

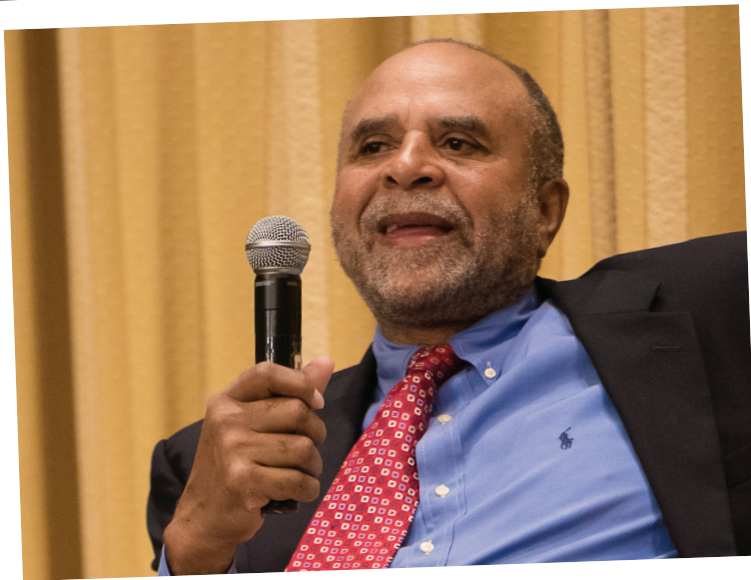
actuarialREVIEW

VOL 48 / NO 1 / JANUARY-FEBRUARY 2021

PUBLISHED BY THE CASUALTY ACTUARIAL SOCIETY 

Pioneering CAS Fellows:

*Linda Shepherd and
Ollie Sherman Reflect
on Their Careers*



**CAS Strategic
Plan Creates
Bold New Vision**





2020

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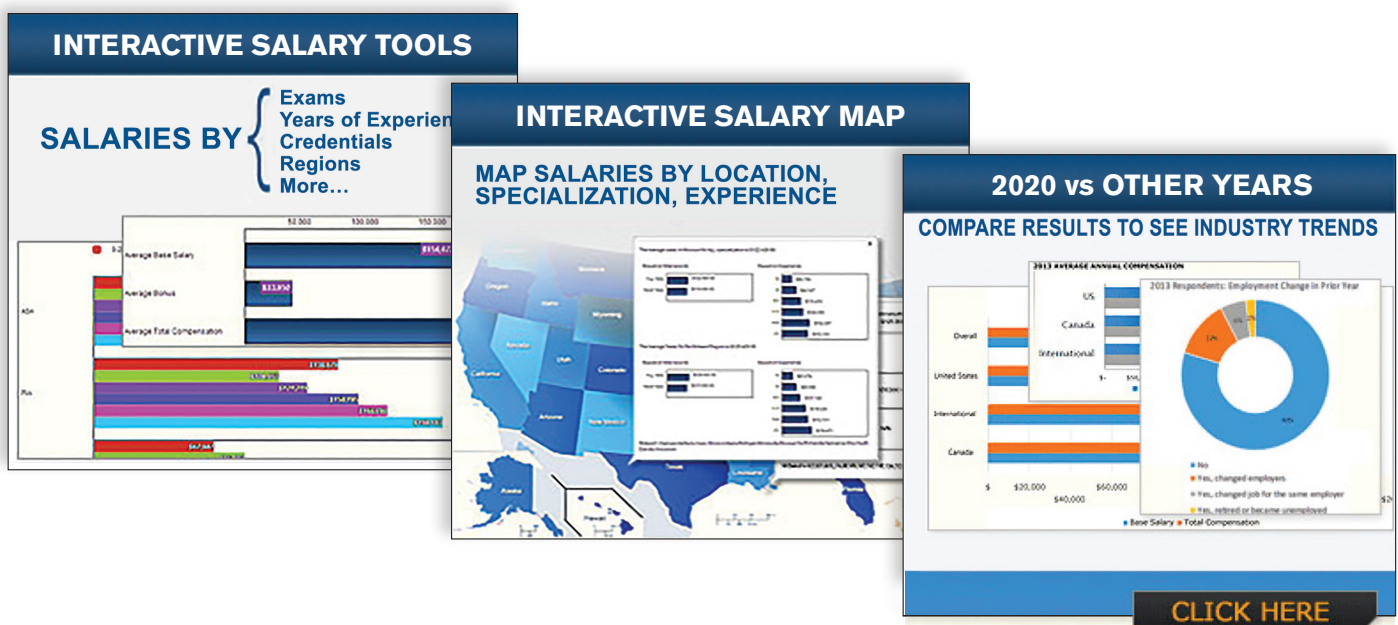
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Actuarial Consultant - Illinois, Georgia, California, or Remote: Well known client is in search for a designated ACAS or FCAS with at least 5 years of actuarial experience. The ideal candidate would be highly organized, possess strong project coordination, and have excellent leadership skills. Candidate will participate in all phases of the development of analytics projects including data preparation, Exploratory Data Analysis (EDAs), development of predictive models, and project documentation. Must be proficient in Microsoft Office and possess some programming knowledge. Consulting experience preferred. Salary \$175k-\$250k. (#49889)

Pricing Actuary - Michigan or Remote: Growing Michigan client is seeking an ACAS with 6+ years of actuarial experience. The ideal candidate would have a strong background in personal lines and pricing. This individual will prepare and review rate indications for major insurance lines of business as well as provide pricing and product management support. Must be able to provide leadership and mentor junior staff. Salary \$90-110K. (#49849)

Actuarial Analyst - Florida or Remote: Amazing opportunity available in Florida for a recent ACAS or student actuary with 2+ years of actuarial experience and at least 3 exams completed. This individual will be responsible for providing quantitative and qualitative support for actuarial pricing, product development, financial analysis, management reporting, and other actuarial research. Must be able to collaborate closely and effectively with Underwriting and Product Management. Reserving experience is required, must be proficient in Excel & Access. E&S, Cat Modeling experience would be a plus. (#49829)

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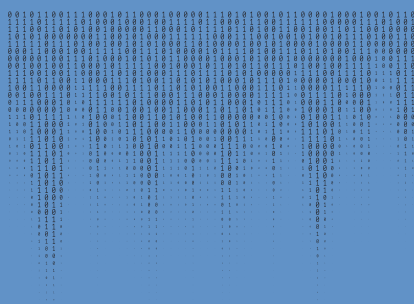
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on the cover

Pioneering CAS Fellows: Linda Shepherd and Ollie Sherman Reflect on Their Careers

By LAURIE McCLELLAN

In ways small and
large, Linda Shepherd
and Ollie Sherman

have forged a path for others looking for
fulfilling actuarial careers.



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CAS Strategic Plan Creates Bold New Vision

A new Envisioned
Future for the CAS
will ensure that its
members are sought
after throughout
the world for their
analytics, problem
solving and domain
knowledge skills.



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editor'sNOTE By ELIZABETH A. SMITH, AR MANAGING EDITOR

Tomorrow, Yesterday and Today

Despite all the challenges of 2020, people adapted to the situation, kept things going and even made substantial progress. The CAS staff and volunteers made the year one of the most productive ever. Need I remind readers that CAS Exams are now computerized? This is a rare, good thing that happened. This *AR* shows how the CAS is planning for the future, reflecting on the past and soldiering on.

Nestled in the middle of this *AR*, the CAS Strategic Plan is a bold blueprint for moving the organization forward that is centered on skills-building, member diversification and global expansion. CAS President Jessica Leong shakes up her President's Message, creating a series of video interviews with actuarial power-houses. Frank Chang of Uber kicks off the interviews, which are available as web-exclusives on the *AR* website.

Much like a year's ending, retirement is a time to reflect. Our cover story tells of two pioneering CAS members, newly retired Linda Shepherd and Ollie Sherman (retired in 2010), who have the distinction of being the first African American woman and man to become CAS Fellows. Being first can be great and can have its

downsides. In families, first-borns often bask in their parents' full attention. Firsts in a profession can carry the weight of being a role model, perhaps unfairly, but they can leave a legacy of excellence and support for those who come after them. Shepherd and Sherman shine a light on the people and experiences that led them into the actuarial profession and helped shape their careers. Becoming an actuary was not an obvious choice for either of them — they had to discover it and were fortunate to have people in their lives who took an interest in their futures.

Also in this issue are reports on key topics discussed at sessions from the virtual 2020 CAS Annual Meeting. Although temporarily overshadowed by COVID-19, these concerns are still starkly relevant: social justice, opioid addiction and risk prediction. And just when you think that the year 2020 could not get any worse, it does. Note the correction below.

Correction

Due to a production error, several copies of the November/December 2020 *Actuarial Review* print edition have transposed pages. See the *AR* website for the correct pdf. The CAS regrets the error. ●

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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Bootstraps, Leadership & Uber: A Conversation with Frank Chang

For my President's Message columns, I will be talking to distinguished actuaries who embody the new Envisioned Future for the CAS. Videos of these interviews will be available on the Actuarial Review website and the CAS YouTube channel.

Franks Chang found his way to the actuarial profession by following insurance stocks for The Motley Fool. He traded piano lessons so he could study for his first two actuarial exams and taught himself Python at age 40. Now he heads up the Department of Safety and Insurance Analytics at Uber. He's the first subject in a series of interviews to highlight the CAS's new Envisioned Future, which says: "CAS members are sought after globally for their insights and ability to apply analytics to solve insurance and risk management problems."

Jessica Leong: If I'm sitting in an Uber, what would I notice that you and your team have done to make my ride safer?

Frank Chang: A lot of the safety features. So, for example, the safety center that you see in the app that you can find at the bottom, the SOS button that's in the safety center and a few of the newer features we've launched. Some rides actually have a PIN confirmation where you can make sure that you have the right driver. For COVID, there are photos with mask detection to see if folks are wearing their masks, which is required in all Ubers.

JL: You made your way up from director of actuarial services to the head of safety and insurance analytics at Uber. How did you

manage to take on bigger and bigger roles?

FC: You have to be intellectually curious ... I've said this before to other actuaries. The actuarial exams are a good preparation for a wide variety of subjects. We could always ask, "Why do we need to learn regulation on our exams?" But if you dig into that, you then become an insurance professional. When you leave an insurance company, folks don't really understand insurance.

Both the insurance and data science aspects of my knowledge base improved because folks were asking, "Can you solve this?" and "Can you solve that?" You have the competitive advantage here. From that I was able to get into Uber ... Insurance and safety merged, and I was able to credibly talk about safety. We deal with rare events all the time [as actuaries]. Not very many data scientists out there are used to it. They don't know the difference in errors. They don't have the thought of how to cut your data, so you have homogeneity and credibility at the same time.

JL: What you're saying is "play to your strengths." We have this very deep knowledge in insurance and that is sought after outside of the insurance industry. You also taught yourself the data science skill set.

FC: I did teach myself Python at Uber at a fairly ripe age. I started at Uber when I turned 40. So, it's never too late! I learned Python from scratch there.

JL: Let's go back to the beginning of your career. You did a Ph.D. in math and you also studied music and Chinese.

FC: This is hope for all the career changers and late bloomers out there! I got a Ph.D. in math. I'll be completely honest — my parents pushed me to it. I'm the oldest child and my parents both have Ph.D.s. It was a very typical Taiwanese-American household, where they're just like, "We both have Ph.D.s. This is the path that we know, son. You need to go get a Ph.D." And so, I did. By hook or by crook, I finally got one. When I graduated and was trying to find a job and — oh my goodness — that was really difficult because now you have this huge academic degree. You don't have a whole lot of communication skills. You make things way too technical because you're used to defending your thesis or arguing with your advisor.

I was a stay-at-home dad and I found work at The Motley Fool monitoring their online discussion boards. The only pay that they gave was free subscriptions to all their newsletters, which I consumed voraciously, and so I got into stocks and that was how I discovered the actuarial profession. The stocks I covered were financial and insurance stocks. I read a lot of reports that talked about actuaries and had these numbers shaped like triangles. And I said, "Wow! That's really interesting. Let me see if I can learn more about this."

I do have a degree in music, so I taught piano lessons while I was a stay-at-home dad. I exchanged lessons for childcare, so I didn't take any money. I used the time that folks watched my kids to study for the first few actuarial exams. I took Exams 1 and 2, and I got a job at Esurance.

President's Message, page 8

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President's Message

from page 6

JL: I read some of the [Motley Fool] posts. You seem to know a lot about insurance.

FC: Wow! That's a blast from the past! I read all the 10-Ks, all the 10-Qs and a bunch of books that Motley Fool recommended ... I read *One Up on Wall Street* and *The Davis Dynasty*, which is about Shelby Davis, who invested in insurance. There was a lot of stuff about Jack Byrne, whom Warren Buffett calls the "Babe Ruth of Insurance." So, yeah, I did a lot of studying about the industry before diving in.

JL: So, in terms of CAS members learning more about the industry, is that what you would recommend? Read the books? What can they do on the job to learn more about the business?

FC: I'm going to start with the folks who work at [insurance] carriers because that's how I came up and that's near and dear to my heart. For those insurance carriers, learn what you're selling. Read the policies. Figure out what the endorsements are. Befriend your stakeholders. For consultants ... get yourself out there. Don't network just within your consultancy. You have clients and those clients may have friends and, if you get enough of a network, you're going to be able to touch different parts of the industry that ... others would just not see.

JL: Your Motley Fool profile a long time ago recommended *The Now Habit*. I actually borrowed it from the library. Should I read it?

FC: Absolutely! Oh my gosh! Every

exam-taker out there should read *The Now Habit*! The "unschedule" is a good technique for anyone who has a problem with procrastination. Why I recommend it to exam-takers is, clearly, the people who are taking exams have the cleanest apartments or they have the best homemade bread.

Getting More by Stuart Diamond is one that I recommend a lot. That's a book about negotiation. It's not just about hard negotiation, but about getting more. One that I've read a few times is *Crucial Conversations on Communication* — a very good book about not treating folks that you're talking to as if they're villains or treating yourself as a victim when you go into a hard conversation. As actuaries, I feel like we do shy away from hard conversations. *The HBR Guide to Office Politics* is also an important read. [It's] not a book about politics, but about how to survive at work honestly, how to deal with difficult situations and how to carry yourself as a leader. It's about a lot of things that you learn on the job, but it's all one book. It's fantastic!

JL: The CAS recently launched its new Envisioned Future that says: "CAS members are sought after globally for their insights and ability to apply analytics to solve insurance and risk management problems." I want to get your take on our Envisioned Future and what things you feel that we need to overcome at the CAS to really make sure we're heading towards our Envisioned Future?

FC: I recently read a Harvard Business School paper about Ron Johnson, a fascinating guy who worked directly with

Steve Jobs to get all the Apple stores out. He was seen as a retail genius. JCPenney, which was struggling at the time, had brought him in and he lasted 18 months. He tried to move too fast and disenfranchised his core customer — the people who looked forward to coupons, sales and deals. At the very beginning, he said, "We're not going to do sales anymore. We will remove that from our vocabulary. Everything is just going to be everyday low prices," and it just didn't work.

[At] the CAS, some of the things we need to do is ... make sure that we are still the Society that supports the folks doing traditional pricing/reserving. We cannot lose our support for that important function. We are the actuarial society and that's core actuarial work. So, we need to manage that while also being able to attract new customers, right? And we already have some. You heard Elon Musk talk in his earnings call about how much he likes actuaries. And so you see more and more folks demanding actuaries in their jobs. How do we support that? How do we encourage companies that are not thinking about actuaries to think about hiring actuaries? How do we encourage actuaries to learn the skills needed for those slots? ... In order for us to succeed, we need to have a strategy for how we do that expansion. What is that expansion about? What are the analytical skills we're going to teach first? ... We already have the Certified Specialist in Predictive Analytics (CSPA) through The CAS Institute. Do we leverage that and make that into a more scalable set of exams that help actuaries prepare for these jobs? Those are some of the things that we have to overcome that we haven't thought about in the past. ●

COMINGS AND GOINGS

CAS President-Elect **Katherine Antonello, FCAS**, has been named chief executive officer of Employers Holding. Antonello joined Employers Holding in 2019 as executive vice president and chief actuary.

Dave Hartman (FCAS 1972) and his wife, Kitty, are honored to have established and endowed the David G. Hartman Actuarial Scholarship fund at the University of Michigan. Among other criteria, the scholarship recipients will be pursuing CAS Fellowship or Associateship, careers as casualty actuaries, majors in actuarial mathematics, and majors or minors in business administration. The endowment will initially provide \$20,000 per academic year for scholarships.

Sharon Robinson, FCAS, and **Donna Glenn, FCAS**, have been named among 30 Business Insurance Women to Watch. This program began in 2006 to recognize women leaders doing out-

standing work in risk management and commercial insurance.

Insurance Business Magazine named **Kuda Chibanda, FCAS**, and **Josh Kraft, FCAS**, to its list of 2020 Rising Stars. The list is composed of 85 up-and-coming professionals aged 35 and younger who are on track to becoming tomorrow's industry leaders.

Kathleen Reardon, FCAS, has been named chief executive officer of Hiscox. Reardon was most recently CEO of Hamilton Re.

Kingstone has named **Minlei Sarah Chen, FCAS**, its new chief actuary. She joins Kingstone from Homesite.

Kevin Murphy, FCAS, has been appointed to executive vice president and CEO at Indiana Farm Bureau of Insurance. Murphy has 30 years of extensive experience in the insurance industry. ●

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

CALENDAR OF EVENTS

March 15-17, 2021

Rate-making, Product, and
Modeling Virtual Seminar

May 23-26, 2021

Spring Meeting
Disney's Coronado Springs Resort
Orlando, FL

June 8-9, 2021

Virtual Seminar on Reinsurance

September 13-15, 2021

Casualty Loss Reserve Seminar

November 7-10, 2021

Annual Meeting

Spring 2022

Actuarial Colloquia
(hosted by the CAS)

ACTUARIAL REVIEW LETTERS POLICIES

Letters to the editor may be sent to ar@casact.org or to the CAS Office address. Please include a telephone number with all letters. Actuarial Review reserves the right to edit all letters for length and clarity and cannot assure the publication of any letter. Please limit letters to 250 words. Under special circumstances, writers may request anonymity, but no letter will be printed if the author's identity is unknown to the editors. Event announcements will not be printed.

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IN MEMORIAM

John M. Bragg (ACAS 1957)
1921-2019

Linda M. Groh (FCAS 1988)
1946-2021

Andrew W. Moody (FCAS 1997)
1952-2020

Edward R. "Ted" Smith (FCAS 1966)
1931-2019

CAS STAFF SPOTLIGHT

Meet Kellee Jenkins, CAS Professional Education Coordinator

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

Kellee Jenkins.

- **What do you do at the CAS?**

As the professional education coordinator, I help our team enhance and implement a variety of educational initiatives for CAS members. This includes working with member volunteers to create new content for our yearly events and streamlining the CE Record Review process. Now that we've had to pivot many of our in-person events to an all-virtual environment, I help train speakers, moderators and fellow staff on various online platforms.

- **What do you enjoy most about your job?**

I enjoy engaging with members, working with an amazing team and being a part of an organization that values diversity.

- **Where is your hometown?**

Although I was born in New York City, I've moved many times. I claim Charleston, South Carolina, as my hometown, as that's where I graduated from high school.

- **Where did you go to college and what is your degree?**

I earned a bachelor's in economics and international business from the University of South Carolina. I also studied abroad at Kansai Gaidai University in Osaka, Japan.

- **What was your first job out of college?**

I worked in the structured finance group of KPMG in Tysons Corner, Virginia.

- **Describe yourself in three words.**

Enthusiastic. Creative. Compassionate.

- **What is your favorite weekend activity?**

Spending quality time with my husband and three amazing teenagers.

- **What is your favorite travel destination?**

- **What is your favorite travel destination?**

One of my favorites is Jamaica. When I visit my family there, everything is *irie, * mon!*

- **Name one interesting or fun fact about you.**

I participated in the Washington D.C. AIDS Ride, biking 330 miles over four days from Raleigh, North Carolina. We helped raise money for charities dedicated to improving the lives of those living with HIV/AIDS. ●



Kellee Jenkins



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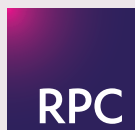
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2020 Annual Report of the CAS Discipline Committee to the Board of Directors

Background

The CAS Rules of Procedure for Disciplinary Actions (as amended May 3, 2009 by the Board of Directors) requires an annual report by the Discipline Committee to the Board of Directors and to the membership. This report shall include a description of its activities, including commentary on the types of cases pending, resolved and dismissed. The annual report is subject to the confidentiality requirements.

2020 Activity

The Discipline Committee received a report of an Actuarial Board for Counseling and Discipline proceeding in November 2019. In accordance with the CAS Rules of Procedure for Disciplinary Actions, a hearing was held on May 28, 2020; the Discipline Committee Panel voted unanimously to publicly reprimand the subject actuary for materially violating Precepts 1, 3 and 4 of the Code of Professional Conduct. The Appeals Panel of the CAS Board of Directors affirmed this decision in December 2020.

In March 2020, a complaint was received alleging that a candidate had materially violated Rule 2 of the CAS Code of Professional Conduct for Candidates. In accordance with the CAS Rules of Procedure for Disciplinary Actions involving Candidates, the chair of the Discipline Committee requested that the subject candidate respond to the allegations. Having received the candidate's perspective on the matter, the case was dismissed by the chair of the Discipline Committee.

Finally, in December 2019, the Discipline Committee was asked to make inquiry concerning a matter that involved 67 individuals, 21 of whom

were CAS members and the remainder CAS candidates. The matter involved potential violations of Precept 1 of the Code of Professional Conduct by CAS members and of Rules 1 and 2 of the Code of Professional Conduct for Candidates by the CAS candidates. Members of the Discipline Committee interviewed all of the CAS members and a sampling of the candidates to better understand their involvement in the matter. A report on this matter is being prepared and is expected to be presented to the CAS Executive Committee in the first quarter 2021.

There are no cases currently pending before the committee.

—Pat Teufel, Chairperson of the
'2020 Discipline Committee
December 30, 2020 ●

PKU-CAS Actuarial Month Continues Tradition at Peking University

"PKU-CAS Actuarial Month" marked its ninth year of collaboration between the CAS and Peking University (PKU) with a month-long event in November 2020 to promote the property-casualty actuarial profession to universities and their students. Taking place in Beijing, the program gives faculty and students the chance to understand more about how P&C actuaries think and work in practice.

"PKU-CAS Actuarial Month" involved a series of lectures covering

non-life insurance pricing, reserving and reinsurance, and capital modeling. Other hot topics included C-ROSS Phase II, which is the new solvency supervisory regime, and motor insurance reform in the current Chinese market.

Associate Professor Kai Chen of Peking University's School of Economics praised the joint campaign, calling it a great benefit to the university's education system that presented the actuarial practice in great depth.

CAS Fellows supporting the event include Mr. Xiaoxuan (Sherwin) Li, chair

of the CAS Asia Regional Committee; Mr. Chuoxiang Zhao, pricing actuary of China United P&C Insurance; Ms. Ran Kan, actuary for Swiss Re Beijing; and Mr. Ran Guo, director of international relations for the CAS.

In the future, the CAS will continue collaborating with Asian universities to foster more P&C actuarial talent from this emerging market. For more information on "PKU-CAS Actuarial Month" and other CAS international initiatives, write to Ran Guo at rguo@casact.org. ●

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Why are you in the insurance industry?

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Pioneering CAS Fellows:

Linda Shepherd and Ollie Sherman Reflect on their Careers

By LAURIE McCLELLAN

In ways small and large, Linda Shepherd and Ollie Sherman have forged a path for others looking for fulfilling actuarial careers.

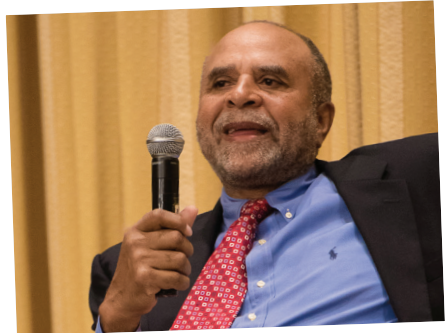


Photo credit: Vaughn Broune.

November 2020 marked a milestone for actuaries as Linda Shepherd, who in 1988 became the first Black woman to earn a CAS Fellowship, officially retired.

Four years earlier, in 1984, Ollie Sherman became the first Black actuary to qualify for Fellowship. (Sherman retired in 2010). How did these pioneers achieve their historic firsts? Although they followed very different career paths, both point to the value of mentors, the importance of a community of colleagues, and an abiding interest in the problem-solving work of the profession itself.

Shepherd thinks her introduction to the job was unique — especially for the 1970s. “I’ve told my story for the last 40 years,” she says, “and no one has had a similar story until recently.” Shepherd first heard about the career from her

Two careers in photos (top to bottom):

Linda Shepherd, FCAS, (third from left) with other inductees of the first Copiague High School Hall of Achievement in 1997. The man behind her to the right is the actor Kene Holiday.

Shepherd with a plaque given to her by colleagues celebrating her earning the CAS Fellowship in 1988.

Speakers gather after a session honoring leaders of the International Association of Black Actuaries (IABA) in 2017. Pictured left to right are Jeff Johnson, FSA; Stafford Thompson Jr.; Tenesia McGruder, FSA; Ollie Sherman, FCAS; and Chris Cooper, the session’s master of ceremony.

Sherman speaks during the session honoring IABA leaders at the organization’s annual meeting in 2017.

Photos courtesy of Linda Shepherd and the International Association of Black Actuaries.

high school guidance counselor, who happened to have a neighbor who worked as an actuary. The counselor even arranged for Shepherd to visit the neighbor's office and take a tour.

With her mother along to supervise, the high school junior took the Long Island Railroad into Manhattan and entered the doors of George B. Buck Consulting Actuaries in Penn Plaza. "It was absolutely an adventure," she recalls. Then the truly unexpected happened. "They asked if I'd be interested in a summer job. And I was laughing, because I was thinking to myself, 'Is the Pope Catholic?'"

On the spot, Shepherd took a paper-and-pencil test in which she computed a retirement benefit. She got the correct answer and was hired for a summer internship as a benefit calculation clerk.

Sold on the job, Shepherd applied to the University of Pennsylvania's Wharton School so she could major in actuarial science. After her junior year at Wharton, a summer internship at Philadelphia's General Accident Group in property-casualty insurance, turned out to be the key to her career. "That's when I decided I was interested in property and casualty," Shepherd says. After graduation, she landed a job at Aetna in Hartford, Connecticut. She describes the world of property-casualty insurance in 1981 as a little like the Wild West. "There weren't that many P&C actuaries," she explains, "because a lot of the work until then had been done by a rating bureau, the Insurance Services Office (ISO)."

Due to the changing times, Shepherd got started with a group of other newbies. "When I first got into my program on the P&C side," she remembers, "there were six of us hired directly out of school. Only two of us had one exam, and everybody else had no exams. Life was established, but it intrigued me that on the P&C side, it was just coming

On the spot, Shepherd took a paper-and-pencil test in which she computed a retirement benefit. She got the correct answer and was hired for a summer internship as a benefit calculation clerk.

up with new processes and trying to figure it out. On top of that, we didn't have personal computers back then! When the company got the first personal computers, we had to sign up for an hour of time to use them." She fondly remembers her first spreadsheet program, the venerable Lotus 1-2-3.

Shepherd discovered that Hartford was not a diverse city. But within Aetna, she soon found a community of other African Americans. "Within a couple of years after I started," she says, "Aetna had a luncheon for all of the African American actuaries that had been hired by either the life or the casualty side. There were 13 or 14 people who were at that luncheon in the mid-1980s. I

thought that was pretty cool that they were very tuned into diversity and wanted to make sure that the program was strong with African Americans. It was a neat thing to be able to see so many African Americans like myself studying to become



A guide and inspiration: Linda Shepherd and one of her mentors, Robert Randall, FSA, the first Black Fellow of the Society of Actuaries, at Shepherd's CAS Fellowship party in Hartford, Connecticut, in 1988. Bob Randall died in 2012.

actuaries.”

At the lunch, Shepherd crossed paths with Ollie Sherman, who started working at Travelers in Hartford in 1975. “I was surprised by the number of folks in the Aetna program who looked like me,” Sherman says. “They had organized a network to provide study assistance and moral support to students in their exam efforts.”

Unlike Linda Shepherd, Ollie Sherman became an actuary almost by accident. “I’d never even heard of an actuary until I was out in the job market,” he says. At the University of Virginia, Sherman started out as an engineering student. “Then they opened a program in applied math and computer science during my senior year,” he says, “so I moved over to that. I was one of the first majors. I liked the practical applications of mathematics and the problem solving and the logic.”

Sherman took his applied math degree to the Federal

“Aetna had a luncheon for all of the African American actuaries that had been hired ... There were 13 or 14 people who were at that luncheon in the mid-1980s. I thought that was pretty cool that they were very tuned into diversity ... — Linda Shepherd

Reserve Bank of Richmond, Virginia, but found the work too bureaucratic. He came across one vital clue to his future there, however, when he learned the actuarial method of calculating rebates for customers who paid off loans early. He searched for more information about actuaries, found some recruiting materials from Travelers Insurance and moved to Hartford in 1975 to start work there.

Sherman was in for a shock. “When I joined the actuarial profession,” he recalls, “I was pretty naive and pretty cocky. I thought, ‘the exams gotta be pretty easy. I’ll knock them out in no time and then I’ll decide what I really want to do.’” Not only did the exams prove much tougher than Sherman expected, but he was also surprised by “the quality of people that I was dealing with and the kinds of issues that they were dealing with. I found them pretty

interesting.”

Sherman kept powering through the exams, but the last one was particularly hard and took three years to complete. Says Sherman, “I thought, if I don’t do it this time, I really need to reconsider what I’m going to do.” But eight years after he started, in 1984, Sherman became a CAS Fellow.

“I was proud of that,” he says, “and my parents were proud. That was one of the driving forces, trying to make my parents proud of me. Neither one of them had an opportunity to go to college. My older brother and I were the first in our family to attend college.”

Four years later, Linda Shepherd also became a CAS Fellow. “There was this nice-sized pool of African Americans actuaries in Hartford at the time,” she remembers, “and they surprised me with a Fellowship party.” Some 20 guests celebrated her accomplishment with dinner and cake, and a must-have accessory for 1988: a briefcase.



A big mahalo for a rewarding career: Linda Shepherd at the 2019 CAS Annual Meeting in Hawaii.

For Ollie Sherman, becoming the first African American FCAS wasn't easy. "I don't think, when I was hired at Travelers, that they ever expected me to complete the exams and to go all the way to the Fellowship. At that time, there weren't any successful minority candidates in the casualty actuarial profession," he says. "One of the first guys I met there, Jim Walker, was kind of my role model and mentor. He was an African American gentleman. He had started out in the actuarial profession, and he felt like they never gave him the opportunity to pursue the exams. So one of the driving factors for me was to finish what he had started. Whenever I got discouraged or feeling down about the exams, I'd speak with him and he'd encourage me to keep going."

Linda Shepherd found the support of those who broke barriers before her was invaluable, including Bob Randall, who became the first Black Fellow of the Society of Actuaries in 1952. (Randall, a Yale graduate, served in World War II with the Tuskegee Airmen. Told he was too tall to be a pilot, he worked as a mechanic with the unit. He later became the first Black president of a national insurance company.) "He was an inspiration to almost all of us who were able to meet him at that time," Shepherd says. "He came to a lot of our functions. His attitude was, you're an actuary and I'm supporting you." Randall even made it to Shepherd's Fellowship party.

Shepherd also credits other Black women pioneers, including Daisy McFarlane Coke, the first African American woman to become a Fellow of the Institute of Actuaries in 1970, and Marsha Bera-Morris, the first African American woman to become a Fellow of the Society of Actuaries in 1978.

As their careers began to flourish, both Shepherd and Sherman joined the fledgling International Association of Black Actuaries

"Jim Walker ... had started out in the actuarial profession, and he felt like they never gave him the opportunity to pursue the exams. So one of the driving factors for me was to finish what he had started."
—Ollie Sherman

(IABA), which was launched in 1992. Just three years earlier, industry analysts had estimated that out of the nation's 11,500 actuaries, only some 50 were Black. Says Sherman, "We got together as a community to support each other and to encourage other people to take on the challenge of the exams." For Sherman, that sense of community was an antidote to the isolation he felt when he first started taking exams. "I was kind of struggling with it alone," he says. "You don't see people who look like you and the majority candidates don't fully appreciate all of the things that happen with the minority applicants."

Linda Shepherd found that joining IABA let her help others discover a fulfilling career. "I knew there were lots of other people like me — a little girl who loved math — and really wanted to make sure I had a very nice career. I

always thought that was my calling: to reach back and try to



Photo credit: Vaughn Broune.

Ushering in a new generation of actuaries: From left to right, Ollie Sherman, Tenesia McGruder, FSA, and Marsha Bera-Morris, FSA, at the IABA Annual Meeting in 2017. Bera-Morris became a Fellow of the Society of Actuaries in 1978, the first Black woman to do so.



Photo credit: Vaughn Broune.

Dispensing wisdom: Sherman at the 2017 IABA Annual Meeting.

explain to people what I do and why this is a great career. A lot of other people thought the same way, and that's why IABA was formed."

Shepherd says that in the early days of the IABA, "It was even hard to find where the African American actuaries were working. It started really slow, but then we really picked up steam." Shepherd served as president from 1996 to 1998. She credits Stafford Thomson, who became IABA president in 2002, with taking the organization to the next level. "Thomson was the first person to say, 'Let's work with corporations who want to improve the number of African Americans they have and see if we could get funding from them.' And we could have scholarships and other types of programs," she says. "It got much bigger to do the work that we needed to do — to find talented African Americans who wanted to be actuaries."

Shepherd went out to look for the next generation of Black actuaries herself, under the auspices of the IABA and the Joint Committee for Inclusion, Equity and Diversity, a collaboration of CAS and the Society of Actuaries. "I spent a lot of time, especially as a newly minted Fellow, going into places like Howard University, Florida A&M University, and then more recently, Morgan State University — schools that have actuarial science programs," she says.

Ollie Sherman got involved with the same recruiting program and worked with Howard University's summer actuarial program. "Howard had this program where they'd bring in high school juniors to introduce them to the actuarial program," Sherman says. "We set up an advisory board for the actuarial program at Howard that was supported by the industry, and I was initially Travelers' representative on that board, and then I became the Tillinghast representative."

One of Sherman's goals was seeing Black students complete more exams before graduation. "One of the things that I found out was that a lot of the majority folks came out of school with three or four exams, so they're at an advantage to begin with," he says. "We're trying to better promote the profession in the minority community, so they can take advantage of those opportunities to look at it earlier and start to develop some background that might help them."

After becoming a CAS Fellow, Linda Shepherd went on to a long career in property-casualty insurance, eventually taking management positions at Prudential in New Jersey, Safeco in Seattle and Fireman's Fund Insurance in California. Ollie Sherman moved to Towers Perrin and spent more than 25 years as a consultant and practice manager for the company's property and casualty division. Both have served on the board of the IABA, which has now grown to over a thousand members. And both believe that African Americans have made inroads in the actuarial world since they first started. "I think that the face of the industry has changed pretty dramatically over the last decade," says Sherman. "It wasn't fast progress, but it certainly has accelerated over the last decade."

Sherman remains hopeful about the future. "One of the things that's been really rewarding for me is being involved with IABA and seeing all the young people coming through who are starting to pursue the actuarial profession," he says. "It's pretty encouraging to see these young folks, who are willing to work hard for themselves, as well as be involved to help others."

Looking back on her career, Shepherd says, "I've never had any regrets about choosing this career. It was very rewarding for me, because it gave me the opportunity to use the skills that I had in math, with loving computers, and loving bringing other actuaries on."

She notes that finding out about the career is far easier now, compared to 40 years ago. "Today, if you want to know what to do with your math degree, you can just jump online and get all sorts of career questionnaires and things that could guide you." Shepherd recently took one of the career quizzes for fun and found out that she should become ... an actuary. "If I'd had this questionnaire way back when," she says, "it would have said the same thing." ●

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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CAS Strategic Plan Creates Bold New Vision

On November 9, 2020, the Casualty Actuarial Society released its 2021-2023 Strategic Plan, setting the direction for the organization's continued growth and success over the next three years. The inspiration for the Strategic Plan is illustrated through a new Envisioned Future that foresees:

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

The Envisioned Future is shaped by a variety of trends that surfaced through extensive market research with insurance industry and other employers that determined potential gaps in employee data analytics and other skillsets. The research also identified opportunities for the CAS to address those gaps and evolve the role of its members. With this market intelligence, the Strategic Plan is designed to prepare CAS members with skills in three primary areas:

1. Analytics, to tackle the important insurance and risk management problems in our data-rich world.
2. Problem solving, built upon strong strategic thinking and communication skills.

3. Domain knowledge, specifically property and casualty insurance and risk management.

"Imagine these three skill sets as a Venn diagram," says CAS President Jessica Leong. "The professionals in the middle are CAS members, who possess not only an incredible depth of domain knowledge, but also creative abilities to get from data to insights to impact."

The new Strategic Plan will pursue the Envisioned Future building on three pillars of opportunities that the CAS will aggressively pursue over the next three years:

Pillar 1. Building Skills for the Future.

Pillar 2: Diversifying the Pipeline.

Pillar 3. Expanding Globally.

These pillars will be supported by a reimagined staff and volunteer workforce. "The new Strategic Plan calls for the CAS to expand, innovate and deliver value in creative ways, and doing that requires us to embrace collaboration and teamwork," says CAS CEO Victor Carter-Bey. "An evolution of this caliber will entail new levels of resources and support, and we will change with a spirit of optimism and tenacity as we move towards our Envisioned Future."

CAS members and other stakeholders can provide any feedback on the new CAS Strategic Plan by emailing CEO@casact.org. ●





CAS 2021-2023 STRATEGIC PLAN

LETTER FROM THE CAS PRESIDENT AND PRESIDENT-ELECT

The CAS is thriving. Over the past five years, our membership has grown consistently, with an average annual growth rate of 6%, and membership now exceeds 9,200. Likewise, the number of candidates taking our exams has grown – between 2015 and 2019, exam registrations grew at an average of 7% annually. Professional education program attendance is also expanding — up 55% in 2019 from 2018.

Transformation and reinvention are best accomplished when an organization is in a position of strength. Accordingly, now is the ideal time for the CAS to look over the horizon at a new Envisioned Future that will allow us to maintain our role as the leading international organization for credentialing and professional education for our future and current members.

On behalf of the CAS Board of Directors, we are therefore pleased to share the CAS's 2021-23 Strategic Plan, which encapsulates our new Envisioned Future, the Vivid Descriptions of that future, and our strategic areas of focus for the next three years that will propel us forward.

Our 9,000+ members and those in our pipeline are at the forefront of our Envisioned Future, which states:

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

Our Envisioned Future was informed by extensive market research, in which we spoke to employers within and outside the insurance industry to identify potential gaps in employee data analytics skillsets and the opportunities for the CAS to address those gaps.

Current and future employers of CAS members are facing formidable disruptions that will require a new kind of elite professional who brings a powerful combination of skills that represent the actuarial talent of tomorrow. These include:

1. **Analytics**, to tackle the important insurance and risk management problems in our data-rich world.
2. **Problem solving**, built upon strong strategic thinking and communication skills.
3. **Domain knowledge**, which, in our case, is property-casualty insurance and risk management.

Imagine these three skill sets as a Venn diagram: The professional in the middle is a unique executive with abilities to get from data to insights to impact, all represented in CAS members and their credentials.

So, how do we attract talent from the next generation and create this new brand of CAS member — all while widening our areas of influence around the world?

The answers lie within our Strategic Plan. The plan centers on three pillars:

- Pillar 1. Building Skills for the Future
- Pillar 2. Diversifying the Pipeline
- Pillar 3. Expanding Globally



These pillars will be supported by a reimagined staff and volunteer workforce, led by our new CEO, Victor Carter-Bey.

We will aggressively pursue the opportunities that will drive us towards our Envisioned Future.

We invite you to read more about our plans for the future — ones we believe will position us for accelerated growth and strong brand recognition to benefit CAS members, future members, and all whom we serve.

It is an amazing time to be a member of the CAS community! We look to the future with tailwinds at our back and opportunities in front of us.

Sincerely,



Steve Armstrong
CAS President



Jessica Leong
CAS President-Elect

THE CEO'S PERSPECTIVE FOR CHANGE

Risk and change are familiar to Actuaries. The CAS is ready to meet the challenge.

At the time I officially began my role at the CAS this past January, we could not have anticipated the enormous challenges this year would present. Something that did not change during this time, however, was our singular dedication to our work and to the members we represent. I worked alongside the CAS Board as we created a clear strategic vision for the next chapter of the organization; now, with this new direction, we are moving forward to ensure that the CAS has the structural and operational capabilities in place to meet this new era and Envisioned Future.

From my first days at the CAS, I have advocated for growth — not just in the number of candidates and members, but in the geographies that we serve and the international markets that we reach. We also need growth in the new talent that we are bringing into the profession as well as in the skills and talents of existing members. With that infusion of diversity and talent, the profession can grow into new and exciting areas to apply the actuarial skill set. The new Envisioned Future that the Board established reflects that same vision: The CAS is an organization that expands, innovates, and delivers value in creative ways, and it is one that will embrace collaboration, support, and teamwork to ensure it reaches that potential.

Change of this caliber will entail new levels of resources and support. It will require us to realign our operating model and staff/volunteer framework to meet these new demands and to best position us for this new future. Staff and volunteers will work together to improve our organizational and operational capabilities in a variety of key areas, such as expanding our commitment to staff professional growth; improving our technological infrastructure; developing clear procedures to measure, evaluate and communicate the impact of our work; and addressing new ways to foster innovation.

If this vision presents a bold new phase for CAS, then consider our Strategic Plan a jump-start into that new future: an aggressive period in which we will launch this important work with renewed vigor. I hope you will share my excitement as you read through the Strategic Plan and learn more about this thrilling new phase for the CAS. I believe that through the execution of our plans with the Envisioned Future in our sights, the CAS will continue to be an agile organization, recognized for its ability to disrupt and improve the insurance industry — and CAS members will continue to be revered for their innovation and expertise.



Sincerely,
Victor Carter-Bey, D.M.
CEO
Casualty Actuarial Society

ENVISIONED FUTURE

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

VIVID DESCRIPTIONS



CAS members and candidates have a pronounced and measurable advantage in the job market; there is **global demand** for the services and expertise of CAS members as evidenced by requirements for CAS credentials in hiring decisions.



CAS members and candidates are growing in numbers around the world, with more **rapid growth** in the geographic areas where the CAS is focusing its international strategy.



CAS members possess the competencies needed to serve as essential, deployable, agile, and **creative problem-solvers** across the broad range of insurance company operations. In addition, CAS members have the intellectual curiosity and resources to acquire and build new competencies as needed. This allows members to proactively expand beyond current actuarial roles with confidence and be employed increasingly in broader roles, including data science, catastrophe modeling, and other quantitative professions.



As part of its expanding global presence strategy, the CAS collaborates and partners with local organizations and CAS members to conduct meetings, seminars and Courses on Professionalism and to promote other CAS-sponsored initiatives and activities.



CAS members explore key highway safety topics on a field trip to the research center of the Insurance Institute for Highway Safety-Highway Loss Data Institute.



Meeting attendees applaud the new graduating class of CAS Associates.



CAS student programs expose high school and college students to the actuarial profession.



CAS members are routinely consulted for their **expertise and insights** on the impact of policy proposals on property-casualty insurance by regulators, policymakers, and the media.



CAS members are skilled at bridging technical analysis and business context to communicate with stakeholders, which enables them to be leaders within their organizations and **influence better business strategy** and decisions.



CAS members of the future will emerge through a **pipeline that represents a wide variety** of universities, majors, degrees, and other pathways, and they will pursue a variety of career paths and opportunities afforded by the CAS educational system.



CAS members, candidates, and staff support **diversity, equity, and inclusion** in the actuarial profession. CAS members are empowered to positively influence diversity efforts and create inclusive environments within their workplaces.



CAS members advance the theoretical and practical application of property-casualty actuarial science and are on the **forefront of new techniques** to solve global insurance and risk management problems.



CAS members are actively engaged in the association at every level — from attending professional education events to participating in governance — thus making the CAS a **healthy and vibrant community**.



The CAS Institute's annual Predictive Analytics Community of Practice event offers practitioners workshops, roundtable discussions and master classes and as well as networking opportunities.



“ We change with a spirit of optimism and tenacity as we move towards our Envisioned Future.

—Victor Carter-Bey, D.M.,
CEO, Casualty Actuarial Society

THE THREE PILLARS OF THE STRATEGIC PLAN

The CAS 2021-2023 Strategic Plan is focused on three key pillars, all of which will be supported by building new capabilities among the CAS staff and volunteer workforce.



For over 100 years, the CAS has been setting the standard of expertise, credibility, and professional integrity for the P&C actuarial profession. At the same time, the world is constantly changing, as demonstrated by the extraordinary events of 2020. The CAS strives to lead our members through change and serve as a model of opportunity, adaptation, and innovation so that actuaries will continue to play pivotal roles in bringing stability to an increasingly volatile, unpredictable, and complex world.

To better understand the evolving needs of employers and to identify opportunities to maintain the relevance of our members' skill set in an increasingly competitive market, the CAS commissioned a comprehensive market research project with a third-party research firm.

The overarching goal of the research was to determine from employers, both within and outside the insurance industry, where there are gaps in employee data analytics skill sets and what role the CAS could play in helping address those gaps.

Phase 1 of the research was an environmental scan to compare CAS competitors and understand what certifications, credentials, or trainings exist today that could address data analytics skills gaps.

Phase 2 involved in-depth interviews with current and prospective CAS member employers to discuss the importance of data analytics in property-casualty insurance and other industries, in an effort to understand the current and future trends. Companies outside of the P&C industry included Amazon, Facebook, and Nielsen.

What did we ask and what did we learn? Two key questions were:

1. *Considering the growing need for, and advancement of, data analytics in business, what challenges and trends will employers face in the next three to five years?*

Challenges and trends over the next three to five years included:

- Dealing with the proliferation of data
 - Shifting to cloud-based platforms
 - Relying more and more on AI, machine learning and increasingly complex models to achieve more optimal outcomes
 - Facing competition from non-traditional competitors (adapt-or-get-left-behind mentality)
 - Developing more customer-centric approaches, shaped by shifting consumer expectations and preferences
 - Ensuring appropriate regulations are established that won't hinder innovation, as technology is evolving faster than regulations can keep pace
2. *Given those challenges and trends, what skills and competencies will be required of employees when it comes to strong data analytics skills?*

It's becoming increasingly important to have technical and soft skills to translate analysis into business terms. While technical skills are needed to get a foot in the door, those best positioned for success will also possess:

- The intellectual curiosity to proactively identify business problems
- The ability to apply logic to a problem
- The business and industry knowledge needed to provide effective recommendations from the analysis
- Strong communication skills to tell a clear story

- The ability to conquer the "last mile" problem in analytics to successfully get end-users to use the analytics for impact

The bottom line of the research is that CAS is well positioned to enhance our existing FCAS and ACAS credentialing programs to provide members with skills and knowledge to expand their existing competencies and strengthen their professional value.

With the intelligence gathered through the market research, the CAS designed an Envisioned Future and a Strategic Plan that will position CAS members to fulfill the market's needs.



Building Skills for The Future

Earlier this year, Elon Musk invited actuaries to join Tesla to create a revolutionary insurance company, saying, "I have great respect for the actuarial profession...We want revolutionary actuaries."

Just as the profession is transforming and changing at an accelerated pace, so must the CAS revolutionize how it prepares our members for the future. The CAS is prepared to answer the call to help develop revolutionary actuaries.

We will do this by preparing our members to have skills in three areas: (1) analytics, (2) problem solving, and (3) domain knowledge. These are the competencies our members need to serve as essential, deployable, agile, and creative professionals across the broad range of insurance company operations. We also want CAS members to have the intellectual curiosity and resources to acquire and build new competencies as needed. This allows members to be proactive and expand beyond current actuarial roles with confidence and to be employed in broader roles, including CEO, CFO, data science, and other quantitative professions. Computer-based testing, a new three-year admissions roadmap that covers our entire exam and credentialing process, and a competency-based professional education program are key parts of our Strategic Plan bringing this vision to life.



Diversifying the Pipeline

In the big picture, diversifying the pipeline of CAS members ensures that we attract high-potential professionals into our community who love to solve business problems with data and analytics.

Our Strategic Plan will see future CAS members emerge who represent a wide variety of universities, majors, degrees, and other pathways. They will be able to pursue a variety of career paths and opportunities afforded by the CAS educational foundation.

As a profession, we seek to increase our diversity along the lines of ethnicity, race, gender, nationality, background, and thought. To that end, we've committed to increasing our outreach efforts and making diversity, inclusion, and equity a particular focus in our Strategic Plan.



Expanding Globally

Currently, 17% of the students taking CAS exams are from outside of North America. The supply of CAS credentialed members is currently not sufficient to support the insurance industry in the regions experiencing rapid growth. We are therefore increasing our investment in becoming more global. We will be expanding our footprint to be ready to serve our members working in these regions, to raise awareness of our credential with key stakeholders, and make our credentials more accessible for those who seek the premier General Insurance actuarial education.

Supported by Building Capabilities at CAS

We believe it takes audacity to try to change the world and effective management to follow through. Staff and volunteers working together will dramatically improve the value that the CAS delivers to its members. As the key delivery mechanism for driving member value and executing the organizations strategy, CAS operations will evolve by:

- Aligning our organizational structure to support implementation of the strategic plan.
- Expanding our commitment to staff's professional growth and development.
- Identifying future volunteer leaders and opportunities to contribute.
- Refining the management of our product life-cycle to address new ways of fostering innovation.
- Improving our technological infrastructure to support the Strategic Plan.
- Developing clear ways to measure, evaluate, and communicate the impact of our work.
- Supporting a highly engaged Board.



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Understanding Threats: Gray Swans, Black Elephants, and Butterflies (Oh My!) By ANNMARIE GEDDES BARIBEAU

COVID-19 caught too many people by surprise, but it did not have to be that way, Rade Musulin told attendees at the CAS Annual Meeting break-out session, “Gray Swans and Black Elephants: Why We Keep Getting Surprised and What We Can Learn from Them.”

Musulin should know. Currently a principal of the Sydney, Australia-based Finitly Consulting, the international actuary has made a career out of anticipating, calculating, preparing for and watching extreme risks. COVID-19, he told the virtual audience, was not actually a black swan event, but a black elephant one.

The distinction matters. Understanding the different characteristics of threats can help actuaries better understand how extreme events can affect their work.

Citing *The Black Swan* by Nassim Taleb, Musulin explains that black swan events are unpredictable and have consequences and retroactive “explainability.” “Sometimes you can’t really predict black swan events,” Musulin says, but understanding the resilience of systems

can provide “a very good handle on which ones are likely to fail

catastrophically.” Volatility helps make systems stronger, according to Taleb’s theory.

Black elephant events, however, are a cross between a black swan event and the proverbial elephant in the room. They are clearly known to be dangerous, he explains, but go ignored. Such is the

COVID-19, [Musulin] told the virtual audience, was not actually a black swan event, but a black elephant one. The distinction matters.

case with COVID-19. In 2019, the Johns Hopkins Center for Health Security, the World Economic Forum and the Bill and Melinda Gates Foundation hosted “Event 201,” which simulated a coronavirus pandemic. There was also the Crimson Contagion exercise run by the U.S. Department of Health and Human Services in 2019 that found the country was not ready for a pandemic.

The world is beset by herds of these “black elephants,” Musulin says, citing observations by author and environmentalist Adam Sweidan who coined the phrase.

Two examples of black elephants are global warming and massive freshwater pollution.

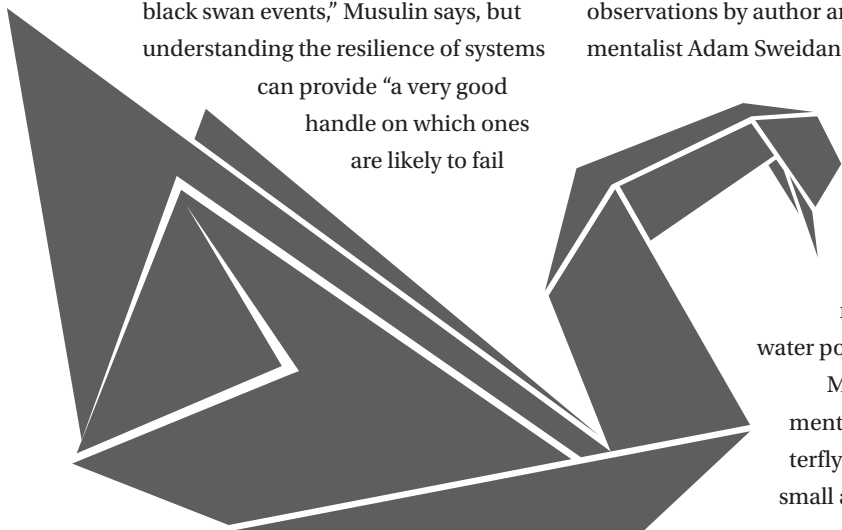
Musulin also mentioned the “butterfly effect,” where a small and unpredict-

able change in initial conditions can result in massive differences in outcomes. For example, the assassination of the Austro-Hungarian Empire’s Archduke Franz Ferdinand, which contributed to the start of World War I, was made possible by a small occurrence — the wrong turn of his driver.

Extreme events are often made worse by aspects of human psychology, Musulin says. *New York Times* commentator David Brooks identifies extreme events as the propensity for becoming acclimated to risk, placing too much faith in elaborate backup devices, matching complicated systems with complicated governance, having the tendency toward good news and becoming overcome by groupthink. One example is last summer’s explosion in Beirut, which was caused by an impounded ship full of aluminum nitrate sitting too long in a warehouse. “The authorities knew it was sitting there and eventually, no surprise, it blew up,” Musulin says.

He refers to “gray swan events” as large macroeconomic or social events that severely disrupt society, such as the global financial crisis of 2008. These often lead to significant improvements in risk management frameworks that can transform extreme risks into manageable ones.

Urging attendees to learn from his-



The Insurability of Major Risks By Jim Lynch

“Grey Swans, Black Elephants” session panelist Leigh Wolfrom, a policy analyst at the Organization for Economic Co-operation and Development (OECD), focused on three major risks affecting property-casualty insurers: climate change, cyberattacks and pandemic. He discussed the research on the insurability of these risks with the goal of understanding how “problematic they may be for the insurance market.”

A risk was insurable if the cost of underwriting coverage that generates a reasonable profit is less than what people are willing to pay for that coverage, suggested Wolfrom. The cost of coverage is a function of the size of the expected loss, the uncertainty of results and the requirements of the suppliers of capital and regulators. (Capital requirements take into account the ability of insurers to take advantage of the law of large numbers in building a portfolio of diversified risk.)

Wolfrom provided the following insights about each type of risk:

Climate change

- The expected loss is quantifiable but is growing rapidly. Under climate change, hurricanes seem likely to become more powerful, wild-

fires seem likely to become more prevalent and an increase in intense rainfall seems likely to bring more floods.

- The natural catastrophes are well-modeled at the moment, but as the climate changes, uncertainty grows.
- It should still be possible to diversify risks, though there is a chance that correlation across territories and risks could increase as the climate evolves.

Cyberattacks

- The expected loss will grow as our digital systems grow and become more integrated.
- Uncertainty is relatively high because the risk is fairly young and modeling techniques are still new.
- Capital needs are significant, and it may be hard to diversify because a single attack can affect systems around the world.

Pandemic

- The size of loss from an event is large and there is uncertainty about frequency. It is easy to call the current pandemic a

one-in-100 year event, but climate change, globalization and evolving viruses could make it more frequent than that. On the other hand, societies may be able to manage future pandemics better than this one.

- Modeling for the key property-casualty pandemic exposure — business interruption coverage — is in early stages.
- Capital requirements might be prohibitively high in the case of a truly global outbreak as the global risk cannot be diversified away easily.

Actuaries should have a role in calling attention to these enormous risks, both known and unknown.

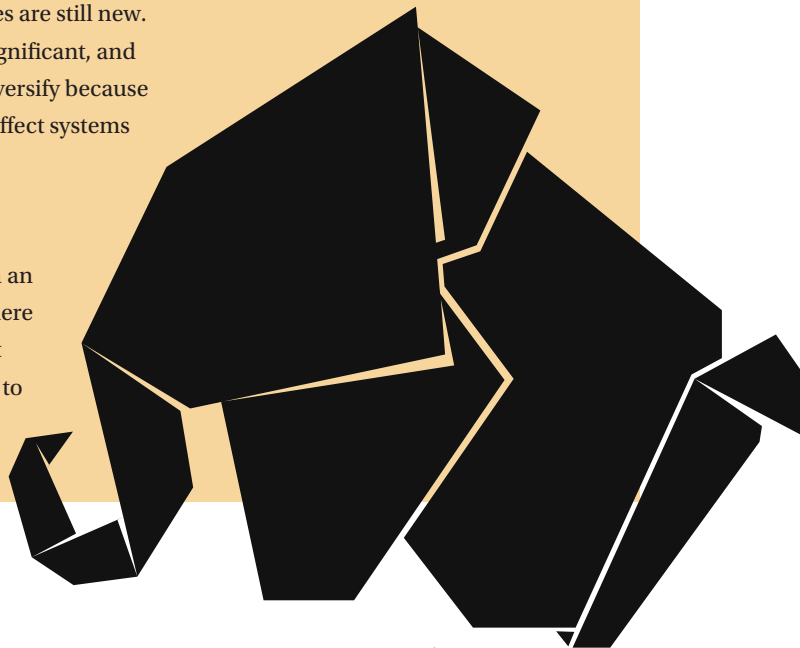
tory to prevent risk, Musulin cited the tsunami that hit Japan in 2011, causing a severe nuclear accident at Fukushima. The disaster resulted from building a nuclear power plant along the coast despite a warning on “tsunami stones” in the area telling readers not to build below the point where earlier tsunami waters had reached, including a massive

one in 1700.

This example also shows why actuaries should keep longer-term threats in mind. “One of the mistakes we often make is that we simulate the last 10 years 10,000 times instead of looking at what actually happened in the past few centuries,” Musulin says. Due to the “collision of natural hazards

in modern society,...we’ve obviously often become too comfortable with our modeling and ignore risk that falls outside our models.”

Actuaries need to understand “the collision between history and technology,” he says, encouraging attendees to



consider past events and see their far-reaching implications in today's world. For instance, the 1859 Carrington Event, which was caused by a severe geomagnetic storm and solar flare, shocked and burned telegraph operators. If a similar geomagnetic storm happened today, it would cost trillions of dollars in losses, destroy transformers and require up to 10 years to restore the affected electric grids. Such an event is another example of a black elephant because "it is clearly something that can happen based on the 1859 event but is not on many people's risk radars," Musulin says.

The good news is that there are examples of avoided black elephants, such as ending the use of fluorocarbons to save the ozone layer and using childproof medicine caps to stop product

tampering. Musulin also pointed out that there are dire situations, such as the 9/11 terrorist attacks, that brought about new institutions and tools to manage and cover the risk.

tors allowed the dams to overflow during a La Niña event, causing billions of dollars in losses. "What we need to try to do is turn unknown unknowns into known unknowns and try to move risk down the ladder, so we have less consequences when extreme events occur," Musulin says. He adds that reducing risk potential requires a problem-solving mindset. "The mindsets of great problem solvers are just as important as the methods they employ," he observes.

The good news is that there are examples of avoided black elephants, such as ending the use of fluorocarbons to save the ozone layer and using childproof medicine caps to stop product tampering.

Musulin also encouraged attendees to remember that managing one risk can create another and that even if a system is well-designed, the human factor can render it ineffective. These lessons stem from what happened when dams built in Queensland, Australia were mishandled by operators. The flood control system was so effective that thousands of homes were built downstream. However, to secure sufficient water for Brisbane following a major drought, the dam opera-

tors allowed the dams to overflow during a La Niña event, causing billions of dollars in losses. "What we need to try to do is turn unknown unknowns into known unknowns and try to move risk down the ladder, so we have less consequences when extreme events occur," Musulin says. He adds that reducing risk potential requires a problem-solving mindset. "The mindsets of great problem solvers are just as important as the methods they employ," he observes.

To help actuaries forecast and address issues such as the current pandemic, Musulin offered his take on six problem-solving mindsets from a McKinsey & Company report published in September 2020.

The problem solver mindsets:

- Are curious, and curiosity is the engine of creativity.
- Tolerate ambiguity, stay humble and embrace imperfection.
- View potential challenges through multiple lenses.
- Look at what happens in time and space without bias.
- Tap into collective intelligence because crowdsourcing ideas work.



- Practice storytelling to compel action.

"As actuaries we have to think stochastically and embrace uncertainty," he says, offering questions actuaries should ask themselves when thinking about risk, such as:

- Are you over-relying on modeling?
- Have you allowed for human failure?
- Are you lulled to sleep by many decades of stability that leave you unprepared for black or gray swan events?

During his presentation, he also disagreed with the idea that pandemic insurance is impossible to offer customers. "I know I'm in the minority saying this, but I think pandemic insurance may be possible," he says. Citing Australia's success with quelling the spread of COVID-19, he adds, "We may get pandemics under control and have a market for pandemic risk in the future." ●

Annmarie Geddes Baribeau has been covering insurance and actuarial topics for nearly 30 years. Find her blog at www.insurancecommunicators.com.

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**Expertise. Insight.
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CEOs on the Big issues of 2020 By JIM LYNCH

Chief executives have the view from the top.

When you assemble several of them together, as the CAS did for a general session at the organization's Annual Meeting in November, it makes sense to find out what the view is like — especially in this most unusual of years, where a pandemic has changed the way all humans live and a deep conversation about diversity and equity has laid bare some startling truths.

CAS President Steve Armstrong interviewed four executive leaders:

- Victor Carter-Bey, CEO of the Casualty Actuarial Society
- Sean Kevelighan, president and CEO of the Insurance Information Institute
- Ryan Michel, FCAS, president and CEO of Allstate Insurance Company of Canada
- Alice Underwood, FCAS, global leader of insurance consulting and technology for Willis Towers Watson

Not surprisingly, the pandemic and its implications for property-casualty insurers was the focus of most of the discussion. When the session occurred, drug manufacturers were making promising announcements about a vaccine, while the number of cases and deaths in the United States and much of the world was increasing rapidly.

Michel noted the many facets of the pandemic, such as how it is affecting employees. More broadly, however, he wondered what the industry can do to help solve bigger issues — ones that have historically been viewed as uninsurable, but where actuaries have expertise, such as health care risks and

climate change impacts.

Underwood said that one major change is the work schedule. The ability to have a flexible work schedule, she said, “is going to be a permanent change.” Even when the pandemic ebbs, “many of our colleagues may not want to go back to the office.” Such a change will require a creative approach, she noted,

The pandemic has highlighted how relatively new technologies, like Zoom conferences, can address challenges. That may make insurers and other industries more likely to adopt tech solutions in the future.

to have effective team meetings when some staffers are present and others are participating virtually.

The embrace of the virtual affects customer relations as well as employee relations, Carter-Bey said. Consumers are placing more online orders and conferences are being held online. These changes may have occurred to accommodate the pandemic, but technology is lowering barriers to entry and giving consumers more ways to engage. Carter-Bey thinks that businesses will have to be more agile “to accommodate both types of offerings.”

The pandemic has also raised insurance coverage questions, particularly with respect to business interruption.

“It’s hard for us to actually talk about” the business interruption issue, said Kevelighan, as it presents two significant risks. The first is an existential risk. Were all pandemic-related closures insured, the resulting losses could have bankrupted the industry. The second is a reputational risk. The media focused

on the travails of famous restaurateurs during the lockdown, generating coverage that was sympathetic to them and sometimes less than flattering to insurers. The industry has been proactive in that public relations battle.

“If you aren’t in control of communications, you are in someone else’s hands,” he said, “and that can be a dan-

gerous place.” His organization formed a coalition called FAIR, the Future of American Insurance and Reinsurance, to communicate the industry’s point of view.

The pandemic has highlighted how relatively new technologies, like Zoom conferences, can address challenges. That may make insurers and other industries more likely to adopt tech solutions in the future.

“We are going to be different coming out than we were going in,” Underwood said.

Beyond the pandemic, 2020 has also been a year for deep discussion of diversity issues, driven by the death of George Floyd and others. CAS President Armstrong asked what employers and the industry can do to enhance inclusion, equity and diversity.

Michel and Kevelighan agreed that insurers need to look like their customers to serve them.

Michel quantified that challenge. His organization serves customers in 27



languages. Fifty-five percent of his board is female, as is 50% of his leadership team. And the embrace of diversity has to go across many dimensions and be a proactive stance — it won't just happen.

“The industry has done a lot and that’s not enough,” Kevelighan said. “If we are going to serve a customer base, we have to look like that customer base.”

“The industry has done a lot and that’s not enough,” Kevelighan said. “If we are going to serve a customer base, we have to look like that customer base.” The industry’s stability in face of recession gives it an advantage, he said. “We have jobs to give in the industry . . . We have an incredible ability to make [ours]

a diverse talent pool.”

Employers are taking tangible steps. Underwood’s organization is looking at its job postings, to make sure the requirements don’t cause people to self-

select out of a job. For example, does a position *really* require a college degree? Technically, an actuary doesn’t need one, she said. They just have to be able to pass exams. Many of the most successful brokers Underwood knows do not have college degrees.

And difficult conversations are

opening up between senior leaders and persons of color, to share the sometimes difficult experiences that can occur in an organization.

Carter-Bey noted that the CAS wants to ensure the pipeline of candidates comes from additional paths than solely actuarial science majors. The organization wants to attract people from fields like biology and chemistry, to benefit from the fresh ideas that intellectual diversity brings.

“It is all about stretching our boundaries,” Carter-Bey said. ●

James P. Lynch, FCAS, is chief actuary and vice president of research and education for the Insurance Information Institute.

Social Justice and the Actuary: What's Next? By JIM LYNCH

Racial injustice and discrimination became a prominent issue in 2020. As awareness of the true scope of disparate impact and discrimination has grown, property-casualty insurance — and actuarial techniques in particular — have come under greater scrutiny.

The key questions are as follows:

- Does insurance perpetuate inequities in biased systems?
- Do predictive models eliminate discrimination or make it worse?
- What can math-centric types like actuaries do?
- What is the CAS doing?

These were addressed at the CAS Annual Meeting in November 2020 during the general session titled, “The Actuary and Social Justice.” CAS Board Director Kudakwashe Chibanda led the discussion that included presentations from CAS President Jessica Leong; Board members Mary Frances Miller, founder and the senior consulting actuary with Select Actuarial Services; Talithia Williams, associate professor of mathematics at California’s Harvey Mudd College; and Tomantha Kyle, a senior data scientist in analytic marketing for PayPal.

A brief history of inequity

Kyle provided a historical perspective by describing the Black experience in America from the arrival of the first slaves in 1619 and pairing the history with landmark events in the insurance industry’s treatment of Blacks.

The historical record shows occasional advances. The country had anti-slavery societies as far back as 1775 and slavery was abolished with the end of the Civil War. Black wealth grew at the

turn of the 20th century, and Congress passed the Civil Rights and Fair Housing Acts in 1964 and 1968, respectively.

Insurance also had progressive moments. The first Black actuary, Asa T. Spaulding, practiced in the 1930s. Major life insurance companies retired race-based mortality tables in the 1960s.

But these advancements are punctuated by far too many setbacks.

Insurance also had progressive moments. . . But these advancements are punctuated by far too many setbacks.

The freedom won by Blacks was accompanied by a fierce backlash through the 1920s, when membership in the Ku Klux Klan encompassed about one American in 20. Even after World War II, laws like the G.I. Bill, which encouraged prosperity and wealth accumulation through education and homeownership, systematically excluded Blacks. This robbed Blacks of a boost into the middle class.

Slave insurance was a booming business in the 1840s; owners would rent out enslaved people and insure against the chance that they would be injured while working for others — an early, disgusting example of industrial risk management. Kyle said that there were as many Southern enslaved people so insured as there were Northern Whites purchasing life insurance. Insurers also practiced redlining — refusing to write in areas with large Black populations — well into the 1960s.

Inequities persist today. Kyle showed that many communities — her example is New York City — are as segregated now as they were decades ago.

And today, while 7% of all U.S. households lack a checking account, 20% of all Black households do.

Kyle says that her goal is to help people “relook at our modern-day approaches” to address past injustices because government and regulations have not successfully dealt with the problems.

Miller examined insurance’s role in perpetuating injustice today. She started

from the heart of insurance pricing law, something virtually all casualty actuaries have memorized: An actuarially sound rate is “not excessive, not inadequate, and not unjustly discriminatory.” Those laws harken back to the 1800s, she said, when wealthier people could negotiate lower rates.

Much of today’s discussion on race and insurance focuses on a different issue: disparate impact. The term comes from a court case in which a public utility used a job test on which Black applicants scored lower; the test had no bearing on the ability to do the job. The court determined that it did not matter whether the employer consciously used the test to screen out Blacks but that the test acted as a screen and was evidence of discrimination.

Unfair discrimination and disparate impact are not the same thing, Miller pointed out. Unfair discrimination focuses on the inputs — the rating variables that insurers use to distribute costs. Disparate impact focuses on the outputs — whether some groups are charged more than others.

You can have one without the other, but Miller said that there can be times where apparently fair discrimination leads to disparate impacts.

“So maybe it’s time we started to rethink our assumptions,” Miller said.

Algorithm decision-making: The good and the bad

Williams, the faculty member on the panel, laid out the pros and cons of algorithmic decision-making.

The pros:

- **It can handle lots of data.** This is always a positive point.
- **It can avoid certain biases.** Williams cited an example showing that judges give more lenient sentences after lunch — a bias absent from a sentencing algorithm.

The cons:

- **The model is a black box.** Thus, no one can tell what reasons led to its conclusions.
- **The model may have been constructed from biased data.**

Williams showed a blurred picture, but clear enough to show former President Obama. She then showed how facial recognition software unblurred the photo, turning Obama into a White man. Early iterations of facial recognition software misrecognized Blacks and Asians 10 to 100 times more often than Whites. The software was trained on photos with relatively few Blacks, Asians or Latinx people.

Sometimes the bias can have devastating effects. Software that identified high risk health patients had been unintentionally, but systematically, discriminating against Black people. It assigned Blacks lower risk scores even when they

were just as sick as their White counterparts. The software rated health by the amount spent on a person’s health care not realizing that the average amount spent treating Blacks was less, on average, than Whites with the same diagnoses.

“Even today we can create algorithms that we think are bias-free — that avoid inequities — even when they don’t,” said Williams, who offered the following recommendations for actuaries and other number-crunching professionals:

- **Do not ignore potential discrimination.** When creating data sets, collect information on race and gender. Run regular reports and occasional audits to look for inadvertent discrimination — and disclose your findings.
- **Make algorithms “discrimination-aware.”** Set explicit objectives to treat Blacks and Whites equally.
- **Control the dissemination of information that might let others discriminate.** She cited an example of Uber revealing a picture of the rider to the driver, and vice versa, after the ride has been booked. This prevents either from being rejected because of their color.

Actuaries and statisticians, Williams said, need to “move the needle when it comes to bias and prejudice in the work that we do.”

The work to be done

CAS President Jessica Leong addressed some of the current trends in the world of insurance as well as what the CAS is doing.

- The National Association of Insurance Commissioners has created

a special committee on race and insurance with a broad mandate to look at diversity in hiring and promotion. The special committee will also examine whether current insurance practices, like rating, put minorities at a disadvantage. It will make recommendations in both areas.

- Introduced in September 2020, the Prohibit Auto Insurance Discrimination Act seeks to make insurance companies use only insureds’ driving records and driving abilities to set rates. The bill’s sponsor asserts that insurance scores are proxies for income; insurance industry groups oppose the measure. (Note that using driving records could create disparate impact if moving violations and accidents are included.)
- In October 2020, the CAS Board of Directors adopted a strategic approach to racial equity and created a new Board committee specifically dedicated to diversity, equity and inclusion (DE&I).
- The CAS is considering including race-based issues as part of its basic and professionalism education.

Most in the audience seemed to agree with the approach. For a polling question that Leong posed, 94 percent of the audience responding agreed that “the CAS should show leadership and collaborate on the topic of race in insurance.”

Leong concurred. “It is somewhere that we can lend a lot of thoughtful guidance,” she said.

To learn more about volunteering for DE&I initiatives with the CAS, contact volunteer@casact.org. ●

Speakers Reveal Complex Impact of Opioid Epidemic on P&C Insurance

By ANNMARIE GEDDES BARIBEAU

Who can resist a silver bullet? At least, that's what long-term opioids appeared to be in the mid-1990s. Carrying promises to quell the worst physical pain without being habit-forming like those old-fashioned, short-term narcotics of yesteryear, long-term opioids arrived at the scene not a minute too soon — or so it seemed.

Twenty-five years later, the silver bullet continues to affect liability coverages, including workers' compensation, general liability (GL), directors & officers and errors & omissions. During the CAS Annual Meeting session, "The Opioid Epidemic and Insurance," Mark Pew, senior vice president of product development and marketing for Preferred Medical, and Kevin Harris, an attorney with BatesCarey, LLP, provided insight into the epidemic's complexity and how it is affecting proper-

ty-casualty insurance.

Pew provided insightful context into the epidemic's prelude starting in the early to mid-1990s by discussing four practically simultaneous trends that fueled the spread of long-term opioid use. First, doctors at that time were being criticized for not taking their patients' pain seriously enough. "They were actually held accountable by their associations, by government and, most especially, by patients for not providing adequate pain relief," Pew says.

Second, Purdue Pharma launched OxyContin with marketing that downplayed the potential for addiction.

Concurrently, the third development was the introduction of the pain scale. Although intended to make pain, which is highly subjective, into an objective criterion for selecting a treatment modality, it led to doctors prescribing more potent pain killers.

Fourth was the advent of patient surveys that greatly affected prescribers who wanted positive reviews

from patients because they could impact their careers.

In this backdrop, it is no wonder that clinicians began prescribing long-term opioids.

The opioid epidemic has taken place in three waves. The first wave began in the 1990s. By 2003, a few people, including Pew, who works in the workers' compensation sphere, began to notice the horrific consequences long-term opioids were having on injured workers, including inappropriate polypharmacy regimens, i.e., chasing symptoms with more drugs, dependence, addiction and even death.

Then came the second wave. While the evidence of opioid-related harm was coming to light through research around 2010, heroin addiction was spreading beyond the stereotypical street junkies. From household-name celebrities to ordinary people, who had become addicted to prescription opioids, began turning to the underground heroin market for relief, Pew explains.

Finally, there is the current or third wave focused on synthetic fentanyl and various analogues that are less expensive but more potent than heroin. The majority of overdose deaths now are not from prescription opioids or heroin but from fentanyl.



Opioid Litigation

Beyond the large, headline-making settlements, legal developments resulting from opioid litigation are creating new liability risks for other social problems. This could affect insurers and their clients, warns Harris, who specializes in general liability insurance law.

The theories of liability are novel and complex. For example, state and local governments, which have filed the most cases, have sought financial remedy for the public expense caused by the opioid epidemic. Connecticut Judge Thomas Moukawsher dismissed several opioid cases filed by Connecticut cities

questions about the duty to indemnify the pharmaceutical industry for its liability, he adds.

In particular, GL policies are intended to cover past damages incurred as a result of “bodily injury” to specific people. However, in the underlying claims filed by governmental entities, plaintiffs have sought to prove their claims through “aggregate” statistical data, rather than evidence of harm to particular individuals.

Further, Harris says, acknowledging the complex issues of causation noted by the Connecticut judge, government plaintiffs have generally abandoned

As a result, he advises underwriters to holistically evaluate current and prospective insureds before offering GL coverage. “You really do want to follow up on different kinds of threads,” he says. To gain a broader look at potential liability, he advises looking beyond a potential insured’s revenues and loss runs. Research should also include asking questions about any pending lawsuits and a company’s position within its industry, adherence to laws and regulations and treatment in the media.

Both presenters’ comments are a reminder that the opioid crisis and its vast implications are far from over. Successfully treating chronic pain still eludes the medical community, which is becoming more open to alternative approaches in the hopes of success. Pew is concerned that the efforts to address the opioid crisis have been delayed due to the COVID-19 epidemic. Also disconcerting is the extension of liability in recent case law at a time when the costs of liability coverage were already expanding before the epidemic began. ●

Legal developments resulting from opioid litigation are creating new liability risks for other social problems that could affect insurers and their clients.

because plaintiffs would never be able to prove which defendants caused the harm. Any attempt to allocate liability and damages among the defendants, the judge observed, would lead to “junk justice,” Harris says.

Not long ago, judges favored the insurance industry’s positions on opioid cases, he observes. However, judicial attitudes are beginning to shift. Several courts have recently held that government plaintiffs alleging past economic losses due to opioid abuse could trigger insurers’ duty to defend, Harris observes. While courts have found a potential for coverage under the exceedingly broad duty to defend standard, developments in the underlying litigation raise

their claims for past incurred costs in favor of claims for public nuisance, seeking prospective equitable relief that would fund programs to prevent (or “abate”) potential future opioid-related harms. These “abatement” measures, Harris notes, may fall outside the class of past “damages” that GL insurance covers.

Although most opioid litigation is currently stayed, years of opioid litigation experimentation have created a “playbook” of strategies and approaches for those who have been harmed by other social problems, such as the costs of obesity and the impact of social media, he warns.



EXPLORATIONS By DAVE CLARK

Smoothing Splines for Trend

Business Problem

Severity trend for insurance losses is typically estimated using loglinear regression of average loss amounts on historical period (accident or calendar year). This results in a single trend estimate for a block of years. This method is sufficient if the trend can be assumed to be constant over time.

If the trend is changing over time, a simple regression model may no longer be appropriate. An alternative is to use the actual year-to-year changes to produce an inflation trend index. The main disadvantage of this is that year-to-year changes can be highly volatile and produce unusual patterns if used in pricing.

Smoothing splines provide an easy tool for a compromise between a single trend for all years and a different trend for each year.

Smoothing Splines as a Blending Method

Smoothing splines are useful in smoothing noisy time series. The degree of smoothing is controlled by a single parameter, which plays a role much like the K value in Bühlmann credibility.¹ A very small smoothing parameter means that each historical period stands on its own; a very large smoothing parameter means that the individual periods move towards a simple linear regression.

The smoothing spline model results

in a curve that comes as close to the data as possible (by minimizing squared error) while also being subject to a penalty to avoid too much wiggle in the curve (penalizing the second derivative or curvature).

By construction, the resulting smoothing spline is a natural cubic spline with linear extensions beyond the last data point. This allows us to extrapolate to prospective periods using a constant trend that is most heavily influenced by the latest points. The extrapolation to future periods works with the smoothed data points, rather than the actual data points, and so the forecast to future periods has some stability. The use of the spline for forecasting has been well-studied and found to be a special case of an ARIMA time-series model (see Hyndman et al.).

The smoothing parameter can also be mapped to a measure of degrees of freedom or “effective number of parameters.” A large smoothing parameter leads to a two-parameter model (a linear fit), whereas a small smoothing parameter leads to a curve that interpolates the actual data, with the number of parameters equal to the number of points in the time series.

When performed on the logarithms of the severities, a very large smoothing parameter approaches the traditional loglinear regression as a limiting case.

The algorithm for calculating smoothing splines is available in most statistical software. The central calculation is the “Reinsch algorithm,” which requires a bit of linear algebra, but can easily be programmed by an actuary (even in Visual Basic for Excel 😊).

An Example

To illustrate this technique, the graph below shows data from the U.S. Bureau of Labor Statistics for the inflation on hospital costs. This is one of the components that go into the Consumer Price Index. We first take the logarithms of the cost index and then calculate the spline on that sequence.

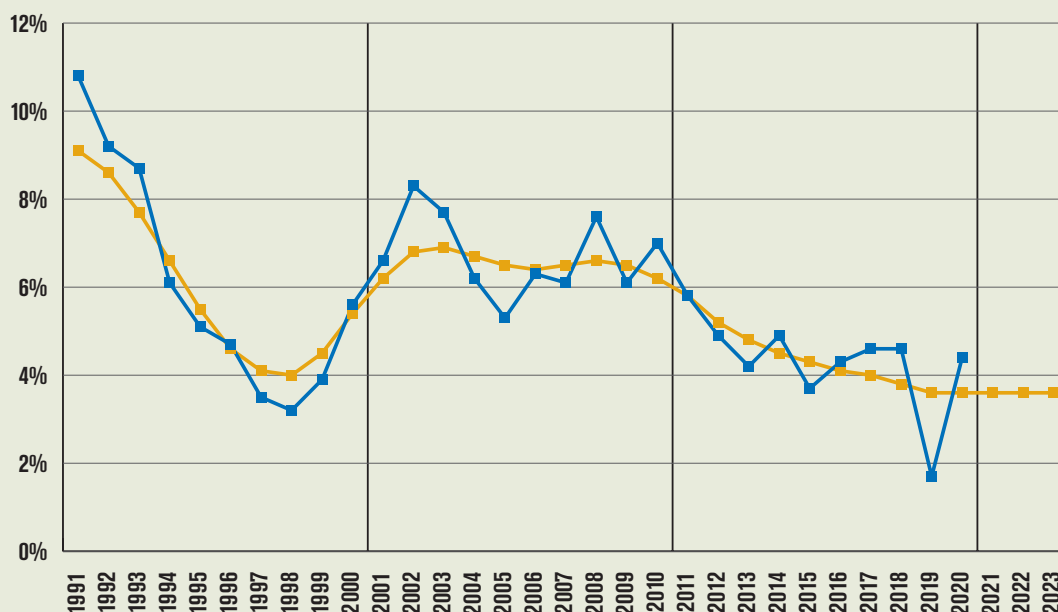
In this example, a smoothing parameter of 4.0 was selected, implying a curve with effectively 8.7 parameters on a time series of 31 points. While there are many discussions on how best to choose the smoothing parameter, it is easy to simply try a few values and select a desired level of smoothing based on aesthetics of the graph on the following page.

The smoothed curve is extended to future periods as a constant trend, represented in the graph as a flat line for 2021 to 2023. The analyst is not required to take this smoothing spline as the final answer, but it does provide a quick way of identifying changes in the inflation rate over time without overreacting to

¹ This similarity is not coincidental. Smoothing splines can be interpreted in a Bayesian framework. See Wahba (1978), as the pioneer for this connection. Hastie et al. show that smoothing splines can be arranged as generalized ridge regression, also with a Bayesian interpretation.

Hospital and Related Services

Change in Cost from Prior Year



any single point.

The reader is encouraged to try this technique on their own severity series and see if it offers insight into changing trends over time.

Further Extensions and Research

Beyond the generic version of the smoothing spline, additional tools are available:

- Weighting functions can be introduced to give more weight to some periods and to deemphasize other points.
- Confidence intervals or ranges around the smoothed curve can be produced (see Hyndman et al. or Wahba (1983)).
- Alternative smoothers, such as local regression (LOESS) or regression splines (where “knots” are assigned by the user) can be tried as alternative methods.

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R Packages

<code>smooth.spline()</code>	function in stats package
<code>smooth.Pspline()</code>	function in pspline package ●

Dave Clark, FCAS, is a senior actuary in corporate pricing & underwriting services for Munich Re America Services, Inc. in Princeton, New Jersey.

FRESH LOOK By STEPHEN J. MILDENHALL

Bailey Simon Minimum Bias Reexamined, Part 2

Actuarial Review introduces a new column, *Fresh Look*, that aims to reassess core areas in actuarial science with more current tools and practices. Part 1 appears in Actuarial Review November-December 2020.

Development

In a GLM, an observation's mean value is a function of a linear combination of covariates, and the observation is sampled from an exponential family distribution. The parameters are determined using maximum likelihood. The function linking the mean domain to the linear domain is called the link function, customarily denoted g .

Exponential family distributions are assumed to be nondegenerate. They are parameterized by a canonical parameter θ that is a function of the mean, and which we will identify in a moment. Most importantly, their density (or probability mass function) factors as

$$f(y; \theta) = c(y)b(\theta)e^{y\theta},$$

with symmetric roles for the observation y and parameter θ . Both c and b are non-negative functions. The factorization reflects the dual meaning of the density: It is the probability of observing y if the true parameter is θ as well as the likelihood of the parameter θ given an observation y .

Since b is non-negative, we can write $b(\theta) = e^{-\kappa(\theta)}$ on the support of f , giving $f(y; \theta) = c(y)e^{y\theta - \kappa(\theta)}$. It follows that the log likelihood of θ is $l(y; \theta) = \log(c(y)) + y\theta - \kappa(\theta)$. Differentiating with respect to θ and setting equal to zero shows the maximum likelihood estimator (MLE) of θ given y solves the score equation $y - \kappa'(\theta) = 0$. Given a sample of independent observations y_1, \dots, y_n , the MLE solves $\bar{y} - \kappa(\theta) = 0$, where \bar{y} is the sample mean.

Thus, the mean is a sufficient statistic for θ in an exponential family.

If a random variable Y has an exponential family distribution with density f , then it has a cumulant generating function $K(t) := \log E[e^{tY}] = \kappa(t + \theta) - \kappa(\theta)$. The mean of Y is given by $K'(0) = \kappa'(\theta) = \mu$, which identifies the relationship between μ and θ . $\kappa'(\theta)$ is often denoted $\tau(\theta)$. The variance of Y is given by $K''(0)$

tion defined on a mean domain we can work backwards, solving two differential equations, to determine a cumulant generating function and hence a unique exponential family distribution with that variance function and domain. V only determines the distribution uniquely within the exponential family, not within all distributions. For example, kX for any X with $E[X]=1$ and $\text{Var}(X)=1$ has

If we start with a variance function defined on a mean domain we can work backwards, solving two differential equations, to determine a cumulant generating function and hence a unique exponential family distribution with that variance function and domain.

$= \kappa''(\theta) = \tau'(\theta)$. By assumption, exponential family distributions are non-degenerate and therefore have a strictly positive variance. Three important conclusions follow:

1. That K is a convex function, and hence l is concave ensuring a unique maximum likelihood estimate.
2. That τ is increasing and hence invertible.
3. This implies that the variance of Y is a function of its mean.

The third conclusion, the mean-variance relationship, is captured by the variance function, $V(\mu) = \kappa''(\tau^{-1}(\mu)) = 1/(\tau^{-1})'(\mu)$ (chain rule).

If we start with a variance func-

$V(\mu) = \mu^2$, but the only exponential family distribution with variance function $V(\mu) = \mu^2$ is the gamma (with a different parameterization).

It is possible to show that using the exponential family distribution with variance function V is equivalent to making no assumptions other than the mean-variance relationship. Technically, the exponential family has minimal Fisher information. This is a very reassuring fact for the modeler, who must specify some distribution to build a statistical model necessary to evaluate Bailey and Simon's criteria. But making a choice is fraught: what evidence backs it up?

The actuary knows from the physi-

cal, economic and contractual operation of insurance that a reasonable V will fall between a linear and a quadratic function. Using an exponential family distribution can test various alternatives in this range while making no additional assumptions. And the story gets better. It turns out that every $1 < p < 2$ determines an exponential family distribution with $V(\mu) = \mu^p$, called a Tweedie distribution. Tweedie distributions are ideal for modeling insurance losses because they are compound Poisson distributions with a gamma severity (the identification is made by solving the differential equations alluded to above and identifying the resulting cumulant generating function). They take non-negative values and are continuous except for a probability mass at 0. As p approaches 1 from above ($p \downarrow 1$), the Tweedie approaches a Poisson, and as p approaches 2 from below ($p \uparrow 2$), a gamma.

GLMs encompass a wide range of model forms. They are much more flexible than normal-error general linear models because they separate the linearizing transformation, the link function, from the error distribution. A linear model uses the same function to linearize and to stabilize the variance.

Now consider the fourth criterion: chance. Let's model Y using an exponential family distribution with the identity link function. Given an observation y in a cell with fitted mean μ , how should we evaluate whether the difference $y - \mu$ "could reasonably be caused by chance"? The residual error, $y - \mu$, lacks scale and context. The theory of linear models suggests various standardized residuals, such as the Pearson residual $(y - \mu) / \sqrt{V(\mu)}$. A frequentist

creates a confidence interval such as $y \pm 2\sqrt{V(\mu)}$ for the class mean. If μ falls within the confidence interval, then the experience could reasonably occur by chance. An obvious problem with this approach is the need for it to hold simultaneously for many observations, which will be vanishingly small.

Alternatively, we can use likelihood to evaluate chance. A class rate is likely if its likelihood is close to the maximum likelihood. In the mean parameterization, the log likelihood becomes $l(y; \mu) = \log(c(y)) + y\tau^{-1}(\mu) - \kappa(\tau^{-1}(\mu))$. At the maximum of l , the score function

$$\frac{\partial l}{\partial \mu} = \frac{y - \mu}{V(\mu)} = 0.$$

Remember, $\kappa'(\tau^{-1}(\mu)) = \mu$ by definition. Thus the score is a good measure of chance. For the most likely parameter it is zero. When the score is small the rate μ is reasonably likely, but when it has a

large absolute value, l falls off quickly from its maximum value and μ is much less likely. Although dividing by the variance rather than standard deviation seems odd from a classical statistics perspective, it makes sense when considering likelihoods.

Finally, we need an overall assessment of model fit that avoids arbitrary choices. We can create one from the likelihood function. We can compare

the model-constrained likelihood with an unconstrained, saturated model likelihood to get a measure called model deviance. Since we already know the maximum likelihood estimate for μ is y , the deviance will be

$$d(y; \mu) = 2(l(y; y) - l(y; \mu)) \geq 0.$$

The factor of 2 is included to ensure agreement with the normal distribution. Since $\partial d / \partial \mu = -2 \partial l / \partial \mu$ we see

$$d(y; \mu) = 2 \int_{\mu}^y \frac{y - m}{V(m)} dm.$$

The limits of integration are chosen so that d has the correct derivative, forcing μ on the bottom, and $d(y; y) = 0$ forcing y on top. Notice that the nuisance $\log(c(y))$ term in l disappears in d .

What is the deviance for a Tweedie, $V(\mu) = \mu^p$? For $p \neq 1, 2$, simply integrate:

$$\begin{aligned} \frac{d(y; \mu)}{2} &= \int_{\mu}^y \frac{y - m}{m^p} dm = \frac{ym^{p+1}}{1-p} - \frac{m^{p+2}}{2-p} \Big|_{\mu}^y \\ &= -\frac{y^{2-p}}{(2-p)(p-1)} + \frac{y\mu^{1-p}}{p-1} + \frac{\mu^{2-p}}{2-p}. \end{aligned}$$

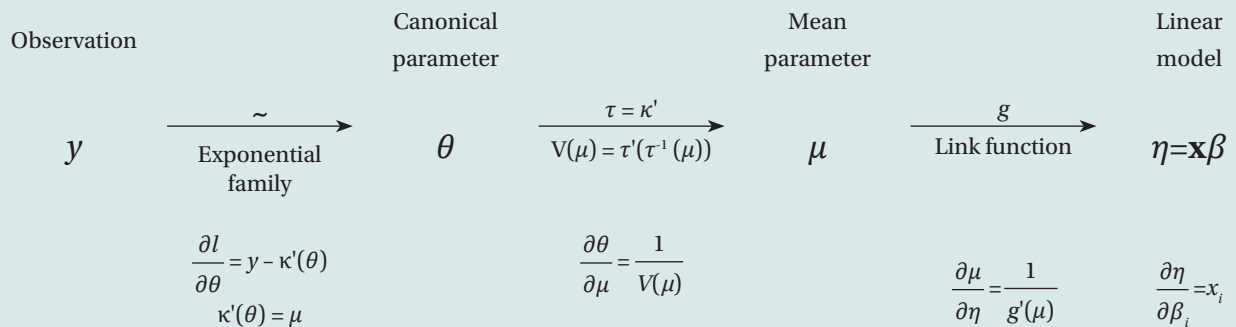
The density of the exponential family can be expressed in terms of the deviance as

$$f(y; \mu) = c_0(y) \exp \left\{ -\frac{d(y; \mu)}{2} \right\}$$

where $c_0(y) = c(y) \exp(l(y; y))$. It is an easy exercise to check that when $V(\mu) = 1$ the deviance is $(y - \mu)^2$, and so the corresponding exponential family distribution is the normal. (Exercise: Work out which distribution corresponds to $V(\mu) = \mu$.)

To summarize: we can fit a GLM using maximum likelihood or, equivalently, using minimum deviance. The deviance provides a measure of model fit customized to each exponential distribution family and can be used to compare models using that error distribution. Scaled differences in devi-

Figure 1



ance have an asymptotic χ^2 distribution. Other methods are needed to choose between models using different error distributions. Deviance generalizes the fact that maximum likelihood for the normal is the same as minimum square error.

GLMs encompass a wide range of model forms. They are much more flexible than normal-error general linear models because they separate the linearizing transformation — the link function — from the error distribution. A linear model uses the same function to linearize and to stabilize the variance. Linear, logistic and Poisson regressions, and analysis of variance are all special cases of GLMs.

Suppose the linear predictor for a unit (observation) y is specified as $\eta = \mathbf{x}\beta$, where \mathbf{x} is a vector of covariates and β is a parameter vector, and the mean of y is linked to η by $g(\mu) = \eta$. Then the log likelihood function becomes $l(y; \mu) = \log(a(y)) + y\tau^{-1}(g^{-1}(\mathbf{x}\beta)) - \kappa(\tau^{-1}(g^{-1}(\mathbf{x}\beta)))$. Therefore, using the chain rule, the score for β_i is given by

$$\frac{\partial l}{\partial \beta_i} = \frac{\partial l}{\partial \theta} \frac{\partial \theta}{\partial \mu} \frac{\partial \mu}{\partial \eta} \frac{\partial \eta}{\partial \beta_i} = \left(\frac{y - \mu}{V(\mu)} \right) \frac{1}{g'(\mu)} x_i$$

The decomposition of the score reflects the components of the GLM. (See Figure 1.)

When the linear model is a two-

way classification, the score equations $\partial l / \partial \beta_i = 0$ give the famous Bailey minimum bias iterations, only substituting a variance-adjusted $(y - \mu) / V(\mu)$ bias measure in place of the normal model's $y - \mu$. While not recommended for production work, the iterative solution is easy to implement in a spreadsheet, providing an excellent way to test your understanding and confirm results from R `glm` or SAS `proc genmod` or other implementations—see the example below.

Parameters determined by solving a minimum bias iterative scheme generally agree with the maximum likelihood estimates of a GLM with some variance function, even when the scheme is formulated without an explicit statistical model. The situation is analogous to Mack's identification of the stochastic model underlying the chain-ladder method. Before Mack, we happily squared triangles without knowing the underlying assumptions. But knowing the implied statistical model is an essential part of assessing whether the model is appropriate for its intended use.

Examples

Here are two simple examples which capture the essence of the modeling problem. Assume that each cell contains the same number of exposures

and model using an exponential family distribution with variance function $V(\mu) = \mu^p$.

The first example is a two-way classification, with each level taking two values. You can think: youthful operator yes/no and prior accidents yes/no. The observations for no/no, no/yes, yes/no, yes/yes are $y_0=1, y_1=2, y_2=3$, and $y_3=7$. The linear model has means $\beta_0, \beta_1, \beta_2$ and $\beta_1 + \beta_2 - \beta_0$ (equivalently, $\beta_0, \beta_0 + \beta_1, \beta_0 + \beta_2$ and $\beta_0 + \beta_1 + \beta_2$).

The second is a linear regression, with covariate taking values 0, 1, 2 and outcomes 1, 2 and 4.

In both cases it is clear the model does not fit perfectly. How should the “bias” be apportioned between the classes? The appropriate bias is variance-adjusted, $(y - \mu) / V(\mu)$.

In the first model the bias for each cell has the same absolute value b , and is split $b, -b, -b, b$, to achieve balance by class and in total. In the linear model it will be $b, -2b, b$, achieving a covariate-weighted analog of balance ($\partial \eta / \partial \beta_i = 0, 1, 2$ for the three observations). The value of b depends on V , i.e., on p , reflecting the fact there are many balanced models.

To find a specific solution, set up a spreadsheet as shown below and use Solver to minimize the deviance

(computed in the Development section) over β_i . The tables show the solution for $p=1.6$. Solver will readily handle the problem because the deviance is a well-behaved, concave function with a unique maximum. You could also use the minimum bias iterations, or mimic the GLM iteratively re-weighted least squares algorithm. All of these are easy to implement in Excel. It is worth noting that the solutions are maximum likelihood parameter estimates for a density that you can't actually write down in closed form!

Exercise: What happens to the fit as you vary p ? Why? (See Figure 2.)

It's always good to double check your work. The R code below reproduces the Excel Solver solution.

```
library(tidyverse)
library(statmod)
```

```
# two way classification
df = tibble(a=c(1,0,0,-1),
b=c(0,1,0,1), c=c(0,0,1,1),
y=c(1,2,3,7))
m1 = glm(data=df,
family=tweedie(var.power=1.6,
link.power=1), y~a+b+c-1)
summary(m1)
```

```
# Coefficients:
# Estimate Std. Error t value
Pr(>|t|)
# a 0.91075 0.50969 1.78687
0.32481
# b 2.42873 1.04994 2.31320
0.25977
# c 3.92350 1.38479 2.83328
0.21600
#
# Residual deviance: 0.3086021
on 1 degrees of freedom

# linear regression
df2 = tibble(x=c(0,1,2),
y=c(1,2,5))
m2 = glm(data=df2,
family=tweedie(var.power=1.6,
link.power=1), y~x)
summary(m2)

# Coefficients:
# Estimate Std. Error t
value Pr(>|t|)
# (Intercept) 0.939632
0.342186 2.74597 0.22233
# x 1.684947 0.525511
3.20630 0.19247
#
# Residual deviance: 0.1422328
on 1 degrees of freedom
```

Lessons

GLMs allow actuaries to model with an error distribution that incorporates known facts about the loss generating process, but overlays no further arbitrary assumptions. The distribution is specified by the relationship between the mean and variance. It provides a variance-adjusted score, or measure of bias, that satisfies the balance equations and a quantification of model fit. Model parameters can be estimated using an efficient algorithm, implemented in R and Python, or from first principles in a simple spreadsheet. GLMs naturally extend Bailey and Simon's four criteria, giving them more exact meaning. Since GLMs assume the input data is representative, unbiased and credible, the modeler must always exercise good judgment. Nevertheless, GLMs provide an excellent framework that the actuary can use to build fair and transparent rates. Long live statistics and rational, fact-based government! ●

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Figure 2.

x_{i0}	x_{i1}	x_{i2}	y_i	β	μ	$V(\mu)$	Score b	$d(y;\mu)$
1	0	0	1	0.91075	0.91075	0.86107	0.10365	0.00880
0	1	0	2	2.42871	2.42871	4.13620	-0.10365	0.04917
0	0	1	3	3.92352	3.92352	8.91006	-0.10365	0.10996
-1	1	1	7		5.44148	15.03651	0.10365	0.14068
0.30860								
Constant	x_i	y_i		β	μ	$V(\mu)$	Score b	$d(y;\mu)$
1	0	1		0.93963	0.93963	0.90518	0.06669	0.00389
1	1	2		1.68495	2.62458	4.68269	-0.13338	0.09586
1	2	5			4.30952	10.35349	0.06669	0.04248
0.14223								

IN MY OPINION By GROVER EDIE, ACTUARIAL REVIEW EDITOR IN CHIEF

Use Your Tools to the Fullest

If we only used the tools we already have a little better, we would be amazed with the results.

I have been making that statement for years — okay, decades — and generally applying the concept myself. I try to apply it to my personal life, not just at work.

There are two aspects of this. First, we need to utilize the tools we have a bit better. It is like learning new functions in Excel.

The second aspect is to use tools that we already have at our disposal but are not using. Structured query language (SQL) and R language are both free programs, but how many of us use them? I started working with them last year and found them very handy.

This concept is not the same as “sharpen the saw” story of the seventh habit in Stephen Covey’s *The 7 Habits of Highly Effective People*. “Sharpen the saw” deals with refreshing and improving skills that you already have. It speaks of increasing your competency and of continuous improvement, like taking advanced courses in subjects you already know. I think this is especially important for professional knowledge workers, as the skill levels keep advancing, and to only maintain your current skills means you are falling behind.

To better utilize

the tools we possess requires a better focus on the tools themselves.

For example, the quick analysis feature in Excel 365 is a tool I use a lot, but not to its full capacity. Quick analysis lets you add graphics such as data bars, top 10%, and greater than a specified amount as well as format some cells that

keep forgetting is the line and bar charts option.

Quick analysis is one of my best tools, but what good is it if I keep forgetting to use it? Instead, I go through the whole inefficient “insert/charts/etc.” process. I need to use this tool a little better.

Like many actuaries, I am a problem-solver. I keep looking for solutions to problems that I have and increased efficiencies with my tools.

you select. All you do is highlight a group of cells, right click, and select “Quick Analysis” to view the options.

Quick analysis has helpful features like conditional formatting. I like to use graphs and often overlook this quick and easy way to create them — the one I

I recently revised the radio service for my cars. I no longer have an hour commute and do not use my commuter car much. My wife and I have another newer car that we use when we go out. When I found out that I could stream the service on my mobile phone, I kept

the service on our main car and dropped the service on my commuter car. Now, if I am driving my commuter car and want to listen to the service, I do it on my phone.

I have always had that streaming feature on my phone. I just never used it before. This is another tool I had in my possession that I did not take full advantage of.

How do these tools escape my notice and what can I do to be in the know? I can read up on tips and talk to people,





like my friend, Al, who introduced me to another useful tool.

The U.S. Postal Service leaves packages for us in front of our garage door. The other delivery services leave packages at the front door. We can see packages through the glass panes on either side of the front door, but we cannot see what is left in front of the garage door. A few months ago, Al told me about the USPS Informed Delivery service. (Thanks, Al.) I enrolled and now get a daily email telling me what to expect in the mail, including packages. Now I know if I should check in front of the garage for parcels. The app also has a photo of the mail pieces, and so I can be alerted to bills and refunds as well as holiday cards.

Informed Delivery is free to anyone with mailing and email addresses. It is another example of something that is already available, clearly useful, but underutilized to the point of not being used at all. I can use the application to suspend mail when and if I ever travel again. (I recently added a video camera with a motion detector that overlooks the driveway and garage doors, just to make sure I don't miss anything. It lets me know when someone drives up in the driveway, an added benefit.)

Some of the video conferencing and web call programs are free as well. Many of us have not only learned the ins and outs of these utilities in recent months, such as how to share content, but some have even learned how to look our best

on screen. Creating an impressive background — either real or virtual — has also become a thing. A Twitter account has taken to rating the rooms of talking heads on news programs.

Like many actuaries, I am a problem-solver. I keep looking for solutions to problems that I have and increased efficiencies with my tools. Often I am surprised. Just like my conversation with Al, sometimes someone alerts me to a solution that is free and readily available. I become aware and my knowledge expands.

I encourage you to look for those underutilized tools and make full use of the ones you have. ●

IT'S A PUZZLEMENT By JON EVANS

Some Infinite Games

Hypatia and her brother Horatio play a game where they take turns writing down a 0 or a 1 to form an infinitely long binary sequence S . Both siblings can see all the binary digits that have been written down at any point. Hypatia starts. Below are several different alternative rules for determining which sibling wins. In each alternative case, Hypatia wins if the condition stated for that alternative rule is true for sequence S , otherwise Horatio wins.

1. Beyond some point S , is a constant sequence of only 0s or only 1s.
2. There is no point after which S is periodic (an endless repetition of a fixed sequence of finite length).
3. S does not contain all possible finite binary sequences in it. Equivalently, at least one binary sequence of finite length is nowhere in S .
4. For a given set C of countably many infinite binary sequences $C = \{S_1, S_2, \dots\}$, $S \in C$. That is to say S must be some element of C .

For each alternative rule, is there a guaranteed winning strategy for either Hypatia or Horatio, and, if so, for which sibling and what is that strategy?

The Logic of Psychiatry

Luc Langlois provided the following solution.

Patient A is Evening type and Time T = PM

Here is the proof:

Morning Type = MT

Evening Type = ET

Options:

- O1 = Patient A is MT and T in AM (A is right)
- O2 = Patient A is MT and T in PM (A is wrong)
- O3 = Patient A is ET and T in AM (A is wrong)
- O4 = Patient A is ET and T in PM (A is right)

From Abby's conversation with

Student S1:

- At T, A thinks he is ET and PM.
- Hence, A can't be O1 because he would have been right and would have said he is MT and T in AM.

- But he can be O2, O3 and O4.

- By knowing A's type, S1 cannot know T.
- That means A is ET since S1 must have two options (O3 and O4)

From Abby's conversation with Student S2:

- By knowing T, S2 can't know A's type.
- S2 has also eliminated O1 (same process as S1).
- That means T must be PM since S2 must have two options (O2 and O4).

Hence O4 is the one shared by S1 and S2. So, it is the only viable answer.

Solutions were also submitted by Cara Campbell, Bob Conger, John Berglund and Jonathan "J.R." Robinson. ●



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