actuarial REVIEW
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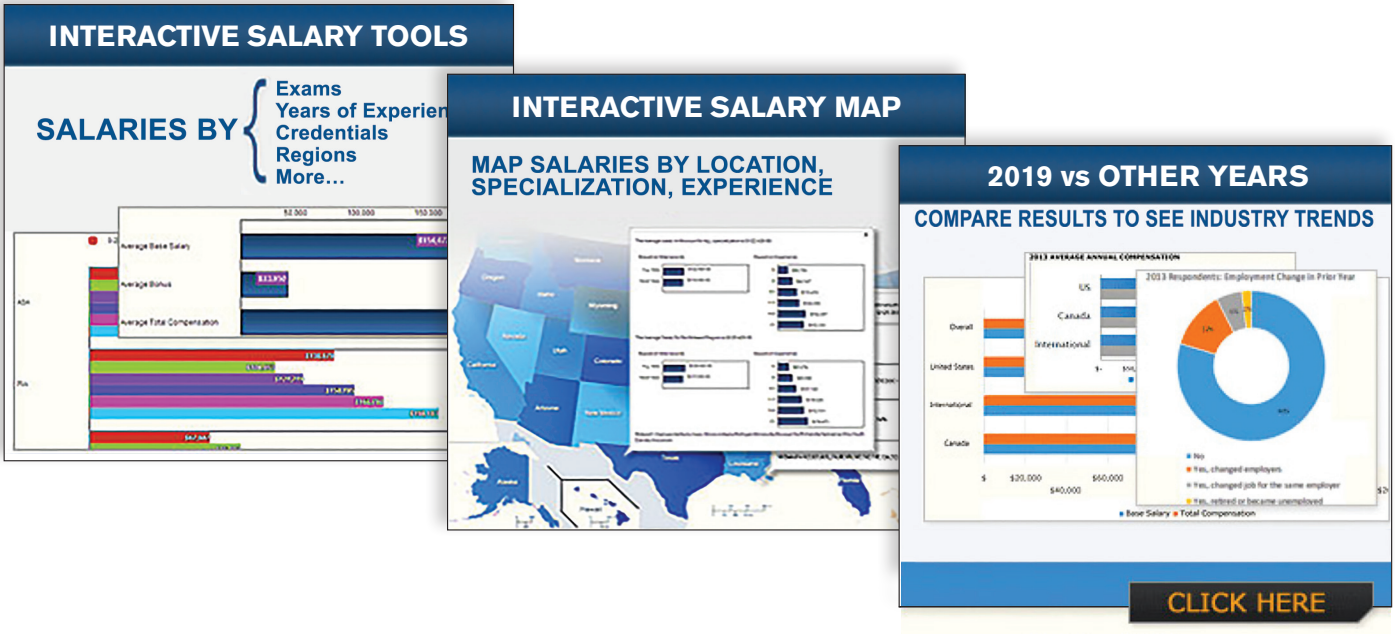

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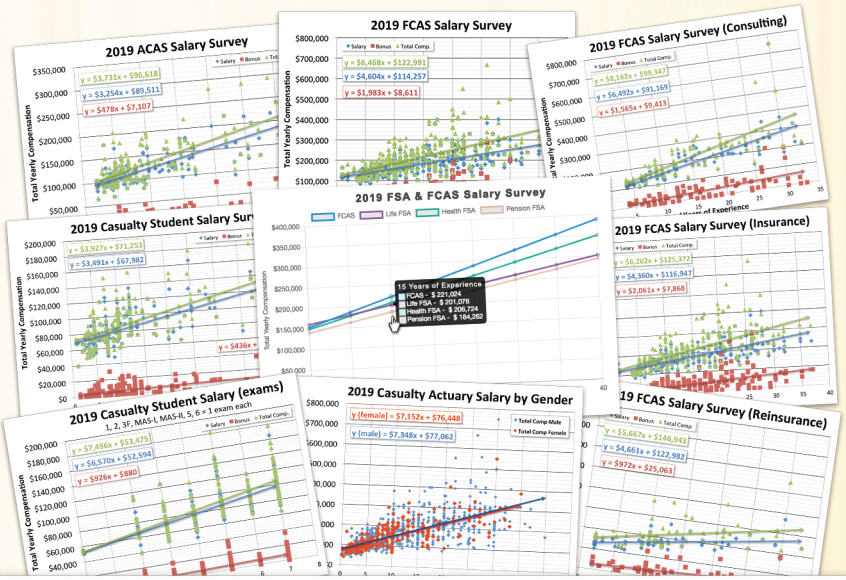

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Volunteers Make Things Happen

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Images: Getty Images

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Ways, Small and Large

"A man's reach should exceed his grasp, or what's a heaven for?"

—Robert Browning

A lot of people fear failure — so much so that some do not push themselves. They may be content with that or may secretly wish that they had reached for more.

Many people embrace challenges. And when those challenges pay off, it can be like a little slice of heaven.

Expanding your skills can be exhilarating, but when you are juggling a family, work and social life, volunteering can be quite daunting. Yet, year after year, CAS volunteers take on new endeavors, mostly while holding down full-time jobs and devoting time to kith and kin.

It's a tradition for the last *AR* issue of the year to honor the outstanding volunteers of the CAS. This year we have also included nonmembers who have supported our success.

In small and large ways, CAS volunteers exceed their grasps, stepping beyond their zones of comfort. Listing names is a small way that we can thank those who have given so much. I hope that these outstanding individuals will feel a little heavenly for having played a large part in the CAS's success.

Certify Compliance with the CAS Continuing Education Policy

All Fellows and Associates need to certify their compliance with the CAS CE Policy's requirements as of December 31, 2019. Compliance with the CAS CE Policy allows the member to provide actuarial services in the year immediately following certification of compliance. Note that even members who are not in actuarial roles should review the requirements as CE compliance may still be required. If members are not providing actuarial services at all, they must still attest this on the website.

For more information on certification, visit http://www.casact.org/education/index.cfm?fa=ceinfo.

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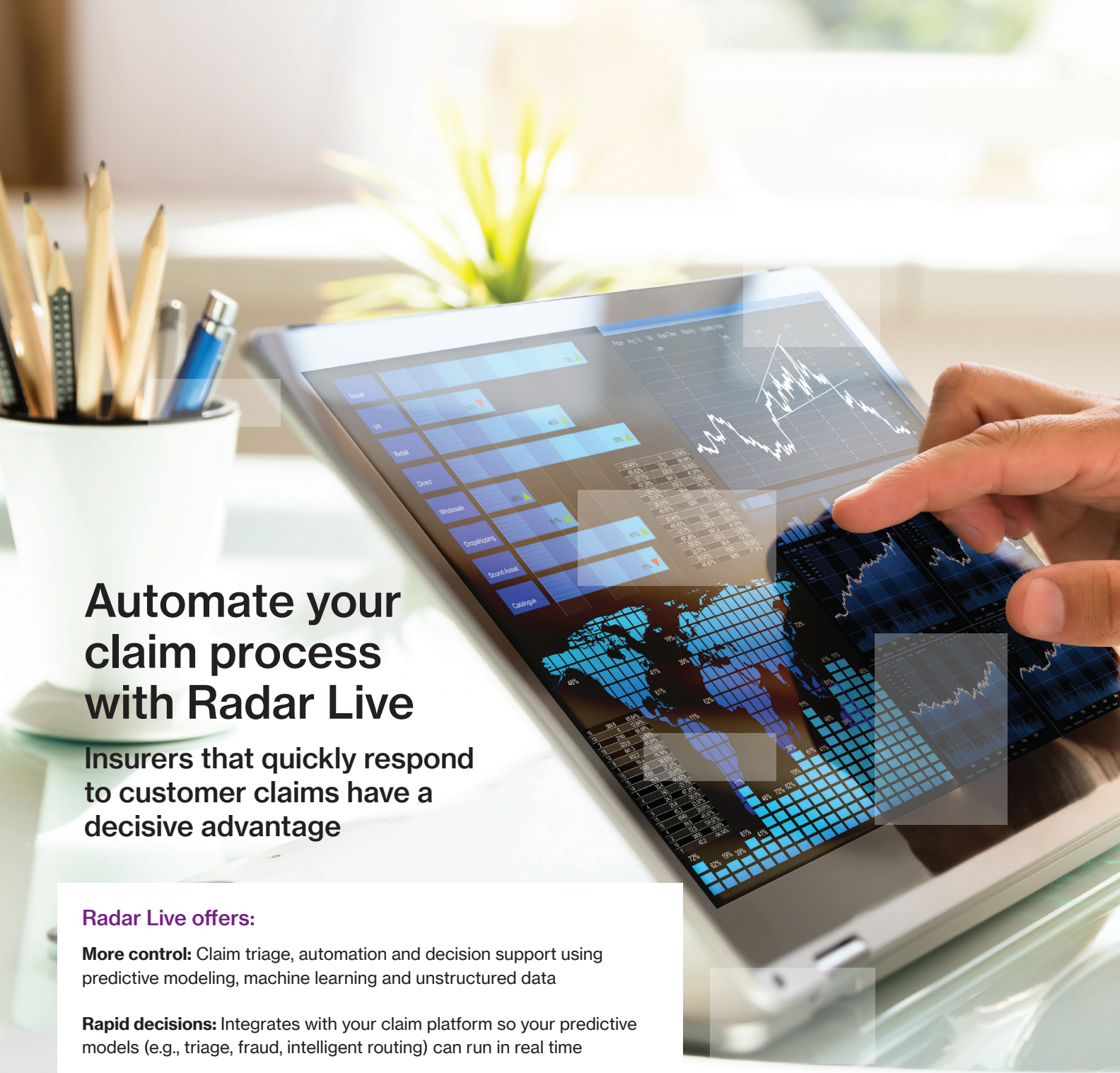

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Drawing to a Close

It has been almost two years since I was elected to the CAS leadership. As my term comes to an end, it is a good time to reflect upon what I have seen and learned during my time in office as president-elect and president.

When I was elected it had been about a decade since I had been actively involved in any CAS leadership role, having taken only occasional special project volunteer roles with the CAS in the interim. I soon discovered the CAS was certainly not the organization I had come to know so well from my previous terms as vice president-admissions and board director.

While many issues facing the CAS seemed to be timeless, there were also many new concerns. Perhaps the biggest change I saw in the CAS over that intervening decade was its sheer growth in size, both in membership count and geographic diversity. With every CAS meeting I continue to be impressed by the new Associates and Fellows — not only the number of those becoming members but also the enthusiasm and diversity of each new class. The CAS staff has also grown commensurately with the CAS membership, and the staff has added many skill sets to better serve our membership.

Upon joining the CAS leadership team as president-elect, I learned of two new and very exciting initiatives by the CAS: technology-based exams (TBE) and the CAS combination with the SOA, neither of which proved successful. Although the outcomes of these initiatives were difficult to take, the CAS leaders and I learned quite a lot.

For TBE, we've gone back to the drawing board and will be bringing a new version of TBE to candidates when we are completely satisfied that it will work smoothly for all involved. We hope to offer TBE in the future.

As for the combination, we learned that both organizations hold like values and do many things similarly. Each group also learned that the other has some great alternative practices.

We have soldiered on, and I believe that we are a better organization and that I am a better leader because of those challenges last year while I was president-elect.

My presidential year has been a time of recuperation and regeneration. I am happy to report that there have been a number of significant events this year as well.

We completed our quinquennial membership survey, which, as usual, has given CAS leadership much to consider. Membership input is vital to developing and refining our strategies for growth.

We established board task forces that have been very busy on a number of CAS initiatives:

1. Predictive analytics
2. Education process review
3. Strategic alliances criteria
4. The CAS Institute expansion
5. CAS staff/volunteer model evolution
6. Diversity and inclusion joint efforts

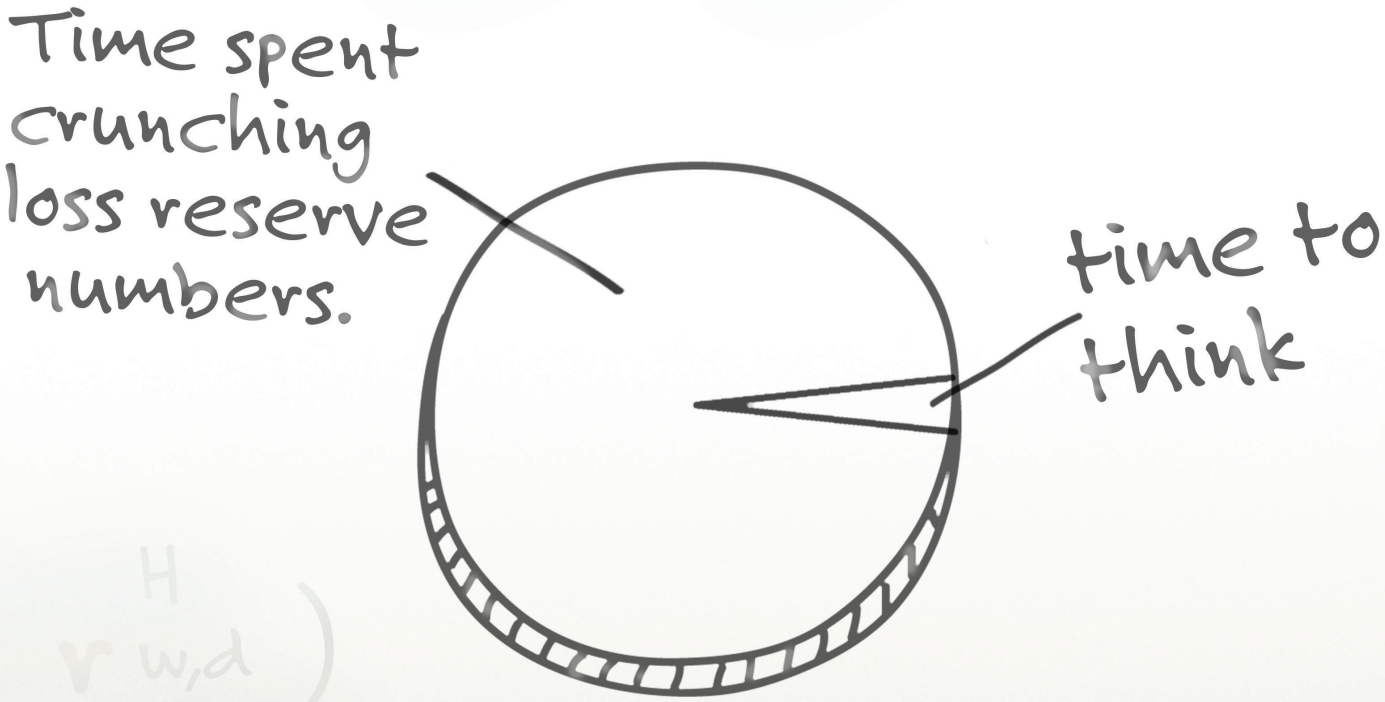
Before my term as president ends, each of these task forces will have brought or will be bringing recommendations to the board to consider in the coming year.

And lastly, I want to thank and wish a fond farewell to our executive director, Cynthia Ziegler, who will leave the CAS at the end of this year. In her 18-year tenure, she has led the organization through tremendous growth. The search for a suitable new executive has been completed and Victor Carter-Bey joins the CAS on October 28 as our CEO. I am looking forward to working with him and seeing the new directions that our organization will take.

With every CAS meeting I continue to be impressed by the new Associates and Fellows — not only the number of those becoming members but also the enthusiasm and diversity of each new class.

We expanded our staff, hiring two new staff actuaries. Ran Guo, FCAS, is our director of international relations, lives in China and has hit the ground running as our point person leading CAS initiatives in that part of the world. We also hired Wes Griffiths, FCAS, for the newly created position of admissions actuary. He is a long-time CAS volunteer and he will work out of his home in Minnesota and CAS headquarters in Virginia.

It has certainly been a tremendously exciting time to be CAS president. Thank you for putting your trust in me.



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COMINGS AND GOINGS

Katherine Antonello, FCAS, has been appointed to executive vice president, chief actuary, at Employers Holdings, Inc. Antonello most recently served as the chief actuary for the National Council on Compensation Insurance.

GEICO has promoted **Ashley Schneider, FCAS,** to assistant vice-president of the company's product management division. Schneider began her career at GEICO in 2007 in pricing and product management.

Ken Hawkins, ACAS, has joined Pinnacle Actuarial Resources as a consulting actuary. Hawkins returns to Pinnacle after three years of leading pricing and rate implementation for a regional insurer's commercial lines products.

Ben Ng, FCAS, has been appointed CEO of AIA Malaysia. Ng joined AIA in 2011. Prior to the current appointment, he was president director of AIA Financial in Indonesia.

Lussier Dale Parizeau has named **Michel Laurin, FCAS,** president and chief operating officer. For the past 17 years Laurin has worked for Industrial Alliance, including roles as president and chief operating officer.

James Norris, FCAS, has assumed the role of chief actuary at EC3 Brokers U.S. Norris was most recently president of Lapis Resources.

Katey Walker, FCAS, has been appointed to Americas P&C sales and practice leader within the Willis Towers Watson Insurance Consulting and Technology (ICT) business. Walker will also join the Americas ICT leadership team.

Merchants Insurance Group has promoted **Sam LaDuca, FCAS,** to senior vice president, underwriting, product and actuarial. LaDuca was previously vice president of product management and product development functions.

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

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IN MEMORIAM

Douglas J. Hoylman (FCAS 1979)
1943-2015

Joshua Stewart Sawyer (ACAS 1969)
1942-2018

Paul J. Struzzieri (FCAS 1994)
1961-2019

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New CAS CEO Victor Carter-Bey Is Hired

Victor Carter-Bey

Victor R. Carter-Bey is the new CEO of the Casualty Actuarial Society.

Carter-Bey began work at the CAS Office on October 28 and will work with current CAS Executive Director Cynthia Ziegler until her departure on December 31. He will be formally introduced to the CAS membership during the CAS Annual Meeting's business session in Honolulu on November 11.

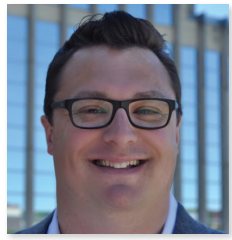
"I am humbled by this appointment and incredibly excited to begin my journey alongside the CAS Board of Directors, volunteers and staff," said Carter-Bey. "As workforce development is a critical element of global business, I am looking forward to the collective contributions we at CAS will make to influence the professional development and career trajectories of our current and future members around the world."

Carter-Bey is an accomplished senior executive with experience in credential development and commercialization, workforce value enhancement and member engagement. He was most recently director of certification at the Project Management Institute, where he oversaw the development and implementation of product growth and workforce development strategies to enhance member value and engagement for over 1,000,000 global professionals in the project management profession.

"After an extensive search, we are pleased to have identified the right person to bring the CAS into its next era of growth and success," said CAS President Jim Christie. "Victor's impressive background aligns closely with our own goals to create highly competitive and valuable credentials that remain the gold standard for property and casualty actuaries worldwide. We look forward to working with Victor to continue delivering exceptional programs, credentials and resources to our members and their employers."

Carter-Bey has a Doctor of Management from University of Maryland Global Campus in Adelphi, Maryland, and an MBA from the New York University Stern School of Business in New York City. He also holds a bachelor's degree in political science from Johns Hopkins University in Baltimore, Maryland.

Griffiths Chosen CAS Admissions Actuary



Wes Griffiths

The CAS has named Wesley Griffiths, FCAS, as its admissions actuary. A long-time CAS volunteer, Griffiths has been instrumental in leading several efforts including University Engagement, Leadership Development and the joint CAS/SOA Committee on Career Encouragement and Actuarial Diversity. He has also served on exam committees, contributed to several task forces and served on the CAS Board of Directors from 2014 to 2016. Griffiths also serves the industry on the board of trustees of Gamma Iota Sigma, the insurance industry's collegiate talent pipeline, and just completed his term as board president. Griffiths has over 20 years of actuarial experience and comes to the CAS from Travelers in St. Paul, Minnesota, where he most recently served as second vice president. He performed pricing and reserving functions across the company's commercial business segments and led the actuarial support function for the technology and public entity industry segments in his last assignment. He earned bachelor's degrees in mathematics and economics from the University of Minnesota-Duluth.

The admissions actuary is a newly created position that will support implementing the CAS's long-term vision and strategic plan and will contribute to the organization's ongoing efforts to deliver value to the casualty actuarial profession. Griffiths will work closely with executive leadership, volunteer members and CAS staff to advise on all aspects of CAS basic education, including working closely with the Syllabus and Examination Committee, evaluating and updating the current CAS Syllabus of Basic Education and exploring and implementing Technology-Based Examination (TBE).

Griffiths joins CAS members Ran Guo, Brian Fannin and Ken Williams as one of four actuaries employed by the CAS.

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March 9-10, 2020
ERM Symposium
The Westin Tampa Waterside
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March 23-25, 2020
Ratemaking, Product and Modeling (RPM) Seminar & Workshops
Sheraton New Orleans
New Orleans, LA

May 10-13, 2020
Spring Meeting
Hilton Chicago
Chicago, IL

June 1-2, 2020
Seminar on Reinsurance
Loews Philadelphia Hotel
Philadelphia, PA

September 14-16, 2020
Casualty Loss Reserve Seminar (CLRS) & Workshops
Hilton Orlando Bonnet Creek
Orlando, FL

November 8-11, 2020
Annual Meeting
Washington Marriott Wardman Park
Washington, D.C.

Former CAS President Inducted into Tennessee Insurance Hall of Fame

Mary Frances Miller, CAS president from 2002 to 2003, has been inducted into the Robert E. Musto Tennessee Insurance Hall of Fame. The induction ceremony took place on September 12 at Middle Tennessee State University in Murfreesboro. Created in 1999, the Tennessee Insurance Hall of Fame honors entrepreneurs who have made a difference in their companies and their communities, significantly affecting the lives of many people and advancing the role of insurance in society.

Miller is a founder and senior consulting actuary at Select Actuarial Services in Nashville, Tennessee. An active contributor to the actuarial profession since achieving her CAS Fellowship in 1988, she has served as president of both the CAS and the American Academy of Actuaries. She has also served on the board of the Conference of Consulting Actuaries, and she currently serves on the board of the Tennessee Captive Insurance Association. Miller served as the CAS vice president-admissions from 1999 to 2001. Her international work includes a six-year term as chair of the International Actuarial Association's Education Committee and volunteer service with Actuaries Without Borders. She remains an active volunteer leader for the CAS, having recently been elected to serve the on the CAS Board of Directors through 2022.

"Mary Frances is incredibly passionate about volunteering for the actuarial profession," said CAS President Jim Christie, who introduced Miller at the induction ceremony. "We have been lucky to benefit from her talent, insight and leadership over the years. On behalf of the CAS, we congratulate her on this remarkable achievement."

Celebrating a prestigious career: Mary Frances Miller raises a glass with CAS President Jim Christie (left) and her husband, Jonathan (right).

CAS STAFF SPOTLIGHT

Meet Ran Guo, FCAS

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

- **What do you do at the CAS?**
  As the director of international relations, my primary responsibility is to engage with the local stakeholders in Asia to promote the CAS brand and to serve our members. The stakeholders are universities, regulators, local members and students. The services include professional education and training as well as hosting social events.
- **What do you enjoy most about your job?**
  The world needs more actuaries! We have a special set of skills to view and analyze risk. The most satisfying part of my job is to introduce the wonderful profession of an actuary to the young students in the region. Being an actuary has given me the opportunity to travel the world. The training we receive through the examination process adequately prepares us for the challenges we face at work.
- **What's your hometown?**
  This is a difficult question to answer. The first 30 years of my life were split half and half between China and the U.S. I was born in Beijing and grew up in California. Now four years since moving back to China, I have finally settled down in Beijing again, so I'd probably say my hometown is Beijing. On a side note, if any of our members ever travel to Beijing and need some restaurant suggestions or fun things to do, feel free to reach out!
- **Where'd you go to college and what's your degree?**
  I am a proud Cal Bear! I earned my undergraduate degree in statistics from University of California, Berkeley. I followed up on that with a master's from UCLA, also in statistics.
- **What was your first job out of college?**
  I was lucky to be hired by Farmers Insurance during the financial crisis. As an intern, my first project was a by-peril homeowner product segmentation using GLMs. It was during this time that I learned what it's like to be an actuary and made the career choice.

Ran Guo, FCAS

- **Describe yourself in three words.**
  Energetic, down-to-earth, mission-driven.
- **What's your favorite weekend activity?**
  Basketball used to be the game of choice, but nowadays I spend my time on the bike trying to stay fit and improve my FTP or functional threshold power.
- **What's your favorite travel destination?**
  I am a big fan of the outdoors. I recently visited Switzerland — its rugged mountains are truly mesmerizing. Tibet also has some very impressive natural landscapes. I would highly recommend the two destinations, although, Tibet may be difficult to access for foreigners due to its tight border control.
- **Name one interesting or fun fact about you.**
  My name *Guo Ran* in Chinese means something happens just as expected. That's the approach I take to work and life — no surprises. A fun fact about me is that I have lived in six different cities in four years since moving back to China.

Switzerland is one of Ran Guo's favorite destinations. Below is a panoramic view of the Alps in Canton of Valais.

DOWNTIME BY LAURIE MCCLELLAN

Lift Every Voice

Members of Travelers Men's Actuarial Choir perform at a benefit concert for Habitat for Humanity, held at St. Christopher's Episcopal Church in Roseville, Minnesota. From left to right are Peter Soulen, FCAS; Cale Nelson, FCAS; Rick Sutherland, FCAS; Kevin Hanson, FCAS; Eric Zange, ACAS; Chris Westermeyer, FCAS; Ben Mesick; Kevin Zech, ACAS; Matt Cole; Trevor Franda, ACAS; David Iverson, FCAS; and Zach Westermeyer, ACAS.

In the classic 1991 movie *The Commitments*, a scrappy group of Irish musicians come together to form an R&B band. In one of the opening scenes, every person who auditions for the band is asked the question, "Who are your influences?" Spoiler alert: No one auditioning has any R&B experience.

The singers who have come together to form the Travelers Men's Actuarial Choir at Travelers in St. Paul, Minnesota, faced a similar dilemma. Their musical influences ranged from *The Pirates of Penzance* to a brass quartet to Ozzy Osbourne. A baker's dozen of singing actuaries, the group tackles the challenging art of singing in close four- and eight-part harmonies. What's more, they sing a cappella — without any instruments to guide or assist their voices — a style new to nearly all of them.

The daring enterprise is only in its fourth year, but it's part of a surprisingly long tradition of actuarial choirs. The Travelers Chorale in Hartford, Connecticut, founded in 1924, claims the title of the oldest company-affiliated choir in the United States. Highlights of its long history include broadcasting Christmas carols on the radio and singing at the 1965 World's Fair in New York City.

In St. Paul, a mixed choir of both men and women has been gathering each fall since the 1930s to practice holiday music that they perform in December. Trumpet player and CAS Fellow Chris Westermeyer, who currently leads the firm's workers' compensation product team, was excited to find a musical outlet at work when he arrived at Travelers. He joined the mixed choir during his first year with the company.

More than 10 years later, Westermeyer noticed that musical entertainment was missing from the company's annual summer boat cruise. "I got the idea," he says, "since we have so many men [who are] actuaries who sing, that we could get a group together to sing on this boat cruise." There was only one problem, according to Westermeyer. "When we're on a boat, there's no piano." Out of necessity, the group became an a cappella choir. Westermeyer picked the music, a repertoire ranging from traditional ballads like *Danny Boy* to classical pieces, *Over the Rainbow* and songs by Billy Joel. The choir debuted at the company's 2016 boat cruise.

Westermeyer, who usually sings

bass, brings a wealth of musical experience to his role of organizing the group, even though singing isn't his main musical focus. "I am mostly a trumpet player by training," he says. He currently plays the trumpet in the Minnesota Symphonic Winds and a brass quartet in addition to a gig with the Lake Wobegon Brass Band, a traditional 30-piece British brass band that tours overseas.

Joining Westermeyer in the men's choir that first year was tenor Ben Mesick, who is currently one exam away from earning his ACAS designation and is working in his second rotation in the five-year Travelers Actuarial Analytics Leadership Development Program. Like Westermeyer, Mesick sees himself as more of an instrumentalist than a singer. "I mainly would consider myself a guitar player," he says. In high school, Mesick played in a rock and metal band with a set list that ran from Guns N' Roses' *Sweet Child of Mine* to Ozzy Osbourne's *Crazy Train*. After graduating from high school, Mesick earned an associate's degree in guitar performance from McNally Smith College of Music in St. Paul. "That was great," he says, "but I realized it's tough to make a living in music pretty quickly. So, I went back to the University of Minnesota and got a bachelor's in math there, with the idea of becoming an actuary."

They soon recruited baritone Kevin Hanson, whose musical past includes stints as a tuba player in the marching band at his high school and at Drake University. Hanson, an FCAS who specializes in predictive modeling, had also sung in choirs his freshman year at Drake, and was disappointed to find out that he'd missed the auditions for the Gilbert and Sullivan operetta *The Pirates of Penzance* by one day. "But I went to see the people in charge anyway," he says, "and they said, 'We'd love to have you. We can always use more pirates!'" Surrounded by theater and music majors, Hanson says, "I was the only actuarial science major in the opera."

The Men's Actuarial Choir seems to embody the common observation that people who are skilled with math can have a knack for music as well. Mesick has seen that connection in his own work and feels that the two skills share a similar learning process.

"When it comes to practicing music," he says, "you sit down, you don't know how to do something, and then you run through it a bunch of times, until you get it into your fingers, and you figure it out. And I feel like it's similar for math, for example, learning how to do integrals. You start out, you don't know how to do it, you look at a bunch of problems, you work through them. And then at some point, it kind of clicks, and you get it."

Most of the choir's members divide the year between the larger mixed choir, which practices holiday music between September and December, and the men's choir, which begins rehearsing in January for the company's boat cruise in July, and then disbands until after the holidays. What makes all those rehearsals worth it? "I love making music, and doing it really well. And this group of guys is really good," says organizer Westermeyer.

Hanson enjoys "the challenge of singing a cappella," he says. "You have to depend on each other, for everyone to sing their part and sing it well — and there are some way better singers in the choir than me!" Ben Mesick finds the group has given him an easy way to include music in his working life. "I've been doing music for most of my life, and it's nice to have that structured group now that I'm working and not in school anymore."

This year, the choir decided to tackle two new challenges: a benefit concert and Taylor Swift. After four years of singing at retirement parties and performing mini-recitals at work, in addition to the annual boat cruise, "we decided we'll put on our own little concert in the evening," says Westermeyer, "and do it as a fundraiser for Habitat for Humanity, which is a group that Travelers has long supported, both through donations as

Read More: The Math-Music Connection

The blockbuster book, *Gödel, Escher, Bach: An Eternal Golden Braid,* by Douglas Hofstadter, celebrates its 30th anniversary in 2019. Winner of both a Pulitzer Prize for nonfiction and a National Book Award for science, the book investigates links between the work of mathematician Kurt Gödel, optical illusion artist M.C. Escher and composer Johann Sebastian Bach. *Time* named the book to its list of top 100 nonfiction books of all time, with reviewer Lev Grossman writing, "Ordinary language can't convey Hofstadter's ecstatically brilliant improvisations: He uses paradoxes, palindromes, dramatic dialogues, *kōans*, diagrams, symbolic logic, musical scores and, where necessary, terrible puns to braid music theory, mathematics and the visual arts into one single strand that leads the reader deep into the mystery of how the mind works."

well as through volunteers to work on houses."

The June concert raised $1,300 in donations, and it featured Taylor Swift's pop hit S*hake It Off*, a song requested by a coworker. According to Ben Mesick, "The big thing is the dance moves that we added. So, we spent most of our rehearsal time this year just working on that one song."

Chris Westermeyer may direct two choirs and play in three bands, but he's not a dancer. So, he turned to coworker Christina Kyllo, who is currently taking exams for her actuarial credentials and is in her third year of the Actuarial Analytics Leadership Development Program. Kyllo competed with the ballroom dance team at the University of Minnesota and currently dances and competes in West Coast Swing. "When Chris Westermeyer first asked if I'd choreograph their dance," says Kyllo, "I was a little apprehensive because I've only done partner-style dancing. But I was also excited because I knew the choir would be a great crew to work with, and being part of their T-Swift debut sounded like so much fun."

For more help with the choreography, Kyllo recruited Brooke Smith, FCAS, who's in her fourth year of the Actuarial and Analytics Leadership Development Program at Travelers and started dancing at the age of two. Smith competed in dance in high school and at Drake University.

Smith says their goal was to make the choir's moves "humorous, without making anyone feel embarrassed, and also fun to watch. We did fun things like split the group in half and have them perform different moves to make it more interesting for the audience to watch." The choreographers found a soloist in Chris Westermeyer's son, Zach Westermeyer, who recently passed his exams to become an ACAS. "I think he had hardest part," says Smith, "as we encouraged him to enthusiastically improv for much of his part. Believe it or not improv is often much harder than performing a prepared routine, plus he is performing those moves alone!"

The rehearsal process went smoothly, according to Kyllo, who says, "Since they're a group of musicians and already understand music so well, they were really good at picking up the timing of the choreography." She didn't see the final result until the benefit concert in June, where she says, "There was no question that they put on a fantastic show, and the audience loved it."

For Kevin Hanson, that kind of audience reaction is part of what makes performing in the choir worthwhile. "It's fun singing for coworkers and seeing the enjoyment they get out of it," he says. "The whole actuarial community is very supportive about coming to listen to us when we do mini-recitals in the common area." When the choir sang at a retirement party recently, he rewrote the lyrics of the song *Hard Times, Come Again No More*, changing the title to "Pam Doesn't Work Here Any More," a witty commentary on his colleague's life at the office and her sunny plans for the future. Hanson explains, "I rewrote some of the lyrics, sort of as a retirement gift. That was a lot of fun — getting to give that gift." (See ar.casact.org for the video.)

Chris Westermeyer enjoys an added bonus to singing with his coworkers: These days, he's also singing with his son, Zach, who joined the company in 2015. "It's great to have the opportunity to work at the same company as my son and to sing in the choir with him," Westermeyer says. "He's a much better singer than I am, so I've learned a lot from him." As the choir's organizer, Westermeyer hears kudos from his coworkers. After a recent performance, he says, "Someone who was in St. Paul from the Hartford office came up to me afterwards and said our singing alone made her trip out to St. Paul worthwhile."

Ben Mesick sees a future in which the Travelers Men's Actuarial Choir is no longer as uncommon as it is today. "For other large companies," he says, "if they've got a lot of musical actuaries, I'd encourage them to try it out. I think it's a lot of fun."

The choir also includes CAS Fellows David Iverson, Alex Kranz, Cale Nelson, Peter Soulen and Rick Sutherland; CAS Associates Trevor Franda, Eric Zange and Kevin Zech; and Matt Cole. ●

Laurie McClellan is a freelance writer and photographer living in Arlington, Virginia. She is on the faculty of Johns Hopkins University, where she teaches in the M.A. in Science Writing program.

Host an actuarial sing along!

Kevin Hanson rewrote the lyrics to this common tune, usually sung as a round, to give it a more mathematical bent (and to give actuarial audiences a chance to participate). Sing it to the tune of *Are You Sleeping?* (also known as *Frère Jacques*).

Statisticians

Sta-tis-ti-cians, Sta-tis-ti-cians,
Let's pre-dict! Let's pre-dict!
Give us all your data,
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Not hand-picked, not hand-picked.

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News from The Actuarial Foundation By HOLLY MONAHAN

The Actuarial Foundation's *Educate.Connect.Change.* Campaign

We're excited to launch a special fundraising campaign commemorating The Actuarial Foundation's 25th Anniversary. The *Educate.Connect.Change.* Campaign showcases the Foundation's primary focus to educate in math and financial literacy, to connect students with actuaries and to prompt positive change in the lives of students. *Educate. Connect.Change.* kicked off officially at the end of October 2019. A five-year pledge period will follow, allowing for *Educate.Connect.Change.* to bookend the Foundation's 25th and 30th anniversaries.

The Foundation's Largest Personal Gift

The Actuarial Foundation recently announced its largest, single personal gift in the organization's 25-year history. Robert Deutsch, FCAS, ASA, MAAA, informed the Foundation of his planned gift of $1 million. This transformational gift will allow The Actuarial Foundation to continue its tradition of providing lifelong math education and financial literacy to middle and high school students through its programs and scholarships.

Actuarial Mentors Needed!

The Actuarial Diversity Scholarship mentoring program links actuarial diversity scholarship recipients with actuaries who serve as mentors. The overall goal is to help these students acquire the knowledge needed to meet their goals of becoming actuaries. As one actuary mentor said, "If anything, it's rewarding to learn about someone else. It's also important to take pride in the profession and be a part of helping the next generation."

If you would like to help college students on their paths to becoming actuaries, please sign up using the form at soa.wufoo.com/forms/kq6citr1wn9oov/.

Building Your Future Financial Literacy Curriculum

Studies have shown that individuals who had taken a financial management class in high school had a better understanding of money management and saved more money. To meet this critical need and fulfill the Foundation's vision of an educated public in pursuit of a secure financial future, we partnered with Young Minds Inspired, a leading provider of educational outreach programs to revamp the *Building Your Future* program. The revamp is intended to broaden the use of the *Building Your Future* program among teens and young adults while appealing to a more modern and tech-savvy audience. The revamped program was slated to launch at the end of August. Visit ymiclassroom.com/lesson-plans/byf/ to learn more about this vital program.

Hardest Math Problem Student Contest

The Actuarial Foundation's *Expect the Unexpected With Math*® series, developed with Scholastic, is well-known for its distinct, interactive math resources. The Hardest Math Problem Student Contest is a middle school math competition designed to help students practice critical thinking supported by accurate computation. In its inaugural year, over 6,000 students participated in the contest. Congratulations to the winners of the 2018-2019 Hardest Math Problem Student Contest! We are gearing up for the second annual Hardest Math Problem student contest to start later this fall. See the following link for this year's winners: actuarialfoundation.org/2019-hardest-math-problem-winners/.

Math Motivators

Winner of the 2018 American Society of Association Executives' Power of A Summit Award, the Math Motivators tutoring program continues to expand and is now operating in 10 cities. We've increased

The Actuarial FOUNDATION

the number of volunteer tutors from 200 to almost 1,000. We've gone from helping 310 students in six high schools to more than 700 students in more than 20 middle schools and high schools. Our goal is to continue to grow Math Motivators to 15 cities and increase our volunteer base to 3,000. Most importantly, we want to continue to help more students improve their math skills and introduce them to the actuarial profession. Volunteer to be a tutor by filling out the form at this link: soa.wufoo.com/forms/kq6citr1wn9oov/.

Modeling the Future Challenge

The second annual Modeling the Future Challenge was a huge success! A total of 191 teams participated, which included 873 high school junior and senior students. Student teams worked to develop mathematical models of how future cures or treatments for diseases may affect our lives. For a full recap of the Challenge, visit actuarialfoundation.org/2019-mtfc-recap/.

Climate change is the topic for the 2019-2020 Challenge and team registration opened on September 23. The success of the Modeling the Future Challenge is largely due to our volunteers. If you are interested in helping with outreach, mentoring or judging for the 2019-2020 Challenge, please fill out the volunteer form located at the following link: soa.wufoo.com/forms/kq6citr1wn9oov/.

Holly Monahan is marketing & communications specialist for The Actuarial Foundation in Schaumburg, Illinois.

Actuaries Meet in Vietnam to Discuss Common Issues

"Connect, Collaborate, Contrast" was the theme of the Vietnam Actuarial Seminar, held this summer on July 25. Around 120 attendees from around the world met in Ho Chi Minh City for this general insurance seminar that covered such diverse topics as data management and catastrophe modeling. The seminar marked the second time that the CAS was a sponsor of the event.

Prior to the conference, a team of CAS Fellows, Michael Owen, Cathy Hwang and Steve Kolk, met with the representatives from University of Economics Ho Chi Minh City for a formal introduction presentation and an exchange of gifts. The two groups talked about ways to collaborate together in the future. Owen, Hwang and Kolk were also conference speakers.

Some CAS members were also able to meet informally with a regulator in Vietnam.

Cathy Hwang

Steve Kolk

Michael Owen

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Volunteers Make Things Happen

The 2019 CAS Volunteer Honor Roll

We are an association of people, professionals and friends.

Since the founding of the Casualty Actuarial Society in 1914, volunteers have been the main life force sustaining the Society through its various dimensions of growth — in the expanding examination process, increasing variety of continuing education activities and a surging membership roll. An effort of this scale generates a continuous need for volunteers, with generally one in three CAS members volunteering each year. These positions span the entire range of CAS activities: the examination committee members, exam proctors, research and development contributors, liaison representatives, various program committee members and the speakers who serve as faculty for these programs. We recognize that none of these activities can take place without the active participation of the many CAS volunteers, both members and nonmembers, and for this, the CAS thanks you!

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Ao Zhou
Bei Zhou
Christina Tieyan Zhou
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The Hartford
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Travelers
Willis Towers Watson
Allstate Insurance Company
The Hartford
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ISO/Verisk
Munich Re America, Inc.
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Moving Parts

ADAS Go For a Ride

By ANNMARIE GEDDES BARIBEAU

Thanks to advanced driver assistance systems, quantifying risk will never be the same

Advanced driver assistance systems (ADAS), which partially automate driving and boost vehicular safety, are saving lives and reducing accident frequency.

Confidently quantifying the actuarial value of these safety systems, however, has been elusive. Despite lowering frequency, ADAS generally have eye-popping repair bills that push severity upwards. ADAS are not perfect but evolving. Safety technologies change year-by-year and by make and model. As they change, they can also introduce new risks and may contribute to accidents in some situations. And the relationship between people and ADAS? Well, it's complicated.

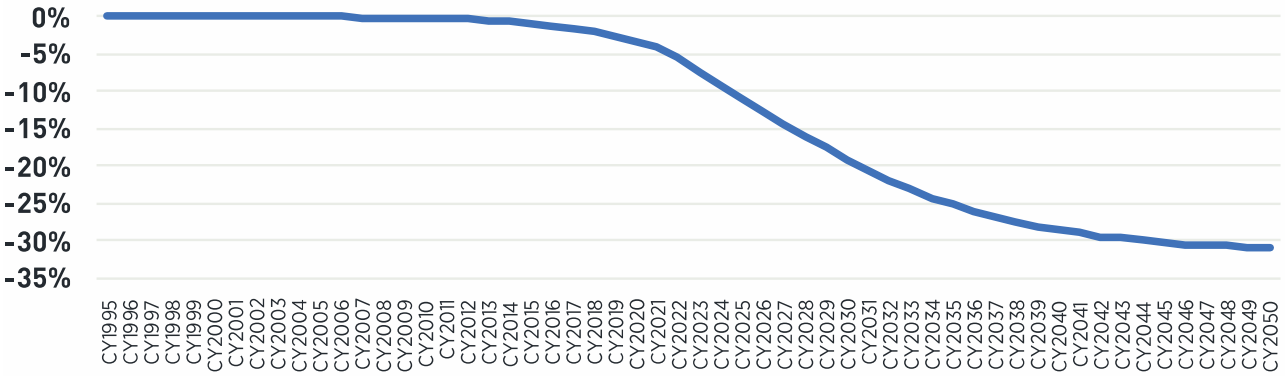
As for useful data, there is little to be found when only a small percentage of the United States fleet contains the automated technology and when auto manufacturers are loath to share information. Even when data accessibility improves, ever-changing technological advances will pressure both historical and new variables to be increasingly dynamic. Auto insurance actuaries may need to adapt strategies from their cyber insurance colleagues.

Monitoring and quantifying constellations of so many moving parts will not be the only important metric as ADAS become more ubiquitous. For actuaries, ADAS provide a clearer window into the safety promises being made by driverless car manufacturers.

Figure 1.

Potential Decline in Number of Vehicles in Accidents as ADAS Feature Adoption Grows

CY1995-CY2050 | SOURCE: CCC INFORMATION SERVICES INC.



Source: CCC. Used by permission.

Falling Frequency

ADAS reduce accidents and insurance claims. Roughly one-half of the 2% to 3% auto claim frequency reductions from 2017 to mid-year 2019 can be attributed to ADAS, says Susanna Gotsch, director and industry analyst for CCC Information Services Inc., which serves the automotive, insurance and collision repair industries.

Since the safety technologies are currently effective for a small percentage of use cases, a dramatic impact on accident reduction is yet to come, according to a 2018 analysis by SBD Automotive provided to *Actuarial Review*. ADAS will reduce accidents by 19% to 24% by 2030, plateauing at a 30% reduction by 2060, the U.K.-based international automobile research and consulting firm anticipates.

CCC's Crash Course reports for 2018 and 2019 predict ADAS will contribute to a 5% decline in vehicular crashes by 2022 from a baseline 1995 statistic and 20% by 2030 (see Figure 1). Drivers using ADAS have observed the technologies' ability to reduce crashes. In a *Consumer Reports* (CR) survey published in August, 57% of respondents say at least one ADAS feature prevented a crash. Subscribers participating in CR's survey on ADAS own model year 2015 to 2019 private passenger vehicles with one or more of the safety systems (see Sidebar).

Manufacturers roll out ADAS by feature. It can take a while — even decades — for available ADAS to transition from optional to standard to common on U.S. roads. For example, it has taken 17 years, from 1995 to 2012 model years, for electronic stability control to become standard. It will take until the 2030s for this safety feature to be in 95% of the U.S. auto fleet, according to the Insurance Institute of Highway Safety (IIHS).[1]

One much-hailed feature, automatic emergency braking (AEB), should become standard in most new cars by September 1, 2022. Thanks to commitments jointly brokered by IIHS and the National Highway Traffic Safety Administration (NHTSA) in 2015, 20 car manufacturers, which collectively produce 99% of private passenger vehicles, promised to install AEB.

Expanding the population of ADAS-featured cars, however, it not merely a matter of manufacturers installing them as standard. Assuring that the U.S. fleet grows with ADAS features is ultimately up to consumers — and they are holding on to their wheels longer than ever. In 2019, the average car in use is 11.8 years old in the United States, according to IHS Markit estimates published in June. The organization expects a 22% increase in vehicles 16 years or older from 2018 to 2023.

The trend is not surprising. Cars are better built than a generation and a half ago. Maintenance costs are lower for older cars, allowing owners to keep their vehicles longer and

[1] "Predicted availability of safety features on registered vehicles — a 2016 update," Highway Loss Data Institute *Bulletin* 33:15, September 2016.

A Glossary of Terms

ADAS	Advanced Driver Assistance Systems
AEB	Automatic Emergency Braking
BSW/D	Blind Spot Warning/Detection
FCW	Forward Collision Warning
LDW	Lane Departure Warning
LKA	Lane Keeping Assist

to avoid nagging monthly payments. Both new and late model used cars, which are most likely to have ADAS features, are financially out of reach for large portions of the U.S. population.

Consider that the median annual household income in June 2019 was $64,430, according to Sentier Research. Kelley Blue Book estimated in August 2019 that new light vehicles cost more than half that amount —$37,169 — reflecting a 3.5% price increase for these vehicles from July 2018 to July 2019.

The average price of a used car is not cheap either, rising to a record-breaking $20,247 for the first quarter of 2019, according to Edmunds' "Used Vehicle Report" released in June. Typical used cars are newer and have lower mileage and sport utility vehicle bodies, according to Edmunds. The report also noted that "automated driving hasn't yet struck a chord with the masses."

There is enough demand for cars with the Society of Automotive Engineers (SAE) Level 2 classification — the latest level of automation — by those who can afford them. A comparison of first quarter 2018 to 2019 shows sales grew by 322%, according to Canalys, a technology research firm (see Figure 2). Specifically, customers bought more than 250,000 cars with Level 2 technology such as Tesla's Autopilot, accounting for 7% of new cars, the firm announced in May.

Overall, ADAS are making a positive impact on car safety. However, the evolving technologies are not perfect. In some cases, they can increase claim frequency, reports the Highway Loss Data Institute (HLDI). Specifically, forward collision warning (FCW) and front automatic emergency braking (AEB) combined increase the rear-end crash rate by 20%.[2] Lane departure warning (LDW) increases claim frequency by 2.2% for collision and 6.3% for bodily injury (BI). Parking sensors increase BI claim frequency by 1% and rear cameras push up collision claim frequency by 0.9%.[3] Furthermore, *The Wall Street Journal* reports in August that more than 400 complaints were filed with NHTSA over the past three years mostly because brakes were unnecessarily engaging or failing to deploy.

ADAS also introduce risks similar to those presented by driverless cars. "Additional complexity of systems can increase potential for failures," explains Jonathan Charak, vice president and emerging solutions director at Zurich North America and vice chair of the Casualty Actuarial Society's (CAS) Automated Vehicle Task Force. For example, sensors can fail, become dirty and not work properly. However, he notes, redundancy systems that overlap with radar, lidar, cameras and other computer vision systems can help limit this risk. On top of that, hackability remains a concern.

The Severity Factor

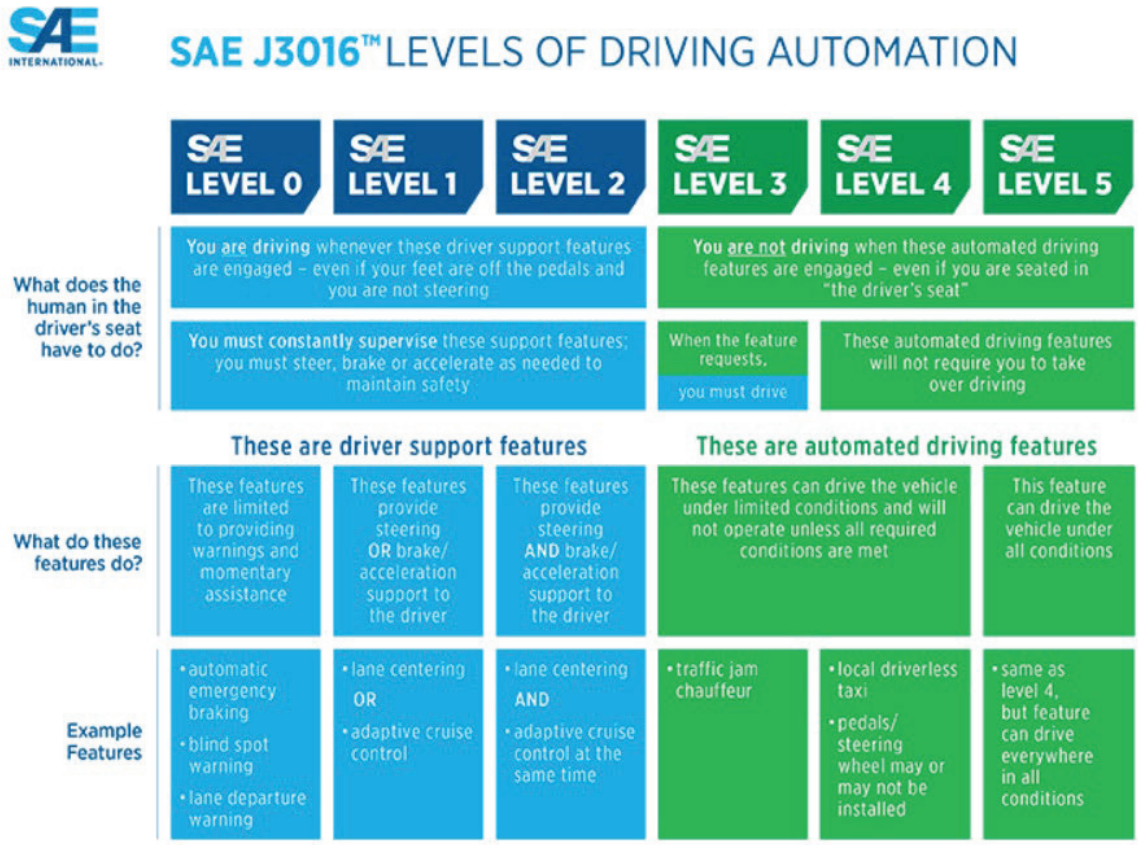
The cost of repairing ADAS is a one-two punch for insurers. The first blow is that repair costs are pressuring claim costs upward. Repairing a minor front or rear collision on a car with ADAS costs $5,300 — almost two and half times the expense for vehicles without ADAS, according to the AAA report, "Advanced Driver Assistance Systems (ADAS) Repair Costs," published in 2018. Damage to ADAS windshields, bumpers and door mirrors from minor incidents can cost $3,000 more to fix compared to conventional vehicles lacking the technology.

"The challenge with mapping out long-term impacts to severity," Gotsch explains, "is there are many more variables compared to frequency." Although Gotsch is pleased with the 20 manufacturers committing to install AEB in 2022, she is concerned about the overall lack of standardization. The technology varies and is located in different places on vehicles depending on the make and model year. So far, while there has been a small but meaningful decline in frequency from ADAS, repair costs for a vehicle equipped with ADAS are trending higher for the same damage.

The second blow to insurers is that expensive car repairs can encourage policyholders to file claims that they formerly covered themselves to avoid premium increases. AAA, which estimates that one out of three Americans cannot afford to cover an unexpected repair bill of $500, "strongly" urges consumers to check their insurance policies and be cognizant of

[2] Cicchino, Jessica B., "Effectiveness of forward collision warning and autonomous emergency braking systems in reducing front-to-rear crash rates," *Accident Analysis & Prevention*, February 2017.
[3] "Compendium of HLDI Collision Avoidance Research," HILDI *Bulletin* 35:34, September 2018.

Figure 2.



Source: Society of Automotive Engineers International. Used by permission.

ADAS-related repair costs.

Finding a technician to repair the car correctly is another challenge. ADAS repairs are nuanced, Charak explains. "Repair shops have to specialize in certain technologies or in how specific car manufacturers create systems, which lowers the availability of repair shops that can fix the highly specialized cars."

Diagnostic tools also need to improve to ensure that cars are being repaired correctly, explains David Zuby, senior vice president of vehicle research for IIHS and HLDI.

Post-repair sensors can be misaligned because the calibration process can miss a problem, resulting in cars leaving the shop with compromised ADAS. Roosevelt C. Mosley, a principal with Pinnacle Actuarial Resources, Inc., says this is a "real issue" for insurers because "if the repair work was not done properly, the system may not function as it is supposed to," and there is no way for drivers and their insurers to know.

There is some good news, however. In some cases, the technology can mitigate crashes, reducing claims severity and frequency, HLDI finds. Front AEB, for example, reduced overall losses by 2.6%. The calculation includes a 13% reduction of property damage liability claim frequency and a 23.2% drop in BI frequency.

CCC found that FCW with or without AEB is reducing the impact of crashes that do occur and may be preventing low-speed crashes altogether. The cars with ADAS show a smaller share of volume within both the lowest and the highest Delta-V (a measure of vehicle velocity) ranges, Gotsch explains. This suggests that "ADAS is also slowing the speed of the vehicle prior to impact for those crashes that otherwise might have had higher Delta-Vs."

Human Interaction

The more cars operate with automated auto technologies, the more critical human interaction becomes. Determining fault and assigning liability will become more complex. This is not

just a question of who — or what — was in control, but also the circumstances around vehicular accidents.

This is a point made by the NHTSA bulletin, "Critical Reasons for Crashes Investigated in the National Motor Vehicle Crash Causation Survey," released in March 2018. The paper, which originally concluded that human error causes 93% of accidents, backpedals on the word "cause" from its much-quoted 2008 "National Motor Vehicle Crash Causation Survey," explaining its initial study was not intended to blame drivers. Rather, it states that drivers are the "critical reason" for 94% of accidents (94% is an updated percentage from the original).

For its part, the CAS Automated Vehicles Task Force reviewed the same data in 2015 and concluded human error was the cause of 74% of accidents (*AR* May/June 2018). The ground-breaking CAS study also introduces the risks associated with automated technology, especially as it relates to human interaction.

So far, studies by IIHS show that drivers can rely too much on automation, allowing themselves to be distracted, miss warnings or have trouble taking control of vehicles, which suggests a need for better driver training. The CAS report also warns that automated technology can result in an overreliance on automation that could lead to driver skill deterioration, less engagement and higher pass-off risk.[4] This is critical when inclement weather or Bambi darting across the highway requires human intervention. "Drivers have to pay attention because ADAS does not replace their roles," Charak says.

Some driver overreliance could be the result of marketing. A 2019 IIHS study reveals that some ADAS branding names can give drivers the false impression that their attention is unnecessary with SAE Level 2 technology. The fact remains that there are limits to automation's ability to reliably manage lane keeping and speed control all the time. Specifically, 48% of about 2,000 participants believe the name of Tesla's "Autopilot" means it is safe to drive hands-free.[5] For other SAE Level 2 packages, such as Cadillac's Super Cruise or BMW's Driving Assistance Plus, 33% or fewer believed the same.

Most fundamentally, ADAS has to be turned on to work. Nearly 100% of the blind-spot detection, 97% of rear cross-traffic alert systems and 93% FCW were operating when arriving at the dealership for service, according to a 2018 IIHS study. However, consumers are not loving LDW and lane keeping assist (LKA). Only 51% of these features were turned on upon arrival to the dealership, according to the study.[6]

[4] According to the CAS Automated Vehicles Task Force report, pass-off risk is "the risk that is created when the vehicle goes from technological control back to human control."
[5] Teoh, Eric R., "What's in a name? Drivers' perceptions of the use of five SAE Level 2 driving automation systems," Insurance Institute for Highway Safety, June 2019.
[6] Reagan, Ian J., et al., "Crash avoidance and driver assistance technologies — are they used?" *Transportation Research Part F*, January 2018.

Some ADAS Features At-A-Glance

Advanced driver assistance systems (ADAS) will gradually become more commonplace. Here's a snapshot of some features:

Blind Spot Warning/Detection (BSW/D)

- Garners the highest praise by respondents in Consumer Reports' (CR) Advanced Driver Assistance Systems survey released in August.
- Prevented a crash according to 60% in the CR survey.
- Eliminated 14% of lane change crashes, reduced lane change crashes with injuries by 23%, and reduced property damage liability (PDL) claims by 6.8% and collision claims by 1.5%.
- Is available in 76% of 2019 model cars.
- Is expected to be in 30% of registered vehicles by 2022.

Rear Cameras

- Introduced in 2003.
- Reduce backing crashes by 17%.
- Lower PDL claim frequency by 4.1%, medical payments (MedPay) claims by 5.3%, personal injury protection (PIP) claims by 4% and BI claims by 2.2%. Raise collision claims by 0.9%.
- Are nearly 100% standard on virtually all new vehicles as of May 2018.
- Should be available in 55% of registered vehicles in 2022.

Rear Cross-Traffic Alert cut 22% of backing crashes.[7]

Rear Cross-Traffic Alert and **Rear Automatic Emergency Braking (AEB)** prevented a crash for 52% of CR study participants.

Rearview Camera and **Rear Parking Assist** reduce backing-related crashes by 42%.

Introduced in 1995 models, **Rear Parking Sensors** are available in 90% of 2019 model cars. By 2041, 95% of registered vehicles should be equipped with rear parking sensors IIHS estimates.

Review Camera, Parking Sensors and **Rear AEB** reduce backing crashes by 78%.

Forward Collision Warning (FCW)

- First offered in 2001.
- Decreases PDL claim frequency by 8.6%, collision by 2.5%, BI by 15.9%, MedPay by 19.3% and PIP by 9.5%.
- Cuts 27% of rear-end crashes.
- Reduces rates of rear-end striking crash involvement with third-party injuries by 18%.
- Lowers rates of being rear struck in rear-end crashes by 13%.
- Available in 78% of 2019 model cars.

FCW and AEB (otherwise known as Front Crash Prevention)

- Introduced in 2000.
- Lower frequency of collision claims by 2%, PDL by 13%, BI by 23.2%, MedPay by 1.7% and PIP by 2.0%.
- Reduce severity of collision claims by 0.6% and overall collision losses by 2.6%.
- Prevented a collision according to 47% of CR survey respondents.
- Reduced front-to-rear crashes by 50% and lowered front-to-rear crashes with injuries by 56%.
- Increased rates of rear-end crash involvements by 20%.
- Should be standard by 2022.
- Available in 64% of 2019 model cars.

Lane Departure Warning (LDW)

- Introduced in 2005.
- Significantly lowers single-vehicle, sideswipe and head-on crashes by 11% and reduces those with injuries by 21%.
- Believed to have helped avoid a crash by 33% of CR survey respondents.
- Available in 74% of 2019 models
- Projected to be in 95% of cars by 2040.

Lane Keeping Assist (LKA)

- Introduced before 2008, it is currently available 64% of 2019 models.
- Has the distinction of being the least liked and most disabled feature.
- Believed to have prevented an accident by 31% of CR study participants.

[7] Cicchino, Jessica B., "Real-world effects of rear cross-traffic alert on police-reported backing crashes," *Accident Analysis & Prevention*, February 2019.

Toward Quantification

ADAS study results provide actuaries with a starting point for knowing what is relevant, Mosley says. Quantifying the true insurance value of ADAS, he adds, is tough without sufficient granular data.

"Collision avoidance capabilities of each ADAS differ between manufacturers," observes Alain Dunoyer, head of the autonomous car division for SBD Automotive. "For actuaries to correctly assess the value of current ADAS, they need to understand their capabilities." Some systems only work correctly on the highway, only operate in good weather conditions or only react to specific "objects" on the road, he explains. There are also differences in the car manufacturer's fitment strategy, such as optional or standard, and the activation default.

As automation evolves, risk factors and their value will change. Essentially, the less people are actually driving the cars, the lower the value of historic driver-related risk factors. Tried-and-true variables, such as driver age or moving violations, will transition from high to medium importance when cars reach SAE Level 4 automation, according to SBD Automotive.

Moreover, factors related to vehicle characteristics such as make, model, age and annual mileage will continue to be highly important. New risk factors from automation, such as driving skill requirements during pass-off or handover, previous experience with handling ADAS and the proportion of driving on different road types will also affect pricing.

Being able to identify the presence of ADAS features on a per-vehicle basis would be a big step forward, experts agree, but manufacturers generally are not sharing the information. Zuby of the IIHS and HLDI is pushing for a public national database of vehicles with ADAS and provided testimony last year to NHTSA.

Actuaries can get clued in on which cars have ADAS bundles through vehicle identification numbers (VINs), Zuby advises, because the safety technology tends to be linked to particular engines. However, he cautions, "A lot of things that we have learned that affect risk of vehicles are not encoded in the VIN." Meanwhile, vendors including Verisk Analytics, AutoData Solutions and Swiss Re are working to provide actuarial data and tools.

Mosley is working with Carfax, Inc. to build a quantitative product for insurers. He anticipates that in the next several months, insurers will learn how many ADAS features are in the current U.S. fleet, understand specific adoption of features by vehicle, and identify the most important variables for pricing insurance. "There are so many ADAS variables that just eliminating those with little or no value will be helpful," he says.

Ironically, as manufacturers improve ADAS, the safety promised by autonomous cars could already be available in conventional cars. "It is not at all clear to me that you need full automation to reduce the number of crashes that occur," Zuby says.

In the meantime, SBD Automotive expects very limited SAE Level 3 technology around 2022, Dunoyer says. "It should have been two years ago," in the Audi A8 he adds, but the United Nations Economic Commission for Europe is working out a vehicle homologation process that automakers from around the world will try to follow. Homologation is a standardization process for vehicles or particular vehicle components to meet requirements set by various statutory or regulatory parties.

Conclusion

While ADAS safety features are generally showing positive results, they will not be able to address all accident scenarios. Since Americans are increasingly holding on to older cars and ADAS standard fitment is incremental, it will take at least 10 to 15 years for ADAS to become commonplace. That timing is not much different from when autonomous cars are expected on the market.

While greatly celebrated for its advantages, ADAS are not perfect. They are limited to specific situations, can be compromised through dirt or miscalibration, and sometimes contribute to accidents. The complex interaction between drivers and ADAS also carries risk when people overestimate the safety systems' abilities, do not take control of the wheel and are confused or distracted by stimulating dashboards, beeps or rumblings.

As ADAS evolve, the technology will do more than complicate pricing and risk selection through new and changing variables. As assumptions and rising expectations about ADAS continue, it is essential for the insurance industry, including actuaries, to educate consumers, regulators, lawmakers and other stakeholders.

Annmarie Geddes Baribeau has been covering insurance and actuarial topics for nearly 30 years. Her blog can be found at www.insurancecommunicators.com.

RATEMAKING PRODUCT AND MODELING

SEMINAR AND WORKSHOPS

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IN MY OPINION By GROVER EDIE, *AR* EDITOR IN CHIEF

Ask a Professional

The door between our house and the attached garage is probably the one my wife and I use the most. Going somewhere, we go out that door into the garage to get into the car.

If I do any work in the yard, I go out that door as the mower, snowblower and other tools are in the garage.

Over the years, that door and its lock have had a lot of use. Recently, the door became difficult to lock and even more difficult to get the key out of the lock. Being a do-it-yourself sort of person, I first tried several different keys in the lock and decided the problem was the lock, not the key. I had several alternatives. I could replace the entire lock, asking the hardware store to re-key the new lock to match the old one, but that would be expensive: I am too frugal to do that.

My second idea was to go and have the tumblers replaced; since all of the keys were getting stuck in the lock, I figured it was something to do with the lock. Since the lock had been in place for about 22 years, I thought the tumblers had worn down and were to the point of not properly working.

I thought of going to a nearby, big box hardware store, but the idea of having my locks worked on by someone who worked on keys and locks only as a small part of their job made me uncomfortable.

I decided to go to a locksmith who was further away, but I thought they would be skilled in fixing my lock and have the necessary parts to re-tumble it. I took the tumbler part of my lock to the locksmith shop, along with one of the original keys for the lock. I wanted an original key because I didn't want any duplicate key, which might have been subject to poor duplication, to introduce an error into the fit.

The tumblers in locks are designed to last as long as the lock, which is for a lifetime. The problem was not in the lock itself, but in its maintenance.

Oops! Maintenance — that' s my job.

Upon arriving in the locksmith's store, I asked the locksmith how long tumblers last in a lock. I mentioned that the lock was about 22 years old, and I thought the tumblers might have worn to the point it wouldn't work properly. Rather than answer, he told me that in the 1930s the federal government tried to get the lock manufacturers to build locks that would last 12 years. The lock manufacturers balked at the idea: They built locks to last a lifetime. I thought that was an odd answer to my question, but he went on to explain why the problem I was having with my lock was

not the tumblers wearing down.

He went on to say that the tumblers in locks are designed to last as long as the lock, which is for a lifetime. The problem was not in the lock itself, but in its maintenance.

Oops! Maintenance — that' s my job.

He excused himself and went into the back of the store and came out with a yellow spray can. Taking my cylinder case, the thing that contained the key slot and the tumblers, he sprayed some of the contents of the spray can into the holes and slots of the cylinder case.

He then took the key, put it in the slot, and had no problem rotating it and taking it out. As if by magic, he had fixed my lock.

Locks get grime and other things in them that inhibit their operation. If you know how the tumblers in a lock work, any dirt or debris will inhibit their travel up and down the channel in which they reside and can make it hard to get the key in or out. The locksmith further explained that an ordinary spray lubricant wouldn't work, as it only adds a lightweight oil and doesn't clean up the old oil and dirt, solving the problem for a short time but eventually making the matter worse. A cleaner and a lubricant is needed to clear out the dirt, grime, old lubricant and re-lubricate the tumblers.

With a few sprays of the mixture from the yellow can, my lock was as good as new.

That was when I learned that every year, you should spray some of this stuff into each of your locks. He said people often come in to say their locks have suddenly become hard to work, only to discover that some nearby construction has raised up dust into the air, and it got into the lock and created the problem. A few sprays of the cleaner/lubricant and their lock worked fine.

I paid about twice for that can of lock cleaner/lubricant as I would have at a big box hardware store, but I was willing to do that because the locksmith took the time to tell me what the problem was, how to fix the problem and how to keep it from happening in the future.

The big box store was on my way home and I could have bought a can of lock cleaner/lubricant there for less money. But I had seen firsthand that his yellow can of cleaner/lubricant worked. I knew it had the ingredients I needed, and I wouldn't have to remember those items and read the label of lock cleaner/lubricant at the big box store before purchasing it, if they even had it. I paid about twice for that can of lock cleaner/lubricant as I would have at a big box hardware store, but I was willing to do that because the locksmith took the time to tell me what the problem was, how to fix the problem and how to keep it from happening in the future. In a sense, I paid partly for the can of spray and partly for the knowledge I gained, and I was happy to do so.

It was a sobering reminder that even a lock, as simple as I thought it was, was outside my expertise; I could learn from an expert. I hope this lesson will remind me to seek the advice of other professionals in the future, including situations regarding insurance.

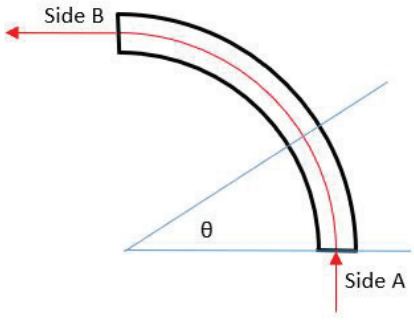
I also hope that I remember to use that yellow spray can every year.

IT'S A PUZZLEMENT By JON EVANS

Bending a Laser Beam

Dr. Snell is an expert in applied optical physics at the patent review office. He receives a patent application (figure below) for an optical element in the shape of a 90-degree arc of a translucent annulus.

The application claims that this device can gradually bend a laser beam entering Side A by a total of 90 degrees upon exit from Side B. The mechanism of the bending works on the premise that the index of refraction of the material inside the device, $N(\theta)$, is a continuous and smooth function of angle $N(\theta)$. What do you think Dr. Snell's opinion will be as to whether this device can work? If he thinks it can work, what is the function, or possible different functions, for $N(\theta)$?



Grading on a Curve

Professor Mannboltz was hired to calibrate the ranges of numeric scores assigned to letter grades on a new standardized exam, which will be scored from 0 to 2,400 points. Without any information about actual scores except that the average score on an exam like this is 30% of the points, Mannboltz had to target the following percentages of students for each grade:

A+	1%
A	5%
A-	10%
B+	13%
B	13%

B-	13%
C+	13%
C	13%
C-	10%
D+	2%

D	2%
D-	2%
F+	1%
F	1%
F-	1%

A good way to solve a problem like this, in the tradition of Professor Mannboltz's specialty of statistical mechanics, is through maximum entropy distributions, as described in Lewis H. Roberts's *Proceedings* article, "A Discipline for the Avoidance of Unnecessary Assumptions."*

There are many probability distributions on the possible scores from 0 to 2,400, that average 720, or 30% of the possible points. In the absence of any other information, it makes sense to pick the distribution with the least additional information, the maximum entropy distribution with average 720.† The general form for the probability density of a maximum entropy distribution given its mean is $P(x)=e^{c_0+c_1 x}$. The constant c_0 is uniquely determined by the normalization requirement for any choice of the constant c_1. Assuming 2,401 discrete possible scores, the integers from 0 to 2,400, we can search (through calculations in Excel, R, etc.) for the value of c_1 that gives a mean of 720. The values are approximately c_0=-6.730133071 and c_1=-0.001112339. Summing up the probabilities for the discrete score intervals suggests the following grade ranges, given the previous targets for percentages of students in each range:

F-	0 - 7
F	8 - 15
F+	16 - 24
D-	25 - 41
D	42 - 59
D+	60 - 77
C-	78 - 173
C	174 - 316
C+	317 - 486
B-	487 - 696
B	697 - 971
B+	972 – 1,367
A-	1,368 – 1,868
A	1,869 - 2,286
A+	2,287 – 2,400

Note: We could have reached a similar solution by modeling the scores as a continuous distribution. With a continuous approach, however, it is best to allow the point range for the distribution to be the interval from -0.5 to 2,400.5 in order to equitably account for the actual minimum score of 0 and actual maximum score of 2,400.

Solutions were also submitted by Bob Conger, Rob Kahn and Stephen Mildenhall.

* Roberts, Lewis H., *PCAS*, LIV, 1967.

† Roberts, p.214: "[G]iven only the mean of a non-negative variable, we know the exponential distribution is the minimally prejudiced estimate of the distribution."

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

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NOTE: The results or output created by use of the *Best's Capital Adequacy Ratio Model* ("Output") is for informational and internal purposes only, and such Output may not match or be consistent with the official BCAR scores that AM Best publishes for the same rating unit. The Output is not guaranteed or warranted in any respect by AM Best. The *BCAR Model* is a non-rating services product, and its purchase is not required as part of the rating process.

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HOMEOWNERS PRICING AND ANALYTICS ACTUARY is needed in California for Position 85798. Insurtech opportunity for an ACAS or FCAS.

Midwest **DATA STEWARD AND CASUALTY ACTUARY** sought for Position 85471. FCAS/ACAS with 12+ years of actuarial and data analysis experience is needed. Manage small staff.

Southeast client seeks FCAS **MEDICAL MALPRACTICE ACTUARY** for Position 86289.

Midwest client plans to hire an **FCAS OR ACAS OR NEAR-ACAS** for Position 86290. 4-10 years of actuarial exp. Requires experience with predictive analytics.

For Position 86212, Northeast client seeks **SENIOR ACTUARIAL ANALYST** with 3-7 yrs of exp. Reserving, reporting and analysis opportunity. Exam support.

For Position 86293Q, an **INSURTECH CLIENT-FACING ACTUARY** is immediately needed in the Midwest. ACAS with 4-9 years of actuarial experience. Requires work with predictive analytics and primary insurance pricing. Emblem or R/SAS software experience a big plus.

FCAS/ACAS with 7-15 Yrs of Exp sought in Michigan for Position 86270. **ERM AND CAPITAL MODELING** opportunity. Must have management experience.

PROPERTY REINSURANCE PRICING ACTUARY is sought in NY for Position 86145. FCAS/ACAS.

Chicago client seeks **ACTUARIAL ANALYST** for Position 86085. 3+ yrs of exp. Pricing, financial reporting, profitability studies, product development and other assignments.

CASUALTY REINSURANCE PRICING ACTUARY is sought for Position 86299. FCAS/ACAS.

CASUALTY ACTUARY OR SENIOR ANALYST with WC exp. sought in Northeast for Position 86160. ACAS or near-ACAS. Some travel.

ACAS/near-ACAS with primary insurance **PRICING AND MACHINE LEARNING EXPERIENCE** is immediately needed in Connecticut for Position 86294.

DATA SCIENTIST sought in Southeast for Position 84814. Requires 5+ years of statistical modeling and predictive analytics experience.

COMMERCIAL LINES PRICING ACTUARIAL ANALYST needed for Position 86318. Must have some commercial multi-peril ratemaking experience within an insurer. Exam support.

Northeast client, unique Insurtech role. Some travel. Casualty Actuary sought with **MACHINE LEARNING EXPERIENCE** for Position 85841W. FCAS preferred. Must have 5 to 17 years of property and casualty actuarial experience.

SENIOR ACTUARIAL ANALYST is sought in Midwest for Position 86248. 2-6 years of experience, as well as 3+ exams.

Client plans to hire a **RESERVING ACTUARY** for Position 86257. ACAS with 5-10 years of exp.

Ideal candidate will be an **FCAS OR NEAR-FCAS ACTUARY** at this Insurtech. 6-15 yrs of property and casualty actuarial experience. Casualty Actuary with insurance predictive modeling and pricing experience is sought in Chicago for Position 86293. Some travel.

CT client seeks **FCAS/ACAS** with 7-20 yrs exp for Position 86294G. Requires significant primary insurance pricing and predictive modeling experience.

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