actuarial REVIEW

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Regulation in Insurance

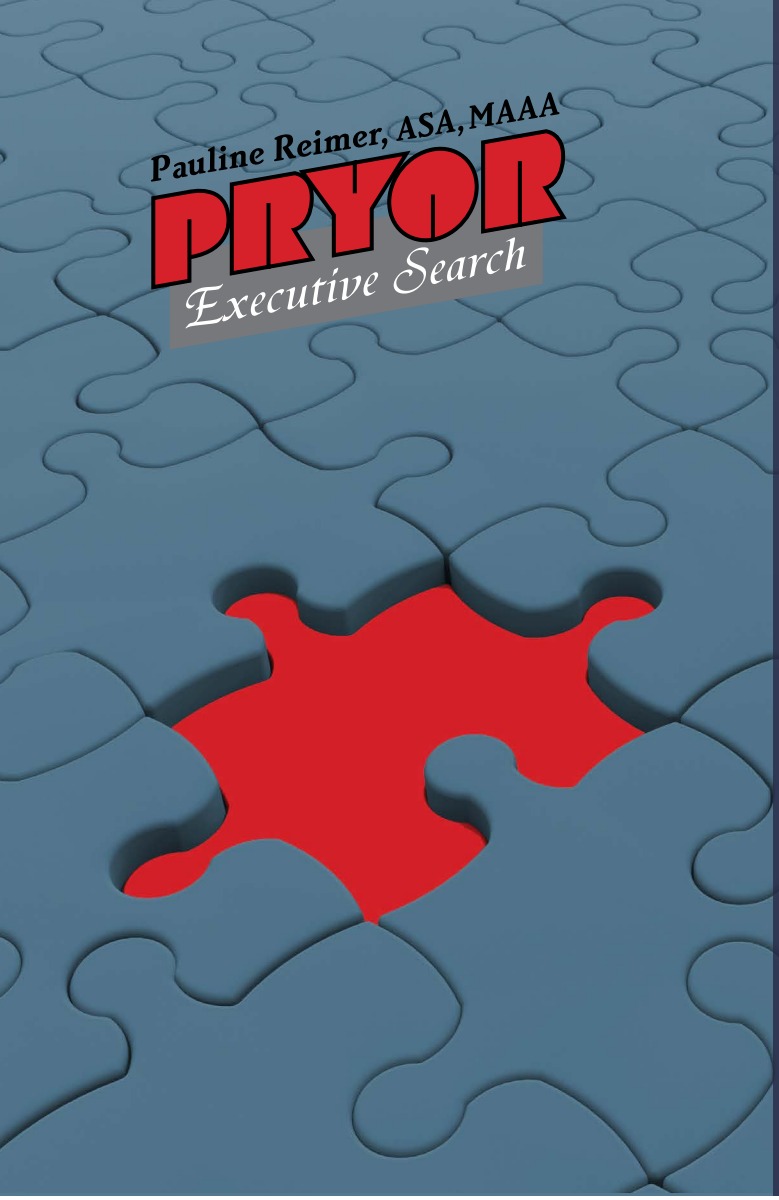
A Road to Unintended Consequences?

The 15 Most Popular CAS Research Papers of 2024

Volunteer Service Award Winners

Pauline Reimer, ASA, MAAA

PRYOR Executive Search



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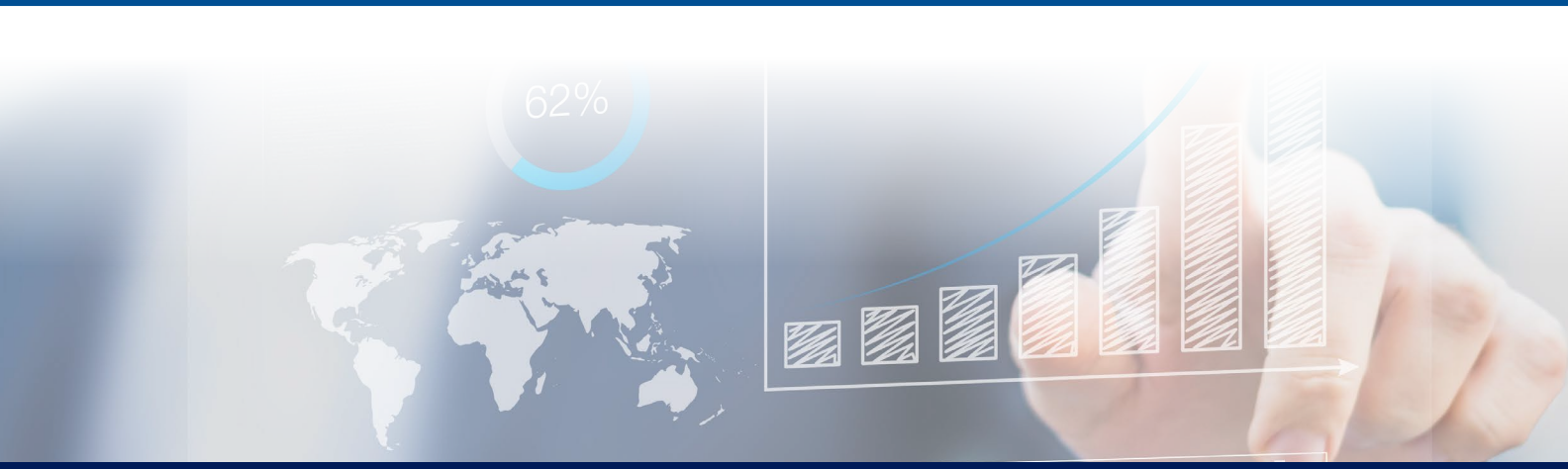

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The International Society of Catastrophe Managers (ISCM) and The CAS Institute (iCAS) have joined together to offer two credentials in catastrophe risk management. The Certified Catastrophe Risk Management Professional (CCRMP) credential is available to experienced practitioners in the field through an Experienced Industry Professional (EIP) pathway. The Certified Specialist in Catastrophe Risk (CSCR) credential is available both through an EIP pathway and an examination path.

Required assessments and courses for earning the CSCR include:

- Property Insurance Fundamentals
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- The Cat Modeling Process
- Online Course on Ethics and Professionalism

Some exam waivers are available for specific prior courses and exams.

For more information, visit CatRiskCredentials.org.

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The CAS Institute's Certified Specialist in Predictive Analytics (CSPA) credential offers analytics professionals and their employers the opportunity to certify the analytics skills specifically as applied to property-casualty insurance. The program focuses on insurance as well as technical knowledge and includes a hands-on modeling project that challenges candidates to apply what they have learned throughout their studies to address a real-world scenario.

Required assessments and courses for earning the CSPA include:

- Property-Casualty Insurance Fundamentals
- Data Concepts and Visualization
- Predictive Modeling — Methods and Techniques
- Case Study Project
- Online Course on Ethics and Professionalism

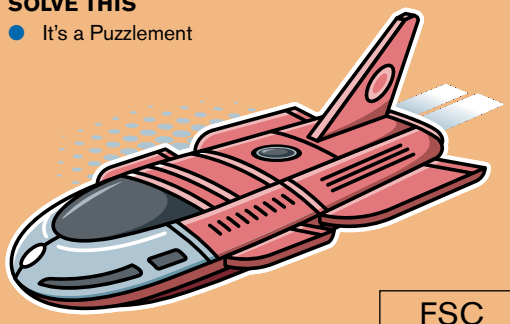
Some exam waivers are available for specific prior courses and exams.

For more information, visit TheCASInstitute.org.

March-April 2025

actuarial REVIEW

departments



FSC LOGO

on the cover

AI Regulation in Insurance – A Road to Unintended Consequences?

By ERIN LACHEN

As AI regulations rapidly evolve with varying approaches taken by different states, companies are left to decipher competing definitions, conduct bias testing and mitigate unfair discrimination—all while balancing profitability and fairness. This article explores the unintended consequences of AI regulation in insurance and the critical decisions insurers must make to stay ahead.

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Learn more about our 2024 winners and their service journey with the CAS.

The 15 Most Popular CAS Research Papers of 2024

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By ANNMARIE GEDDES BARIBEAU

The results are in. Browse our list of summaries to find your next read.

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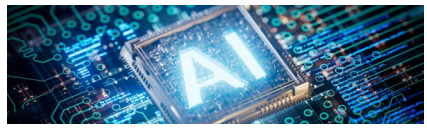
A Focus on Research and Volunteers

Artificial intelligence is transforming insurance, and regulators are scrambling to keep up. In our latest cover story, Erin Lachen, FCAS, explores the patchwork of AI regulations emerging across the U.S. and the unintended consequences they may create for insurers. From varying definitions to differing bias-testing requirements, these regulations present challenges that could impact competition, compliance and fairness. Lachen delves into the question, "How should insurers navigate this evolving landscape?"

Rachel Hunter, FCAS, brings us the scoop on one of the newest papers in the CAS Research Paper Series on Race & Insurance Pricing, "Balancing Risk Assessment and Social Fairness: An Auto Telematics Case Study" by Jean-Philippe Boucher, Ph.D., and Mathieu Pigeon, Ph.D. — a paper that explores how telematics data can enhance fairness in auto insurance models.

You will also get to hear from our 2024 Volunteer Service Award winners about their journey with the CAS and what volunteering means to them. I would like to give special acknowledgement to Sara Chen, FCAS, for her incredible work with the *Actuarial Review* and for earning one of these prestigious awards.



We're also featuring two member profiles in this issue. You will have the pleasure of meeting Professor Barry Posterro, FCAS, Worcester Polytechnic Institute's first CAS Fellow. Posterro is at the forefront of advancing actuarial education at his institution in Massachusetts. You will also meet "The Maverick Actuary" himself, Dominic Lee, ACAS. Lee tells the story of how he got started and how he came to create his popular podcast while maintaining a content-rich social media profile across multiple platforms. He shares how his podcast ranked number one globally among actuarial podcasts in January 2024. Their stories and advice are inspiring.

Finally, don't miss Annmarie Geddes Baribeau's Top 15 Research Papers of 2024. Her succinct synopses and reasons to read will give you the insights you need to pick out the next paper for your reading list.

We hope you enjoy the issue!

Actuarial Review welcomes story ideas from our readers. Please specify which department you intend for your item: Member News, Solve This, Professional Insight, Actuarial Expertise, etc.

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Follow the CAS

Save the Date!

2025 CAS Annual Meeting
Fairmont Austin • Austin, TX
Nov 9–12, 2025

Growing Globally

Since being elected in 2023, I have had the opportunity to learn and experience many aspects of the CAS that I had little exposure to previously. This includes the CAS's presence, influence and growth in areas outside the U.S. Although my career has been focused within the U.S., I have come to appreciate the many ways that our international engagement benefits all of us and makes our profession stronger. In this article, I'd like to share some of the things that I have learned.

About 20% of CAS membership today is currently located outside the U.S.

Today there are more than 2,000 CAS members in other countries. The largest of these is Canada, where more than 1,300 members live and work — a number that has more than doubled over the past 10 years. While our affiliation with the Canadian Institute of Actuaries (CIA) has existed for many years — long before I became an actuary — this recent significant growth demonstrates the value the CAS brings to this major North American market. This year, we will join with our colleagues in Canada to celebrate the 80th anniversary of the founding of the CIA. I look forward to continuing to strengthen this long-standing relationship.

We are also seeing rapid growth in other parts of the world. There are now more than 600 CAS members outside the U.S., Canada and Bermuda — a number that has also doubled over the past 10 years, with accelerating growth in more recent years. Much of that growth is happening in China, where 36% of our international candidates and 28% of our international members are located.

The CAS is increasingly recognized by P&C/general insurance practitioners in many countries, and many want to affiliate with us.

Over the past year, I've had the opportunity to meet many actuaries who practice in countries outside the U.S. and Canada. I have been impressed with how many experienced actuaries follow the CAS publications and education offerings. They rely on us to develop their own skills and expertise in general insurance. And many of them want to become a more formal part of our Society.

There are now more than 600 CAS members outside the U.S., Canada and Bermuda — a number that has also doubled over the past 10 years, with accelerating growth in more recent years.

To help address this need, the CAS recently enhanced our Affiliate Membership program. This level of membership is an opportunity for established actuaries from around the world to tap into the CAS community and depth of professional education resources. In 2024 we made improvements to the application process to gain Affiliate status. We also increased marketing at international events to help more professionals learn about this opportunity. In just a few months after we implemented these changes, we saw a 33% increase in Affiliates, drawing in new Affiliate members from Brazil, China, Germany, India, the Philippines and other countries.

CAS engagement in international markets elevates general insurance practitioners.

One of the things I didn't realize is how limited the continuing education resources are for general insurance actuaries outside the U.S. and Canada. In many nations, the actuarial profession is dominated by life insurance. As a result, their local actuarial associations often provide little educational content that focuses on issues and applications within general insurance. However, when the CAS engages there, we bring expertise and many educational offerings that enable the actuaries to elevate their skills and increase their influence in their growing general insurance sectors.

For example, the CAS sponsored the General Insurance Summit in Hangzhou, China, in 2024 — truly a unique offering — to have an entire day focused on general insurance topics for actuaries. It was attended by more than 150 CAS members and candidates from across China. Topics presented at the summit demonstrated the CAS's leadership in emerging P&C topics, such as AI, catastrophe modeling, climate risk, electric vehicles and more. This forum also demonstrated the demand for expertise that we are uniquely able to deliver.

International students and university faculty are very interested in the CAS and general insurance.

President's Message, page 8

SEMINAR ON

REINSURANCE

JUNE 4–6, 2025
GAYLORD NATIONAL RESORT
& CONVENTION CENTER
NATIONAL HARBOR, MD
(WASHINGTON DC METRO AREA)

President's Message

from page 8

One of the most remarkable ways that the CAS is extending its reach is through students and universities around the world. Our Student Central Summer Program has evolved to over three formats to suit the needs of a broader array of students. In 2024, we held the Mentor-led Summer Program, the Independent Study Program and the East Asia Summer Program. Each format provides students with the opportunity to learn and apply actuarial techniques to real-world problems — similar in many ways to an internship experience. More than 450 students across 30 countries graduated from this program last year.

I had the opportunity to meet students from the University of Lagos in Nigeria who participated in this program last year. They all spoke very highly of their experience. They enjoyed building on their academic experience and deepening their interest and commitment to pursuing an actuarial career in general insurance.

The CAS is also building the skills and expertise of university faculty to teach general insurance topics. In October 2024, we held our first-ever CAS Teaching Summit in Malaysia, attracting faculty members from 23 universities across Asia to explore the opportunities to enhance the span of general insurance topics covered in the classroom. Participants exchanged best practices and learned about proven teaching methodologies, enabling them to better train future general insurance actuaries in their countries.

In addition, the CAS implemented an International University Recognition Program to highlight universities that are committed to providing students with a strong foundation in general insurance and resources to help them improve their academic offerings. We now have 18 international universities enrolled in this new program, located in Australia, China, Hong Kong, India, Malaysia, Nepal and Thailand.

Our international engagement positively impacts our educational offerings for all members.

I've come to appreciate how many innovations and advancements in our profession have developed outside the U.S. before taking root in the U.S. Early in my career, I saw this happen with the rapid development of generalized linear models in actuarial practice in Europe and the U.K., several years before these essential tools became commonplace in the U.S. Today there are developments in a variety of areas that are happening at a different pace in other countries, such as the adoption of electric vehicles, the pressure to address climate challenges and the integration of AI-based methods into actuarial practice. The CAS has active working groups addressing each of these topics, with significant involvement from members outside the U.S. This demonstrates how the CAS can become the preferred community for actuaries in general insurance to exchange ideas in these and other advancements. As we do so, we will all benefit by advancing our capabilities and expertise in the dynamic world of P&C/general insurance.

The more I have learned about the CAS's international reach and growth, the more enthusiastic I have become about our profession's ability to grow globally and benefit economies around the world. And I've seen many ways that the Envisioned Future in our Strategic Plan is coming to life — CAS members are sought after globally for their insights and ability to apply analytics to solve insurance and risk management problems.

ACTUARIAL REVIEW *LETTERS POLICY*

Letters shall not contain personal attacks or statements directly or implicitly denigrating the characters of individuals or particular groups; false or unsubstantiated claims; or political rhetoric. Letters should be no more than 250 words and must include the author's name and phone number or email address, so the editorial staff can confirm the author. Anonymous letters will not be published. There shall be no recurrence of topics; issues previously addressed will not be the subject of continued letters to the editor, unless new and pertinent information is provided. No more than one letter from an individual can appear in every other issue. Letters should address content covered in AR. Content regarding the CAS Board of Directors or individual departmental policies should be directed to the appropriate staff and volunteer groups (e.g., board, working groups, committees, task forces or councils) instead of AR. No letter that attempts to use AR as a platform for an ulterior purpose will be published. Letters are subject to space limitations and are not guaranteed to be published. The AR editorial volunteer and staff team reserves the right to edit any submitted letter so that it conforms to this policy. Decisions to publish letters and make changes to submissions shall be made at the discretion of the AR Working Group and CAS staff.

For more information on AR editorial policies, visit https://ar.casact.org/wp-content/uploads/2023/06/AR_Statement_of_Purpose.pdf

COMINGS AND GOINGS

Jeff Chen, ACAS, has been appointed chief risk officer at Kettle. Chen brings nearly 20 years of experience in insurance, reinsurance and risk analytics, with leadership roles at Root Insurance and AIG.

Sarah Shine, FCAS, has been promoted to executive vice president at Erie Insurance. She previously served as senior vice president and has been a member of Erie's Executive Council since June. Shine began her Erie career in 2000 as an actuarial analyst for personal lines and shifted focus to commercial lines. She had held roles as vice president, commercial underwriting and regional vice president of underwriting in the Southeast region; senior vice president of commercial products; and most recently as senior vice president, experience and customer service.

William H. Scully, FCAS, has been appointed president of The Automobile Insurers Bureau of Massachusetts (AIB). Scully has been with the AIB since August 2000, serving as interim president since May 2024 and vice president, chief actuary since 2020. Prior to this, he served as an actuary for two national insurance companies. Scully has been responsible for all aspects of auto insurance ratemaking and actuarial services for AIB.

Kristen Bessette, FCAS, has been appointed chief data officer at Zurich North America. Bessette brings experience in data, analytics, capital modeling and reserving, gained through executive management positions at multinational commercial insurers. In her previous roles, she led a multiyear data strategy focused on improving customer and partner interactions. She has been widely recognized in the industry, including being named a Woman to Watch by *Business Insurance* in 2015 and an Executive to Watch by *t* in 2022.

Mark Moitoso, FCAS, has been appointed president at ICW Group Insurance Companies. In his new role, Moitoso will oversee the company's underwriting and shared services operations, with a focus on driving growth, product line expansion and enhancing organizational efficiencies. Moitoso brings a comprehensive knowledge of the property and casualty insurance industry to ICW Group with more than 35 years of experience leading successful teams and delivering customized solutions. He has extensive technical and operational experience, working within multiple functions throughout his career.

EMAIL "COMINGS AND GOINGS" ITEMS TO AR@CASACT.ORG.

See real-time news on our social media channels. Follow us on Facebook, Instagram and LinkedIn.

CALENDAR OF EVENTS

May 4–7, 2025
CAS Spring Meeting
Toronto, Ontario, Canada

June 4–6, 2025
Seminar on Reinsurance
National Harbor, MD

September 8–10, 2025
Casualty Loss Reserve Seminar & Workshops
Philadelphia, PA

November 9–12, 2025
CAS Annual Meeting
Austin, TX

Visit casact.org for updates on meeting locations.

Dedication

Donna Faye Royston

1955-2024

The CAS Publications and *Actuarial Review* Staff dedicate this issue to our colleague Donna Royston, former CAS Managing Editor. A 17-year CAS employee, Donna Royston was part of the team that launched *Variance* and CAS Monographs, and she was an *AR* contributor. A lover of language and a kind, thoughtful editor, she retired from the CAS in November 2024.

IN REMEMBRANCE

In Remembrance is an occasional column featuring short obituaries of CAS members who have recently passed away. These obituaries and sometimes longer versions are posted on the CAS website; search for "Obituaries."

The Sports Enthusiast

Ronald "Scott Rees" (ACAS 2010)
1973-2024

Ronald "Scott" Rees of Waukee, Iowa, passed away in August 2024. He was born to Ron Rees and Linda Moser (Miller) in Knoxville, Iowa. He went to school in Knoxville, graduating from high school in 1992. Throughout his young life he loved playing sports, especially basketball and football. He played basketball throughout his high school career and was proud to be selected for the Academic All-State Team and continued to play into his adult life. He graduated from Drake University in 1996 with a degree in actuarial science. During this time, he was a Kemper Scholar, which led him to Illinois and his first job as an actuary at Kemper Insurance, where he met his wife Denice in 1998. They were married in 2003 in Lake Geneva, Wisconsin. In 2006, they welcomed their daughter Kayla Nicole and in 2009 had their son Connor Scott. Whether at an NFL game, the races, wrestling shows, watching the kids play sports or just hanging out, he was always so fun to be around. Those left to honor Rees's life include his wife Denice, daughter Kayla, son Connor, parents Linda Moser and Ron and Julie Rees; sisters Dee (Chad) Bradshaw, Candy (Dave) Mullins, and Kelli Cooper; beloved nieces and nephews; cousins, in-laws and friends. He was preceded in death by his grandparents Donald and Dorothy Rees and Marion "Tumpy" and Alpha Miller, stepmother Judy Rees, stepfather Ron Moser and parents-in-law Vicki and Loren Ross.

The Eclectic Volunteer

Terence "Terry" Richard Robinson (ACAS 2013)
1984-2024

Terence "Terry" Richard Robinson of Philadelphia, died at home in December 2024. A dedicated volunteer, he served the CAS as chair of the Reinsurance Working Group for four years and as a University Liaison with Temple University, where he earned an actuarial science degree. Robinson was an assistant vice president at Old Republic Specialty Insurance Underwriters and previously worked at JLT Towers Re, Guy Carpenter and Towers Watson. Born in Meadowbrook, Pennsylvania, Robinson loved people, connection, curiosity, banter and wonder. He was the "mischievous" co-host of Mage: The Podcast. In addition to being an Eagle Scout, Robinson was a camp leader and member of the Order of the Arrow, scouting's National Honor Society. He could survive in the wilderness, identify birds, convince teenagers to care about ecological succession and whip up dozens of mini pizzas at a moment's notice. After engaging in frequent above-and-beyond acts of generosity, Robinson would simply say, "A Scout is helpful." A man of eclectic interests, Robinson was a writer for Onyx Path Publishing, citizen planner for the American Planning Association and member of the Savoy Opera Company in Philadelphia. His hobbies included operating drones, collecting art books and photographing hundreds of weddings and events. He also crafted book bindings — often of "World of Darkness" (the horror role-playing game) supplements. Robinson was predeceased by his father Richard Robinson and survived by his wife Julia Robinson Skochko, mother Maura Robinson (nee Diamond), brother Ryan Robinson (Amanda), nephew Finn Robinson, stepchild Avery Markow and other family members.

The Outdoorsman

Nicholas Schlarmann (ACAS 2017)
1993-2024

Nicholas J. Schlarmann, 31, of Des Moines, Iowa, and formerly of Worthington, Iowa, passed away on Tuesday, June 25, 2024, at his home. Nick was born in Dubuque, Iowa, the son of Michael and Cindy (Pfab) Schlarmann. He was a 2011 graduate of Western Dubuque High School, University of Iowa graduate with a degree in actuarial science and consultant for Nationwide Insurance. Schlarmann could often be found spending time with his dog, Digby, going for walks and enjoying time in nature. He also enjoyed rock climbing, photography, video games, board games, camping and hiking. He liked to experiment with different musical instruments, including his guitars, violin and keyboard. Schlarmann had a kind soul, was valued for his intelligence and was cherished at work. He will be greatly missed by his family and friends.

Meet Olivia Curtis, Cross-Functional Program Coordinator

Welcome to the CAS Staff Spotlight, a column featuring members of the CAS staff. For this spotlight, we are proud to introduce you to Olivia Curtis.

- **What do you do at the CAS? How does your role support the Strategic Plan?**
  I am the cross-functional program coordinator here at the CAS. I support four different departments, those being International, Marketing, Engagement and iCAS. My work across these departments allows me to support the Strategic Plan from multiple angles. For example, with Marketing, I help with our social media to strengthen our brand on LinkedIn, and with International, my work supports the goal to increase our membership globally. Being able to support the Strategic Plan from so many avenues is a very rewarding experience.
- **What inspires you in your job? What do you love most about your job?**
  Because my role is new and unique to the CAS, one of the things that inspires me the most is the idea of "pioneering" this position. I love that I get to help build something new here, and the diversity of my role allows me to see the CAS from so many different angles.
- **Describe your educational and professional background. What do you bring to the organization?**
  I have my bachelor's degree in history from the American Military University. Prior to joining the CAS, I was working in business management for a small business, which was a great segue into this role.
- **What is your favorite hobby outside of work?**
  Outside of work, my hobbies include being with my family, walking my dog, writing, reading and watching paranormal shows.

Olivia Curtis

- **If you could visit any place in the world, where would you go and why?**
  If I could visit any place in the world, I would want to go to Egypt and see the Great Pyramids. I have had an interest in Egypt, specifically Ancient Egypt, since I was a kid, so it is definitely on my bucket list!
- **What would your colleagues find surprising about you?**
  Something surprising about me is that I am the author of a sci-fi/dystopian trilogy that I self-published on Amazon.
- **How would your friends and family describe you?**
  This is a tough question, but I think my friends and family would describe me as loving and caring, as well as determined and inquisitive.

MEMBER SPOTLIGHT

Redefining Actuarial Science Through Content By DOMINIC LEE

As an actuary, I've often thought about how our profession is perceived, and I'm on a mission to change that. My journey has been one of innovation, exploration and a determination to elevate what it means to be an actuary in today's world.

A lifelong competitor

My story begins in Jamaica, where I spent several years as a competitive swimmer. Competing on the Jamaican national team and at the high school and collegiate levels after moving to the U.S. helped me develop a competitive spirit, a trait that has defined much of my career.

A childhood friend introduced me to actuarial science. At the time, I was majoring in chemical engineering at the University of Maryland, Baltimore County, but realized it didn't align with my natural abilities. I was instantly drawn to the actuarial profession's multidisciplinary construct, the ability to apply math in a business setting and the compensation prospects. The competitive nature of actuarial exams appealed to my inner athlete, and I knew I had found my calling.

After switching majors, I went on to earn a bachelor's degree in actuarial science from the University of the West Indies and a master's degree in actuarial science from the University of Nebraska-Lincoln. From the start, I was drawn to property & casualty insurance because of its dynamic nature. Encouraged by a family friend, I pursued this path, knowing it offered high growth potential.

I think of my career in two chapters: the foundational chapter and the transformational chapter. These two phases encapsulate my journey from a traditional actuarial path to a bold new direction in content creation and thought leadership.

The foundational chapter

My career started in a traditional way. I joined a major insurance carrier's actuarial rotation program, where I spent a decade gaining experience in various lines of business, leadership styles and problem-solving approaches. This foundational chapter of my career provided me with the technical expertise and industry knowledge I needed to succeed.

However, despite my achievements, I often felt constrained by the corporate bureaucracy I experienced at the time. Promotions eluded me, and the rigid structures of traditional organizations stifled my creativity and ambition. As such, I had to redefine leadership and lead by example without defined authority or a prescribed mandate.

The only way I knew how to do that was to create content and distribute it on social media, where I could reach a broad audience and be measured by the quality of my ideas, not my corporate title.

The transformational chapter

The COVID-19 pandemic was a watershed moment for me. It exposed numerous risk management challenges from medical supply chain diversification to federal fund allocation that actuaries were uniquely qualified to address. Yet, I noticed that actuaries in North America had minimal impact on the pandemic response, unlike our counterparts in the U.K., who were instrumental through initiatives like the COVID-19 Actuaries Response Group.

Dominic Lee

This realization drove me to identify three critical gaps that were holding the actuarial profession back: lack of name recognition, an unclear value proposition and a shortage of strategic thinking. Determined to address these issues, I set out to amplify our profession's voice and broaden its impact.

The Maverick Actuary

My journey into content creation began on LinkedIn, where I shared personal stories and professional insights. My first major breakthrough came in 2021 with "Beyond Insurance," a TED-style presentation that showcased my vision

for the actuarial profession. The video became one of the most viewed actuarial and risk management productions on YouTube, introducing me to a global audience. It also led to my current role at an innovative data and AI firm, where I help the company's sales organization maximize revenue and drive software adoption in the insurance industry.

Inspired by this success, I adopted the name "The Maverick Actuary" to reflect my unconventional approach. In 2022, I launched the "Live with The Maverick" podcast to address a glaring content gap in our profession. Actuarial content on the web primarily consists of technical papers that are indecipherable to most and paid conferences that are inaccessible to many. The podcast is my way of making education on actuarial science, risk management and analytics accessible to all. With 105 episodes featuring guests from 17 countries, the podcast has reached audiences in 99 countries and 1,100 cities. The show achieved a #1 peak global ranking among actuarial podcasts in January 2024.

My content portfolio is diverse. It spans public speaking engagements, including keynotes at conferences, actuarial society clubs, university actuarial programs, panels, interviews and webinars. I collaborate on special projects, executing social campaigns and influencer marketing initiatives with trusted brand partners to raise awareness about actuarial science. My thought leadership is reflected in regular LinkedIn short form posts that spark discussions within and beyond the actuarial community. Additionally, I engage students and early-career analysts through Q&A sessions on platforms like Instagram. To engage my community in a lighthearted way, I incorporate humor and relatability by sharing actuarial-themed memes on Instagram and LinkedIn. Lastly, my legacy media contributions include articles that bridge the gap between insurance and risk management, such as my piece for *Insurance Journal* on the Palisades Fire and wildfire mitigation.

These efforts have allowed me to shine a brighter light on the actuarial profession, introducing new career paths and opportunities for actuaries worldwide.

Lessons from my journey

One of the most rewarding aspects of my journey has been the ability to share what I've learned so that others can leverage my experiences to advance their own careers. Through content creation, I've learned valuable lessons about personal branding. I hope these lessons will empower others to take control of their professional narratives:

1. **Break free from hierarchy.** Social media values contributions over titles, credentials and years of experience. Focus on adding value.
2. **Share insights, not information.** Audiences want context. Instead of telling them what happened, explain what it means, why it matters and who it affects.
3. **Be personable.** Relationships are the cornerstone of a durable online presence. Share personal stories and engage with your community.
4. **Find your voice.** Your online presence should reflect your personal interests and perspectives, not your employer's.
5. **Seize the Opportunity.** Only 1% of LinkedIn users create original content. The social media business platform offers immense potential for those willing to contribute.

Building a legacy

In closing, I've benefited greatly from becoming a content creator. I've built a diversified content portfolio, a global actuarial knowledge base, strong relationships across industries and a modern skillset by becoming proficient in sixteen content forms and working with legacy media teams in multiple geographies, a global actuarial knowledge base and strong relationships across industries.

And the best part is that opportunities come to me, not the other way around.

Content leads to brand, and brand generates inbound leads. This philosophy has enabled me to transcend traditional roles and unlock career opportunities I hadn't previously envisioned. The impact has been profound, both personally and professionally.

A call to action

Creating a lasting impact in today's world requires acknowledging and capitalizing on the power of social capital, even in conservative industries like insurance and professions like actuarial science. Despite potential naysayers, building a durable personal brand in an age of mass consolidation is one of the greatest opportunities of our time.

Content creation offers an organic way to achieve this. By sharing your unique insights and fostering authentic connections, you can position yourself as a leader and open doors to opportunities you never imagined.

Dominic Lee, ACAS, is an actuary, content creator and public speaker known to the insurance community as The Maverick Actuary.

MEMBER SPOTLIGHT

Advancing Actuarial Education at Worcester Polytechnic Institute

By TAMAR GERTNER, CAS DIRECTOR OF ENGAGEMENT

The actuarial journey rarely takes a straightforward path, but for Professor Barry Posterro, it has been a masterclass in blending academic excellence with industry expertise. As the first CAS Fellow at Worcester Polytechnic Institute (WPI), Posterro is leading the charge in modernizing actuarial education there. In December 2024, Posterro earned his Fellowship, reflecting his dedication to advancing both his own expertise and the actuarial program at WPI.

With an impressive 15 years of industry experience and a strong commitment to aligning WPI's curriculum with CAS standards, he's inspiring the next generation of actuaries to tackle complex challenges head on. From pioneering spreadsheet-based learning at WPI to securing grants for advancing education, Posterro's story is one of innovation, dedication and the transformative power of a supportive community.

From industry to academia

Posterro joined the faculty at WPI in Massachusetts in 2015, after gaining 15 years of industry experience as an actuary, holding the designations ASA, CFA and FRM.

Upon entering academia, he was determined to pursue the CAS course of study, as his students were working with many local P&C companies on projects, and he wanted to serve as a resource to them.

Integrating CAS expertise into the curriculum

Posterro's expertise in topics such as ratemaking, estimating unpaid claims and price and capital allocation has helped WPI introduce key P&C insurance concepts into its curriculum. WPI has integrated CAS syllabi papers into its introductory actuarial classes. For example, Richard Goldfarb's paper on company valuation, formerly part of CAS Exam 7, is now included in WPI's Theory of Interest course. In addition, its Loss Models course has transitioned from using the traditional Klugman *Loss Models* book to the CAS Monograph "Distributions for Actuaries" by David Bahnemann, with the first course utilizing this material in fall 2024.

Enhancing student projects with CAS materials

Under Posterro's guidance, actuarial students at WPI have explored CAS syllabi papers in senior projects, including:

- *Measuring the Variability of Chain Ladder Reserve Estimates* (Thomas Mack, Exam 7)
- *Stochastic Loss Reserving Using GLMs* (Taylor and McGuire, Exam 7)
- *Managing Interest Rate Risk* (Panning, Exam 9)
- *Individual Risk Rating* (Fisher et al., Exam 8)

Barry Posterro with Sarah Olson, head of the WPI Mathematical Sciences Department

Introduction of new courses

WPI has developed a two-course sequence, Introduction to Actuarial Ratemaking and Actuarial Estimation of Unpaid Claims. These courses cover substantial material from CAS Exam 5, including content from the Werner and Modlin textbook and the Friedland textbook. "Last year, we had a major success with these courses when our student Jack Cascone passed Exam 5 after taking these courses and studying additionally on his own, making him the first WPI undergraduate student to pass CAS Exam 5 while still in school," says Posterro. "We are so proud of Jack."

Modernizing with spreadsheet-based learning

Having witnessed the evolution of CAS Exams from paper and pencil to spreadsheet-based formats during his Fellowship path, Posterro has helped modern-

A former actuarial mathematics student of Posterro, Alison Lambert explains her solution to a homework assignment in the class Actuarial Estimation of Unpaid Claims at WPI.

ize the actuarial program to reflect this shift. Lectures, homework and exams are now conducted in Excel, helping students focus on concepts while reducing manual arithmetic. This approach has been well received by students and has enhanced their readiness for modern exam formats. "Selfishly, for me, these exams are not only easier to grade but also easier to demonstrate to the student what their error was and how correcting the error will flow through the spreadsheet to the right answer," says Posterro.

A growing actuarial program

The WPI actuarial mathematics major is housed within the Mathematical Sciences Department and typically has 30 to 40 actuarial majors at any time. It is supported by two dedicated faculty members, both with extensive industry experience and credentials.

Recognizing the CAS community

Throughout this journey, Posterro says he has benefited greatly from the support of the CAS community.

The encouragement and assistance from his CAS University Liaison Jaris Wicklund, FCAS, and Hanover Chief Actuary, William Finn, FCAS, have benefitted Posterro and his students, helping to make the actuarial major at WPI as relevant as possible. "The CAS community is unparalleled in its comradery," says Posterro.

He also recognizes me and my staff, CAS University Engagement Manager Margaret Gaddy. "Their answer to everything is always 'Yes, how can we help?' Also, they are so gracious to include me when they have a need for a panelist or need someone to discuss educational ideas like how to get more CAS material into undergraduate programs," says Posterro.

CAS support for academic pursuits of ACAS and FCAS credentials

The CAS offers exam fee reimbursements for full-time professors who pass CAS exams and provides grants to academic institutions when a faculty member attains a CAS designation. Professor Posterro's accomplishments have resulted in $12,500 in grants being awarded to WPI, $5,000 when he earned his Associateship and $7,500 upon becoming a Fellow of the CAS.

Posterro's journey from industry to academia illustrates the profound impact one individual can have on shaping the future of actuarial education. By bridging the gap between professional standards and academic innovation, he has redefined what is possible for aspiring actuaries at WPI. With a curriculum infused with CAS expertise, a focus on modern learning tools and a supportive CAS community, Posterro's legacy serves as a testament to the power of dedication and collaboration.

As the actuarial field evolves, his work will undoubtedly inspire educators and students alike to pursue excellence and push the boundaries of what actuarial education can achieve.

NAWA

Network of Actuarial Women and Allies

Why become a member?

Invest in Yourself

- Develop your professional and personal skills through training and other opportunities
- Expand your network across multiple regions and disciplines
- Broaden your industry knowledge

Develop Your Community

- Participate in an impactful and important effort in our profession
- Connect through mentoring, peer groups and other networking events
- Volunteer with a meaningful organization

Create Opportunities in Our Profession

- Promote representation of women through speaking engagements and panel participation
- Encourage allyship and advocacy
- Use the NAWA platform to develop women in their careers and leadership

Become a Member

Upcoming Events

Past Events

nawaactuaries.org

A Message from NAWA

Network of Actuarial Women and Allies

In honor of Women's History Month in the United States, celebrated each year in March, CAS members are encouraged to learn more about the Network of Actuarial Women and Allies (NAWA). NAWA is dedicated to connecting and empowering women in the actuarial profession, regardless of their backgrounds, races, ethnicities or life circumstances. As part of their mission, NAWA has joined forces with the CAS, the SOA and the Academy to produce a "Barriers to Entry and Success Report." The goal of this report is not only to identify and educate the profession on barriers that exist for women to enter or succeed in the actuarial profession but also to help influence actions aimed at closing those gaps. As the research for this report aims to take both a qualitative and quantitative approach, NAWA will be looking for actuaries throughout the industry to share their perspectives and experiences as they develop insights for this report. Please keep an eye out for opportunities to participate and contribute your perspectives to this research.

NAWA is also excited to celebrate Women's History Month throughout March! Become a member (all gender identities are welcome), follow NAWA on LinkedIn or visit www.NawaActuaries.org for more information on how to join the celebration through upcoming events and for the latest episodes of their new podcast, *Real Actuarial Women* (*RAW*).

CAS Conducts its First Actuarial Case Competition in Latin America

By RAFAEL COSTA, VOLUNTEER CHAIR OF THE LATIN AMERICA REGIONAL WORKING GROUP

University students in Latin America have long shown strong interest in CAS programs. This was clearly demonstrated by the demand for participation in the Latin American cohorts of the CAS Student Central Summer Program over the past two years. As part of that program, students had access to lectures from the highly knowledgeable CAS members in topics including pricing, reserving, data visualization, soft skills and many more. In addition, they took part in a case competition that happened at the end of the program. The program was held entirely in English, but the mentor-led cohorts from Latin America had weekly meetings with mentors in either Portuguese or Spanish, which was important to keep students engaged and allowed them to ask questions in their native language.

Inspired by the success of the CAS Student Central Summer Program, the Latin America Regional Working Group (LARWG) took the initiative to develop case competitions dedicated to university students in the region, 100% hosted in their native languages. There were two events happening in parallel: one in Portuguese, dedicated to students in Brazil, and one in Spanish for most of the other Latin American countries.

The competitions had students act as a part of a hypothetical consulting company serving a property insurer that was looking for better ways to visualize data related to its exposure to flood risk and seeking to improve its long-term profitability. The competition judges acted as actuarial and underwriting executives of the insurer; they received the work product of their consultants through 15-minute presentations followed by five minutes of Q&A.

The competitions were incredibly successful and engaged Latin American university students in record numbers. The one conducted in Portuguese had 19 teams registered, with a total of 82 students representing 11 universities throughout Brazil. The one in Spanish had 33 teams registered, with a total of 138 students representing 11 universities in five different countries (Argentina, Colombia, Costa Rica, Mexico and Peru).

Besides the unique opportunity to apply academic knowledge to a realistic business problem in P&C insurance, students were also attracted by valuable prizes, including free exam and DISC registrations, cash prizes and access to exam study materials. Each winning team also received a trophy, which we hope they will proudly display in their universities to inspire future students to engage with the CAS and participate in future competitions.

Hosting competitions in Latin America for the first time with an overwhelmingly positive response required many people to come together:

- Swiss Re and Addactis were the corporate sponsors for the Portuguese and Spanish competitions, respectively. In addition to funding a significant portion of prizes, one actuary from each company — Ana Carolina Alves and Juan Ignacio de Oyarbide — actively participated in the organizing committee and acted as judges.
- LARWG volunteers went above and beyond on the creation of a brand-new case for analysis, outreach activities for sponsors, universities and students, and the implementation of a thorough logistics and communications plan to make these competitions possible. CAS Fellows Roberto Pérez, Fernando Alvarado and Celeste Bremen demonstrated their passion for the cause through their incredible engagement.
- Besides judges representing the sponsors and the CAS, the competition also relied on local industry expertise from judges representing various actuarial organizations in Latin America: Claudia Ribeiro, AFFI, MIBA (Brazil); Leonardo Dufour (Argentina); Andrés Vesga

Did you know?

Latin America is experiencing robust growth in general insurance markets. In their "Latin American Market Report 2024," Swiss Re reported that total insurance premiums rose by an estimated 7.6% in real terms in 2024, and projections indicate a 3.8% increase in 2025. This expansion is supported by stable operating environments and economic growth across the region. The actuarial profession is playing a key role in this development by providing expertise in risk management and financial modeling to support the growing insurance sector.

(Colombia); and Eduardo Esteva, AFFI (Mexico).

- Katie Mulembe, CAS Director of International Relations, provided strong support for the competition, and delivered prizes and certificates to participants.
- University professors from 22 universities throughout Latin America acted as mentors to their students, supporting an extracurricular activity and, in many cases, joining in to listen to their team's presentation to the judges. I would like to extend a special acknowledgement to the mentors of the winning teams: Dr. Máris Caroline Gosmann (Universidade Federal do Rio Grande do Sul, Brazil) and Dr. María de los Angeles Yáñez Acosta (Instituto Tecnológico Autónomo de México).

The LARWG is grateful for the engagement of the CAS community and hopes to be able to turn the competition into an annual tradition. The group wants to bring additional educational opportunities to future cohorts of the actuarial students in Latin America and to continuously raise awareness of the CAS in the region.

Rafael Costa, FCAS, is staff risk engineer for Cruise.

The 2024 CAS Volunteer Awardees: In Their Own Words

Approximately one-third of CAS members volunteer their time and expertise each year. Among those dedicated members, 10 exceptional individuals were recognized with the 2024 Volunteer Awards during last year's CAS Annual Meeting. What makes these honorees particularly noteworthy is that their nominations came directly from their peers. Some are emerging leaders who have made a significant impact early in their volunteer journeys. There are also long-time contributors whose decades of service have helped shape the profession.

As National Volunteer Week approaches — running from April 21 to April 27 this year — it's the perfect time to spotlight these inspiring volunteers. We asked the award recipients to share their thoughts on volunteering with the CAS: why they do it, what they enjoy most and what makes their experiences memorable.

These exceptional individuals have gone above and beyond, making outstanding contributions to the CAS community and to the actuarial profession.

The New Members Award

Recognizing the rising stars within our community, this award honors CAS members who have made significant volunteer contributions within five years of earning their most recent credential.

Chor Leong Aw Yong, FCAS

For contributions to Asia Regional Casualty Actuaries (ARECA) and the Asia Regional Working Group

Yong

I volunteer at the CAS because I enjoy the opportunity to step out of my comfort zone and interact with various levels of leadership and the community. There were no barriers, and we were all treated equally and fairly. You could be in the C-suite of a large corporation or a student from a university, but as a CAS volunteer, we are all the same! Without barriers, information and knowledge are freely shared and exchanged. This fits exactly the purpose of the CAS — to advance the body of knowledge of actuarial science. I would not have been able to meet so many amazing and wonderful people if I did not volunteer. Meeting Geoff Werner is certainly one of my best volunteering memories! My generation of Exam 5 utilizes his text, *Basic Ratemaking*, extensively. The local university volunteers even brought copies of his textbook to be autographed! I worked with a couple of volunteers and CAS staff across the world, and it was so exciting when we finally met in person! It's like meeting up with long-time friends who we haven't seen in a while. JFK said, "Ask not what your country can do for you; ask what you can do for your country." And as the idiom goes, "Many hands make light work." Just raise your hand to help out in any way you can! Start small. Be proactive. It's actually much easier than you think it is. And most importantly, enjoy volunteering! Sidenote: If you haven't, I strongly recommend all actuaries read *The Psychology of Human Misjudgment* by the late Charlie Munger. I became a better actuary and a better person with his wisdom.

Rohan Bhale, FCAS

For work on the Property & Casualty Predictive Analytics (PCPA) project

Bhale

I volunteer for the CAS because I truly believe in their mission to make a positive impact on our community of P&C actuaries. The work the CAS does aligns with my values of giving back and promoting our professional society. Volunteering also allows me to grow personally and professionally, as I'm constantly inspired by the people I work with and the kind of tangible impact we can have. What I'm most proud of in my volunteering experience is how it has pushed me to step out of my comfort zone and try new things. I have had opportunities to collaborate with others on developing the PCPA exam and project. I also had

the opportunity to participate at the DC Black College Expo to share with high schoolers information about the actuarial profession. My advice to new CAS members is to start by being open-minded and proactive. Volunteer work can be a learning experience, so don't hesitate to ask questions, offer ideas and take on new challenges. It's also important to build strong connections with your fellow volunteers, as teamwork and mutual support are key to making a lasting impact.

Jack Richards, FCAS
For efforts with the Candidate Advocate Working Group


Richards

I enjoy the impact I am able to make in partnership with other CAS volunteers and staff! Seeing the Student Central Summer Program develop from an idea into a program that has had an immense educational impact on hundreds of students every year has been very rewarding. If you have an idea, you can turn it into action at the CAS in combination with the broad network of other actuaries you build through volunteering. My favorite memory of volunteering is seeing fellow volunteers in person at CAS meetings! After years (sometimes) of Teams meetings, it's nice to finally meet folks in person. As I've attended Annual Meetings over the years, I've made intentional efforts to meet up with other volunteers to get to know one another better and discuss what's to come at the CAS! There are plenty of opportunities for you to immediately give back to the profession and your peers — from helping educate and inspire the next generation of actuaries through the Student Central and University Engagement programs to helping evaluate the next generation of actuaries through writing and grading. You'll find your passion as you go and meet lots of friends and colleagues along the way!

Zach Suter, ACAS
For contributions to the Professionalism Education Working Group


Suter

I started volunteering for a couple of different reasons. First, I specifically remember thinking when I took my Course on Professionalism (COP) that the facilitators were really enthusiastic and brought a lot of energy to the course. I wanted to do the same for future candidates after having such a good experience at what I expected to be less than exciting. On top of that, I wanted to start giving back to the actuarial community in a way that I could help bring about positive change that I wanted to see. I have had some struggles throughout my exam process and wanted to be able to influence changes to help future candidates not face what I faced. It has been incredibly rewarding to work with candidates and help to give them a voice. I really enjoy facilitating the COP and getting a chance to meet and work with soon-to-be Associates. It's been an absolute pleasure meeting so many new folks who are on the cusp of finally getting their credentials and sharing in the excitement. I have had the opportunity to continue to keep in touch with many candidates and see many at CAS meetings and even help motivate some to volunteer (many for the Professionalism Education Working Group). It's very rewarding to help give others the same experience I was able to have at my COP. Additionally, I have made some incredible lifelong friends from my volunteering with the Professionalism Education Working Group who I never would have met, and I am very thankful for that! One of my favorite memories from volunteering was seeing so many of my fellow volunteers and prior COP candidates in Phoenix at the 2024 CAS Annual Meeting, which was my first big CAS meeting since I started volunteering back in 2020. It was so fun catching up with past candidates and seeing so many familiar faces in the crowd at the sessions I presented. And of course, spending time with all of my committee friends I have made over the years throughout the four days! My advice is to just dive into a volunteer opportunity that you think sparks your passion. There are plenty of different opportunities available, and I would strongly recommend at least exploring the possibilities. The VIP survey is an easy consolidation of options out there that anyone can read through and get more information from. And if someone is interested in learning more about the COP or the Professionalism Education Working Group, I would love to hear from you and share my experiences.

Above & Beyond Achievement Award

Celebrating those who surpass expectations, this award is for volunteers who have recently made exceptional contributions that stand out. The 2024 Above and Beyond Achievement Award is presented to:

Kyle Bartee, ACAS
For involvement with the University Engagement Advisory

Working Group, the Case Competition Task Force, and the CAS Student Central Summer Program

Bartee

I started my professional life as a teacher, teaching math, obviously! Since then, I've always had a passion for helping students because I want to see them achieve more than what they think is possible. Within the CAS, I am still able to do that as a University Liaison, a Summer Program mentor and most recently as the chair of the Case Competition Task Force. With math in particular, the biggest challenge as a teacher was getting students to believe in themselves because of the self-narrative, "I'm just not good at math." This is especially true in the lower socioeconomic school where I taught. Around the time I stopped taking exams in 2018, the CAS increased their focus on bringing awareness about our profession to students who never heard of an actuary. Since I am competitive by nature, I really enjoy being a part of closing that gap in the talent pipeline by winning those students back from other STEM careers. It goes hand in hand with encouraging those students to dream big and to achieve even more. As an ambassador of our profession, I had the honor of meeting some of the students in person I've mentored virtually while presenting at the student sessions of several CAS meetings. Seeing them in person and catching up is rivaled only by the follow-up mentor meetings where I get to hear about how far my teams make it in the competitions. It's difficult to pick a favorite between the two. One of the teams I mentored had a modeling project where they wanted to use open-source data to predict the lobster migration patterns in the Atlantic to increase efficiency and reduce the environmental impact of the lobster industry. To be fair, it was part of the Actuarial Foundation's Modeling the Future Challenge, and the team was from a high school in the New England area. It was one of the first teams I mentored with the Actuarial Foundation, and they were using geospatial modeling techniques that were beyond my skills at the time, so I connected them with my CSPA modeling mentor. Come to find out, my mentor used to work in research and one of his topics was analytics for the lobster industry! I know people say it's a small world in our profession, but that one still makes me smile when I think about what the chances are. It really has nothing to do with me in particular, but I have the privilege of seeing firsthand the talented high school and college students that our profession has the opportunity to attract, and I couldn't be prouder of them. Some bemoan the "next generation" from the difference in work styles to the slang they use, but seeing what this generation is capable of as a mentor in these challenges is an encouragement. I am always impressed with the skills they are able to bring to the table, and it even inspires me in my own work. I am proud of the work they are able to do, and I am so thankful that I get to be a part of their journey.

Sara Chen, FCAS

For outstanding work on the Actuarial Review

Chen

Volunteering for the CAS has been a fun and fulfilling experience. Not only does it give me opportunities to give back to the organization, but it also allows me to meet and collaborate with other actuaries from diverse backgrounds and walks of life who have inspired me both personally and professionally. One aspect of volunteering that I particularly enjoy is learning skills that I wouldn't typically get the chance to as an actuary, such as video storyboarding for microlearning, and editing and writing articles for *Actuarial Review*. It's a refreshing break from looking at numbers and spreadsheets all day and has helped me develop my communication skills. The culture among the CAS staff and the volunteer working groups is non-judgmental, collaborative and supportive. It's a great community to be a part of. I encourage new volunteers to keep an open mind when exploring all the volunteer opportunities the CAS has to offer and not be afraid to try something new!

Jimmy Molyneux, FIAA, FCAS

For contributions to Asia Regional Casualty Actuaries (ARECA) and the Asia Regional Working Group

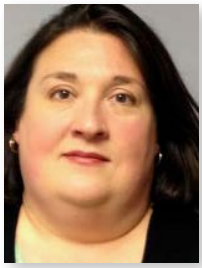
Molyneux

I volunteer for the CAS for the chance to get exposure to topics and develop skills that I might not be as readily able to in my daily work. The second reason is the opportunity to network, discuss and share knowledge with other actuaries from around the world (who are also very willing to share their knowledge and experience). The third reason is the chance to help the profession and pay it forward; just as today's actuaries have benefitted from the efforts of past

volunteers, volunteering now is a way to ensure future members benefit in the same way too. I think it's the culture within the CAS volunteer community of inclusiveness and curiosity. I'm not exactly the "typical" CAS volunteer; most of my career has been outside of North America, and as an Australian I spell and say my words differently (colour vs color, organise vs organize, etc.). But I've found with the CAS, my fellow volunteers not only don't care about any of those things but value my (often different) perspective and look to incorporate it into what the CAS does. One of my best memories of being a volunteer is being one of the facilitators for the Asia COP— not only for the interactions with the students, but many of the facilitators have been doing the course for several years now and the discussions we've had between ourselves have been both thought-provoking and a lot of fun. In May 2024 we did our first in-person COP since the pandemic, and meeting up with the other facilitators was like catching up with old friends. My advice to new CAS members just getting their start in volunteering is to get stuck in; try different things that get you out of your comfort zone and see which ones you find interesting and enjoyable.

Fran Sarrel, FCAS

For dedication to the Admissions Transformation Plan



Sarrel

I have been volunteering on the Syllabus & Examination Working Group for about 16 years. I started there, mainly because the committee chair called me. Of the Admissions committees, I thought Syllabus was the most impactful — to be part of the group who decides what's on the exams. I then decided that grading and item writing would help with Syllabus, so I volunteered to grade and write items for that exam sitting. I learned a lot by grading (it's weirdly fun, if time-consuming) and item writing. Over time, the syllabus committee got folded into the Exam Committee, mainly for better communication, but I think it has worked out pretty well. After putting in my time commitment for grading and writing, I remained on Syllabus and became the general officer through the Job Task Analysis/Admissions Transformation Plan process. I have met some really great people through volunteering, which is definitely the biggest benefit. Personally, I think everyone should grade at some point and write items if you have that skill. Learning "how the sausage is made" gives you new perspective on the exams. For example, did you know that what you think is a trick in an exam question is rarely an actual trick? Take the question as written. Answer the question as written. Don't overthink it! Volunteering is what you make of it. Especially for exams, graders, item writers and syllabus updaters are needed every sitting. But if you really want to make an impact, talk to the team leads, vice chairs and chairs. We often need people to step into leadership roles. And you don't have to put in 10+ years to get there.

Ernesto Schirmacher, PhD, FSA, CSPA, Affiliate Member

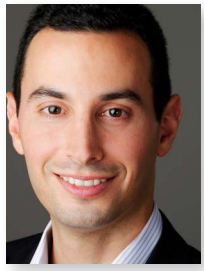
For work on the Property & Casualty Predictive Analytics (PCPA) project

Schirmacher

I view volunteering as an important part of hearing and sharing different points of view and staying current with what others are doing. What I enjoy most about volunteering is working with others outside of my usual work group to accomplish something that will benefit many people. One of the aspects of volunteering that stands out to me is that the perspectives from other people (CAS staff and other actuaries) have all been important to me and helped me shape my own thinking about different topics. My best memory about volunteering is working with Rohan Bhale, FCAS, and Dustin Larson, CAS certification program manager, when we were able to put the puzzle pieces together on a hands-on project. When on a tight deadline, small is beautiful! A big dose of collaboration and some elbow grease can yield amazing results! I am most proud that through volunteering we have been able to put together some interesting projects to further skill development for the next wave of actuaries. When you first join a volunteer group, ask questions, offer your insights, and ask to pair up with someone else to accomplish some tasks.

Josh Taub, FCAS

For contributions to the Professionalism Education Working Group



Taub

Volunteering gives me an opportunity for additional exposure to things I find interesting — anything from learning about how new technologies are impacting insurance to discussing how behavioral economics relates to the

ethical decisions actuaries need to make. I enjoy volunteering because I get to work with fun and smart people, and I get to share things I find interesting with them. Learning and sharing learning is a passion of mine. I've been able to meet tons of people through the volunteer work and speaking that I've done. That certainly includes many other CAS members, but it also includes insurance experts and actuaries from around the world. Volunteering has definitely broadened my network.

Matthew Rodermund Memorial Service Award

Established in 1990 in memory of Matthew Rodermund's dedication to the CAS, this prestigious award honors CAS members who have made significant volunteer contributions throughout their careers.

Paul Kinson, ACAS

Kinson

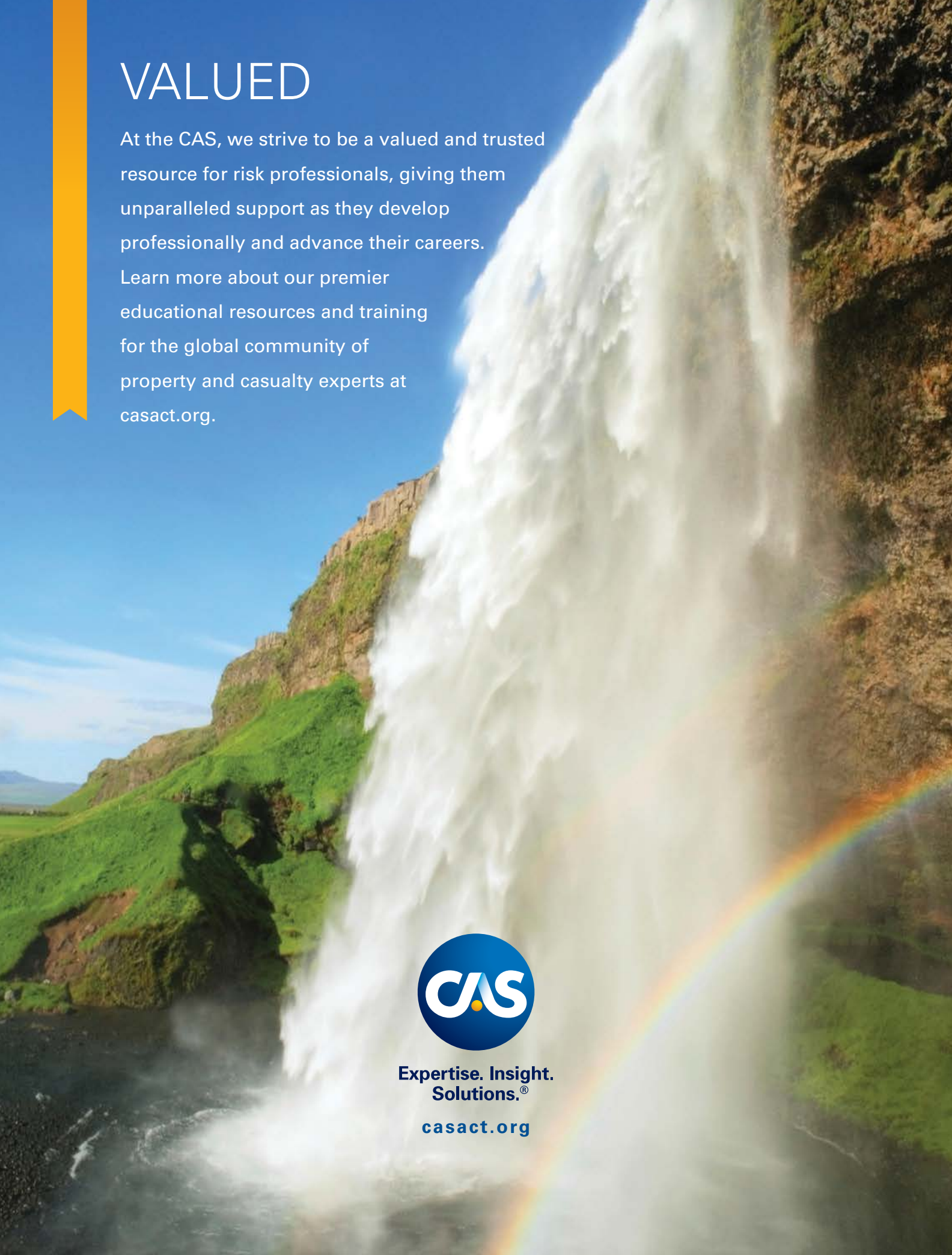
A week before I finished college, a recruiter from Aetna Insurance was on campus talking to students about the actuarial career. I was intrigued by what I heard and thought it would be a good fit for me. Prior to that, I knew very little about the actuarial career. This is what has driven my passion to help students learn more about the career at an earlier stage than I did. That is why I have volunteered with the University Liaison program and the University Engagement Committee. I have mentored students at CAS meetings as well. Volunteering is a great way to network! The actuarial profession is relatively small, and it is surprising how often your path crosses with those of other actuaries throughout your career. An actuary's network is useful in many ways — from lifelong friendships, to future job opportunities, to sources for advice on projects, to recommendations for committee assignments, to dinner companions at CAS meetings, and many others. My favorite CAS memories surround volunteering as a mentor for the Student Program at CAS meetings. It is inspiring to talk with the students who will be the next generation of actuaries — they are so much more knowledgeable and worldly than I was at that age. I enjoy sharing what I have learned about the profession and what makes it interesting to me and learning from them what they have experienced in classes and internships. Their questions often make me think of things long forgotten (it's been quite a while since I was an entry-level actuary).

Andy Kudera, FCAS

Kudera

I volunteer for the CAS to give back to the profession because it has given so much to me in terms of personal and professional satisfaction. Meeting and collaborating with other members and the CAS office staff is what I enjoy most about volunteering. My best memory about volunteering is the friendships that have developed over the years.

These honorees are a testament to the passion, dedication and excellence that define the nearly 3,000 CAS volunteers. Their contributions make our community stronger and the profession better. All award winners were recognized at the 2024 CAS Annual Meeting this November in Phoenix, Arizona.


VALUED
At the CAS, we strive to be a valued and trusted resource for risk professionals, giving them unparalleled support as they develop professionally and advance their careers. Learn more about our premier educational resources and training for the global community of property and casualty experts at casact.org.
Expertise. Insight. Solutions.®
casact.org

Regulation in Insurance

A Road to Unintended Consequences?

By ERIN LACHEN

Insurance Regulations Are Catching Up to AI

As actuaries, we are accustomed to Division of Insurance (DOI) scrutiny — from basic filing requirements, generalized linear models (GLM) questionnaires and responding to objections. Complying with regulations is old hat. Artificial intelligence (AI) is relatively new on the scene and moving quickly. Insurance regulations in this space are just now starting to catch up, giving us all a chance to continue to flex our compliance muscle.

The National Association of Insurance Commissioners (NAIC) first published their model bulletin on AI in December 2023 (as mentioned in the *Actuarial Review* article, "NAIC Model Bulletin Recommends NIST's Approach" and my Developing News article in the Jan/Feb *AR*). Since that time, just under half of all U.S. jurisdictions have adopted the bulletin. Some adopted the bulletin wholesale; others adjusted to be either more or less prescriptive.

Other states decided to take a different route to the same intended destination. The Colorado (CO) DOI worked with O'Neil Risk Consulting & Algorithmic Auditing (ORCAA) to develop regulation for life insurers, with the personal auto regulations in development as of the writing of this article. Similarly, the New York Department of Financial Services created their own rules.

This accounting only considers state-level insurance-specific regulations within the U.S. At a state level, federally and globally, AI legislation and regulation continue to be proposed, refined and approved. **These regulations are all aiming for the same goal — namely, to protect consumers from potential adverse outcomes.** Their means to do so differ, however, setting us down a path of forked roads.

Same Ends, Different Means

What are these regulations asking insurers to do to reach their goal of consumer protection?

Definitions

The first step to understanding a given regulation is understanding the definitions: What shared lexicon will facilitate our compliance? See Table 1 for the definition the NAIC provides for AI.

With these different definitions come different interpretations. Does Colorado really mean something different by predictive model than the NAIC? Why do Colorado and New York omit a definition of AI? Why doesn't the NAIC include a definition of External Consumer Data and Information Source (ECDIS)? Carriers doing business in multiple states now need to grapple with these questions to determine how to comply.

Table 1. Comparison of definitions of terms in NAIC, Colorado, and New York regulations regarding the use of AI in insurance.

	Regulation		
Defined Term	**NAIC Model Bulletin on AI**	**CO DOI 3 CCR 702-10 (P&C regs in development)**	**NY DFS Insurance Circular Letter No. 7**
Artificial Intelligence (AI)	Refers to a branch of computer science that uses data processing systems that perform functions normally associated with human intelligence, such as reasoning, learning and self-improvement, or the capability of a device to perform functions that are normally associated with human intelligence such as reasoning, learning and self-improvement. This definition considers machine learning to be a subset of artificial intelligence.	Not included	Not included
AI System (AIS)	A machine-based system that can, for a given set of objectives, generate outputs such as predictions, recommendations, content (such as text, images, videos or sounds) or other output influencing decisions made in real or virtual environments. AI Systems are designed to operate with varying levels of autonomy.	Not included	Means any machine-based system designed to perform functions normally associated with human intelligence, such as reasoning, learning and self-improvement, that is used — in whole or in part — to supplement traditional health, life, property or casualty underwriting or pricing, as a proxy for traditional health, life, property or casualty underwriting or pricing, or to identify "lifestyle indicators" that may contribute to an underwriting or pricing assessment of an applicant for insurance coverage.
Predictive Model	Refers to the mining of historic data using algorithms and/or machine learning to identify patterns and predict outcomes that can be used to make or support the making of decisions.	Means a process of using mathematical and computational methods that examine current and historical data sets for underlying patterns and calculate the probability of an outcome (Section 10-3-1104.9 - Insurers' use of external consumer data and information sources, algorithms, and predictive models - unfair discrimination prohibited - rules - stakeholder process required - investigations - definitions - repeal. Colo. Rev. Stat. § 10-3-1104.9 | Casetext Search + Citator).	Not included
External Consumer Data and Information Source (ECDIS)	Not included	Means, for the purposes of this regulation, a data or an information source that is used by a life insurer to supplement or supplant traditional underwriting factors or other insurance practices or to establish lifestyle indicators that are used in insurance practices. This term includes credit scores, social media habits, locations, purchasing habits, home ownership, educational attainment, licensures, civil judgments, court records, occupation that does not have a direct relationship to mortality, morbidity or longevity risk, consumer-generated Internet of Things data, biometric data and any insurance risk scores derived by the insurer or third-party from the above listed or similar data and/or information sources.	Includes data or information used — in whole or in part — to supplement traditional medical, property or casualty underwriting or pricing, as a proxy for traditional medical, property or casualty underwriting or pricing, or to identify "lifestyle indicators" that may contribute to an underwriting or pricing assessment of an applicant for insurance coverage. ECDIS does not include an MIB Group, Inc. member information exchange service, a motor vehicle report, prescription drug data or a criminal history search. (Insurance Circular Letter No. 7 (2024): Use of Artificial Intelligence Systems and External Consumer Data and Information Sources in Insurance Underwriting and Pricing | Department of Financial Services)

Once these definitions are clarified — likely in partnership with legal and compliance departments — the scope of your company's models for each state becomes clearer (even if your interpretation varies from your competitors'). Now the question becomes: What do insurers need to do to comply with these regulations?

Requirements

Each regulation has extensive requirements that touch on governance, risk-based frameworks, basic model testing, fairness testing and bias testing. How they approach each is highly summarized below; links are provided to dive deeper into the specific language used:

- The CO regulation requires a governance and risk management framework to be established to ensure ECDIS and predictive models are documented, tested and validated. Further, annual testing to detect unfair discrimination as well as steps taken to address unfairly discriminatory outcomes is required.
  - Although the P&C regulations are in development, they are expected to have similar requirements.
- The NY DFS circular letter requires an insurer to establish that the underwriting or pricing guidelines are not unfairly or unlawfully discriminatory with a comprehensive assessment with three steps that need to be included at minimum. A governance and risk management framework are also required with appropriate documentation and oversight, like Colorado.
  - These guidelines speak in generalities rather than mention specific tests or imputation methods.
  - Several quantitative assessments are provided as examples, though none are prescribed.
  - Testing must be done on a "regular cadence."
- The NAIC model bulletin requires a governance and risk management framework around the use of AIS to ensure predictive models are documented, tested and validated including unfair discrimination in the insurance practices resulting from the use of the model.
  - No specific tests or imputation methods are listed.
  - No frequency of testing is mentioned.

Yet again we see the different means toward the shared end of consumer protection, this time in the descriptiveness and prescriptiveness of the regulations. As is addressed to different degrees by these regulations, and what we all need to be focused on, is bias testing.

Bias — The heart of the issue

As described, these regulations target models and their associated outputs. The data is the driver of this vehicle and is likely riddled with biases before a model is even considered. From data selection to sampling and the values themselves, it will reflect the biases unique to each carrier and the jurisdictions within which it does business.

Data values can also have biases. Some are seemingly driven by business practices, like differences in claims denials, payouts and fraud identification.

For example, data sampling bias may be present if the historical batch of insurance policies used to develop a model contains a different mix of risk characteristics than the future policies to which the model-informed decisions are applied (as described in Part 1 — Practical Application of Bias Measurement and Mitigation Techniques in Insurance Rating). On the face of it, this is a common problem we often face when building pricing models. We want our model to generalize well on future business. We try to ensure our model predictions appropriately reflect what that future business looks like. Due to seemingly benign practices like underwriting risk selection guidelines and marketing strategies, however, certain protected classes may be inadvertently over- or under-represented in the modeling dataset.

Data values can also have biases. Some are seemingly driven by business practices, like differences in claims denials, payouts and fraud identification. Other data values may be biased due to decisions not within control of the business, such

as the likelihood of certain groups to be pulled over for traffic stops. If violations are used in a model, these data biases will be amplified.

Beyond data, several aspects of the modeling process open the door to further bias. These biases all potentially contribute to the adverse consumer impacts these regulations are trying to avoid.

Complying with regulations: Bias identification

First, Label

To identify whether and how these biases are showing up in our data, we must first label our data with the variable of interest. Of primary interest to insurance regulators is race. We don't track demographic data by necessity — most insurers don't want even the semblance of discrimination. Yet now we are in a bind since collecting that information would facilitate more appropriate measurements of bias. In the absence of accurate race data, we must look to imputation methods to comply with these AI regulations. The path to imputed race continues us down our forking road; these decisions add to the complexity of compliance.

A few different methods have been developed to impute a policyholders' race. The primary methods to impute race are the Bayesian Improved Surname Geocoding (BISG) and the Bayesian Improved First Name Surname Geocoding (BIFSG) approaches. Deciding which method of imputation to use is the first fork in the road for insurers attempting to comply with these new regulations. [Colorado explicitly calls out BIFSG in their regs.]

Models must be built to leverage these methods. Datasets are available, published by the United States Census Bureau, though these datasets are not consistent representations of the U.S. population. Deciding which dataset to use to make the imputations is another fork.

More forks are encountered along every subsequent road. If using BIFSG, do you start with geocode, surname or first name? What programming package do you decide to use? How will you cleanse your policyholders' data to be able to impute properly? How do you use the imputed probabilities: classify based on maximum probability, use the probability directly, randomly assign with likelihood based on the imputed probabilities? Every decision made leads to a potentially different outcome for the company's bias identification.

Then, Assess

Now that the modeling dataset has been labeled, you need to assess for fairness, discrimination and bias. The regulations do not specify what tests to use for this purpose, though many are available. Testing should be done throughout the modeling lifecycle, from data collection and adjustments to model development, implementation and monitoring. A single test is unlikely to yield robust results, so multiple are often advised. Note this list is not exhaustive:[1]

- From Quantifying Discriminatory effects paper:
  - Demographic parity
  - Conditional demographic parity
  - Equal opportunity
  - Equalized odds
  - Calibration
  - Well-calibration
- From Practical Applications Part 1 paper:
  - Premium parity
  - Loss ratio parity
  - Lift charts
- From the NY DFS circular letter Section C.18:
  - Adverse impact ratio
  - Denials odds ratios
  - Marginal effects
  - Standardized mean differences
  - Z-tests and T-tests
  - Drivers of disparity

Yet again we are making decisions that could differ significantly from our competitors. How many tests should we conduct? What is the appropriate threshold for a given test? How do we consider tests that provide different answers? We choose our forks in the road and drive on to the next stop: What do we do when we determine unfair discrimination is present in our models?

Doing the right thing: Mitigation

We know bias is not a new problem, and we know it is not possible to eliminate bias entirely. What these new regulations are asking of us as actuaries, though, is to do the right thing. What this means for each company may differ. For those doing business in Colorado, they will (eventually) be required to

[1] For a more thorough treatment of bias, bias testing and bias mitigation, see Part 1 and Part 2 of Practical Application of Bias Measurement and Mitigation Techniques in Insurance Rating, included in Phase II of the CAS Research Paper Series on Race and Insurance Pricing.

take steps to address unfair discrimination. For everyone else, this is another decision to be made. Here are some potential pathways toward mitigating the impacts of bias present in your data and models. Again, this list is not exhaustive.

- From Quantifying Discriminatory effects paper:
  - Reweighting
  - Disparate impact remover
  - Prejudice remover
  - Bayes optimal equalized odds predictor
  - Reject option classification
  - Calibrated equalized odds
- From Practical Applications Part 2 paper:
  - Remove linear dependence
  - Equalize outcomes
  - Perturb variables
  - Control for protected class within the model
  - Use a penalized fitting process
  - Transform model estimates to align with fairness axioms
  - Leverage adversarial debiasing

Depending on how proactive your company would like to be, you may or may not yet need to take steps to mitigate any observed disparity in fairness. This decision leads us further down different forked roads — do they lead us all to the same destination?

Unintended consequences?

As illustrated, these regulations are prone to interpretations and assumptions along every step of the path. If implementation of and accountability to these regulations is not handled in an equitable way, there is significant potential for adverse selection. Suppose one carrier, Carrier A, was proactive in identifying bias, reported the results to a state DOI, and was advised to remove variable *X* due to its results across several tests. Another carrier, Carrier B, who has yet to file a new model, uses variable *X* in their models. Until Carrier B undertakes the necessary testing and unless that testing shows similar results of discrimination based on the use of variable *X*, then there is significant potential for Carrier A to be adversely selected against. And they were trying to do the right thing!

With these regulations, fairness is yet another constraint to be considered in the modeling process. The challenge lies in the bifurcating decisions piling up within each company that lead to potentially different outcomes. Whereas for existing state regulations that restrict use of variables like gender, these new regulations could see different variables being used or not used depending on the decisions made by each company individually, influenced by their historical and current decision-making.

Several outstanding questions remain that will hopefully be resolved prior to adverse consequences coming to bear.

1. How will these regulations be enforced with timing that would allow for all insurers to be held to the same standards at the same time?
2. If a given variable runs afoul of bias testing requirements inconsistently across carriers due to differences in underlying data, what is the outcome?
3. If a given variable runs afoul of bias testing requirements inconsistently across different models at the same company, what is the outcome?
4. How will regulators account for different standards being established by each company due to their unique decisions?

There is a real tradeoff between "doing the right thing" and keeping your company profitable. Do you proactively assess and address any bias within your company's data and models? Or do you take your time, waiting for regulations to force your company's hand? Making the correct decision could be critical to your company's bottom line.

The worry about bias is real, and so are the potential unintended consequences for insurers and the insurance market more broadly. Collaboration between regulators and carriers is crucial to get this right without adversely impacting consumers — our shared goal in the first place.

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DEVELOPING NEWS

Artificial Intelligence Gone Nuclear By JIM WEISS

Demand for generative artificial intelligence (Gen AI) has surged recently. For example, ChatGPT's weekly active user count increased from 100 million to 200 million between November 2023 and August 2024. This in turn has stoked demand for electricity. A standard ChatGPT query consumes ten times more electricity than a Google search and "drinks" one-third to one and a half ounces of water. Data centers already use 1-2% of global electricity and Goldman Sachs estimates this will increase to 3-4% by 2030. To find enough electricity to power these pursuits, tech giants are going nuclear. Recently, Google purchased power from Kairos Powers' fleet of small modular reactors (SMRs), Amazon invested in Dominion Energy to develop SMRs and Microsoft is partnering with Constellation to reactivate the reactor at Three Mile Island. Chinese startup Deepseek shocked U.S. players (and capital markets) in early 2025 with a more energy efficient large language model, but its energy impacts are debatable in that this may just stimulate even more corporate AI use.

Most P&C insurance policies exclude damages resulting from nuclear accidents (although Swiss Re questioned the robustness of these exclusions), with private risks socially insured by the Price-Anderson Act. Energy companies also purchase liability coverage from a pool of mostly brand-name insurers called American Nuclear Insurers, which paid hundreds of millions after Three Mile Island melted down in 1980 but otherwise has not experienced any significant triggering events.

What this means for actuaries:
A would-be nuclear renaissance may feel similar to the unexpected 32% compound annual growth of global cyber insurance between 2017 and 2022, which illustrated the industry's (and actuaries') facility to rise to the challenge of rapidly emerging perils. However, not unlike the fragile nuclear exclusion, academics caution that the industry is ill-equipped to handle "silent cyber" exposure in lines such as property. A non-cyber example of "silent" property exposure is how the industry dodged a bullet during COVID-19 due to a communicable disease exclusion ISO developed in 2009. Informed by history, actuaries should work with experts in their organizations to firm up existing policy language and ensure fairly-priced coverage is available to service a burgeoning market of AI-driven risk (including but not limited to nuclear liability).

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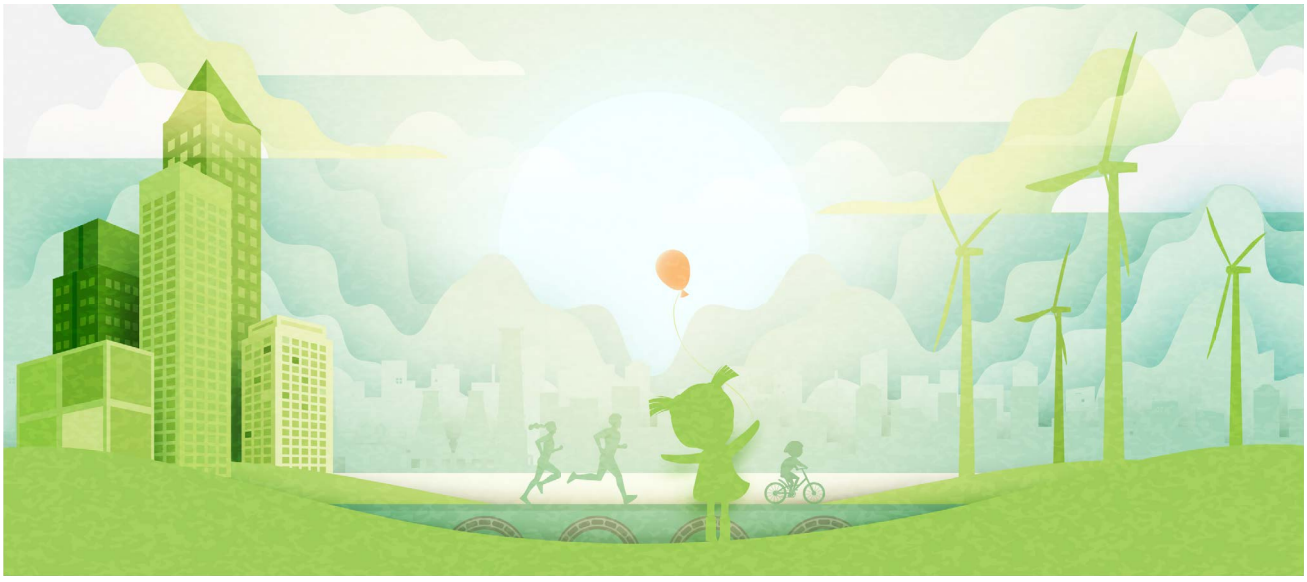
Hello, Partner By XUAN YOU

According to recent research by AXIS Capital, most energy producers "view the insurance industry as a service provider that protects customers through risk transfer solutions, rather than a strategic partner that can help spark investments and support innovation in the energy transition." Additionally, according to the same research, 84% of energy producers would increase renewable investments if insurers were involved earlier. This highlights the growing opportunity and demand for insurers to act not just as risk mitigators but as proactive partners in scaling renewable energy.

Where are we currently with the energy transition? Renewables accounted for 30% of global electricity in 2023, while fossil fuels fell to 60%, their lowest share in 50 years according to the International Energy Agency. However, emerging markets face the largest financing gaps, with geopolitical tensions and government policy uncertainties further complicating the situation.

What this means for actuaries:
As we continue to journey to net-zero emission by 2050, insurers and actuaries don't have to sit on the sidelines. Insurers can play a critical role by participating early in developmental stages and providing comprehensive underwriting for innovative technologies. They can also allocate capital toward emerging clean technologies and renewable energy products.

Based on a recent report by the Geneva Association, larger re/insurers are investing in technologies such as floating turbines and advanced solar modules, many of which lack sufficient pilot testing and thus make historical performance data insufficient. Pricing these risks requires a prototype-driven approach. For new, untested risks associated with prototype projects such as green hydrogen, actuaries must collaborate on research initiatives to better understand and mitigate risks.



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DEVELOPING NEWS

Insurers Let Go of Brakes on Troubled Vehicle Models

By JIM WEISS

Last October GEICO debunked rumors that it was no longer insuring the Tesla Cybertruck, calling them "completely made up." A policyholder previously posted on X an alleged letter in which GEICO communicated non-renewal of a Cybertruck insurance policy based on underwriting guidelines.

However, when State Farm and others reduced writings of 2010-era Hyundai and Kia models beginning in 2023, this was more than a rumor — the insurers confirmed as much. Theft rates of those vehicles surged in late 2022 after TikTok videos illustrated how to start them without keys. Reports of non-renewals persisted into 2024. Several Hyundai and Kia vehicles (as well as Cybertrucks) join dozens of others on the New York Department of Financial Services' "difficult to insure vehicle" list.

Relief started to come to beleaguered vehicle owners and their insurers in 2024. The Highway Loss Data Institute (HLDI) found Hyundai's and Kia's software updates significantly reduced thefts, which may lower rate pressure.

Owners of stolen vehicles also benefited from a $145 million USD class action settlement in early 2024. Dozens of insurers signed onto their own pending class action against the automakers, and Allstate subsidiaries are litigating against Hyundai and Kia over other 2006 and later vehicles whose circuitry allegedly caused them to combust.

What this means for actuaries:
The insurance industry plays a critical role in making vehicles safe for travel and reliable. Automakers often boast when the Insurance Institute for Highway Safety selects their vehicles as Top Safety Picks. Actuaries in particular may be called upon to develop discounts for new safety features or right-size rates to what the HLDI (or perhaps even TikTok and X) indicates as vehicles' current loss potential. The best way to prevent their models from being "difficult to insure" is for automakers to raise their safety game. The flurry of recent insurer-automaker litigation is a reminder for actuaries to consider subrogation potential in analyses.

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Not To Be Missed: The 15 Most Popular CAS Research Papers of 2024

By ANNMARIE GEDDES BARIBEAU, CAS RESEARCH MANAGER

Providing thought leadership with a continual focus on the essentials, CAS Research delivers quality research thanks to the dedication of nearly 200 volunteers who assure that every piece contributes to the overall body of knowledge for the P&C actuarial profession.

The top 15 most visited CAS research reports and papers feature fresh thinking on emerging topics such as artificial intelligence, while also showcasing modeling techniques for ratemaking, reserving and reinsurance. Other topics include finding bias in ratemaking, developing useful marketing models and taking a new look at autonomous vehicles and potential approaches to insuring them.

Not surprisingly, the most popular research is relevant — being released in 2023 or 2024. However, a couple of papers from 2021 are holding their own, demonstrating that older papers can maintain relevance.

Loss Modeling from First Principles

Pietro Parodi, Derek Thrumble, Peter Watson, et al., *E-Forum*, 2024

The authors establish a first principles approach that reshapes loss modeling and enhances clarity, precision and predictive power by balancing data fitting with dynamic risk. The methodology avoids complex, parameter-heavy methods, proposing those grounded in intuition and mathematics instead.

Why Read: Modeling from first principles can still be the best approach.

GLM for Dummies (and Actuaries)

David R. Clark, *E-Forum*, 2023

Offering insights that support robust, interpretable and adaptable ratemaking models, the paper addresses common modeling challenges, such as data sparsity, regulatory requirements and real-world variability. By calculating a fitted model so the weighted average of the fitted loss costs balances with the actual data, the paper strives to make the calculation more intuitive.

Why Read: Learn what anyone (including actuaries) would want to know about GLMs — but were afraid to ask.

Machine Learning and Ratemaking: Assessing Performance of Four Popular Algorithms for Modeling Auto Insurance Pure Premium

Sofia Colella, Harrison Jones, *E-Forum*, 2023

By integrating modern, evolving machine learning ratemaking techniques, such as XGBoost and neural networks, the authors discuss the competitive advantage that GLMs can provide. While offering actionable insights on tuning and performance, the paper can also help readers understand the trade-offs between accuracy and interpretability.

Why Read: Machine learning is powerful, but there's always nuance.

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1) The CAS library
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3) *Variance*

CAS research is also shared through presentations, so check out the Professional Education Library as well.

A Simple Method for Modeling Changes over Time

Uri Korn, *Variance*, 2021

Using a regression-based state space model (RSSM) to enhance time series forecasting in reserving by blending penalized regression and time series components, the author demonstrates how to improve historical data interpretation and forecasting accuracy. By highlighting practical applications in reserving, profitability studies and insurance pricing — along with scalable solutions for big data — this paper stands the test of time.

Why Read: There is an innovative approach to time series forecasting.

Ultimate Loss Reserve Forecasting Using Bidirectional LSTMs
Lahiru H. Somarantne, *E-Forum*, 2022

By introducing models like recurrent neural networks (RNN) and long short-term memory (LSTM), the author reveals how machine learning can handle temporal components of loss data effectively, surpassing traditional methods such as chain ladder in accuracy, especially for volatile early loss development periods.

Why Read: Leveraging machine learning in predictive loss reserving can address age-old challenges.

Framework of BERT-Based NLP Models for Frequency and Severity in Insurance Claims
Shuzhe Xu, Vajira Manathunga, Don Hong, *Variance*, 2023

Introducing an innovative structure to leverage textual information in insurance datasets using bidirectional encoder representations from transformers (BERT)-based natural language processing (NLP), the paper demonstrates why integrating BERT with artificial neural networks enhances predictive accuracy and stability for claim frequency and severity — and also outperforms traditional approaches.

Why Read: Incorporating text data in complex models is made possible with a practical, powerful approach.

Have a great research idea? Please share at https://www.casact.org/publications-research/research/suggest-research-idea

Capital Allocation Techniques: Review and Comparison
Qiheng Guo, Daniel Bauer, George H. Zanjani, *Variance*, 2021

Bridging theory and practice, the authors provide a critical review of capital allocation methods, exploring their underpinnings, practical implementations and stability through examples. This still sought-after paper also identifies key differences between methods, tail-focused measures and those considering entire distributions, covering the instability of methods such as value-at-risk (VaR) under certain conditions.

Why Read: The C-suite will always appreciate capital allocation supported by robust metrics for portfolio optimization and risk-adjusted return.

Recommender Systems for Insurance Marketing
Giorgio Alfredo, Giuseppe Savino, *Variance*, 2022

Just as e-commerce and entertainment industries use state-of-the-art recommender system algorithms to market their businesses, so can insurance companies — with help from actuaries, of course! The authors show how supervised learning models, such as gradient boosting and neural networks, can better predict insurance purchases compared to traditional techniques. As an added bonus, the paper shares insights to enhance cross-selling strategies, improve customer engagement and drive business growth.

Why Read: It never hurts to gain appreciation from the marketing department.

A Practical Approach to Quantitative Model Risk Assessment
Carole Bernard, Rodrigue Kazzi, Steven Vanduffel, *Variance*, 2023

Building a practical framework for quantitative model risk assessment, the authors highlight the risks from model assumptions, propose innovative tools to measure assumption contributions to model risk and introduce a formula for determining model risk capital. The research also helpfully addresses regulatory requirements and offers ways to enhance model reliability.

Why Read: Evaluating, mitigating and communicating model risks can bolster stronger financial decision-making.

Projection of On-Road Liability Losses for Autonomous Driving
Tetteh Otuteye, Corey Rousseau, Rafael Costa, et al., *E-Forum*, 2022

Integrating actuarial insights with autonomous vehicle (AV) technology and safety advancements, the authors cover the evolving challenges in assessing

liability and offer ways to project risks, price coverage and anticipate reserves by considering liability exposure quantification, collision frequency, claim severity and loss distribution. The authors also discuss blending product and personal liability, regulatory framework variation and historical data scarcity.

Why Read: Staying up to speed on AV technology and the implications for insurers is future-critical.

An AI Vision for the Actuarial Profession
Ronald Richman, *E-Forum*, 2024
Highlighting the value of combining AI with traditional actuarial principles while addressing challenges including bias, ethics and regulation, the paper presents methods for improving efficiency, accuracy and innovation in actuarial disciplines such as pricing and reserving.

Why Read: AI will forever change the actuarial profession.

The Actuary Takes the Stand: Compensation for Personal Injury
Sule Sahin, Gary Venter *Variance*, 2024
Offering a transformative approach to litigation and compensation, the authors introduce a hybrid methodology combining systems in the U.K. and the U.S. to enhance fairness in calculating compensation through innovative age-earnings profiles.

Why Read: Enhanced methodologies are available to quantify loss of income and to potentially set reserves.

A Practical Guide to Navigating Fairness In Insurance Pricing (Part of Phase II of the CAS Research Paper Series on Race and Insurance Pricing)
Jessica Leong, Richard Moncher and Kate Jordan, 2024
Offering a framework for developing models more likely to comply with evolving regulations concerning unfair discrimination and bias, the authors discuss governance approaches — along with pros and cons of each — for bias mitigation in all stages in insurance modeling.

Why Read: Today's regulatory climate demands that insurers consider bias that could be embedded in their pricing models.

Regulatory Perspectives on Algorithmic Bias and Unfair Discrimination (Part of Phase II of the CAS Research Paper Series on Race and Insurance Pricing)
Lauren Cavanaugh, Scott Merkord, Taylor Davis, et al., 2024
By providing the views of 10 state insurance departments, this critical report gauges regulatory commitment — and concerns — related to potential bias in insurance pricing. Is using race or ethnicity to conduct bias testing appropriate? When conducting testing, should there be one or multiple tests? What about using the Bayesian improved first name surname geocoding (BIFSG) as a proxy for racial data?

Why Read: Regulators may increasingly consider racial or ethnic disparities in insurance outcomes as well as how best to test for them.

Did you know that reviewing research papers is a way to earn continuing education credit? Become a CAS research volunteer today!

An Actuarial Approach to Stochastic Modeling of Casualty Catastrophe Risk
Neil Bodoff, Eric Dynda, Brandon Stevens, et al., *E-Forum*, 2023
Natural catastrophic (CAT) models and scenarios have come a long way, but not so much for casualty CATs. That's where stochastic modeling can come in, according to the paper, which also identifies flaws in current methods and emphasizes accurate tail risk quantification for ratemaking. Bonus features include actionable algorithms and critical insights for robust risk management.

Why Read: When a century-old household staple (talcum powder) leads to billions of dollars in losses, actuaries must be ready for surprises.

Why Read It? Paper Explores Telematics Data, Enhancing Fairness in Auto Insurance Models

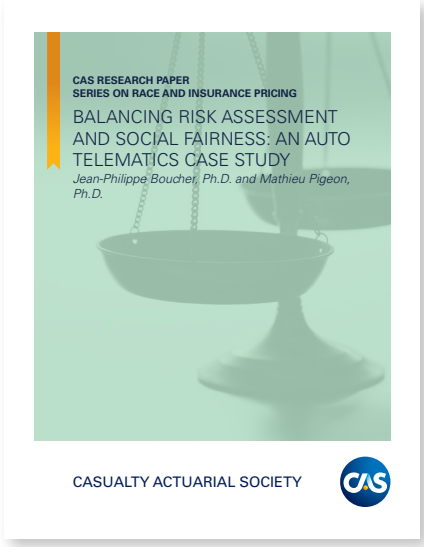
By RACHEL HUNTER

This fall the CAS released four new reports in Phase II of the CAS Research Paper Series on Race & Insurance Pricing. While three of the papers focus heavily on regulation, model governance and approaches to avoid bias in pricing, the fourth presents a case study with actual data and aims at giving a real-life example of how new variables could remove bias in pricing.

"Balancing Risk Assessment and Social Fairness: An Auto Telematics Case Study" by Jean-Philippe Boucher, Ph.D. and Mathieu Pigeon, Ph.D., does not directly explore the question of race in pricing but does look at other potentially sensitive variables such as gender, marital status, age, credit score and territory of residence to see if their ability to differentiate expected cost in auto insurance pricing can be replaced through the use of newer telematics data. The authors point out that there are concerns about the strong links between ethnicity and variables such as territory, marital status and credit score.

There are many good reasons to read this paper:

1) The paper includes a short overview of the current state of the market for telematics-based pricing usage in the Canadian market and dispels the popular notion that telematics-based pricing programs will be chosen primarily by drivers who know they are good drivers.
2) There is a nice overview of the types of telematics variables available in the data and ways to understand and normalize them for analysis. The paper also shows the relationship of these variables to frequency and severity as well as the overall impact that including telematics variables has on the residual impact of sensitive variables in overall model lift.
3) It provides a good example of the practical application of newer approaches to building pricing models including GLM-net (GLMs with an elastic net penalty term) and a tree-based XGBoost (gradient boosting) approach. The traditional GLM does not do well at fitting models with highly collinear variables, but as the paper demonstrates, some of the variables an insurer may wish to add with telematics are highly corelated with existing pricing variables. This paper could be read as an example of the value that can be gained by moving to these more complex approaches, some of which are now available in off-the-shelf actuarial pricing software packages. The authors share their theoretical approach and tuning process for the models selected and also share their code in a GitHub project.
4) In addition to the paper's narrative conclusions and charts, the authors share detailed assumptions and a link to their GitHub project and associated website, which allows readers to explore the code and the synthetic dataset. A reader who wanted to try their hand at these newer methods could use this paper as a guide to learn more.
5) On the website associated with the paper, readers can see the initial project proposal that was submitted. This could serve as a template for readers who are interested in responding to future research proposal requests in hopes of furthering the actuarial literature.
6) It's not as long as it looks! Much of the length comes from useful charts and tables as well as appendices describing the modeling approach and giving brief synopses of prior



The authors point out that there are concerns about the strong links between ethnicity and variables such as territory, marital status and credit score.

papers on relevant topics. You might find that the small amount of time spent reading the paper satisfies your bias topics continuing education requirements.

My reading of this paper got me thinking about other questions that are not directly answered in the results. A curious reader might be able to explore these questions in the synthetic data used for the study or when doing analyses on a non-synthetic dataset:

- When we include telematics variables, can we show the degree to which pricing within various sensitive classes becomes more equitable by identifying the higher risk drivers within each class (e.g., unmarried men aged 20-25 with bad credit scores) rather than putting all of them in a single unfavorable rate bucket.
- Are there special pockets of drivers that stick out as having a significant change in expected cost that would be valuable for an insurer to understand either in terms of segmentation of price or in marketing or program design?
- Could an actuary cite a paper like this to convince other stakeholders of the value of moving to more complex modeling techniques or of including telematics data? Here I'm thinking of two main categories of stakeholders: insurance companies and regulators.

I personally found that reading this paper was worth my time, and I commend the authors and, in turn, the CAS for sponsoring this research and making available these results, synthetic data and code.

To read this paper and others in the Race and Insurance Pricing Series, visit the CAS website at https://www.casact.org/publications-research/research/research-paper-series-race-and-insurance-pricing.

CAS Hosts Its First International General Insurance Teaching Summit — Advancing General Insurance Education in Asia

By BO LIN, CAS ASIA REGIONAL DIRECTOR

The P&C insurance market is experiencing dynamic growth across Asia, driven by factors such as economic expansion, urbanization, rising middle-class incomes and increasing digitalization. In Southeast Asia, emerging markets like Indonesia, Vietnam and The Philippines are seeing heightened demand for motor, property and natural catastrophe insurance, while more mature markets like Thailand and Malaysia focus on motor and *Takaful* insurance products. Despite this growth, low insurance penetration and high exposure to natural disasters remain key challenges. In China, the P&C market is one of the largest globally, propelled by government support, expanding auto and liability insurance segments, and rapid insurtech adoption through partnerships with tech giants.

In response to this market growth, the CAS is increasing efforts to prepare the next generation of actuaries with the skills they need to meet the local demands. Partnerships with Asian universities and professors are central to these efforts.

The inaugural CAS International General Insurance Teaching Summit took place from October 16–18, 2024, in Kuala Lumpur, Malaysia, with participation from more than 50 representatives from across Asia. This milestone event united professors from 23 universities and actuarial leaders to celebrate partnerships and exchange best practices in higher education. It is also the first-ever summit in Asia that focused exclusively on general insurance education.

The event is evidence of the CAS's commitment to continued international expansion, as reflected in our membership base in Asia, which has been growing at an average rate of 8% per year over the past five years. CAS members in Asia serve as the leading talent pool for analytics on emerging topics such as electric vehicle insurance, IFRS 17 and various solvency regimes.

Celebrating university partnerships

A central focus of the summit was advancing partnerships with universities recognized under the CAS University Recognition Program. In just one year since its introduction, we have 55 university partners on the recognition list, with 17 in Asia.

The CAS deeply values our partners in higher education who are supporting the development of the next generation of actuaries. This initiative recognizes institutions committed to enhancing general insurance actuarial education.

Photo of CAS Members and Faculty at the Teaching Summit includes (front row, third from left) Joyce Warner, Bo Lin, Ronald Kozlowski, Alisa Havens Walch, Geoffrey Werner and Ran Guo.

Partner universities benefit from CAS support and resources to equip students and graduates with the knowledge, skills and innovative thinking to be future leaders in the actuarial world.

Building foundations for future actuaries

Another key focal point of the summit was exploring strategies for bridging the gap between academic learning and early-career demands. With the actuarial profession evolving due to technological advancements, young actuaries must develop versatile skill sets. Industry leaders and educators in attendance shared insights into the skills vital for early-career actuaries, offering practical advice grounded in real-world applications. CAS speaker, Geoff Werner, FCAS, and co-author of the CAS Exam 5 textbook, led participants through an in-depth introduction to fundamental general insurance concepts on ratemaking. Emerging trends in the field were also introduced and discussed, including wildfire risk evaluation using Wildland Urban Interface (WUI) Fire Protection Scores, the development of catastrophic risk atlases and the navigation of new challenges such as cyber risks, telematics, electric vehicles and even flying cars.

From left to right: Daniel Nee, Yew Khuen Yoon, Nurul Syuhada Nurazami and Delvin Cai.

From left to right: Geoffrey Werner, Alisa Havens, Ran Guo, Joyce Warner, Bo Lin, and Ronald Kozlowski.

Strengthening the actuarial community through collaboration and contributions

University representatives shared ideas and experiences in enhancing actuarial education, including course development and design as well as case studies and teaching techniques. Innovative approaches, such as leveraging AI advancements to reimagine actuarial education and empowering students through peer-assisted learning programs, were also shared. These discussions emphasized innovation and strategic engagement in shaping the future of actuarial education.

This teaching summit was a great success, with support and contributions from CAS volunteers, industry and university partners. A heartfelt thank you to the CAS member speakers, including Alisa Walch, Geoff Werner, Delvin Cai, Nurul Syuhada Nurazami and Ron Kozlowski. Their contributions provided attendees with global perspectives and invaluable expertise. Special thanks also to our industry partner speakers, Daniel Nee and Yew Khuen Yoon, as well as all of the speakers from our partner universities who generously shared their teaching experiences and insights. Together they created a dynamic platform for mentorship, collaboration and knowledge exchange, laying the groundwork for advancing general insurance education in Asia and beyond.

Seizing Opportunities in a Growing Market — CAS Expands Influence in Vietnam

By BO LIN, ASIA REGIONAL DIRECTOR

Vietnam's insurance market and regulatory transformation

Vietnam's insurance market is on a rapid growth trajectory, fueled by an expanding middle class and increasing awareness of insurance's importance. Projections indicate that gross written premiums will reach approximately $5.75 billion USD in 2024, with average per capita spending in non-life insurance expected to hit $57.79, according to Statista. This growth is set to continue, with a steady annual increase of 4.55% from 2024 to 2028, resulting in a market volume of $6.87 billion by 2028.

The non-life insurance sector, in particular, is thriving, driven by demand for commercial lines products and Vietnam's emergence as a hub for foreign direct investment (FDI).[1]

The introduction of Decree No. 46 in 2023, which implements articles in the Vietnamese government's new Law on Insurance Business, has further reshaped the insurance landscape, opening the market to wholly owned foreign companies and setting stricter qualifications for actuaries. Non-life actuaries are now required to attain Associate and Fellow designations from internationally recognized actuarial societies, including the CAS, within specific time frames.

These regulatory changes signal a rising demand for highly skilled actuarial professionals, presenting a unique opportunity for the CAS to expand its influence in Vietnam and support the market's development.

CAS membership growth in Vietnam

In response to this changing environment, the CAS has made significant strides in Vietnam. The number of active CAS candidates has surged from one in 2022 to over 20 in 2024, signaling a notable increase in interest in CAS exams and credentials. In fall 2024, we welcomed our first CAS Associate in Vietnam, Vu Huy Ha, actuarial specialist in MSIF Vietnam.

Vu Huy Ha, ACAS

"Choosing the CAS has been the defining choice in my journey to become an actuary in General Insurance," says Ha. "It offers unparalleled expertise, rigorous training and a robust network that empowers me to excel in analyzing and managing risks. With the CAS, I'm not just earning credentials; I'm joining a community dedicated to excellence in risk management and actuarial science."

These milestones highlight the in-

[1] https://www.vietnam-briefing.com/news/vietnams-non-life-insurance-sector-attracts-strong-fdi-amid-favorable-regulatory-changes.html/.

Skyline of Saigon (Ho Chi Minh City), Vietnam.

creasing demand for CAS credentials in a market eager to adopt global actuarial standards.

CAS Trust Scholarship winners leading the way

Two exceptional students from Vietnam's National Economics University (NEU) are at the forefront of this transformation, thanks to their achievements as CAS Trust Scholarship recipients.

Nguyen Ha Tuan Long, a junior studying actuarial science, is making strides in Vietnam's nascent property and casualty (P&C) actuarial sector. As an intern at VietinBank Insurance, Long is leveraging the knowledge he gained while studying for CAS Exam 5 to develop ratemaking and reserving models, setting a new standard for actuarial practices in the region.

"It's an honor to be recognized as a scholarship recipient, and I am deeply grateful for the opportunities the CAS provides. This award supports my educational endeavors and inspires me to expand the boundaries of the actuarial profession within our evolving industry," Long shared.

Nguyen Thu Hai, also an NEU student specializing in actuarial science and risk management, is contributing to the field through innovative research. Her work focuses on machine learning applications in reserving techniques and portfolio optimization, demonstrating the potential for cutting-edge technologies to transform the actuarial profession.

"Receiving the Trust Scholarship from the CAS is an incredible honor that fuels my determination to pursue my dream career. I hope to give back to the actuarial community and am deeply grateful for everyone who has supported me," Hai remarked.

Inspired by their recognition as CAS Trust Scholarship recipients, Long and Hai have used their CAS Trust Grant to establish a CAS exam reimbursement program at NEU. This initiative aims to ease financial burdens for aspiring actuaries and reflects their dedication to nurturing the next generation of actuarial professionals in Vietnam.

Vietnam's general insurance market is poised for continued growth, driven by a robust economy and regulatory advancements aligning with global standards. The CAS is playing a vital role in shaping the expanding actuarial profession in Vietnam, as evidenced by these remarkable achievements of CAS members and scholarship recipients.

Technical Debt For Actuaries By JIM WEISS

Here is a morbid hypothetical: You have been given five years to live, and you have no spouse or next of kin. You have $10 million USD in assets. In your precious time left, you plan to fulfill your dream of living on the Jersey Shore, and you have already located beautiful beachfront property valued at $9 million. You have a choice of paying cash or taking a 30-year mortgage at 10% APR with $1 million down. An APR of 10% seems high, but you're not exactly thinking more than five years out. You could find a lot of fun uses for $9 million while you count down your days. How are you purchasing? More on that later.

For now, let's focus on the present. Assume instead you are "married" to a bloated, fashion-challenged policy admin system named Cliff that outlived his original life expectancy by 20 years and counting. His vitals are strong, but he requires constant support. His largesse and resistance to change limit his speed and your variety of activities together, but he is the "devil" you know. Do you consciously uncouple with Cliff and start courting a young, fitter replacement named Blayze? Or do you make it work with your partner of decades — piling on workaround after workaround for his copious limitations? Herein lies the essential question of technical debt.

Gartner defines technical debt as "work that is 'owed' to an IT system when teams 'borrow' against long-term quality by making short-term sacrifices, taking shortcuts, or using workarounds to meet delivery deadlines."[1] The words in the definition — owed, short-term, shortcut, against quality — give technical debt a bad name. They also imply deadlines, perhaps even arbitrary ones, get in the way of high-quality, long-term sustainable decision making. But if you take out the pejoratives, you are left with a perfectly economically rational way of doing business: debt financing.

Promises versus track record

Let's take a closer look at Cliff. Given how long Cliff has existed, he likely:

- Resides on premises rather than in

[1] https://www.gartner.com/en/infrastructure-and-it-operations-leaders/topics/technical-debt.

the cloud.
- Leverages less secure, older technology and requires frequent manual patching.
- Requires support by legacy skill sets that today's STEM grads may not have.
- Executes tasks on the slower side.
- Contains vast hard-coded exception handling (e.g., for certain endorsement scenarios).
- Has limited native ability to log on and off via application programming interfaces (API).
- Stores most of the information in column-based architecture.

Surely Blayze is better than this! Blayze is cloud native, multifactor, fully API-exposed, format flexible and massively parallel — everything Cliff is not. Actuaries can instantly and securely extract analysis data from Blayze, deploy new rating plans at the push of a Blayze's button, and wade into the brave new world of nonstructured data (oh how much insight must live in those images and user notes!). Blayze promises that if we court him for five years and whisper all of our exception cases in his ear over that time, then we can have all these benefits and more.

Could Cliff ever offer us all of these things? Maybe! For example, what if we:
- Create a lightweight cloud-based user experience (UX) that "sits on top" of Cliff.
- Build a giant moat around Cliff that no one besides the UX can cross …
- … and a drawbridge (gateway/port) only you and enterprise security can cross …
- … and a gondola (API) as an alternative to the drawbridge.
- Cache data for frequent tasks in the cloud layer so that they run faster.
- Sunset exceptions that no longer make sense.
- Organize images and notes into columns using hashing rather than chucking them.
- Have STEM grads code in Python and use ChatGPT to translate it back to Fortran.

In other words, what if we trick out Cliff to make him look more like Blayze? Cliff promises that if we buy him all the accessories he wants, he can give us all the same happiness that Blayze offers in just six months, and he actually has a solid track record of delivery on such promises. Is that any less reasonable than all the time and money Blayze demands to extricate from Cliff? Even if Cliff fails on one or two fronts, his history shows he will probably deliver on the rest. Meanwhile, Blayze could be just as needy as Cliff, for all we know — once the honeymoon is over.

Now versus later

If it were a sure thing Blayze would deliver, most actuaries could probably build a solid case that Blayze would pay for itself over a useful life of, say, 20 years. Investing more in the relationship with Cliff adds more "kids" (technology components) into the settlement when it inevitably gets ugly. However, three aspects of the business case should receive careful attention:

- *What is the opportunity cost of what we lose during the five-year Blayze courtship?* Investing in Blayze is time and effort that presumably could not also be spent upskilling Cliff. Organizations may view accessorizing Cliff at the same time as duplicate expense and/or as counterproductive to the transformation (e.g., a distraction or mixed messaging). Therefore, Cliff versus Blayze is an "either-or" that is very likely to occur in practice.
- *What are the timing and certainty of Blayze's value adds?* Blayze promises cool things, but it may take longer than we expect to get to the altar. Also, happiness may not feel like we think it will. Blayze may bloat up, i.e., start to take on workarounds and shortcuts during the courtship. For example, what if we learn midway into the overhaul that Blayze's capabilities are insufficient to natively handle exception handling programmed into Cliff? We may, ironically, need then to invest in making Blayze more like Cliff after we commit.

Blayze may also start to demand more and more over time. For example, Blayze told us he was cloud-native, but did he tell us that this would incur us cloud computing costs beyond just the costs of our matrimony to him? Cliff's cost model is pretty well understood, but all we know about Blayze at the moment is he seems capable and has expensive taste.

- *Will Blayze's adds still be valuable five years from now?* This may be the biggest question. Blayze takes five years of courtship to solve many of today's problems, but we don't know for sure if these will be the problems of tomorrow.

On the last front, consider if the goal of our project is to optimize our systems to interact with ChatGPT 4o API and Azure Document Intelligence (ADI) — creating dialog capabilities within the policy admin upstream and enhanced analysis capabilities downstream (e.g., structuring notes and images). Given the current rate of evolution of artifi-

cial intelligence (AI), input/output and interaction modes may be completely different five years from now than today, and it may make more sense to wait until closer to the technology asymptote to start courting replacements for Cliff than to anchor to a transitive technology state. On the other hand, optimizing for ChatGPT 4o and ADI may well optimize for future generations (is backwards compatibility still a thing in the AI renaissance?). In other words, OpenAI may not suddenly shut off 4o when it gets obsolesced by Deep Research — so there may be no need to pause. In that case the question reverts to whether AI initiatives are best served by "shortcutting" Cliff or trading up.

The answer could go either way. One overlooked and paradoxical aspect of AI is that it makes it easier to service technical debt but also to accrue it.[2] Having AI that can code as well as an experienced developer allows us to seamlessly heap accessories on Cliff and have recent grads translate modern (programming) languages such as Python back to dead languages such as FORTRAN so we can have the tough conversations with Cliff. Committing to Cliff increases debt, but AI helps reduce our interest rate by mitigating or eliminating the effects of his limitations. Switching to Blayze helps eliminate debt from the picture, but replatforming a core system is a Herculean endeavor that may be harder for AI to solve than accessorizing a current one.

Jumping off the Cliff

The key theme of the prior section is uncertainty. Blayze may protect us from a future that is very difficult to envision (especially at the pace of technological and societal change). Cliff is our best tool to get work done now. Actuaries should consider granting themselves permission to take "shortcuts" and think "short-term" with Cliff. This is debt financing. Short-term and long-term are not always mutually exclusive. We can squeeze more mileage out of Cliff while we flirt with Blayze, and this often happens in practice. But if we bet on Blayze without paying attention to Cliff, and Blayze doesn't pan out, we pay both the opportunity cost of what we could have gotten done with Cliff as well the technical debt of having spent five more years with him as he ages further.

Speaking of aging, let's revisit that Jersey Shore property from earlier. Given the two scenarios illustrated in the intro, I'm personally taking the 30-year mortgage and betting that, unlike Cliff, I don't outlive my life expectancy that significantly. I may wish I'd pursued less predatory financing options (and Blayze) should I receive a new medical prognosis, but it is difficult to know what the state of modern medicine will be in five years. I can always try to unload my Jersey Shore property in that case. In the meantime, I don't want to miss my opportunity to live the sweet life as a result of excessively thinking long term. Actuaries, of all people, are very well-positioned to help their organizations understand the time value of money.

Jim Weiss, FCAS, CSPA, is a vice president for Crum & Forster and is editor in chief for Actuarial Review.

[2] https://www.mckinsey.com/capabilities/quantumblack/our-insights/ai-for-it-modernization-faster-cheaper-and-better.

EXPLORATIONS By DAVE CLARK

Imaginary Balls

The title of this essay is taken from a comment made by David Spiegelhalter on the original thought experiment of Thomas Bayes, introducing the ideas behind what became known as Bayes' Theorem.

The thought experiment is found in Bayes' "An Essay towards solving a Problem in the Doctrine of Chances," edited and published (1763) by his friend Richard Price. The goal of Bayes' essay was to quantify "inverse probabilities." That is, how to estimate the probability of some state of the world having observed some experimental data.

To address this problem, Bayes set up a thought experiment for randomly rolling balls on a long table. In the initial setup, a white ball is rolled on the table in such a way that it could randomly land anywhere, and its position is unknown to the experimenter. In the second step, a number of red balls are rolled on the table also randomly and with their exact locations not known to the experimenter. The only information known is how many red balls, P, are to the left of the white ball, and how many, Q, are to the right of the white ball. (See Figure 1.)

Knowing only the numbers $P = 2$ and $Q = 3$, can we make a statement about the probability that the white ball is between any two points $X1$ and $X2$? For example, if we assume that each red ball has an equal probability of rolling to any point from 0 to 1, what is the probability that u is between 0.40 and 0.50? Bayes gave an answer to this by estimating a series expansion for what we would now recognize as a beta distribution.

$$Prob(X1 \le u \le X2|P,Q) = (\int_{X1}^{X2} u^P \cdot (1-u)^Q \, du) / (\int_0^1 u^P \cdot (1-u)^Q \, du)$$

If we want a point estimate of the parameter u, the expected value is found as:

$$E(u|P,Q) = ((P+1)/(P+Q+2))$$

We would estimate the position of the white ball as $u = 3/7$ based on this formula. This differs from the maximum likelihood estimate of $P/(P+Q) = 2/5$. The expected value has an extra "1" in the numerator and a "2" in the denominator.

Unlike the maximum likelihood estimate, the conditional expected value never reaches either 0 or 1. Even if all of the red balls are to the right of the white ball, we do not estimate $u = 0$.

The additional 1 in the numerator and the 2 in the denominator act as ballast and are based on the "prior knowledge" that the white ball was equally likely to have landed anywhere on the table. Spiegelhalter (2021) notes the connection to data augmentation because the prior knowledge can be viewed as "imaginary balls," one on either side of the line separating left and right.

> "In fact, since Bayes' formula adds one to the number of red balls to the left of the line [position of white ball] and two to the total number of red balls, we might think of it as being equivalent to having already thrown two 'imaginary' red balls, and one having landed at each side of the dashed line." (Page 325.)

This is a remarkable idea: Our prior knowledge (that the white ball could be anywhere on the table) can be introduced either as an explicit prior beta distribution, or in the form of data augmentation (adding imaginary balls).

The expression for the posterior expected value can also be written in the familiar credibility form:

$$E(u|P,Q) = (P/(P+Q)) \cdot (N/(N+K)) + (1/2) \cdot (K/(N+K))$$
$$N = P+Q,\ K = 2$$

In the credibility form, N is the number of actual balls observed, and K is the number of imaginary balls representing the prior knowledge.

For actuaries, this example is instructive because it provides an alternative interpretation to the familiar credibility constant K. In the usual Bühlmann interpretation, K is equal to the ratio of the expected process variance (EPV) to the variance of hypothetical means (VHM). But K can also be viewed as the amount of pseudo-data (imaginary balls).

Including our prior knowledge in the form of pseudodata is a simple but powerful way to perform a blending of observed loss experience with prior knowledge. The method is not limited to Bayes' billiard balls but can be expanded to other models such as generalized linear models (GLM) as described in Huang, et al., where noisy data in predictive models can be stabilized by introducing a small amount of imaginary data.

Figure 1. Bayes' Thought Experiment

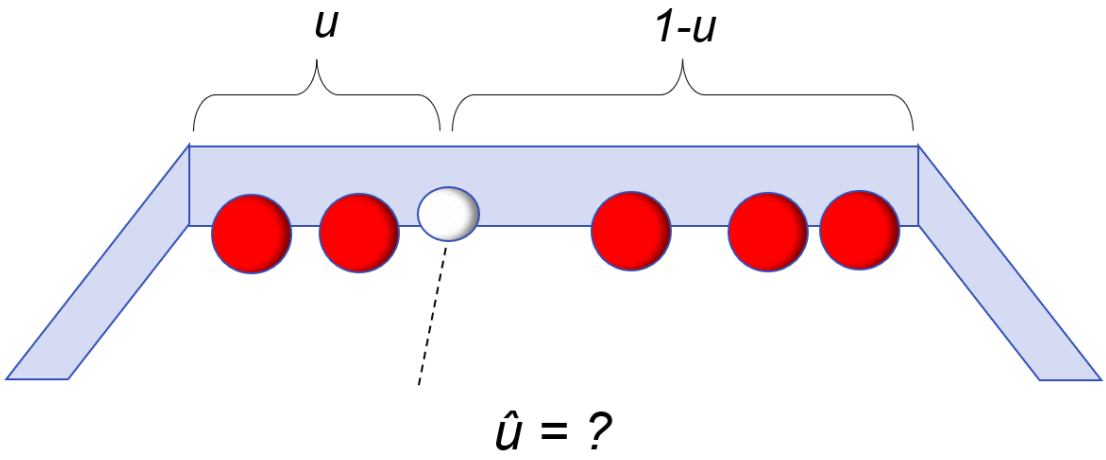
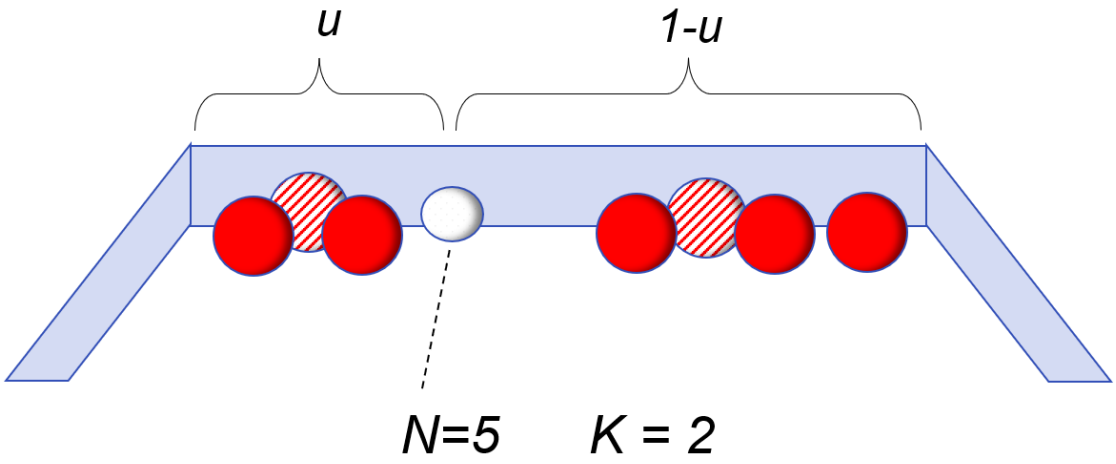


Figure 2. Including "Imaginary Balls."



They note:

"The practice of using synthetic data (or pseudo data) to define prior distributions has a long history in Bayesian statistics. It is well known that conjugate priors for exponential families can be viewed as the likelihood of pseudo observations."

The idea of incorporating prior knowledge in the form of pseudo data to augment observed loss data may be a fruitful area of future research for actuarial models.

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Dave Clark, FCAS, is a senior actuary with Munich Re.

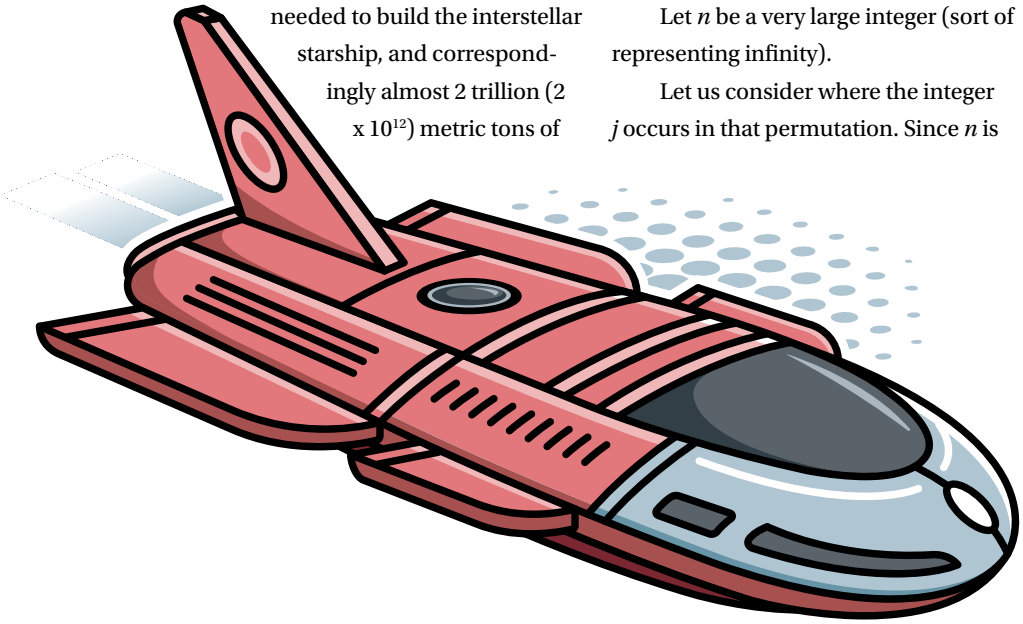
IT'S A PUZZLEMENT By JON EVANS

Refining Unobtainium To Boldly Go …

Raw unobtainium ore is only 0.0001% pure unobtainium. For the intended application, building an interstellar starship, the final refined product must be 99.9999% pure unobtainium. When feedstock is fed into a single state-of-the-art separation unit, pure unobtainium particles have a 50% chance of being output in the concentrate and a 50% chance of ending up in the tailings. Non-unobtainium particles have a 90% chance of ending up in the tailings and a 10% chance of being output in the concentrate.

Estimate the minimum number of separation units needed to produce a quantity of final product (99.9999% pure unobtainium) that is half the quantity of pure unobtainium in the raw ore.

Extra credit: Suppose that 1 million metric tons of final product is needed to build the interstellar starship, and correspondingly almost 2 trillion (2×10^{12}) metric tons of raw ore is provided. Also, an individual separation unit can process 1 kilogram of feedstock per hour. Estimate how many separation units are needed to produce the amount of final product needed within 90 days.



Non-adjacent permutations

What is the probability that a random permutation of the numbers 1 through 100 will not show any consecutive numbers next to each other?

Eamonn Long submitted the following solution.

Intuitively, we can reason that the probability will be very close to $e^{(-2)} \approx 13.5\%$ since 100! is a very large number. The argument is as follows.

Define a permissible permutation on $(1, \ldots, n)$ to be a permutation with no two neighbors being consecutive numbers.

Let n be a very large integer (sort of representing infinity).

Let us consider where the integer j occurs in that permutation. Since n is large, j will with probability approaching 1 occur somewhere in the middle of the permutation with neighbors on either side.

For a permissible permutation, the options for each side of j are reduced by a factor very close to $(1\text{-}2/n)$ and for both sides by $(1\text{-}1/n)^2$.

This is true for each $j = 1, \ldots, n$ and since for large n the events of no consecutive neighbors for each j will be close to independent events, the reduction in options for permissible permutations is $(1 - 2/n^n)$ or, as $n \to \infty$, $e^{(-2)}$.

More rigorous argument

We are interested in constructing the exact probability for each n and showing that, for n=100, there will be no practical difference from just using $e^{(-2)}$ as the probability.

A few definitions are needed.

Let a block within a permutation be a maximal length string of consecutive integers within the permutation. Here, maximal means that adding a neighbor to either side will void the consecutive property. So, for example, we may have one or more blocks in a permutation (or indeed none at all). To make this clearer, consider (1, 2, 3, 6, 4, 5) to be a permutation of (1, 2, 3, 4, 5, 6). In this example, there are two blocks (1, 2, 3) and (4, 5).

An event of interest (EOI) occurs in

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a permutation when, for some integer j, that j is next on one side or the other $j+1$. So, for a block to occur, there must be at least one EOI.

Our strategy is to use the inclusion-exclusion principle to count the number of permissible permutations as those without any blocks.

Claim: Let m be the number of blocks. The number of nonpermissible permutations of $(1, \ldots, n)$ with m blocks and at least k EOI is given by:

$((n-k)|m)\ ((k-1)|(m-1))\ (n-k)!\ 2^m$

Where $(a|b) = a!/b!\ (a-b)!$ for $a \geq b$.

Demonstration of claim:

As there are m distinct blocks, there are at least m EOI and at most $n-m-1$.

Let us attach an index set I to the set of EOI. Let us say that q is in the index set if an EOI occurs at q. Note that there are at most $n-1$ elements in I. Let k be the size of I and so equal to the number of EOI.

If there are k EOI, this means that there are $n-k-1$ values where an EOI does not occur, drawn from the set $(1,2, \ldots, n-1)$ and noting that n itself cannot index an EOI.

Between these $n-k-1$ values there are $n-k$ gaps (including the outside gaps) where a block of EOI may be placed. So, the number of ways of placing m blocks is $((n-k)|m)$.

Within each possibility of placing the m blocks, there is some variation around the ways of placing the k EOI indices within the blocks of indices. The count of this is well known and is $((k-1)|(m-1))$.

As a block may be ascending or descending, there are two choices of orientation for each block, and this gives us 2^m choices of orientation to include.

Treating now each Block as a separate symbol, say from a, b, c, ..., we now have $m+(n-k)$ from the indices not used for EOIs. However, there are m numbers at the end of each block, leaving $=n-k$ symbols to permute.

Multiply altogether to get the claim for given block number and a given (at least) number of EOIs.

Inclusion exclusion principle (PIE)

There are $n!$ permutations in total. To count the number of permissible permutations, we subtract the number of permutations with at least one EOI, add back in those with at least two EOI, now removing again those with at least three EOI, and so on.

Grouping by blocks, this gives us the number of permissible permutations $= n! + \sum_{m=1}^{\infty} 2^m \sum_{k=m}^{n} [((n-k|m)\ (k-1)|(m-1))\ (n-k)!(-1)^k]$.

Asymptotic behavior

The asymptotic behavior is now more accessible and tends to a proportion of permissible permutations being $e^{(-2)}$.

This is clear(er) when we consider that, for a given $m\ \Sigma\_(k=m)^n\ [((n-k|m)\ ((k-1|(m-1))\ (n-k)!\ (-1)^k]$ will be asymptotically tending from below, again use PIE, to $(-1)^m$ times the number of ways of permuting $n-m$ objects chosen from n objects without repetition, in other words, then the co-efficient of 2^m will tend to $-1m\ (n!)/(m!)$.

Solutions were also submitted by Krishna Chakravartula, Al Commodore, Bob Conger and Ken Klinger.

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