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VOLUNTEERS
MAKE THINGS HAPPEN

Unexpected Developments in Personal Auto

Tackling Inflation with Financial Theory

actuarialREVIEW

November-December 2023

departments

FSC LOGO

on the cover

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actuarialREVIEW

The magazine of the Casualty Actuarial Society

editor'sNOTE By GROVER EDIE, *AR* EDITOR IN CHIEF

Making it All Happen

This is our annual "Volunteers Make Things Happen" issue, where we highlight groups of people for their outstanding contributions. This year two groups take the stage: the Predictive Analytics Task Force and the Capability Model Task Force. These volunteers have been hard at work enhancing the path to CAS Associateship and helping members pinpoint the professional education they need to be top-notch actuaries.

Annmarie Geddes Baribeau's article on personal auto trends is a must read for all who are working in that space, and a should read for a lot of the rest of us. We also have a piece by *AR* Working Group member Rob Kahn on the insurance new business paradox.

In our "Making Things Happen" column, we focus on Dalesa Bady, ACAS, who is doing her part to grow the CAS pipeline of potential members with her company mentoring Black women actuaries. Speaking of potential new members, the winners of the CAS Trust Scholarship are also featured. We hope that these rising young college students will one day choose the P&C path with the scholarship's assistance.

In conclusion

This is the last edition for which I am the editor in chief. Jim Weiss, one of our *AR* editors and outgoing CAS VP-Research, will be taking the helm with the January-February 2024 issue. I enjoyed the task and wish Jim the best in his new role. "Task Times" is my last column as editor in chief, but I plan to submit an occasional piece in the future.

I would like to thank Elizabeth Smith for her role as *AR* managing editor and her patience working with me. She is a great asset to the magazine.

***AR* Managing Editor's Note:** Grover Edie and I have worked together a long time (since 2010!), and we have learned a lot together. Grover saw us through the change from a newsletter to a four-color magazine, which was no small feat, and has kept us going through thick and thin. On behalf of the entire *AR* Working Group and the many past *AR* editors, I thank Grover for his service on *Actuarial Review*.

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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president's MESSAGE By ROOSEVELT MOSLEY JR.

A Year in Review

Eleven months ago, at the close of the 2022 CAS Annual Meeting in Minneapolis, I began my term as president of the CAS. As I am writing this, I have one more month to go before my term is complete, and my emotions are mixed. I am surprised that this year has gone by so quickly. I feel a twinge of disappointment as I feel as if I ran out of time to do more, and at the same time I feel a bit of relief, as this year has been a busy one.

In the midst of this mixture of emotions, I want to use this last President's Message column to do a year in review. I want to celebrate the accomplishments from the past year and look forward to what the coming year will bring.

Accomplishments

This past year has been an active one — the volunteer leaders, CAS staff and volunteers have many accomplishments over the past year to be celebrated. I have highlighted a number of these accomplishments here.

- The Board undertook a governance review that resulted in a number of recommendations to improve the governance structure of the CAS and ensure that the organization is managed effectively and efficiently.
- CAS volunteers and staff continued to make progress on the Admissions Transformation Plan, releasing content outlines and beginning to develop revised exams.
- The CAS announced the launch of a predictive analytics module, which will become a required part of our exam pathway in 2025. The first offering of this module will be available this fall, with an official launch in May 2024.
- The first Student Ambassador Conference since the 2018 pilot program was held in conjunction with the 2022 Annual Meeting. CAS Student Ambassadors are members of the CAS Student Central who promote the CAS and P&C actuarial practice at their universities. Student Ambassadors attended educational sessions, networked with CAS members and met with CAS leaders.

I want to celebrate the accomplishments from the past year and look forward to what the coming year will bring.

- The CAS established new DE&I partnerships, including becoming an exhibitor at Black college expos.
- The CAS completed a disability and accessibility review and has begun to implement the results of the study.
- The volunteer appreciation program was enhanced to include a "Meet the Volunteer Group" series to highlight the contributions of volunteers, expanding our social media coverage of volunteer award winners and piloting a volunteer information and appreciation station at the CAS Spring and Annual Meetings.
- CAS Student Central Summer Program made changes to boost the value of the experience for those participants. We received over 400 applications from students in 29 countries representing 175 universities. More than 200 students completed the program, and each student was rewarded with a free registration for the CAS Data and Insurance Series course "Introduction to Data and Analytics" (DISC-DA). The end-of-program employer networking was also enhanced.
- We launched a new course called "Impact of Unintentional Bias in Insurer Decision Making." This specialized, on-demand course was created by iCAS in partnership with The Institutes. It covers methods for recognizing how data modeling can contribute to unintended consequences to better mitigate risks associated with decision making.
- We designed a new continuing education program for the Certified Specialist in Catastrophe Risk (CSCR) and Certified Catastrophe Risk Management Professional (CCRMP) credentials, which are jointly administered by the International Society of Catastrophe Managers and The CAS Institute. The program was designed to encourage and acknowledge ongoing professional development through continuing education so credential holders are always prepared to meet the demands of the evolving business environment.
- The CAS hosted the first China Insurance Summit in December 2022. This event, conducted primarily in Mandarin, brought together CAS

President's Message, page 8


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President's Message
from page 6

members and other actuarial leaders to discuss the latest developments in the field.

- The CAS showcased its expertise through speaking engagements at actuarial conferences around the world, including Australia, the Caribbean, Hong Kong, India, Kenya, Malaysia, Nigeria, Singapore, Taiwan and the U.K.

These are just highlights — I don't have enough space to list all the accomplishments. But you can see your volunteer leaders, CAS staff and volunteers have been hard at work moving our key strategic initiatives forward. They should be applauded for all their efforts.

Looking forward

As I think about what lies ahead for the CAS, I am excited for a couple of reasons. First, CAS members are uniquely skilled to be valuable members of the teams that help our customers solve the business problems they are facing in a rapidly changing world. Second, I am confident that we have the right volunteer leaders, volunteers and CAS staff to ensure this happens.

Think back to the Envisioned Future articulated in our Strategic Plan:

> "CAS members are sought after globally for their insights and ability to apply analytics to solve insurance and risk management problems."

Analytics involves applying modeling techniques to data to identify insights that can be used to implement solutions. As we look to the future, we know that data and analytics techniques will continue to advance. Therefore, to ensure we can achieve our envisioned future, actuaries will need to evolve as well. We have access to more data than ever before, and that data is available at a pace that is significantly faster than it has ever been. Analytics techniques have also continued to advance, and technology is also advancing at a rapid speed. Technology advancements allow for faster analysis of more data and facilitate the implementation of more sophisticated solutions. But equally as important as the data and technology is the ability to understand the process that generated the data and to understand how the analytics insights will be deployed.

Our steps being taken in the Admissions Transformation Plan and the predictive analytics project will help to prepare our candidates for a new analytics world. The capability model will allow our members to identify areas where they can improve their skills to adapt to a changing world and will also help the CAS provide appropriate continuing education to meet our members where they are.

Additionally, a new Actuarial Practice Analysis (APA) will engage with stakeholders to ensure actuaries are prepared to meet the challenges of the future. This APA will also inform our admissions and continuing education plans.

More trends are coming that we do not yet know. But I am confident that, whatever the challenge, the volunteers, staff and volunteer leaders will face it confidently and appropriately. I have had the chance over the last two years to interact with many volunteers, to work collaboratively with the CAS Board and to work closely with Victor Carter-Bey and CAS staff, and I can say without hesitation that we have highly

I am confident that whatever the challenge, the volunteers, staff and volunteer leaders will face it confidently and appropriately.

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* competent leaders who truly care about ensuring the CAS doesn't just maintain its place of leadership as P&C actuaries, but elevates its status in our areas of expertise. And I know that with Frank Chang and Dave Cummings stepping into this role over the next two years, the CAS is in great hands.

It has truly been an honor to serve as president of this great organization, and I am excited not just about where we have been, but where we are going! And I have no doubt that when the "year in review" happens next year, we will have much more to celebrate!

Correction

The following disclaimer was omitted from the "Meet the VEEP, William Wilder" column in *AR* September-October:

The views expressed in this article are solely the views of William Wilder and do not necessarily represent the views of Ernst & Young LLP or other member firms of the global EY organization. The information presented has not been verified for accuracy or completeness by Ernst & Young LLP and should not be construed as legal, tax, or accounting advice. Readers should seek the advice of their own professional advisors when evaluating the information.

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COMINGS AND GOINGS

Kelly McKeethan, FCAS, CERA, CPCU, has been appointed to the position of actuary, commercial reserving, at Liberty Mutual. Previously McKeethan has worked at Merastar Insurance Company, Southern Heritage Insurance Company, Insurance Industry Consultants, Bank of America and American Home Shield.

Rade Musulin, ACAS, MAAA, CCRMP, was recognized as the 2023 Actuary of the Year by the Australian Actuaries Institute. Musulin is an actuary with more than 40 years of experience specializing in natural perils, catastrophe risk modelling, public policy development and sustainability, and has assisted industry and government with improving their resilience and understanding of climate change. Musulin and coauthor Alp Can recently wrote "Climate Change Risk (and Opportunity) for the P&C Actuary" (*AR*, September-October 2023).

Jonathan Charak, FCAS, MAAA, CPL, was recognized as one of Crain's Chicago Business 2023 Notable Leaders in Sustainability. Charak is the vice president and emerging solutions director in sustainable underwriting at Zurich North America and has been in the insurance industry since 2003. In the CAS, he served as vice chair of the Automated Vehicles Task Force that produced the report "Automated Vehicles and the Insurance Industry — A Pathway to Safety: The Case for Collaboration" (E-Forum Spring 2018). He previously volunteered for the Education Structure Implementation Task Force, International Member Services Committee and the Asia Regional Committee.

Joseph Dumas, ACAS, was appointed head of risk and analytics for Trium Cyber's U.S.-based services division. In his new role, Dumas will oversee Trium Cyber's risk and analytics practice while pioneering innovative approaches to utilize computer science for a deeper understanding and mitigation of cyber risks. Dumas joins Trium from Beazley Group, where he was the head of cyber data science and analytics. Prior to this role, Dumas served as a senior actuarial consultant at Ernst & Young, with expertise in modeling, predictive analytics, underwriting, pricing, and reserving and claims.

Carol Sorenson, FCAS, has been appointed vice president of analytics for Topsail Re. In the new role, Sorenson's responsibilities will include pricing accounts and providing actuarial and pricing analytics. Before joining Topsail, Sorenson managed a reserve portfolio and team of actuaries in her role as vice president and director at Zurich North America. Collectively, she has over 17 years of primary experience in commercial lines.

Mark Kaufman, FCAS, has been appointed chief actuary for the National Programs Division of Brown & Brown, Inc. Kaufman's career spans over 30 years across many specialty lines of business. Prior to this, he held leadership roles at industry-leading firms, including commercial lines CFO at Nationwide, chief pricing actuary at QBE NA and chief actuary at CNA for the Specialty Division.

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

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."

CAS Past President (1996-1997)
Robert A. Anker (FCAS 1972)
1941–2023

Robert A. Anker, 81, of Carmel, Indiana, died in August 2023. He was born in Austin, Minnesota, to the late Alvin and Ruth (McGuire) Anker and graduated from Lawrence University in Appleton, Wisconsin, where he earned his degree in mathematics. Anker's career as an actuary and insurance executive began at Employers Insurance of Wausau in 1964 and brought him to American States Insurance in Indianapolis in 1974. He retired from American States as chair and CEO at the end of 1997. In his retirement, Anker enjoyed trips to his home in Santa Fe, New Mexico, solving Sudoku and crossword puzzles, and celebrating the arts. He was happiest having fun and making memories with his family and friends. Anker loved the arts and served on the boards of the Indiana Repertory Theatre, the Indianapolis Art Center, Indianapolis Symphony Orchestra, the International Violin Competition of Indianapolis and the Fort Wayne Philharmonic. His civic involvement included the Washington Township School Board and the Indianapolis and Fort Wayne Chambers of Commerce. He was proud to have served as a trustee of his alma mater. In addition to his parents, he was preceded in death by his brother, John Anker. Survivors include his wife of 55 years, Pat; children Sean (Loni Dishong) Anker, Kevin (Julli) Anker, Jennifer Anker and Jackie (Matt) Allman; aunt, Shirley Madison; six grandchildren; two great-grandchildren; his extended family as well as many friends and associates.

Illinois Proud
James Matusiak (FCAS 2002)
1976-2023

James John Matusiak Jr., age 47, of Frisco, Texas, passed away peacefully at his home following a brief illness in January 2023. He is survived by his wife, Pamela (nee Denning) Matusiak; children Anna (18), Evelyn (16) and Ian (12); his parents, James Sr. and Ellen Matusiak; grandmother, Louise (John) Matusiak; brother, Paul (Kelly) Matusiak; sisters Carrie Sullivan and Kristin (Dan) Blaskovitz; numerous nieces and nephews, the extended Denning family and many friends. A proud father, he was married for 25 years to Pam, who was the love of his life and his high school and college sweetheart. He and his family moved from Illinois to Bermuda and then back stateside to Austin, Texas; St. Louis, Missouri; and Dallas, Texas. Raised in Orland Park, Illinois, Matusiak was the oldest of four children. He attended Carl Sandburg High School in Orland Park and the University of Illinois-Urbana-Champaign, where he majored in actuarial science and was a leader in the Pi Kappa Alpha Fraternity. He graduated early from college and cultivated many lifelong friendships and an undying love for the Fighting Illini. After college, Matusiak began his career at Allstate. After Allstate, he was a respected leader within the reinsurance industry for esteemed firms like Renaissance Reinsurance, KPMG and Guy Carpenter. Most recently, Matusiak was proud to be part of the team at Howden Tiger. He will forever be loved and remembered by his family and lifelong friends.

The Irish Lad
William Francis O'Connor (ACAS 2015)
1968-2022

In August 2022, William "Liam" O'Connor passed away unexpectedly of natural causes, leaving his many friends and family members heartbroken in his absence. O'Connor was born in Oakland, California, six minutes after his twin brother, Tim. He attended Moreau High School in Hayward, California, then studied mathematics at UC Berkeley, which led him to his lifelong career as an actuary. True kindred spirits, O'Connor and his wife Trish enjoyed 25 years of marriage, their happiness made complete with the addition of their two children, Kieran and Claire, and adorable dog Charlie. After seven years with WCIRB, O'Connor spent the following 21 years at AIG supporting in various actuarial roles. Many of his closest friendships were developed through work, and both he and his wife truly cherished these lasting connections. A resident of San Ramon, California, for 23 years, he loved and served his community. He was a longstanding member of the local chapter of the Knights of Columbus. He enjoyed his family and found joy and satisfaction in hosting holiday dinners, listening to Irish music, watching *Jeopardy!* and cooking up clever concepts for his family's annual Halloween card. In addition to his wife and children, survivors include his mother, Barbara O'Connor; brothers Michael and Tim O'Connor (Diane) ; sisters Julie Villeneuve (Roger), Mary O'Connor and Pauline O'Connor (David Jargowsky); his in-laws; several nieces and nephews; friends Chris and Johanna Prevost; and many aunts, uncles and cousins in the U.S. and Ireland. O'Connor was predeceased by his father, Bill O'Connor.

The Explorer
Vladimir Shander (FCAS 2003)
1956-2023
Vladimir Naumovich Shander, born in Moscow, Russia, passed away unexpectedly in April 2023, while traveling abroad in Petra, Jordan. Vladimir volunteered in different capacities for the CAS from 2003 to 2020. He graduated from Moscow State University with a degree in mathematics. Vladimir was an actuarial director for ISO from 1999-2022. He was a volunteer member of the CAS Member Advisory Panel, Claims Level Analytics Working Group, Accounting Changes Committee and Task Force, Implementation Task Force for the Education Paper on Reserving, Reserves Committee, and Syllabus and Examination Committee. In his personal life he was a dedicated father and grandfather, a husband of 35 years to Alla Laufer prior to her passing in 2017, a mathematician, a teacher and a cave explorer. He is survived by his two children Aleksandra and Lizzie Shander.

AR Web Exclusives: CAS Leaders' Views on Reaching 10K Members

Check out our *AR* Web Exclusives online at ar.casact.org where you will find a three-part series that celebrates reaching our 10K member milestone. We talked to past presidents, our current president, our CEO, board members and vice presidents, both incoming and outgoing. Learn what these leaders accomplished with the help of volunteers and staff, their perspectives of where we are now as an organization and what they hope for the future.

CALENDAR OF EVENTS

March 17–20, 2024
Ratemaking, Product and Modeling Seminar and Workshops
New Orleans, Louisiana

May 5–8, 2024
CAS Spring Meeting
Atlanta, Georgia

June 3–4, 2024
Seminar on Reinsurance
Boston, Massachusetts

September 9-11, 2024
Casualty Loss Reserve Seminar
San Francisco, California

November 3-6, 2024
CAS Annual Meeting
Phoenix, Arizona

Visit casact.org for updates on meeting locations.

IN MEMORIAM

Robert A. Anker (FCAS 1972)
1941–2023

Gregory Andrew Finestine (FCAS 2011)
1979-2022

James Matusiak (FCAS 2002)
1976-2023

William Francis O'Connor (ACAS 2015)
1968-2022

Vladimir Shander (FCAS 2003)
1956-2023

2023 CAS Election — Cummings to be President-Elect

David Cummings has been elected CAS president-elect. He will assume his role at the close of the 2023 Annual Meeting in November, along with new board members Wanchin Chou, Sandy Lowe, Joe Milicia and Kathleen Ores-Walsh.

Balloting results for the 2023 CAS election closed on August 30. According to the election procedures approved by the Board, all vote counts are released to the membership. The counts follow:

President-Elect

David Cummings	1,766

Directors

Kathleen Ores-Walsh	1,132
Sandy Lowe	1,057
Joe Milicia	1,000
Wanchin Chou	974
Emma Casehart	955
Michael R. Larsen	945
John Aquino	755
Tom Struppeck	623

A total of 2,139 voting members cast ballots (25.6%), as compared to 3,070 voting members last year (37%).

David Cummings, FCAS

Wanchin Chou, FCAS

Sandy Lowe, FCAS

Joe Milicia, FCAS

Kathleen Ores-Walsh, FCAS

D.W. Simpson Contributes to the CAS Trust

The Trustees for the CAS Trust are pleased to announce that D.W. Simpson Global Actuarial Recruitment donated $5,000 to the Trust in 2023, bringing the company's total lifetime contributions to $250,000.

Established in 1979, the CAS Trust is a non-profit organization that funds actuarial research and education. One of its most notable programs is the CAS Trust Scholarship, which aims to build students' interests in the P&C actuarial profession and to encourage the pursuit of CAS designations. The CAS Trust offers up to $30,000 in scholarships each year — four $5,000 scholarships and four $2,500 scholarships.

The CAS sincerely thanks D.W. Simpson Global Actuarial Recruitment for its continued support of the CAS mission to advance actuarial science.

Inquiries and contributions to the CAS Trust should be addressed to the CAS Chief Financial Officer Todd Rogers at trogers@casact.org.

Certify Compliance with the CAS Continuing Education Policy

All Fellows and Associates need to certify their compliance with the CAS CE Policy's requirements by December 31, 2023. Members must certify compliance at the end of each calendar year as compliance with the CAS CE Policy allows the member to provide actuarial services in the year immediately following certification of compliance. This means that members should be certifying or attesting as to whether they have complied with their CE/CPD requirements during the 2023 calendar year in order to be able to provide actuarial services in 2024.

If a member is practicing as an actuary, the member should indicate the proper attestation year as the year during which they are able to practice after having met the prior years' necessary CE/CPD requirements. For example, a member who completed their required CE/CPD requirements during 2023 will be able to provide actuarial services in 2024.

Note that even members who are ***not*** in actuarial roles should review the requirements, as CE compliance may still be required.

If members are not providing actuarial services, they must still attest within their CAS membership account. Members who do not provide actuarial services do not have to earn CE or meet the CAS CE Policy. The CAS CE Policy defines "Actuarial Services" as "Professional Services provided to a Principal by an individual acting in the capacity of an actuary. Such services include the rendering of advice, recommendations, findings, or opinions based upon actuarial considerations."

Should you certify compliance if …

Circumstance	Answer
You recently became a new ACAS/FCAS member and are still taking actuarial exams?	**YES,** the time you spend in independent study for exams may be counted toward CE requirements.
You are an actuary working in a nontraditional area of practice (e.g., underwriter, risk manager, CEO)?	**YES,** actuaries in nontraditional areas may still be providing "actuarial services" as defined above.
You did not complete the relevant amount of CE/CPD needed for your chosen Qualification Standard or Requirement?	**YES,** even if members have not yet met their CE/CPD needed for their chosen Qualification Standard or Requirement, they must still attest. If actuaries attest as non-compliant, they may not provide actuarial services until they become compliant with their chosen Recognized National Standard. Actuaries may update their attestation at any time of the year to "compliant" once they have met the requirements.
You are no longer providing actuarial services?	**YES,** if you recently stopped providing actuarial services, you must attest this year. Members that attested "not providing actuarial services" last year and plan to continue not providing actuarial services in 2024 will not be required to attest again unless their status changes.
You are retired?	**YES,** members who are retired may still be subject to CE Policy. Only if you are not currently providing actuarial services, are you exempt from attesting on an annual basis and exempt from meeting the CE requirements. If you are retired but continue to provide actuarial services from time to time, you should attest appropriately and meet CE requirements.
You are an Affiliate of the CAS?	**NO,** you do not need to attest because Affiliates are not subject to the CAS CE Policy.

How to Certify Compliance

To certify compliance, members should attest for 2024 by December 31, 2023, by following these steps:

1. Go to www.casact.org.
2. Sign into your CAS member account by clicking on the "Login" tab at the top of the page.
3. Click on the "Profile" tab.
4. Under the "My Account Links," click on "My Attestation."
5. Click the "Add" button found in the upper right-hand corner.
6. Select attestation year "2024."
7. Under the "Compliance Attestation" field, select which statement applies to you.
8. Under the "Method" field, select the Recognized National Standard with which you are complying.

Members who do not certify their compliance or who do not indicate they are not providing actuarial services by February 1, 2024, will be shown as non-compliant under the Continuing Education heading of the membership directory on the CAS website. Members who are listed as non-compliant may be subject to further administrative penalties as determined by the CAS Board.

For more information on certification, visit the Continuing Education Policy webpage, review the CAS CE Policy or email ce-review@casact.org.

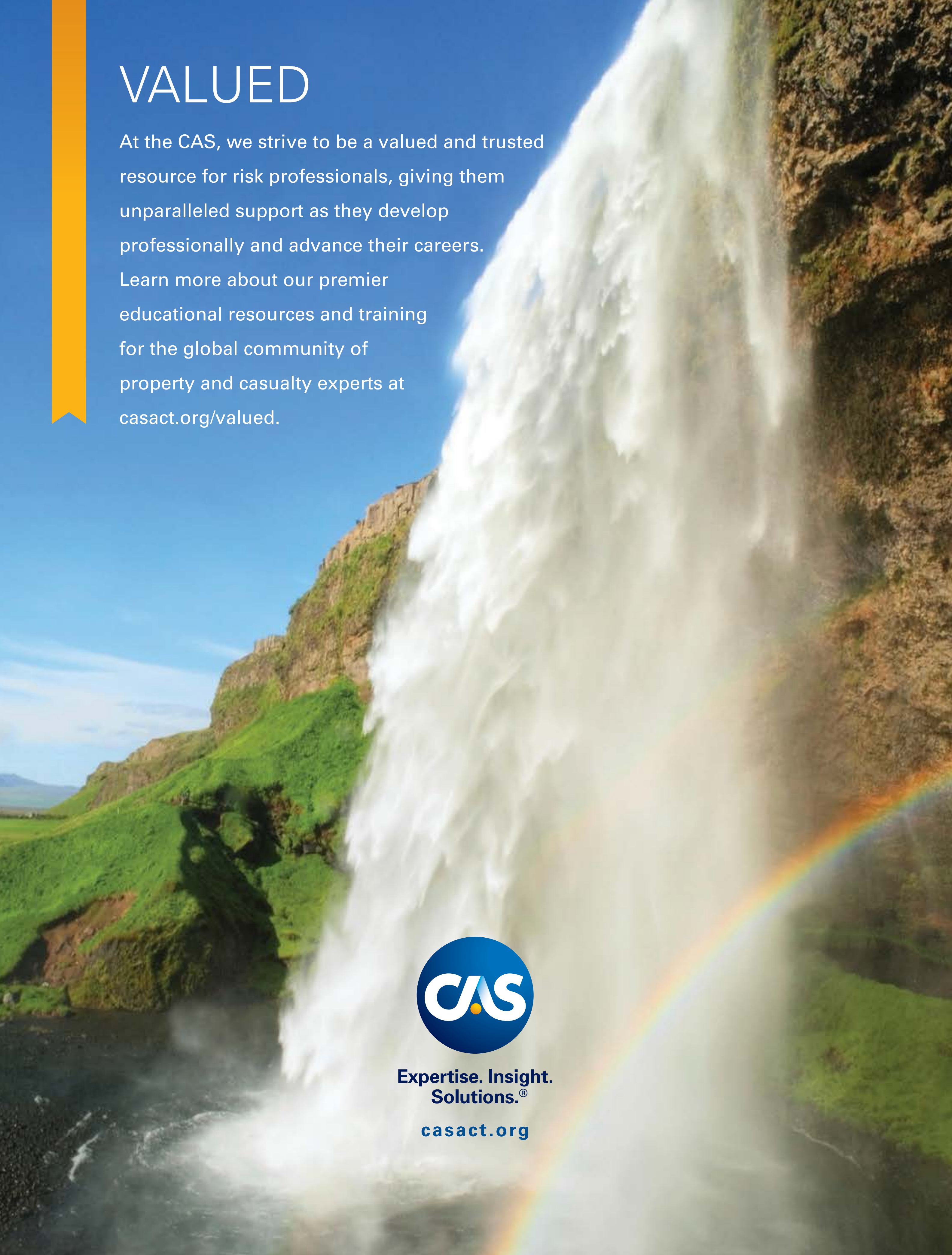
CAS STAFF SPOTLIGHT

Meet Joyce Warner, Chief Business Officer

Joyce Warner

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

- **What do you do at the CAS?**
  I work with the international and IT teams and our corporate sponsors. The international team is working on our international growth and member support strategy. IT is developing a new association management system to improve the member experience and streamline business operations. I also work with Victor Carter-Bey, our CEO, on projects that span the CAS.
- **What inspires you in your job, and what do you most love about it?**
  I love being among a group of energetic staff and volunteers and having a challenging set of goals. The CAS has grown significantly in membership over the last several years, and I'm excited to help support that trajectory.
- **Describe your educational and professional background.**
  I have a BA from Stony Brook University, an MA from American University and an MBA from Virginia Tech. Across those degrees, I studied a mix of international relations, education, languages, business, and information systems. I've had many wonderful opportunities to work with many inspiring people. I have worked in a few different sectors but spent much of my career working on educational systems in emerging markets. Before the CAS, I led a national non-profit providing emergency assistance and disaster relief. I am also a Certified Association Executive (CAE) and Senior Professional in Human Resources (SPHR).
  I believe that non-profit organizations of all types should use a business mindset paired with lots of heart to best meet their goals.
- **What is your favorite hobby outside of work?**
  International travel, architectural tours and pickleball! I've been to 35+ countries and now aspire to travel internationally at least once a year. I love modern and mid-century homes, and I try to go on tours in the D.C. area and when we travel. My husband and I took up pickleball last summer and now are part of that crazy growing cult.
- **If you could visit any place in the world, where would you go and why?**
  Next summer we are planning a trip around Sicily. Once before I visited the area my great grandparents emigrated from, but I'm looking forward to seeing the rest of Sicily this time.
- **What would your colleagues find surprising about you?**
  Several years back I was invited to testify alongside the gracious and lovely Geena Davis (from *Thelma and Louise*) for the House Foreign Affairs Committee on the topic of women and technology. My organization was working to get women and girls more access to the internet to improve learning, livelihoods and overall wellbeing in countries with limited infrastructure. Davis was there to discuss her institute's work creating more gender balance and inclusion in the entertainment industry. Other brushes with celebrities include serving as an interpreter for Vanessa Redgrave (from *Howard's End*), hanging out with Linda Ronstadt and James Ingram after their show in which a musician friend was playing back up.
- **How would your friends and family describe you?**
  First, that I have an almost unnatural love for 70s music (imagine how happy I was to hang out with Linda Ronstadt). Kidding aside, I think they would also say that I wouldn't complain about something without trying to do something to improve the situation and that I don't sweat the small stuff.


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/valued.
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MEET THE VEEP

Kendra Felisky, VP-International

By DR. SARAH SAPP, CAS EDITORIAL/PRODUCTION MANAGER

For Kendra Felisky, FCAS, growing the pipeline of actuaries includes looking beyond U.S. borders.

As the CAS VP-International, her primary responsibilities are to further Pillar Three of the CAS Strategic Plan, which is "Expanding Globally."

"We are doing this by targeting growth in members through candidate support and student outreach as well as communicating with employers and regulators about the benefit of property and casualty actuaries," Felisky said.

Felisky is also responsible for ensuring that the CAS meets the needs of its members who work outside North America. Currently, the organization has just over 5% of its members residing outside North America and around 7% to 8% of its candidates.

Her main goal has been to put in place a solid support structure for CAS volunteers and staff so that they can further the goal of expanding globally.

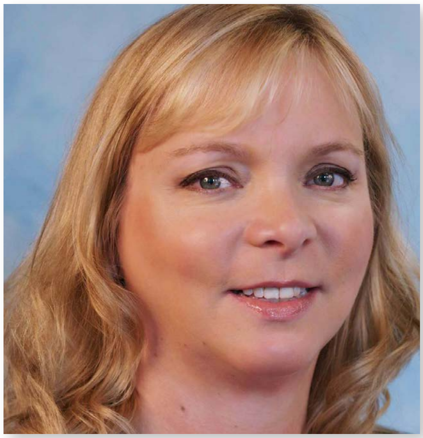
"It will take a number of years to see the effects of our efforts, so we are concentrating on increasing our interactions with university students, candidates, members, employers and regulators as much as possible," Felisky said.

She is excited about the webinars the CAS has begun hosting that are aimed at an international audience and at appropriate times for people on the other side of the world. She is also delighted to see positive progress with new University Engagement programming designed to raise student awareness early on about the CAS.

Felisky is most proud of putting in place a structure for evaluating the countries and areas in which the CAS can make the most difference. Instead of being reactive or trying to be everything to everybody, the CAS is purposeful in its approach. She is also proud of the work being done to create awareness that the CAS has members located outside of North America and connecting those members with each other locally.

"It will take a number of years to see the effects of our efforts, so we are concentrating on increasing our interactions … ." — Kendra Felisky

"I'm always interested in doing what I can to promote the CAS internationally — it is the best education for producing the actuaries of the future," she said. "It is also full of really nice people to work with."



Kendra Felisky

Felisky's CAS volunteer history naturally led her to the VP-International position. "I've always volunteered in the international space, such as with the Regional Affiliate, Casualty Actuaries in Europe and the predecessor groups to the International Member Services Working Group," Felisky said.

After graduating in applied math from UC-Berkeley, Felisky stumbled into the property-casualty field. "I've spent most of my career as a consultant, on both sides of the 'pond,' but I've also been a chief actuary and a chief risk officer. I am now an independent non-executive director for three insurance companies in London," she said.

For those who want to make their way up to volunteer leadership roles, Felisky offers this advice: "Put your hand up! Don't wait to be tapped on the shoulder. And network like crazy — you never know where it will lead."


CV
Manager
OBJECTIVE
EXPERIENCE
EDUCATION
SKILLS
HOBBIES

MAKING THINGS HAPPEN By DR. SARAH SAPP, CAS EDITORIAL/PRODUCTION MANAGER

Bady Coaches Black Women in Insurance to Take it to the Next Level

The Making Things Happen column features CAS and iCAS members who serve the associations in many capacities and enrich the volunteer experience for all.

Dalesa Bady, ACAS

Personal development has always been a fascination for Dalesa Bady, ACAS.

She didn't know what type of impact this fascination would have on her career, but as a highly determined and ambitious person, it was important for her to build a career she could be proud of that allowed her to grow.

For a while, her career as an actuary appeared to be on track. In fact, all of the right things were happening. She passed actuarial exams, increased her exposure and visibility in the profession, expanded her skillset and ultimately watched her career grow.

But, in the back of her mind, something felt oddly off.

"Over time, I began to realize my career goals were becoming less and less clear," Bady said. "This wasn't an ideal situation for me. I felt lost, and it ate at me, constantly."

She knew she needed support, so she found a coach.

"It was the best decision I've made in my career so far," Bady said. "I uncovered a lot about myself and began to strengthen muscles that I didn't know I had. I got the clarity I needed and so much more in the process."

It didn't take long before concluding *she* wanted to become a certified coach and serve as a resource for Black women in the actuarial profession. While still working full-time last year, she launched her coaching business and has now helped dozens of Black women in STEM fields.

"This type of work speaks to my interests, my strengths and my mission for supporting Black women in the workplace and moving the needle toward a more diverse workforce in the insurance and actuarial space," Bady said.

In her current capacity as a coach, Bady provides transformational alignment and professional development support for her clients. More specifically, she helps Black women in STEM fields become more confident, renew their energy and lead careers that are connected to their true, authentic selves.

"As a Black woman, a coach and practicing actuary, I come to the table with a unique perspective," Bady said. "And as a result, I often wear a number of hats when I partner with my clients. More importantly, I understand my clients' struggles and empower them to go after the fulfillment they deserve in their careers and lives."

At the center of everything, Bady helps her clients achieve their vision and drive results by uncovering barriers, building new habits and bridging the gap from their present to future self.

As an actuary at GuideOne Insurance, she acts as a liaison where she connects the business with the data and analytical arm of the organization. In this role, she works with a number of people across a variety of technical functions and has an opportunity to collaborate with underwriters to fill gaps and understand their data and analytical needs from a portfolio management perspective. She is also a key partner in corporate strategy and planning at GuideOne Insurance

She first discovered the actuarial profession as a senior in high school when she had the opportunity to spend an afternoon with a chief actuary at a life insurance company in her hometown.

"I don't remember much of our dialogue, but what I did take away from our afternoon together was this level of excitement and energy he had for his work," Bady said. "Those things seemed to just ooze out of him in a way that was contagious to me."

"I decided to lean into the actuarial profession at that point because I wanted to have those same feelings about my work in my career. And today, I'm fortunate to be in a place where I can have exactly what I was looking for all those years ago."

Bady attended The University of Texas at Austin (UT Austin) and received her BS in mathematics with a concentration in actuarial science.

It didn't take long for her to get acclimated to the culture at UT Austin, so she became involved in multiple campus organizations and activities. Because of her level of involvement, she always felt that her professional career truly began at UT Austin. Being a student at an institution with a strong actuarial science program afforded her great opportunities and a wealth of exposure to companies hiring actuaries.

During her time at UT Austin, she also had internships at a large, multinational company. These experiences played a major role in shaping her understanding of an actuary's role in the workplace and expanding the technical skills in her toolbox.

After graduating from UT Austin, she went into the property and casualty insurance industry and never looked back.

She first discovered the actuarial profession as a senior in high school when she had the opportunity to spend an afternoon with a chief actuary.

"I've been working in this industry for the last 12 years and have accumulated a wealth of knowledge and experience," Bady said.

Her actuarial career began at USAA with a focus on pricing personal lines products. She later moved into a number of nontraditional actuarial roles, including product management, forecasting and planning, and data analytics. Following USAA, she worked as a consulting actuary for Pinnacle Actuarial Resources and led a variety of actuarial work for captives and multiline insurance carriers prior to joining GuideOne Insurance.

She is an active volunteer in the CAS and International Association of Black Actuaries (IABA).

After she became an Associate, she turned to student engagement as a way to begin her CAS volunteering journey. She worked with UT Austin and The University of Texas at Dallas as a CAS University Liaison, providing direct support and guidance for students interested in the actuarial profession. She also served in a mentor capacity across several CAS programs, including the CAS Student Central Summer Program, which was introduced in 2020 to provide an alternative professional and educational experience for those impacted by canceled internships during the pandemic.

She is also a member of the CAS Leadership Development Committee (LDC) and contributes ideas and develops articles for the LDC newsletter. The primary audience for the LDC newsletter is CAS members.

Within IABA, she leads the Student Programs Committee. This committee focuses on the development and promotion of Black students and career changers entering the actuarial profession. In this position, she works with IABA volunteers to ensure IABA's student programs are aligned with the organization's vision and strategic plan.

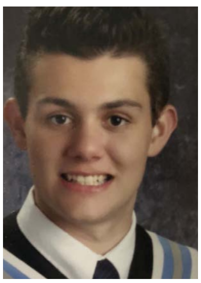
Some fun facts about Bady: Because she grew up in Texas, family and football have always held a special place in her heart. Without fail, she drives herself crazy each season as a fan of the Dallas Cowboys. She has an 18-month-old British Shorthair cat named Stormi. Outside of her time working in either of her professional capacities, she loves to travel. Earlier this year, she spent two weeks in Italy, and she looks forward to making new memories with her family as they travel over the upcoming holiday season.

Eight Promising Students Earn 2023 CAS Trust Scholarships

Eight university students have been chosen to receive the 2023 CAS Trust Scholarship. The CAS Trust Scholarship has been crafted to amplify students' passion for the property-casualty actuarial profession while fostering a path with the CAS. These scholarship recipients have demonstrated remarkable achievements having meaningful impacts, both academically and professionally, throughout their actuarial career journeys. Following are brief profiles of the 2023 awardees.

$5,000 CAS Trust Scholarship Recipients

Nickolas Grammatico is a third-year student at the University of Waterloo, where he is studying actuarial science. He has had multiple actuarial co-op placements, including one at Intact Financial and two at PwC. Grammatico has served as the vice president of finance for the University of Waterloo's actuarial science club and as a delegate for the 2022 ASNA conference.



Grammatico

"I am deeply grateful for the Casualty Actuarial Society's commitment to recognizing individual merit and promoting excellence in the actuarial profession. Being honored for my efforts fuels my dedication to the pursuit of excellence in my work."

Kevin Konop is a senior at the University of Wisconsin-Madison studying actuarial science and risk management and insurance. He spent the summer of 2022 at Secura Insurance as an actuarial intern, followed by his current role as an actuarial summer scholar at Deloitte. At UW-Madison, Konop is heavily involved in the actuarial club, where he has held leadership positions since his sophomore year. Konop and three of his classmates secured a spot among the top six teams in the Munich Re Cup Actuarial Case Competition, where their performance earned them an overall second-place finish in March 2023.

Konop

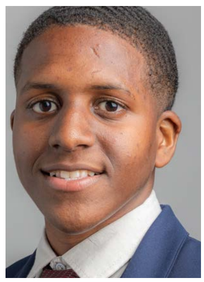
"It fills me with profound gratitude to receive this remarkable acknowledgment from the CAS. As a dedicated student actuary, I will persist in my disciplined efforts and contribute to the community that has played a crucial role in my journey thus far."

Daniel Polites is a senior at the University of Illinois at Urbana-Champaign, where he is studying actuarial science and statistics. He has been interning with State Farm since 2021 and has spent time in their property-casualty and life/health departments. Polites has served as the University of Illinois actuarial science club president and serves as the CAS Student Ambassador for the university.

Polites

"I am grateful for everything the CAS does, including this support. It is an honor to achieve this recognition, and I am thankful for the opportunities it provides. Thanks to everyone who has supported me along the way, including my mentors, professors and supervisors."

David Ramdeen is a senior at St. John's University, where he is studying quantitative risk and insurance (a mix of actuarial science and risk management and insurance courses). He spent the summer of 2022 interning at CoAction Specialty Insurance in their catastrophe and capital modeling department. This summer Ramdeen is working at Liberty Mutual on their U.S. personal lines pricing team. To hone his craft and develop appreciation for the industry, he participates in various insurance programs and case studies on behalf of his university.



Ramdeen

"It is a remarkable feature to be recognized by the Casualty Actuarial Society as a scholarship recipient. As a student from Jamaica, I am motivated to continue my actuarial journey and give back to the communities that have helped me to date."

$2,500 CAS Trust Scholarship Recipients

Emily Pietersz is a senior at The University of Texas at Austin, where she is studying mathematics with a concentration in actuarial science. In the summer of 2022, Pietersz interned at Liberty Mutual and returned as an actuarial intern again this summer. Pietersz is the vice president of her university's actuarial science club and is an active member of its Gamma Iota Sigma chapter.

"I am grateful and honored to be recognized by the CAS and selected as a recipient of the Trust Scholarship. This award inspires me to continue pursuing my dream career path, with the desire to one day give back to the actuarial community. I want to thank everyone who has supported me along my journey, especially my family, mentors and professors."

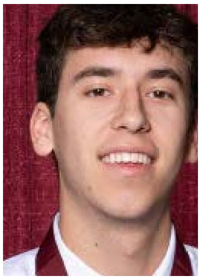
Pietersz

Aimee Xu is a senior at the University of California, Los Angeles and is pursuing a degree in statistics and data science with a minor in math. This past summer, she interned at Liberty Mutual on the global retail markets team in Seattle and in summer 2023 at The Cigna Group on the commercial pricing team in Denver. Xu currently serves as the co-president of the UCLA statistics club and the director of the alumni mentor program, where she strives to help others achieve their educational and professional goals.

Xu

"Receiving this award has been a tremendous honor and is one of many avenues of opportunity that the CAS has provided me on my professional journey. I would like to thank my family, mentors and the actuarial community for their continuous support."

Zachary Rodgers is a sophomore at Texas A&M University where he is studying applied mathematics. He spent the spring and summer of 2023 interning at Nationwide Financial, where he worked on the asset-liability management and retirement solution teams. Rodgers is also involved with the Organization of Latino Actuaries and Texas A&M's on-campus actuarial club.



Rodgers

"I would like to thank the CAS and their donors for honoring me with this award. It is extremely encouraging and motivating to see an organization like the CAS invest in the future generation of actuaries."

Nick Zonarich is a senior at Elizabethtown College studying actuarial science. In 2022 he was a summer intern at the Department of Insurance for the Commonwealth of Pennsylvania. He spent summer 2023 at Aon exploring the consulting industry. Outside of class, Zonarich is the president of his college actuarial club and tutors in the mathematical sciences department.

"I am honored to be awarded the CAS scholarship and aim to pay it forward in the future."

The CAS celebrates the achievements of these exceptional students and their promise as future P&C actuaries. ●

About the CAS Trust Scholarship Program

Funded by donations to the CAS Trust, the CAS Trust Scholarship program affords members and others an income tax deduction for fund contributions used for scholarships and research grants. The CAS Trust was qualified by the Internal Revenue Service in 1979 as a non-profit organization exempt from federal income tax under section 501(c)(3) of the Internal Revenue Code.

CAS members are invited to contribute to the CAS Trust; inquiries and contributions should be addressed to CAS Chief Business Officer Joyce Warner at jwarner@casact.org. For more information about the CAS Trust Scholarship program, including previous winners and the 2023-2024 application, please visit casact.org/trustscholarship.

VOLUNTEERS MAKE THINGS HAPPEN

By DR. SARAH SAPP, CAS EDITORIAL/PRODUCTION MANAGER

The work of two CAS Task Forces aims to take members' abilities to new heights.

For each November/December issue of *Actuarial Review*, it has been our custom to honor volunteers who are making outstanding contributions to the organization. This year we highlight two groups whose work has furthered the CAS Envisioned Future for its members to be the sought-after sources for applying analytics to solve insurance and risk management problems globally: the Capability Model Task Force and the Property and Casualty Predictive Analytics (PCPA) Task Force.

Capability Model Task Force

As discussed in *AR* July/August 2023, the CAS Capability Model is a visual framework that articulates the traits, skills and knowledge important for most property-casualty actuaries, and it offers guidance on how users can enhance their capabilities.

Using the Model, CAS members and candidates will be able to self-assess the levels of their professional attributes in 18 different areas and then identify continuing education opportunities to further develop their expertise.

The Capability Model is composed of Traits, Skills and Content Areas, each of which contains six attributes organized according to three levels of proficiency, with Level 1 as the most basic and Level 3 the most advanced.

The model is backed by extensive research and input gathered from a variety of stakeholders, including a CAS membership survey as well as the Employer Advisory Council, Candidate Advocate Working Group, Risk Management Committee, Member Advisory Panel and CAS Board of Directors. A task force of volunteers and staff managed the model's development.

ACS Ventures served as an outside vendor that created and analyzed the membership survey. They provided drafts using their expertise with similar con-

From left to right, a few members of the Capability Model Task Force: Avraham Adler, Jonathan Charak and Mario DiCaro.

“I saw the project as one of importance to the CAS ... I believe in giving back to an organization that has given me my livelihood . . . .”
— Morgan Bugbee

cepts from the psychometric field and interpreted all the feedback from the actuaries to iterate the model until the task force was satisfied with the final results. The vendor also collated all existing research in the field to feed into the early model drafts.

Morgan Bugbee, FCAS, MAAA, CSPA, explained that the greatest challenge was the charge itself — “How do we identify what content, traits and skills are, and will be for as far into the future as we can see, most critical and defining for actuaries?”

The process of creating the capability model gave Bugbee the opportunity to think about the long-term impact of decisions, both positive and negative on the CAS, and hear different perspectives on changes.

“It’s important to be able to listen to others’ perspectives because you might find important considerations that you overlooked,” Bugbee said.

Bugbee contributed to the group with his professional background in personal lines data science and predictive modeling.

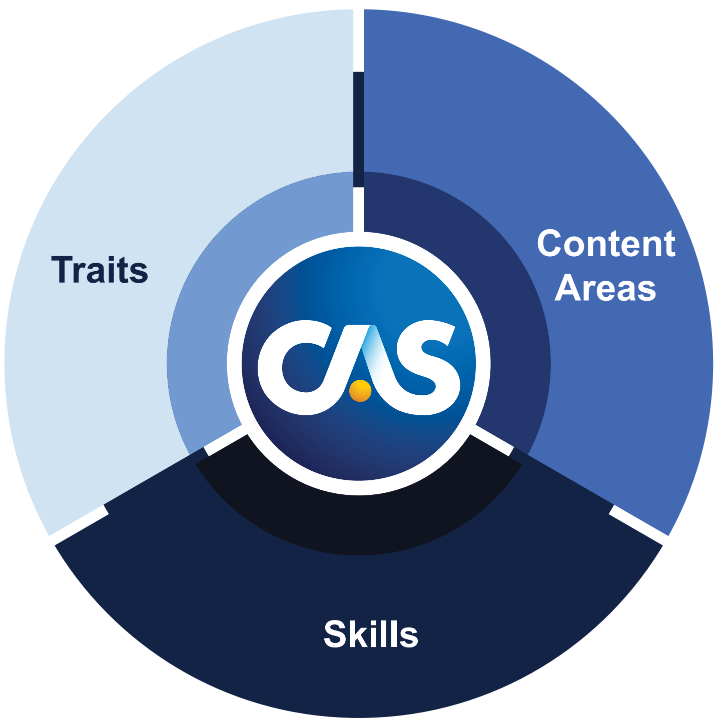
“I also became interested in the insurtech space over the past five years and have worked at two insurtech carriers,” Bugbee said. “I also brought my passion for how technology can enhance both our profession and our industry.”

Bugbee appreciated the opportunity to build and deepen his professional network.

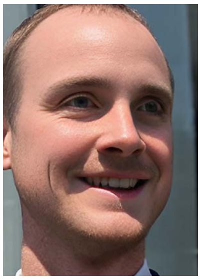
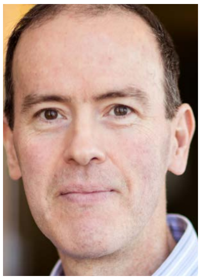
“There were a number of current and past leaders of the CAS involved in the task force, and the task force gave me exposure to those people that I wouldn’t have otherwise had,” Bugbee said. “I saw the project as one of importance to the CAS and one for which . . . I had strong views. I believe in giving back to an organization that has given me my livelihood, so when the task force came along, it was an easy decision for me to participate. By helping to deliver a project of importance to the CAS in an area I felt passionate about, it was very fulfilling to do so. I hope that many other actuaries can benefit from the Capability Model for years to come.”

Bugbee highly recommends other CAS members who are considering volunteering for a working group or task force do so.

Throughout the process of putting the Capability Model together, Mario DiCaro, FCAS, CERA, was reminded of how much he enjoys CAS members and the CAS staff. “I’m proud to be part of the CAS,” he said. “Although change sometimes seems inadequate compared to the pace of the world, I think the CAS is doing well at keeping up with industry needs. I’m glad to be an FCAS.”



The CAS Capability Model

From left to right, a few members of the Property and Casualty Predictive Analytics Task Force: Henry Cheng, Louise Francis, Bobby Jaegers, Jason Nikowitz and Ernesto Schirmacher.

Property and Casualty Predictive Analytics Task Force

Key CAS stakeholders identified that organizations are increasingly turning to predictive analytics to solve difficult problems. Recognizing that the CAS must also evolve by revolutionizing how it prepares actuaries with problem-solving skills for the future, the CAS Board of Directors approved a new predictive analytics requirement as part of the Admissions Transformation Plan.

The Property and Casualty Predictive Analytics (PCPA) project aims to give candidates and professionals in the actuarial field a deeper understanding of key concepts and to improve their predictive capabilities. The PCPA project had a soft launch in fall 2023 and will officially launch in May 2024. The PCPA will be an ACAS requirement beginning with the October/November 2025 exam administration.

The new PCPA project supports the CAS Strategic Plan by playing a key role in helping actuaries build skills for the future. The work of the PCPA Task Force ensures that the PCPA incorporates analytics, problem solving and domain knowledge into an exam plus project design that assesses both essential skills and streamlined practical application for predictive analytics.

To determine the best ways for actuaries to learn and apply predictive analytics, the task force brought together experienced actuaries who specialize in predictive analytics, along with data scientists, candidates and employers. Through interviews, focus groups and brainstorming sessions, the task force developed several iterations of the project, refining it with examples of real-world experience and as more feedback was gathered.

To create the assessment content for the PCPA, the task force looked to several members of the iCAS CSPA Exam 3 Committee and CSPA Project Committee for their expertise and experience in developing predictive analytics business cases, data sets and exam questions. The task force also expanded the volunteer group to include new FCAS members and senior data scientists for additional perspectives.

The CAS's psychometric partner, ACS Ventures, has supported this effort in facilitating workshops to develop the exam content outline and providing training to exam writers and reviewers. ACS Ventures will also be providing psychometric review and analysis of exam and project performance to ensure the assessments are fair, reliable and appropriate for the target candidate.

PearsonVUE will be delivering the

exam portion of the PCPA. The multiple-choice exam will be available on a continuous basis year-round, with results available immediately upon completion of the exam.

The Institutes will be the platform provider for the project portion of the PCPA, available on a quarterly window basis. This tool will allow candidates to download the case study and data sets to complete the project from home, as well as the tool to submit their final files for grading.

According to Alicia Burke, director of portfolio and product development for the CAS Institute, the most challenging aspect of the project was taking all the amazing, creative ideas and refining the best path forward.

"The PCPA Task Force led an initiative to create a brand-new product within the CAS credentialing pathway — something that has not been done in many years," Burke said. "The approach that the task force is taking is fresh and innovative — the passion that each member brings to the group is inspiring," Burke said. "We look forward to what new opportunities this product will provide future candidates."

"The volunteers were key in bringing their expertise and vision to the discussion and getting us to this exciting point where we have designed the exam content outline and are bringing the PCPA to life," Burke said. The most rewarding part of PCPA project for Burke has been the opportunity to meet and collaborate with brilliant and dedicated volunteers. "[They] are passionate about predictive analytics and designing the optimal offering to enhance the ACAS experience," she said.

PCPA Task Force Member Bobby Jaegers, ACAS, CSPA, was thrilled to be working on such an innovative project that tests candidates' understanding of predictive analytics and gives candidates real-world examples that encourages them to apply the techniques they have studied.

"It has been very rewarding collaborating with other experts in the field of predictive analytics to develop a project that will challenge candidates and prepare them for predictive analytics problems they may see in their career as an actuary," Jaegers said.

Members of the Capability Model Task Force

Avraham Adler
Morgan Bugbee
Jonathan Charak
Mario DiCaro
Richard Florian
Barry Franklin
Li Li Lin
Chester Szczepanski

Members of the Predictive Analytics Task Force

Henry Cheng
Brian Fannin
Louise Francis
Bobby Jaegers
Todd Lehmann
Jean Li
Jason Nikowitz
Ernesto Schirmacher

Unexpected Developments in Personal Auto

By ANNMARIE GEDDES BARIBEAU

It might take more than raising rates to make this line healthy again.

For the first time in at least 30 years, if ever, the personal auto insurance line's combined ratio is 112.2, according to AM Best. That means for 2022, insurers saw an underwriting loss of $12 for every hundred dollars they collected in premium.

AM Best is projecting that the combined ratio will be around 106.5 for 2023, demonstrating that higher rates are helping to cover costs. However, the loss trends are not looking much better in 2023.

In response, insurers are raising rates quickly by double-digits and pursuing undesirable options to reach equilibrium and return to profitability.

Individual insurers are responding by making tough business decisions. Roosevelt C. Mosley observed that some companies are announcing they are getting out of personal lines due to significant losses. "Others are facing surplus issues and being forced to exit," said Mosley, who is the current CAS president and principal with Pinnacle Actuarial Resources.

Meanwhile, insurers might not be able to compensate for shortfalls in collected premiums with investment income. "Unless somehow returns are in the high double digits, the investment will not help as it has before," Mosley said.

Insurance regulators are generally approving significant rate increases, he said. The hope is that regulators and consumers will tolerate the rate increases long enough to return the line to equilibrium.

At the same time, if losses ultimately pressuring premiums do not abate, and if accident frequency continues to climb, the industry's troubling situation will grow worse.

"Overall, the industry is not in trouble," said Louise Francis, president of Francis

Analytics, but some insurers have become vulnerable.

This article is part one of a series covering the conditions impacting the auto insurance line. This first article covers what made the line transcend from healthy to unprofitable. A future article will take a deeper dive into the potential impact of automobile technology and will offer ways actuaries can rethink pricing and reserving.

Taking a look at the personal auto insurance industry's dashboard, all indicators show a deteriorating line.

Losses, rates and premiums (Oh my!)

Taking a look at the personal auto insurance industry's dashboard, all indicators show a deteriorating line. The combined ratio leaped a shocking 10.7% from 101.4 in 2021 to 112.2 in 2022, surpassing 109.4 in 2000, according to AM Best.

Verisk's Fast Track Data shows that the loss ratio rose 15% from 82% for the four quarters ending 4th quarter of 2017 to a whopping 97% for the prior quarters ending 1st quarter of 2023. Since the rolling third quarter of 2021, the loss ratio has been the highest in recent memory. (See Chart 1).

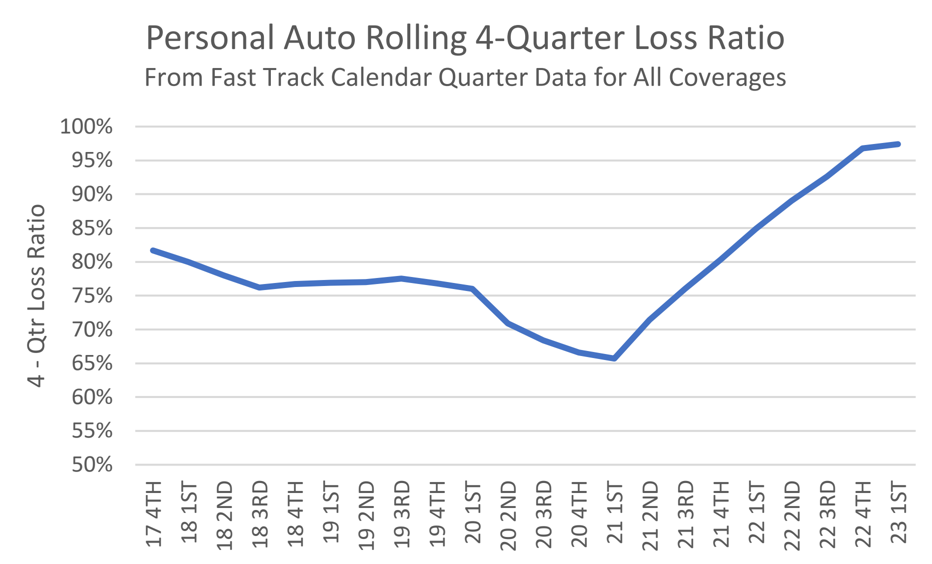
Just how much have rates risen? In 2023, "Filings are up more than 30-plus for physical damage and 20-plus for all coverages combined," answered Frank Gribbon, actuarial director of personal lines core products at Verisk. He added that in 2022, filings were up 20-plus for physical damage and 10-plus for all coverages combined.

Mosley said he has never seen the pace of rate increases go up so quickly during his 30 years as an actuary. "Not only are insurers taking rate changes as fast as they can, increasing rates doesn't stop the business flow," he explained. Since a preponderance of insurers are universally raising rates, consumers can no longer find cheaper options like in the recent past.

For policyholders, the average premium for all U.S. cities increased a stunning 17.1% from May 2022 to the same month in 2023, said Francis, citing data from the Bureau of Labor Statistics (BLS).

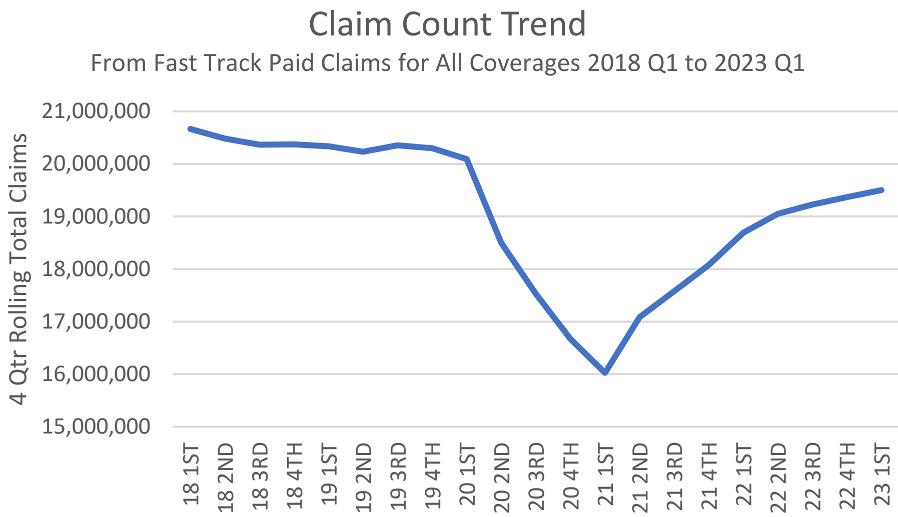
Based on Verisk's loss ratio data, where the first quarter loss ratio, rather than the four rolling quarters leading to it, declined for 2023, she said, "the rate increases in 2022 are hav-

Chart 1.



Source: Fast Track Monitoring System; © Insurance Services Office, Inc., 2023, Chart by Francis Analytics and Actuarial Data Mining.

Chart 2.



Source: Fast Track Monitoring System; © Insurance Services Office, Inc., 2023, Chart by Francis Analytics and Actuarial Data Mining.

ing a beneficial impact." While that is a positive development, carriers will need to continue increasing rates to lower the loss ratio, she explained.

Causes of loss

If there is a saving grace for personal auto, it is that since COVID-19, the number of claims has been below pre-pandemic levels. "Frequency went down during 2020 and 2021," Gribbon said, but has been going up since. The number of paid claims for the prior four quarters ending in first quarter 2023 is reaching the pre-pandemic level of the four quarters ending in fourth quarter 2019. (See Chart 2.)

Claim frequency stayed below pre-pandemic levels because fewer people were on the roads, said Alexander DeWitt, director and senior actuary of pricing analytics and actuarial services for Allstate. According to the U.S. Department of Transportation's Federal Highway Administration (FHWA), miles driven — a proxy for exposure to accidents — declined by 38.5% in May 2020 compared to May 2019. This major indicator of risk remained significantly below 2019 levels through April 2021 and within 5% of the level in May 2019. "Actuaries will need to make adjustments due to rapid changes in mileage," he added.

Losses primarily stem from car accidents, although those involving pedestrians and bicyclists also occur. Unfortunately, since the COVID-19 pandemic, primary causes of accidents such as distracted driving, speeding and driving while under the influence of alcohol or drugs, are on the rise.

According to the National Highway Traffic Safety Administration (NHTSA), auto accident fatalities increased in 2021 to a 16-year high of 42,939 people. For 2022 the federal agency projects the number of fatalities to be down 0.3% to 42,795.

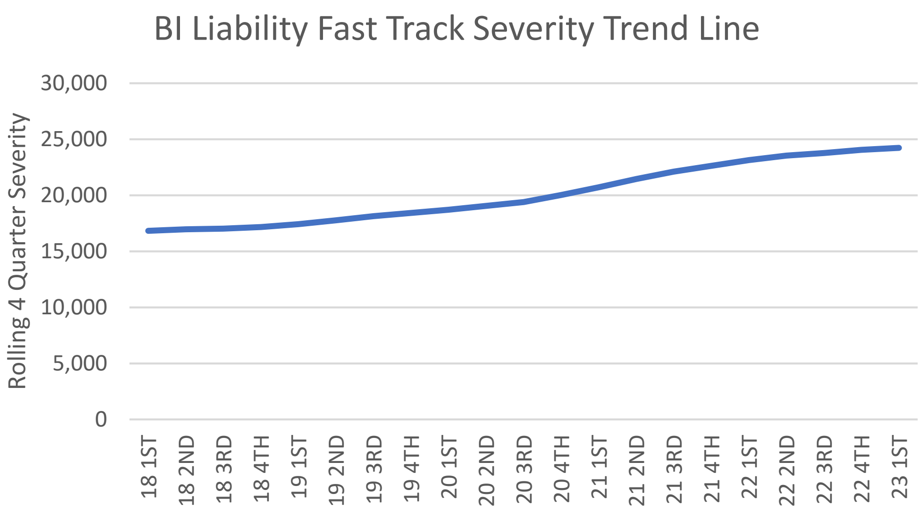
Plenty of evidence shows that driving behavior has become less safe since the pandemic began. The AAA Foundation for Traffic Safety's 2021 Culture Index revealed an increase in unsafe driving behaviors between 2020 and 2021 after three years of steady declines. Further, an Insurance Institute for Highway Safety (IIHS) survey looking at the propensity of drivers to engage in distracting behaviors revealed that 65% did so within the last 30 days.

Severity rising

When looking under the hood, there are several components — many of which insurers cannot control — pressuring claim severity upwards. First, inflation has been pushing costs in general (*AR*, May-June 2022). And though it is calming down, prices remain higher than in the fall of 2021 when inflation began its ascent well beyond pre-pandemic levels.

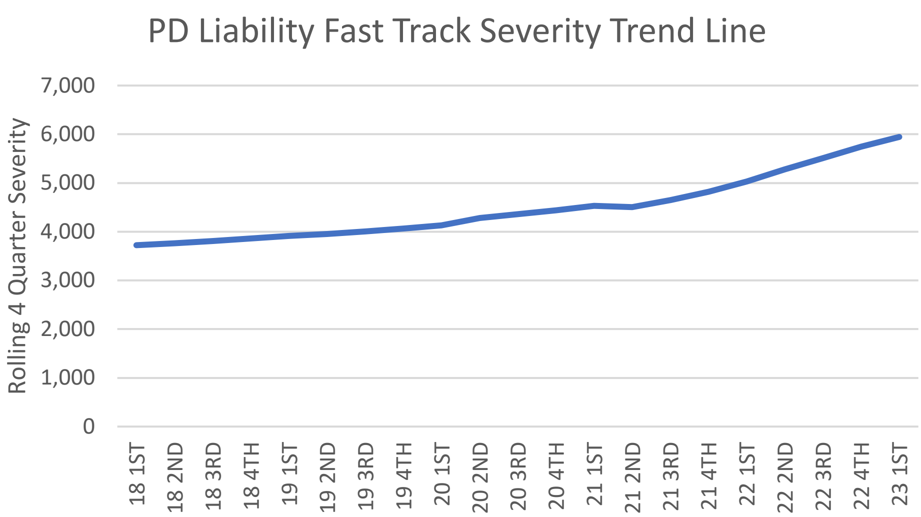
Some contributors to rising rates include medical inflation, climate catastrophes, social inflation and state regula-

Chart 3a.



Source: Fast Track Monitoring System. © Insurance Services Office, Inc., 2023. Chart by Francis Analytics and Actuarial Data Mining.

Chart 3b.



Source: Fast Track Monitoring System. © Insurance Services Office, Inc., 2023. Chart by Francis Analytics and Actuarial Data Mining.

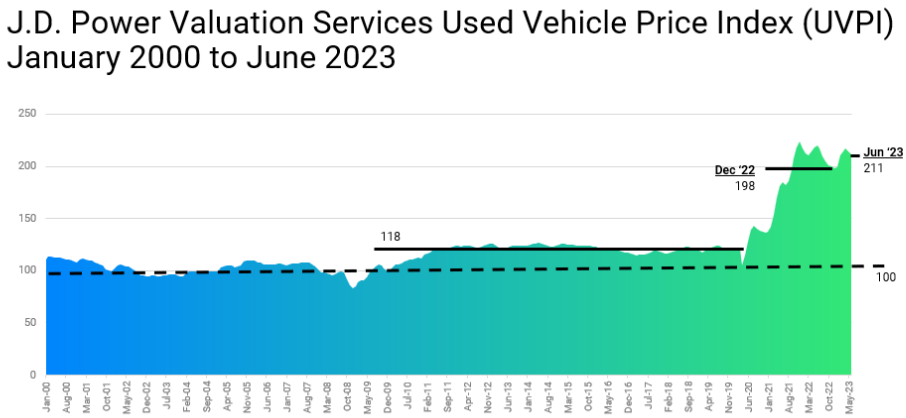
tions, but experts agree that the two primary contributions to claim severity are the repair and replacement of vehicles.

Most recently, the extreme cost drivers were not medical or bodily injury liability costs as Mosley has seen in the past, but physical damage. "I have never seen physical damage results this bad absent a catastrophe," he said. "It's not even close."

Claim severity trends driving rising loss ratios show that bodily injury liability severity rose 44% from $16,831 per claim during the rolling four quarters ending 1st quarter 2018 to $24,234 (See Chart 3a.) in the 1st quarter 2023, according to Verisk's Fast Track Data. Property Damage Liability rose during the same period by 60% from $3,723 to $5,945. (See Chart 3b.)

Before COVID-19 arrived, insurers were already becoming concerned about physical damage costs, but the situation is now far worse. Since June 2023, repair costs have spiked by 39.9% since the same month in 2019, observed DeWitt, citing

Chart 4.



Source: J.D. Power. Used with permission.

BLS data. In the most recent one-year period — from June 2022 to June 2023 — repair costs rose nearly 19.8%.

As a general rule, the more technological the car — whether it is loaded with advanced driver assistance systems (ADAS), partial automation or run by electricity — the more expensive it is to repair.

In the late 2010s, insurers noticed that previously simple repairs were becoming more expensive in high-tech cars (*AR*, November-December 2019).

Replacing a windshield offers a striking example. Windshield repairs have become more expensive due to head-up displays and ADAS, according to the *Kelly Blue Book* article, "It May Cost More Than You Think to Replace a Windshield," published in March 2023. For cars with high-tech windshields, repairs now cost more than $1,000. A typical windshield repair is about $300 to $600 for a vehicle with little to no tech.

Repairing high-tech cars in the late 2010s was expensive, but there were relatively few. At the same time, the labor portion of repairing cars started to rise. Specifically, the mean wages for auto technicians rose by 13.9% from 2018 to 2022, said Katie Pipkorn, a consultant for Milliman, citing BLS data. In comparison, there was an 8.6% increase from 2014 to 2018.

There are several reasons why there is a shortage of auto technicians and why labor costs are rising. Some reasons mirror the causes of labor shortages in general.

Also, fixing late-model high-tech cars requires both mechanical and sophisticated technical prowess. Older, experienced repair technicians, who started their careers when cars were more mechanically based, can find keeping up with technology overwhelming, while younger, tech-savvy individuals find opportunities outside the auto shop. Unfortunately, the labor shortage is not expected to abate soon.

The COVID effect

The year 2020 began with insurers recognizing that repair costs were rising. The developments since COVID-19 arrived exacerbated some problems and introduced new ones that overlapped one another, complicating matters even more.

At first, the lockdowns were positive for auto insurers because they significantly reduced accident exposure, which impacts frequency. (See Chart 2.) Insurers, sometimes from regulator encouragement, returned premium dollars to policyholders.

As a result of the lockdowns, U.S. manufacturing, including auto production, significantly declined. Once workers could return with restrictions, the components necessary to move cars from the assembly line to the showroom became scarce, explained Martin Ellingsworth, president of Salt Creek Analytics. The short supply of microchips is the most notable example.

Because fewer cars were made, the value of new and used vehicles unexpectedly began to appreciate rather than depreciate as usual, Ellingsworth said. While the situation is a simple matter of supply and demand, the effects on insurers and consumers are complex and extensive.

Pre-pandemic in January 2020, only 0.3% of new vehicles sold for more than the manufacturer-suggested retail price (MSRP), Pipkorn said, citing Kelley Blue Book. A year later, in January 2021, the percentage of new car buyers who were paying over MSRP had risen to 2.8%. By January 2022, she added, 82.2% of new vehicles sold for above MSRP.

Automobile appreciation has several implications for insurers. For starters, replacing totaled cars has become more expensive. J.D. Power's Used Vehicle Price Index shows the value of cars aged eight years or less has nearly doubled from 118 in January 2020, before COVID-19, to 224 almost two years later in December 2021. Used car prices cooled slightly in 2022, but as of June 2023, the index was 211. (See Chart 4.)

"If the only factor in an insurance claim were the value of a like-for-like used vehicle," Ellingsworth said, "then claims costs would have about doubled."

Thankfully, new car prices are starting to calm down as manufacturing returns to pre-pandemic levels.

Meanwhile, Ellingsworth observes that used car replacement costs are likely to continue to move higher even though auto manufacturing productivity is increasing. "Given that the value at risk has gone up so much in so short a time, price increases will take time to adapt," he explained. "The hollow fleet and low new vehicle production during the pandemic years will haunt the insurance industry for the foreseeable future," he warns.

The replacement cost of vehicles is more severe because insurers total more cars. According to the LexisNexis Auto Insurance Trends Report 2022, the percentage of collision claims that result in total losses has risen 35% from 17% of collision claims in 2016 to 23% in 2021.

How much an insurer is required to pay a policyholder for reimbursement is determined by each state, explained Dan Hill, National Sales Director at CARFAX, who said the total loss formula is generally about 65% of actual cash value. He added that the formula has not changed for many years and is outdated, resulting in collision claims increasingly becoming total losses.

As a result, Hill said, "Many insurers are stuck with vehicle damage that exceeds the total vehicle loss threshold, so they are sold as salvage vehicles and either crushed, salvaged for parts or sold at auctions." Unfortunately, vehicles sold at auction can be partially repaired or rebuilt and returned to the road. "These repaired vehicles have a significantly higher loss experience in future accidents," he observed.

Insurers cannot do much to address the causes that are driving up physical damage costs. "So, the only recourse is raising rates and tightening underwriting," Mosley observed. "We are going to be in this continuous cycle until inflation is under control or affordability issues become so acute that other, more significant actions must be taken," he added.

While some issues related to the COVID-19 pandemic are expected to be resolved, it is unknown how the multiplicity of trends will develop.

With cars increasing in value, vehicle theft is trending upwards. For the first time since 2008, more than one million cars were stolen in 2022, according to the National Insurance Crime Bureau (NICB). The organization's "hot wheels" list, which offers the top 10 most stolen vehicles, includes the usual suspects: Camrys, Corollas and pick-up trucks.

And though the theft of car components is nothing new, removing catalytic converters from hybrid vehicles for harvesting precious metal has also become a profitable criminal activity. Catalytic converter replacement can cost from $1,000 to more than $3,500, according to NICB, depending on the type of vehicle. Also, the NICB reported that insurers replaced about 53,000 in 2022, and that does not count replacements by manufacturers and auto owners.

… removing catalytic converters from hybrid vehicles for harvesting precious metal has also become a profitable criminal activity. Catalytic converter replacement can cost from $1,000 to more than $3,500, according to NICB, depending on the type of vehicle.

A new wrinkle in car theft or hijacking is stealing cars just for fun. In 2021, the alleged, self-described "Kia Boyz" began posting instructional videos showing how to steal Kias and Hyundais solely for joyriding and vandalizing purposes, using only a USB charger and a flat screwdriver. The incidents occurred frequently enough that some insurers stopped covering Kias and Hyundais that lack theft-deterring immobilizers.

Over time, high-tech features will become more mainstream, adding cars that are more expensive to repair to the country's fleet. The hope is that as more cars have ADAS features or become more autonomous, fewer vehicle accidents and claims will be filed.

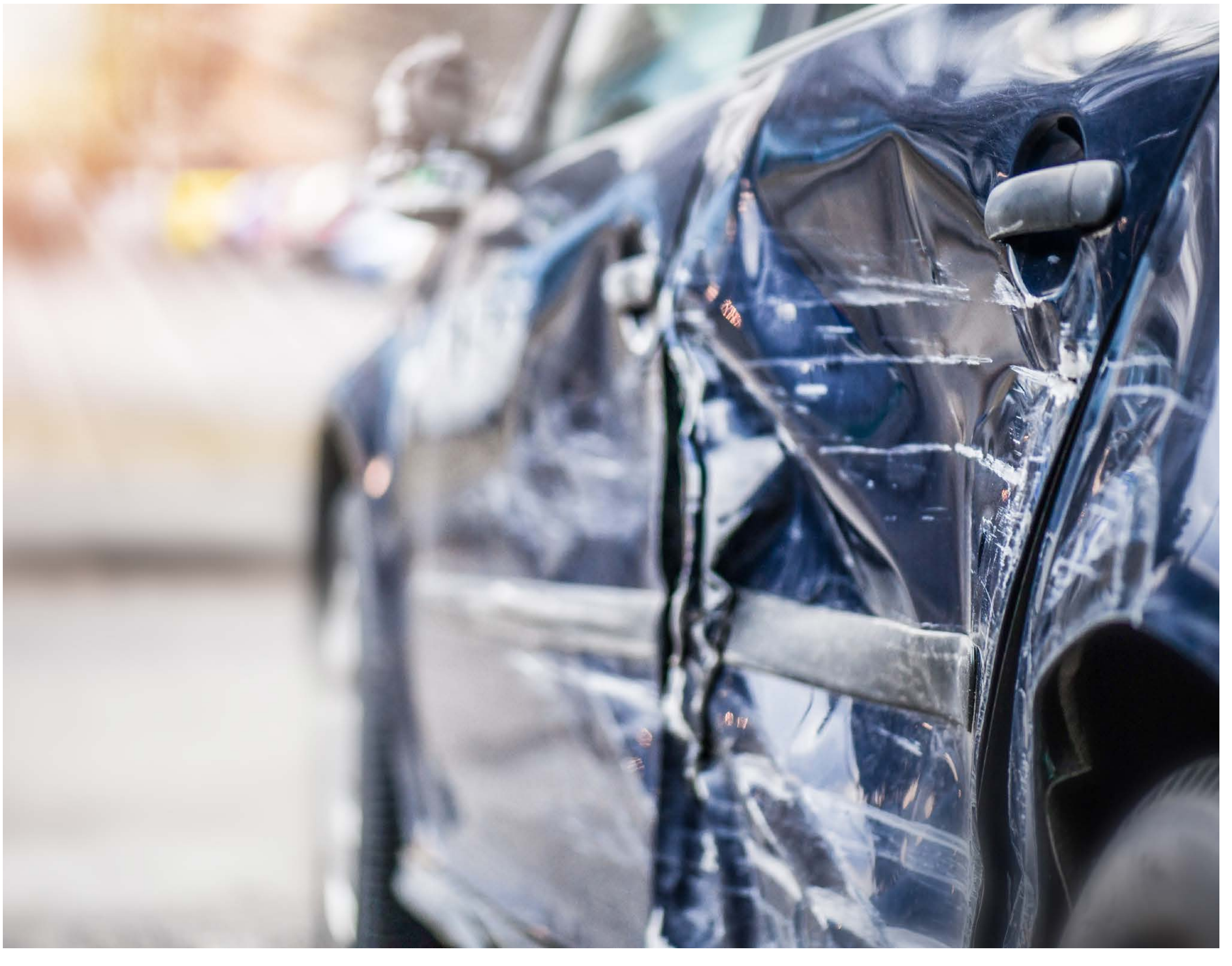
Conclusion

Before the COVID-19 lockdowns, insurers recognized that property and physical damage expenses — primarily related to labor and cars with high-tech features — were growing. Since then, insurers have been grappling with unexpected developments arising from or during the COVID-19 era that will remain in play in the near future.

Increasing auto manufacturing productivity should help relieve vehicle shortage. However, since high-tech features are becoming more commonplace in new cars, insurers and consumers alike will continue to face high repair and replacement costs while hoping to reap the benefits of lower frequency sooner or later.

In the meantime, all signs point to claim frequency continuing to rise at a trajectory that will bypass 2019 claims frequency levels. Businesses are calling their telecommuters back to the office while driving habits are worsening. Unless the upward trends for physical damage and frequency reverse, insurers may face resistance to rate increases and will need to adjust approaches that made sense in the past.

Annmarie Geddes Baribeau is an insurance consultant and writer who has been covering insurance and actuarial topics for more than 30 years. You can email her at annmarie@insurance-communicators.com.



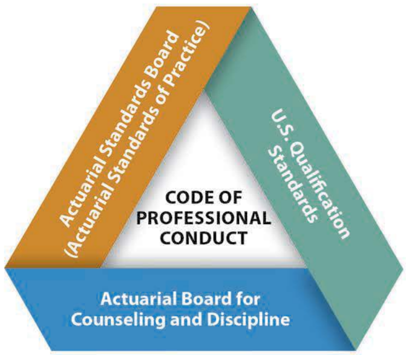
The American Academy of Actuaries — Promoting Professionalism and Advancing Public Policy and Specific Property-Casualty Initiatives

By LISA SLOTZNICK, PRESIDENT-ELECT OF THE AMERICAN ACADEMY OF ACTUARIES

AMERICAN ACADEMY of ACTUARIES

The voice of the U.S. actuarial profession on public policy and professionalism issues—the American Academy of Actuaries (Academy)—was established in 1965 by the U.S.-based actuarial organizations, including the Casualty Actuarial Society. Its mission is to serve the actuarial profession and the public. By fostering professionalism, actuaries more effectively serve the public, that is, actuarial services meet a high standard and promote the financial stability of the economy. By providing public policy commentary, actuaries demonstrate that they are more than just number crunchers. They are knowledgeable of societal systems, and thus public policy commentary enhances the reputation of actuaries. This article delves into the crucial role the Academy plays in promoting professionalism among actuaries and advancing public policy issues. It also highlights some recent initiatives applicable to property-casualty actuaries.

The Academy provides for the establishment, maintenance and enforcement of high professional standards of actuarial qualification, practice and conduct. Through the Code of Professional Conduct,[1] the U.S. Qualification Standards,[2] the Actuarial Standards Board (Actuarial Standards of Practice)[3] and the Actuarial Board for Counseling and Discipline,[4] the Academy is committed to maintaining the highest standards of professional conduct among its members, ensuring their expertise is consistently utilized with integrity and transparency. The core of the Web of Professionalism[5] is the Code of Professional Conduct, which outlines ethical principles and responsibilities that actuaries must abide by. This Code addresses conflicts of interest, client confidentiality, competence and the obligation to communicate effectively with stakeholders. By adhering to these guidelines, actuaries foster trust and confidence in the integrity of their work. By having these four components of the Web of Professionalism, actuaries protect their status as a self-regulated profession.



The Web of Professionalism

Continuing education and professional development

The U.S. Qualification Standards set forth continuing education (CE) requirements for U.S. actuaries. The Academy supports the requirements by providing access to workshops, webinars, symposiums and conferences to enhance skills and knowledge on professionalism topics and public policy issues impacting its members and the public. This ongoing commitment to providing diverse and cost-effective professional development ensures that actuaries have access to the knowledge that keeps them at the forefront of their profession, offering high-quality services and insights to their principals and the public.

Advancing public policy

Public policy

The Academy actively calls for sound

[1] https://www.actuary.org/sites/default/files/files/code_of_conduct.8_1.pdf
[2] https://www.actuary.org/sites/default/files/2021-11/USQS_2021.pdf
[3] http://www.actuarialstandardsboard.org/standards-of-practice/
[4] http://www.abcdboard.org/
[5] The Academy and the Web of Professionalism: Key elements of the professionalism infrastructure of the U.S. actuarial profession, https://www.actuary.org/sites/default/files/files/imce/WebOfProfessionalism2017.pdf

public policy related to actuarial issues. By liaising with elected officials, regulators and other policymakers, the organization helps shape federal, state and sometimes international legislation and regulation that directly and indirectly impact how actuaries work. Using the expertise of its volunteers, the Academy offers thoughtful and actionable commentary on issues across practice areas. This involvement extends to areas such as health care, Social Security and pensions, life insurance and property-casualty insurance. By contributing to the formulation of well-informed policies, the Academy helps safeguard the financial security and well-being of individuals and businesses.

Research and publications

The Academy promotes research and publication of actuarial studies and insights, fostering the exchange of ideas and appropriate practice among actuaries as well as providing information for our public stakeholders. Feature articles in *Contingencies* magazine, white papers, professionalism discussion papers and research documents are the vehicles for spreading these insights, enhancing the profession's collective understanding of complex issues. This commitment to research helps actuaries and public stakeholders make appropriate decisions and aids the Academy in providing more supported views on public policy work products.

Specific property-casualty initiatives

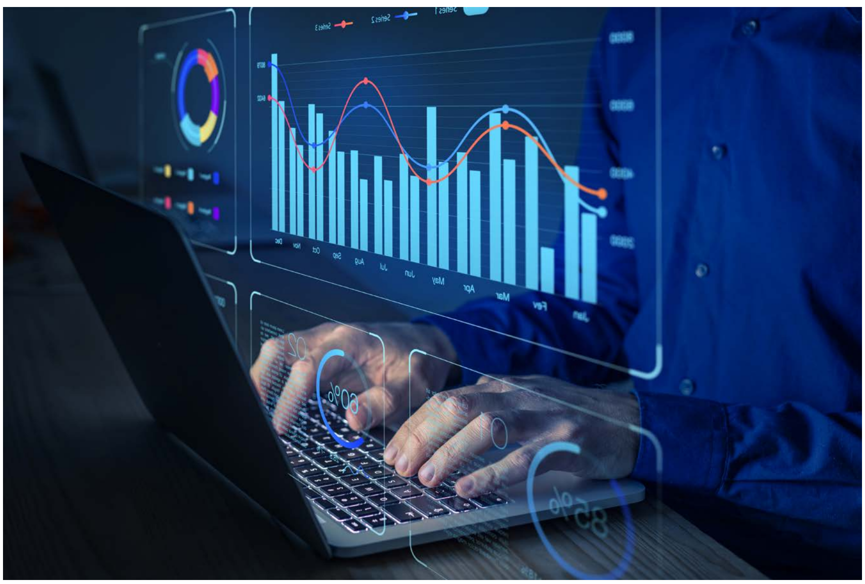
The Academy, both through specific committees of the Casualty Practice Council (CPC) and through what the Academy terms "cross-practice" efforts, focuses on areas of interest to CAS members. Included below are some examples of the Academy's public policy activities that CAS members may find interesting.

Extreme events—Wildfire

Just as the CAS has focused on wildfire at its 2023 Spring Meeting with breakout sessions and a film, the Academy also has wildfire top of mind. To provide a base knowledge for public policymakers who are dealing with various aspects of this issue, the Academy's Extreme Events and Personal Lines Committee published an issue paper on wildfire[6] covering the wildfire peril, the current state of modeling and pricing for the wildfire peril, California laws in particular, and insurance impacts through 2021. That was not the last word on wildfire, however. A lot has been happening recently related to insurance availability as well as mitigation and adaptation efforts of communities and insurers, keeping wildfire an ongoing focus.

Identifying bias in data

The Academy recognizes that data is core to actuarial work. In today's world, the available data has expanded to include big data as an additional source of information for actuaries. Data may be biased due to the way it is collected and used, as well as how actuarial models are designed, built and implemented around the data. The Academy's Data Science and Analytics Committee is active in providing tools for actuaries to understand the definition, impacts and

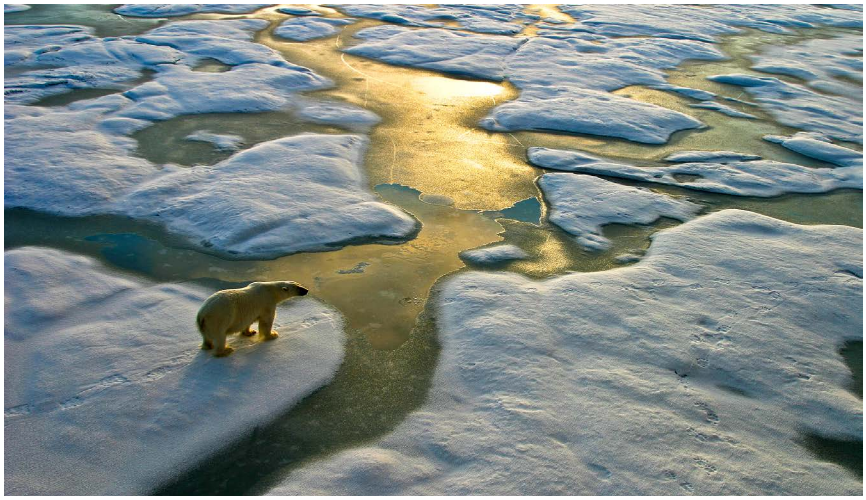


[6] https://www.actuary.org/sites/default/files/2022-02/Wildfire.2022_.pdf

consideration of bias in data through a recent issue brief.[7] Bias introduced by artificial intelligence and machine learning has the potential to be identified by actuaries, and thus this ability to identify bias is added to the actuarial toolkit.

Defining "unfair discrimination"

Through the CPC's P&C Committee on Equity and Fairness, the Academy provides independent actuarial perspective on equity and fairness topics and insurance practices that potentially disadvantage people of color and other groups. As an example, the CPC has been liaising with the Colorado Division of Insurance on regulation tied to a law that relates to unfair discrimination in insurance practices, offering an actuarial perspective on proposed regulations as that state considers how best to protect its policyholders from unfair discrimination.



Actuaries play a crucial role in assessing the long-term effects of climate change on risk exposures, pricing, underwriting and financial reporting practices.

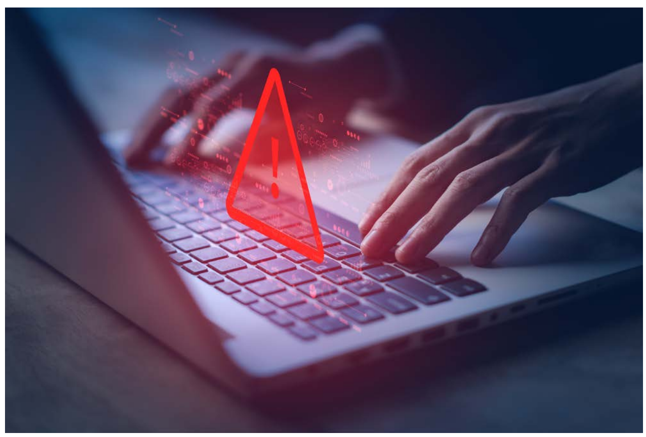
Climate change

As climate change and individual climatic events pose increasing challenges to the U.S. financial security system, the Academy is addressing its impact across the spectrum. While property-casualty insurers and actuaries are well aware of the physical risks of climate change, they are in a position to lead actuaries in other practice areas to an understanding of climate risks. Actuaries play a crucial role in assessing the long-term effects of climate change on risk exposures, pricing, underwriting and financial reporting practices. The Academy has collaborated with the National Oceanic and Atmospheric Administration (NOAA) and the National Science Foundation (NSF) to open dialogue between catastrophe modelers and climate modelers with the goal of increasing the accuracy of both kinds of models. Academy members have access to the recordings of a series of webinars from this collaboration.[8]

Cyber risks

The CPC has developed and continues to build out its Cyber Risk Toolkit, a series of papers addressing issues pertinent to cyber risk insurance and cyber exposure. This toolkit is intended to be a resource for interested readers of the general public, public policymakers, the actuarial profession, the insurance sector and other stakeholders. The Toolkit offers a cohesive overview of the challenges posed in the cyber insurance market, covering the basics of the cyber landscape, autonomous vehicles, cyber terrorism and the role of digital assets in cybercrime, to name a few.[9]

Lisa Slotznick, MAAA, FCAS, retired from PwC in 2022, where she served as managing director.



[7] https://www.actuary.org/sites/default/files/2023-07/risk_brief_data_bias.pdf
[8] https://www.actuary.org/NOAA-NSF_Climate_Webinar_Series
[9] https://www.actuary.org/cybertoolkit

ETHICAL ISSUES

The American Academy of Actuaries' Applicability Guidelines and a Puzzle

By KENNETH HSU AND MIKE SPEEDLING, MEMBERS OF THE CAS PROFESSIONALISM EDUCATION WORKING GROUP

The Professionalism Education Working Group often gets asked to clarify if the Code of Professional Conduct and the Actuarial Standards of Practice (ASOPs) apply to various scenarios. While the articles will be posing scenarios as they apply to credentialed actuaries, we feel that these could apply to anyone doing work of an actuarial nature, regardless of whether they intend to become credentialed.

To make this truly a learning and professionalism experience, we want your feedback. You can send your comments and questions to ar@casact.org.

The Applicability Guidelines for Actuarial Standards of Practice serve as a valuable resource for actuaries practicing in the U.S. Published by the Council on Professionalism and Education of the American Academy of Actuaries, these guidelines aim to assist actuaries in identifying which Actuarial Standards of Practice (ASOPs) might provide guidance on common assignments. They do not impose any mandatory compliance on actuaries, but rather offer non-authoritative guidance on the ASOPs that could be relevant to specific tasks. The guidelines are periodically updated, and it is the actuary's responsibility to stay current with changes to the ASOPs and ensure their professional services align with the applicable version of each ASOP. While not binding, these guidelines play a role in promoting professionalism within the actuarial community, helping actuaries make informed decisions in their practice.

The Applicability Guidelines is an Excel file, with six tabs: **Cover**, **Introduction**, **Casualty**, **Life**, **Health** and **Pension**. The **Cover** tab includes basic information on what the American Academy of Actuaries is, but most importantly, it notes the revision date of this document. The Introduction tab gives a brief summary of the document, including the definition of ASOPs and Applicability Guidelines. Most of the key information has been summarized in the introductory paragraph of this article. The last four tabs: **Casualty**, **Life**, **Health** and **Pension**, list each of the major practice areas for actuaries. And of course, the **Casualty** tab will be most relevant to members of the CAS.

Focusing on the Casualty tab, we see that there are relevant ASOPs listed for each of the seven major practice assignments, which are:

- Appraisals
- Data Management
- Enterprise Risk Management
- Expert Advice, Witness and/or Testimony
- Financial Analysis, Projections and Reporting
- Product Development/Ratemaking/Pricing
- Reserving

For each of these practice assignments, relevant ASOPs are shown so they can be easily referenced. Note that at the top of the tab, ASOPs 1, 23 and 41 are always applicable.

We have designed a puzzle for the **Casualty** practice area, and specifically **Product Development / Ratemaking / Pricing** that includes ASOPs 1, 7, 11, 12, 13, 20, 23, 25, 29, 30, 38, 39, 41, 53, and 56.

You can find the most current version of the Applicability Guidelines on https://www.actuary.org/content/applicability-guidelines-actuarial-standards-practice-0.

Across

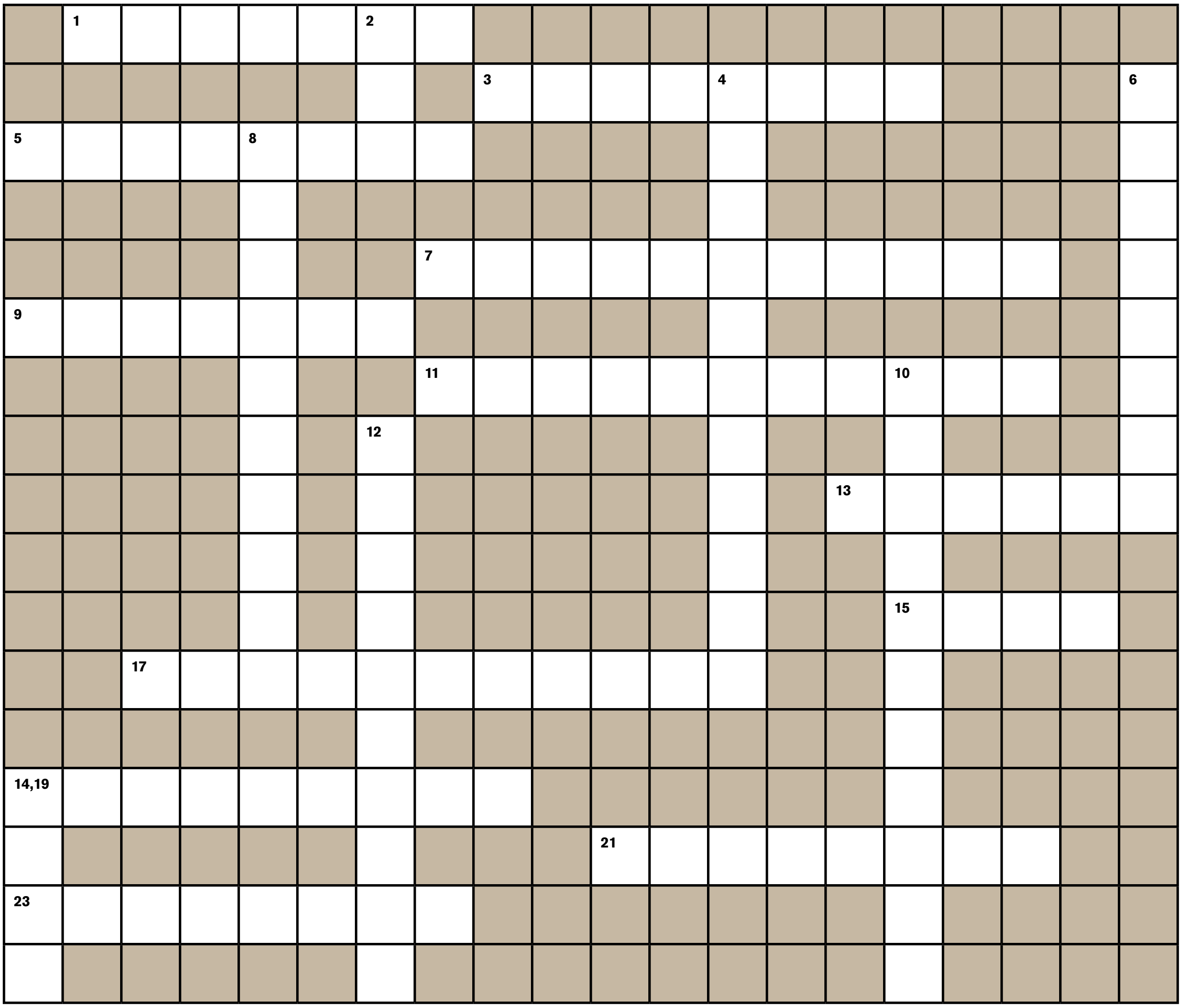
1 (ASOP 53) Examples of Intended _____ include mean, the mean plus risk margin, the high or low estimate within a range of reasonably possible outcomes, and a specified percentile of the distribution of reasonably possible outcomes.

3 (ASOP 13) Consider _____ and social influences that can have a significant impact on trends.

5 (ASOP 13) A procedure to estimate future values by analyzing changes between exposure periods.

7 (ASOP 25) In carrying out credibility procedures, the actuary should consider the _____ of both the subject experience and the relevant experience.

9 (ASOP 41) Actuarial _____ is defined as the result of actuarial services, including advice, recom-



mendations, opinions or commentary on another actuary's work.

11 (ASOP 39) A relatively infrequent event or phenomenon that produces unusually large aggregate losses.

13 (ASOP 38) Focuses on standards for actuaries using _____ outside their area of expertise.

15 (ASOP 30) It is defined as an estimate of the expected value of future costs.

17 (ASOP 25) A measure of predictive value that the actuary attaches to a particular set of data.

19 (ASOP 39) A lack of independence between the occurrence of losses among different entities.

21 (ASOP 30) It is a measure of the relative amount of risk to which capital is exposed, typically expressed as the ratio of an exposure measure, such as premium or liabilities, to the capital amount.

23 (ASOP 41) An actuarial _____ includes all actuarial communication in any recorded form. However, notes taken by someone other than the actuary are not considered.

Down

2 (ASOP 56) Model _____ is the process of transforming a particular set of input to a particular set of output in a model.

4 (ASOP 12) Risk characteristics should be selected that can be determined _____.

6 (ASOP 29) It includes these five components (1) loss adjustment costs, (2) commission and brokerage fees, (3) other acquisition costs, (4) general administrative costs and (5) taxes, licenses and fees.

8 (ASOP 7) A contract is any security that derives its value from underlying financial instruments.

10 (ASOP 38) Communications and Disclosures mention "Documentation," " _____ Information" and "Disclosures."

12 (ASOP 23) Containing enough data elements or records for the analysis

14 (ASOP 23) Confidential information should be handled consistent with Precept 9 of the _____ of Professional Conduct.

Did you solve the puzzle? Send us a picture of it to ar@casact.org!

Back of the Envelope — BAD Plus WORSE Equals BETTER! The Insurance New Business Paradox

By ROB KAHN

What would you say if I told you that a way to improve the profitability of an insurance company is to write — new business that is materially underpriced? Sounds unlikely, right?

Have you ever been in a meeting where you heard something that sounded borderline outlandish and immediately spoke up and declared that the previous assertion couldn't possibly be right? Well, I did, and I was wrong!

The assertion was that our company could afford to write new personal lines auto business at a combined ratio of over 120% and still improve our results. As a point of reference, most insurance companies generally target a combined ratio of 96%-97% for personal lines auto, so the idea that an insurer could pay out 20% more than they take in on new business and still come out ahead seemed far-fetched. I understood that additional risks meant that fixed costs could be spread over a larger base, which would allow an insurer to write at a loss, but a 120% combined ratio on each additional policy? That couldn't possibly be! But it could!

How could this possibly be correct? How could an unprofitable company write new business that is even more unprofitable than the existing book and have the net impact of writing this even more underpriced business be an *improvement* to the bottom line?! Hold on to your hats because that is exactly what will be demonstrated below!

Two hypothetical examples are offered to illustrate how unprofitable business (i.e., BAD) plus new business which is even more underpriced (WORSE) can lead to a net gain (BETTER) — the heart of the Insurance New Business Paradox. Example 1 provides a detailed breakout of a hypothetical new and renewal book. The existing book consists of 100,000 policies and those policies are charged an average premium of $1,000 each. On average, the expected loss of the existing book is $700 per policy. The 10,000 new business policies have a true underlying loss potential 10% higher than the renewal book (so $770 in loss per policy). Even though the new business has a higher loss potential, the new business is charged 10% *less* to get them to switch to our hypothetical carrier (so a $900 premium per policy). In summary, the

Example #1

	Renewal Business	New Business	Total Book
Premium	$100,000,000	$9,000,000	$109,000,000
Number of Policies	100,000	10,000	110,000
Average Premium	$1,000	$900	$990.91
Risk's True Loss Cost	$700	$770	$706.36
Loss Ratio	70.0%	85.6%	71.3%
Fixed Expense	$25,000,000	$0	$25,000,000
Variable Expense (11%)	$11,000,000	$990,000	$11,990,000
Loss & ALAE	$70,000,000	$7,700,000	$77,700,000
Total Cost	$106,000,000	$8,690,000	$114,690,000
Total Profit/(Loss)	($6,000,000)	$310,000	($5,690,000)
Total Book Expense Ratio	33.9%	33.9%	33.9%
Combined Ratio	103.9%	119.5%	105.2%

New Business premium is 10% lower than renewal premium
Premium covers loss and variable expense, as well as helps to cover a share of the company's fixed expense.
Total book expense ratio assumed to apply for both new and renewal business.
Result of charging 10% less on new risks that are 10% Worse — NET OVERALL IMPROVEMENT

Example #2

	Renewal Business	New Business	Total Book
Premium	$100,000,000	$8,651,685	$108,651,685
Number of Policies	100,000	10,000	110,000
Average Premium	$1,000	$865	$987.74
Risk's True Loss Cost	$700	$770	$706.36
Loss Ratio	70.00%	89.00%	71.51%
Fixed Expense	$25,000,000	$0	$25,000,000
Variable Expense (11%)	$11,000,000	$951,685	$11,951,685
Loss & ALAE	$70,000,000	$7,700,000	$77,700,000
Total Cost	$106,000,000	$8,651,685	$114,651,685
Total Profit/(Loss)	($6,000,000)	$0	($6,000,000)
Total Book Expense Ratio	34.0%	34.0%	34.0%
Combined Ratio	104.0%	123.0%	105.5%

New Business premium only covers loss and variable expense.
No premium remains to help carry the burden of the fixed expense.
Total book expense ratio assumes to apply to both new and renewal business.
Result is that new business loss ratio equals one minus variable expense ratio - BREAKEVEN

existing book has a 70% loss ratio and the new business has a significantly worse 85.6% loss ratio.

Despite the fact that more severely underpriced business has been added, the hypothetical carrier does indeed come out ahead. The existing book by itself generates a $6,000,000 loss, but the addition of the new business improved the profit by $310,000! What trickery is at work here you ask? The reason for this counter-intuitive result is that the new business will add value to the enterprise, so long as the new business has a loss ratio less than one minus the variable expense ratio. Said another way, *if new business premium exceeds the associated loss and variable expense, it can pitch in and help shoulder the burden of the fixed cost, thereby adding value.*

Example 2 shows a detailed breakout of the same hypothetical new and renewal book. However, this time, the new business premium is set such that the loss ratio would be equal to one minus the variable expense ratio. This means the new business is now exactly covering its costs and is neither adding nor subtracting value — the break-even point.

… most insurance companies generally target a combined ratio of 96%-97% for personal lines auto, so the idea that an insurer could pay out 20% more than they take in on new business and still come out ahead seemed far-fetched.

Shown at the bottom of Examples 1 and 2 is the combined ratios for the new and renewal business. In Example 1, a new business combined ratio of less than 123% would add value to the enterprise.

For some of you reading this article, this will be new information. For others, you've seen this before. The *real* lesson in all of this is to always, always, always withhold judgement. No matter how ridiculous something sounds in a meeting — withhold skepticism. Counter-intuitive does not equal wrong. Bite your tongue, go back and do the necessary homework and then after careful consideration share your results with others. If only I could have taken my own advice!

Rob Kahn, FCAS, is a pricing manager for Horace Mann Insurance and a member of the Actuarial Review Working Group

Tackling Inflation with Financial Theory By JIM LYNCH

Stephen D'Arcy used inflation to open a window to the modern investing world.

D'Arcy presented "A Strategy for Property-Liability Insurers in Inflationary Times" at the 1982 CAS Annual Meeting in November. The paper was later published in the *Proceedings of the Casualty Actuarial Society*.

The moment was right. Overall prices were running about 5% higher than a year earlier. This was good news; the United States had suffered almost nine years of inflation exceeding 5% a year, peaking above 14% in April 1980. Insurers were looking hard for ways to predict inflation or somehow cope with it.

D'Arcy's solution was a classic example of how actuaries find innovative solutions to seemingly intractable problems: Use modern portfolio theory to hedge away inflation risk.

The paper also recalls an era when actuaries were just beginning to consider the link between underwriting, pricing and investment income.

D'Arcy had a unique perspective. He had been an actuary in the 1970s, first at Aetna's property-casualty division, then handling homeowners and personal auto at CUMIS (a division of CUNA Mutual, an insurer that focuses on credit unions, their members and customers). By 1981 he was studying finance as a graduate student at the University of Illinois at Urbana-Champaign.

His starkest classroom lessons in inflation came from an economics professor who had experienced German hyperinflation: A loaf of bread that cost about 160 marks at the end of 1922 cost 200 billion marks about a year later. D'Arcy recalls one classroom story: If you went to a dentist for oral surgery, you paid in advance before you were anesthetized. By the time you woke up, you couldn't afford the surgery anymore.

America's inflation wasn't as dire as Germany's had been, but it was a challenge for actuaries to forecast. In 1968, near the outset of America's decade-plus of higher inflation, Norton E. Masterson created a claim cost index for insurance products. Masterson's paper, "Economic Factors in Liability and Property Insurance Claim Costs," was on the CAS syllabus for much of the 1980s.[1]

His starkest classroom lessons in inflation came from an economics professor who had experienced German hyperinflation: A loaf of bread that cost about 160 marks at the end of 1922 cost 200 billion marks about a year later.

But D'Arcy's finance studies left him with a different lesson: "You can't forecast inflation," he told me in August 2023. "But you can hedge it." The tool, D'Arcy wrote, was portfolio theory.

Today, portfolio theory is part of standard finance courses, and casualty actuaries have to understand it to demonstrate proficiency in finance (most do so through Validation by Educational Experience (VEE)). This wasn't the case when D'Arcy approached the subject.

Briefly, portfolio theory suggests that the most effective investment strategy is to diversify: Put money in lightly correlated assets. It will be a rare year where they all rise or all fall. The variance of total return will be minimized.

Harry Markowitz developed the theory in 1952, but it was still working its way into private finance. As a graduate student, D'Arcy saw how to apply the problem to insurance companies.

His approach relies on an important premise: An insurer's underwriting profits are an asset class, akin to stocks or bonds.

D'Arcy gathered data on inflation, underwriting profit margins and investment income results for stock insurance companies. He also gathered data on returns for stocks, long-term government bonds, long-term corporate bonds and Treasury bills.

It isn't a perfect data set. He had inflation and insurance data from 1926 to 1981, which represents only 66 data points. For much of his analysis, D'Arcy drops data before 1933 because the Great Depression caused prices to fall. "Because the concern here is for a strategy to deal with inflation," he writes, "the deflationary period up through 1932 is

[1] His index lives on through the work of actuaries at WTW. The 2022 update can be found at U.S. inflation high — expect strong insurance inflation to follow — WTW (wtwco.com).

not considered in developing the statistical relationships used in this model."

Further, returns on some of the individual investments weren't available before 1951 or after 1976.[2] That forces him to exclude the biggest spikes in inflation in 20th century America — the post-war inflation of the late 1940s, and the 1970s driven by oil embargoes and the ending of price controls imposed by President Nixon in 1971. So, he makes his calculations focusing on a 26-year period that is less volatile than the eras that preceded and followed it.

Data shortcomings might have hindered the robustness of the results; however, the approach remains sound.

Inflation and underwriting profit, he found, were negatively correlated, though the "variation in underwriting profitability that is explained by inflation … is not high, as many other factors impact insurance underwriting profitability."

"However," he wrote, "inflation does significantly affect underwriting profitability."

Insurers' investment income is also negatively correlated with inflation.

Individual investment vehicles yielded mixed results. Common stocks were negatively correlated with inflation at a statistically significant level. Long-term government and corporate bonds were not correlated at a statistically significant level with inflation.

Treasury bills were positively correlated with inflation. Of all the correlations, this is perhaps the most important for D'Arcy's paper. To insulate yourself from inflation, he said, insurers needed to load up on Treasury bills.

With all that information, D'Arcy provided two methods for insurers to immunize themselves.

First, they could continue to underwrite as they had been, and they could apportion their investment assets as they had been — except they could put more into Treasury bills. Using the 1951-1976 data, he estimated that putting 81.8% of investable assets into Treasury bills would immunize insurers from the sting of inflation on assets and underwriting results.

This seems like a drastic solution, and D'Arcy recognized that "immunization is not costless." The immunized portfolio was considerably less risky, so an insurer with one could expect a lower return. Over the long run, insurer operating results would be lower — 4.0% for the immunized portfolio from 1951 to 1976 versus the 5.1% the industry achieved investing as it had.

The result wasn't particularly stable. In an update within his paper, D'Arcy recalculated results with data through 1981. He found the ideal allocation for Treasury bills fell to 42.8%, about half the previous proportion.

In D'Arcy's second method, the insurer would adjust its entire investment outlook to minimize inflation risk, not just create a shrunken version of its previous portfolio. This version of an inflation-immunized portfolio would have 84.2% Treasury bills and 15.8% common stock. The portfolio would hold no long-term government or corporate bonds.

Today, D'Arcy says a lot of insurers were interested in the approach, but he doesn't recall any takers. Officials at one company told him they didn't want to sacrifice stock returns for the stable result the immunized portfolio promised. He understood and pointed out that their decision showed they had a greater risk tolerance for inflation than they thought.

If he addressed the topic today, D'Arcy told me, he'd consider a much wider range of investments. When he wrote, standardized trading of commodity futures and options had only just begun. The opportunities to hedge inflation risk are greater today.

Papers like D'Arcy's had an important influence on pricing. Before 1980, actuaries rarely considered investment income in determining the appropriate profit margin.

"Investment!" D'Arcy told me. "We didn't even think of that!"

The CAS's *Foundations* textbook, published in 1989, provides a more nuanced history of profit margins. Well into the 1960s, most lines of business were pegged to a 5% underwriting profit.[3] The growth of liability lines — whose long tails provide more investment income — and increases in stock and bond returns post-1980 changed things, though slowly.

D'Arcy wrote most of his paper in 1981, while still a student. A year later he was on the University of Illinois faculty. He remained an important academic actuary for four decades. He is retired and living near Boston. ●

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[2] D'Arcy doesn't spell it out, but his charts indicate he lacked data on long-term corporate and long-term government bonds after 1976. This shows the challenge D'Arcy faced working in the era that he did. He couldn't find those values, despite being a graduate student at a well-regarded finance school. Today we would in seconds find them on the internet.

[3] D'Arcy and I both recall workers' compensation sought a skinnier, 2.5% margin as well.

IN MY OPINION By C. K. "STAN" KHURY AND ROBERT J. FINGER

Affirmative Action and DEI

The CAS DEI program claims many benefits, including, as provided on the CAS official website:

> ... creating an innovative and competitive membership that is able to relate to the multi-faceted issues facing today's employers [of actuaries], building a broad array of backgrounds and talents to approach and solve business problems in the modern global economy, and creating a diverse membership reflective of the broader general population that recognize the full horizon of issues that are central to the success of our members, their employers and society as a whole.

Similarly, the goals given by advocates of race-based college admissions as submitted in the defendants' briefs to the Supreme Court of the United States (SCOTUS), included: "training future leaders, acquiring new knowledge based on diverse outlooks, promoting a robust marketplace of ideas, and preparing engaged and productive citizens." The case at hand is *Students for Fair Admissions, Inc. v. President and Fellows of Harvard College*. This case, decided in June 2023, considered race-based undergraduate admission programs at Harvard and University of North Carolina. Both race-based admissions policies and the CAS DEI program use similar overall strategies: They privilege individuals

We seek to apply the tests applied by SCOTUS to race-based college admission policies to the CAS DEI program.

IN MY OPINION By THE CAS DIVERSITY, EQUITY AND INCLUSION COMMITTEE

DEI Increases Awareness of the Profession and Attracts Qualified Future Members; CAS Standards Remain High

The Supreme Court ruled that universities cannot use race as a consideration in the admissions process. The CAS has never used race and will never use race as a consideration in the admissions process.

The CAS strategic approach to diversity, equity and inclusion (DEI) strives to promote equality of opportunity along the entire actuarial career path and foster a sense of belonging and community among members of all identities. By doing so, the CAS can attract more qualified candidates to our profession, which is impor-

One reading of this opinion piece by Khury and Finger might give the impression that the CAS DEI policies do something other than what they actually do. For example, the CAS is not "attempting to change the ratemaking principles" or applying anything other than "objective standards for credentialling . . . . "

Note to readers

Actuarial Review *recommends that CAS members read the 239-page opinion, including the dissent. The opinion can be found at* [*https://www.supremecourt.gov/opinions/22pdf/20-1199_hgdj.pdf*](https://www.supremecourt.gov/opinions/22pdf/20-1199_hgdj.pdf).

from underrepresented groups in various ways in order to achieve a purported greater purpose. We seek to apply the tests applied by SCOTUS to race-based college admission policies to the CAS DEI program. While this column is not a constitutional compliance analysis, we believe that the logic applied by SCOTUS in doing its work has direct relevance to what the CAS is doing in DEI and thus can be useful in judging the CAS DEI program.

The recent SCOTUS decision overturning race-based admission policies of institutions of higher learning affirmed the broad and unqualified sweep of the Equal Protection Clause of 14th Amendment to the U.S. Constitution, that all people are equal under the law. No state shall "deny to any person ... the equal protection of the laws." Affirmative Action programs such as race-based college admission policies have been permitted

The recent SCOTUS decision overturning race-based admission policies of institutions of higher learning affirmed the broad and unqualified sweep of the Equal Protection Clause of 14th Amendment

to exist only as limited temporary exceptions to the 14th Amendment. After an exhaustive review and analysis of race-based college admission policies, SCOTUS concluded that those policies do not meet the criteria that permitted their existence in the first place. Accordingly, race-based college admission policies were struck down.

Although the SCOTUS opinion, among other things, cited six test criteria, due to space limitations, we focus on just four (text in quotations indicates language from the SCOTUS opinion):

Strict scrutiny. Strict scrutiny means that whatever the goals of race-based college admission policies may be, they must be sufficiently "coherent" to permit "meaningful judicial review" and measurement of prog-

tant to advance casualty actuarial science. Many of the CAS DEI efforts are focused on increasing the awareness of actuarial science as a profession, an explicit purpose of our Mission Statement.

One reading of this opinion piece by Khury and Finger might give the impression that the CAS DEI policies do something other than what they actually do. For example, the CAS is not "attempting to change the ratemaking principles" or applying anything other than "objective standards for credentialling," yet these bul-

Knowing that women constitute 47% of employees in the fields of mathematics but only 35% of our exam candidates might imply there are opportunities to attract more potential members to our pipeline … .

lets imply otherwise. Rather than debate the accuracy of each bullet point-by-point, readers interested in the topic are encouraged to visit https://www.casact.org/about/diversity-equity-inclusion to read about the specifics of CAS DEI efforts.

Two items in the bullet list of this opinion piece are aspects of the CAS DEI efforts that may benefit from further commentary — the support of scholarships and the collection of data.

Regarding the scholarship program, the CAS and the Society of Actuaries have jointly offered a diversity exam reimbursement program for more than 11 years. The aim of this program is to attract, encourage and provide support for aspiring actuaries from underrepresented communities, ensuring equal opportunities and ress. “While these are commendable goals, they are not sufficiently coherent for purposes of strict scrutiny[.]” or more specifically, “whether a particular mix of minority students produces ‘engaged and productive citizens’ or effectively ‘train[s] future leaders’ is standardless.” Thus, race-based college admissions do not meet the strict scrutiny test.

Meaningful connection between means and goals. SCOTUS sought to find a meaningful connection between race-based college admissions and the stated goals of Affirmative Action. The universities were unable to provide any such connection, either in their briefs or in oral argument. The policies were found to be amorphous. SCOTUS concluded that “respondents’ admissions programs fail to articulate a meaningful connection between the means they employ and the goals they pursue.”

Narrowly tailored policies. Exceptions to the 14th Amendment must be narrowly tailored. SCOTUS concluded that “respondents measure the racial composition of their classes using racial categories that are plainly overbroad (expressing, for example, no concern whether South Asian or East Asian students are adequately represented as ‘Asian’); arbitrary or undefined (the use of the category ‘Hispanic’); or underinclusive (no category at all for Middle Eastern students).” This classification system is ambiguous and, because of that, is not narrowly tailored.

No end point. Another criterion that permitted exceptions to the 14th Amendment to exist is an endpoint. “Respondents suggest that the end of race-based admissions programs will occur once meaningful representation and diversity are achieved on college campuses. Such measures of success amount to little more than comparing the racial breakdown of the incoming class and comparing it to some other metric, such as the racial makeup of the previous incoming class or the population in general, to see whether some proportional goal has been reached. The problem with this approach is well established: ‘[O]utright racial balancing’ is ‘patently unconstitutional.’”

SCOTUS listed and dealt with two other criteria: The policy cannot be used to do harm to those not

fostering a sense of belonging. Participating in this program helps the CAS attract qualified candidates to our pipeline that otherwise might go on to choose a field of study other than actuarial science.

Regarding the collection of data, understanding the demographics of our members and candidates helps the CAS to achieve greater insight, which can be used to make strategic decisions that further our goals. For example, knowing that women constitute 47% of employees in the fields of mathematics but only 35% of our exam candidates might imply there are opportunities to attract more potential members to our pipeline, and knowing that Asian members represent 25% of CAS volunteers but only 11% of committee chairs might imply there are opportunities to better identify and train potential future leaders. The CAS collects this information only to better understand the diversity of our membership and monitor the effectiveness of the CAS Diversity, Equity, and Inclusion activities. This information is not displayed publicly in the online membership directory, and the data will only be published in the aggregate. Providing demographic information to the CAS is optional, and no member or candidate is treated differently based on the demographic information they provide or choose not to provide; 80% of CAS members and 90% of current exam candidates have provided this information voluntarily.

The CAS’s actions in the area of DEI are constantly evolving. The CAS included specific questions on the DEI strategy in the quinquennial survey that was distributed in October 2023. All CAS members are encouraged to express their thoughts through responding to that survey so that the CAS can best consider the viewpoints of the membership in total.

CAS Board Director Jason L. Russ, FCAS, leads the DEI Committee, the members of which include CAS Appointed Board Director Stephanie Espy; CAS Vice-President Marketing & Communications Kimberly W. Guerriero, FCAS; and CAS Fellows and Board Directors Amber M. Rohde, FCAS, and Erika Helen Schurr.

favored by the policy and the policy cannot be used to "stereotype" those favored by the policy, that is, it must not assume that members of a particular group think alike. Space does not permit exploring them here. Suffice it to say, the court did not find a single criterion that was met by race-based, college admission policies.

It is now easy to see that the CAS goals of DEI are founded on similar thinking as race-based college admissions. To be sure, we also examined the contemporary literature on DEI and compiled a wide variety of stated goals of such programs and we find that the CAS goals are typical of the thinking on the subject, and do not present any particularly innovative elements that are specific to the CAS. Clearly, the CAS goals are not sufficiently coherent to meet the strict scrutiny test. Nor do they show any explicit connection between the actions the CAS has taken and the stated goals. They are broadly aimed and not narrowly tailored to the specific stated goals. And to date, the CAS has not indicated any end point to this program. That is, when will the CAS know that the objectives have been achieved?

Therefore, given the results of applying the SCOTUS tests to the CAS DEI program, we believe that the CAS needs to take a fresh look at what it is doing in DEI given the overwhelming rejection by SCOTUS of Affirmative Action programs that seek to treat different groups of the population differently, instead of according to the individual characteristics of each member of the group. In light of the overwhelming evidence of the incoherence of Affirmative Action programs as well to the CAS DEI program, it is incumbent upon the CAS to re-examine this issue in a new light and try again.

At a minimum, the CAS needs to examine its DEI program and (a) do away with anything that fails these tests and (b) strengthen the elements that would prevent the CAS from encouraging practices and policies that would ultimately fail these tests. Of particular note are the following:

- Rejecting a purely race-based scholarship program.
- Ceasing all attempts at changing the ratemaking principles through ersatz research aimed at demonstrating that an actuarially sound method can produce racially biased rates.
- Abandoning all programs that are premised on an assumption of "systemic racism."
- Abandoning all attempts at classifying CAS members according to ambiguous classification schemes.
- Affirming or codifying that the same objective standards for credentialling are applicable to everyone regardless of race or ethnicity.
- Affirming or codifying in a tangible enforceable way that race and ethnicity are not suitable rating variables for casualty insurance.
- Abandoning all activities that are based on confusing correlation with causation.
- Abandoning all efforts to involve the CAS in any public policy issues. In other words, stick to our main mission of educating and credentialling actuaries and advancing actuarial science.

Such a new examination should serve the CAS well in that the CAS per force will emerge with a stronger posture with respect to DEI and avoid dividing its membership into various groupings that serve to enervate the common interests of CAS members.

C. K. "Stan" Khury, FCAS, is retired, a long-time volunteer and a past president of the CAS. Robert J. Finger, FCAS, JD, is retired and editor in chief of the Foundations of Casualty Actuarial Science (4th Edition).

IT'S A PUZZLEMENT By JON EVANS

Turning Into Traffic

You are at a stop sign on a two-lane road that intersects a four-lane (two lanes going each way) road without a stop sign. In each individual lane of the four-lane road, on average, a car passes by the stop sign every four seconds. Given your car's performance, cars on the intersecting road need to be at least four seconds away for you to safely make the turn. If you are in a right-hand traffic country, like the U.S, how long do you expect to wait to make a right-hand turn? How long is it for a left-hand turn? What if you are unlucky and have to wait a long time (worst 10%, worst 1%, …)?

Estimate the volume

The SHA-256 hash: 88b8448136047d588c-fa8cd091a4f0b3d9d0cb-7c7808508bf660d515c2719ea5 comes from the text below which describes the true lattice extreme lattice point coordinates and corresponding volume:

The 3 dimensional integer lattice spans between diagonal points (0, 0, 0) to (36, 46, 72) and volume 119,232.

This puzzle was inspired by a famous real-world problem, "The German Tank Problem," from World War II. There is a thorough Wikipedia article on this problem. What is amazing about the historical story is that simple statistical methods applied to data on the serial numbers of captured German tanks produced dramatically more accurate estimates of German tank production than more elaborate conventional military intelligence analysis.

This puzzle is essentially a three-dimensional version of the German Tank Problem. One slight difference is that the lattice coordinates have a minimum value of 0, whereas serial numbers have a minimum value of 1. This can be handled by adding 1 to each of the sample coordinates and then subtracting 1 from the estimated values in the formulas used.

Figure 1.

Max Lattice Coordinate	Sample Size	Largest Observed Value Plus 1	Point Estimate Formula Minus 1	Variance of Point Estimate Formula	2nd Moment of Point Estimate Formula
L	10	32	33.2	6.61200	1108.85200
M	10	47	49.7	16.77325	2486.86325
N	10	70	75.0	41.16667	5666.16667

Here is one estimation approach. Two key frequentist estimation formulas are:

$\hat{N} = m(1+1/k)-1$

where $\hat{N}$ is the estimated maximum serial number, m is the largest observed serial number, and k is the sample size, and

$Var(\hat{N})=((N-k)(N+1))/(k(k+2))$.

Figure 1 is a table of calculations for the three dimensions of the lattice.

So, the point volume estimate for the lattice is naturally $\hat{L}\hat{M}\hat{N} = 33.2 \times 49.7 \times 75 = 123{,}753$ and the variance of this volume estimator is:

$Var(\hat{L}\hat{M}\hat{N})=E[(\hat{L}\hat{M}\hat{N})^2]-E[\hat{L}\hat{M}\hat{N}]^2 = E[\hat{L}^2]E[\hat{M}^2]E[\hat{N}^2]-E[\hat{L}]^2 E[\hat{M}]^2 E[\hat{N}]^2$

which is naturally estimated as:

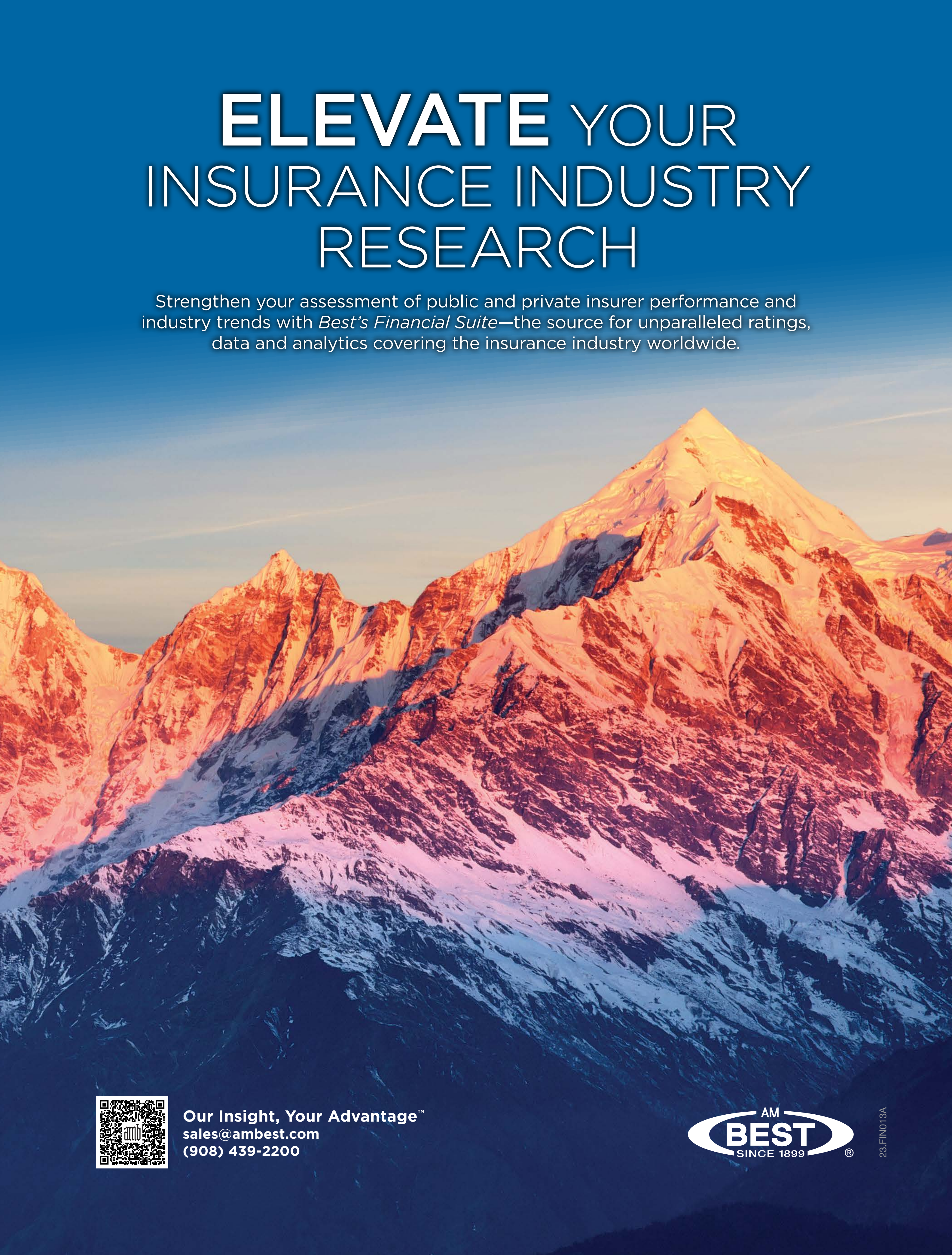
$=1108.85200 \times 2486.86325 \times 5666.16667-(123{,}753)^2$

$= 310{,}008{,}177.460093$

$StDev(\hat{L}\hat{M}\hat{N})=\sqrt{(310{,}008{,}177.460093)}=17{,}607.04908$.

John Berglund, Bob Conger, Glenn Meyers and Rob Thomas also submitted solutions.

Know the answer? Send your solution to ar@casact.org.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