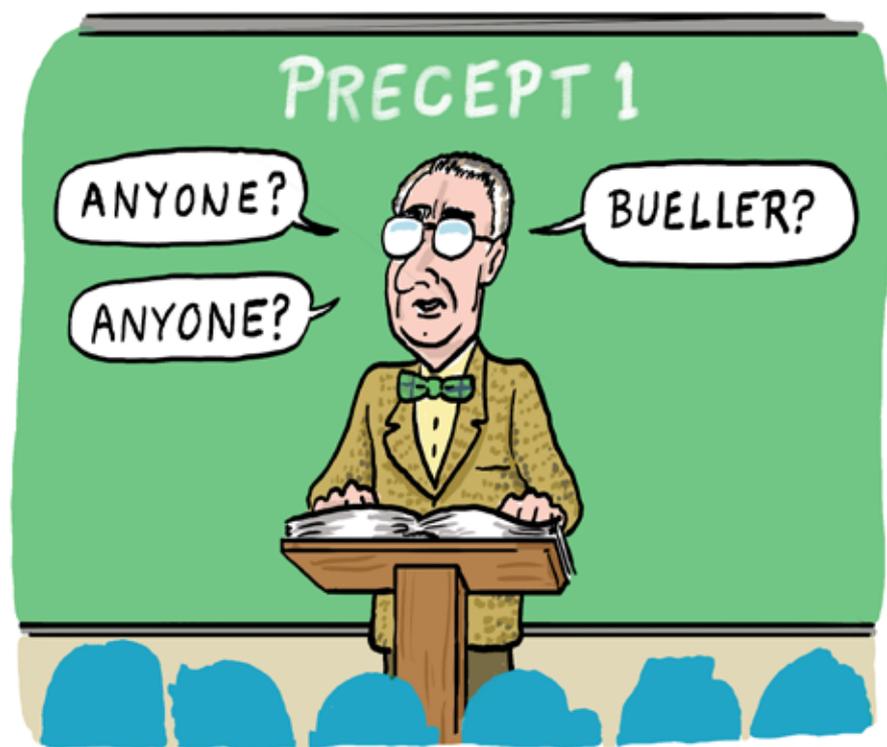
The Economic Impact of Extreme Cyber Risks

BY MARTIN ELING

From ransomware outbreaks to multisector IT failures, the framework outlined in the article estimates potential losses from extreme cyber events and shows why insurers, risk managers, and policymakers must act before these disruptions set off a chain reaction across the economy.

On the morning of May 12, 2017, doctors and nurses in the United Kingdom's National Health Service turned on their computers to find an ominous red screen: *Your files have been encrypted. Pay $300 in bitcoin to recover them.* Across 150 countries, the same ransomware—WannaCry—was spreading like digital wildfire, crippling hospitals, banks, transport providers, and other companies across the world. Within hours, surgeries were canceled, trains were delayed, and entire organizations were forced offline.

The total bill for WannaCry was estimated at around $8 billion, according to a 2019 *Harvard Business Review* article "Sizing Up Your Cyberrisks"—and it could have been far worse. Imagine if the ransomware had spread just a bit faster or hit a broader range of systems. What if it had struck not just few organizations, but the core infrastructure of multiple sectors at once?

That is the uncomfortable question at the heart of our research. Cyberattacks are no longer rare, isolated events—they are an ongoing feature of our

Why This Matters for Actuaries

Model systemic exposure: Cyber events can cascade across sectors, making it essential to capture interdependencies rather than treating risks in isolation.

Account for uncertainty: Loss estimates can vary tenfold depending on assumptions about recovery and disruption—highlighting the importance of sensitivity testing.

Shape resilience strategies: By stress-testing scenarios and informing capital requirements to portfolios and capital models, actuaries can guide insurers and policymakers in preparing for systemic shocks.

interconnected economy. But while we have plenty of headlines about data breaches and ransomware, we have far less reliable information on the potential economic damage of truly *extreme* cyber incidents—and even less on how those losses might compare across different types of scenarios.

This matters because if we don't have a realistic picture of the potential fallout, it's hard for risk managers, insurers, and policymakers to decide how much to invest in prevention, how much to transfer through insurance, and when—if ever—governments should step in with financial backstops.

That's why we developed a standardized framework for estimating the economic impact of a range of cyber risk scenarios. Using a modeling approach borrowed from disaster economics, we calculated potential losses for six widely discussed extreme cyber events—and, importantly, made them comparable. The results offer both a dose of perspective and a call to action: While the modeled losses are large, they are generally within the realm of insurability. But the uncertainty is significant, and the clock is ticking.

The following article relates to the paper, *The Economic Impact of Extreme Cyber Risk Scenarios,* that I co-authored with Mauro Elvedi and Greg Falco. It was originally published in 2023 in the *North American Actuarial Journal.* The structure follows the logic of the original paper: beginning with motivation and context, describing the modeling framework, introducing the selected scenarios, presenting the results, and discussing their implications for insurers, risk managers, and policymakers.

The Cyber Threat Landscape

Today's economy is a finely tuned machine—and it runs on digital fuel. From industrial control systems that manage power grids to cloud platforms that store business data, nearly every sector now depends on a network of interconnected technologies. This brings efficiencies and opportunities, but it also creates what we call *accumulation risk*: the chance that a single point of failure could trigger losses across multiple sectors simultaneously.

Monocultures make us vulnerable. When large numbers of organizations use the same operating systems, software packages, or cloud providers, they create a "monoculture" in the digital ecosystem. If a vulnerability is found in that shared technology, an attacker can exploit it to impact thousands—even millions—of users at once. This is what made the 2017 WannaCry attack so potent: It exploited a Windows vulnerability present in countless systems worldwide.

Another factor reshaping the threat environment is the rapid adoption of artificial intelligence (AI), smart devices, and 5G connectivity. While these technologies create efficiencies, they also expand the attack surface. A flaw in a widely used internet-connected sensor or a compromised AI algorithm could impact millions of users simultaneously. Combined with geopolitical tensions, where cyberattacks are increasingly used as tools of statecraft, the threat landscape is becoming both broader and more unpredictable.

Historical data aren't enough. In traditional insurance modeling, analysts often look to past loss events as a guide to the future. But cyber risk is different. Attack tools evolve quickly, threat actors change
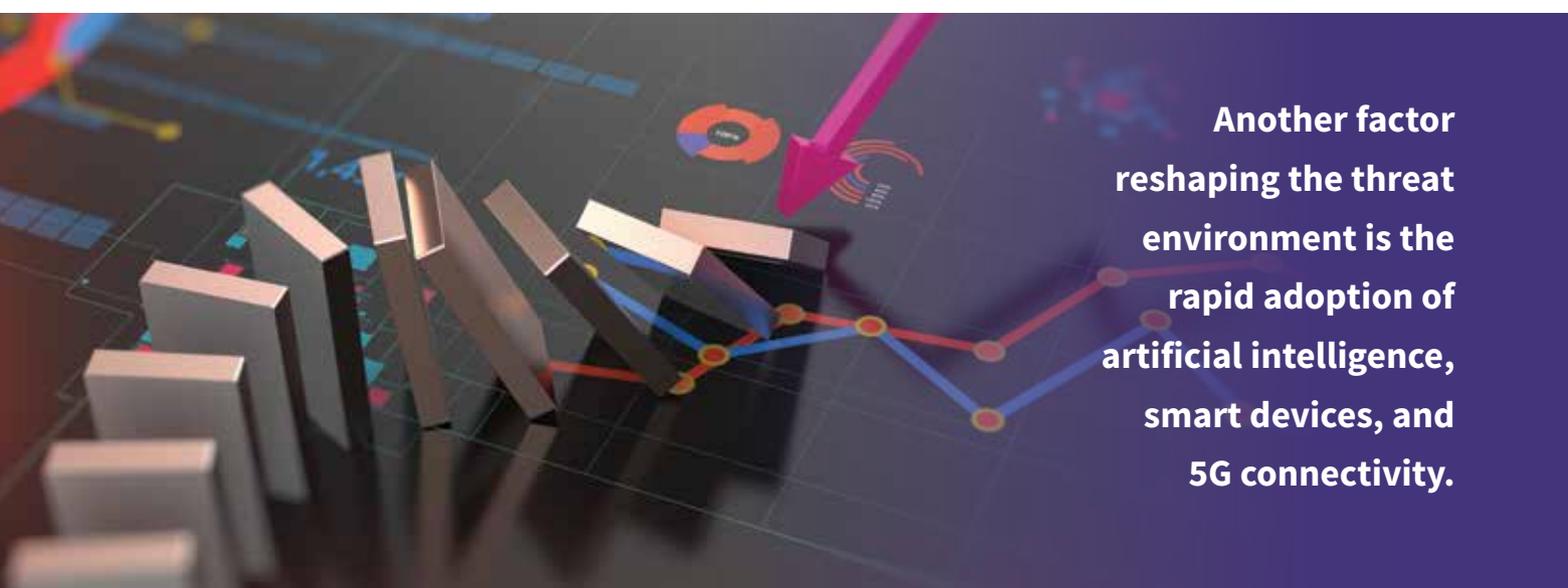
Another factor reshaping the threat environment is the rapid adoption of artificial intelligence, smart devices, and 5G connectivity.

Table 1. Summary of Total Economic Losses by Scenario

Scenario	Risk factor	Total economic damage (million USD)								
			Variation inoperability only				Variation inoperability & recovery time			
		Mean	Min	Max	Range	Range/ Mean	Min	Max	Range	Range/ Mean
1	Industrial control system extortion	23,220	11,610	34,830	23,220	1.00	11,610	34,830	23,220	1.00
2	Cloud service failure	722	—	—	—	—	542	1,264	722	1.00
3	Health sector and hospitals	28,481	5,178	51,784	46,606	1.64	6,214	62,141	55,927	1.96
4	Municipal services	23,261	—	—	—	—	—	—	—	—
5	Telecommunications	1,521	—	—	—	—	—	—	—	—
6	Cross-sector attack	34,881	26,756	43,186	16,430	0.47	24,160	47,112	22,952	0.66

tactics, and new vulnerabilities emerge constantly. Historical data are sparse—and in some cases deliberately hidden, as victims may be reluctant to disclose incidents. That makes it nearly impossible to estimate extreme loss potential solely from past events.

Faced with these challenges, many industry studies have turned to scenario analysis—a structured way of imagining plausible future events and estimating their consequences. But here's the problem: Most existing scenarios are difficult to compare. They differ in methodology, assumptions, and the scope of what's included. Without a consistent framework, it's like comparing apples to oranges—or, more accurately, like comparing apples to a basket of fruit salad. Our goal was to change that.

Building a Standardized Scenario Framework
To make sense of extreme cyber risk, we needed a model that could handle two things at once:

1. Direct impacts on the sectors that are hit first.
2. Ripple effects that spread through the economy as those sectors struggle to recover.

We turned to a tool known as the dynamic inoperability input-output model as described by authors Yacov Y. Haimes and Pu Jiang in their article, "Leontief-Based Model of Risk in Complex Interconnected Infrastructures." Originally developed for analyzing the economic consequences of natural disasters and infrastructure disruptions, it works a bit like a set of interconnected water pipes: If one pipe is damaged, the flow to others is reduced, and the effects ripple through the whole system.

In our case, the "pipes" are economic sectors and the "water" is their output. If a cyberattack knocks a sector partially offline—say, the telecommunications industry—the model tracks how that reduced capacity affects all the sectors that

depend on it. It also factors in recovery time, because some sectors bounce back quickly, while others take weeks or months to restore full operations.

Why does this matter? By applying the same methodology to multiple scenarios, we can directly compare their estimated economic losses. This is something that's been missing from most industry analyses, where each scenario is modeled in isolation.

Another strength of this approach is its ability to run "what-if" sensitivity tests. By adjusting variables such as the initial inoperability rate, the pace of recovery, or the interdependence between sectors, we can explore a range of plausible loss outcomes and identify which assumptions have the greatest influence on the final numbers. This is particularly important for cyber risk, where uncertainty is high and the threat landscape changes rapidly. In practice, this means our framework is not just a one-time estimate, but a living tool that can be updated as new vulnerabilities, technologies, or attack vectors emerge. It also allows decision-makers to stress-test their preparedness plans under more and less favorable recovery conditions—a critical step in translating scenario results into actionable resilience strategies.

For example, if telecommunications capacity were reduced by 40% for two weeks, our model could trace the cascading impact on retail sales, financial transactions, and even health care delivery. This kind of detailed stress test highlights why conventional actuarial models, which often assume independence across risks, are ill-suited for systemic cyber events.

The Six Extreme Cyber Scenarios
We selected six scenarios from widely cited industry and academic studies. Together, they cover a broad range of attack types, targets, and potential impacts (see also Table 1):

In practice, an outage in one sector can rapidly affect others through a web of dependencies—for example, a telecommunications failure can stall payment systems, which in turn disrupts retail and supply chains.

1. Extortion of Industrial Control Systems

- Attackers take over supervisory control and data acquisition (SCADA) systems used in manufacturing, energy, and transportation.
- Initial disruption: partial shutdown of critical operations.
- Estimated U.S. loss: **$11.6 billion to $34.8 billion**.

2. Cloud Service Provider Failure

- A major cloud provider suffers a prolonged outage, affecting thousands of businesses that rely on its services.
- Estimated U.S. loss: **$0.54 billion to $1.26 billion**.
- Lower than others because recovery can be relatively quick—but high potential for disruption given the growing reliance on cloud.

3. Cyberattack on the Health Sector and Hospitals

- Hospitals lose access to patient records, diagnostic systems, and scheduling software.
- Recovery takes two to three weeks.
- Estimated U.S. loss: **$6.2 billion to $62.1 billion** (largest range due to uncertainty in recovery speed).

4. Compromise of Municipal Services

- City government systems—from emergency response to public utilities billing—are disabled.
- Estimated U.S. loss: **$23.3 billion**.

5. Telecommunications Impairment

- A cyberattack cripples major internet backbone providers.
- Recovery takes about a week.
- Estimated U.S. loss: **$1.5 billion**.

6. Strategic Cross-Sector IT Failure

- A coordinated attack disrupts multiple critical sectors at once (energy, manufacturing, finance, etc.).
- Estimated U.S. loss: **$24.2 billion to $47.1 billion**.

These numbers may sound large—and they are—but here's an important perspective: even the largest modeled loss, $62 billion, is just 0.3% of U.S. GDP. For comparison, the 2011 Japanese tsunami caused an estimated $210 billion in damage, and Hurricane Katrina in 2005 cost around $125 billion. Those events were covered (at least in part) by the insurance and reinsurance industries.

While each scenario is distinct in its technical execution and initial point of impact, they all share one crucial feature: the ability to cascade far beyond their original targets. In practice, an outage in one sector can rapidly affect others through a web of dependencies—for example, a telecommunications failure can stall payment systems, which in turn disrupts retail and supply chains. This interconnectedness means that the economic toll is often magnified not only by the breadth of the initial attack but also by the vulnerability of downstream sectors. By framing the scenarios in both narrative and quantitative terms, we aim to highlight the human and operational realities behind the numbers, making the risks tangible for decision-makers.

What the Model Reveals

1. **Losses are within the realm of insurability.** Even in worst-case cyber scenarios, the modeled losses are of a size that the insurance and reinsurance markets have handled for other catastrophes. That's encouraging—it means coverage for extreme cyber events is possible in principle.
2. **Uncertainty is high.** For some scenarios, like the hospital

attack, our estimates vary by more than a factor of 10 depending on assumptions about recovery time and inoperability. That makes precise pricing and risk transfer challenging.

3. **Qualitative context matters.** Numbers alone don't tell the full story. The affected sector, the nature of the disruption, and the degree of interdependence all influence how the losses ripple out. That's why we pair the quantitative analysis with a qualitative scenario framework.

Implications for Insurers, Risk Managers, and Policymakers

For insurers and reinsurers, this framework provides a starting point for:

- Designing products that cover systemic cyber risks.
- Stress testing portfolios for potential accumulation losses.
- Setting capital requirements that reflect correlated exposures.

For corporate risk managers, the message is: Identify which extreme scenarios are most relevant to your operations, and plan accordingly. That could mean investing in redundancy for critical systems, diversifying technology providers, or increasing cyber insurance limits. For policymakers, the results can help decide when public-private partnerships or backstop mechanisms might be warranted—for example, in scenarios where the potential for widespread societal disruption is high.

Beyond the immediate tactical responses, these findings also point to a strategic need for cross-sector coordination. Insurers, corporations, and public authorities often approach cyber preparedness in silos, yet the scenarios we model demonstrate that systemic events rarely respect such boundaries. Establishing joint simulation exercises, sharing anonymized incident data, and harmonizing response protocols can help close the gap between isolated planning and collective resilience. For insurers, participating in such collaborations can yield richer exposure data, more accurate pricing models, and innovative coverage structures that reflect the interconnected nature of cyber risk.

Policymakers are also beginning to recognize the systemic nature of cyber risk and are responding with new regulatory frameworks. In the European Union, the Digital Operational Resilience Act (DORA) will require financial institutions and their technology providers to demonstrate that they can withstand severe cyber disruptions, effectively pushing resilience planning into the boardroom. In the United States, the Cybersecurity and Infrastructure Security Agency (CISA) has launched initiatives to map critical dependencies and coordinate responses across sectors, reflecting an acknowledgment that cyberattacks can ripple across the economy just as natural disasters do. These efforts highlight a shift from treating cyber

incidents as isolated IT problems toward viewing them as systemic economic and security challenges.

Conclusion

We can't predict exactly when or how the next major cyber incident will occur. But we can map the contours of the risk—and that's what our standardized framework aims to do. By making scenarios comparable, we can have a more informed conversation about priorities, preparedness, and the role of insurance. The digital economy will always carry some degree of cyber risk. The challenge is to ensure that when the dominoes start to fall, we've already planned how to keep them from toppling the whole system. Cyber risk is becoming the hurricane of the digital age—unpredictable in timing but inevitable in occurrence. Building resilience now through diversification, redundancy, and public-private cooperation is the best way to ensure these shocks do not become systemic crises. ▲▲

MARTIN ELING is the dean of the School of Finance, Director of the Institute of Insurance Economics, and professor for Insurance Management at the University of St. Gallen, Switzerland.

Academy Resources on Cyber Risk

- Read *An Overview of the Global Cyber (Re)Insurance Market* and *Personal Cyber: An Intro to Risk Reduction and Mitigation Strategies*, the latest additions to the Cyber Risk Toolkit. They can be accessed on the Academy website.

- Read "Cybersecurity Month Highlights Need to Remain Resolute Against Ever-Changing Threats," an *Actuarially Sound* blog post on how the committee and Academy helps keep stakeholders informed on cyber risk. The blog is available on the Academy website.

- Listen to the *Actuary Voices* podcast episode in which Committee on Cyber Risk member Bobby Jaegers discusses building a strong U.S. cybersecurity infrastructure and strengthening cyber resilience at the personal level. The podcast is available on the Academy website and major podcast platforms like Apple Podcasts and Spotify.

- Watch the recording of the Committee on Cyber Risk 2025, which provides an overview of the 2025 cyber insurance market and highlights the latest additions to the Academy's Cyber Risk Toolkit. Access the recording through Academy Learning.

Designing

Artificial intelligence and big data can sharpen risk predictions—but they can also hide bias. Actuaries are developing models that make fairness measurable, actionable, and central to modern insurance.

BY FEI HUANG AND XI XIN

Fairness in Insurance Pricing

ACTUARIES USE DATA FOR GOOD.

Yet as insurers deploy larger datasets and more sophisticated algorithms, a pressing question emerges: What if these tools unintentionally discriminate?

Imagine two drivers. Both have comparable cars, many years of safe driving experience, and are of the same age. Yet one pays hundreds of dollars more for auto insurance. The difference is not their driving history or risk profile, but their ZIP codes—even when they live across the street from each other. ZIP codes can act as proxies for protected characteristics such as race or ethnicity. Even if the insurer never used race explicitly, the proxy effect may still exist.

This is the challenge of indirect discrimination in insurance, and it is attracting growing attention from regulators and actuaries alike.

From Big Data to Big Questions

Over the past decade, insurers have embraced big data and advanced algorithms across a wide range of operations, including underwriting and pricing. Predictive accuracy has improved, but so has the risk of bias. Machine learning models, often operating as "black boxes," can uncover subtle correlations that effectively reintroduce proxy effects of protected attributes.

Direct discrimination, explicitly using race, gender, or other protected attributes, is prohibited in most jurisdictions. But indirect discrimination, where neutral-looking factors act as stand-ins, sits in a regulatory grey zone. This uncertainty creates both a compliance challenge for insurers and an opportunity for actuaries to lead.

Around the world, regulators are beginning to grapple with this problem. The European Union banned gender-specific premium differentiation through its "gender directive" and the 2011 Test-Achats ruling, which mandated unisex rates. In Australia, the Human Rights Commission has issued guidance on algorithmic bias and the use of artificial intelligence (AI) in decision-making.[1] And in the United States, a patchwork of state laws and national conversations is beginning to shape the future of fairness in insurance pricing.

Some U.S. states restrict or prohibit the use of proxies such as education, occupation, or credit-based insurance scores in auto rating, recognizing their disproportionate impact on minority or low-income groups. The National Association of Insurance Commissioners (NAIC) has urged insurers to avoid proxy discrimination when deploying AI models. And in 2021, Colorado passed SB21-169, which went further by requiring insurers to test whether their models result in unfair discrimination when using external data, even if they never explicitly used protected attributes.

Together, these developments illustrate a clear trend: Regulators are moving from input-based prohibitions ("don't use race, don't use credit scores") toward effects-based scrutiny ("show that your models don't produce unfair outcomes"). That shift highlights the need for actuarial approaches that can measure, mitigate, and balance fairness with predictive accuracy.

Building a Bridge: Regulation, Fairness, and Models

The machine learning community has developed dozens of fairness criteria over the past decade. But most were designed for binary classification problems such as hiring or lending—not for regression problems like insurance pricing. Our research

paper, "Antidiscrimination Insurance Pricing: Regulations, Fairness Criteria, and Models" (*North American Actuarial Journal*, 2024, Vol. 28, Issue 2),[2] which received the 2025 American Academy of Actuaries' Annual Award for Research, set out to bridge legal frameworks, fairness criteria, and actuarial practice. The award recognizes work by an early-career scholar contributing significantly to an actuarial perspective on a public policy issue of interest to U.S. actuaries and public policymakers. Read also "Call for Submissions" on page 21.

We began this project at the University of New South Wales Business School in 2020, motivated by conversations with regulators and industry leaders who were grappling with these issues. The collaboration itself grew quite naturally: Xi, then a Ph.D. student, approached Fei for research ideas, and Fei had just completed a paper with Edward (Jed) Frees on discrimination in insurance, later published in the *North American Actuarial Journal*.[3] Building on that foundation, we set out to explore how quantitative fairness criteria from the machine learning literature could be applied to insurance pricing and aligned with existing regulations—an idea that quickly became the first major project of Xi's doctoral studies and the starting point of our joint work.

What Counts as Fairness?

Fairness can mean different things depending on perspective. Individual fairness emphasizes treating similar people similarly. Group fairness is about making sure that different groups—for example, people of different races or genders—are treated in a way that leads to similar outcomes. Both approaches have merit, but they often conflict.

Consider a few representative criteria. Fairness through unawareness excludes the protected attribute from the model. This approach is simple, and common in industry practice, but it is inadequate when proxies reintroduce the attribute indirectly. Fairness through awareness goes further by requiring that similar policyholders pay similar premiums, based on task-specific similarity measures. On the group side, demographic parity requires premiums to be independent of protected attributes. In practice, however, demographic parity can be difficult to apply in many lines of insurance pricing, where risk differences exist between groups and where insurers' portfolio mixes vary widely. A middle ground is conditional demographic parity, which permits disparities tied to legitimate risk factors while restricting those linked to illegitimate proxies. Many other fairness criteria have also been introduced and discussed in recent literature.

Each of these definitions reflects a different regulatory philosophy. And there is no one-size-fits-all answer: The appropriate fairness criterion will vary by line of business, regulatory environment, and the goals of the insurer or regulator. In short, context matters.

Implementing Fair Models in Practice

To make these ideas concrete, we applied fairness-aware pricing strategies to a French auto insurance dataset, treating gender as the protected attribute. There are three approaches to implement fair models: adjusting the data before training (pre-processing), building fairness constraints directly into model training (in-processing), and adjusting predictions after the fact (post-processing).

We tested both generalized linear models (GLMs), the long-standing workhorse of actuarial science, and modern methods such as XGBoost, a popular machine learning algorithm.

Our results show that fair models could be implemented in practice, evaluated with familiar actuarial metrics, and compared along fairness and accuracy dimensions. While introducing fairness generally reduced predictive accuracy somewhat, the decline was modest for our empirical application. In some scenarios, fairer models even improved insurers' competitive position by attracting more low-risk drivers and fewer high-risk ones.

We also found that model choice matters. Machine learning methods like XGBoost, while powerful, can be more sensitive to small group differences than GLMs. That sensitivity raises important questions for regulators and actuaries about how modeling techniques influence fairness outcomes.

The Trade-Offs: Fairness, Accuracy, and Solidarity

Fairness interventions inevitably shift costs across groups. Some strategies lead to cross-subsidies, for instance, from low-risk to high-risk consumers. This highlights the classic tension between actuarial fairness (similar risks, similar premiums) and solidarity (sharing risks more broadly across society).

Our research demonstrates that there is no single "fair" answer. Each criterion, model, and regulatory approach involves trade-offs between statistical accuracy, consumer equity, and market stability. The task for actuaries is to make these trade-offs explicit, measurable, and transparent.

Why It Matters for Actuaries and Regulators

For actuaries, fairness is not just an ethical or legal consideration—it is a modeling choice with business implications. Insurers that rely solely on "fairness through unawareness" risk regulatory scrutiny and reputational harm. Those who adopt deliberate fairness strategies can align with evolving regulation and demonstrate leadership in responsible data use.

For regulators, actuarial approaches provide tools to translate fairness principles into auditable standards. Instead of vague aspirations, they can set measurable criteria that insurers can test against real data.

For consumers, fairer models can improve trust in insurance markets. When customers understand that their premiums are determined transparently and equitably, confidence in the system grows.

Looking Ahead

Much work remains to be done in this area. Which fairness criteria should apply in different lines of business? At what stage of the pricing process should fairness be enforced—technical cost modeling, final pricing, or both? How can fairness be ensured when protected attributes such as race are not collected?

Our subsequent research explores these questions, from fairness in annuity pricing and retirement outcomes[4] to the welfare implications of regulatory interventions.[5] Other researchers are also advancing complementary approaches. Together, these efforts mark the emergence of fairness in insurance as a truly multidisciplinary field.

As insurers harness more data and deploy more sophisticated algorithms, the potential for unintended discrimination grows. But actuaries have the expertise to ensure that fairness is not just an aspiration but a reality embedded in pricing practice.

By linking regulation, fairness criteria, and actuarial models, our research shows how insurers can navigate the fairness-accuracy trade-off, respond to evolving laws, and build systems that are both predictive and just.

This is how actuaries can continue to use data for good: not only to measure risk, but to ensure that risk is priced in ways that are fair, transparent, and trusted. ▲▲

FEI HUANG is an associate professor and **XI XIN** is a Ph.D. candidate at the School of Risk and Actuarial Studies, University of New South Wales, Australia.

Call for Submissions

The Academy's Award for Research is devoted to research on a particular theme with broad applicability across different policymaking and regulatory environments and across actuarial practice areas. It recognizes work by an early-career scholar contributing significantly to an actuarial perspective on a public policy issue of interest to U.S. actuaries and public policymakers. For 2026, the theme is "Advancing Literacy in Insurance and Finance: Understanding Risk, Overcoming Misconceptions, and Strategies for Improvement". The Academy's Research Committee invites submissions for consideration by March 31, 2026. The winner of the Award will be announced during the summer of 2026. The award includes a $7,500 honorarium.

Last year, the committee solicited submissions on the theme of "Bias in Assessing Financial Risk: Origins, Detection, Mitigation." Xi Xin, a Ph.D. candidate at the University of New South Wales in Australia, received the award as co-author of research published in 2024 in the *North American Actuarial Journal* (Vol. 28, Issue 2), "Antidiscrimination Insurance Pricing: Regulations, Fairness Criteria, and Models."

Related to the award's theme of biases that might affect actuarial assessments in insurance, retirement planning, and/or financial risk, Xin's and co-author Fei Huang's research, as described in the article, proposed actuarial approaches squarely aimed to help meet insurance pricing challenges as interest in the regulation of indirect discrimination has been increasing. It posited fairness criteria, explored how they could be used relative to existing and possible regulatory approaches, and provided specific modeling examples for actuaries.

The Academy hosted Xin and two other 2025 Award for Research finalists on a webinar to discuss how actuaries and academics might translate these research findings into practical changes that have the potential to mitigate bias in actuarial assessments in insurance and retirement planning. The webinar recording is available on Academy Learning (learning.actuary.org; member login required). For additional discussion on the implications of Xin's research, the Research Committee is developing an issue brief, to be published in 2026, highlighting perspectives on how actuaries might take the findings from Xin's award-winning research and apply them in current practice.

Endnotes

[1] Guidance Resource: AI and Discrimination in Insurance, Australian Human Rights Commission, 2022.

[2] "Antidiscrimination Insurance Pricing: Regulations, Fairness Criteria, and Models," *North American Actuarial Journal*, 2024.

[3] "The Discriminating (Pricing) Actuary," *North American Actuarial Journal*, 2023.

[4] Towards Fairer Retirement Outcomes: Socio-Economic Mortality Differentials in Australia. Available at SSRN, 2025.

[5] Welfare Implications of Fair and Accountable Insurance Pricing, Available at SSRN, 2025.

Pauline Reimer, ASA, MAAA

PRYOR

Executive Search

The Perfect Fit...

It Takes One to Know One...
An Actuary Placing Actuaries

To have Pauline personally advise you on finding your perfect fit, please contact her at:

✉ pauline@ppryor.com

🌐 www.ppryor.com

📞 (516) 935-0100 x 307 or (866) 6-ACTUARY

For five decades, local, national, and international insurance communities have benefited from Pryor's exceptional recruitment services.

Our renowned Actuarial, Risk, and Modeling Division has been directed by Pauline Reimer, ASA, MAAA, for the past thirty-five years.

JOB SEEKER
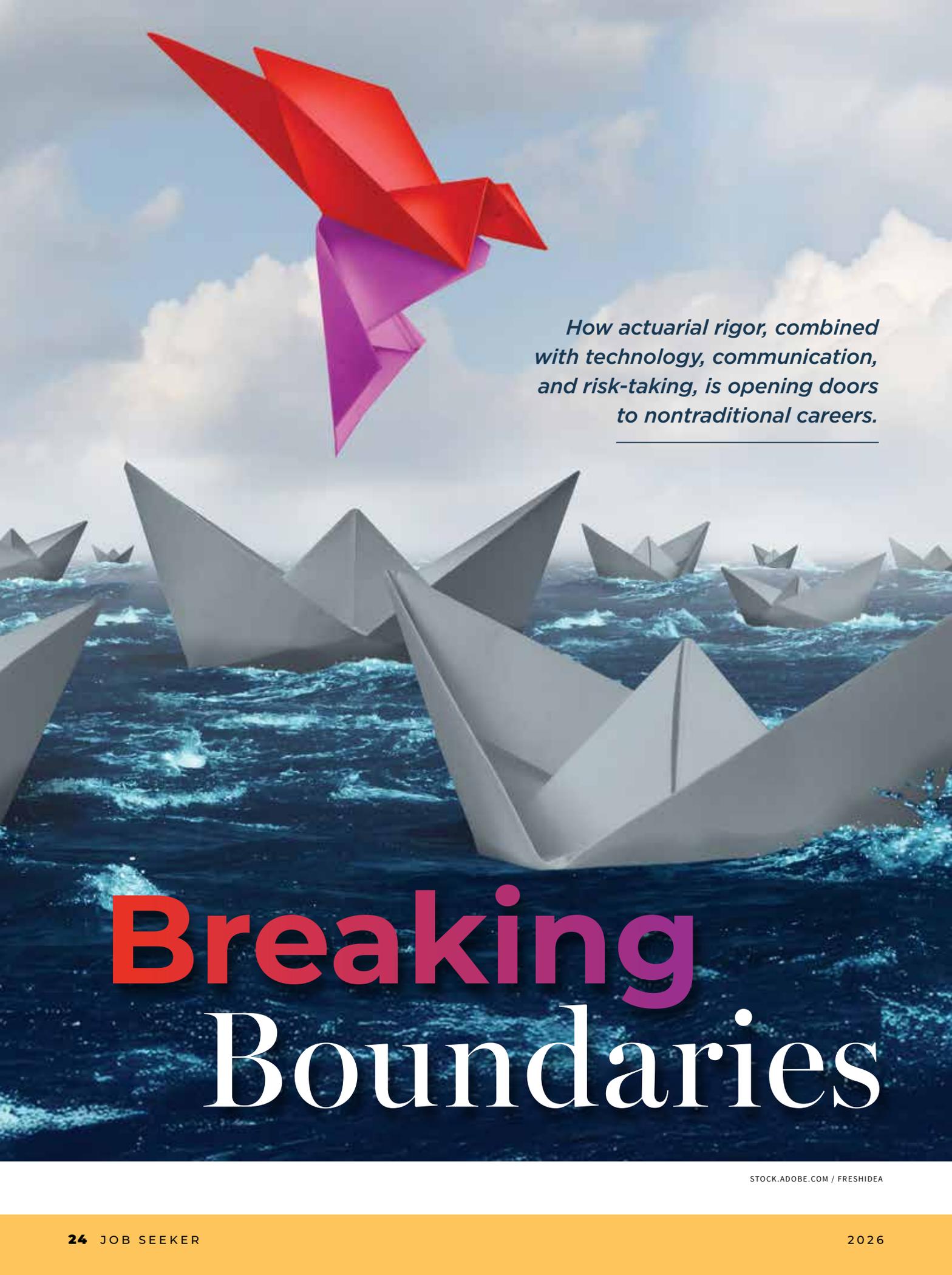
How actuarial rigor, combined with technology, communication, and risk-taking, is opening doors to nontraditional careers.

Breaking
Boundaries

BY BARBARA BRYANT

For many actuaries, a typical day involves analyzing and predicting risks, helping set insurance premiums, or calculating pension plan reserves for an insurance company. These skills not only support actuaries in traditional roles but also enable them to expand into new positions, sometimes in industries where actuaries have rarely, if ever, had a formal presence.

The trailblazers featured in this article attribute their success in seizing such opportunities to mastering skills beyond the standard curriculum, taking risks to chase their passions, and learning from others. They include Chelsea Adler, senior state product manager and actuary at Root Inc.; Frank Chang, Uber's vice president of Applied Science; Ian Duncan, adjunct professor of actuarial statistics, University of California, Santa Barbara; Kyle Bartee, founder of Aviation Ops Ally; and James Guszcza, cofounder and a principal at Clear Risk Analytics LLC. They also emphasize that their actuarial skills have been vital in helping them pursue new opportunities and overcoming unfamiliar challenges.

Tackling Technology

"I learned Python early on the job at Uber," recalls Frank Chang, who joined the company nearly 12 years ago. "I needed to process a lot of data to calculate mileage, which you can't do in Excel." That's just one example of the skills Chang had to acquire after leaving his lead actuary job at Google, where the company had a far smaller automotive footprint.

As Uber's director of actuarial services, he focused heavily on risk assessment related to the significant insurance coverage Uber purchases from large carriers. He then moved into increasingly varied roles, first as head of Insurance and Safety Analytics and later as head of Core Safety Analytics. Now, as vice president of Applied Science, Chang manages large actuarial and data science teams that focus not only on safety and financial risk, such as fraud, but also on applying data science across a wide range of operational functions. These functions include customer service reporting, identifying customer payments within the Uber app, managing worldwide payment flows, and ensuring reliable messaging across Uber's ride-sharing platform.

Ian Duncan drew on his graduate degree in economics, a Ph.D. in actuarial science, and experience in management consulting, predictive modeling, and value-based contracting to found or co-found several health care data companies, as well as an employee benefits decision-support company. He has worked for a diverse set of employers, ranging from Aetna and PwC to Walgreens and the University of California, Santa Barbara, where he serves as an adjunct professor of actuarial statistics.

In 2023, Duncan sold his last company, Santa Barbara Actuaries, to Arbital Health, a software company focused on the health care industry's transition to value-based care.

While using his insurance expertise to advise clients on lines of business strategy and product development, financial projections, and enterprise-wide systems for PwC's managing consulting practice, Duncan also worked with SAP, a German company that develops enterprise software to manage business operations.

"That was unusual for an actuary—helping to implement big systems, including finance, HR, and supply chain operations for insurance companies. This is how I learned about technology and systems," he explained.

Duncan began using the underwriting systems he developed and claims data to build predictive models that could identify which individuals were likely to incur high medical costs. "What I knew about predictive modeling was in demand; there was a

need to find a way to deliver predictions to clinicians who could manage patient risk, so I helped a few health plans implement these systems. My approach was to take predictive modeling and build workflows and systems around it. And now, actuaries are beginning to be hired to do predictive modeling in-house for physicians."

That led him to co-found a company focused on health care predictive modeling and workflow systems technology, which he and his partners sold at the height of the dot-com bubble.

"Doctors and engineers know how to build technology and about health care, but [they] don't know how to get paid for it," Duncan said. "In health care engineering startups, actuaries understand the payers and payment mechanisms. That's what I've built business on in the last 25 years; it's interesting non-traditional work and I get to see a lot of startups."

For Kyle Bartee, founder of Aviation Ops Ally, stepping into a hybrid technology-and-actuarial role helped propel his career forward. As an intern studying actuarial science, he learned how to use Excel hotkeys to create macros, spreadsheets, and templates, including a rater template product that reduced the time required to process 100 policies from eight hours to just 10 minutes. The process efficiencies he developed quickly elevated him from the company's "Excel guru" to a project manager, setting him up for continued success. Later, while working at a 1-year-old startup, he helped engineers develop rules for a program that enabled the company's internal policy management system to handle renewals more efficiently.

"It was an IT project, not actuarial, but from there I became the company's underwriting and product manager. I was also the IT and business analyst, translating business requirements into IT requirements." Bartee also handled pricing, reserving, and reinsurance; managed relationships with program administrators; and took on reporting responsibilities. "After a while, I realized I could do all of this on my terms, so I started my own aviation insurance company."

James Guszcza, a principal at Clear Risk Analytics LLC, was the first person to serve as Deloitte's U.S. chief data scientist. While working at the Allstate Research Center in 1999, he built the company's first continuous credit scoring model. He first learned what would later be called "data science" through a short professional development course on statistical learning by Trevor Hastie and Rob Tibshirani, several years before their (and co-author Jerome Friedman's) seminal textbook, *The Elements of Statistical Learning*, was published.

After moving to Los Angeles, Guszcza accepted a predictive modeling role with Deloitte (then Deloitte & Touche), using artificial neural networks—a simpler form of deep learning that today is the cornerstone of AI engineering.

"I suspected that neural networks weren't the right tool for messy and sparse commercial insurance data and, indeed, we quickly embraced linear models," Guszcza recalled. "Deep learning is a big deal today because text, films, conversations that are digitized and stored in the cloud, can be treated as training data for machine learning algorithms. And this gives us things like image recognition and generative AI. In contrast, commercial insurance data is thin, heterogeneous and noisy—so [it] calls for simpler models.

"Part of the joy for me was the ability to experiment and the feeling of creating a new sub-discipline," Guszcza explained. "The work we were doing wasn't mainstream or taught in universities, which focused mostly on principles of statistics but not on how to apply them—and certainly not in commercial insurance."

Leaning in Hard on the Soft Skills

Technology's usefulness in helping actuaries collect, organize, and analyze vast amounts of data—and streamline processes and procedures—are indisputable. But many of those featured in this article pointed to another type of expertise as equally essential and often harder to master. They stressed the importance of developing soft skills: empathy—the ability to understand other people's perspectives, priorities and concerns—as well as clear, persuasive communication and presentation skills, and the ability to lead and motivate others.

"Learning technology isn't that hard," Chang said. "It just requires dedication. Mastering soft skills is harder. You need to gain trust from your colleagues and clients to win business. It requires networking, storytelling with data, and understanding your audience, which I learned the hard way by doing post-mortems on bad meetings."

Chang recalled a sales forecast presentation he made to Google executives after the company bought Motorola's phone line. "I rearranged data into triangles—a format actuaries understand—to examine variables that could affect phone sale volume," he said. "When I presented the results to leadership, I pegged sales at the 75th percentile, but they didn't understand what that meant until I reframed it as our having a 1-in-4 chance of hitting our sales target. That, they understood."

> **"Learning technology isn't that hard. It just requires dedication. Mastering soft skills is harder. You need to gain trust from your colleagues and clients to win business."**
> —Frank Chang

Chang learned a similar lesson while pitching a proposal to executives at Uber, where he highlighted the accuracy of his phone sales forecast to demonstrate his skill set. "I failed by just focusing on my successes. They weren't that interested. If I'd taken the time to read the room, I could have provided more background that mattered to them. I should have prepared by showing more curiosity and doing more fact-finding. You also need to know how to collect intel by holding back-channel conversations."

Bartee stressed the importance of efficiency and brevity. "One of my biggest barriers I had to break down as an actuary was overexplaining when talking to executives or decision-makers. Actuaries tend to want to display the depth of their analysis to add credibility to what they're proposing. It took me 10 years to realize that I overexplained my pitch, which was why executives weren't adopting my proposals. I was so far in the weeds that I was losing my audience."

He advised paring that 20-slide presentation you worked so hard on down to three, and using plain language to get the point across.

"Executives need to move fast, so the longer you take to give them the information, the greater you're at risk of losing them," Bartee said. "Show the meat and potatoes in the first graph, with a little context. Follow that up with one [slide] on implementation strategy, KPIs, or metrics you're going to influence, and finish with the estimated impact—all translated into language they'll understand."

Duncan also drove home the importance of developing effective communication skills.

"I advise actuaries to practice making public presentations and to write," he said. "I never refuse an opportunity to speak into a microphone. Some years ago, I interviewed former Academy and SOA [Society of Actuaries] president Barbara Lautzenheiser, about how she

grew her practice. She explained that she never turned down the opportunity to get behind a microphone. She once said, 'I turned from mousey to mouthy.'"

Accentuating Actuarial Acumen

Although this article focuses largely on nonactuarial skills, experiences, and roles, all of those interviewed emphasized that the rigorous training the profession provides has been central to their success.

After working as a pricing actuary at State Farm, Chelsea Adler joined Root Inc., an auto insurance startup in Columbus, Ohio, where she moved into state management. In this role, "I'm almost a mini-CEO for the markets I'm responsible for," she explained. "I own profit and loss and am responsible for every decision in the states I'm assigned to. It's a unique and exciting opportunity because it gives me exposure to every aspect of insurance."

She said that her work overlaps somewhat with her previous actuarial work, including decisions on rate calibration, implementing models for filings, and maintaining relationships with regulators.

"But now I'm involved much more broadly with our insurance products, such as underwriting and claims," Adler said. "Getting to use data to drive those decisions leverages my actuarial skill set, but I'm applying it to solve different problems."

Adler also credits actuarial training with opening doors to a variety of other professions, noting that she has seen former co-workers transition into product management, software engineering, and data science careers, and points out that Root's CEO is a credentialed actuary.

"The training ensures you have the necessary rigor from a statistical standpoint, so decisions are data-driven, and it pairs that with an understanding of the business you're operating in. We're strong analytically and can apply that appropriately and recommend sound business decisions because we understand how insurance works and the fundamentals of what we're building models for."

Duncan explained how he has used his actuarial skills and predictive modeling to work with health care providers to help them track health insurance costs. "The industry needed someone who knew technology and the data side of things, and I developed a consulting practice on that, working with a now-defunct industry trade group, Disease Management Association of America, which managed chronic populations." As the only actuary in the group, which was composed mainly of doctors and businesspeople, he was able to explain how money flowed from insurers to doctors and hospitals. "If you want to demonstrate that you reduced costs, you need an actuary to assess whether you've been successful at lowering cost per member per month," he explained.

Guzscza foresees a broader, more ambitious role, and sphere of influence for insurers—and actuaries—because of their ability to draw on statistics, data science, and behavioral science to improve human judgement and decision-making. He believes this could be accomplished by integrating machine learning methods, Internet of Things and digital technologies, artificial intelligence (AI), and behavioral economics to help insurers encourage policyholders not just to insure against risks but actively reduce them.

"This might take the form of giving policyholders timely reminders, social-norm nudge messages, customized checklists on how to fortify their homes, instructions for improving fire safety by clearing brush or weatherproofing windows before storm season, and guidance on improving their driving habits and safety behaviors on the job," Guzscza explained. To this end, he envisions the emergence of "a breed of business- and social-minded actuaries [who] will help broaden our focus beyond traditional actuarial segmentation and profitability to create business models that improve the customer experience and create new forms of value for policyholders. This could be a way of making a kind of 'behavioral actuarial science' mainstream."

Taking on Risks—and Creating Opportunities

Transitioning to new roles often requires the ability and willingness to step out of one's comfort zone—to react in unfamiliar ways to new situations and make decisions and predictions based more on current operational factors and less than on historical data.

Chang described a credit card project that Google wanted to offer to its ad buyers. "The company didn't know how to set the risk threshold, how much to charge, or what the underwriting risk was likely to be—they had no data. I pulled

Transitioning to new roles often requires the ability and willingness to step out of one's comfort zone—to react in unfamiliar ways to new situations and make decisions and predictions based more on current operational factors and less than on historical data.

hundreds of prospectuses for buying securitized debt. I used this information to simulate debt outcomes for default and used it to launch the card. My predictions weren't quite as accurate as they were for the Motorola phones, but you have to solve a problem. I don't take a strictly actuarial approach to everything I do, but I never stray far from my roots; my work has to be quantifiable and accurate."

Duncan believes his academic background helped equip him to succeed as an entrepreneur, but he felt he couldn't take on the professional risk of launching his first startup until one of his children was in college and the other had graduated. While acknowledging the uncertainty taking such chances poses, he suspects others are simply reluctant to venture out of their comfort zones.

"The money is so good in traditional roles that stepping into the unknown and taking a huge pay cut in hopes there'll be a big payoff in the future is the type of risk not many are willing to take on." But, he added, "On the other hand, I also know that I don't make a good employee; I learned that I needed to work for myself."

Duncan believes that the actuarial profession should encourage its members not to stay in their lane. "The biggest need isn't education; it's to get actuaries to become more entrepreneurial, innovative, and continue to learn. We're trained to say no, to follow regulations, that's much of what we do. But many actuaries actually are entrepreneurial and we need to find ways to encourage that."

"Always think about how you can improve something and, if you're

interested in entrepreneurship, develop something new yourself. That's what differentiates you: what you can turn into a product or service. And everyone should start a company at some point in their career," he added. "You'll learn how difficult it is and will be less likely to complain about your boss. It's not easy, but it is rewarding, and you learn a lot quickly."

Duncan has helped young and future actuaries do just that. He has hired a number of former students to work for him. He recalled one who joined him as a business partner and later turned an idea into a new startup the two of them launched, which is now run by that protégé.

Adler said she was grateful to take on the unfamiliar and more ambitious leadership and planning roles her state management position entails, which she believes helped her gain a deeper and more holistic view of the company she joined.

"Mine is less of an execution role and more of an influence role now. I'm setting the priorities rather than having them handed to me and I'm executing on them. It's important to invest in relationships so I can get priorities I think are important onto a roadmap to help make them happen."

Adler also has better insight into how and why upper management decisions and plans are made. "I understand now that this is why we do things a certain way and that there's so much more to the picture than I could previously see. It gives me a valuable perspective on pain points that I hadn't known about. If I stepped back into a traditional actuarial role, I could use this perspective."

Paying it Forward

Several of these trailblazers are thankful to role models and helpful colleagues who supported their progress, and they have committed to mentoring others in turn. Adler said her father, an agent at State Farm, modeled how to help others and encouraged her to develop leadership skills. She recalled accompanying him and her sister on trips to policyholders' homes after storms to help them clean up their yards. She has sought to pave the way for others to enter and excel as actuaries through her blog, *Inspiring Actuaries* (inspiringactuaries.com), and by recruiting volunteers to write and grade actuarial exams. And she's found that she gets as much from volunteering as she gives.

"Most people want to pay it forward, but I've never met someone who didn't get something in return: gratitude or new friendships they never anticipated. And the people you meet or reconnect with can open the door to new opportunities. It's a powerful way to project your career forward."

Bartee said he started his company to use his actuarial skills and insurance industry knowledge to support the goals of those who share his passion. "I'm not in it for the money. I want to help all general aviators get from the hangar to the horizon with fewer of the pain points they experience before they get to fly."

Duncan, who is the Society of Actuaries' president-elect, said, "I'll also put in a word for academia." The university professor, who has taught and guided more than 1,000 students over the years, said, "It isn't for everyone, but for an actuary who wants to give back to the profession and is able to afford a pay cut, teaching, training, and mentoring young actuarial students is extremely rewarding." ▲▲

BARBARA BRYANT is a technical writer at the Academy.

Actuaries and AI: Opportunity with Guardrails

Actuaries are finding many interesting ways to use artificial intelligence (AI) to advance their careers and help clients. That said, they also recognize that "guardrails are needed," says Chelsea Adler, senior state product manager and actuary at Root Inc.

Frank Chang, Uber's vice president of Applied Science, treats AI chatbots as a teaching—and testing—tool. "I ask the product I use to employ the Socratic method to teach me about a subject. I ask it for useful information and resources and then tell it to ask me questions to see if I understand what I've learned. It helps me to figure out what questions to ask, what problems to solve, and who to talk to about a particular space."

James Guszcza, a principal at Clear Risk Analytics LLC, believes it's a mistake—and an underestimation—to view AI as simply a "labor substitution technology" or a way of using an algorithm to automate decision-making. He asks, "How do you create a human–algorithm system that produces the right outcome?" He's also excited about the prospect of using generative AI to revise human workflows and urges exploration into "when and how to design and deploy AI to streamline ratemaking, rate filings, competitive analysis, customer support, claims adjudication, marketing, underwriting, nudging safer risk behaviors, and so on. It's a great set of issues for actuaries to get involved in."

Guszcza believes that actuaries have a valuable role to play in promoting responsible AI use. "If the AI world had something analogous to the actuarial profession, its practitioners would be more than machine learning engineers. They would also need to understand different ideas of algorithmic fairness; they'd work to understand how different stakeholders are affected by AI algorithms, and to design and deploy them in ways that respect their safety and autonomy. The current landscape creates a need for people who both understand the technology and are willing to be socially responsible actors. To me, that sounds reminiscent of the actuarial profession."

Kyle Bartee, founder of Aviation Ops Ally, recalls that when he was working as a pricing and reserving actuary, he used AI to master a specialty he knew nothing about: reinsurance. In less than a month, he learned enough to help conduct a $2 million reinsurance negotiation on the fly. "After three weeks of self-training using AI, I was able to dig into the contract, review previous contracts and get a reduction in the capital requirement for the older contracts to offset the $800,000 in capital the company was asked to put up for the new one. I learned how to wield AI like Excalibur. But I don't use it in legal contracts or to understand FAA regulations because I don't have that subject-matter expertise to identify hallucinations or outdated information. I only use it in areas where I'm fluent."

Adler sees AI as a useful tool but stressed that rules and training are needed to ensure the technology is used responsibly and accurately. "I've heard from people who have hired interns or entry-level actuaries that they're lacking the ability to think deeper, to question things, and to consider whether the output they're receiving is reasonable," she said. "They're just taking it at face value, so training on how to interact with tools as they evolve will be important for actuaries."

Ezra Penland

The Leaders in Actuarial Recruitment

111694
Lead Product Actuary – P&C – Atlanta/Remote
- Highly visible role influencing product & pricing strategy
- Support rate adequacy, underwriting, and long-term profitability across admitted products
- ACAS/FCAS with 5+ years' MPL experience
- Exposure to state regulatory DOI rate & rule filings
- Strong programming tool proficiency

111228
Chief Actuary – P&C – Multiple Locations
- Lead client engagements, provide strategic insights, and identify growth opportunities for a Regulatory-focused Consulting firm
- Develop new tools & methodologies and evaluate rate & rule filings, ensuring regulatory compliance and high-level deliverables
- ACAS/FCAS with 10-15+ years' P&C actuarial experience
- Strong pricing and reserving background with Commercial and Personal lines expertise
- Proven leadership with exceptional presentation & project management skills

111164
Senior Actuarial Pricing Analyst – P&C – Atlanta
- Work on diverse actuarial projects and foster meaningful business relationships, contributing to profitability & innovation
- Provide complex pricing analyses and risk assessments
- Participate in product design and executive facing pricing discussions
- Leverage actuarial tools & statistical software to support financial reporting and trend analysis
- 3+ years' P&C insurance experience and 3+ exams (Exam support available)
- Hands-on database management and SQL proficiency
- Excellent presentation & project management skills

111453
Actuary & Underwriting Analyst – P&C – Chicago
- Pricing role primarily focused on Workers' Compensation
- Collaborate closely between Actuarial & Underwriting
- 1-3+ years' P&C insurance experience including close partnership with Underwriting
- 2+ exams to recent ACAS (Exam support available)
- Excellent attention to detail & project management skills

111653
Healthcare Data Analyst – HEALTH – Florida
- Support Actuarial Healthcare Consulting team through data extraction, analysis, transformation, automation, and reporting
- Manage large claims datasets, build & validate data workflows, and produce client-ready reports
- Relevant Bachelor's degree required and 2+ years' experience in healthcare data analytics/engineering
- Strong SQL/SAS proficiency with the ability to clearly communicate complex data findings

111176
Senior Actuary – LIFE – Midwest
- Strategic Senior role leading high-impact initiatives across financial planning, capital analysis, valuation, pricing, and product development
- Partner cross-functionally and with senior stakeholders to deliver actionable business insights and shape profitability for Life & Annuity
- Participate in optimization of actuarial tools and processes
- FSA with 10+ years' actuarial experience
- Exceptional communication & technical proficiency

110997
Associate Actuary – LIFE – Chicago
- Role focuses on capital markets risk management, dynamic hedging strategies, and advanced model development
- Support financial reporting, M&A due diligence, and product development
- Collaborate cross functionally to deliver high-impact client solutions and enhance modeling tools
- ASA with 2+ years' actuarial experience
- Strong technical & project management skills

111619
Actuary & Manager – LIFE – Northeast
- Oversee a small team and collaborate broadly to deliver accurate, well-controlled results
- Own and enhance actuarial models and analyses
- Communicate insights to leadership, partners, and auditors
- FSA with 5+ years' experience including strong valuation/ financial reporting background
- AXIS modeling experience and knowledge of international regulatory and financial reporting frameworks desirable

111625
Actuarial Analyst IV (Medicare) – HEALTH – Remote
- Develop and maintain advanced Medicare Part D pricing models and develop bid assumptions
- Assess financial risk, support regulatory documentation, and inform strategic decision-making
- Analyze product line financials, pricing, reserve, valuation, and perform cash flow analysis
- ASA with 6+ years' actuarial healthcare/Medicare experience
- Proven leadership with the ability to build cross-functional relationships
- Good work-life balance and competitive salary package

111726
Stop-Loss Actuary – HEALTH – Northeast/Remote
- Analyze large healthcare claims datasets, build stop-loss pricing models, and help promote business growth
- Lead discussions with business partners & underwriters
- Contribute to market insight, support product & program design, and promote data-driven decision-making
- Near-ASA to FSA with 5+ years' experience and deep stop-loss expertise
- Strong business acumen and advanced technical skills

EzraPenland.com | Actuaries@EzraPenland.com | 800-580-3972

We Listen

We care about you, and we want to help you find the best job for you!

Your recruiter at Ezra Penland will take the time to understand your skills and interests, and your career aspirations and goals. We also know personal preferences play a big part in deciding what the best next move will be, and those are very important, too.

We work hard to understand all the factors that are important to you, and to find the best fit, with the idea that what is the best fit for you will also make for a great fit for your future employer!

Our Mission

Our mission is to be the leading actuarial recruitment firm in the world while serving the long-term needs of clients and actuaries.

Our educated, knowledgeable, and highly trained staff will always exhibit business ethics, integrity, empathy, and strong listening skills to help you reach your goals. When our candidates and clients are happy, we are happy.

2025/2026

Actuarial Salary Surveys

Maximize Your Earnings

View the industry's best compilation of salary information using the QR code above.
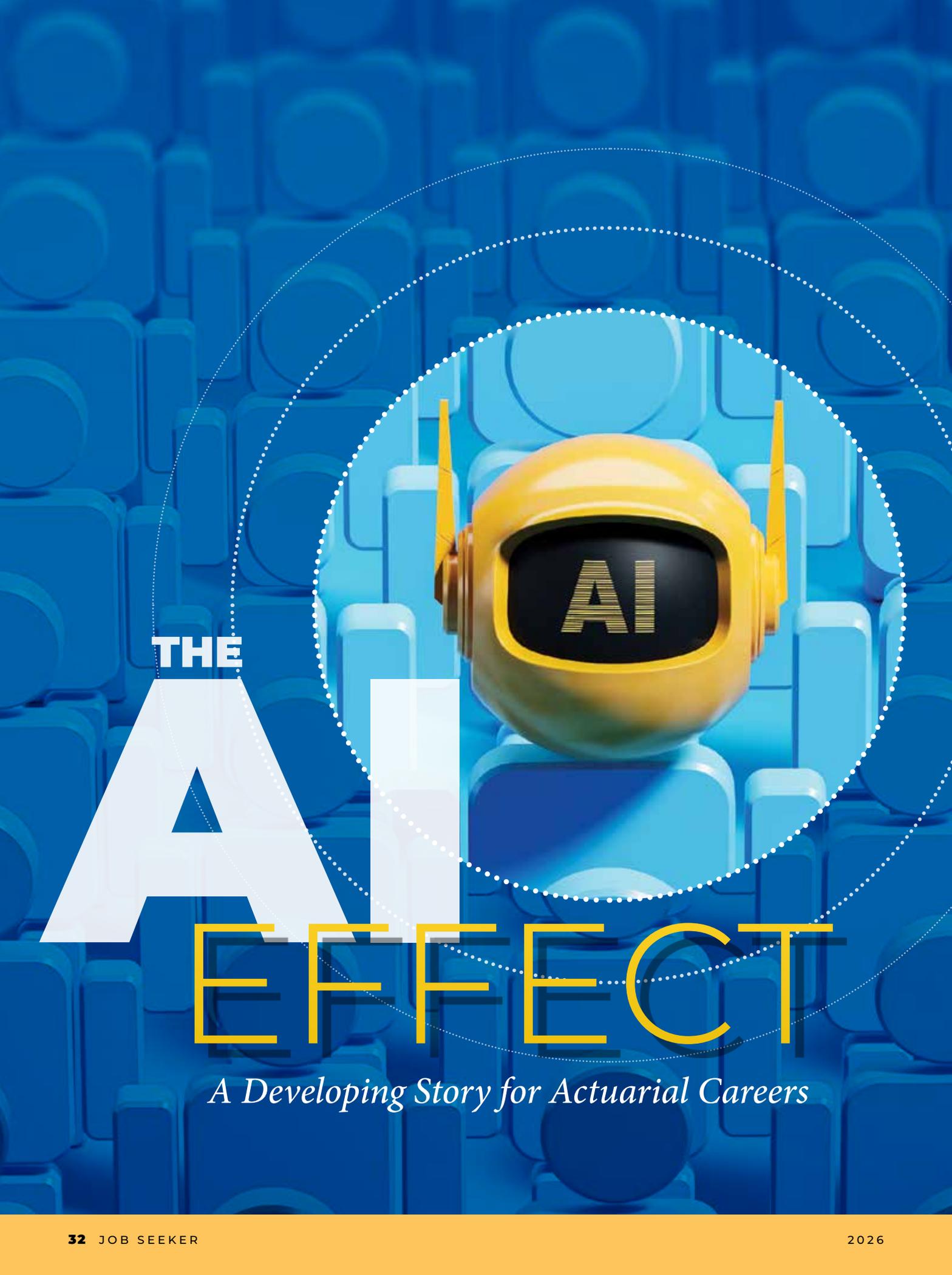
THE AI EFFECT

A Developing Story for Actuarial Careers

Find out how artificial intelligence is reshaping roles, skills, and the very structure of the profession—and how actuaries can thrive in this evolving landscape.

BY SALLY EZRA

THE ACTUARIAL PROFESSION has witnessed various technologies that were considered threats to the profession. With each technological shift, the demand for the actuarial skill set has only increased. Will artificial intelligence (AI) be different? Will actuarial jobs be automated? Will they go away? This is one of the most frequently asked questions, and although no one knows for sure what the future brings, optimism outweighs pessimism. This is clearly a developing story!

To understand AI's potential impact, it helps to reflect on how past technologies reshaped the profession.

"Predictions that technology will reduce the need for human labor have a long history but a poor track record," says a Goldman Sachs article, "How Will AI Affect the Global Workforce?" The computer is a great example. Computing power was once viewed as a serious threat to the actuarial profession. Many thought actuaries would be replaced, but the exact opposite occurred, and it evolved into a highly useful tool that actuaries across the profession now embrace.

But AI, a technology that can tackle an expansive array of tasks, and generative AI that can learn, are evolving at a remarkably rapid speed. For some, AI is a technology that threatens to automate virtually any task and replace us all! For others, it is a tool that will allow actuaries to increase their value.

To better understand how new technologies can create opportunities, it helps to look at historical examples outside the actuarial field.

The quick rise of the tractor in the early 1900s gives an interesting perspective on changes brought on by technology. By 1945, it became evident that horses and mules had been sent out to pasture in favor of tractors.

The animals as tools were replaced, but the humans adapted. Perhaps fewer people were needed to work the land, but factories that made tractors had to be built, new factory jobs emerged, the tractors had to be sold, farmers were still needed to

Tractor Power Overcomes Horsepower in 1945
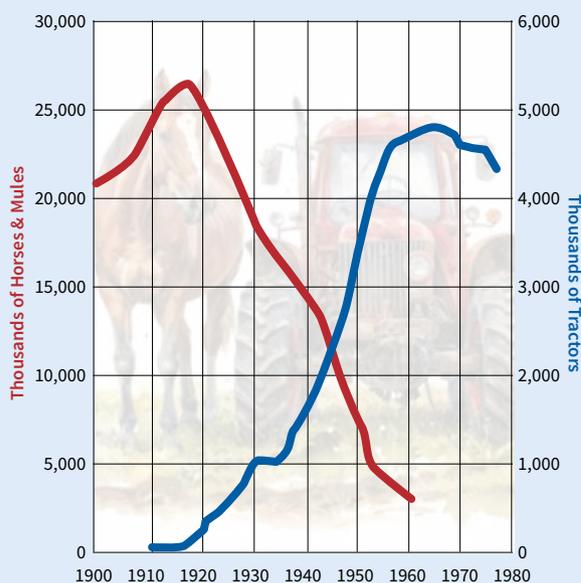
Animal and tractor power. Data from U.S. Dept. of Commerce. (Graph based on estimate that one tractor could replace five horses on a farm.) Source: Cato Institute

work the tractors, they needed diesel to run, and they needed to be serviced. Jobs evolved, and the new technology—the tractor—was a substantial net positive for job creation.

Similarly, AI may create new opportunities for actuaries, even as it changes or eliminates certain tasks.

New Opportunities

A *Fortune* magazine article quotes Nvidia CEO Jensen Huang, who, at the U.S.-Saudi Investment Forum in November 2025, said he believes "the technology will unleash a wave of new ideas and unfinished projects—leaving people busier, not freer, as 'everybody's job will be different.'" These new ideas, and the projects that will be picked up again as they can now be solved with the help of AI, will almost certainly result in more work that needs to be done.

Chuck Bloss, MAAA, FSA, FCA, believes actuaries stand at the crossroads of data and discovery. "By embracing emerging technologies like machine learning and automation, we can unlock deeper insights and redefine the value we bring to organizations and society," he says. "Yet true innovation must always be grounded in the core principles and standards of practice that define our profession. Those who courageously adapt will shape the future of actuarial science, and those who don't risk being left behind by it."

John Buchanan, MAAA, FCAS, sees a shift in the role actuaries will play, predicting the possibility of a reduction in the need for traditional and repetitive skills, along with an expansion of the roles of savvy actuaries. It may take time to understand how and when, but it is widely understood that the role of the actuary is going to evolve.

Preparing Members for AI

The actuarial profession's governing bodies and societies have always gone to great lengths to ensure two things: that the profession remains relevant and strong, and that its members are prepared for what lies ahead. Today is no different. All hands are on deck to ensure the profession is prepared to embrace this technological moment and flourish.

The Academy's *Actuarially Sound* blog post, "The Academy Is Engaged as AI Use in Insurance Increases," underscores the Academy's commitment to serving as a trusted resource across actuarial disciplines and various stakeholders, particularly regarding policy and standards of practice, as AI adoption in insurance accelerates.

In his presidential address at the 2025 Casualty Actuarial Society (CAS) Annual Meeting, Dave Cummings, past CAS president, said, "We are a profession that collectively advances our knowledge and instills ethics to guide us through times of change and innovation. All of these factors matter in building and controlling AI applications that can be trusted by our employers, by our industry, and by society at large."

A Google search of either the Academy, Society of Actuaries, or CAS, combined with the term AI will produce a significant number of results that illustrate the many ways the actuarial organizations are helping prepare their members for the changes being brought by AI.

> **Most professions do not have governing bodies to prepare their field like the actuarial profession does, and do not have strict standards of practice that actuaries need to follow—standards that AI cannot be depended on to adhere to.**

When I speak with aspiring actuaries at various universities, the most common question that arises is about the impact of AI on hiring. I let them know they are entering a field with societies that are committed to the profession, and how unique that is. Most professions do not have governing bodies to prepare their field like the actuarial profession does, and do not have strict standards of practice that actuaries need to follow—standards that AI cannot be depended on to adhere to.

With the profession and its standards in mind, actuaries can take concrete steps to thrive in a landscape increasingly influenced by AI.

Building Skills to Thrive

Brad Lipic, ASA, whose career has been focused on the implementation of new technologies, recommends newer entrants to the field concentrate on developing deep foundational knowledge and strategic adaptability.

"Don't rely solely on this super easy access that we have to external systems or automation to do the thinking or knowledge storing for you," he says. "Fully understanding core actuarial concepts and technical skills is non-negotiable. Without that foundation, you won't be able to judge whether an

AI-generated solution is reasonable or useful. Organizations will always need people who understand the principles behind the models and the mechanics of machine learning and AI. AI is taking over many routine tasks, which means your value will increasingly come from thinking bigger picture; acting as an orchestrator, designer, and architect of solutions."

Dominic Lee, ACAS, who is known as "the Maverick Actuary," has interviewed hundreds of insurance professionals—with one of his goals being to help actuaries add value far beyond being technical resources. He describes three interrelated topics that are important for actuaries to keep at the forefront. "The first is not having a clear understanding of how their work impacts the organization," he says. "That limits the scope and depth of their contributions. The second is when decision-makers are not aware of their contributions. In that

case, they are not top of mind when new opportunities and promotion discussions arise. The third is not having a proactive mindset toward development. Actuaries who do not seek growth and stretch opportunities tend to stagnate in their careers."

Another piece of advice that Buchanan gives is to "take AI courses and make it your friend." He says that for actuaries to understand AI and use it effectively, "actuaries need to understand the limitations of AI, as it will be wrong quite often and just not stand up to actuarial or logical sniff tests. As human brains potentially get lazier just letting AI do it, the more difficult it will be to keep critical thinking skills sharp. Those who let critical thinking skills slide may have the farthest to fall; those who can master its amazing potential will rise the farthest."

When asked what he believes actuaries need to understand about AI to use it effectively without losing the core actuarial

AI Applications in Actuarial Work

Generative AI (GenAI). AI that creates new content (text, images, code, models) based on patterns in data.
Actuarial angle: Accelerates documentation, analysis, model building, and scenario design.

Agentic AI (AI Agents). AI systems that take actions autonomously, not just answer questions—like scheduling tasks, running workflows, or completing multi-step analyses.
Actuarial angle: Could automate end-to-end processes like data cleaning → modeling → reporting.

AGI (Artificial General Intelligence). Hypothetical AI with human-level reasoning across any task.
Actuarial angle: Not real today—but often referenced in conversations about AI's long-term future in decision-making and risk. Some predict it can happen as soon as 2026, while others believe it will take decades.

Machine Learning (ML). Algorithms that learn patterns from data to make predictions.
Actuarial angle: Core technique behind pricing, reserving, and underwriting models.

Natural Language Processing (NLP). AI that reads, interprets, and generates human language.
Actuarial angle: Useful for policy review, claim notes, underwriting files, and consumer sentiment

Computer Vision. AI that interprets images and video.
Actuarial angle: Used for property inspections, auto damage estimating, and fraud detection.

Explainable AI (XAI). Methods that make AI decisions transparent and understandable.
Actuarial angle: Crucial for regulatory compliance in pricing and underwriting.

Large Language Models (LLMs). Advanced AI trained on massive text datasets to generate language outputs.
Actuarial angle: The brains behind today's GenAI tools used for documentation, coding, and analysis.

Telematics AI. AI models using real-time driving data.
Actuarial angle: Used for UBI (Usage-Based Insurance)

Fraud Detection AI. ML systems that identify anomalous behavior.
Actuarial angle: Used in claims review.

The Impact of AI Hallucinations

Hallucinations occur when AI makes up facts, details, numbers, or citations and presents them confidently as true. These occur because language models predict plausible text, not factual correctness. In actuarial work, hallucinations can lead to regulatory problems, data quality issues, and incorrect assumptions if not carefully checked.

Examples include:

- Incorrect rate filing rules confidently stated as fact
- Invented mortality assumptions that don't match any real table
- Fake loss development sources cited in a reserving memo
- Fabricated competitor rates in a marketing report
- Descriptions of nonexistent insurance regulations

Implications include:

- **Regulatory Exposure.** Providing fabricated or inaccurate reasoning behind pricing or underwriting decisions can violate actuarial standards and insurance regulations.
- **Data Integrity Risks.** AI may invent numbers, citations, or assumptions—damaging models or documentation.
- **Client/Stakeholder Trust.** Hallucinated explanations in reports or emails could lead to misunderstandings or errors.
- **Model Governance Issues.** AI-generated outputs must be verifiable and traceable—hallucinations break auditability.

In order to reduce hallucinations:

- Ask the AI to show reasoning or cite sources.
- Request step-by-step logic, not final answers only.
- Provide structured, complete input.

Communication and Career Success

When discussing what it takes to be a successful actuary, actuarial leaders always mention the importance of communication skills.

When asked what differentiates the actuaries who advance quickly in organizations from those who plateau, Sherry Chan, MAAA, FSA, EA, FCA, MBA, said, "So much of what we deliver is technical at its core. Actuaries who are able to translate this concisely and simply enough for their audience (coworkers, senior leadership, board, client, or others) to grasp really set themselves up for success in the future. Additionally, their ability to stay ahead of the follow-up questions and needs of others and being proactive in delivering solutions to those is one key commonality I've observed in actuaries who have advanced quickly, and continue to advance, in their careers."

Lipic agrees. "The future highly valued and sought-after skills aren't the ones who code every detail, but the ones who can articulate the what and why, ensure quality, and connect disparate systems into something that makes a positive impact."

It's important to learn how to communicate effectively to your audience. Analysis and the output are only valuable if they are effectively used to solve the business problem they aim to address. As technology advances, the ability to communicate not only the answers but also the analysis behind those answers will become increasingly important.

Curiosity and Lifelong Learning

Beyond communication, trust and intellectual curiosity are recurring traits cited as important for one's career growth. Continued learning of both the technologies available and the business context is of utmost importance.

"Stay curious," Lipic says. "Ask why certain prior efforts or solutions failed and always frame your work in terms of solving real business problems that matter to your organization, the industry, and/or society. Those who combine technical depth with strategic vision and adaptability will thrive, standing on the shoulders of this powerful new AI landscape."

Buchanan recommends choosing a topic that interests you—whether it's related to a hobby, your

mindset, Lee replied, "I think the question is more relevant today for generative AI. Always approach responses to prompts with a critical mindset. Never accept the answer as gospel without vetting it. Be grounded in your technical foundational knowledge, actuarial judgment, and ethical principles. As always, be guided by actuarial standards of practice."

Beyond technical expertise, success in the profession also increasingly depends on how effectively actuaries communicate their insights.

profession, or academics—and using AI tools to explore it by asking questions and following suggested prompts within those tools. "It won't take long to see the power of the various AI tools. By actively exploring AI tools and supplementing your investigation with articles and books on the subject, you'll develop your own informed perspective on this transformational technology."

To stay relevant, actuaries need to learn the many uses of AI and continue learning, as changes and applications will evolve rapidly.

To remain well positioned for the future, Lee tells new entrants to the field to first learn the business. "That will help you understand the decisions your work supports. Then focus on developing the technical skills that will be used to support those decisions. Next, learn how the technical work translates into business impact. Finally, learn how to communicate the results of your work so that it actually supports decision-making."

To stay relevant, actuaries need to learn the many uses of AI and continue learning, as changes and applications will evolve rapidly.

Evolving Roles and Responsibilities

AI usage by insurers has the potential to reshape the actuarial positions available by level. I often explain that actuarial opportunities can be described as a pyramid: many positions are available for analysts, fewer as the level rises, and at the tip, only a few very senior roles are available at any given time (with high competition when they do). There is talk of the shape of actuarial roles available shifting into a diamond. The repetitive skills of the analysts are some of the most at risk of being automated by AI, so fewer roles may be available at the junior levels. Then at the level where analysis and recommendations need to be made, the number of roles increases. The number of role reduces again at senior levels.

Insurers and actuarial leaders will need to decide how to align hiring with the needs at the middle and upper levels. The analysis and recommendations will need to be done by people who have learned core actuarial skills—the skills underlying the tasks AI can performing faster and more cheaply. If enough hiring is not done at the entry level, a dire situation could develop, and due to the actuarial path being a long-term journey, the mistake of not hiring and training future problem-solvers and decision-makers will take years to fix. That is a risk the actuarial leaders will need to anticipate and manage. They will need to clearly communicate to leadership that the cost of hiring and training future leaders will be substantially higher than simply plugging AI into those roles.

A Positive Outlook

I have faith that the employment outlook for actuaries will remain strong, and I am excited to see how the profession evolves as it adopts AI. Although I realize that AI is coming in faster and stronger than the emergence of predictive modeling did, there is a comparison I would like to make. When GLMs (generalized linear models) were a new phenomenon, there was talk that data analytics professionals might take jobs away, even at a significant level. The actuarial organizations worked hard to ensure actuaries had the tools and education needed so that data analytics professionals became collaborators instead. The emergence of predictive analytics ultimately increased the demand for actuaries and, in many ways, has become core to the analysis actuaries perform.

Although AI presents numerous potential pitfalls and challenges that make its integration less certain, I believe it will mirror what we saw with predictive analytics: an increase in demand for actuaries—particularly at the mid to senior levels—and new ways of address both old and new problems insurers face.

Actuaries are making bold predictions about AI's impact on the profession. While some are pessimistic, the majority remain optimistic. I have shared some predictions here as well—but please remember, this is very much a developing story! ▲▲

SALLY EZRA is a partner at Ezra Penland Actuarial Recruitment.

Ezra Penland.

Starting Lineup 2026

Your Actuarial Career Dream Team

Sally Ezra
Years: 30
Sally@EzraPenland.com

Kevin Elliott
Years: 14
Kevin@EzraPenland.com

Jennifer Retford
Years: 18
Jennifer@EzraPenland.com

Lauren Scalzo
Years: 11
Lauren@EzraPenland.com

Liz Ritchie
Years: 6
Liz@EzraPenland.com

Thrishna Samaroo
Years: 3
Thrishna@EzraPenland.com

Lauren McKee
Years: 1
Lauren.McKee@EzraPenland.com

Sarah Kluger
Years: 1
Sarah@EzraPenland.com

Bailey Collins
Years: 10
Bailey@EzraPenland.com

Brea Davis
Support Team
Brea@EzraPenland.com

Leia Ziomek
Support Team
Leia@EzraPenland.com

Diane Vanik
Support Team
Diane@EzraPenland.com

Caitlin Ritch
Support Team
Marketing@EzraPenland.com

Peter Trinh
Support Team
Peter@EzraPenland.com

Gigi Castro
Support Team
Gigi@EzraPenland.com

David Mokaya
Support Team
David@EzraPenland.com

EzraPenland.com | **Actuaries@EzraPenland.com** | **800-580-3972**

Bringing
Actuarial Expertise
to Capitol Hill

During the Academy's annual Capitol Hill Visits, volunteers meet with congressional and regulatory staff to share objective, nonpartisan analysis on pressing policy issues. Their input informs decisions, raises the profession's profile, and deepens volunteers' understanding of how their work shapes public outcomes.

FOR MORE THAN 20 YEARS, Academy volunteers have participated in annual Capitol Hill Visits to support the organization's public service mission. More recently, the Academy has been hosting these Hill Visits on a single day in the spring, bringing together all five policy practice councils for an annual "actuaries visit Washington" day, but the purpose remains the same. Volunteers bring actuarial insight and objective expertise to congressional committee staff and individual member offices, addressing key policy issues across practice areas, including Medicare, Social Security, climate events, lifetime income, and artificial intelligence (AI). These conversations play an essential role in helping the Academy demonstrate who we are and how we support policymakers.

With preparations in full gear for the upcoming Hill Visits on March 10, both first-time and returning participants share their experiences in this article.

Reflections on My First Hill Visit

As members of a profession driven by data, modeling, and objective analysis, actuaries bring a unique perspective to discussions about programs that touch millions of Americans, from health care to climate change to Social Security. As part of its mission to provide independent actuarial input on key policy issues, the Academy annually arranges for actuaries to visit Capitol Hill to explain how actuarial expertise can help inform public policy.

In 2025, I had the privilege of participating in my first Hill Visit with a group of about 40 other actuaries who volunteer on the Academy's life, retirement, health, casualty, and risk management and financial reporting practice councils. It was the first time that the Life Practice Council was represented. As a life actuary whose Academy participation focuses mainly on tax issues, I wasn't sure what to expect.

After arriving in Washington, D.C., we attended a training session where the Academy's public policy staff provided practical and strategic guidance on how to approach the Hill Visits. There was an opportunity for role-playing interactions with congressional staff, including how to engage them and which topics to avoid. We were then divided into smaller groups with complementary areas of expertise, allowing us to tailor our conversations to the committees we were assigned to visit. My team included both life and retirement actuaries.

While I've been to Washington, D.C. many times and visited the Capitol building as a child, this visit offered a perspective I hadn't experienced before. Our meetings took place in the Senate and House office buildings, where state flags line the hallways and special "Members Only" elevators carry elected officials to their appointments. Observing the government going about its daily business in these spaces provided a clearer sense of how congressional work unfolds behind the scenes.

The first meeting my team attended was with staff from the Senate Health, Education, Labor, and Pensions Committee. Much of the discussion focused on the challenges facing the Social Security Disability program, particularly how staffing reductions have slowed benefit approvals. The staff also expressed interest in topics such as ERISA and PBGC premiums, and the growing attention around lifetime income options in retirement plans. While the discussion was largely outside my area of expertise, it was interesting to hear how actuarial insights could help illuminate the policy trade-offs involved in these issues.

Later, my team met with staff from the Senate Finance Committee. The conversation centered on a proposal championed by Sen. Ron Wyden to create child savings accounts, a concept that eventually appeared in the One Big Beautiful Bill Act. As actuaries, we were able to provide perspective on how savings patterns, investment design, and longevity expectations could influence long-term outcomes for such a program. Our next stop was the House Budget Committee, where we met with the chief economist. This meeting underscored how valuable the Academy's educational role can be, since not every congressional staffer is familiar with the actuarial profession. Our Social Security expert explained the implications of the Old-Age and Survivors Insurance trust fund's projected depletion and why acting sooner rather than later would provide policymakers with a broader range of options.

One of the most interesting conversations of the day was with a staff member from the House Veterans Affairs Committee. He was relatively new to the Hill and had limited experience with insurance and retirement concepts but was a veteran himself, so he was personally invested in our discussion. We talked with him about veterans' life insurance benefits and the importance of financial literacy for service members transitioning to civilian life. The Academy staff offered to send educational materials, and the staffer asked whether the Academy might testify at a future hearing, a strong sign that these visits truly make an impression.

Participating in the Hill Visits underscored the value actuaries can bring to the policymaking process beyond our technical day-to-day work. I encourage actuaries who can take part in a visit to consider doing so. It offers a practical way to support informed public policy and to represent the profession in an area where our expertise is increasingly relevant.

—**Mary Elizabeth Caramagno, MAAA, FSA**, member of the Life Practice Council (LPC) and past chairperson of the LPC's Tax Committee

Bringing Forward the Unique Actuarial Perspective

As the chair for the Committee on Cyber Risk, I participated in the Hill Visits in 2024 and 2025. Prior to the visits, Academy staff organized a session to review the purpose of the visits, the Academy's history, antitrust and conflict of interest policies, its position to not advocate for specific positions, and its mission to provide expert, objective actuarial analysis of relevant legislation and regulations.

In 2024, Cyber Risk Committee members visited the Office of the National Cyber Director to discuss their initiatives and policies; the Consumer Federation of America to hear consumer perspectives and areas of focus; the Senate Banking, Housing, and Urban Development Committee to discuss CAT and affordability issues; the House Financial Services Committee to discuss the insurance market, catastrophe, and availability and affordability topics; the Congressional Budget Office with a focus on cyber, flood, hurricanes, catastrophic risk, terrorism, and pandemics; the Senate Homeland Security Subcommittee on Cybersecurity and Infrastructure Protection to discuss cybersecurity and TRIA; and the Federal Insurance Office to share our perspective on federal catastrophic incident response, which their office has been engaged in over the past year.

We also joined by the other Casualty Practice Council (CPC) Committees on Climate, Extreme Events, Workers' Comp, Homeowners, and AI in several meetings when schedules permitted. A follow-up meeting was held to brief participants on topics discussed and outline next steps.

For the 2025 Hill Visits, CPC volunteers were organized into three different groups aligned with their expertise across different committees. Team 1 was led by Susan Kent, Team 2 by Lisa Slotznick, and Team 3 by Seong-min Eom. Each team had different committee members during the visit.

I belonged to Team 2 and we visited:
- Sen. Bill Cassidy to discuss subjects related to the National Flood Insurance Program (NFIP), including legislation to extend the NFIP;
- House Financial Services for the NFIP and the impact of climate events on insurance;
- House Homeland Security committee to discuss AI and cybersecurity;
- House Financial Services committee to discuss AI, digital finance, and cybersecurity; and

- Senate Banking, Housing, and Urban Affairs for the NFIP and the impact of climate events on insurance.

Several key property & casualty/climate risk topics were discussed during the Hill Visits, aligned with subjects addressed at many NAIC national meetings: climate change and catastrophe modeling; flood insurance reform; insurance availability and affordability; AI and big data; and cyber risk, including the latest trends in cyber insurance and the Academy's interaction with the NAIC H Committee Cybersecurity Working Group.

The Hill Visits provide significant value to the actuarial profession in several ways: elevating the profession's visibility; demonstrating thought leadership; influencing policy with technical expertise; building relationships with policymakers; professional development and engagement; and strengthening the Academy's mission.

Getting involved in Hill Visits is a great way to contribute to the profession and public policy. The Academy has many practice councils (Health, Life, Pension, P&C, Risk Management) and committees (e.g., Cyber Risk, AI, Climate). Volunteering with one of these groups is often the first step toward participating in Hill Visits.

—Wanchin Chou

The Hill Visits and other meetings held throughout the year help public stakeholders gain a greater understanding of the Academy's role as the the public policy voice for the U.S. actuarial profession, the importance of the U.S. actuarial profession, and the unique actuarial perspective on many public policy issues.

Getting involved in Hill Visits is a great way to contribute to the profession and public policy. The Academy has many practice councils (Health, Life, Pension, P&C, Risk Management) and committees (e.g., Cyber Risk, AI, Climate). Volunteering with one of these groups is often the first step toward participating in Hill Visits.

—Wanchin Chou, MAAA, FCAS,
chairperson, Committee on Cyber Risk

Actuaries as Public-Interest Partners

It's one thing to analyze long-term financial projections from your desk; it's another entirely to walk the halls of Congress and translate that analysis into direct, meaningful insights for those shaping national policy. That principle is one of the Academy's primary missions, and I remember being deeply impressed by it when I first became a member: a commitment not only to the actuarial profession, but fundamentally to the public interest. I knew then that I wanted my professional journey to include contributing to that larger purpose.

For me, the annual Hill Visit has become one of the most direct and tangible expressions of that goal—a chance to apply our actuarial knowledge and skills in service of the public good. There is a profound satisfaction in knowing that, even in a small way, I can participate in that process and engage with those who shape our nation's policies.

While the Academy is in continuous dialogue with policy-makers—sharing our papers and providing analysis throughout the year—the annual Hill Visit holds unique significance. It's a focused, structured event that brings actuaries from multiple practice areas together for a common purpose, enhancing our teamwork and sharpening our message. It was particularly meaningful for me to help establish the first joint visit between the Risk Management and Financial Reporting Council and the Casualty Practice Council and to see that collaborative spirit come to life. Stepping into those congressional office buildings with your actuarial team is a powerful experience.

What surprised me most, though, wasn't the grandeur of the buildings, but the dynamic quality of the conversations. The congressional staffers and agency experts we meet are smart, well researched, and genuinely trying to tackle incredibly complex problems. They aren't expecting us to have all the answers but to share a perspective they can't get anywhere else. We're not there to push an agenda; we're just there to be a resource.

I've had discussions about the emerging risks from climate change and the use of AI, big data, and machine learning; the difficult balance of insurance affordability; and the long-term pressures on Medicare, Social Security, and long-term care systems from an aging population. What I find most fascinating is how these seemingly separate issues all weave together into the broader questions of community sustainability. For instance, a conversation on the impacts of an aging population might begin with Medicare, but it can quickly expand to other areas. I learn so much from the holistic view that policymakers bring, and it's in these moments that the value of our team approach becomes clear. A health actuary might speak to the specific vulnerabilities of seniors. As someone focused on climate, I can then provide context on how a significant weather event, influenced by broader climate patterns, can intensify those risks, which allows a casualty expert to explain the downstream effects on property insurance and community resilience. It's a powerful demonstration that our profession can serve as a reliable, nonpartisan resource across a surprisingly wide range of critical topics.

This experience gives back to you personally, too. It challenges you to distill complex actuarial concepts into clear, relevant insights that speak directly to the policy questions at hand. You also get to connect with fellow actuaries from different practice areas, all united by a shared commitment to public service. It's a wonderful reminder that our skills are not just for our day jobs; they are tools that can directly support the public's long-term security.

I know the idea of "going to the Hill" can sound intimidating, but it's truly a rewarding and collaborative experience. The Academy's influence comes from volunteers like us sharing what we know. If you're a junior actuary curious to see how our analysis informs the policy process, or a senior actuary wanting to contribute in a new way, I'd really encourage you to look into it. Getting involved—whether by helping with an issue brief or joining a visit—is a chance to use your expertise to make a quiet but meaningful difference.

—Seong-min Eom, MAAA, FSA, chairperson of the Climate Change Joint Committee and member, Risk Management and Financial Reporting Council

The Long Game in Policy

One of the core missions of the Academy is to carry forward the knowledge and capabilities of actuaries to support the public policy dialogue. Volunteers bring their individual expertise to bear on this mission, and the Academy helps channel that expertise to maximize its influence with policymakers.

I've participated in a number of Capitol Hill Visits over the years, most often to agencies like the Government Accountability Office, Congressional Budget Office, and Congressional Research Service. Their function is not so different from ours, as they work to shed light on policy issues and identify potential solutions. So, there is an inherent connection, and we strive to build an environment of mutual support.

We've also met on occasion with individual legislators' policy staff members. They usually express active interest in a narrower set of policy topics that are of immediate political interest. But the meetings also provide opportunities to raise awareness of broader, contextual issues that they may not be actively focused on currently but could become important in the future.

Back in the 2000s, there was an extremely active interest in pension funding reform. The Academy and other groups invested considerably in analyzing various policy alternatives, and there was a significant opportunity to influence the policy dialogue within the executive and legislative branches. We sought to support and help shape the emerging reform proposals, and I believe we succeeded in doing so.

It is now becoming obvious that the dialogue about Social Security reform solutions will be heating up in the coming years as that system's trust fund heads toward depletion. Once again, we want to provide our expertise and actively support that policy conversation. While serious reform discussions have yet to begin, our meetings help raise awareness of our intellectual-capital capabilities, and build relationships that position the Academy as a trusted source when that policy dialogue heats up.

I have noted that sometimes committee members may get frustrated, as the lack of immediate action on critical issues may make it seem that the work on relationship building and policy analysis is not yielding results. But it's important to realize that the political arena operates on its own timetable. Our time now is well spent if it enables us to become established as a trusted resource, with support structures that are well known to Capitol Hill staff.

—Jerry Mingione, MAAA, FSA, member, Social Security and Pension Committees

Strengthening Policy, the Profession, and Volunteer Experience

For Academy volunteers who have yet to participate in Hill Visits, these are a series of meetings, coordinated and scheduled by Academy staff, that are designed as focused, strategic engagements where Academy volunteers meet with members of Congress, legislative staff, regulatory agencies, and other policymakers to discuss public policy issues that involve actuarial considerations.

The purpose of each meeting is to establish and maintain relationships with policymakers, allow them to ask the Academy volunteers questions about issues they are working on that are actuarial in nature, and to identify opportunities where the Academy might be able to provide objective, independent, and nonpartisan actuarial insights that help clarify complex issues and inform evidence-based policymaking.

While serious [Social Security] reform discussions have yet to begin, our meetings help raise awareness of our intellectual-capital capabilities, and build relationships that position the Academy as a trusted source when that policy dialogue heats up.

—Jerry Mingione

Through these meetings, the Academy is able to connect legislative and regulatory decision-makers with existing Academy work products and actuarial expertise. These meetings also provide the Academy with important insights that shape the direction of ongoing and future Academy committee work.

For policymakers, the value of Hill Visits is unmistakable: By making its resources and expertise available, the Academy enables policymakers to enhance their understanding of issues such as social insurance programs, health care financing, pension systems, and risk management. Through direct dialogue, the Academy's volunteers are also able to explain highly technical concepts in a more readily understandable language when needed and can highlight the implications of various policy options. Frequently, these meetings lead to ongoing dialogue between Hill and Academy staff throughout the year as issues evolve or new topics arise, which helps to ensure that the work of Academy committees is both relevant and timely.

Likewise, it is straightforward to see how Hill Visits accrue benefits to the U.S. actuarial profession. Engaging directly with lawmakers, regulators, and Hill staff allows actuaries to demonstrate their expertise and credibility, as well as to reinforce the Academy's commitment to providing independent, unbiased guidance. By sustaining these efforts over time, they position the profession as a trusted source of information and help to ensure that actuarial perspectives are considered throughout the policymaking process.

By contributing independent analysis free from political or commercial pressures, actuaries are able to play an important role in addressing many of the challenges facing legislators and regulators. Moreover, these interactions enable actuaries to shape the narrative around complex policy issues. This leadership role strengthens the profession's relevance and impact, fostering greater recognition of the unique value actuaries bring to addressing society's most pressing challenges.

While it may not be as immediately obvious, there are significant benefits to the Academy's volunteer actuaries who participate in Hill Visits as well. First and foremost, participating in Hill Visits deepens the volunteers' understanding of the legislative and regulatory context in which actuarial issues exist and

> *For policymakers, the value of Hill Visits is unmistakable: By making its resources and expertise available, the Academy enables policymakers to enhance their understanding of issues such as social insurance programs, health care financing, pension systems, and risk management.*
>
> *—Ron Ogborne*

provides a broader perspective on the impact of actuarial work on public policy and society.

Additionally, Hill Visits are an opportunity for volunteers to develop their communication and advocacy skills, which are essential for effective professional practice. It is also typical that Hill Visit meetings will cover issues that span multiple market segments and perspectives within a given practice area, which creates unique opportunities for volunteers to make connections between actuarial issues inside and outside of their area of expertise.

Finally, participating in Hill Visits enables volunteers to take an important opportunity to expand their professional network, allowing actuaries from different practice areas to connect, share expertise, and collaborate.

In conclusion, the Hill Visits are a vital mechanism through which the Academy fulfills its mission. They provide policymakers a means to access the Academy's independent, nonpartisan actuarial resources and expertise while also elevating the profession's voice in critical public policy matters. At the same time, they represent a unique opportunity for Academy volunteers to deepen their understanding of the policy landscape, sharpen their communication skills, and build meaningful professional networks.

If you are an Academy volunteer looking to make a meaningful impact on public policy while advancing your professional growth, consider reaching out to the chairperson of the committee you serve on or the Academy staff supporting it to learn how to get involved.

—Ron Ogborne, MAAA, FSA, CERA,
Academy member selected director and
member of the Health Practice Council

Have I (We) Done Any Good in the World Today?

Past as prologue: Many decades ago, I was unemployed in the midst of the Reagan recession, and a year after graduating from college, I came across the actuarial field in an ad in my local paper: "Wanted—person with math aptitude." That small ad introduced me to the actuarial field. A recruiter set up an interview with a local P&C company, The St. Paul Companies. I had no exams and had majored in economics—not the ideal background for a new actuarial hire—but I had done well in my program, and my wife and I were expecting our first child in a month, so we were hopeful of the possibilities ahead.

At the end of the day, the senior actuary asked what my favorite college course had been. I should have said linear algebra or advanced econometric courses, but I shared my enthusiasm for a graduate course I took my last semester on Dante's *Divine Comedy* and its telling of a pilgrim's journey to make sense of the world—of hell and of heaven. I could tell that as I said this his eyes glazed over, and I thought I heard in his head the phrase, "These are not the new hires we are looking for." But I persevered and later began my actuarial career in Dallas.

Today's question: How and why does the Academy conduct annual Hill Visits every spring to meet with the Congressional Budget Office, Government Accountability Office, and key staff members on both sides of the aisle who are assigned to actuarially relevant committees in the House and Senate?

Today, the *Divine Comedy* still ranks as a favorite course of mine, and I have come to appreciate it as a great example of how the Academy does "good." In Dante's journey through *Inferno* he meets many people who seek attention and to reclaim their fame in the world above. But as he journeys through *Purgatory* and then *Paradise*, there is a marked shift in the tone—from the "I" of *Inferno* to the cooperation needed to do good, and finally to the blessing of living in collaborative service to others.

The last two annual Hill Visits have included Academy members with relevant committee expertise in topics that may be considered during the upcoming legislative agenda, such as Medicare, access to fire and flood insurance, workers' compensation, cyber risk, big data and artificial intelligence, Social Security, private pensions, longevity risk, long-term care (LTC), and more. During both the Hill meetings and the dinners afterward, I heard thought leaders listen carefully and share the objective, pragmatic advice available through the Academy.

After each Hill Visit I was surprised and grateful to see how much the staff and the Academy have in common. The role of a typical Hill staff person is to be a "truth-teller" to their boss on what is actually possible. The elected official seeks reality checks from their staff. They will take the staff input but frame their public comments based on their political agendas. I often arrive in Washington, D.C., a bit cynical about how the meetings may go. But I return home each time buoyed from meeting people working hard in D.C. to realistically understand how they can help make or amend productive laws for our country.

Laws do have costs and consequences due to the inherent compromise typically needed to pass a law or to fulfill popular expectations. Some aspects may not be well thought out. This is where the Academy's approach to offer trusted, objective counsel is so helpful. Our audience during those visits is not the media but those who make laws and regulations. Our Hill Visits build credibility with both sides of the aisle so the changes needed are more likely to be addressed.

Two Examples

1. The original Affordable Care Act (ACA) included an LTC provision. But the LTC benefit, as enacted, was not sustainable. The Academy explained this to those drafting and debating the ACA. Eighteen months after enactment, the Academy's counsel proved to be sound, and the LTC provisions were repealed.

2. One of the federal actions in spring 2025 stopped funding public access to NOAA data needed for catastrophe models. This NOAA data—the Billion-Dollar Disaster (BDD) database—was also used by many nonactuarial professionals. As a regular user of this database, Steve Kolk, chairperson of the Academy's Extreme Events Committee (EEC) and one of the Academy's Hill Visit volunteers, convened the EEC in June. The committee drafted a letter to Congress explaining the vital public good the data had provided.

As a result, in August, six members of Congress introduced H.R. 5002, the *Protect Americans from Climate Disasters Act*. H.R. 5002 is in the first stage of the legislative process and proposes re-funding NOAA staff and programs, notably including the BDD. With the importance of the Billion-Dollar Disaster data now part of the congressional record, the nonprofit Climate Central has begun republishing some of the BDD information while Congress deliberates on the bill, which now has a dozen co-sponsors.

I hope that you, like me, can appreciate how and why the Academy continues to engage in the sometimes Sisyphean—and sometimes effective—task of providing valued and objective advice to policymakers.

—Dave Sandberg, MAAA, FSA, CERA, FCA,
Academy past president, and former vice president, Life
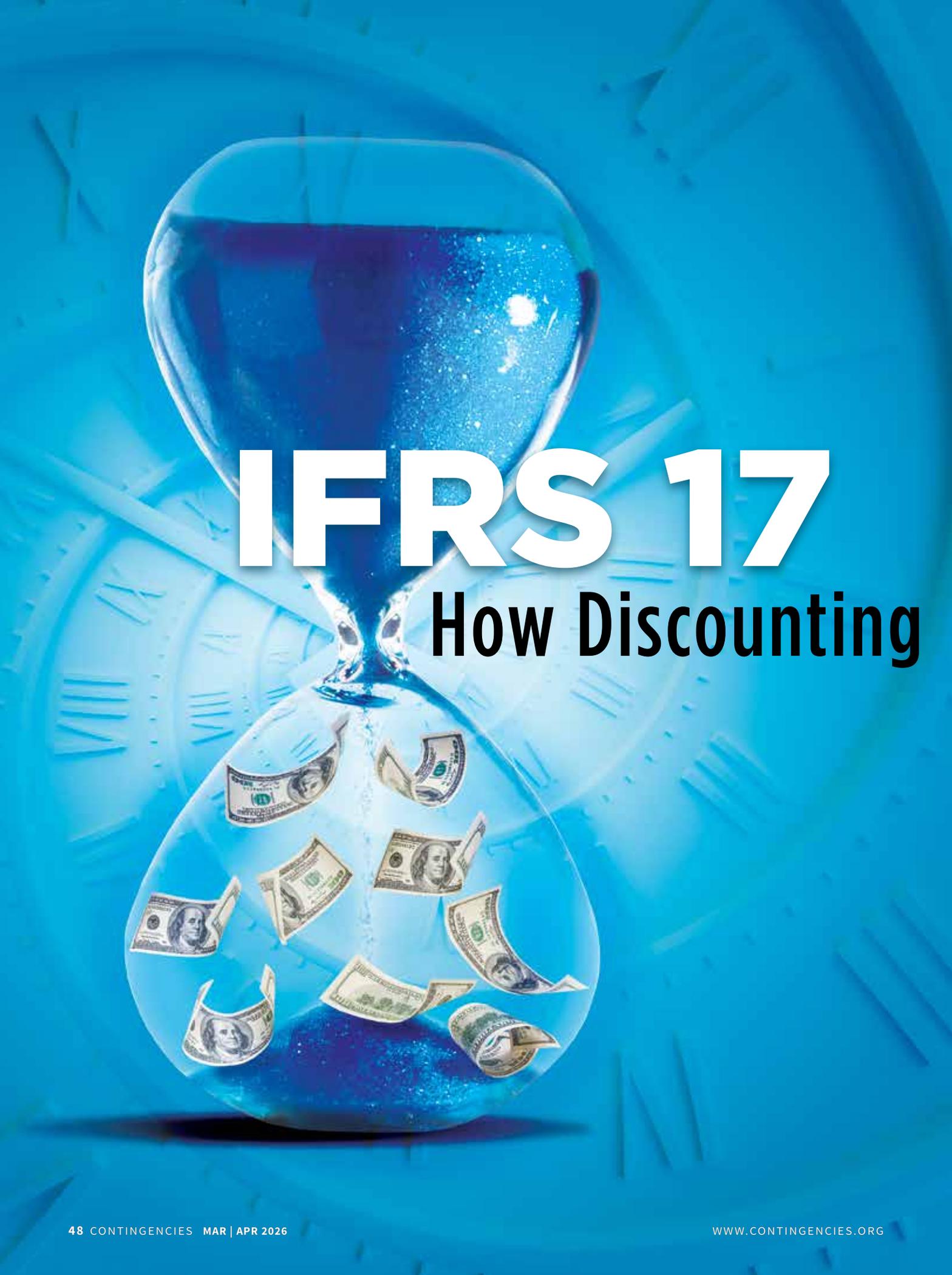
IFRS 17

How Discounting

Find out how IFRS 17 discount rates determine present value and influence reported liabilities, as well as the practical challenges insurers face in deriving and applying them across markets.

BY MICHAEL WINKLER AND SUNIL KANSAL

Shapes Financial Outcomes

This article provides an overview of the issues involved in determining the time value of money (i.e., the discounting in the IFRS 17 accounting framework). The concept of discounting future cash flows has not been consistently applied in previous standards; for example, many non-life insurance companies did not discount their reported claims reserves to keep a conservative margin. In IFRS 17, discounting is consistently applied to all long-term cash flows. The discount rates are supposed to reflect only financial risks whereas an explicit margin for nonfinancial risks—the so-called Risk Adjustment—is added to the liabilities. In several markets, deriving reasonable discount rates is challenging given the limited availability of suitable market data.

A sum of money currently available now has a greater value than the same sum to be paid in the future because of its earnings potential in the interim. This so-called time value of money is a core principle of finance and is reflected in IFRS 17. Therefore, suitable discount rates must be applied to the projected future cash flows.

According to IFRS 17, appropriate discount rates applied to the estimates of future cash flows must:

- reflect the time value of money, the characteristics of the cash flows, and the liquidity characteristics of the insurance contracts;
- be consistent with observable current market prices (if available) for financial instruments with cash flows whose characteristics are consistent with those of the insurance contracts, including timing, currency, and liquidity; and
- exclude the effect of any factors influencing such observable market prices that do not affect the future cash flows of the insurance contracts.

Basis Rules to Derive Discount Rates

Under Solvency II, a European regulatory framework that sets capital requirements and risk management standards to ensure insurers can meet their long-term obligations, the Matching Adjustment (MA) enables insurers to adjust the risk-free interest rate used for discounting specific long-term insurance liabilities. This adjustment incorporates the illiquidity premium associated with holding less liquid assets that are closely aligned with the cash flows of these liabilities.

In contrast, IFRS 17 does not impose explicit restrictions on the selection of the reference portfolio. Insurers have the flexibility to use their own asset portfolios, provided the resulting discount rates appropriately reflect the characteristics of the insurance contracts and are consistent with observable market data.

FIGURE 1
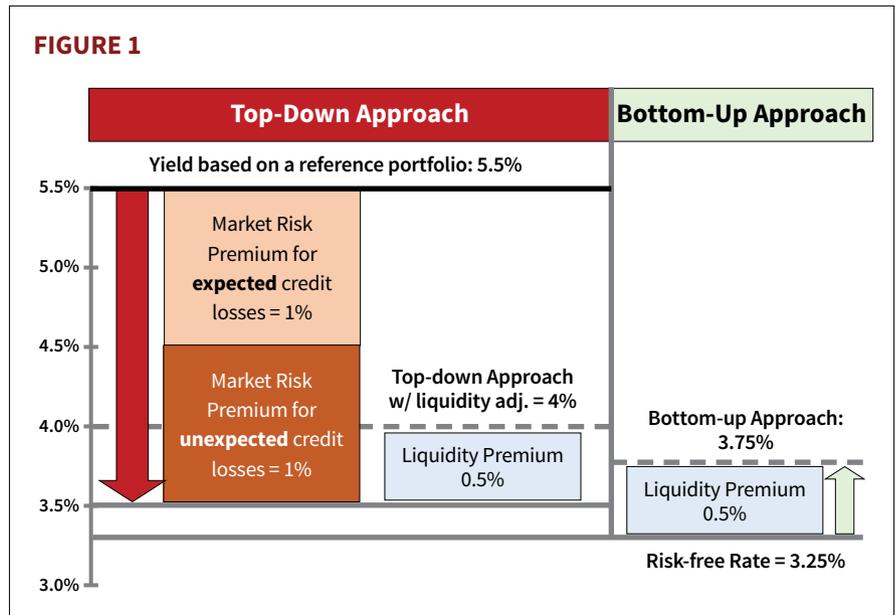
Furthermore, similar to the Volatility Adjustment in Solvency II, discount rates can be derived by starting with risk-free rates and adding an allowance for illiquidity,

We therefore end up with two approaches to setting the discount rate, namely the "top-down" and "bottom-up" approaches:

- The top-down approach is based on a yield curve that reflects the current market rates of return implicit in a fair value measurement of a reference portfolio of assets and is adjusted to eliminate any factors that are not relevant to the insurance contracts.
- The bottom-up approach is based on adjusting a liquid risk-free yield curve to reflect the differences between the liquidity characteristics of the financial instruments that underlie the risk-free rates observed in the market and the liquidity characteristics of the insurance contracts.

See the example in Figure 1.

Most companies use a bottom-up approach often very closely aligned with the Volatility Adjustment used in Solvency II. However, there are some exceptions:

- Aegon has generalized the two approaches into a unified direct discounting technique, where discount rates are determined as the sum of the risk-free rate plus a percentage of the (product-specific) illiquidity premium.
- Aviva and Phoenix (U.K.) use a top-down approach for annuities, incorporating the Matching Adjustment as in Solvency II.

Cash flows that vary based on the returns on any financial underlying items—for example, when applying the Variable Fee Approach (VFA) for direct participating business—shall be:

1. Discounted using rates that reflect that variability; or
2. Adjusted for the effect of that variability and discounted at a rate that reflects the adjustment made.

Option 1 aligns with a real-world valuation framework, which aims to produce a realistic view of potential future economic variables. In this framework, discount rates for variable cash flows reflect the projected rates of return on the underlying items (asset-based discount rates).

Option 2 permits a rate of return on underlying items which is not necessarily a real-world framework. Here, cash flows

are adjusted to ensure consistency, and the framework relies on mathematical relationships among financial instruments. This may include risk-neutral valuation, where risk-free rates of return (with or without liquidity premium) are used both to project the underlying items and to discount the cash flows.

Challenges

A notable challenge for many insurers is the duration and yield mismatch between the company's own portfolio and a market-referenced portfolio, particularly when long-dated liabilities are paired with medium-term matching assets. In such cases, applying a liquidity premium based on the entity's own portfolio can lead to meaningful outcomes:

- **Scenario 1:** If the insurer holds highly illiquid assets with long-term horizons, these typically offer yields and coupons significantly above market averages. Consequently, the discount rate applied to insurance liabilities is higher, leading to lower reported liabilities.
- **Scenario 2:** Conversely, if the insurer has invested in low-yield assets in a high-interest-rate environment, the discount rate would be lower, resulting in higher reported liabilities.

Furthermore, currency and term mismatches introduce additional complexities, particularly in product lines such as annuities or whole-of-life contracts, where liability durations often exceed the maturity profiles of available matching assets.

Concrete Implementation

Actuarial guidance provides a practical framework on how to derive the IFRS 17 discount rates in practice:[1]

- **Establish the last observable point on the yield curve:** Use observable market prices where available in active markets.
- **Set the ultimate risk-free rate:** Develop unobservable inputs using the best available information and place more weight on long-term estimates than short-term fluctuations.
- **Set the liquidity premium:** The discount rates reflect the characteristics of the insurance contracts, including liquidity.
- **Set discount rates for products containing cash flows that vary with an underlying item.**

The last observable point corresponds to the term of the asset with the longest maturity that has a quoted price from an active market (a market in which transactions for an asset take place with sufficient frequency and volume to provide pricing information on an ongoing basis). To determine market activity, consider factors such as bid-ask spread, trading volume, trade size, and the impact of trades.

When setting the discount curve beyond the last observable point, consider the following characteristics:

- **Stability:** The ultimate interest rate would be more stable over time (on average, one might expect the variability of long-term interest rates to be lower than short-term rates).
- **Smoothness:** Interpolated rates would follow a smooth path

A notable challenge for many insurers is the duration and yield mismatch between the company's own portfolio and a market-referenced portfolio, particularly when long-dated liabilities are paired with medium-term matching assets.

from the last observable point to the ultimate long-term rate.

- **Simplicity:** The approach would be easy to understand and implement.

Setting the liquidity premium is not straightforward. Market-based methods often use the spread difference between covered bonds and risk-free bonds in the same currency. However, due to missing liquidity and longer-term durations of the corresponding instruments, this approach may not be feasible in many markets.

Most European companies base IFRS discount rates on Solvency II rates, which are consistent with IFRS 17. Euro rates are typically based on market rates up to 30 years, in contrast to the European Insurance and Occupational Pensions Authority (EIOPA) rates, where the extrapolation to the ultimate forward rate starts much earlier. As a result, Euro rates are expected to react more in line with the asset movements. For portfolios with less liquid liabilities, such as annuities in payment, insurers add significant illiquidity premiums. Portfolios measured using the VFA use more conservative discount rates.

In developing markets, companies often struggle to determine discount rates based on observable market data. Risk-free rates may not exist and neither do long-term investments: The longest duration may be a few years or even less than a year. In such cases, applying any sophisticated methodology like those described above, does not make sense. The primary reference point is typically the long-term investment return the company can achieve, less an allowance for unexpected losses. An exception occurs in countries whose currency is pegged to the U.S. dollar or another leading currency with long-term rates; in these cases, companies usually take those rates as a starting point.

For each accounting period, the discount rates must be updated in line with market movements, since companies are required to use current assumptions.

Changing Discount Rates

For each accounting period, the discount rates must be updated in line with market movements, since companies are required to use current assumptions. For long-term liabilities, this can have a significant impact on the time value of money and, as a result, on the fulfilment cash flows.

Companies can specify in their accounting policy whether the impact of changes in market discount rates is recognised in profit and loss (P&L) or in Other Comprehensive Income (OCI). In the latter case, interest is accrued to the P&L at the discount rate set at inception.

At first glance, OCI may appear to be a better choice because the volatility stemming from updated discount rates would not distort the P&L. However, changes in the fair value of some assets, particularly those used for interest rate hedging, always flow through the P&L. A careful analysis should be made to determine the most appropriate choice for a given company.

Observations

In the Solvency II environment, discount rates published by EIOPA provide a natural reference point. In a survey conducted by EIOPA, 42% of respondents reported using the same or nearly the same rates, while the remaining 58% typically applied higher discount rates than under Solvency II.[2]

- About 58.5% of respondents use the same risk-free rate as in Solvency II. For those who do not, the main differences relate to a more remote last liquid point (for example, 30 years for the Euro) and a different ultimate forward rate.
- There are some further observations in countries around the world: In developing markets with local currencies pegged to the U.S. dollar, companies normally use U.S. dollar rates with a particular uplift.
- Some companies vary the discount rates by product type. For example, in many cases the discount rates for annuities in payment are significantly higher than those typically derived

from the yield of the asset portfolio backing the specific liabilities ("top-down") and include a higher illiquidity premium.

- Many companies use different rates for the General Model (GMM) and the Premium Allocation Approach than for the Variable Fee Approach (VFA), with VFA rates being more conservative.

- Disclosures of the discount rates vary by company: most indicate the rates used for certain durations (for example, 1, 5, 10, 20, and 30 years), some publish an ultimate rate for exceptionally long durations, while others report only a range (either by duration buckets or overall).

The spreads in discount rates used by sample companies vary significantly. Figures 2 and 3 for year-end 2024, compare the discount rates with the risk-free rate published by EIOPA for Solvency II purposes.

The spreads in Euros (EUR) are relatively constant but appear to drop for durations longer than 20 years. This effect is largely artificial, stemming from different extrapolation methods for long durations, as EIOPA rates converge toward the Ultimate Forward Rate.

In contrast, U.S. dollars (USD) spreads used by various companies seem to increase with duration in most cases, although several companies do not disclose discount rates for long durations.

Some companies initially decided to use average rates for their interest-sensitive business that did not accurately reflect the actual pricing rates for different cohorts. This seemed to be a reasonable simplification, given the administrative burden of maintaining multiple sets of yield curves over time. However, in many cases, cohorts turned onerous despite having reasonable pricing margins in reality.

We therefore strongly recommend analysing the quantitative impact of such "simplifications" as early as possible. ▲▲

FIGURE 2

2024: EUR Spread over EIOPA risk-free
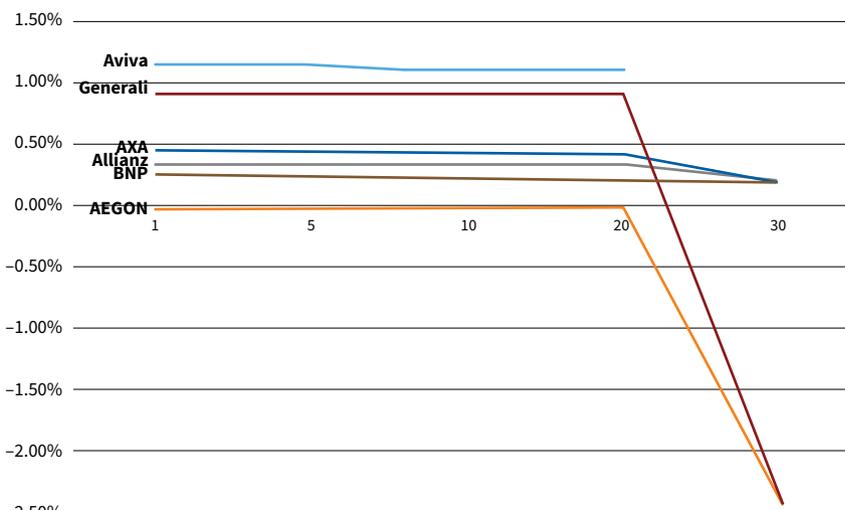
(Source: Published Financial Statements as of Dec. 31, 2024)

FIGURE 3

2024: USD Spread over EIOPA risk-free
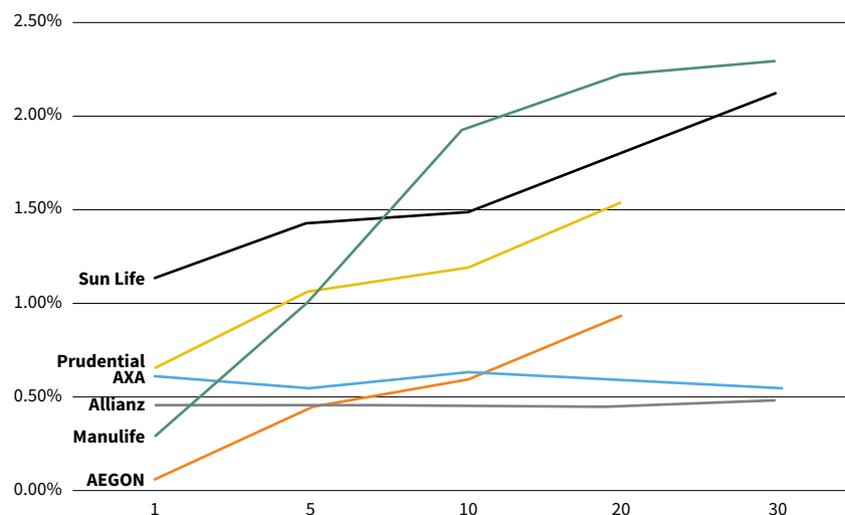
(Source: Published Financial Statements as of Dec. 31, 2024)

MICHAEL WINKLER is an actuary (SAA/DAV) at RefinSol and Shasat Consulting and has previously held senior actuarial positions at Swiss Re, Munich Re/New Re, and Winterthur Group. **SUNIL KANSAL**, Head of Consulting at Shasat, is a chartered accountant and a Fellow of the Institute of Chartered Accountants in England and Wales. They are authors of the book, *Navigating IFRS 17: A Practical Guide to Accounting & Actuarial Implementation.*

Endnotes

[1] Canadian Institute of Actuaries: Draft Educational Note / IFRS 17 Discount Rates for Life and Health Insurance Contracts, June 2020

[2] EIOPA: "IFRS 17 – Insurance contracts report", April 2024

2026 Events Showcase Academy's Policy Role

UNDERSTANDING THE LANGUAGE OF ACTUARIES is not so simple for those outside the profession. Too often, the important insights that Academy volunteers contribute to policy papers do not translate easily to broader audiences, as readers can get lost in the technical jargon.

Since its inception, the Academy has recognized that part of the value we bring to the profession is our ability to help translate actuarial expertise into public policy vernacular. Our practice councils and leadership frequently ask the question, "Who is the audience, and what do they need to know?" Working to meet people where they are and to provide information through multiple communication channels has been a focus for a number of years, resulting in the *Actuarially Sound* blog and this column.

Engaging Policymakers Through Direct Outreach

Our outreach efforts to those who work in the world of policy—legislators, regulators, consumer advocates, and industry and trade groups—go beyond words on a printed page or a screen. Each year, we host multiple events where Academy members and staff engage with elected officials and others who help shape and influence proposed legislation and regulation, in an effort to fulfill our mission of assisting policymakers by providing actuarial expertise, analysis, and insight in a balanced and objective manner.

On March 9, the Academy will host the Spring Policy Summit, a full day of continuing education programming featuring leading Academy volunteers, representatives from Capitol Hill, federal agency staff, and key stakeholder groups. Together, they will explore emerging priorities and challenges for 2026, with insights from leaders shaping insurance regulation and policy at the highest levels. Participants will engage in dynamic discussions on the evolving policy landscape and examine critical questions around professional standards and self-regulation.

On March 10, volunteers and staff representing each practice area will visit Capitol Hill to meet with congressional staffers, discussing a broad range of issues, including the cost drivers of health insurance, Social Security and retirement security, the impact of climate events, artificial intelligence, annuities, and more. (Read also, "Bringing Actuarial Expertise to Capitol Hill" on page 40 and the Public Compass column in the January/February issue of *Contingencies*.)

Building and maintaining congressional office relationships and holding in-person meetings with staff in Washington, D.C., and in state capitals are essential outreach efforts to remind and reinforce to those crafting the rules of the road that the Academy is here to provide independent and objective actuarial insight and analysis.

Collaborating with Stakeholders

These Hill Visits will be followed in mid-April with a Health Practice Council-sponsored summit in Washington, D.C., titled "Broadening the Focus—Evaluating Health Care Programs." This summit will bring together volunteers from the Health Equity Committee, actuaries, and nonactuaries to discuss the need for and the development of a principles-based framework that may be helpful when

STOCK.ADOBE.COM / WINWIN

assessing and potentially making recommendations for program changes aimed at more efficient use of health care resources.

Next, on May 12-13 in New York City, the Life Practice Council will hold the second annual Insurance Investment Summit. This year's event will expand on last year's general theme of "Insuring the Future," with a greater emphasis on life insurance companies investing in private credit, an emerging hot topic in the investment space. Golub Capital President David Golub will serve as keynote speaker, with other sessions focused on reinsurance, rating agencies, and new or improved structured products. Like last year, a panel featuring regulators is anticipated, and attendees will benefit from continuing education.

A summit offers the Academy an opportunity to engage with stakeholders, focused on timely issues that impact an actuary's day-to-day work, with an eye toward evolving priorities and practices, while also offering continuing education. The intended audience is mixed—actuaries, other practitioners, and trade groups—and registration is required. While it does not usually focus on the elected official audience, they are active participants as they share their thoughts and prospectives.

Early in the fall, the Retirement Practice Council will hold its annual Retirement Symposium. As has been the case for the past two years, the event will highlight key policy issues in retirement and financial security, bringing together speakers from Capitol Hill and key federal agencies with Academy volunteers. While 2024 and 2025 marked some key anniversaries—the 50th anniversary of ERISA in 2024 and the 90th anniversary of the Social Security program—this year's focus will remain grounded in issues of retirement security, the changing landscape of employment and savings, and the very real implications of anticipated federal legislation and proposed retirement reforms that have the potential to directly impact nearly every employer and individual in the near future.

Symposia are great opportunities for the Academy to more directly speak to and collaborate with our public stakeholders. These events are usually hosted free of charge and are intended to provide an opportunity to share ideas on potential solutions, freely discuss priority issues, such as the affordability and accessibility of insurance coverage, and encourage dynamic conversations between our members and the people who share our concerns and focus on specific issues.

Education through Seminars

Later in the year, the Academy will host the annual Seminar on Effective P/C Loss Reserve Opinions in Nashville on Dec. 7–8. The event is designed for property/casualty actuaries who prepare, or help prepare, the National Association of Insurance Commissioners (NAIC) annual statements of actuarial opinion on P/C loss reserves.

Seminars are educational events, aimed at the actuarial profession and offering a targeted and nuanced agenda that provides perspective and education that actuaries need to continue performing in their day-to-day work.

In addition to the Opinion Seminar, the Academy also hosts the annual Life and Health Qualifications Seminar every fall—another event that spotlights the value of the Academy and the content that we provide on a regular basis, both for our stakeholders involved in policy engagement as well as for our members and the broader U.S. actuarial profession.

Together, these events provide an opportunity for those inside and outside the actuarial field to learn more about the role the Academy plays in policy and professionalism. Our symposium, summits, and seminars—along with stand-along events like Hill Visits and our webinars, podcasts, and blogs—are tools that we use to fulfill our mission to serve the public and the U.S. actuarial profession, while demonstrating the organization's core values of independence, objectivity, and balance.

Our volunteers and staff are available to policymakers to educate and inform, but never to lobby. To learn more about these events and to stay informed about registration, go to the Careers & Education tab on the Academy's website and click on the Event Calendar. ▲▲

TED GOTSCH is policy content and publications manager at the Academy.

Surround Yourself with Great People

ZHE "GIGI" LI, A 2025 RISING ACTUARY AWARD RECIPIENT, often credits the "great people" around her for shaping her growth. A health actuary, she began her career in health care pricing and rate filing before becoming a senior manager at EY. Today, she leads actuarial and financial reporting audits and serves as an Appointed Actuary for several clients. In this Q&A, she describes, among other things, how her Academy membership and volunteer work have deepened her expertise, expanded her professional community, and allowed her to contribute meaningfully to the standards that guide the profession.

What led you to become an actuary, and what attracted you to the profession?

I was a finance major in college. My first internship was in the claims operations department at a health insurance company, where I met some actuarial interns and got my first glimpse into the profession. Quite frankly, their internship projects sounded way more interesting and challenging than mine. Later, I was fortunate to get an actuarial internship at the same company, where I met some of the best managers and colleagues. I'm so grateful for that opportunity—it introduced me to a profession that I truly enjoy.

Describe a time when your professionalism training has helped you in your career.

Professionalism is an inseparable part of my daily work. As an actuarial auditor, I must consistently maintain integrity and adherence to the actuarial standards of practice [ASOPs] and relevant GAAP and STAT regulatory requirements. Especially when my findings challenge a client's methodology or assumptions, my professionalism training has helped me stay grounded in those moments. My training has been especially valuable when preparing and signing Statements of Actuarial Opinion. I hold myself to high standards and frequently return to the ASOPs for guidance to ensure that my procedures are compliant, well supported, professionally sound, and appropriately documented.

Tell us about a time when your actuarial expertise influenced an important decision in your workplace.

I'll take a slightly different take on this question. One of the moments I felt my actuarial expertise truly made an impact was serving on the ASOP No. 28 (*Statements of Actuarial Opinion Regarding Health Insurance Assets and Liabilities*) Task Force. Drawing on my experience working with a wide range of clients, I was able to provide practical insights about handling health insurance assets and liabilities.

What made the experience especially meaningful to me was the sense that my years of work had culminated in something that benefited the broader profession—something bigger than my day-to-day work. I felt incredibly honored to have a chance to shape a standard that helps fellow actuaries. At the same time, I learned a great deal from collaborating with fellow task force members and deepened my understanding of several complex valuation issues. I've since been able to apply those learnings in my daily work and share them with my team.

What's one of the biggest lessons you've learned in your career?

My entire career has been a continual lesson in humility. I have been fortunate to work alongside many exceptionally capable actuaries, and I am consistently reminded of how much there is to learn from them. What amazes me most is that some of the most brilliant and knowledgeable actuaries I've met are also the

> **The greatest benefit of my Academy membership has been the opportunity to volunteer and connect with fellow actuaries. I have had the pleasure of presenting webinars with fellow Academy members, being involved in developing actuarial standards of practice, and taking part in the Actuarial Standards Board's Health Committee.**

most humble—and that has taught me just as much as anything!

What advice do you wish you were given at the beginning of your career?

I'm grateful for a piece of advice I received relatively early in my career from the CFO of my previous company: "Surround yourself with great people." It's simple but incredibly powerful. The people you work with can shape how you grow, challenge your thinking, and support you when you're learning or taking risks. I've benefited so much from the talented, collaborative, and inspiring colleagues and friends who have made all the difference in both my professional and personal growth.

What do you value most about your Academy membership and volunteer work? What does the MAAA designation mean to you?

The greatest benefit of my Academy membership has been the opportunity to volunteer and connect with fellow actuaries. I have had the pleasure of presenting webinars with fellow Academy members, being involved in developing actuarial standards of practice, and taking part in the Actuarial Standards Board's Health Committee. These activities provided opportunities to learn from thought leaders and stay current on emerging trends and best practices. I also appreciate the many continuing education (CE) opportunities the Academy offers.

What is the value of your MAAA designation?

Being a member of the Academy allows me to participate in the broader professional and public interest aspects of the profession. I've also found the Academy's CE and professionalism resources extremely helpful, including the Life and Health Qualifications Seminar, which I recently attended and highly recommend.

What advice would you share with aspiring or new actuaries, or those interested in volunteering for the Academy?

I am a strong advocate for volunteering, and it has been immensely rewarding for me both personally and professionally. If you are considering volunteering for the Academy, do not hesitate! I cannot recommend it more! All it takes is one step forward, and it'll open up a whole flood of opportunities.

My own journey began with my first volunteer role as chair of the Society of Actuaries Health Financial Reporting Subgroup. From there, additional opportunities naturally followed, and I have since volunteered for multiple initiatives. The network you build and the perspectives you gain outside of your day-to-day work are invaluable and, in my view, an essential part of a fulfilling actuarial career.

Beyond work—what are your hobbies or personal interests?

I love spending time with my family, traveling and exploring different cultures. My six-year-old daughter is truly a treasure—full of both delightful and unexpected surprises—and she keeps me happily busy. I also like volunteering at her school whenever I can. When I do have time to myself, I enjoy listening to audiobooks. Some of my recent favorites include T*he Let Them Theory, Quiet, The Infinite Game, The Scaffold Effect*, and *The Pathless Path*, to name a few. ▲▲

> **Help Us Highlight Exceptional Members**
> Do you know a talented Academy member we should profile? We're looking for members who are making an impact in their practice areas, contributing to the profession, or inspiring others through their work or volunteer activities. Tell us about them at editor@actuary.org.

Al-tourney-tive
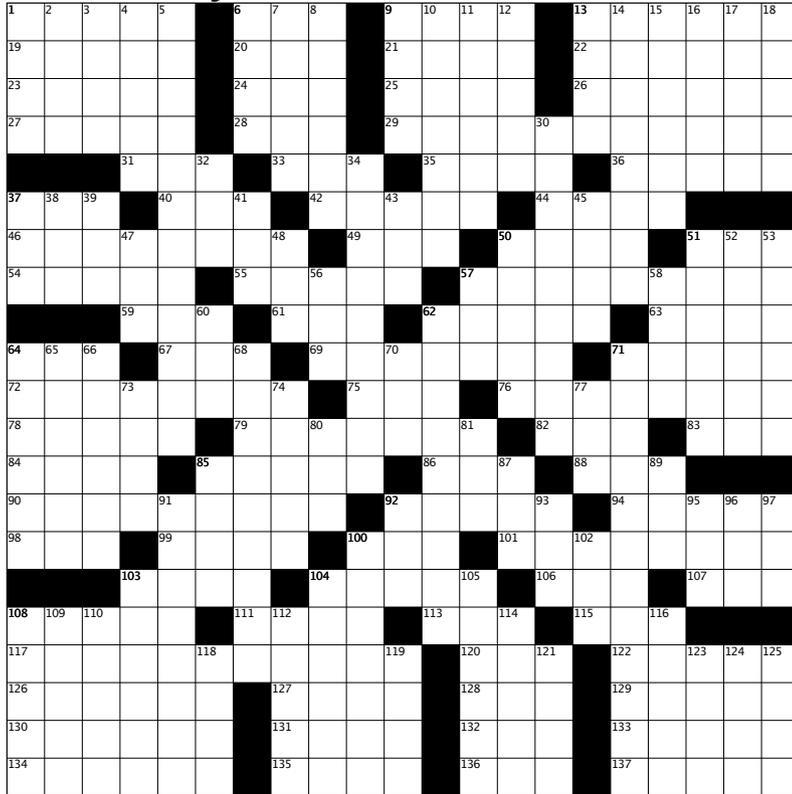
Across

1 AKA, blank check companies
6 Laughter syllables
9 Auto-loan figs.
13 Eye liner
19 Column footing
20 "Skyfall" actor Rapace
21 Plastics ingredient
22 Feeble
23 The Big ___, starring Bogart
24 "Wowzers!"
25 Place, in legalese
26 1/3 of a K
27 Cream and club, e.g.
28 DOD division
29 Al-tourney-tive #1
31 Research complex in Bethesda, Md.
33 PC key
35 Joint protection?
36 Rich soil deposit
37 PC key
40 Common practice
42 Affect
44 Resolve target
46 Naturally followed
49 Follower of Christ
50 Stuff to the gills
51 Org. for entrepreneurs
54 1997 World Series city
55 Make clear
57 Al-tourney-tive #2
59 A.L. West team, on scoreboards
61 Chablis descriptor
62 Catalogs
63 Lean on
64 Compass dir.
67 Compass dir.
69 Candy cover
71 1
72 Of the essence
75 Draft pick
76 Intensified
78 Gull genus
79 Oenologist's activity
82 Canal site
83 Norton and Sullivan
84 Bon ___ (Grammy-winning indie band)
85 Bellow and more
86 ___ Hammarskjold, former U.N. secretary general
88 PC key
90 Al-tourney-tive #3
92 Bar offering
94 First, second, third
98 Jeans feature
99 Extremely popular
100 Tight spot
101 Cloud content
103 Came down
104 Temple trademark
106 Antelope variety
107 Rub the right way
108 Jonathan ____, political columnist for The Atlantic
111 The world's oldest mutual insurer (abbr.)
113 Midsection of midsection
115 Bulky TV screen
117 Al-tourney-tive #4
120 The only one on the pitch who can stop Messi
122 By dint of
126 La ____, major port city of Venezuela
127 Keen
128 96 down homonym
129 Lake south of Leningrad
130 "Given the circumstances..."
131 Mrs. McKinley and others
132 Calgary-to-Moose Jaw dir.
133 Malay wild ox
134 Prime
135 Fit to be tried
136 Born, on society pages
137 Down units

Down

1 Found in 5 down
2 Italian explorer
3 Killed, say
4 Type of break
5 Al-tourney-tive #5
6 Emmett Kelly persona
7 Unabetted
8 "That's life," e.g.
9 Glaswegian old
10 Hierophants
11 Reverberate again and again
12 Hailing from Hail
13 ICU tool used to measure alertness
14 Genus of fungi
15 Guerrilla tactic
16 Ammonia compound
17 Some court wear
18 Big servers
30 East Indian hardwood
32 Deerstalker, e.g.
34 Donkey disciples
37 It's always by your side
38 Chain of Hawaiian islands
39 Counterterrorism org.
41 Joined a union
43 Game with no equipment
45 Hoover and Roosevelt, e.g.
47 Aka Parvati, Gauri, and Devi
48 Dollard-___-Ormeaux, Quebec
50 Was solicitous
51 Prayer site
52 Cadged
53 Adds riders to
56 "... let thy words be ___": Eccl.
57 Shock of locks
58 Pagan festival
60 Darth Vader's nickname as a boy
62 Kind of income
64 Doobie's brother
65 Really go places
66 Legalese adverb
68 Makes complicated
70 Louisville slugger
71 Al-tourney-tive #6
73 Breakers
74 Wound on a wound
77 Put away, in a way
80 Expert in calculating
81 Duke Ellington's "The ___ from Joe's"
85 Alone, in Alençon
87 Pod of whales
89 Baseball club
91 Grandiloquence
92 Kerouac's "Big ___"
93 Plague
95 "How's it goin'?"
96 128 across homonym
97 Array
100 Topper of 92 across
102 First magazine to put Steve Jobs on its cover
103 Delimited
104 Country with the world's longest coastline
105 Pass play
108 Riot control agent, for short
109 Laurie vehicle
110 Be of assistance
112 "Babbitt" novelist
114 Laconic
116 Home to Oral Roberts University
118 Famed editorial cartoonist
119 It can follow no one or someone
121 Between engagements
123 Ajman dignitary
124 Cultivate
125 First place?

Solutions may be emailed to puzzles@actuary.org. In order to make the solver list, your solutions must be received by April 1, 2026.

Previous Puzzle: New Year's Resolution

Solvers: Steve Altschuld, Dean Apps, Todd Dashoff, Charlie DeWeese, Ken Kudrak, Tim Luker, Jim Muza, Ray Niswander, Madhumathi Windon, and Wendy Windsor

Together, We're Making Numbers Count.

$$1 + 1 = 2$$

All for Math
The campaign for math proficiency

At The Actuarial Foundation, we're bringing together the entire actuarial community to build a future where everyone has the opportunity to succeed.

Meet our newest spokesnumber - Two, who joins Zero and One to symbolize the power of math proficiency.

This lively dynamic between Zero, One, and Two, multiply impact and spark transformation. Help us show what the Power of Two can do by donating to our Impact^2 Challenge, a matching gift for every first time donor up to $75,000!

Make your donation today to unlock opportunities for students nationwide!

The Actuarial FOUNDATION

Stop! And Go Play in the Park!

Here is another puzzle from the team of Bob Fink and Jerry Miccolis. Bob and Jerry write:

Concerned that their youngsters, Alan and Claude, were becoming antisocial, Charles and Ada imposed a temporary rule they hoped would help. That rule appears in the unclued entry at 17-Across (for your convenience, every letter is crossed by intersecting Down entries). This rule also describes how eight answers must be treated before they are entered into the grid.

All the one-word entries and all the words in entries that are phrases—both before and after the treatment mentioned above—are playable in Scrabble, with one exception: a proper name. As with all cryptic crosswords, beware of punctuation in the clues, which has been known to deceive.

Thanks to Tom Toce for test-solving and expert editing.

Across

9. Church constructed of barium and quartz (8)
10. Pitches and catches in an MLB game? (10)
11. Showing flexibility, broadcaster Cronkite, without introduction, goes to cable after inauguration (9)
12. For the most part, Alex, Jack & Rod love the Lady Gaga song about her Latin lovers (9)
13. Father (Doctor of Divinity) retracted label by lake to court competition (10)
14. Married men in hot American music groups (8)
15. Elf ultimately enters backwoods to present once again (6)
17. [see instructions] (3,2,3) [or (3,1,1,3)?]
21. Irritable, receiving hug in a crabby manner (6)
23. Erratic dips seen in supply (8)
24. Moving mackerel to a place where beef is often stored (4,6)
26. Quiet characters repeatedly contribute to standard of conduct (9)
27. Note: CBS forensic franchise, to some extent, is a reproduction (9)
28. Sloppy dig is using covering (10)
29. Sufi elder statesmen harboring farm workers? (8)
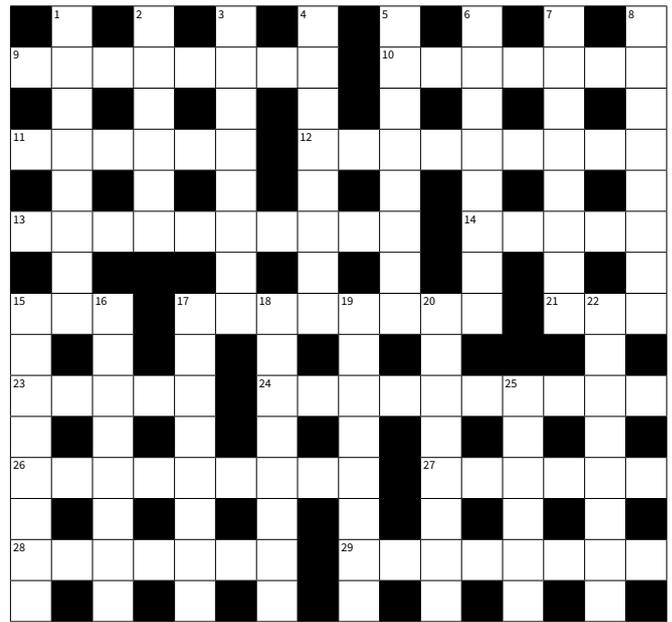
Down

1. Institution's behavior requiring its leader to be replaced by Monday (8)
2. Starting to fancy one second-rate cot, fabricated (6)
3. Frillier Mae, in fur, evens out table in bar (4,4)
4. Squid found in California, Louisiana, Massachusetts, and Rhode Island (8)
5. Somewhat dapper countertenor makes entrance (6,2)
6. "What tars!" erupted boater (5,3)
7. Portfolio of those who take too much housing: Liberal racket? (8)
8. Uchida plays my piano impromptu. "Exudes charisma," everybody ultimately agreed (2,3,3)
15. Emma Stone and Jessica Chastain are two he dreads agitating (8)
16. Examination covering home services website is most harsh (8)
17. Take the edges off this ache: Rub ice, like a little angel (8)
18. Release from the East African country when one overstays one's welcome (4,2,2)
19. Compromise with flexible draft foe? (5-3)
20. At the primaries, unusually persistent legislator, in fight to elect delegates, is elated (8)
22. Old Rover mangled ruler (8)
25. Spy organization entraps rogue with a bug (6)

Solution to Previous Issue's Puzzle—Ad Duo Unum

ACROSS:

8. ALLEGIANCE—ALLEG ("Legal mess") + (F)IANCE
9. LIMA—Anagram of "Mail"
10. TOPS—Double definition
11. ABOVE—First letters in "Aristotelian beliefs, Olympic virtues endure"
12. DRAB—Reversal of "Bard"
13. REIGNS—Anagram of "singer"
15. ALIENATE—A + LIE ("fiction") + N ("librarian at closing") + ATE ("stirred tea")
17. OAHU—O (""zero") + first letters of "hotel upgrade"
19. CHAIN—Double definition
20. SUET—Anagram of first four letters of "Tuesday"
21. PARADISE—Near homophone of "pair of dice" ("a couple of Shakers")
22. ABLEST—Hidden in "notable stats"
24. HEMS—Double definition
26. KNOTS—NOT inside KS ("Kansas")
28. HERO—Anagram of "Homer"—M ("without Marge's lead")
29. YIPE—IP ("IPO's not completed") inside YE (first letters of "young entrepreneur")
30. EYEDROPPER—EYED ("Unending needs consuming pharmacy's closing") + RO (reversal of OR from "operating room") + P ("Page") + PER ("counter rep")

DOWN:

1. ALCOVE—Hidden in "natural cover"
2. BEGS—"Beginners"—INNER("losing essential")
3. RIVALS—RI ("Rhode Island") + V + AL ("Alabama") + S ("earliest of spurious")
4. INFO—Hidden in "uncertain forecast"
5. DELETION—DELEGATION—GA ("Georgia")
6. GLAD—Hidden in "Bangladesh"
7. EMBATTLE—EM ("Dorothy's aunt") + BAT ("winged creature") + TLE ("Let chaos")
14. GOUDA—GO ("Travel") + U ("the fourth of January") + DA ("a couple of danishes")
15. AWAKE—First letters in "Ambien will always kill energy"
16. NASAL—Borders of "Nascent criminal"

18. ACADEMIA—A + CA ("California" + DEMIA ("media disaster")
19. CHICKPEA—Anagram of "Pick each"
22. ABSURD—A + BSU ("beat-up bus") + RD ("Drive in reverse")
23. SURFER—Borders of "Surge buffer"
25. SKEW—SEW (homophone of "So") swallowing K ("potassium")
27. OVER—Hidden in "lovers"
28. HOPE—Last letters of "Elizabeth to help Charlie"

BORDER CLUES:

- Accomplice to one who shoots craps—ABETTOR
- Cut off a connection to either side—ABRIDGE
- Shrink size of a prize—ATROPHY
- Bloke who hands a cheque to a guard at The Clink—AWARDER

Solvers: Steve Alpert, Anthony Amodeo, Dean Apps, Jack Brauner, Jan Brown, Bob Campbell, Lois Cappellano, Laura Cremerius, Jared Dashoff, Todd Dashoff, Christopher Dickens, Mick Diede, Deb Edwards, Matthew Feryus, Bruce Fuller, Phil Gollance, Jason Helbraun, Pete Hepokoski, Catharine Hornby, Max Jackson, Ruth Johnson, Joe Kilroy, Paul Kolell, Mike Kosciuk, Ken Kudrak, George Levine, Tim Luker, Ben Lynch, Mathew Marchione and Marika Brown , Dave McGarry, Jon Michelson, Jim Muza, Charles Page and family, David and Corinne Promislow, Alan Putney, Ram Raman, Danny Rhodes, Jay Ripps, Bill Scott, Andrew Shewan, Karen Skoglund, Sally Smith, Zig Swistunowicz, Tim Tebbe, T. O. C. E. (Josh DenHartog and Sean Donohoe), James and Betsy Uzzell, and Bonnie Veenschoten

The Hole-in-One Challenge

EVERY ONCE IN A WHILE, SOME RANDOM PERSON ON THE STREET asks me what happened with Doc and Hoss, the two runners I profiled two years ago who didn't get along and decided to settle their differences by racing 50 quarter-mile intervals. Well, it's fair to say that there is still a lot of bad blood between these two, as they have continued to challenge each other around town in the most unconventional venues. At this point, everyone here in Columbia has seen these two trying to assert their superiority in any locale imaginable, whether on or off the track.

The latest event took place at the local mini-golf course. I am not sure how this challenge came about, but one day Doc claimed he was a better golfer than Hoss, and before you knew it, the two decided to try to settle the score once and for all on the Putt-Putt course. So when Hoss and Doc finalized a date to meet on the course, I, of course, had to be there to witness whatever shenanigans were about to take place. This putt-off was the competition we needed but truly did not deserve.

And what a scene that day was! The indoor mini-golf course was filled to capacity, as everyone tried to get a glimpse of the two heated rivals. After 17 holes, Doc had a one-shot lead over Hoss as they approached the 18th and final hole. Then, in what would be known around Columbia simply as "The Shot," Hoss did the near-impossible: he putted his tee shot over the hill, through the clown's mouth, and somehow straight into the hole. After a Doc two-putt, our two combatants were back where they started, all tied up.

As expected, Doc threw a temper tantrum after this dramatic hole-in-one, which everyone from Moberly to

Jefferson City got to hear. Doc finished his tirade by saying that at least he still held the record for the most-holes-in-one in a single round, with Doc somehow making a mind-blowing six holes-in-one during one 18-hole round. Hoss countered by saying, "I don't care how long it takes; I am going to take that record from you, even if I have to play a round of mini-golf every day for the next 10 years." A new challenge has arisen!

I sat next to my friend Big T during the 18th hole madness, and he asked me if I thought Doc had a chance to break the record. After watching the 18-hole match, I told Big T that it appears that Hoss has a 1-in-3 chance of holing out each of the easiest six holes, a 1-in-20

chance of holing out each of the toughest six holes, and a 1-in-6 chance of holing out each of the remaining six holes. Big T agreed with my assessment and asked me, "What chance does that give Hoss of completing the challenge?" After watching Doc and Hoss go at it, I was in no position to come up with an answer, but I bet my puzzle-solving friends could help!

For each part below, assume that each hole is independent (no hot or cold streaks) and that Hoss has a 1-in-3 chance of making a hole-in-one on six holes, a 1-in-6 chance on six holes, and a 1-in-20 chance on the final six holes.

1. What is the probability that Hoss ends the round without making a single hole-in-one?

STOCK.ADOBE.COM / YURII SEMONOV

2. What is the probability that Hoss completes the challenge during his first round and gets seven or more holes-in-one on the 18-hole course? Also, what is the mean number of days it will take Hoss to break Doc's record?

3. Bonus: What is the probability that the first day Hoss completes the challenge, he will do so in epic fashion, demolishing the record with at least eight holes-in-one during the round?

Solutions to Last Issue's Puzzles—Happy New Year BY STEPHEN MESKIN

It was mid-November, and I already had my 2026 calendar. It was *Your Daily Epsilon of Math Wall Calendar 2026* from the American Mathematical Society. Each daily box contained a little math problem whose answer was the day of the month. The directions said "If a problem has no directions, solve for *x*."

This month, I had five problems for you in the style of my new calendar, but without the day of month (i.e., without answers). I labelled them A, B, C, D, E, so you wouldn't be tempted to use the problem number as the answer. You could assume that the answers are positive integers, probably less than 32 and probably distinct. You should show how you solved the problems.

Problem A: $\sqrt{y} + x = 28$, $\sqrt{x} + y = 14$
Answer: x=25
Solution: We observe that by equation 1, *y* is a perfect square and by equation 2, less than 14, so it is either 1,4, or 9. Consequently, from the 1st equation, *x* is 27,26, or 25. By the 2nd equation *x* is also a perfect square. Thus, *x* must be 25.

Problem B: Find the number of factors of 1152.
Answer: x=24
Solution: The prime factorization of 1152 is $2^7 3^2$. Thus, the number of factors is (1+7)*(1+2) = 8*3=24.

Problem C: How many integer partitions of 8 are there?
Answer: 22
Solution: 8, 7+1, 6+2, 6+1+1, 5+3, 5+2+1, 5+1+1+1, 4+4, 4+3+1, 4+2+2, 4+2+1+1, 4+1+1+1+1, 3+3+2, 3+3+1+1, 3+2+2+1, 3+2+1+1+1, 3+1+1+1+1+1, 2+2+2+2, 2+2+2+1+1, 2+2+1+1+1+1, 2+1+1+1+1+1+1, 1+1+1+1+1+1+1+1.

Problem D: Find the Frobenius number of {4,10,13}
Answer: 19
Solution: The Frobenius number of a set is the largest number that is NOT a positive integer linear combination ("PILC") of the numbers in the set. The PILCs of 4 and 10 are {4,8,10} and all larger even integers. To get to 19, one needs an odd integer such as 15,11,9 or smaller. But 13 doesn't cut it so 19 is NOT a PILC of the numbers in the set. But is it the largest? Observe,

20=10+10, 21=13+4+4, 22=10+4+4+4, 23= 13+10 and every larger integer differs from one of 20 to 23 by a multiple of 4 and thus are PILCs of {4,10,13}. Thus, 19 is the largest which is not.

Problem E: Find the count of triangular numbers among the following base nine numbers: 11_9, 111_9, …, 111111111_9.
Answer: all 8 of them.
Solution: We show that all such base 9 expressions are triangular numbers. Suppose there are n+1 1s. The expression $R(n) = \sum_{i=0}^{n} 9^i$ is a geometric series. Thus

$$R(n) = \frac{(9^{n+1}-1)}{9-1} = \frac{(3^{n+1}-1)*(3^{n+1}+1)}{8} = \frac{\left(\frac{3^{n+1}-1}{2}\right)*\left(\frac{3^{n+1}+1}{2}\right)}{2}$$

which is the triangular number form: $\frac{K(K+1)}{2}$ where K is a positive integer.

Solvers: Bob Conger, Bill Feldman, Rui Guo, Clive Keatinge, David Promislow, Daniel Ropp, Michael Schachet, Jason Shaw, Matt Stephenson, Daniel Wade, and Abraham Weishaus

In Praise of Books

I ADMIT—I'M ADDICTED TO BOOKS. My addiction spans a wide range. Whether in print or digital format; fiction or nonfiction; science fiction, science fact, bestseller; philosophy or actuarial; or a short story or essay collection—I can only praise and marvel at all of them. Sometimes I veer past my local bookstore, assuming I will buy one more book to add to my unread pile.

Fiction or nonfiction—I try to alternate them. My enthusiasm ebbs and flows with the author, the book's quality, and my mood. Reading goes beyond simple enjoyment and ideas; it can be stress-relieving and a way to step back from work and daily life challenges. It fosters a sense of possibility. It can offer a meaningful escape and a deeper way to learn about life, with benefits similar to those of meditation.

Reading is a time for me to get into my own headspace, to spark new ideas or kill others, and to learn more about myself and my relationships with others. Cat videos can only go so far. No wonder 12th-grade reading scores are at historic lows, and colleges are increasingly seeing students struggle to engage with lengthy or complex texts.

This underscores the long-standing debate over whether to focus on teaching students to pass tests or on deepening their understanding. It's also about whether to help prepare students for standardized tests or to develop them into knowledgeable, thoughtful adults. The pressure to boost students' scores is intense, as these scores impact local real estate values, education funding, and college admissions.

We need high expectations. I remember my senior English class, where grades depended on how many pages you read. Because of this incentive, I read books like Tolstoy's *War and Peace*, developing a deep respect for war, power, relationships, personal pain, and macro-level strategy.

I recall Mrs. Weiss, my seventh-grade teacher, who read *Uncle Tom's Cabin* aloud all semester, and my ninth-grade English teacher, who made us read *A Tale of Two Cities* silently in class—I thought she was just lazy; maybe she was smarter than I had believed.

How different is my addiction from those hooked on social media or headline-only news? Many books will outlast current trends. Social media might disappear. TikTok videos, microdramas, and TV shows come and go quickly. We won't make much progress if we focus on sound bites.

Fiction is essential for children to nurture imagination and creativity, not just for academic reasons but also to explore the complexities of good and evil, moral imperatives, and social realities. It can portray complex characters—everyone is complicated. Movies and episodics can come close, but rarely do they allow me to understand what the actors are thinking.

Life isn't simple. While some see only in black-and-white terms, the most important things are filled with shades of gray. Like many books, I hope we focus more on the gray areas.

Books also help build connections or understand connections with colleagues. They enable me to go beyond artificial intelligence (AI), generating thoughts or messages. Telling or reading a story is the most effective way to learn and communicate. That's why AI is "taught" with thousands or millions of stories. Great books with compelling stories can motivate me to explore new directions, helping me get through difficult times.

Books help me see people or processes as a whole, rather than as sound bites. Reading is not just transactional; it allows us to build on each other's ideas.

Books can depict lives I'll never live and provide more information than can be gathered from reading the daily news. They remind me of what people are capable of, drawing on years of thought, and emphasizing creativity, discipline, and craftsmanship.

Although I don't see book reading as a cure for the loneliness epidemic, it can serve as a good conversation starter. I usually ask, "What book are you reading, and what message are you taking from it?" Or it could be discussed at your monthly book club.

Reading a good novel or truth-telling nonfiction book has helped me grow. It can also reveal my mistakes. Things become easier when my mental library is larger.

There's nothing like sitting in a comfortable chair, finding my bookmarked place in a print or digital book, listening to an audiobook while doing a repetitive chore, or starting a book I haven't read. (I haven't begun re-reading books, but I might, still; there are soooo many of them yet-to-be-unread on my bookshelves!). ▲

SAM GUTTERMAN is chairperson of the Social Security Committee and member of the Retirement Practice Council.

Insuring the Future
Insurance Investment Summit 2026

May 12-13, 2026
New York, NY

Stay Ahead in Insurance Asset Management

The landscape is evolving. Make sure you're part of the conversation.

Keynote Speaker:
David Golub, President,
Golub Capital

Who Should Attend?

Investment actuaries, asset managers, insurance executives, regulators, and other investment industry professionals.

New for 2026:
Pre-Summit Sessions

Deep-dive training on asset classes, ALM modeling, and AG53/AG55 frameworks.

"A very strong seminar that facilitated discussion of important topics. Our industry needs more of these discussions."
— 2025 Attendee

Register at actuary.org/insurance-investment-summit

AMERICAN ACADEMY *of* ACTUARIES

Event Sponsor

BARINGS

Pauline Reimer, ASA, MAAA

PRYOR
Executive Search

The Perfect Fit...

It Takes One to Know One...
An Actuary Placing Actuaries

To have Pauline personally advise you on finding your perfect fit, please contact her at:

✉ pauline@ppryor.com

🌐 www.ppryor.com

📞 (516) 935-0100 x 307 or
(866) 6-ACTUARY

For five decades, local, national, and international insurance communities have benefited from Pryor's exceptional recruitment services.

Our renowned Actuarial, Risk, and Modeling Division has been directed by Pauline Reimer, ASA, MAAA, for the past thirty-five years.

PRYOR ASSOCIATES • 147 W. OLD COUNTRY RD • HICKSVILLE, NY 11801