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An Ordinary Summer Day

AN ICE CREAM TRUCK WAS MAKING ITS ROUNDS through my neighborhood as I returned home from work one afternoon in June. School was out. Pools were crowded. Children were playing and riding bikes. The forecast called for afternoon thunderstorms—nothing out of the ordinary for a summer day. Few could have imagined what would happen next.

Within 30 minutes, uprooted trees blocked roads, crushed cars, damaged homes, and left thousands of nearby residents without power.

The photos accompanying this note capture only a fraction of the storm's aftermath. According to a National Weather Service survey, the destruction was caused by severe thunderstorm downburst winds that topped 90 mph—

demonstrating the value of actuarial thinking as assumptions shift, data evolves, and new risks emerge. “Hard to Reach” (page 22) examines how limited access to health care and sparse data in rural communities make it more difficult to assess risk and design effective coverage, while “The Roth Question” (page 28) explores how actuarial modeling can guide one of retirement's most important financial decisions.



The aftermath of a recent severe thunderstorm in my community.

comparable to a low-end EF1 tornado. Insurers classify events like this as severe convective storms (SCS)—a category that includes damaging straight-line winds, hail, tornadoes, and intense thunderstorms.

The storm lasted less than a minute, but the recovery stretched on for weeks. World Central Kitchen provided meals to residents, while neighbors organized GoFundMe campaigns and other efforts to support affected families.

Until then, I hadn't thought much about the difference between a thunderstorm and a severe convective storm. Seeing firsthand the devastation those winds could cause brought this issue's cover story, “Convective Convergence” (page 12), much closer to home. It examines why severe convective storms have evolved from so-called secondary perils into some of the costliest weather events facing insurers. It also explains why they're challenging long-held views about where significant weather losses can occur—and how insurers and actuaries are responding.

Other articles in this issue raise similar questions, each

I still think about that storm. It arrived on what seemed like an otherwise ordinary summer day and, in less than a minute, changed lives in a nearby community. It reminded me how quickly certainty can give way to uncertainty—and how differently we see risk once it touches our own lives. That same idea runs through the stories in this issue, inviting us to question our assumptions. Sometimes the most ordinary days bring the most extraordinary consequences. I hope you enjoy the issue.

~ ~ ~

Before you turn the page, a couple of quick updates. I'm pleased to share that *Contingencies* recently received two 2026 APEX Awards of Excellence, earning honors in the Covers and Most Improved categories. We're also looking for a new puzzle writer. If you're interested—or know someone who might be—the details are on pages 57 and 60. ▲

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

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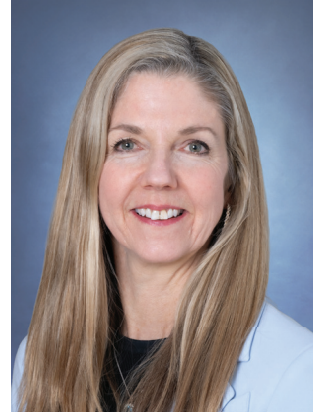
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Is It Still Insurance? Navigating the Era of Data-Driven Pricing

WHEN I LEARNED THAT ACCESS AND AFFORDABILITY OF INSURANCE was a key theme of this issue, I decided to write about the impact that data-driven pricing may have on individuals' ability—particularly higher-risk individuals—to obtain coverage. The insurance industry stands at a pivotal moment, shaped by the rapid emergence of new data sources and technological advances. These forces are revolutionizing how we price coverage and, more profoundly, challenging the foundational principle of insurance as a collective enterprise. In this article, I discuss these changes, explore their implications, and highlight the vital role actuaries must play in guiding the responsible evolution of risk segmentation.

The past decade has witnessed an explosion in the variety and volume of data available to insurers. Information from connected vehicles, wearable health devices, smart home sensors, and even social media feeds now enables actuaries and underwriters to predict risk with unprecedented precision. For instance, automobile insurers can assess driving habits in real time, and health insurers may monitor activity trackers to gauge wellness. These innovations promise more tailored products and fairer pricing for consumers, but they also raise profound questions about equity and the social purpose of insurance.

Traditionally, risk classification depended on broad groupings—age, occupation, geographic location, and other demographics. Today, sophisticated analytics and machine learning are driving much finer segmentation. Actuaries can now identify risk profiles at the individual level, adjusting premiums to reflect unique circumstances. While this enhances predictive accuracy and helps prevent adverse selection, it may erode the communal nature of insurance.

At its essence, insurance is a system of risk pooling in which individuals contribute to a shared fund so losses are distributed

among all. This principle has fostered social solidarity and financial security for centuries. However, as risk classification grows more refined, the pool itself fragments. Lower-risk individuals pay less; higher-risk individuals may face increased premiums or even exclusion. The foundation of insurance as a mechanism for collective risk-sharing is gradually eroding.

If this trend continues unchecked, insurance may increasingly resemble individualized savings programs rather than traditional risk-sharing models. Each person's premium could mirror their own expected losses, with little cross-subsidization among members. Such a shift would fundamentally alter the role of insurance—reducing its capacity to protect vulnerable groups and distribute risk broadly. For consumers, the change might bring transparency and personalization, but also raise the risk of insufficient protection for those who need it most.

Actuaries, by virtue of our strong quantitative skills, ethical standards, and professionalism structure, are especially well-equipped to address the challenges and opportunities of this new era. Our expertise allows us to evaluate complex



The past decade has witnessed an explosion in the variety and volume of data available to insurers. Information from connected vehicles, wearable health devices, smart home sensors, and even social media feeds now enables actuaries and underwriters to predict risk with unprecedented precision.



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data, model risks accurately, and understand the nuances of risk segmentation. Equally important, our professionalism framework emphasizes fairness, integrity, and public interest. As the insurance landscape evolves, actuaries should be at the forefront—ensuring innovation is balanced with actuarial soundness, privacy, and accessibility.

Novel data sources and refined pricing techniques can improve efficiency and reduce fraud, but they also risk undermining the social contract embodied in insurance. It is essential that we foster collaboration among insurers, regulators, consumer advocates, and actuaries to ensure progress does not come at the cost of inclusivity or fairness.

The insurance industry is rapidly evolving, and the decisions we make now will shape its future for generations. As president of the Academy, I urge professionals, policymakers, and the public to engage in thoughtful dialogue. We must embrace innovation, safeguard foundational principles, and rely on actuaries to steer the responsible evolution of risk segmentation. In doing so, we can ensure that insurance remains resilient, relevant, and a pillar of social protection in the face of change. ▲

TRICIA MATSON is president of the Academy.



COMING
SOON!

Here's what we're working on:

- Marking 25 Years of the Code
- Tales from the Dark Side: How Would You Respond to Professionalism Challenges?
- Human Oversight of Thinking Machines
- Celebrating the Rising Star Award Recipients

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.

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Making Investments That Strengthen Our Value and Future

ONE OF THE CORE STRENGTHS OF THE AMERICAN ACADEMY OF ACTUARIES is the expertise and commitment of our members who choose to raise their hands as volunteers. Every public policy work product, professionalism resource, educational effort, and member engagement initiative is made possible because Academy members generously share their time and knowledge in service to both the U.S. actuarial profession and the public. That volunteer-driven model remains the foundation of who we are and the value the Academy brings to our many stakeholders.

As the environment in which we operate becomes increasingly complex, we must continue evolving to meet the changing needs of our members, policymakers, regulators, and other stakeholders. That is why I am excited to share an important investment in the Academy: the addition of four staff actuary positions in the life, health, casualty, and retirement practice areas.

These positions represent more than new roles—they reflect our commitment to strengthening the Academy's mission and continuing to grow and expand our impact. Our mission is to serve the public and the U.S. actuarial profession by providing objective, independent, and balanced actuarial expertise. Achieving that mission requires exceptional volunteer leadership supported by exceptional staff. Historically, the

Academy worked with part-time actuarial consultants as senior fellows, who served as trusted advisors on policy issues and stakeholder engagement. Bringing the role in-house and as a full-time resource retains these strengths while building on and enhancing that value to the many stakeholders we serve.

These new positions will strengthen that partnership by bringing additional actuarial expertise into the organization to work alongside our volunteers. Together, they will help advance professionalism, inform public policy, expand member value, and increase awareness of the profession's value with clarity and transparency.

Working alongside our volunteers, these staff actuaries will help identify emerging issues, conduct research and



By adding actuarial perspective to our staff, we will enhance our service to the profession and respond more effectively to an increasingly dynamic legislative and regulatory environment, while preserving the thoughtful, volunteer-driven processes that define the Academy.

analysis, deepen and expand stakeholder relationships, support priority initiatives, develop timely and responsive resources, and ensure that volunteer efforts can have even greater reach and impact. By adding actuarial perspective to our staff, we will enhance our service to the profession and respond more effectively to an increasingly dynamic legislative and regulatory environment, while preserving the thoughtful, volunteer-driven processes that define the Academy.

This investment also reflects our strategic plan. Across each of our strategic priorities, these new roles create opportunities to elevate the Academy's impact.

- In advancing professionalism and practice, they will help strengthen educational resources, support thought leadership, and reinforce the professionalism structures that reside within the Academy, enabling self-regulation and reinforcing our commitment to serving the public with integrity and excellence.
- In informing public policy, they will enhance our ability to proactively engage with and deepen relationships with our many stakeholders, including policymakers, regulators, and other decision-makers, as we continue to provide timely, objective, and balanced actuarial expertise on issues that affect millions of Americans.
- In enhancing member value, they will help identify emerging trends, develop practical resources, support volunteer engagement, drive alignment between stakeholder priorities and organizational goals, and create additional opportunities for members to contribute their expertise while receiving greater value from their Academy membership.
- And in promoting visibility and transparency, they will help reinforce the value and increase awareness of the Academy and the U.S. actuarial profession while translating complex actuarial issues into information that is meaningful, accessible, and valuable to members, stakeholders, and the public.

These additions also recognize the extraordinary talent of the existing Academy's staff. Fifty-five dedicated professionals support our work across public policy, professionalism, member service and engagement, communications and publications, education, governance,

research, finance, technology, human resources, operations, and organizational leadership. Every day, they work behind the scenes to support our members and volunteers, deepen relationships with stakeholders, and ensure the Academy delivers on its mission.

Adding credentialed actuaries to this already talented team further strengthens the partnership between staff and volunteers. Volunteers contribute deep actuarial expertise and real-world experience from every area of practice, while staff provide continuity, coordination, institutional knowledge, strategic execution, and operational excellence. Together, they create an organization capable of delivering thoughtful, credible, and impactful work that neither could accomplish alone. This collaborative model is one of the Academy's greatest differentiators and essential to our continued success.

As the Academy continues to evolve, we will remain firmly grounded in the values that have defined us for six decades: objectivity, independence, balance, professionalism, collaboration, and service. At the same time, we will continue making thoughtful investments that position the Academy, the U.S. actuarial profession, and our members for the future.

The addition of the staff actuary roles and the continued investment in our staff strengthens our ability to deliver on our mission and increases our impact on behalf of all those we serve. It reflects our confidence in the future of the Academy, as well as our belief that combining outstanding volunteer leadership with exceptional professional staff will enable us to make an even greater impact in the years ahead.

I have never been more optimistic about the direction of the Academy. The challenges facing the U.S. actuarial profession continue to evolve, but so do the opportunities. By investing in our people, building on the partnership between volunteers and staff, and remaining focused on our mission, we are positioning the Academy to continue serving as the trusted voice for actuarial professionalism and public policy in the United States—today and for generations to come. ▲▲

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

Moral Turpitude

THE CURRENT CODE OF PROFESSIONAL CONDUCT was released to the members of the five U.S.-based actuarial organizations on Jan. 1, 2001. In the covering memorandum, the Joint Committee on the Code of Conduct referenced comments received during the exposure process. One such comment was on the term “moral turpitude.”

As stated in the memorandum: “One commenter on Precept 1 suggested adding an annotation dealing with ‘moral turpitude’; the Joint Committee believes that Annotation 1-4, as revised, is sufficient to address the commenter’s concerns.”

The current Code of Professional Conduct has 14 precepts. Most of the precepts have annotations, which are designed to provide commentary or to act as a critical or explanatory note.

Precept 1 reads:

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.

Annotation 1-4 reads:

An Actuary shall not engage in any professional conduct involving dishonesty, fraud, deceit, or misrepresentation or commit any act that reflects adversely on the actuarial profession.

So, what does the term moral turpitude mean, and how is it handled

by the Code of Professional Conduct? One dictionary defines turpitude as baseness, depravity, or evil intent. But there does not seem to be a standard definition. Moral turpitude is cited most often in U.S. legal documents in the area of immigration law when foreign applicants for permanent residence in the United States certify that they have not been found guilty of any acts of moral turpitude.

It’s assumed that everyone knows what the term means, but even within some legal immigration documents, the definitions can have subtle differences.

You’ll Know It When You See It

I’m reminded of the famous remark by U.S. Supreme Court Justice Potter Stewart in a 1964 concurring opinion in which he was trying to define the term “obscenity” and stated:

“I shall not today attempt further to define the kinds of material I understand to be embraced within that shorthand description [hard-core pornography];

and perhaps I could never succeed in intelligibly doing so. But I know it when I see it.” (*Jacobellis v. Ohio*)

It’s likely that each of us also knows if a particular act is one that is encompassed by the term moral turpitude. But not everyone agrees that a particular set of facts warrants such a designation.

Let’s start with a set of facts for which we’ll most likely agree on a conclusion. If an individual, acting as senior manager for an insurance company, demonstrated a lack of honesty and integrity that resulted in the company going into receivership, this would be considered a failure to fulfill a responsibility to the public. If that individual were to be an actuary, and the dishonesty occurred in the course of providing actuarial services, the first clause of Annotation 1-4 would apply and a recommendation of expulsion from the profession would be warranted.

But let’s look at other possibilities. What about crimes that lead to conviction and imprisonment, in which the perpetrator is identified as an actuary but no actuarial services were being provided?

For example, think of a crime involving evil intent but concerned with property—arson, say, or robbery. Should Annotation 1-4 apply? If a crime involves mail fraud, perjury, or willful tax evasion, should there be the same result? If a crime involves offenses against individuals, such as murder, child molestation, or rape, should there be the same result?

Editor’s Note: While this article was originally published in the March/April 2013 issue of *Contingencies*, it discusses concepts and raises questions that are still relevant today. Precept 1 of the Code of Professional Conduct and its annotations are broad—it requires actuaries to maintain personal integrity and uphold the reputation of the profession—even when not providing actuarial services. Is every case of less-than-optimal behavior a violation of the Code warranting discipline? Obviously not. But where should that line be drawn? Much depends on the facts and circumstances of each case. Read on for a thought-provoking article ... where would you draw that line? Readers facing a situation that raises such questions may want to contact the Actuarial Board for Counseling and Discipline with a request for guidance.

Is the result different if an individual isn't publicly identified as being an actuary? Do the individual's neighbors and friends know about his or her professional credentials? If so, is this question even relevant?

Complicating Factors

We frequently hear about "slippery slopes." In these cases, you start out with a clear position on some set of facts but eventually migrate to a set of facts where it is clear that an alternative answer is the preferred response. If it is clear that an actuary convicted of child molestation should be expelled, where did we cross a line that would say a lower penalty would be justified—conviction for manslaughter, conviction of perjury, conviction for driving under the influence? (In passing, I note some recent employment law cases in which individuals have been terminated 30 or 40 years after lying on employment applications. This is an example of enforcing an absolute standard.)

Now let's add the complexity of when the act involved occurred. If it was recent and the individual is still incarcerated, presumably we might all still be in our comfort zone of accepting expulsion under the Code of Professional Conduct. But what if the act occurred 10, 20, or 30 years ago and only recently was made public? Is the result the same whether or not the individual is currently incarcerated or under the supervision of a court?

Is the current wording of Precept 1, particularly Annotation 1-4, sufficient to handle the variety of incidents that may come before the profession's counseling and disciplinary bodies? The 2001 Joint Committee believed the current wording was "sufficient." What are your views?

Should we leave the current language alone and let the circumstances of each situation be evaluated as it comes up for consideration, trusting that the reviewing authorities will make appropriate decisions? Or should we clarify the language to identify all situations that are to be encompassed within the purview of the precept?

For example, should the precept apply only when actuarial services (as defined in the Code of Professional Conduct) are involved? Does the subject actuary have to be identified publicly as an actuary to have the precept apply? Should there be a statute of limitations that would limit the time that action could be contemplated?

It remains likely that each of you will still know what the right answers are to these questions, even though we may reach different conclusions. Perhaps the answer actually is found in the last phrase of Annotation 1-4, where it states, "An Actuary shall not commit any act that reflects adversely on the actuarial



JOE SUTLIFF



Up to Code as it appeared in the March/April 2013 edition of *Contingencies*

profession." The committing of "any act" (whether publicized or not or even whether it is known by the actuarial community) is the actual violation. ▲

At the time of publication, **CURTIS HUNTINGTON** was a professor of mathematics at the University of Michigan in Ann Arbor. He was a member of the Actuarial Board for Counseling and Discipline, a member of the Academy, a fellow of the Society of Actuaries, a fellow of the Conference of Consulting Actuaries, and a member of the American Society of Pension Professionals & Actuaries (ASPPA), and the ASPPA College of Pension Actuaries.

CONVERGENT

The confluence of severe convective storms, rising costs, and evolving hazards is changing how actuaries measure and manage risk.

BY MICHAEL G. MALLOY



EINVCÉE

Fifteen years ago, on May 22, 2011, the enormous tornado that tore through the city of Joplin, Mo., was so large that survivors described a 300-yard-wide “eye,” similar to the center of a hurricane, in the 2025 Netflix documentary *The Twister: Caught in the Storm*. The EF5 tornado—the highest rating on the Enhanced Fujita (EF) scale—killed 161 people and caused an estimated \$2.8 billion in insured losses. Total damages, including uninsured losses factored, reached as much as \$3.18 billion overall, according to *Guinness World Records*.

Tornadoes develop from mesocyclones—rotating drafts that form within severe convective storms (SCS). Unlike tropical cyclones—called hurricanes in the U.S.,

and typhoons or cyclones elsewhere in the world—mesocyclones are a critical ingredient in tornado formation. These rotating updrafts feed into supercell thunderstorms, which can produce high winds and hail, and spawn tornadoes.

As with electricity, there is an element of mystery in exactly how tornadoes form. Even tornado experts with a keen sense of how to chase them, as portrayed in the 1996 movie *Twister* (and its 2024 sequel, *Twisters*), acknowledge that some parts of the process are not fully understood. It’s generally accepted that tornadoes require a collision of cold and warm air, which can create supercells capable of producing funnel clouds and, ultimately, tornadic activity.

Around 1,200 tornadoes form annually in the United States, according to the National Severe Storms Laboratory (NSSL), a division of the National Oceanic and Atmospheric Administration (NOAA). While the U.S. accounts for the majority of the world's tornadoes, they also occur across Europe, Africa, Asia, South America, Australia, and New Zealand.

Since 2007, tornadoes have been measured by the EF scale. Like the categories used for hurricanes, EF ratings range from EF0 (the weakest, with maximum 65 mph gusts) to EF5 (the strongest, with winds exceeding 200 mph).

Growing Costs

Several large global reinsurance companies, including Allianz, Aon, and Swiss Re, have pointed to rising costs in recent years due to SCS activity.

“Unlike hurricanes, SCS events can strike with little or no warning, unleashing significant localized damage and triggering knock-on effects such as flash flooding,” Allianz said in its March 2026 report on SCS activity and costs. “The U.S. is the No. 1 SCS hotspot, accounting for more than 80% of the value of insured losses globally.”

SCS events “have emerged as a major annual loss driver for the insurance industry, accounting for nearly half of all insured natural catastrophe losses last year, totaling over \$60 billion,” Allianz said, adding that between 2023 and 2025, losses added up to more than \$200 billion, citing data from reinsurer Gallagher Re.

SCS events “have surpassed tropical cyclones to become the costliest insured peril of the 21st century,” according to Aon’s 2026 *Climate and Catastrophe Insight* report, released in January. The report noted that while global economic losses from natural disasters reached \$260 billion in 2025—the lowest since 2015—insured losses remained elevated at \$127 billion, marking the sixth consecutive year in which such insurance payouts exceeded \$100 billion.

“This divergence reflects how concentrated, high-severity frequency peril events—particularly in the United States—continue to drive substantial insured loss even in below-average hazard years,” the report stated. “In many regions, especially emerging markets, more than half of economic losses remained uninsured, leaving millions exposed to financial risk.”

Tornado Alley

Through mid-March 2026, the United States had recorded 331 tornadoes, with activity concentrated across the South and extending east of the traditional boundaries of Tornado Alley, which stretches from Texas and Oklahoma through the central

United States, said Victor Gensini, a professor of meteorology at Northern Illinois University (NIU) and director of the Center for Interdisciplinary Research on Convective Storms (CIRCS), a research center operated by NIU and the University of Wisconsin-Madison.

“I think why you’re seeing the [SCS] mandate coming from on high, so to speak, is that they are no longer thought of by many companies, especially reinsurance companies, as secondary perils—to the tune of \$160 billion” in losses in 2024, Gensini said. He added that SCS events are very different from catastrophic events like hurricanes and major wildfires—the larger “Black Swan” events that catastrophe models were originally designed to analyze.

“These events don’t generally reach the level of magnitude of a hurricane loss, or a major wildfire loss. Instead, it’s more like \$10 million here, \$5 million there—death by a thousand paper cuts,” with losses piling up. “It can be the most important peril on your balance sheet.”

—Victor Gensini

Severe storms happen on hundreds of days each year, “so, more often than not there’s somewhere in the U.S. that’s experiencing convective storms,” Gensini said. “These events don’t generally reach the level of magnitude of a hurricane loss, or a major wildfire loss. Instead, it’s more like \$10 million here, \$5 million there—death by a thousand paper cuts,” with losses piling up. “It can be the most important peril on your balance sheet.”

The American Academy of Actuaries became a CIRCS “in-kind member” in 2025. “It will have the ability to help shape and guide projects, and give very important insight” from an actuarial point of view on “the broader landscape of what’s happening across their membership and the pain point, so to speak, it feels with respect to convective storms,” Gensini said.

Funky Perils

The confluence of increasing costs and challenges in forecasting and modeling is keeping actuaries, climate modelers, and insurers busy year-round.

“SCS were previously considered more of a secondary peril, compared to lower-frequency, higher-damage events such as hurricanes or earthquakes,” said Howard Kunst, chief actuary and an extreme-events catastrophe modeler with Cotality, which rebranded from CoreLogic in 2025.

“We’re seeing growth in population and exposures in areas that are prone [to SCS] that maybe weren’t in the past,” Kunst said. “So using historical loss data—similar to wildfires—is not sufficient to really look at where these events can and will occur.

“More insurers are starting to pay attention” to SCS, he added. “When I was working in the insurance world 15 years ago, we found that convective storm models were still a little bit raw ... but over the last 15 years, we’ve seen them improve and become much more useful and predictive.”

SCS are challenging for several reasons, said Rade Musulin, a former Academy casualty vice president. Now based in Australia, Musulin currently chairs the International Actuarial Association’s Climate & Sustainability Committee.

“For one thing, they’re a collection of perils,” he said. “Hailstorms, tornadoes, straight-line winds,

thunderstorms—they all have relatively small footprints” often of a mile or two or less, compared with tropical cyclones, which can span hundreds of miles. And unlike hurricanes—which have records going back centuries, including ship logs and historical reports—SCS have more recent, and more uncertain, track records, he added.

SCS have “historically occurred in uninhabited places, like forests, we didn’t observe,” Musulin said. “And then once people start moving in there, all of a sudden we think the number of SCS events goes up. Well, no, actually, they didn’t. We’re just observing them more now ... so you have kind of a funky peril that’s a collection of things, with a wobbly historical record.”

Musulin noted the challenges posed by modeling such events. “With hurricanes, a model might use 5,000 or 10,000 simulated years or seasons of activity. With severe convective storms, the event set may need to be much larger due to the localized nature of the peril. [SCS are] a lot smaller in scale—but often higher in severity, like when a tornado comes through and blows a town down. So, you also have a computational challenge because of all of the above.”



Modeling Matters

“There’s no formal official scientific definition of an SCS event,” said Karen Clark, CEO and co-founder of Boston-based Karen Clark & Co. (KCC). Clark founded the first catastrophe modeling company, AIR, in 1987 and launched KCC, a climate modeling firm, in 2007.

SCS models aren’t novel—KCC’s SCS model was first developed around 2015—but they are relatively new compared to other models, such as those for hurricanes, which have been around for more than three decades, Clark said.

“After Hurricane Andrew [in 1992], the modeling

industry really took off, because that’s when the insurance industry got religion and said, okay, we really need to use these models,” she said. Andrew was the costliest hurricane on record at the time and, according to NOAA, remains the ninth-costliest U.S. hurricane, causing an estimated \$60.5 billion in damage in inflation-adjusted 2024 dollars.

Because of their irregular nature, “it’s more challenging to estimate industry losses for [SCS] events than for a hurricane,” Clark said. “Severe weather happens every day, and insurance companies get hail and wind [damage] claims almost every day of the year.”

Because of these factors, SCS are much more difficult to



Understanding Your Homeowner’s Insurance Policy

While most homeowners have insurance for their dwellings, many may not understand exactly what is covered, what they’re paying for, or how to qualify for discounts on certain types of coverage.

Roof damage caused by hail is a common expense for homeowners, according to a March 2026 issue brief from the American Academy of Actuaries’ Homeowners’ Insurance Task Force. Wind and hail damage account for 45.5% of homeowner claims nationwide, the issue brief states, citing Experian. The two perils are the leading cause of roof damage claims, and the risk is rising.

It also notes that under actual cash value (ACV) coverage, insurance companies pay replacement costs minus depreciation for a roof’s age and condition. Because losses associated with roof damage are increasing, many insurers are transitioning to ACV coverage for roofs older than 10 years, adding that “such restrictions must be clearly disclosed in the policy.”

With more use of ACV, many homeowners may not realize what they’re signing up for when they shop for the best value in homeowners insurance, said Ian Giammanco, managing director for atmospheric science and lead research meteorologist with the Insurance Institute for Business & Home Safety (IBHS), an independent, nonprofit scientific research organization supported by property insurers, reinsurers, and affiliated companies.

“We are starting to see higher deductibles, which can put more pressure on homeowners when they experience damages,” Giammanco said. “For severe convective storms, a lot of that damage involves roofs,” whether it’s hail or wind.

“The growing issue is in places where you’re having to do roof replacements two and three times within a 10-year period—those dollars are adding up,” he said. “With all the other cost pressures that homeowners deal with, it’s important to make sure you understand what’s in your policy, whether it’s ACV or if the deductible has gone up.”

Inflation Pressures

Karen Clark, CEO and co-founder of climate modeling firm Karen Clark & Co., said the onset of COVID-19 in the early 2020s “caused a lot of labor supply shortages in the construction industry.” Since then, the cost of building the same single-family home has almost doubled because of higher construction costs. combined with more development, she said, those higher costs have “been a key driver in rising claims costs, and I think many people miss that.”

Severe storm damage has also been compounded by more development in newer areas, exposing more homes to risks, said Victor Gensini, director of the Center for Interdisciplinary Research on Convective Storms and a professor of meteorology at Northern Illinois University. “There’s more societal exposure—what I call increases in the human build environment about how we build and where we build,” he said, pointing to growing development in the Interstate 25 corridor near Denver, in an area affected

model, she said, pointing to the familiar hurricane graphics seen during hurricane season, while severe storms often look like blotchy radar images on a weather map.

Spatial Heterogeneity

“One of the biggest challenges in predicting property losses from [SCS] is their highly localized nature,” said Lisa Gao, a professor of actuarial science at the University of Waterloo in Ontario, Canada. “There is substantial spatial heterogeneity within a storm—for example, one homeowner’s experience during a hailstorm may be very different from another’s,” even a short distance away, she said.

“Not only within a storm, but there is also huge variation across storms,” she added. “Most of the time, severe thunderstorms might not do much damage, but there could also be multiple days of downpours leading to flash flooding,” she said.

Gao co-authored a 2025 paper on risk modeling of property insurance claims from weather events—an update to a 2023 paper on modeling of hail-related property insurance claims that was a finalist for the Academy’s annual Award for Research.

Clark also noted the more elusive nature of categorizing SCS. Severe storms “don’t have predictable shapes and forms,” she said. “They’re amorphous. They’re dynamic. They change over time. So the statistical approach that’s been the traditional

by severe storms. Colorado Public Radio reported that Adams County, near Denver, ranks among the top 10 U.S. counties for tornado reports, with 192 since 1950, and the state averages 45 to 50 tornadoes a year, though many are brief and relatively weak in nature.

Giammanco noted that typical homeowner insurance policies cover wind and hail damage, with flood insurance in its own special, separate category. “Most people who get flood insurance [get it] through the National Flood Insurance Program (NFIP),” he said, adding that his own home in Maryland has a basement. “I could absolutely see a big rainfall event causing some flooding in the basement, so we carry an NFIP policy.”

According to the Federal Emergency Management Agency (FEMA), flood insurance is available to anyone living in one of more than 22,000 participating NFIP communities, and homes and businesses in high-risk flood areas with mortgages from government-backed lenders are required to have flood insurance. It’s been widely reported by insurance companies and others that many FEMA flood maps are out of date.

“We’re seeing more insurers use roof age as a key indicator of future performance, because research shows it’s one of the strongest predictors of how a roof will perform in wind and hail,” Giammanco added. “On the positive side, many homeowners may not realize that when you have a higher-performing roof

material like an impact-rated roof or a fortified-roof designation through IBHS’s program, in many places that qualifies you for an insurance discount ... so homeowners should make sure they talk to their agent and don’t miss out on any savings they could get.”

Building materials, particularly for roofs, are key factors in home policies. “From a hail standpoint, there are good performing materials across the board,” Giammanco said. “We’ve seen really good performance from some of the new synthetic composite shingles. In IBHS hail impact testing, we have not observed metal roofing crack under hail impacts, though it can dent ... A modern code metal roof is a very high-performing system,” particularly in hurricane-prone coastal areas, he added.

Tile has also come a long way as a roofing material, Giammanco said. “It’s both wind- and hail-resistant,” though it will reach its limit at very large hailstones (e.g., 2.5–3 inches). Asphalt is generally the lowest-cost roofing material, with metal about twice as expensive and tile two to three times the cost, he said. “There’s good performance across the range of costs and material types.”

Through IBHS’s fortified program, homeowners receive a digital certificate verifying that their homes meet the program’s standards, which can help them qualify for insurance discounts, “and in many places, those discounts are be-

coming really meaningful,” Giammanco said. “They’ve proven their worth in reducing not only claims frequency, but the total amount of claims if you have to file one. They’ll pay for themselves really quickly.”

Modeling Data

In addition to factoring in construction materials and other hazards, catastrophe modeling gives insurance carriers “that big picture of risk and vulnerability,” Giammanco said. As models become more sophisticated, insurers are collecting increasingly detailed information about individual properties. “Homes don’t have VIN numbers, but we’re starting to gather that type of data trying to know everything we can about these structures.”

In the past several decades, residential construction was considered more uniform, “but we’ve learned it’s not as cookie-cutter as we thought,” he added. Homes now incorporate a wider range of materials and structural features, in part because of evolving building codes and the choices that homeowners and builders make.

“That’s one of the critical data points for the next 10 or 20 years,” Giammanco said. “For consumers, that’s going to help across the board. One, it’s about recognizing the reduction in vulnerability for all the good materials you’ve got. And also, identifying more risk than [was] previously known.” — MGM



“You want to make sure that you’re up to date on what’s going on with hazards and that you’re using the most current information and staying on top of what the real risk is today, and accounting for that in your rates and your underwriting.”

—Howard Kunst

approach in the modeling world just does not work for severe convective storms.”

While tornadoes get the bulk of the attention in the news, “you get a lot of claims just from 50 mph winds, trees falling on houses,” she said. KCC scientists have developed a physical model, as opposed to a statistical model, based on atmospheric physics, giving insurers daily downloadable hail and tornado wind footprints that they can use to estimate where claims are going to be, how large they’ll be, and what the losses could potentially be, she said. Then six or nine months after each event, they can compare actual losses to the model’s estimates.

“We’ve archived over 100 terabytes of high-resolution atmospheric data,” Clark said. “It’s actually four-dimensional data, because it’s three-dimensional in space, and then it’s [modeled] over time.” And, “even if some companies don’t want to share all of their claims data, they’ll still give us a lot of feedback as to how the model performed,” she added.

Actuaries also use the model for reserving, Clark said. “When there is a large SCS event, actuaries have ways to estimate what the ultimate losses will be [and] the model helps with that process ... because we estimate the losses for every event.”

Pooling Risks

Gao said that traditionally, actuarial loss models often assume that individual policyholders’ losses are relatively independent of one another. For example, a car accident in one state would generally be considered unrelated to a crash in another state. But when it comes to climate-related events, SCS can affect an entire region, with many simultaneous losses, which reduces the diversification benefit and makes insurance pooling less effective, she said.

“My research is in developing methods to incorporate very rich data to predict individual losses, and, more importantly, characterizing the underlying dependence structure [among losses] so we can better predict when

multiple losses might happen together,” Gao said. “Basically, the main idea behind how well insurance functions has to do with how relatively independent those losses can be,” she said. “When things start happening at the same time—and you have this sort of extreme positive correlation—that’s when the pooling benefit of insurance starts to fall apart.

“More and more, especially with these climate-related risks, an entire area might be susceptible to similar kinds of risk,” she added. “From a data perspective, that’s promising for actuaries, because the increasing availability and granularity of data can allow actuaries to model some of that localized heterogeneity ... with things like high-resolution radar data and satellite imagery, and detailed information on the underlying property exposures.”

Spawning Storms

Category 4 or 5 hurricanes (the strongest of the five categories) can approach or exceed 150 mph sustained wind speeds, such as Hurricane Michael, which hit the Florida panhandle in 2018 as a Category 5 storm with winds topping 160 mph.

“You’ll see that occasionally with tornadoes, though with a much smaller footprint than a hurricane,” Kunst said, adding that hurricanes can often spawn tornadoes around their edges as they move inland from open water. “Most people don’t realize that Florida has more tornadoes per square mile than any other state—just a little bit above Oklahoma and Kansas. Not the most tornadoes overall, but per square mile,” he said.

“You want to make sure that you’re up to date on what’s going on with hazards and that you’re using the most current information and staying on top of what the real risk is today, and accounting for that in your rates and your underwriting,” he added. “The flip side is, if you make too many changes and account for every

little change, you're having to do [rate] filings all the time ... so there's always that push and pull."

Kunst noted that meteorology has come a long way in the past 25 years, including more accurate forecasting of hailstorms. "The things that are harder to model are large, multiday events" like the big system that came from Texas up Tornado Alley and into the upper Midwest in early March, culminating in snow in Wisconsin and large tornadoes in Michigan that killed several people.

One of those outbreaks produced unusually strong tornadoes near Kalamazoo, Mich., in early March, killing at least four people in two counties after temperatures rose 20 degrees in five hours, helping to fuel severe thunderstorms, according to the *Washington Post*.

"We see these shifts all the time—storms will shift a little farther east, then go back and kind of waver through Tornado Alley," he said, adding that "over the last five years we've seen

Billion-Dollar Database

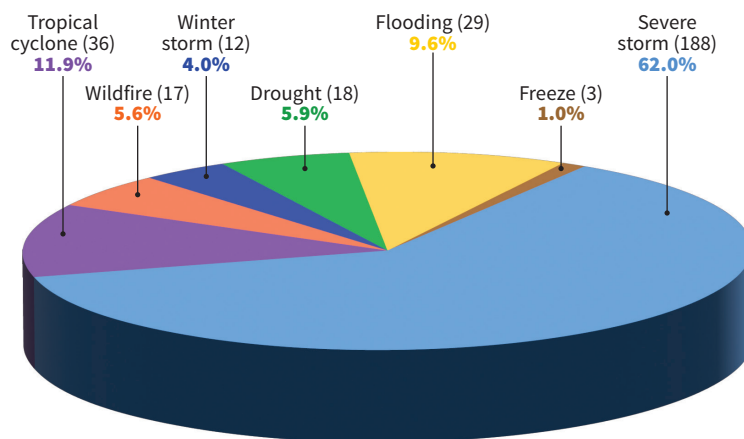
"Flood risk and climate-modeling data are becoming more available at a granular level," said actuary Steve Kolk, CEO of Michigan-based Kolkulations, who helped draft a June 2025 Academy letter urging NOAA to preserve its Billion-Dollar Weather and Climate Disasters database. The letter said that the information helps actuaries, academics, and insurance companies inform public policy actions directly impacting consumers and communities.

After the database was eliminated in 2025 as part of Trump administration budget cuts, the nonprofit Climate Central assumed responsibility for maintaining it. The database tracks U.S. weather and climate disasters that have caused more than \$1 billion in damage since 1980 and, as of March 2026, included 431 such events with total losses exceeding \$3.1 trillion.

Kolk, who has chaired the Academy's P/C Extreme Events and Property Lines Committee, has compiled pie charts from the database showing that the \$303-billion weather and climate disasters occurred between 2006 and 2025, causing nearly \$2.1 trillion in losses. — *MGM*

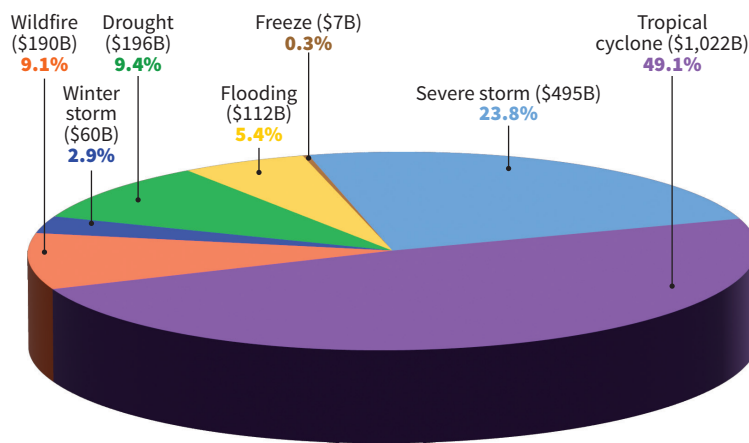
Billion-Dollar Disasters

\$303 billion disaster events
2006 through 2025



Billion-Dollar Disaster Costs in 2026 Dollars

\$2.081 trillion
2006 through 2025



KOLKULATIONS LLC; BILLION-DOLLAR DISASTER (BDD) DATABASE

a tremendous increase in construction costs” that has driven rebuilding costs higher.

For actuaries, “in the past, your PMLs [probable maximum losses] for weather were driven by hurricanes, depending on your geographic location ... now, for a lot of companies, they’re driven by severe-storm losses,” Kunst said. “Understanding how big they can be is important in allocating capital and where to put your money to work, and what type of risk charges you need [and] whether you have to allocate more reinsurance costs” in high-SCS areas.

Shifting Footprints

SCS footprints are also shifting, Musulin said, with parts of the Midwest and Southeast experiencing more severe convective storms beyond the traditional Tornado Alley, which runs north from Texas and Oklahoma through the middle of the country.

“I think that creates some actuarial challenges, because we’re seeing more storms in places and at times of the year we didn’t used to,” he said. “And this is where the regulatory system comes in—regulators want evidence and solid numbers around these things. From an actuarial angle, we have to understand that uncertainty.”

He added that “compound events” also factor into storm-related reconstruction costs. These include high energy prices this year stemming from the Iran war, tariffs, and other geopolitical and economic factors. “That’s just another thing actuaries have got to get on their risk management radar and pay attention to,” Musulin said. (Read also, “Managing Risk in a World of Polycrisis” in the July/August 2026 issue of *Contingencies*.)

Regulatory Lens

For state insurance regulators, there are important financial and actuarial issues to consider with respect to SCS.

“For severe convective storms, it’s about how the actuarial community uses cat [catastrophe] models in pricing for rate adequacy and in reserving for capital adequacy,” said Wanchin Chou, chief actuary and assistant deputy commissioner of the Connecticut Insurance Department.

Chou—who chairs the National Association of Insurance Commissioners’ (NAIC) Catastrophe Risk Subgroup and is vice chair of the NAIC’s Property/Casualty (P/C) Risk-Based Capital (RBC) Working Group—said the subgroup has been reviewing SCS catastrophe models since 2023. “If everything’s running smoothly by the end of this year, we can feel comfortable adding SCS to RCAT in the 2027 RBC report,” he said.

RCAT—or the risk capital adjustment tool that reflects capital needs arising from natural catastrophes—refers to catastrophe modeling used in the insurance and finance sectors. Previous RCAT models have included hurricanes and

earthquakes, and the NAIC is likely to include wildfires by the end of 2026 before potentially adding SCS next year, Chou said.

RBC is used to identify potentially undercapitalized insurers, given their overall business operations with respect to their size and risk profile. It provides a uniform capital adequacy standard across states and gives regulators a basis for timely action while reflecting the unique risks of operating an insurance company.

Chou said that state insurance regulators “review and evaluate all the popular catastrophe models from the major vendors ... for different perils, including earthquakes, hurricanes, wildfires, and severe convective storms.”

Based on 100-year events—extreme events with an estimated 1% annual chance of occurring—regulators want carriers to ensure they have enough capital to prevent solvency problems if such events happen, he said.

Chou, who has served in multiple volunteer roles with the Academy—including on its Climate Change Joint Committee and the P/C Extreme Events and Property Lines and P/C RBC committees—noted that actuaries involved in SCS work need to pay particular attention to the Actuarial Standard of Practice (ASOP) No. 39, which addresses catastrophe or extreme-event losses with respect to future cost estimates.

“For SCS, it’s about how the actuarial community uses all these factors in pricing, reserving, and [assessing] capital adequacy,” he said.

Reinsurance Concerns

Reinsurance—essentially insurance for insurance companies, allowing primary insurers to transfer some of their risk exposure to a reinsurer for a premium—is also a factor, Cotality’s Kunst noted. “A lot of that is driven around by what a multiyear loss is going to be and by looking at the various layers of say, a 50-year, 100-year, or 250-year loss, and what those losses could cost,” he said. “As the return period and the number of years go up, you’re talking about more severe but less frequent events, and PMLs at various year return periods.”

Musulin also noted that reinsurance is becoming a larger part of the SCS landscape. “If you’ve got massive tornado outbreaks tearing up a lot of property in the Midwest, for example, reinsurance markets will react to that, and that could create price pressures for consumers at the end of the day,” he said.

A company operating in the Midwest probably didn’t have to consider a large reinsurance program for severe convective storms 20 years ago, Musulin said. “Now they might have to go buy a bunch of reinsurance for it, and that cost has got to get passed on to their policyholders somehow. So the reinsurance markets are relevant here—reinsurers didn’t use to pay a lot of attention to these perils, because they were focused on the big stuff, like earthquakes.”

No Longer Secondary

The experts interviewed for this article agreed that severe convective storms have outgrown their status as a secondary peril, rivaling hurricanes as the costliest insured peril of the century while remaining among the hardest to pin down. They are a collection of hazards with small footprints, short historical records, and shifting geography—compounded by rising construction costs and growing exposure in storm-prone areas.

Actuaries will play an increasingly important role in helping insurers measure risk, price products, and build

resilience. Historical loss data alone no longer suffices for pricing in storm-prone regions, and PMLs once driven by hurricanes are, for many companies, now driven by severe-storm losses, with consequences for capital allocation and reinsurance costs.

As regulators move toward incorporating SCS into capital adequacy frameworks, the demand for credible modeling—and for actuaries who can interpret it—will only grow. ▲

MICHAEL G. MALLOY is managing editor for member content at the Academy.

Climate Concerns—and Uncertainties

Several experts interviewed for this article noted the uncertainties about how climate change affects severe convective storms (SCS).

The relationship between climate change and severe convective storms is less clear-cut than it is for hurricanes, said Rade Musulin, a former Academy casualty vice president, who currently chairs the International Actuarial Association's Climate & Sustainability Committee.

"With hurricanes, it's quite clear that you're seeing [stronger storms] ... the scientific consensus is high. There's a lot of uncertainty around tornadoes, hail, lightning—all those perils. They're tricky to climate-model, because there's a lot of opposing forces there that are confusing the issue," Musulin said. Those forces include changes in the polar vortex—colder air that flows down from Canada into the U.S. and may spawn twisters—or, conversely, drought conditions that can suppress thunderstorm development by limiting atmospheric moisture, he added.

Victor Gensini, a professor of meteorology at Northern Illinois University (NIU) and director of the Center for Interdisciplinary Research on Convective Storms (CIRCS), said that ongoing and future changes in the world's climate may suggest stronger thunderstorm updrafts, with more heat, humidity, and

energy that could lead to events like larger hailstones.

He likened hail formation—in which water droplets get kicked higher into colder parts of the atmosphere, where they freeze and often refreeze—to balancing a ping pong ball over a hair dryer. "It's pretty easy to balance that ping-pong ball over a hair dryer," he said. "But if you do that with a softball, you're going to need a much bigger hair dryer."

The analogy underscores why researchers are paying close attention to the conditions that produce larger hailstones. A CIRCS report released this summer included an image of a softball-sized hailstone that fell in March and measured 6.6 inches—a record for the state of Illinois.

"One of our research thrusts is trying to identify these 'climate knobs,' for lack of a better word," Gensini said. "What's happening with climate change that could possibly either augment or mitigate these types of events."

Karen Clark, CEO and co-founder of climate modeling firm Karen Clark & Co., said that the Intergovernmental Panel on Climate Change (IPCC), established by the United Nations and the World Meteorological Organization in 1988, publishes periodic reports on climate issues and based on the IPCC's latest report, there is no scientific consensus on climate change's impact



on SCS. Such a correlation would be "highly uncertain... [and] would not be supported by the scientific consensus," she said.

"SCS activity is influenced by cyclical factors," such as El Niño, she said. "So you could go two or three years with losses decreasing" as was the case in the early 2020s, "and then 2024 and 2025 were more active. So, if you're just looking at a few years of data, it can look like a trend, but in reality, it's really cyclical."

El Niño, a naturally occurring climate pattern that typically develops every two to seven years, starts with warmer-than-average Pacific Ocean waters and can influence global weather patterns and trends, including temperatures, rainfall, and drought conditions. The most recent event occurred in 2023–2024, and NOAA's 2026 hurricane outlook suggests conditions that El Niño could return this year. —MGM

HARD TO

Gaps in health care access
and data in rural and
underserved communities
complicate how actuaries
assess risk, design coverage,
and evaluate models of care.

BY NOAH KIRSCH

REACH

SINCE THE AFFORDABLE CARE ACT was adopted in 2010, the number of people in rural areas without health insurance has dropped by nearly half, according to a 2024 report from the U.S. Department of Health and Human Services. Still, significant coverage gaps remain. Rural citizens are more likely to be uninsured than their urban counterparts, according to the report, *Access to Health Care in Rural America: Current Trends and Key Challenges*. And even in urban centers, health care access varies dramatically based on economic and social factors.

These disparities are crucial elements of the American health care landscape at large. A fifth of the population lives in rural areas, according to census data. In these regions, about a quarter of adults are covered by Medicaid (a larger percentage than in urban environments), according to the KFF report, *How Might Federal Medicaid Cuts in the Enacted Reconciliation Package Affect Rural Areas?*

Meanwhile, about 13% of Americans in principal cities within metro areas live below the poverty line—a level of financial insecurity that is correlated with health issues. “Unmet social needs, environmental factors, and barriers to accessing health care contribute to worse health outcomes for people with lower incomes,” the Office of Disease Prevention and Health Promotion said in its Healthy People 2030 initiative.

For actuaries, understanding the unique dynamics and barriers to health care access for rural and underserved urban populations is necessary to accurately model risk and engage with policymakers about potential solutions. This is especially true given recent changes to national and state health policies.

For instance, the One Big Beautiful Bill Act (OBBBA) of 2025 reduced “federal Medicaid spending in rural areas” by an estimated \$137 billion over 10 years, KFF found. At the same time, however, it introduced a \$50 billion Rural Health Transformation Program designed to spark innovation in rural markets to improve “health care access, quality, and outcomes.”

This article examines many of the key hurdles facing both rural Americans and underserved urban Americans, including limited provider networks, transportation challenges, difficulties acquiring quality data, and social factors that can exacerbate health care issues, such as lack of access to fresh produce and

stable housing. It also examines these challenges in the context of actuaries who model health care risk and evaluates emerging care delivery models designed to improve access and efficiency.

Overall, the role of actuaries in the health care system is about much more than simply calculating premiums and risk, said Donna Novak, a member of the Academy’s Health Equity Committee. “If the actuary’s goal is to bring down health care costs in order to bring premiums down, then they get involved in these issues.”

Obstacles to Health Care Access

One of the core challenges to achieving equitable health care outcomes for rural and underserved urban Americans is ensuring they receive care to begin with. “There are just a lot of barriers to providing access,” said Robert Moser, medical director for the University of Kansas Health System’s Care Collaborative.

In rural markets, he observed, poverty rates tend to be higher, and fewer individuals work for large employers that provide access to affordable insurance. “If you look at the average out-of-pocket cost for health care in rural [areas], it’s significantly more than what it is in urban areas,” he said. Kansas is also one of 10 states that have not adopted Medicaid

expansion coverage. Rural populations in those states have much higher uninsured rates, according to the U.S. Department of Health and Human Services.

Brock Slabach, chief operations officer at the National Rural Health Association, noted that rural patients also tend to be older and sicker than their urban counterparts.

Additionally, underserved markets often have fewer providers. The reason for the shortage varies by region, said Mick Diede, chairperson of the Academy's Health Care Delivery Committee, including high crime rates or because the mix of patient insurance plans results in low reimbursements.

On average, rural America has 40% fewer health care providers per capita than the country as a whole, said Jim King, CEO of Fahe, a network of more than 50 nonprofits in Appalachia. That might mean "there flat out aren't any specialists of a certain kind," Diede noted, or that primary care physicians are stretched thin and might not be able to see patients in a timely manner.

For instance, Moser said, "If I want to consult with a rheumatologist in Western Kansas, I'd probably be looking across into Colorado or Wichita," which would require a three-to-five-hour drive and "at least a year wait time to get in." The distance also makes it challenging for specialists and primary care doctors to coordinate care, Novak added.

For doctors who decide to practice in these regions, overhead is higher because practices often need to "deliver a lot more services" and must invest in a wide array of equipment, Moser said. In rural areas with fewer patients, the lack of volume can make it hard to recoup that overhead. This applies to small and large practices alike, and is "one of the drivers behind why more than 100 rural hospitals have closed or reduced core services since 2010," King said.

To remedy this problem, "you need to make the economics work for a provider to be there," said Julia Lerche, the Academy's senior actuary, Health. "That might take some additional investment."

A second barrier to coverage for these demographics is that hospitals and health systems frequently struggle to stay open. This is true for several reasons. One factor, Diede said, is that many procedures that used to require inpatient care can now be done on an outpatient basis, which reduces revenue

For actuaries, the implication of modeling health care needs in areas with few providers and struggling health systems is that market dynamics don't operate as they do elsewhere. As a result, it is more challenging to ensure that patients have access to care and that medical systems remain viable.

for hospitals. Moreover, he said, reimbursement rates often don't cover the total cost of operating a hospital or other medical practice.

These issues may become more pronounced due to certain elements of the OBBBA, originally known as H.R. 1. As part of cost-saving measures, it is expected to increase the number of uninsured Americans in rural areas, and it "reduces Medicaid payments to many hospitals as well," Lerche said.

Even when care is available, patients in underserved and rural regions may struggle to receive it. Reliable transportation isn't always available in these communities, said Susan Pantely, co-vice chairperson of the Academy's Health Practice Council. Lower-income individuals face an additional hurdle in that they might not be able to take off work for an appointment, Novak added.

Separately, for patients who need to be transferred to larger health care systems in rural markets, there often aren't enough ambulances or drivers available, Moser said. In some cases, that means patients are transferred using air transport, a much costlier alternative.

Virtual and digital health models are seeking to remedy some of these issues, Pantely said, but patients still need access to stable internet, which is not always the case.

Price, of course, is a barrier as well. In rural areas, insurance plans often include higher out-of-pocket costs, Novak said, "so people will go without services sometimes."

There are also qualitative obstacles, said Yi-Ling Lin, a member of the Academy's Health Equity Committee. For example, patients might have trouble finding a local practitioner who speaks their language or who they can relate to (for instance, regarding the nuances of their sexuality).



For actuaries, the implication of modeling health care needs in areas with few providers and struggling health systems is that market dynamics don't operate as they do elsewhere. As a result, it is more challenging to ensure that patients have access to care and that medical systems remain viable.

Moreover, Lerche said, actuaries should recognize that addressing these problems won't immediately transform them; it will require long-term investments. "You can't just put a [new] primary care provider in place and then, the next day, emergency room visits are going to go down," she said. "It takes some time."

Data Credibility

Another ramification of the health care dynamics in rural and underserved areas is that actuaries often struggle to obtain quality data to forecast medical needs. This is partly true because of the barriers to access outlined in the prior section. When "people aren't going to the doctor, understanding their health risk is hard," Pantely said. On the other hand, "when people have access, they can use a lot of services."

Therefore, a person who can't afford their prescription medicine and doesn't go to the pharmacy—or who can't find or reach a local physician, or who lacks insurance and doesn't seek care—may appear in the data to be healthy because there are few health visits in their history. Ultimately, though, that individual "could be more costly because they're going to wait until they're in a crisis mode and maybe have a hospitalization," Pantely said.

There are other reasons for actuaries to worry about accessing credible data. In rural regions, populations are smaller, and there is more variability in utilization and costs from year to year, Novak said.

It can also be challenging to segment data in an effort to draw insights about risk, Pantely added—and even more so when the sample size is small. "Most of the time as actuaries we are limited to claims data, and we have to tie it to other data in order to figure out what the income level is," she said, citing one possible sub-category. "Anytime you're combining data sets that aren't directly linked, it's an imperfect process."

Population-level data is available, she noted, but much of it relies on self-reporting and surveys, which are not necessarily



Another ramification of the health care dynamics in rural and underserved areas is that actuaries often struggle to obtain quality data to forecast medical needs.

reliable or “a strong predictor of the individual risk level.” This issue may improve with more structured data from electronic health records and “Z codes”—diagnosis codes designed to offer details on patient backgrounds beyond illnesses and diseases, such as social determinants of health like housing security and financial well-being.

The problem, Lin said, is that Z codes are frequently left empty. “Even if you see a primary care physician, some of them may not actually ask you those questions or the information may be misrecorded or incomplete.” In her view, the codes are helpful data points, but the data set as a whole is “sparse and unreliable.”

For actuaries, missing or inaccurate data makes it extremely difficult to forecast costs and assess risks. Lin cited the theoretical example of a ZIP code with a high number of breast cancer screenings. That might lead actuaries to assume that the area needs more attention, such as additional public safety announcements, more screenings, and more access to doctors.

In that scenario, an actuary might assume that a ZIP code with no breast cancer screenings doesn’t require as much of an investment. However, the lack of data might simply be because people can’t access doctors, she said. Failing to note these concerns creates a “very cyclical problem” that could disadvantage certain rural and underserved areas that already aren’t receiving the same level of care, she said. Lin noted that, in cases where limited data is available, actuaries already attempt to extrapolate statistics from other locations to avoid falling into this trap.

Lastly, Lin said, actuaries seeking to address coverage gaps should not just consider short-term costs when debating the effect of spending or policy changes. “If health outcomes are better but your costs are higher because people want to

get more screenings, that’s a good thing,” she said. “But that doesn’t end up showing up in the premiums, not for a long time.”

Innovations and Emerging Models

There are numerous efforts underway to improve health care outcomes for rural and underserved urban patients. The first category of initiatives centers on social determinants of health: increasing access to quality food, housing, clean water, and other things that many of us take for granted, Lerche said.

King offered the example of a health center in Whitesburg, Ky., that operates a “Farmacy” and gives vouchers for free food and produce to patients who come every week to have their blood pressure and vitals checked.

Simple, low-cost initiatives can both serve patients and save the health system money in the long run, said Jackie Mayo, CEO of HomeSource east tennessee, a nonprofit working to address housing insecurity. The organization is working on various “aging-in-place” efforts that would reduce the frequency of emergency

room and hospital visits, particularly as more hospital systems are closing in rural areas. “It might be something as simple as step-in showers,” she said.

Pantely offered a similar potential policy: helping families that have children with asthma purchase a vacuum cleaner to preempt health problems. “Our system isn’t always set up to pay that way, but in the end, it’s much cheaper to buy them the vacuum than to have them go into the hospital,” she said.

On local and national levels, there are ongoing efforts to encourage more providers to practice in underserved areas, and to help buoy struggling hospitals. Still, Lerche said, private insurance companies might also consider how they can “support access in communities,” particularly if those initiatives ultimately result in savings.

Another potential way to help providers is to shift to new models of reimbursement, such as those that don’t rely purely on volume. For instance, doctors or health systems could get paid using a “value-based model”—with compensation tied to health care

On local and national levels, there are ongoing efforts to encourage more providers to practice in underserved areas, and to help buoy struggling hospitals.



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outcomes or delivered in a bundled manner for a patient's overall care.

"That gives a little bit more stable income to providers that may have a smaller number of patients," Lerche said. Still, Diede added, even alternative models will not ultimately help providers if their overall revenue doesn't increase.

Slabach noted that more than 3,000 rural health clinics and roughly 590 critical-access hospitals are currently participating in an Accountable Care Organization (ACO), in which they coordinate patient services and care. The Centers for Medicare & Medicaid Innovation (CMMI) also recently released program guidance on its initiative called the Long-term Enhanced ACO Design (LEAD) Model that hopes to attract rural providers to apply, he said.

Public and private entities are also working to increase access to care. Examples include treating patients on site rather than transporting them to the hospital, utilizing more nurse practitioners or other health care professionals to free up time for doctors, and investing in mobile clinics for health screenings and treatments, Pantely said.

"If you want to keep Medicaid costs down, you have to provide transportation to the OB-GYN for low-income [pregnancies] because they can have a transportation problem," Novak added. More regions are also investing in community health workers paid by insurers to help people navigate the health care system, Lerche said, which can ensure underserved patients receive attention before suffering more severe health problems.

As a separate measure, providers are utilizing technology to reduce barriers to medical access as well. Wearable devices can monitor real-time health statistics and vital signs. Remote ultrasound devices and apps that can potentially diagnose skin cancer have also been in use for years, Novak said.

In North Dakota, she continued, officials launched the state's Rough Rider Network, which uses "AI technology to identify high-risk patients and give them value-based care." The state is also investing in broadband infrastructure, which will make telehealth treatment more widely available.

The challenge with remote care is that some conditions, like heart attacks, aren't treatable with it, Diede said. Moser added that these visits aren't always reimbursed "at a level that makes it worth the time away from the in-person volume."

The Rural Health Transformation Program, part of H.R. 1, designates \$10 billion each year between 2026 and 2030 to fund health care initiatives, ranging from clinical recruitment to chronic pain management to value-based care and other new payment models.

Academy Participates in Texas Health Care Affordability Hearing

The Academy was invited to testify before the Texas House Select Committee on Health Care Affordability, along with other witnesses, during a two-day hearing in May. The newly created committee in the Texas House of Representatives has been charged with comprehensively reviewing the factors affecting health care affordability in Texas.

The hearing, held April 30 and May 1, was the first in what is expected to be a series of discussions among state legislators, insurers, hospitals, academics, consumers, and actuaries aimed at understanding the underlying drivers of health care costs, identifying affordability solutions within the commercial market, and exploring potential improvements in health care delivery.

Health Practice Council Co-Vice Chairperson Susan Pantely testified at the hearing. Read more in the Actuarially Sound blog post, "Academy Brings Actuarial Perspective to Texas House Committee Hearing on Healthcare," available on the Academy website at actuary.org.

The grant money will hopefully spark innovation and help surround patients with medical attention from all sides—including care coordinators, nurse navigators, telemedicine, and beyond—Moser said. That would also ensure that physicians' practices aren't solely responsible for ensuring that "preventive measures are addressed and taken care of."

Already, Kansas is planning to launch a hub-and-spoke transport model to help transfer patients from rural hospitals to regional health centers. "We'll see a significant decrease in the number of patients that get transported by air," he said.

In the end, actuaries will need to grapple with these proposed and ongoing innovations to offer advice on the best way forward, even though many of the models don't yet have a track record and their impacts are therefore hard to predict.

In Novak's view, actuaries are well-equipped to handle that task. "We're not just mathematicians," she said. "We're problem solvers with a lot of math in our pocket to help figure out solutions." ▲▲

NOAH KIRSCH is a freelance writer for *Contingencies*.



THE ROTH QUESTION

BY MARK SHEMTOB

How does a retiree use their accumulated wealth?

Generally, it is allocated to one or more of the following four areas:

1. To fund living expenses during retirement, including both fixed and discretionary costs.
2. To leave to heirs, whether family or friends.
3. To support charities or other favored causes.
4. To pay taxes owed to the government.

With few, if any, exceptions, retirees prefer to limit the taxes owed to the government to the extent legally possible. Most funds accumulated for retirement are in traditional tax deferred retirement accounts such as 401(k) plans and individual retirement accounts (IRAs) and are subject to taxation in retirement. While taxes generally cannot be completely avoided, retirees can sometimes reduce them, thereby providing more funds for living expenses, bequests, and charitable giving. This article will focus on the Roth conversion: A strategy that some retirees can use to achieve this tax-savings goal.

How actuarial modeling and long-term planning can help determine whether a Roth conversion will increase a retiree's after-tax wealth.

The Roth Conversion

Well-trained and experienced professionals working as wealth managers or financial advisors, often provide some clients with an analysis of the potential value of a Roth conversion. Under a Roth conversion, some or all of an IRA or 401(k) account that has not yet been taxed is transferred to a Roth account. The amount transferred is subject to income taxes payable for the year of the transfer. Thereafter, withdrawals of earnings from the Roth account are generally tax-free, provided the funds have been in the Roth account for at least five years and the owner is at least 59½ years old.¹ In addition, under current SECURE 2.0 rules, original owners of both Roth IRAs and Roth 401(k)s are entirely exempt from lifetime required minimum distributions (RMDs), which otherwise begin at age 73 for traditional accounts. This allows for true tax-free accumulation in, and distribution from, a Roth account.

Whether a conversion is a sound strategy depends on whether it provides a sufficiently greater net wealth for the retiree or beneficiaries over time.

Whether a conversion is a sound strategy depends on whether it provides a sufficiently greater net wealth for the retiree or beneficiaries over time.² The increased wealth is derived primarily from three main sources:

1. Shifting taxable income across years to take advantage of lower marginal tax rates.
2. Using funds outside of retirement accounts to pay the taxes incurred by the conversion, which would otherwise be subject to income taxes on investment earnings.
3. Reducing RMDs, which are taxable.

A thorough analysis of the advantage (if any) of a Roth conversion requires building a model which uses a variety of assumptions and testing alternative strategies. This type of modeling and testing is the experience actuaries can bring to individual retirement planning.

So, what does such an analysis involve?

Components of Roth Conversion Analysis

A Roth analysis requires information regarding demographic data, assumptions, and strategies to be tested.

A. The items listed below represent the required data. Each is fixed at a point in time but is constantly changing.

1. The retiree(s) age
2. IRA/401(k) balances (non-Roth): amounts that are available for conversion
3. Current Roth balances, if any³
4. Nonretirement account savings and investments, including unrealized gains/losses: funds available to pay taxes on Roth conversions
5. Income sources (pensions, annuities, Social Security, part-time employment, etc.): amounts available to supplement nonretirement funds

B. The items listed below represent assumptions used to perform the analysis. Each may be modified periodically to reflect alternative or changing scenarios.

1. Tax rates: rates used to determine the taxes to be paid on income including Roth conversions
2. Expected tax deductions (itemized or standard): deductions used to determine taxes to be paid
3. Living expenses (discretionary and nondiscretionary), including gifts to family, friends, and charities): spending levels that affect nonretirement assets available to pay tax on Roth conversions
4. Annual increase in expenses: projected future expenses
5. Expected rates of returns on investments: different accounts may call for different asset allocations and expected returns. For example, nonretirement assets that are needed to live on and pay taxes are likely more conservatively invested and thus assume a lower return assumption than retirement accounts that may not be needed for many years.
6. Social Security cost-of-living adjustments (COLA): projected future benefit increases
7. Overall relative value of different types of investments (Roth, pretax, and nonretirement funds): used to analyze the extent to which a Roth conversion strategy increases wealth based on tax considerations. Roth funds are the most valuable, followed by nonretirement funds (taking into account any potentially taxable unrealized gains) and regular pretax funds.

C. The items listed below are among the parameters generally tested to analyze the value of different strategies:

1. Annual Roth conversions amount
2. Social Security Commencement Age: annual cash flow permits payment of Roth conversions. This might be a reason to accelerate and/or delay Social Security payments either for cash flow or shifting taxable income between years.
3. Timing of taxable income and tax-deductible expenses in retirement where available

Issues with Current Roth Conversion Tools

There are many programs available either online or through financial advisory firms that are designed to assist in the Roth conversion analysis. However, some may lack certain key components:

1. Designed only to analyze a conversion for the current year as opposed to building a multiyear variable strategy
2. Do not allow for different rates of returns for investments with different tax considerations
3. Ignore some cash flows (income and expenses) in the determination of available funds to use to pay taxes on conversions
4. Don't provide an "overall relative valuation" based on different investment types (pretax, Roth, nonretirement funds)
5. Focus too much on doing conversions based on timing market dips which are tough to predict
6. Provide as the sole measure of value the amount of taxes saved as opposed to the increase in overall tax adjusted wealth

7. Don't analyze optional timing of payments such as Social Security or tax deductions

Example of Roth Conversion Strategy Analysis

The following example illustrates the potential value of Roth conversions. It has been kept relatively simple by assuming a single retiree with limited future income options.

Data

1. Age: 67 single
2. Pretax funds: \$500,000
3. Current Roth funds: \$0
4. Nonretirement funds: \$350,000 (includes \$50,000 in unrealized gains)
5. Social Security at age 67: \$3,000 per month
6. Fixed-income annuity: \$2,500 per month (no option to vary start date or amount)

A thorough analysis of the advantage (if any) of a Roth conversion requires building a model which uses a variety of assumptions and testing alternative strategies. This type of modeling and testing is the experience actuaries can bring to individual retirement planning.



Assumptions

1. Current and future income tax rates: based on rates for 2026 for a New Jersey resident
2. Expected income tax deductions:
Federal: \$15,750; New Jersey: \$15,000
3. Expenses: \$80,000 per year
4. Annual increase in expenses: 2% per year
5. Rates of return on investments: Roth and pretax: 6.5%; nonretirement: 5%
6. Social Security COLA: 3%
7. Relative value adjustment for different types of taxable investments:
 - Roth: Full value
 - Pretax: 75%
 - Nonretirement: 94%⁴ and a 20% tax on unrealized gains

Note that depending on the specific circumstances of the retiree (or the retiree and partner), additional data and assumptions might be called for. Thus, there is a need for customization in the analysis.

Strategies

There are many possible strategies that can be analyzed. This article illustrates only four strategies for simplicity's sake. However, once the model is built and assumptions are selected, dozens or more alternative strategies can be analyzed. An Appendix available online at contingencies.org provides a complete year-by-year comparison based upon the four different strategies with respect to the following:

A. Roth conversion pattern

B. Social Security commencement age (Other refers to nonretirement assets)

- Strategy 1 (base case): No Roth conversions or Social Security delay
- Strategy 2: \$19,000 annual Roth conversion and no Social Security delay
- Strategy 3: \$24,000 annual Roth conversion and delay Social Security to age 70
- Strategy 4: \$70,000 annual Roth conversions for three years, \$50,000 for three years, and \$10,000 for two years with Social Security delayed to age 70

Table 1 provides a limited sample of information from the results of the comparisons of the four strategies. It is important to review results at a variety of future ages to help the retiree in

considering the alternative strategies. The Appendix provides much greater detail by showing, for all ages from 67 to 95, the amount of funds projected to be in each of the three classes of funds—Roth, pretax retirement, and nonretirement (Other)—as well as the overall relative value.

TABLE 1. Comparisons of the Four Strategies

Age	Strategy 1	Strategy 2	Strategy 3	Strategy 4
71	795,080	797,075	715,716	716,906
76	908,015	919,410	868,719	885,819
81	1,026,161	1,064,945	1,062,006	1,106,469
86	1,144,150	1,245,694	1,315,291	1,400,744
91	1,252,851	1,478,752	1,656,665	1,793,144

As illustrated above, the use of Roth conversions will negatively impact overall relative wealth in the earlier years, but over time, it will provide greater overall wealth. Twenty years (the approximate life expectancy for a very healthy 67-year-old male) into the future, strategy 4, which is the most aggressive conversion option modeled, provides an additional \$256,000, or 22% of wealth, over the base non-conversion strategy. This is accomplished by front-loading Roth conversions and delaying Social Security, which can reduce taxes and increase overall wealth.

Considerations and Comments

1. The analysis used here is based on deterministic modeling and assumptions. Models can be built using stochastic methods with Monte Carlo simulations. Most retirees, however, are better able to evaluate a deterministic approach while also incorporating some alternative assumptions to test different scenarios.
2. Any sort of analysis regarding future outcomes requires assumptions that should be selected with care based on best estimates.
3. Lack of sufficient nonretirement funds limits or eliminates the value of Roth conversions since funds are needed to pay taxes on conversions.
4. Not all retirees will benefit from Roth conversions, and those that do will not realize any significant increase in wealth for many years.
5. Analysis should be performed annually with updated data and assumptions as appropriate.
6. Generally, starting Roth conversions younger in retirement improves results.
7. For those with very large accumulations of wealth, Roth conversions can also be used to reduce estate taxes by

reducing the actual dollars in one's estate through payment of taxes upfront.

8. Though not modeled in this article, retirees can use the increased wealth in later years to cover long-term care costs as well as give away funds to charities or family.
9. What is critical in reviewing results of different strategies is not the actual dollars in the accounts but the overall relative value after taxes at different points in time in the future.

Summary

Retirees are often reluctant to incur taxes until necessary. For that reason, some retirees may exhibit hesitation toward Roth conversion strategies. Therefore, it may be more palatable to stretch conversions over multiple years, even if this approach does not provide the best long-term results. Doing so also allows for

changes to strategy in the future, based on changes in health, actual or expected market returns, and/or tax rates.

Although retirees might prefer to attempt to achieve increased overall wealth through greater exposure to risky assets, this approach could actually reduce wealth if poor market returns occur. Roth conversions, by contrast, allow for improved wealth accumulations in the later years of retirement without additional investment risk.

Roth conversion analysis is a critical service that advisors offer, and it is clearly in the wheelhouse of actuaries, particularly in building models that incorporate relevant assumptions. This work requires careful analysis using a comprehensive model, with the understanding that all assumptions should be clearly explained to and agreed upon by the client. ▲

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Disclaimer: This article is for informational and educational purposes only and does not constitute individualized tax, legal, or financial advice. Readers should consult a qualified professional regarding their specific financial circumstances

Endnotes

1. Retirement plan FAQs on designated Roth accounts; IRS.
2. It generally takes several years before the increase in wealth is recognized.
3. This is not necessarily needed but may help in reviewing overall wealth at different times in the future which could be subject to estate taxes.
4. Assumes a 10-year payout and a 25% effective tax rate.

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Editor's Note: This article is the second in a two-part series on turning points in the history of insurance. Part I, which appears in the July/August 2026 issue of *Contingencies*, examined foundational developments in law, data, and public policy. This installment focuses on late-20th century innovations that reshaped how insurers and actuaries measure and manage risk.

From personal computers and new retirement products to financial crises that reshaped regulation, the postwar era transformed the actuarial profession and the business of insurance.

BY JAMES LYNCH

In the decades after World War II, the insurance industry entered a period of rapid transformation. Personal computers transformed modeling. New retirement products reshaped how Americans save. And financial crises forced insurers and regulators to rethink how risk should be measured across entire organizations. While Part I of this series examined earlier institutional and technological developments that shaped modern insurance, Part II highlights how later innovations expanded the scope of actuarial work and risk management.

The Spreadsheet Revolution (1979)

It was spring 1978, and Harvard business student Dan Bricklin watched as his professors plugged and chugged a series of calculations on the blackboard. They solved one problem, then moved that answer into the next calculation. That answer fed the next one, and so on.

Then they wanted to change the input to the first equation. They laboriously erased all the previous answers, all the way down, and began again.

Bricklin figured he could do it better—and faster—with his Apple II microcomputer. There, you could chain all the formulas together; when you updated the first number, the rest would instantly recalculate.

With his friend Bob Frankston, Bricklin created VisiCalc, the first spreadsheet for personal computers. It was the forerunner of Microsoft Excel, perhaps the actuary's best friend.

VisiCalc was an instant hit. It unleashed the microcomputer as a business product, and, more important, made it easy to create complicated mathematical models.

VisiCalc sold 200,000 copies in two years.¹ Its publisher was sold in 1985 to Lotus, whose 1-2-3 spreadsheet had come to dominate the market—at least until Microsoft took control with Excel.

In those early days, people would show off VisiCalc at (admittedly nerdy) parties:

Look! You put in a new number at the top, and the answer at the bottom automatically changes. So do the subtotals! And the totals in the far right column change too!

Now put in a new number . . . see! They all changed again!

Consider how actuaries crunched numbers before the spreadsheet. Jerry Tuttle, a retired FCAS, started work at Crum & Forster in 1974. Data for a rate review came from a 1,000-page computer printout that contained information for every state, every line, every coverage within each line, and every product the insurer wrote.

An actuary went page by page, picking out the relevant numbers—one or two on this page, two or three from a few pages down—across 1,000 pages. Another actuary double-checked every selection.

	A ITEM	B NO.	C UNIT	D COST
1	----	----	----	----
2	MUCK RAKE	43	12.95	556.85
3	BUZZ CUT	15	6.75	101.25
4	TOE TONER	250	49.95	12487.50
5	EYE SNUFF	2	4.95	9.90
6				
7				
8				
9				
10				
11			SUBTOTAL	13155.50
12		9.75%	TAX	1282.66
13				
14			TOTAL	14438.16
15				
16				
17				
18				
19				
20				

VisiCalc spreadsheet on an Apple II

The ratemaking model was stuffed into a timesharing mainframe—one machine for a department of 20. When it was available, you punched your data into the model, which was written in BASIC. (Not every actuary could program in BASIC.)

You took your review to the bosses. If they wanted revisions, back to the mainframe you went.

Some calculations were too complicated for a computer. Those were solved via green (always green!) worksheets: legal-sized sheets in landscape mode with maybe 16 columns, remembers Joe

Herbers, a principal at Pinnacle Actuarial Resources. Data in the early columns fed calculations in the later columns.

Herbers, like his fellow actuaries, did the math on a four-function calculator that lacked even a square-root button. (He became a local hero for figuring out how to do reciprocals without using the memory key.)

The worksheet's last column was left blank. It was for data checkers. They verified each calculation. If all was good for a given row, they put a dot in red ink in that last column.

"Red-dotting the green worksheets" was an important job.

Spreadsheets weren't the only upgrade personal computers introduced. Storage grew, so datasets could capture more variables. Processing power accelerated, so more powerful models could glean those datasets.

The spreadsheet made complicated models easy to build. It let the actuary develop Monte Carlo projections to show a range of outcomes.

Perhaps just as important, spreadsheets are communication tools. Their displays show how data flows inexorably toward a conclusion. Their colorful, detailed charts illustrate the important points. And if something changes, with a few keystrokes you can update everything.

Actuaries went from being smart folks pulling stuff from a black box to communicators who could show underwriters and management the story the data told. When they understood what actuaries could deliver, management craved more insights.

They needed more actuaries.

The Casualty Actuarial Society, for example, added 1,783 members in the 1990s—more than in the previous 75 years combined.²

There were a lot of things going on—insurance companies needed an actuary to certify their reserves, and the first *Jobs Rated Almanac* (1988) rated actuary as the No. 1 job—but spreadsheets led the data revolution and made the actuary more valuable than ever.

The spreadsheet transformed how actuaries and financial analysts worked. But technology alone was not reshaping the insurance and financial landscape. While computers were making modeling easier and



faster, new financial products were redefining how Americans saved for retirement—and expanding the role actuaries would play in managing those long-term promises.

The Birth of 401(k) (1980)

In 1980, Ted Benna used a new, overlooked subsection of the 1978 tax code (Section 401(k)) to change pension history.

Benna, then a consultant for The Johnson Companies in suburban Philadelphia, had a banking client that wanted a tax-deferred profit-sharing plan where employees couldn't access the money until they stopped working for the bank.

One way was to replace the cash bonus with a retirement contribution. But two-thirds of employees had to take the deal, and lower-paid employees wouldn't want the entire bonus tied up that way.

But starting Jan. 1, 1980, Section 401(k) of the tax code would become effective. It would let each employee put as much as they wanted into the retirement plan. Still, lower-paid workers might be reluctant to take the financial hit.

Here, Benna had his nation-changing insight: The employer could match the employee's contribution. An employee

contributes \$1, the company contributes, say, 75 cents, and the entire amount grows, tax-deferred, until retirement.

The bank rejected the idea, Benna writes. Too risky, its attorney said.

So Benna's consultancy adopted the first 401(k) plan for its own employees. In 1981, the IRS confirmed that the employer could deduct its matching funds as a business expense. The 401(k) craze was under way.³

By 2020, according to the Census Bureau, more than one-third of Americans had a 401(k) or one of its brethren, such as 403(b)s or 457(b)s. Only about 14% had defined-benefit or cash balance plans.⁴

The traditional defined-benefit pension had already been in decline, but Benna's insight made the 401(k) a viable alternative.

As retirement planning shifted from employer-managed pensions to employee-directed savings, the financial system grew more complex. Insurers, pension managers, and regulators increasingly relied on specialists who could model long-term risk and uncertainty. Just as the profession's importance was expanding, it received an unexpected burst of public recognition.

The late 1980s were a period when the financial system itself was being tested. Rapid innovation in investment strategies and financial products was pushing insurers into unfamiliar territory. When those risks collided with volatile markets, the consequences would reshape how the entire industry measured and managed risk.

When Actuary Became the “Best Job in America” (1988)

In 1988, when almanacs were a thing (as a kid, I wanted an almanac for Christmas; it took three years before my parents believed me), the *World Almanac* put out a side venture: *The Jobs Rated Almanac*. Author Les Krantz rated 250 jobs according to work environment, income, outlook, stress, security, and physical demands.

The No. 1 profession: actuary.

It wasn't the money (\$45,780 was good, not great). “Don't expect a cushy job if you want to earn more than \$50,000 a year,” Krantz told the *Flint Journal*.⁶

But in his system, actuary outranked football player, cowboy, nuclear plant decontamination technician, and more than 240 other professions.

The ranking was a surprise. Most articles about the book mimicked the quote above: What's an actuary?

But if you were a budding quant from 1988 on, you knew what an actuary was, thanks to the *Jobs Rated Almanac*. The book helped create a supply of actuaries when circumstances—laws requiring actuarial certification of reserves and the digitalization of insurance data—increased demand.

There were six editions, the last published in 2002, with the actuarial profession landing at or near the top the entire time.

Of course, actuaries already knew why.

The late 1980s were a period when the financial system itself was being tested. Rapid innovation in investment strategies and financial products was pushing insurers into unfamiliar territory. When those risks collided with volatile markets, the consequences would reshape how the entire industry measured and managed risk.

The Failure that Sparked Modern Risk Management (1990)

As it grew rapidly in the 1970s and 1980s, First Executive Life Insurance Company looked like it would revolutionize the insurance industry.

It did, but not as anyone would have expected. Its spectacular failure created the pathway for risk-based capital and led to the modern enterprise risk management (ERM) framework, within which actuaries became a critical piece.

First Executive was a ragged holding company with two subsidiaries—one in California and one in New York—when Wall Street whiz Fred Carr took over in 1974.⁷

The moment was ripe for innovation. Inflation pushed interest rates into double digits, yet traditional life insurers were still primarily selling whole-life and term policies. Policyholders could borrow against their whole-life policies at low rates and earn guaranteed returns. By

1980, policyholder loans made up 22% of funds available for investment, up from just 4% only two years earlier.⁸

With its weak capital position, First Executive couldn't launch many products. But it could write single-premium deferred annuities: The policyholder sent cash up front, but the insurer began annuity payments only years later. In five years, sales of First Executive single-premium annuities grew almost 100-fold.

First Executive also invested unconventionally, pouring millions into high-yield bonds, known colloquially as junk bonds. These were bonds issued by highly speculative enterprises or by struggling companies that had been severely downgraded.

The junk bond market had been small and illiquid until the 1980s, when the brokerage Drexel Burnham Lambert became its market maker. If no one else would buy a bond, Drexel would. When Drexel wanted to sell, First Executive was one of the first in line.

By the end of 1987, more than 40% of First Executive's assets were in B- and BB-rated bonds. These boosted returns: First Executive's portfolio yielded 270 basis points higher than the industry average at midyear 1983.

But First Executive's actions concerned regulators.

They required First Executive to add capital to account for the bonds' riskiness.

To regulators, First Executive's reinsurance treaties looked like circular arrangements. Business was ceded to companies connected to First Executive, and they were backed by letters of credit issued by First Executive itself. New York regulators rejected the treaties in 1985, the first of a series of setbacks.

■ Global financial markets collapsed in October 1987. Junk bonds fell as well—First Executive's by 20%.

- Tax changes robbed First Executive's annuities of much of their value. Sales volume fell.
- Regulators sharpened their focus, so First Executive couldn't get enough reinsurance. Junk bonds were capped at 20% of its portfolio.
- Running partner Drexel Burnham Lambert collapsed in 1990 amid a hodgepodge of criminal and civil investigations, some involving First Executive. The junk bond market Drexel had created faltered, with securities trading at 60% to 80% of face value.

The key moment came on Jan. 22, 1990. *The Wall Street Journal* published an article: "First Executive Expects to Take Charge of Up to \$515 Million for Bond Losses." It appeared on page A3.⁹

"Even after the write-down, the Los Angeles-based insurance holding company said the market value of its \$14 billion bond portfolio is \$1.4 billion less than its book value . . . future charges may be needed.

"Friday's surprise announcement hints at potential repercussions from the crumbling junk bond market . . ."

The insurer had made similar write-downs before, but this story got policyholders' attention. A run on the insurer began.¹⁰

First Executive had always anticipated cash withdrawals. It had \$2.5 billion in cash when the article was published, but in the first half of 1990, policyholders withdrew \$4 billion—three

times the amount redeemed during the entire prior year.

In the company's defense, CEO Carr told the *Journal* that junk bond prices were "unrealistically low." He was right. The junk bond market recovered the following year and remains viable today. In the long term, Executive Life would have remained solvent.

But the run crushed it.

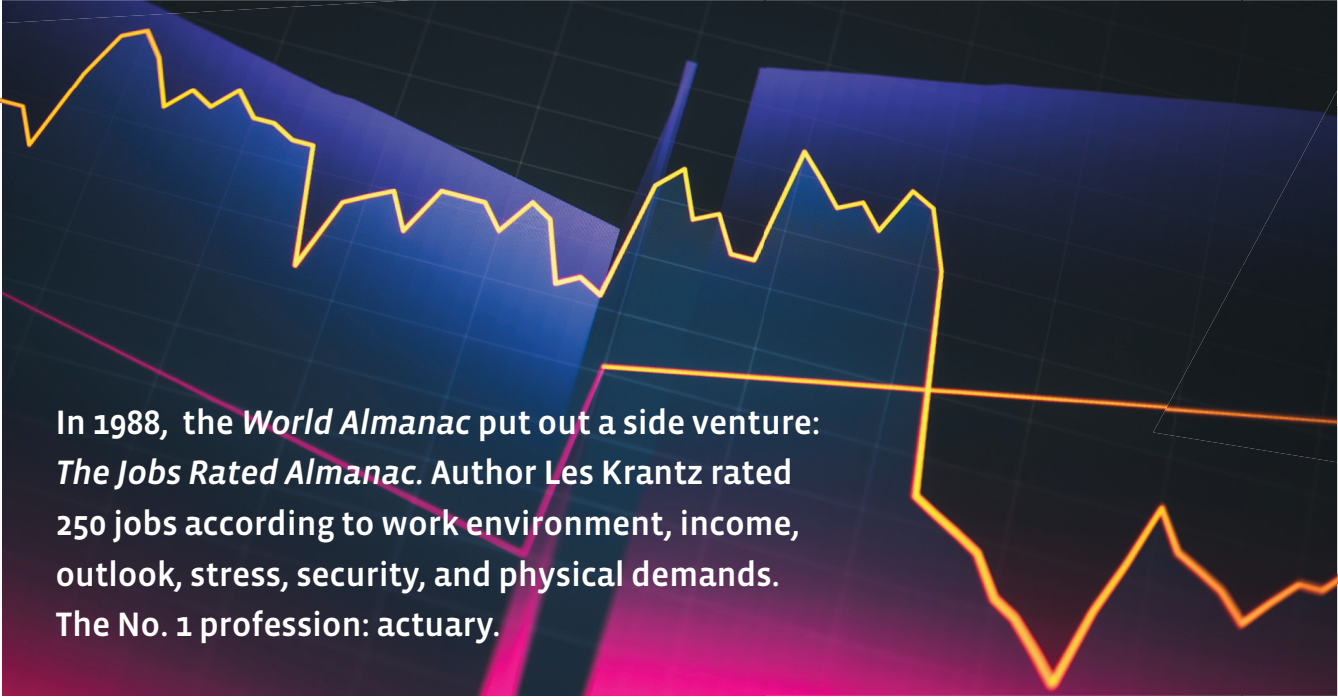
On April 11, 1991, California regulators placed one major subsidiary into conservatorship. Five days later, New York regulators seized the other. The parent company became the largest U.S. insurance failure to that date.

Its end was spectacular, but First Executive was not the only insurance collapse during the whipsawing financial markets of the 1980s. There were several more, including Mutual Benefit Life, a venerable insurer that had lasted more than a century before it was crushed by falling real estate values.

As always, disaster begets blame.

State insurance laws were blamed for not giving regulators the tools to act faster and more decisively. Congress was told: "State insurance regulators lacked timely, complete, and accurate information needed to effectively monitor" troubled insurers.¹¹

The three major rating agencies were blamed for reacting too slowly. They downgraded First Executive *after* the *Wall Street Journal* article appeared. As a 1991 *Miami Herald* story put it, industry leader AM Best had "handed out top ratings like they were campaign buttons."¹²



In 1988, the *World Almanac* put out a side venture: *The Jobs Rated Almanac*. Author Les Krantz rated 250 jobs according to work environment, income, outlook, stress, security, and physical demands. The No. 1 profession: actuary.

Academy Volunteers Bring Expertise to RBC Discussions

Over the past year, the NAIC has held commissioner-led conversations about risk-based capital (RBC). Historically, the Academy has worked with the various NAIC working groups focused on RBC. These working groups are led by state insurance department staff, many of whom are actuaries, and are responsible for maintaining and updating the tool. These working groups conversations do not usually reach the Executive Committee level, making it noteworthy when the 2025 NAIC president, Jon Godfread, identified RBC as a priority for his tenure.

The NAIC created the RBC Model Governance (EX) Task Force, charging it with a three-prong focus: developing guiding principles for the RBC framework to ensure a consistent approach to future adjustments; conducting a gap analysis and consistency assessment to improve the framework; and creating an education and public messaging campaign to highlight the value of the RBC framework as an important part of the U.S. state-based insurance regulatory system.

As the Task Force was established, the Academy was asked to provide an “RBC 101” session for the commissioners and their staff, offering historical and current perspectives on the tool across the life, health, and property/casualty sectors. Since then, the Academy has become an active partner to the Task Force, meeting regularly with the lead consultant and other key stakeholders to help educate and inform their work.

In response to the need for collaboration across its practice councils, the Academy created the Cross-Practice RBC Task Force. This group, composed of volunteers from the life, health, and property/casualty practice councils, has submitted several comment letters in response to public exposure drafts and questions posed by the NAIC Task Force, most recently commenting on the proposed RBC preamble revisions and providing verbal testimony at NAIC national meetings.

The work with the NAIC continues, and the Academy’s volunteers remain key voices in shaping conversations about the future of RBC.

The agencies asserted that it wasn’t the crumbling junk bond market that threatened First Executive. It was the run on the company. While this was ultimately true, it ignored the importance of cash flow to a company that promises liquidity.

Meanwhile, property/casualty insurers were going down a similar path. High interest rates tempted many companies to write weak business and depend on investments to make up for underwriting losses.

Dozens of property/casualty failures in the late 1980s triggered a blistering 1990 report from a congressional subcommittee. The report, *Failed Promises*, came to be known as the Dingell Report, after subcommittee chairman John Dingell.

Criticisms cut across both disciplines, including:

- State insurance departments were overburdened and understaffed, and they monitored companies based on outdated information. The report noted that, at the time, “State governments collect twenty times more from premium taxes than they spend on insurance regulation.”¹³
- The National Association of Insurance Commissioners was designed to develop uniform insurance laws, but it had no enforcement mechanism. In 35 states, audits were not required. In 33 states, there was no requirement that actuaries certify the adequacy of reserves.

The Dingell Report hinted broadly that the federal government should override traditional state regulation under the McCarran-Ferguson Act and take a larger role in regulating insurance. Regulators and rating agencies took a different route.

The NAIC developed an accreditation program. A state insurance department needed to conform to NAIC standards regarding solvency. If it didn’t, other states would not accept its work.¹⁴

The program effectively leveled the playing field among regulators. Every state was held to a standard, but the states remained independent.

Among the requirements: All domestic insurers needed to issue a Statement of Actuarial Opinion.¹⁵ This marked a watershed moment in the development of the actuary as a professional.

All states are accredited today.

The NAIC also developed a quantitative tool: risk-based capital (RBC), a model that estimates the minimum capital an insurer needs to operate and then instructs regulators on how to act when an insurer’s actual capital approaches that level.

Before RBC, regulators trying to remediate a struggling company often ended up in court. With RBC—and the laws backing it up—they could move quickly and objectively.¹⁶

The formula takes an enterprise risk management approach. It considers risks from across the company and tests whether

Two and a half centuries after the nation's founding, the core mission of insurance remains unchanged: understanding uncertainty well enough to allow people and businesses to take risks. Insurance enables commerce, stabilizes families, protects businesses from catastrophe, and helps societies absorb shocks that might otherwise derail growth.

the surplus held can withstand disaster from multiple directions. Life insurers, for example, must have enough capital to ensure that they are protected should some of their investments default, or should their mortality/morbidity assumptions prove faulty, or the markets bludgeon their investments. It also accounts for the default of an affiliate and the risk of derivatives.

AM Best adopted a similar model in 1994, which it called BCAR (Best's Capital Adequacy Ratio). Like the NAIC model, it's not the sole determinant of company health. But, as Best puts it, "BCAR can assist . . . in determining whether . . . capitalization is appropriate for [an entity's] risk profile."¹⁷ Other rating agencies have followed suit.

ERM and RBC weren't new concepts. They can trace their lineage to the computerized management information systems that IBM was touting in the 1960s. But the acceleration is hard to miss. Two years after First Executive's demise, James Lam became the first chief risk officer.

The failure of First Executive and other insurers forced regulators, rating agencies, and companies to rethink how risk should be measured—not just within individual products, but across entire organizations. Out of that turmoil came risk-based

capital requirements, stronger regulatory coordination, and the emergence of enterprise risk management as a defining framework for modern insurance.

Insurance Today

Two and a half centuries after the nation's founding, the core mission of insurance remains unchanged: understanding uncertainty well enough to allow people and businesses to take risks. Insurance enables commerce, stabilizes families, protects businesses from catastrophe, and helps societies absorb shocks that might otherwise derail growth.

The turning points described here—legal decisions, technological inventions, political movements, and financial crises—show that insurance has always evolved alongside the nation itself.

As the United States enters its next 250 years, the profession will almost certainly encounter new turning points of its own. ▲

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Trade

Tariffs and labor market shifts are changing costs, liabilities, and the assumptions that underpin actuarial models.

By Carlos Fuentes

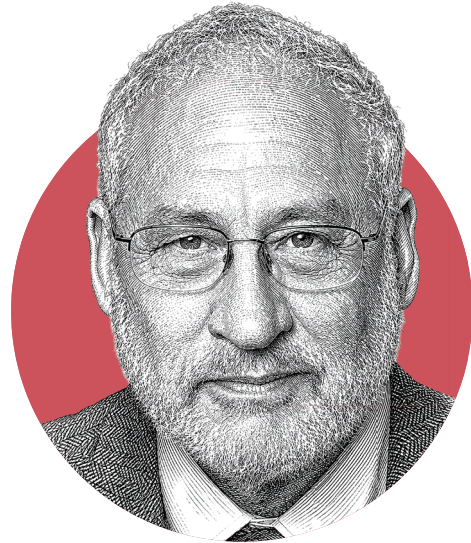
Editor's Note: This is the concluding article in a two-part series exploring how global trade dynamics influence risk, investment, and insurance.

-Offs

This article is a follow-up to “Global Trade and Risk Under Full Employment,” which appeared in the May/June issue of *Contingencies*. Both articles draw on established economic theory.

This article moves from the foundational logic of comparative advantage to the complex realities of protectionism, addressing conditions of unemployment. It examines how the pursuit of national self-interest on a global scale can produce collective harm. The analysis goes beyond economic efficiency to consider compelling non-economic rationales for tariffs, including national security and the infant industry argument.

Two key case studies illustrate the effects of such policies: the Smoot-Hawley Tariff Act and the evolving 2018 tariffs. The article emphasizes that widespread tariffs create financial risk, which in turn presents opportunities for actuaries to manage increased claim severity and volatility.



In developing countries, lack of infrastructure is a far more serious barrier to trade than tariffs.

—Joseph Stiglitz

Key Points

- Historical and recent trade measures illustrate how policy uncertainty amplifies financial volatility.
- Actuaries must update modeling assumptions to account for inflation, discount rates, and macroeconomic shocks driven by trade dynamics.
- Opportunities exist in trade credit insurance, supply chain risk, and scenario-based stress testing, reinforcing the actuarial role in global economic risk management.
- Understanding both economic and non-economic drivers of trade policy is essential for risk assessment and strategic planning.

International Trade and Unemployment

In periods of cyclical unemployment, even robust economies must turn to policy interventions that stimulate demand and restore full employment. Fiscal instruments¹ such as targeted increases in public expenditure or reductions in taxation remain the most direct means of generating jobs, provided that the stimulus is channeled toward domestically produced goods and services. Yet, expanding exports while curbing imports can also absorb idle resources. A surge in foreign sales, say an additional billion dollars' worth, not only raises domestic output but also sets in motion multiplier effects² that amplify the initial gain, potentially doubling its impact on overall economic activity. From the perspective of a single country facing unemployment, export growth thus functions as a consumption boost and a job-creation mechanism.

The picture becomes more complex when multiple nations simultaneously pursue export-led recovery. In such cases, the collective drive for external demand often provokes protectionist countermeasures, producing outcomes reminiscent of the tragedy of the commons.³ What appears rational at the national level can, in aggregate, erode welfare globally. The consequences are well documented: Tariffs and trade barriers raise consumer prices and input costs, supply chain disruptions force reliance on less

efficient alternatives, export industries contract when foreign demand weakens, and overall growth slows as uncertainty deters investment.

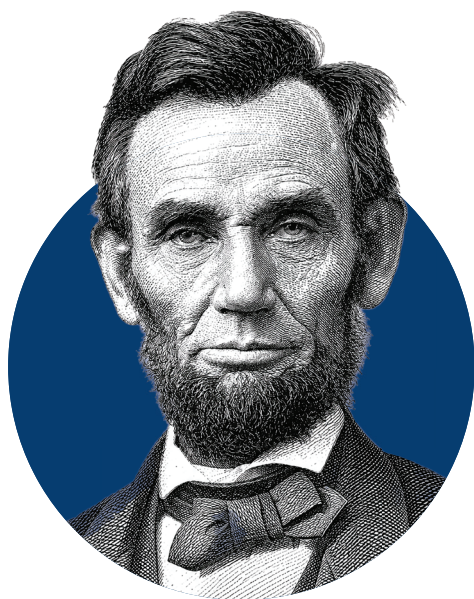
Empirical evidence from recent trade disputes underscores these dynamics. The U.S.-China trade war, for example, disrupted global supply chains, raised costs for firms, and introduced inefficiencies across industries.⁴ Spillover effects on third countries were uneven: Brazilian exporters gained in some sectors but lost in others⁵, while Vietnam's exports to the United States rose by 14%⁶, according to difference-in-differences⁷ analysis, though the benefits varied sharply across industries. Such findings highlight the uneven distribution of gains and losses when large economies engage in protectionist conflict.

Ultimately, advanced economies retain the capacity to reduce unemployment through well-designed domestic measures, enhance productivity by concentrating on sectors of comparative strength, and raise living standards through open trade. However, the temptation to impose barriers, whether driven by political pressures or industry lobbying, remains strong. While blanket protectionism is economically costly, carefully calibrated restrictions may, in certain contexts, serve as a pragmatic complement to broader strategies for stability and growth.

Non-Economic Rationales for Protectionism

Debates over trade policy are often framed in terms of efficiency and welfare, yet many of the most persistent arguments for protectionism rest on non-economic grounds. Tariffs, quotas, and currency interventions⁸ are not merely instruments of economic adjustment; they are frequently justified as tools to safeguard social, political, and strategic interests.

One recurring justification is the protection of domestic industries. Exposure to global competition can erode employment in sectors deemed vital to national identity or resilience. The U.S. tariffs on steel and aluminum illustrate this logic: They were designed not only to preserve jobs but also to maintain the industrial base considered essential for long-term security. Closely related is the infant industry argument, which contends that emerging sectors require temporary shelter until they achieve scale and competitiveness. While historically central



**I am in favor
of a national
bank ... in favor
of the internal
improvement
system and a high
protective tariff.**

—Abraham Lincoln



There are no exceptions to the rule that everybody likes to be an exception to the rule.

—Charles Osgood

to industrialization strategies, critics warn that prolonged protection risks entrenching inefficiency and dependency.

Concerns over trade deficits add another layer of complexity. Deficits are politically salient, often interpreted as evidence of economic vulnerability. They can pressure domestic firms, increase reliance on foreign borrowing, and accelerate offshoring. Yet they also deliver benefits: Consumers enjoy cheaper imports, firms reduce input costs, and strong demand can reinforce currency strength. Economists remain divided on whether persistent deficits signal fragility or reflect the dynamism of a consumption-driven economy.⁹

Dependency on global supply chains has also become a prominent concern. The COVID-19 pandemic revealed how reliance on foreign producers for critical goods, such as medical supplies and vaccines, can leave nations exposed to external shocks. Similarly, accusations of unfair trade practices, including dumping and currency manipulation, have fueled calls for defensive tariffs, particularly in industries like steel where sustainability of domestic production is at stake.

National security arguments extend this logic further. Dependence on external suppliers for food, medicine, or defense-related technologies is often framed as a strategic liability. Historical examples, such as U.S. restrictions on high-technology exports to adversarial states in the 1980s, illustrate the intersection of trade and security. Environmental concerns add yet another dimension: Global demand for commodities like beef

and soybeans has been linked to deforestation in the Amazon, raising questions about the ecological costs of trade liberalization.

Social arguments also feature prominently. Trade agreements can exacerbate inequality and facilitate exploitative labor practices in lower-income countries as evidenced by reports of poor working conditions in textile and electronics factories. Tariffs, meanwhile, serve as revenue tools, functioning like consumption taxes. While often criticized as regressive, they remain a significant source of fiscal income in many states.

The strategic uses of tariffs highlight the diversity of motives behind protectionism. Japan's post-war tariff regime sought to nurture infant industries, encourage technology transfer, and build globally competitive firms such as Sony and Toyota. More recently, U.S. tariffs under the Trump administration were framed as part of a broader strategy to counter intellectual property theft, restructure supply chains, and reinforce national security.

The short-term appeal of tariffs lies in their ability to provide breathing space for struggling industries. Yet long-term evidence suggests, that on a purely economic basis, broad protectionist measures often backfire. OECD modeling¹⁰ shows that liberalization tends to expand opportunities for exporters and reallocate resources toward more productive uses, supporting net job creation. Empirical studies reinforce this point: IMF analysis¹¹ across 151 economies finds that higher import duties are associated with rising unemployment and inequality, while their impact on trade balances remains modest. Labor-market research identifies two key channels: Higher import prices erode real wages, and retaliatory tariffs depress output in export-oriented sectors.

Taken together, these findings suggest that while tariffs can serve as strategic instruments under specific conditions, broad protectionism often imposes wider costs—diminishing consumer welfare, disrupting supply chains, and undermining employment in the very industries it seeks to protect.

Case Studies

The history of U.S. trade policy¹² is punctuated by moments when tariffs became the centerpiece of economic strategy. These episodes reveal not only the political pressures of their time but also the enduring

tension between short-term protection and long-term growth. The two cases discussed below illustrate how tariffs have been deployed with different aims. From a purely economic point of view¹³, they raise the question of whether such measures can genuinely foster sustainable prosperity or whether they risk undermining broader economic health.

The Smoot–Hawley Act of 1930

Passed in the shadow of the 1929 stock market crash, the Smoot–Hawley Tariff Act represented one of the most sweeping protectionist experiments in U.S. history. Championed by Sen. Reed Smoot and Rep. Willis Hawley, and signed reluctantly by President Herbert Hoover, the law raised duties on more than 20,000 imported goods. Average tariffs climbed to nearly 60% on over a third of imports, with special emphasis on the automobile, steel, and textile sectors.

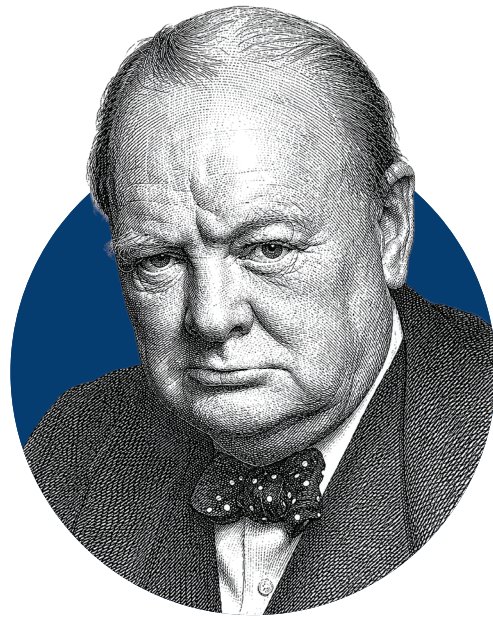
Despite warnings from many economists and business leaders, including a high-profile petition led by Irving Fisher¹⁴ and Paul Douglas¹⁵, Hoover yielded to political pressure and industry lobbying. The hope was that higher duties would stabilize farm incomes and preserve industrial jobs. Instead, the measure triggered a cascade of retaliatory tariffs from 25 trading partners. Between 1929 and 1934, global trade contracted by roughly two-thirds, aggravating deflationary pressures, accelerating bank failures, and deepening unemployment.

The domestic consequences were stark: Imports fell from \$4.4 billion in 1929 to \$1.5 billion in 1933, exports collapsed by two-thirds, and farm incomes, already battered by overproduction, dropped by a third. Consumer goods became more expensive, straining households and supply chains alike. Politically, the backlash was swift: Hoover lost the 1932 election, and both Smoot and Hawley were voted out of office.

The legacy of Smoot-Hawley was not only economic pain but also institutional reform. The Reciprocal Trade Agreements Act of 1934 marked a decisive pivot toward liberalization, granting the president authority to negotiate tariff reductions. Over the following decades, the United States became a leading architect of multilateral trade frameworks—GATT¹⁶, NAFTA¹⁷, and eventually the WTO¹⁸—designed to prevent a repeat of the destructive tariff spiral of the early 1930s.

The Tariffs of 2018

Nearly 90 years later, the Trump administration launched the most ambitious tariff campaign since Smoot-Hawley. Framed as a defense of American jobs and a corrective to chronic trade deficits, the measures drew on two statutes: Section 232 of the 1962 Trade Expansion Act, which imposed 25% tariffs on steel



Want of foresight, unwillingness to act when action would be simple and effective, lack of clear thinking, confusion of counsel until the emergency comes, until self-preservation strikes its jarring gong—these are the features which constitute the endless repetition of history.

—Winston Churchill

and 10% on aluminum under the banner of national security, and Section 301 of the 1974 Trade Act, which targeted Chinese practices related to intellectual property and forced technology transfer. By 2019, tariffs covered \$250 billion in Chinese imports, with additional duties levied on goods from the EU, Canada, Mexico, India, and Turkey.

The economic calculus was complex. On one hand, tariff revenues surged: By mid-2025, importers were paying \$27 billion in duties in a single month, with annual collections projected to exceed \$300 billion—nearly 1% of GDP. These revenues narrowed budget deficits and provided leverage in negotiations. On the other hand, long-term projections painted a darker picture: the Penn Wharton Budget Model¹⁹ estimated a 6% decline in GDP and a 5% fall in real wages under the prevailing tariff structure, with middle-income households losing roughly \$22,000 in lifetime earnings. The Tax Foundation²⁰ reached similar conclusions, projecting a 0.8% contraction in GDP even before accounting for retaliation, alongside \$2.4 trillion in tariff revenues over a decade—or \$1.7 trillion after behavioral adjustments.²¹

Tariffs have often transcended their economic function to serve as instruments of geopolitical leverage. A striking example occurred in 2019, when the United States linked trade policy directly to border security and narcotics control. The administration signaled that escalating duties would be imposed on Mexican imports unless the government intensified enforcement at its southern frontier and curbed the flow of illicit drugs northward. The threat proved effective: Within weeks, Mexico mobilized 6,000 National Guard troops and expanded migration protocols, thereby averting the tariffs. This episode illustrates how trade measures can be repurposed as bargaining chips in foreign policy, blurring the line between economic protectionism and strategic coercion.

With China, tariffs paved the way for the Phase One Trade Deal of January 2020, which promised \$200 billion in additional purchases of U.S. goods and services, though Beijing ultimately fell short of its commitments.

Supporters of the tariffs framed them as strategic tools. White House advisor Peter Navarro argued they were essential to rebuilding the industrial base²²; Oren Cass emphasized that revitalizing local labor markets is essential to restoring the economic foundations of workingclass communities²³; Art Laffer highlighted their function in forcing negotiations²⁴; labor leaders such as the UAW's Raymond Michalowski praised them for protecting auto jobs.²⁵ Hungarian Prime Minister Viktor Orbán, for example, acknowledged their disruptive impact on global trade norms.²⁶

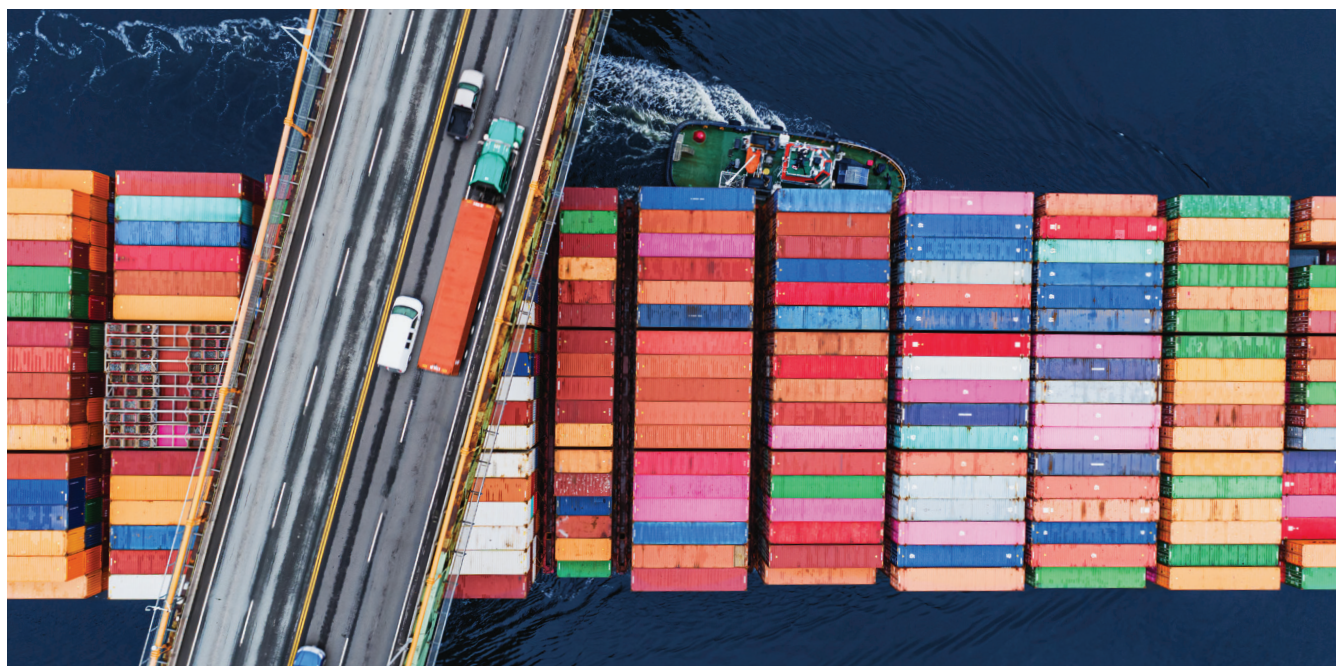
For consumers, the immediate inflationary effects were muted: CPI data in August 2025 showed 2.7% year-over-year inflation, close to the Federal Reserve's target. Yet analysts warned that delayed cost pass-through, particularly in import-heavy sectors like electronics and furniture, could trigger sharper price increases. Meanwhile, corporate pledges of new U.S. investment from firms such as Apple, Nvidia, and Hyundai often came with caveats, reflecting hesitation in

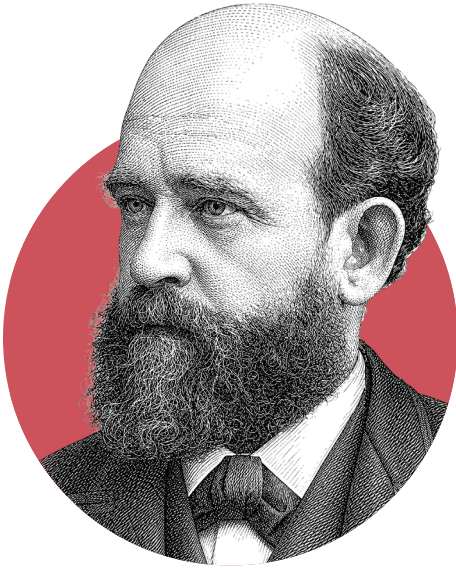
the face of unpredictable trade policy.

The juxtaposition of Smoot-Hawley and the 2018 tariffs underscores the recurring dilemma of protectionism: Tariffs can deliver short-term political gains, fiscal revenues, and negotiating leverage, but they also risk long-term economic contraction, retaliation, and uncertainty. The historical record suggests that while tariffs may serve as tactical instruments in moments of crisis or negotiation, their strategic use must be weighed carefully against the broader costs to growth, stability, and global integration.

International Trade and the Actuarial Profession

Tariff policy reverberates through the actuarial domain by reshaping assumptions, models, and risk profiles across multiple lines of insurance. The imposition of duties alters cost structures, investment dynamics, and long-term liabilities, requiring actuaries to recalibrate their frameworks in response to shifting economic realities.





What protectionism teaches us is to do to ourselves in time of peace what enemies seek to do to us in time of war.

—Henry George

Claims Severity and Property & Casualty Lines

Rising input costs feed directly into claims severity. In auto insurance, for instance, a 25% tariff on imported vehicles and parts can translate into billions of dollars in additional annual claims expenditures—estimates range from \$7 billion to \$24 billion. Homeowner's coverage is similarly affected: higher prices for Canadian lumber, Mexican gypsum²⁷, and Chinese fixtures elevate rebuilding costs, which in turn drive policy premiums upward.

Market Volatility and Insurer Balance Sheets

Tariff-driven volatility destabilizes insurers' financial positions by squeezing margins when investment returns are under pressure. Reduced merger-and-acquisition activity and fewer initial public offerings further limit opportunities for diversification and growth, compounding the strain on earnings.

Inflationary Trends and Long-Term Liabilities

Broader macroeconomic effects also reshape actuarial assumptions. Elevated inflation expectations demand recalibration of discount rates, benefit indexing, and cost-of-living adjustments,

alongside updated stress-testing protocols. Trade-induced slowdowns influence lapse and surrender behavior in life and annuity contracts, while heightened economic stress may increase disability claim frequencies.

Opportunities Amid Disruption

While tariffs introduce risk, they also create new avenues for actuarial engagement. Demand for trade credit insurance is likely to expand as exporters and financial institutions seek protection against payment defaults. Likewise, the



onshoring of manufacturing activity generates novel exposures in product liability and workers' compensation, requiring fresh actuarial analysis.

For the actuarial profession, tariff policy is not a peripheral concern but a central variable in risk management. Developing a working knowledge of international trade dynamics is indispensable for navigating an era defined by global uncertainty, where economic policy and actuarial practice intersect with increasing frequency.

Final Remarks

International trade remains one of the central pillars of global economic life, shaping not only the fortunes of nations but also the trajectory of industries and households. At its core, the logic of specialization and comparative advantage explains why countries gain from exchange: By focusing on what they produce most efficiently, they expand overall productivity and secure access to a wider spectrum of goods and services. The benefits are tangible: higher efficiency, faster innovation, and improved living standards. Yet, these gains cannot be taken for granted. Trade

The curious task of economics is to demonstrate to men how little they really know about what they imagine they can design.

—F. A. Hayek

unfolds within a landscape marked by inequality, political frictions, and institutional barriers that complicate its outcomes.

Crafting intelligent trade policy is therefore less about choosing between openness and protection than about striking a balance: promoting fairness, reducing exposure to shocks, and channeling globalization's benefits toward sustainable growth. Tariffs illustrate this tension. They are an enduring feature of the global economy, sometimes deployed strategically, sometimes defensively. But when imposed at scale, they introduce volatility that reverberates through financial markets and supply chains. Managing this uncertainty requires not only sound economic judgment

but also the tools of risk analysis. Actuaries, with their expertise in quantifying and mitigating financial risk, can play a valuable role in this process if they complement their technical expertise with a working grasp of the economics of international trade. ▲▲

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Disclaimer: This article is based on established economic theory. The discussion is interpretive and does not purport to advance new theoretical contributions.

Endnotes

1. Monetary policy (lowering interest rates to encourage borrowing and investment, leading to job creation) is another important macroeconomic tool, but it is not discussed here because it is unrelated to trade.
2. The *multiplier*, a concept developed by British economist John Maynard Keynes, refers to the effect that an initial change in spending (such as investment or government expenditure) has on the overall economy. Specifically, it measures how much additional economic activity is generated from an initial increase in spending. In the case discussed here and assuming a factor of 2/3, exports are increased by \$1 billion and domestic consumption by \$2 billion.
3. The tragedy of the commons is an economic model that describes how individuals, acting in their self-interest, can deplete shared resources, leading to long-term collective harm. The concept highlights the need for sustainable management practices and cooperation to balance personal interests with the well-being of the community and the environment. It was popularized by Garrett Hardin in 1968.
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5. US-China Trade War: an empirical evaluation regarding its impacts on Brazilian exports; *International Economics and Policy*; July 2024.
6. The impact of the US-China trade war on Vietnamese Exports to the US: a quantitative study using DiD approach; *Journal of Trade Science*; November 2024.
7. Difference-in-differences is a quasi-experimental method for estimating causal effects using observational data. It compares how an outcome changes over time in a "treatment" group versus a "control" group to net out confounding trends.
8. Weakening the currency can be a tool to make goods and services less expensive to consumers of other countries. There are three problems with this approach: (1) devaluation makes imports more expensive, creating inflation; (2) external obligations denominated in foreign currency become costlier to service; (3) trading partners may devalue their own currencies or impose tariffs, eroding the initial advantage. The second problem, which can be significant for countries with large debts, does not exist for lender countries such as China.
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11. Macroeconomic Consequences of Tariffs; IMF Working Paper No. 2019/009; January 2019.
12. By analyzing historical events it is possible to evaluate economic theories. The interested reader may want to review the history and aftermath of the following episodes: The Tariff of 1828 ("Tariff of Abominations"), The McKinley Tariff of 1890, The Fordney-McCumber Tariff of 1922, and The Bush Steel Safeguard Tariffs of 2002.
13. Strategic considerations such as national security cannot be ignored.
14. Irving Fisher (1867–1947) was an American economist and statistician known for pioneering mathematical economics, developing the quantity theory of money, and formulating the Fisher equation, and debt-deflation theory.
15. Paul Douglas (1907–1959) was an American actor who won Theatre World and Clarence Derwent Awards for Broadway's *Born Yesterday*.
16. General Agreement on Tariffs and Trade (1947–1994): A multilateral treaty to reduce tariffs and trade barriers, laying the groundwork for modern trade rules.
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18. World Trade Organization: (1995–present): The global organization that succeeded GATT, regulating trade rules, resolving disputes, and overseeing agreements among over 160 member nations.
19. The Economic Effects of President Trump's Tariffs; Penn Wharton Budget Model; April 2025; and "US Industrial Output To Be Worst Hit Globally by Trump Tariffs"; *Newsweek*; April 2025.
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25. UAW press release; July 10, 2025.
26. Interview on Kossuth Rádió (Hungary's state radio); Aug. 1, 2025.
27. Gypsum is a soft sulfate mineral composed of calcium sulfate dihydrate (CaSO₄·2H₂O), mined worldwide for construction materials like plaster and drywall, as a fertilizer, and occurring in sedimentary evaporite deposits.

2026 SOA ImpACT Conference



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Pauline Reimer has directed the Actuarial, Modeling & Risk Division since 1986, after working as an actuary herself. An ASA, MAAA, affiliate member of CAS and Institute & Faculty of Actuaries, she serves on SoA E&I Section Council and Actuarial Society of Greater NY's Executive Board.

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113530

Actuarial Pricing Director - P&C - Northeast/Midwest

- ◆ Own actuarial initiatives supporting pricing and portfolio performance
- ◆ Evaluate profitability, rate adequacy, and underwriting mix
- ◆ Develop pricing, monitoring, and reporting solutions
- ◆ Partner with business leaders on analytics and automation
- ◆ ACAS/FCAS with 6+ years' actuarial experience
- ◆ Strong Python, SQL, and/or VBA skills

113835

Actuarial Associate - P&C - Personal Lines - Remote

- ◆ Support pricing strategies and state expansion initiatives
- ◆ Build and refine homeowners pricing models
- ◆ Analyze rate indications, filings, and portfolio performance
- ◆ Collaborate with Product, Underwriting, and Claims
- ◆ ACAS with 4+ years' Personal Lines experience
- ◆ SQL, Python, and predictive modeling proficiency
- ◆ Collaborative and creative culture within a high-growth insurer

113797

Pricing Actuarial Associate - P&C - Midwest

- ◆ Partner with underwriting on large account pricing
- ◆ Perform loss sensitive pricing and collateral analysis
- ◆ Build and enhance pricing tools, models, and reporting
- ◆ ACAS/FCAS with 4+ years' actuarial experience and strong Commercial pricing background
- ◆ Robust technical capabilities, including SQL/VBA
- ◆ Relocation assistance available

114029

Business Development Actuary - P&C - Remote

- ◆ Rare opportunity to shape and grow a commercial P&C practice within a private equity-backed consulting firm
- ◆ Partner with executives on new market initiatives and client engagements, strengthening competitive positioning
- ◆ ACAS/FCAS with 7-15+ years' actuarial experience within insurance/consulting and across broad commercial lines
- ◆ Executive-level communication and presentation skills
- ◆ Substantial, top market salary and bonus structure

113444

Actuarial Manager, Pricing Tools - P&C - Northeast/Chicago

- ◆ Lead evolution of pricing tools and processes
- ◆ Manage a small team of actuarial developers
- ◆ Build next-generation pricing platforms and methodologies
- ◆ Partner cross-functionally to deliver innovative pricing solutions
- ◆ ACAS/FCAS with 8+ years' insurance pricing experience
- ◆ Hands-on web-based pricing tool development

113858

Principal Consulting Actuary - Life - Remote

- ◆ Help shape the strategic growth of a market-leading Life & Annuity advisory and transformation practice
- ◆ Partner with carrier executives to design, price, and launch new products
- ◆ Lead complex policy admin platform conversions
- ◆ Serve as a trusted advisor on high-profile product and pricing decisions
- ◆ FSA with 15+ years' actuarial experience and deep Life & Annuity product and pricing expertise
- ◆ Partner-level compensation potential

113576

Assistant Vice President & Marketing Actuary - Life - Northeast

- ◆ Develop client-focused Individual Life reinsurance pricing strategies supporting business growth
- ◆ Structure competitive and profitable reinsurance transactions
- ◆ Manage strategic client relationships and engagements
- ◆ FSA with 8+ years' life (re)insurance experience
- ◆ Pricing and product development expertise preferred
- ◆ Strong career growth and comprehensive benefits

113847

Actuarial Analyst IV - Health - Remote

- ◆ Evaluate product performance, pricing, reserves, and financial risk
- ◆ Develop and design advanced actuarial models and regulatory documentation
- ◆ Collaborate with business partners
- ◆ ASA with 6+ years' actuarial experience
- ◆ Strong work-life balance, salary, and benefits package
- ◆ Remote from many flexible locations

113515

M&A Consulting Actuary - Life - Northeast - Remote

- ◆ Execute actuarial due diligence for M&A and high-profile reinsurance transactions
- ◆ Quantify transaction risk using stochastic models and analytics
- ◆ Present strategic insights to executives and global clients
- ◆ FSA with 3+ years' Life actuarial/consulting experience
- ◆ M&A background preferred but not required
- ◆ Great communication & project management abilities

113629

Senior Actuary - Health - Remote

- ◆ Deliver high-impact tech-forward client solutions
- ◆ Work alongside software engineers
- ◆ Gain exposure to advanced actuarial AI development
- ◆ High-growth innovative startup environment
- ◆ ASA with 8+ years' actuarial healthcare experience
- ◆ Passion to solve complex healthcare challenges

Affordability in Focus

AS THE NATION APPROACHES THE 2026 MIDTERM ELECTIONS, a common theme across the political spectrum is affordability.

While inflation surged in the aftermath of the COVID-19 pandemic, rising prices have largely persisted and, in some cases, have been further amplified by more recent domestic and international policy decisions.

But affordability is not only an electoral issue. Across its practice areas, Academy volunteers are examining the factors driving rising insurance costs and their effects on both the industry and consumers.

Addressing Cost Pressures in P/C Insurance

Earlier this year, the Casualty Practice Council (CPC) released two issue briefs addressing homeowners' insurance and the impact of tariffs on auto insurance. Volunteers also presented the Academy's findings on both topics at the CAS Spring Meeting in May.

In *Homeowners' Insurance: Filling the Coverage Gap*, the Homeowners' Insurance Task Force highlights disparities between home replacement cost valuations and other property valuation methods. The brief emphasizes the importance of regulators, policymakers, and actuaries working together to educate consumers about how insurance valuations are determined.

To support that goal, the document outlines strategies insurers and regulators can use to improve consumer understanding of insurance coverage. Examples of common misconceptions surrounding flood, earthquake, and other coverages underscore the need for collaboration among insurers, regulators, and the public to promote a more



transparent and accessible homeowner's insurance market.

The brief also notes that actuaries should understand how homeowner's insurance valuations affect both rate adequacy and rate equity. Pricing actuaries, in particular, should be familiar with how replacement costs are calculated and ensure that the underlying data is accurate. Understanding the range of coverage and deductible options available within homeowner's insurance products is also critical to developing sound pricing assumptions.

Similarly, the Auto Insurance Committee's issue brief, *Tariffs and Their Effects on Personal Auto Insurance Costs: An Actuarial Perspective*, explains how tariff volatility throughout 2025 and 2026 has created substantial economic uncertainty for both consumers and insurers. Frequent pauses, reductions, and changes in effective dates have contributed to ongoing instability across the insurance marketplace.

According to the committee, the most significant effect stems from rising costs for goods and services directly affected by tariff changes. Increased costs for imported vehicles, parts, and materials have raised the expense of purchasing and repairing both new and used automobiles. Liability insurance costs have also increased because the property damage component of coverage reflects the higher cost of repairing or replacing vehicles.

Despite the U.S. Supreme Court's ruling earlier this year invalidating tariffs imposed under the International Emergency Economic Powers Act, uncertainty remains regarding their long-term impact, said Jeff Clinch, a member of the CPC's Auto Insurance Committee, during a June episode of the Academy's Actuary Voices podcast. The administration subsequently adopted a different legal basis for the tariffs, leaving their future effects unclear.

The November election may still be weeks away, but the affordability concerns dominating public discussion have been building for years. The Academy's work demonstrates its commitment to addressing the complex issues affecting consumers, policymakers, and insurers alike.

"If these tariffs remain in effect, they certainly could lead to higher costs for auto parts and contribute to ongoing supply chain volatility," he said. "If there is more certainty and stability there—so there is less variation by country, such as our parts coming from Canada and Mexico—it will give actuaries a little more certainty as they look ahead ... but you will still need to consider the historic data as well as what you are anticipating when you are making that forward-looking view."

An Actuarial Perspective on Health Care Costs

Affordability is also a major concern in health care. Susan Pantely, co-vice chairperson of the Health Practice Council (HPC), testified before the Texas House Select Committee on Health Care Affordability on May 1 regarding the underlying drivers of rising health care costs.

In her testimony, Pantely focused on actuarial considerations while explaining the factors contributing to premium increases. "Premium growth reflects rising underlying health care costs," she stated. "The same promising and critical therapies that can represent medical progress often raise costs that are ultimately reflected in health insurance premiums."

In addition to the written testimony that the HPC submitted for the record, the council responded to additional questions from the Select Committee

in the weeks following the hearing. The HPC will also remain engaged as Texas legislators meet throughout the summer to discuss potential solutions to address the high cost of health insurance in the state. The HPC has also been working with state insurance regulators, presenting to the Health Actuarial (B) Task Force of the NAIC during recent meetings and sharing updates on cost drivers, actuarial perspectives on the U.S. Department of Health and Human Services' annual proposed Notice of Benefits and Payment Parameters, and other resources to help state officials address the ongoing cost conundrum.

Long-term care (LTC) remains another area where affordability challenges have persisted for years. In 2025, the HPC Long-Term Care Committee published an issue brief examining the current state of the LTC market, with a particular focus on product design, the management of legacy blocks of business, and policyholder engagement.

The brief also addresses ongoing uncertainty within the market, including significant premium increases driven by rising health care costs. Standalone LTC policies have increasingly narrowed benefits to help maintain affordability. At the same time, the market has continued shifting toward combination products that include a life insurance component, addressing the "use it or lose it" concerns often associated with traditional standalone policies.

Bringing Health and Life Expertise Together

The growing integration of life insurance and LTC products has also prompted organizational enhancements within the Academy. Earlier this year, at the recommendation of the HPC and the Life Practice Council, the Academy established the Joint LTC Combination Product Task Force to address the increasing overlap between health and life insurance in these products.

The task force is intended to create an opportunity for the Academy to address the risks associated with these combination products while emphasizing the need for input from both practice areas. As the Academy seeks to support its public policy mission, this task force will incorporate the diverse experiences and perspectives associated with standalone products and the growing variety of LTC combination products that have become an area of increasing interest for state regulators and consumers.

The November election may still be weeks away, but the affordability concerns dominating public discussion have been building for years. The Academy's work demonstrates its commitment to addressing the complex issues affecting consumers, policymakers, and insurers alike. By examining the forces driving insurance costs across multiple sectors, Academy volunteers are helping inform the conversations that will shape policy decisions well beyond Election Day. ▲

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

Beyond the Finish Line

FOR RETIREMENT ACTUARY KYUMAN (Q) LEE, MAAA, FSA, EA, CERA, FCA, CFA, the finish line is never really the end of the race. Whether it's earning actuarial credentials, taking on new responsibilities at work, volunteering for the Academy, or training for the World Marathon Majors, each milestone is a starting point for the next challenge. Lee didn't set out to become an actuary. A computer science major with a knack for mathematics, he discovered a profession that combined technical rigor with business problem-solving—and never looked back. Today, as vice president of actuarial services at Hackensack Meridian Health, he applies actuarial principles to everything from retirement benefits to mergers and acquisitions while encouraging the next generation of actuaries to keep learning, embrace new challenges, and seize opportunities when they arise.

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

I often joke that I'm not sure whether I discovered the actuarial profession or if it discovered me. I started college as a computer science major at the University of Waterloo, often known as Canada's MIT. While I found the coursework challenging, math and statistics came quite naturally to me. A few close friends suggested I look into the actuarial field, and the prospect of blending business, economics, risk management, and statistics in my daily work was incredibly appealing. I passed my first exam (Course 1) during my sophomore year, balanced both majors through my junior year, and eventually switched completely to actuarial science. Ultimately, the strong technical foundation I built in computer science has been a driving force in my career.

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

The concept of a self-policing profession—operating without direct legislative or administrative intervention—is both attractive and an immense responsibility. It demands a consistent, day-to-day commitment to ethical



KYUMAN (Q) LEE, MAAA, FSA, EA, CERA, FCA, CFA

behavior. Making a habit of evaluating my own work through this ethical and quality lens is something rare in other professions, and it has undeniably made me a better professional. In addition, understanding the core purpose of these professional guides empowered me to

establish similar practical frameworks for the teams I've led. By setting clear operational standards that required a strong rationale for any deviation, we significantly reduced the risk of rogue behaviors, such as lowballing or overpromising to clients.

The MAAA is a symbol of professional qualification—a key to an expansive library of actuarial resources, and a membership in an organization that champions meaningful actuarial causes across the country.

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

This happens regularly. As an in-house actuary, I oversee all actuarial matters related to our benefit programs. But I'm frequently called upon for nontraditional areas, like M&A or facilities investments, for data analysis and business profitability forecasting. ASOP [Actuarial Standard of Practice] No. 23, *Data Quality*, in my view, is the premium standard for data quality assessment; no other profession performs data validation quite like an actuary following this standard. Similarly, the actuarial discipline of rigorously validating assumptions and producing comprehensive, well-documented reports isn't the norm outside our profession. By simply following what actuaries consider baseline practice, I've earned the trust of peers and executive leadership alike and have expanded my impact well beyond traditional actuarial roles.

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

A career is full of highs and lows, but a crisis often masks a great opportunity. I started strong as a junior consulting associate, driven by technical skills and a curiosity for reading laws and regulations. When my mentors left the firm, taking much of the client work with them, it felt like a setback. But the clients who stayed needed more from me, and my responsibilities expanded significantly. Having completed my EA [enrolled actuary] exams in my first year, and earning the designation as soon as I met the experience requirements, meant I was ready when that opportunity arrived. The lesson: Endure the process, pursue growth. But more importantly, prepare yourself so that when opportunity comes, you're ready to take it.

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

Keep your technical skills broader than Excel and VBA [Visual Basic Applications]. Losing touch with other tools is my biggest professional regret, and it would have helped me stay ahead of the AI [artificial intelligence] wave. And explore beyond retirement! Health actuarial work is dynamic and full of potential. Strive to become a well-rounded benefits expert rather than confining yourself strictly to retirement. You can learn about much more than just retirement!

What do you value most about your Academy membership or volunteer work?

I am incredibly thankful to serve as a volunteer on the Academy's Retirement Policy and Design Evaluation (RPADE) Committee. Every moment spent with the RPADE committee has been a profound learning experience. The depth, breadth, and sheer diversity of viewpoints among the committee members constantly fascinate and inspire me.

What is the value of your MAAA?

The MAAA is a symbol of professional qualification—a key to an expansive library of actuarial resources, and a membership in an organization that champions meaningful actuarial causes across the country.

Would you like to share anything else with aspiring or new actuaries, or those interested in volunteering for the Academy?

To aspiring and new actuaries: Take your exams seriously, not just because you have to. I've seen too many actuaries treat sponsored exam time as an obligation rather than a privilege, and let work quality slip in the process. Juggling competing priorities is hard, but everyone does it. Also, earning your FSA or MAAA is not a finish line. It opens a door to opportunities that require skills your exam journey never covered. Keep the learning momentum going, especially around business acumen and emerging tools.

To those considering volunteering for the Academy: I was on the fence, and I'm glad I took the leap. You won't regret it. Just do it!

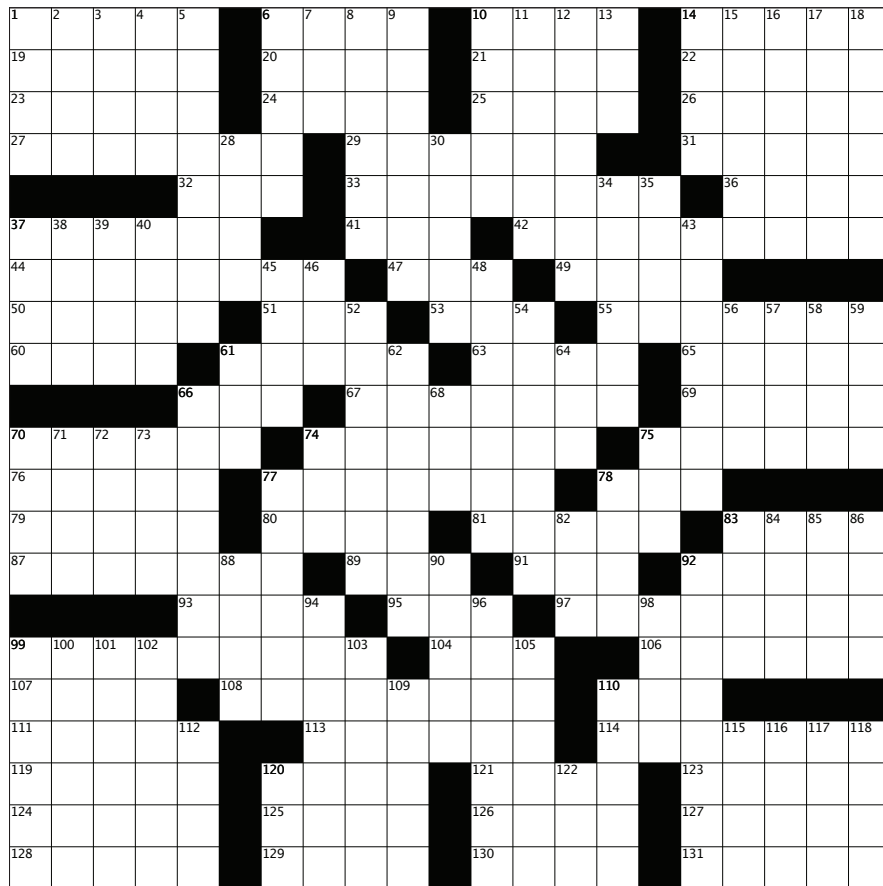
Beyond work—what are your hobbies or personal interests?

I'm a runner. Every morning, I'm out the door, and throughout the year, I race everything from 5Ks to marathons. Running has become such a core part of my life that I've convinced my wife to plan our family vacations around the World Marathon Majors. We're heading to Berlin this fall and Tokyo next spring—with London, Sydney, Boston, and Chicago still on the list. ▲

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.

Word Salad



Across

- 1 Almanac filler
- 6 Capable of
- 10 Chapters of history
- 14 Number by a door?
- 19 City captured by Lawrence of Arabia
- 20 Kind of course
- 21 Compass pts.
- 22 Mites, ticks, etc.
- 23 Rube
- 24 Drink used in Vedic rituals
- 25 Some PC connections
- 26 It's underground
- 27 ____ salad
- 29 Camus subject
- 31 Thiago Messi to Lionel
- 32 Collector's goal
- 33 Hobbes and Locke

- 36 At a Kings game, e.g.
- 37 Capital of Bahrain
- 41 Historical Japanese name for Hokkaido
- 42 Gullet
- 44 Tennis ____
- 47 Gloaming
- 49 Pennsylvania port
- 50 "Trembling" tree
- 51 Kind of jacket
- 53 70 down synonym
- 55 Ties up
- 60 Start of something big
- 61 1988 Tim Rice musical
- 63 Riant reaction
- 65 "1984" worker
- 66 Kentucky bluegrass
- 67 Strangelove portrayer
- 69 Jean de La Fontaine story

- 70 Trivet
- 74 ____ salad
- 75 Used to waterproof leather
- 76 Film category
- 77 Occupy completely
- 78 Site sight
- 79 Eremitic, for example
- 80 Small inheritance
- 81 "... give me liberty, or give me death!" speaker
- 83 Sporrán sporter
- 87 Market activity
- 89 Seminary deg.
- 91 29 across synonym
- 92 American pioneer born 1734
- 93 Heel over
- 95 Use a ladder back
- 97 Compelled
- 99 City north of Liverpool

- 108 Inability to produce written language
- 110 Batik need
- 111 Sardonic
- 113 Set in order
- 114 ____ salad
- 119 Biblical sustenance
- 120 Dutch portraitist
- 121 Boughpot
- 123 Solver of the Konigsberg bridge problem
- 124 Church officer
- 125 Throw out a line
- 126 Hydrogen compound
- 127 Hot spot
- 128 Gems
- 129 Hurricane-tracking agcy.
- 130 Cartoonist Steinberg
- 131 Kind of secret

Down

- 1 Columbian guerrilla group
- 2 1992 Asia album
- 3 Beef
- 4 Aspen transport

- 5 They do better when they close early
- 6 Election Day stunner
- 7 NFL player
- 8 Philly campus
- 9 Give a milky appearance
- 10 ____ salad
- 11 Pledge
- 12 Manumit
- 13 Gov't agency
- 14 Rotary disks
- 15 Tropical tree
- 16 Afire
- 17 Faux gold
- 18 Rain forest flora
- 28 Letter closer
- 30 Captain to Lieutenant
- 34 Sophia and family
- 35 Casual drive
- 37 Shaquille O'Neal and Mitt Romney (abbr.)
- 38 Seat of England
- 39 Chignon spot
- 40 Made a great point?
- 43 Not useless
- 45 Hebrew measure
- 46 The end of August
- 48 Ghana's official language
- 52 Transfers
- 54 Ready to go, in a way
- 56 Type of horse
- 57 ____ salad
- 58 Norse deity who defeated Thor
- 59 Experienced
- 61 "Pay later" letters
- 62 Spy currency
- 64 Cholera
- 66 "... give me liberty, or give me death!" speaker
- 68 John, abroad
- 70 53 across synonym
- 71 Pervasive quality
- 72 ____ salad
- 73 Obtest
- 74 Needle pt.
- 75 Uninspired
- 77 Lait de poule
- 78 Petition
- 82 Robert Louis Stevenson land
- 83 Henry VIII's quest
- 84 Pearl Jam album "No ____"
- 85 11 digits?
- 86 Poets Hughes and Kooser
- 88 Cabbage variety
- 90 Power to pulverize
- 92 Not logical
- 94 British fighter plane
- 96 They take things the wrong way
- 98 Yucatan native
- 99 Knocked
- 100 Emplacement
- 101 It may be hidden
- 102 Neutral territory
- 103 Pink orchid
- 105 It has thick skin
- 109 ____ salad
- 110 "Fain would I ____ on form": Juliet
- 112 Gin mills
- 115 Channel
- 116 Oils of old Rome
- 117 It's overhead
- 118 "A mother, who is really a mother, is never ____": Balzac
- 120 Chick magnet?
- 122 Not worth a ____

A-



Solvers: Dean Apps, Jared Dashoff, Todd Dashoff, Ken Kudrak, George Levine, David H. Lueck, Jim Muza, Ray Niswander, Steve Newman, and Madhumathi Windon

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

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- Enjoys creating puzzles built around engaging stories or scenarios
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 - Has a steady stream of original or adapted puzzle ideas
 - Writes in a clear, engaging style
- Is willing to interact with readers by responding to their submitted solutions

Interested?

We'd love to hear from you—or someone you know.

Contact: editor@actuary.org

Island Rings

Here is another puzzle from Bob Fink and Jerry Miccolis.

ALOHA! This puzzle might best be savored on a tropical beach, under a swaying palm tree, while sipping a cool, refreshing mai tai—indeed, the very conditions under which it was conceived. But we hope you enjoy it wherever you may happen to be.

The six long Across entries comprise the puzzle's theme. They are unclued, unconventional phrases. We don't expect you to be able to derive them solely from their crossing Down entries, so we've provided some additional solving aids. First, the six theme entries share a distinctive feature. Second, this common feature is strongly hinted at by the 11 circled letters in the properly completed grid—but they need to be unjumbled, and when they are, they will spell the title of a popular TV show that ran for over 30 (non-contiguous) years. Third, we provide additional hints below, in random order relative to their respective entries:

- Alohas upon arrival?
- Alohas upon departure?
- Unlikely luau souvenir?
- Diligent Diamond Head defender?
- Tiny bubbles?
- Body of work displayed on "Aquaman" movie posters?

The non-theme entries are all common words or phrases, and each of the words is playable in Scrabble except for one proper name and one English phrase borrowed from Latin. As always, be wary of punctuation in the clues, which can be deceptive.

Thanks to Tom Toce for his expert edits and helpful comments.

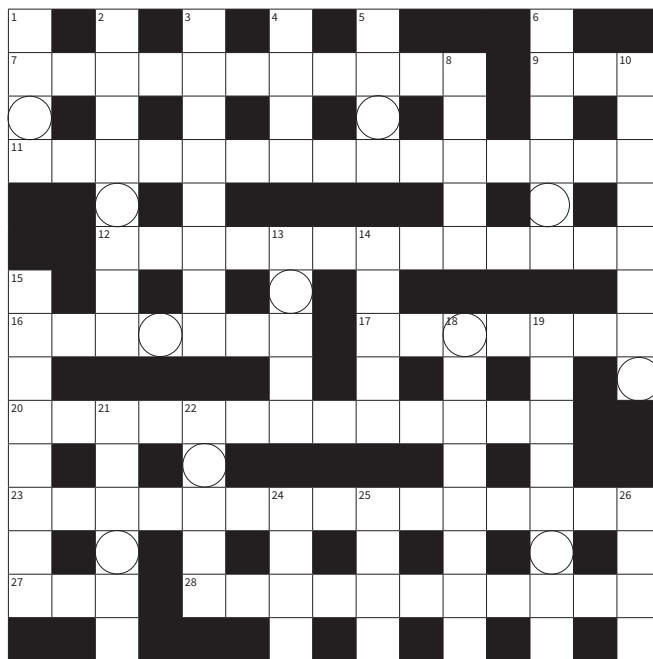
Aloha!

Across

7. [see instructions] (3,8)
9. Swimmer called to mind when singing "That's Amore!" (3)
11. [see instructions] (8,7)
12. [see instructions] (4,3,2,4)
16. On-sites arranged for the most curious (7)
17. A great distance separating sib's expeditions (7)
20. [see instructions] (4,6-3)
23. [see instructions] (5,5,5)
27. Gathering with second grade in the auditorium (3)
28. [see instructions] (4,3-4)

Down

1. Shop ahead offers colorful fish (4)
2. Key players lazily sit in spa (8)
3. It helps determine what's fair in a bird survey, it's said (4,4)
4. Ask Olaf to provide toast (4)
5. Black barn animal is big game (4)



6. Study old piece of Vigenère Cipher once again (2,4)
8. Cycling through Tokyo and another Japanese city (5)
10. Tools Lee refurbished for free (3,5)
13. Addams family member attending gala? Me too! (5)
14. Twangy New Age singers are loud at first (5)
15. John to be reassigned at work (2,3,3)
18. Odd characters, in for noon start of "We the People," filling the seats nearest the stage (5,3)
19. Violent tremors claim none at comfort station (8)
21. Boy grabbing that woman gets slapped (6)
22. Defeat decisively and proceed to dance (5)
24. Delighted sounds slowly emanate from radio (4)
25. Stone atop two unknowns (4)
26. Place to be if you can take the heat right from the start (or not?) (4)

The theme-relevant TV show: _____





Solution to Previous Issue's Puzzle—Duplicity

Across

1. ARTIST TRAITS from theme clue f
9. BART—BART(ENDER)—("Mixologist cut off")
11. SAHL—Homophone of SAUL ("Biblical king")
13. MOE—Homophone of MOW ("do lawn care")
15. TERSE RESET—from theme clue a
16. STAID—Homophone of STAYED ("remained")
17. ROLOS—Every other letter in "Froot Loops"
18. ADOBE ABODE from theme clue c
19. ANT—(PL)ANT ("Part-time plant")
20. ARM—(H)ARM ("harm no humans at first")
22. SWARM—S ("birds finally") + WARM ("get interested")
24. LARVA—Inside "spectacular variety"
27. SUE—Homophone of SIOUX ("Native American tribe")
29. ALI—"Al, I"
32. LEAST STALE from theme clue b
34. SAJAK—SAJA ("Bringing back AJ as") + K ("Jake's third")
37. GUISE—Homophone of GUYS ("People")
38. SOBER BORES from theme clue e
40. AHI—Inside "Bahia"
41. ERSE—(V)ERSE ("poem that needs no introduction")
42. AGES—Righthand side of "shortages"
43. MANTLE LAMENT from theme clue d

Down

1. ABYSMAL—Inside "Baby's male"
2. RATTAN—Inside "Democrat tantrums"
3. TREAD—Anagram of "Rated"
4. SIS—(CRI)SIS ("crisis after missing a few beats")
5. TARA—Word bank for "ratatatat"
6. ALSO—Inside "Fundamental solutions"
7. IMELDA—Anagram of "Mailed"
8. SENSE—Homophone of CENTS ("pennies")
10. TRIOS—Anagram of "Riots"
11. SEVERS—Anagram of "verses"
12. HERBS—HER ("that woman's") + BS ("drivel")
14. OTOE—Every other letter in "on those"
21. MUST BE—MUST ("mold") + B + E ("but ephemeral at first")
23. MIDEAST—Word bank for "Misestimated"
25. REJOIN—Double definition
26. ASKER—Inside "Maradona's kerfuffle"
28. LAURA—Anagram of "Aural"
30. LESSEN—Homophone of LESSON ("practice")
31. ISLAM—Anagram of "mails"
32. LASH—LAS + H ("hot")

1	A	2	R	2	T	4	I	S	T	5	T	R	6	A	7	I	T	8	S
9	B	A	R	10	T	I	11	S	A	12	H	L	13	M	14	O	E		
	Y	15	T	E	R	S	E	R	E	S	E	T	N						
16	S	T	A	I	D	V	A	17	R	O	L	O	S						
	M	18	A	D	O	B	E	A	B	O	D	E	E						
19	A	N	T	S	20	A	R	21	M	22	S	W	A	R	23	M			
24	L	A	25	R	V	26	A	27	S	U	E	28	L	29	A	30	L	I	
31	I	32	L	E	A	S	T	S	T	A	33	L	E	D					
34	S	A	J	35	A	K	36	A	37	G	U	I	S	E					
	L	38	S	O	B	E	R	B	39	O	R	E	S	A					
40	A	H	I	41	E	R	S	E	V	42	A	G	E	S					
43	M	A	N	T	E	L	L	A	M	E	N	T							

33. LIEGE—Inside "Ellie gets"
35. ABET—A ("one") + BET ("risky thing")
36. ARSE—(CO)ARSE ("company may bugger off")
39. OVA—(N)OVA ("A little late for lox")

Solvers: Steve Alpert, Dean Apps, Jack Brauner, Bob Campbell, Lois Cappellano, Laura Cremerius, Jared Dashoff, Todd Dashoff, Christopher Dickens, Mick Diede, Deb Edwards, David Handelman, Jason Helbraun, Pete Hepokoski, Catharine Hornby, Max Jackson, Ruth Johnson, Joe Kilroy, Paul Kolell, Mike Kosciuk, Ken Kudrak, George Levine, David Lueck, Tim Luker, Ben Lynch, Michael Manos and Eric Whitescarver, Mathew Marchione and Marika Brown, Dave McGarry, Becky Moody, Jim Muza, Todd Pierce, David and Corinne Promislow, Ram Raman, Jay Ripps, Bill Scott, Andrew Shewan, Sally Smith, Zig Swistunowicz, Tim Tebbe, T. O. C. E. (Josh DenHartog and Sean Donohoe), and Betsy and James Uzzell

TOM TOCE is an FCAS and a seasonal director at KPMG. He is a member of the Jeopardy Hall of Fame. Solutions may be emailed to ttoce@nyc.rr.com. In order to make the solver list, you should send him your solutions by Oct. 1, 2026.

Bingo!

BEFORE STARTING THIS COLUMN, I want to thank Stephen Meskin for helping me write this puzzle column for the past 10 years. Not only has Stephen written puzzles 10 times the quality of my entries, but he has also been gracious enough to proofread and offer suggestions on my offerings, making sure each of my column reaches its full potential.

Stephen has unfortunately written his last puzzle for *Contingencies*, as he currently has far more pressing matters to deal with than writing a puzzle column three times a year. And to be honest, I feel like my best puzzles are behind me, so I will probably hand off the column in the very near future. What that means is that we have a rare opening here at *Contingencies*! If you want to take over the column and lead this great puzzle-solving community, please email me at puzzles@actuary.org. I am happy to answer any questions that any prospective puzzle writer may have. I know plenty of solvers would make excellent puzzle writers; if you want the fun challenge of writing six puzzles a year (or if two people want the more manageable job of writing three columns each per year), please, please, please let me know. Now, on to this issue's puzzle.

As many people know, earlier this year I changed jobs, switching from working nearly every day in the office to a new job that is fully remote. Occasionally, a friend will ask me how I like working remotely, or whether there is something I miss about going into the office. I tell everyone that most days I like working from home, but the one thing I miss about the office surprises everyone: the yearly Bingo games!

Normally I despise pure games of chance. I haven't bought a lottery ticket in decades, I have never put money into a slot machine, and I got out of my weekly football pool as fast as I possibly could. But for some reason, the game of Bingo is an exception to that, and I am not sure why that is the case. It's not like the game has been glorified in popular media; heck, I can't think of one TV show or movie that prominently featured the great game.

After giving it some thought, I think the reason Bingo piques my imagination is because it's a math game where the players don't need to know any math. Maybe if I focused more on random strategy or good-luck charms, I would have had more success at the game, but let's face it, the math is not only complex, but kind of fun as well. Hopefully my puzzle-solving friends can help solve these Bingo puzzles as I try to work up one or two more puzzle columns.

Note: In every puzzle below, feel free to assume that every ball drawn is completely uncorrelated and random, with each of

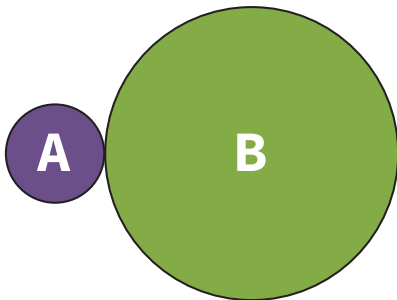


the 75 balls equally likely to get selected. Also feel free to assume that each Bingo card is a 5×5 square, where the first column consists of five random numbers between 1 and 15, the second column consists of five random numbers between 16 and 30, etc. As always, the middle Bingo square is free. The first person to get five in a row—across, diagonally, or vertically—wins.

1. What is the probability that someone gets Bingo after exactly four balls are drawn, the fewest number of balls possible, to win?
2. What is the probability that someone gets Bingo after exactly five balls are drawn?
3. What is the greatest number of balls that can be drawn without your card have a winning Bingo?
4. What is the probability that after exactly four balls are drawn, you will have drawn all four corners of your Bingo board?
5. If 10 co-workers play a game of "Blackout," where the winner must not just get five in a row but cover all 25 squares of the Bingo board, what is the probability that there will be a winner by the 60th ball drawn or sooner?

Solutions to Last Issue's Puzzles—Pencil's Down **JOSH FELDMAN**

1. If $3x + 4y = 5$, then what is $27^x \times 81^y$? Note that $27^x \times 81^y = 3^{3x} \times 3^{4y} = 3^{(3x+4y)}$. But we know that $(3x+4y) = 5$, so the solution is just $3^5 = 243$.



2. If circle A of radius 1 rolls around circle B of radius 3, how many times will circle A revolve? Here circle A revolves around a path that is a radius of 4, the sum of the radii of circle A and circle B. As the circumference of this circle is $8 \times \pi$, and circle A has a circumference of $2 \times \pi$, dividing the two leads to an answer of four revolutions. Note: This is the famous SAT problem where no correct solution was given of the five multiple choice options.
3. If 168 people wait in line every hour, and the average shopper spends five minutes in line, how many people are on line on average? Following the formula $N = rT$, $T = 5$, and $N = 168/60$ (as there are 60 minutes in an hour). So the answer is simply $5 \times (168/60) = 14$. So 14 people are waiting in line on average.

Solvers: Al Spooner, Anna Quady, Anthony Salis, Bill Feldman, Bob Conger, Clive Keatinge, Daniel Wade, David Lueck, David Promislow, Deb Edwards, Jason Shaw, Jerry Miccolis, John Vrysen, Michael Schachet, Rui Guo, Sam Ellis, and Tony Pistilli



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The Skills AI Can't Replace

WHILE REREADING ONE OF MY FAMILY'S FAVORITE CHILDREN'S BOOKS at bedtime the other night, I noticed a striking analogy between artificial intelligence (AI) in education and the title character in *Creepy Crayon!* by Aaron Reynolds.

In this story, the magical, cool-looking purple crayon helps Jasper Rabbit earn better grades on tests and win the prize for best drawing. When Jasper senses that something is off, he decides to stop carrying the crayon with him. However, it comes back, even leaving a message on the mirror: "YOU NEED ME!"

Meanwhile, I was reading the 2025 MIT Media Lab study, *Your Brain on ChatGPT*, which illustrates in scientific terms what the "magical crayon" is doing in terms of cognitive debt.

I told my 9-year-old son that AI can be the "creepy crayon" for us if we let it do all the work. He did not want to agree with me, but it was definitely a good story for us to reflect on our own use of and reliance on AI.

As I ponder what the world will become with the revolutionary development of AI,

I find myself thinking about the critical skills that will be needed going forward. Below are five points I consider vital for the next generation of actuaries:

1. Critical Thinking.

Actuaries are trained to be problem solvers. Pure mathematical problems typically name well-defined closed-form solutions. But, in everyday business situations, there is rarely a single simple solution, nor can we be certain that we have considered all variables.

We often categorize this uncertainty into model risk, parameter risk, and process risk. Quantifying these risks is difficult; recognizing our cognitive blind spots is harder still. In his book *Thinking, Fast and Slow* Daniel Kahneman describes our brains running on two tracks. System 1 operates through

automatic mental shortcuts, and System 2 requires conscious effort.

We should practice engaging more of System 2 in our thinking and become familiar with cognitive biases, such as confirmation bias, hindsight bias, and recency bias. In an AI era, this matters even more: AI output can often feel right even when it has significant errors or hallucinations.

Actuaries consistently demonstrate critical thinking by integrating robust risk-management principles and strong business acumen into each engagement.

I sat for my final set of actuarial exams during the 2008 financial crisis. I was glued to the news—watching the collapse of Lehman Brothers, tracking the cascade of bank bailouts, and wondering what could have prevented such widespread failure.

While AI can accelerate analysis, it cannot accept accountability or ensure that the results are responsible, transparent, and defensible. Increasingly, that will be a key role for the actuarial profession in the AI age.



These events highlighted the importance of enterprise risk management (ERM) and robust regulation in preventing similar crises in the future.

At its core, ERM is a holistic, top-down approach to assessing the complexity of risks within an organization. One of the most critical aspects is building a risk culture: Everyone should participate in identifying, assessing, and managing risks and opportunities. This ERM framework is vital to ensure that we are on the right path to achieving our goals. It also creates a shared language for uncertainty—something spreadsheets and models alone cannot provide.

As John Reed, former Citibank executive, put it in a 2010 interview with the Financial Crisis Inquiry Commission, “Why does a car have brakes? A car has brakes so that you can go fast.” Risk control helps us move forward with confidence.

As mentioned above, actuaries may want the simplest, elegant solution in a pricing or reserving study. However, without considering the external environment in which these analyses are set, we are not addressing the issues properly. A model can be internally consistent but still wrong for the business purpose.

The external environment is a catch-all term that includes commercial issues such as competition, regulation and legislation, environmental and geopolitical issues, social and economic forces such as inflation and unemployment, as well as technological and lifestyle trends. As we think through these items, we are building the business acumen needed in our jobs.

2. Ethics and Professionalism.

According to Laura Hanson, chairperson of the Actuarial Standards Board, “As actuaries, we’re often relied upon to

provide objective, data-driven insights that influence major financial decisions. Without a strong commitment to professionalism, trust can quickly erode.”

This commitment sets us apart from algorithms in the age of AI. We are members of a profession committed to upholding its highest standards in service to society. This is demonstrated through our Code of Professional Conduct and the actuarial standards of practice. Accountability exists through the Actuarial Board for Counseling and Discipline, which helps guide members through various situations and recommends disciplinary actions when the rules are violated.

While AI can accelerate analysis, it cannot accept accountability or ensure that the results are responsible, transparent, and defensible. Increasingly, that will be a key role for the actuarial profession in the AI age.

3. Empathy and Authenticity.

In today’s remote world, much of our communication has become purely transactional. We can get a lot of things done without talking to another person in real time.

Think about your own experience as a consumer. When you phone a utility company to report an issue or seek medical advice from a nurse, would you rather be handled by an automatic virtual assistant, or speak with a real person on the other side of the line? Even if that representative cannot solve every issue on the spot, you value the chance to be heard and understood.

Our clients and teammates are no different. They look to us not only for technical answers, but also for empathy, context, and reassurance. Active listening and understanding are needed to build

trusting relationships. However, these skills do not arrive via a “download” button. We must practice them regularly to improve our listening and understanding of each other.

Google’s Project Aristotle provides compelling evidence. In studying how to build highly effective teams, researchers found that the single most important factor was not having the most intelligent leader; rather, it was psychological safety. In other words, team members want to feel safe taking risks and being vulnerable with each other. This is such a stark contrast against our pursuit of AI, in which we think AI will be the most intelligent and effective tool in the workplace. In reality, it is people—it is the connections we make—that matter most in our lives and in our careers.

4. Perseverance and Self-Discipline.

When virtually any fact can be summoned with a swipe or a voice command, it is fair to ask: Do we still need to commit information to memory? Have we begun outsourcing our brainpower to AI?

Have you ever wondered why, if the first handheld calculator was invented in 1967, children still need to learn the multiplication tables today?

It is effort-based learning that we need to focus on. We are not competing with AI—such a competition would certainly prove futile. However, we should be competing with ourselves.

Each day, are we expanding our knowledge, deepening our wisdom, and uncovering fresh insights? The process matters as much as the outcome. As many parents remind their children, it is the journey—not just the destination—that shapes character and capability.

In an era when smartphones, email, and streaming platforms are always at arm's reach, many of us find our boundaries slipping. Notifications ping during family dinners, urgent messages intrude on weekends, and late-night binge-watching erodes the quality of our sleep. No wonder stress levels have risen and younger generations report historically high rates of anxiety, as suggested by Jonathan Haidt in his book *The Anxious Generation*.

As we learn in economics, everything has a utility curve. The curve often follows the law of diminishing marginal utility. In other words, most things in life are most enjoyable in moderation, but overconsumption can take a toll.

Neuroscience emphasizes the importance of homeostasis—the body's tendency to maintain internal balance. Just as many biological systems function best within healthy ranges, excessive stimulation or deprivation can have unintended consequences.

Time and attention are scarce resources. If we treat them carefully, we can prevent algorithms from capturing our attention and dictating our routines.

5. Curiosity and Creativity.

We are constantly fed information and stimulation from the digital world in today's attention economy. When was the last time we paused long enough to ask ourselves deeper questions—about our work, our assumptions, or the broader impact of our choices? Do we regularly connect the dots between what we do, why we do it, and how it shapes the people and communities we serve?

Curiosity is the catalyst for that type of thinking. It invites us to admit what we do not know, to risk sounding naïve, and to follow a line of inquiry wherever it leads.

Children embrace this instinct naturally; adults, conditioned by social norms and professional expectations, sometimes suppress it. Research suggests that some forms of curiosity may decline with age unless they are actively cultivated. Can we reverse that trend?

Actuaries are a highly specialized profession. We train to be experts in insurance and risk management. However, being a specialist can sometimes limit our creativity in generating new ideas and novel solutions.

In his book *Range: Why Generalists Triumph in*

a Specialized World, David Epstein observes that many top performers spend a “sampling period” early in their careers. They explore multiple disciplines, accumulate seemingly unrelated skills, and later cross-pollinate those experiences to fuel innovation. This breadth of knowledge supports what psychologists call divergent thinking—the ability to generate multiple ideas and make connections across domains—enabling professionals to see patterns, borrow concepts, and craft novel solutions that narrowly focused experts might miss.

Brainstorming, keeping a journal, freewriting, and mind mapping are all ways to stimulate divergent thinking. Note that these are inward-looking activities and require our mental efforts.

We should not rely on AI to replace this important training in creativity. As the MIT study suggests, there may be a cognitive debt associated with overreliance on AI. Cognitive debt defers mental effort in the short term but results in long-term costs, such as diminished critical inquiry, increased vulnerability to manipulation, and decreased creativity.

In other words, we should seek ways to be lifelong learners. I would encourage you to broaden your horizons from actuarial science into another subject, whether economics, literature, or astronomy. Such exploration helps us understand the external environment more fully and become more creative thinkers in a rapidly diversifying world.

In summary, understanding the importance of perseverance, doing difficult work ourselves, setting boundaries, and practicing self-discipline in daily life are all things we should do.

Staying curious, asking questions, and connecting the dots between what we do and how it impacts others strengthen both our thinking and our judgment. Likewise, upholding our highest professional standards and using a risk management framework, business acumen, along with critical thinking, should guide our actuarial analysis.

Finally, being genuine and building real, trusting relationships with the people around us remains one of the most rewarding aspects of both life and work. These skills and experiences should not be replaced in the age of AI. ▲

ZORA LAW, MAAA, FCAS, FIA C.ACT, is a lead actuary at Airbnb.

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