actuarial REVIEW
VOL 45 / NO 1 / MARCH-APRIL 2018
PUBLISHED BY THE CASUALTY ACTUARIAL SOCIETY

THE SLR FACTOR

As Sea Levels Rise, the Flood Risk Equation Changes

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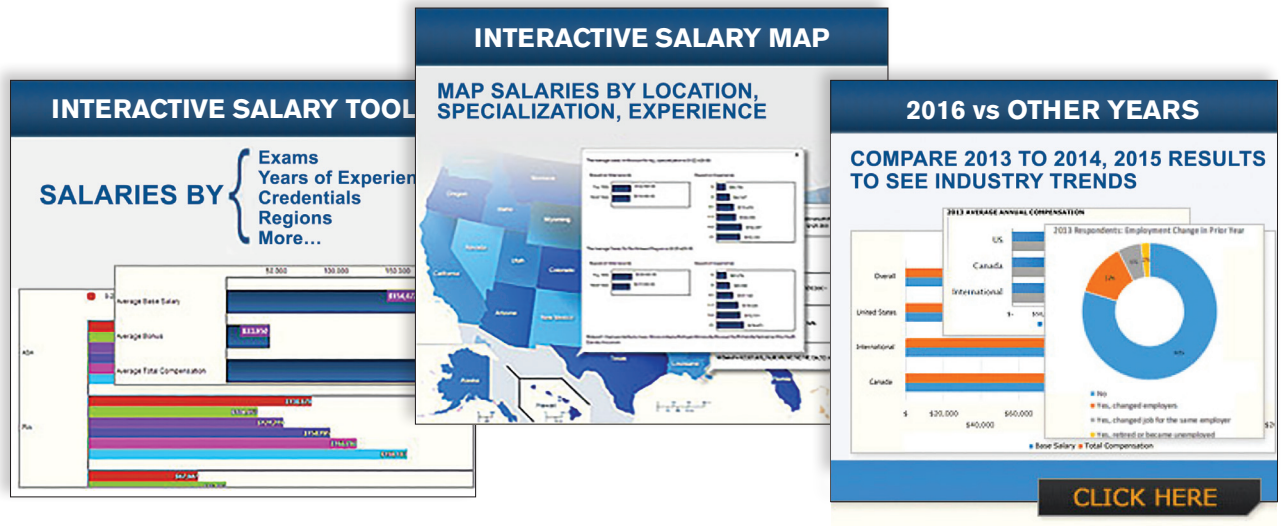
There are a few samples below, but you must go to our website http://www.actuarialcareers.com/ and click on the Salary Survey tab to find the 2017 results. You can also see and query past year's results too!



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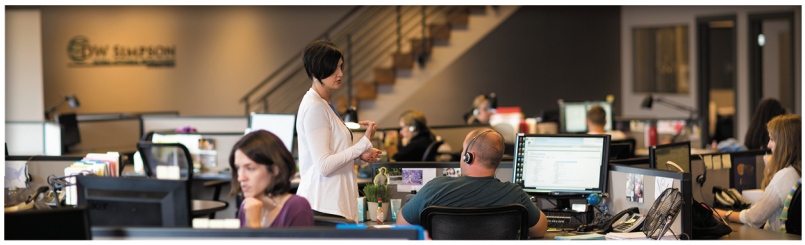

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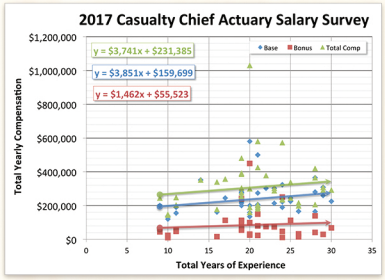

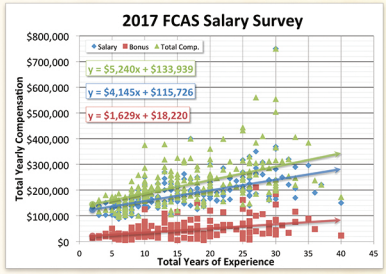

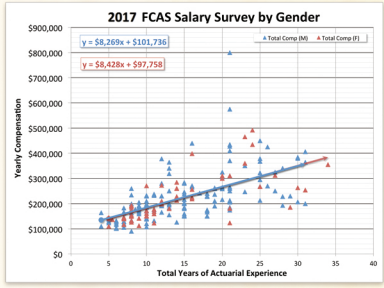

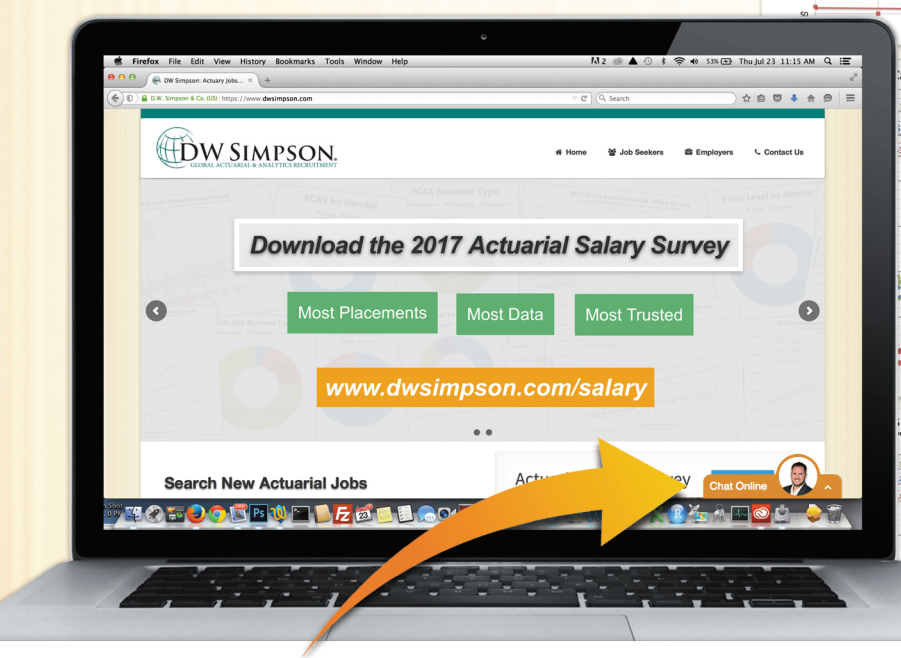

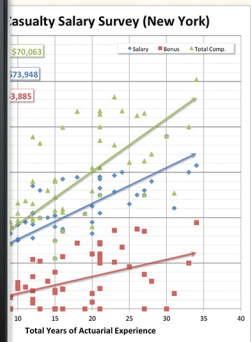

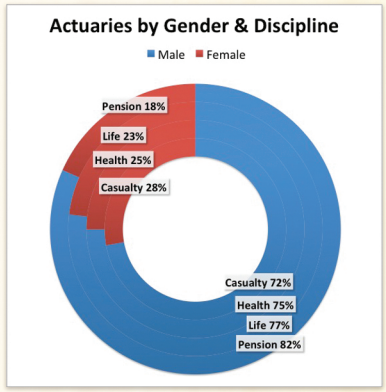

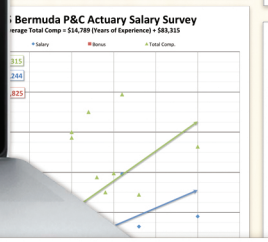

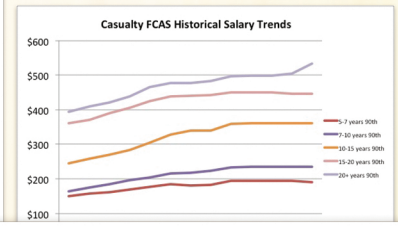

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March/April 2018

actuarial REVIEW

departments

on the cover

Actuarial Review (ISSN 10465081) is published bimonthly by the Casualty Actuarial Society, 4350 Fairfax Drive, Suite 250, Arlington, VA 22203. Telephone: (703) 276-3100; Fax: (703) 276-3108; Email: ar@casact.org. Presorted standard postage is paid in Lutherville, MD. Publications Mail Agreement No. 40035891. Return Undeliverable Canadian Addresses to PO Box 503, RPO West Beaver Creek, Richmond Hill, ON L4B 4R6.

The amount of dues applied toward each subscription of *Actuarial Review* is $10. Subscriptions to nonmembers are $10 per year. Postmaster: Send address changes to *Actuarial Review*, 4350 North Fairfax Drive, Suite 250, Arlington, Virginia 22203.

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The magazine of the
Casualty Actuarial Society

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Another Acronym

Language is a fluid thing. New words are constantly being introduced into the vernacular. Think *fintech* and *insurtech*. We also live in a world of acronyms — CAS, AAA, NFIP, ACI, iCAS — and now there's a new one: SLR.

This particular acronym became an issue after developing this issue's cover. I gave our graphic design firm the story to read and brainstorm for ideas. After some good choices, we finally decided on our concept. A week or so later, I was looking at the finished cover and thinking, "Will the readers know what SLR stands for?"

SLR can stand for single lens reflex or simple linear regression, certainly, but the prevailing meaning for SLR may become this: sea level rise. It's not so much that actuaries are not aware of SLR, it's just that SLR is not a prominent part of the actuaries' argot. At least, not yet.

In our March/April cover story, Annmarie Geddes Baribeau delves into the implications of SLR on multiple lines of P&C insurance. The SLR factor also presents actuaries with an opportunity to refine catastrophe models and help prepare homeowners and business owners for the future.

You may think that SLR will not catch on, à la the line from *Mean Girls*, "Gretchen, stop trying to make 'Fetch' happen." But read the story and then decide: Will actuaries who dismiss the SLR factor do so at their companies' peril?

Survey Says!

On our new *Actuarial Review* website, 87 readers responded to a poll we conducted on the top actuarial stories of 2017. Natural catastrophes around the world came in first place with 28 percent or 68 votes. Coming in second with 18 percent or 43 votes was cybersecurity breaches and growing coverage demands. CAS exams going paperless made a decent third place showing with 14 percent or 33 votes. (Incidentally, I recently spoke with former CAS Admissions Director Tom Downey about paperless exams. He was utterly surprised and glad that the CAS was able to do such a thing — especially in his lifetime!)

Actuarial Review always 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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Celebrating the Women of the CAS

When we talk about the origins of the CAS, we often point with pride to the development of workers' compensation and its impact on society. But digging deeper into our history, we can also be proud of our organization's small but significant role in providing women with prestigious careers in the business world at a time when women's lives were opening up to many more options.

We have a long history of successful and influential women in the CAS. The first women to become CAS members laid a path for future women to succeed as actuaries. In this column, I would like to mention a few of them, starting with a couple of the early pioneers in the profession and ending with some newer ones.

In 1927 only 10 out of 279 CAS members were women. One of these women was Evelyn Davis. When Davis earned her FCAS in 1927, she was doing consulting work for the prestigious firm Woodward and Fondiller (W&F). Davis became a partner at W&F in 1930 and by 1933 her name was added to the firm's stationery. This was quite an accomplishment in the 1930s, but it is especially extraordinary when you consider that back then only 22 percent of women worked outside the home, and of those only 1 in 10 were professional workers.[1]

Perhaps one of the most famous women of the CAS is Ruth Salzmann. In 1968 Salzmann became the first woman vice president of Sentry Insurance and later served on Sentry's board of directors. She may be best known for the Salzmann curves — mathematical tables that for more than 40 years served as the basis for pricing property insurance. Her 1963 paper, "Rating by Layer of Insurance," remained required reading for actuarial students into the 21st century. In 1978 Salzmann became the first woman CAS president. Since Salzmann's presidency, seven women have served on the highest rung of CAS leadership.

One of those leaders is Pat Teufel (CAS President 2011-2012). She led KPMG's actuarial practice before taking her current job as a professor at the University of Connecticut, which is a recipient of the CAS University Award. She has also been a leader in the CAS's activities in the International Actuarial Association and has taken on additional projects to advance the CAS, along with advising the president and president-elect. Teufel is an effective communicator who builds consensus. She has championed our talented CAS staff, empowering them to take more active leadership roles in committee activities and encouraging them to contribute extensively to the CAS's development. Post-presidency, she continues to volunteer for the CAS. As a recent example, she provided research and input to the Leadership Development Committee for a well-received session at the 2017 Leadership Summit on working with CAS staff.

Another successor to Salzmann is Gail Ross (CAS President 2002-2003). Ross retired as a partner at Milliman and is now on the board of directors of Validus Holdings. She has a vast amount of experience with mergers and acquisitions and is intuitive and hard-working. I recall working on an assignment with her in Milwaukee. She was in the middle of running all the computer simulations for a client, but she joined me and some of my family members at a nice restaurant for dinner. This was back when a simulation might take 10-15 minutes or longer to run. She brought her computer to dinner and, after every course, she ran a simulation and then put her computer under the table. It was a fun night and the client was happy that Gail met the deadline.

We have a long history of successful and influential women in the CAS. The first women to become CAS members laid a path for future women to succeed as actuaries.

One of the smartest insurance business people I know is Mary Hennessy. To say that she has had a very successful career is a vast understatement. Mary Hennessy was president and CEO of three

President's Message, page 8

[1] Janet M. Hooks. "Women's Occupations through Seven Decades," U.S. Department of Labor, Women's Bureau, 1947. https://fraser.stlouisfed.org/files/docs/publications/women/b0218_dolwb_1947.pdf

President's Message

from page 6

companies, most recently GMAC Insurance, and has worked on many mergers and acquisitions. She currently serves on several insurance company boards and has her own consulting firm. In addition to her strong technical background, she also has keen business knowledge of underwriting, claims and systems. Her communication style is very direct and honest. In situations where there are differences of opinion, she is able to clearly communicate the differences in a frank, straightforward manner. I have learned so much from her.

Following Ruth Salzmann, there have been many other firsts, such as Joy Schwartzman, the first woman to serve on Milliman's board of directors. Laura Cali Robison was named the insurance commissioner in Oregon in 2013. At the time, she was the youngest person to serve as insurance commissioner in any state.

Some of the other CAS women have also served at the highest levels in business include Melodee Saunders, former president of Midwest Employers Casualty Company, and Nancy Mueller, former chief operating officer of Zurich's North American Operations.

CAS women embody our strong volunteer culture, giving back to their profession and their communities. Sharon Robinson was recognized by the International Association of Black Actuaries (IABA) as a role model for younger members. She is currently working with the CAS and IABA on a project that will expose high school students of color to the actuarial profession. Longtime CAS volunteer Joanne Spalla has been a tremendous asset in launching The CAS Institute (iCAS), visiting employers and advocating for The iCAS exams and the Certified Specialist in Predictive Analytics credential. After just completing her term on the CAS Board, Camille Minogue is following her passion for communication skills and will now chair a task force on the subject. She believes that everyone will benefit if actuaries are better able to express themselves to management, regulators and the public.

CAS women are also pioneers in research. Just one of many examples is the ground-breaking work in asbestos and pollution reserving done by Amy Bouska, Susan Cross and Raji Bhagavatula. In the 1990s, Bouska, Cross and Bhagavatula provided solutions to many insurance companies that were struggling to figure out how to reserve for this exposure. I have the good fortune to know all three of them, and they have taught me a great deal.

CAS women are also developing as global leaders. Yu Shan (Cathy) Hwang, Christie Lai Yin Lee and Zhenzhen (Jenny) Lai, CAS members in Hong Kong, are all talented, driven and multilingual. They are also active CAS volunteers. I am impressed by how much they have achieved in their careers in such a short time.

Nancy Braithwaite, our immediate past president and current chair of the CAS Board, has consistently put the interests of the CAS as her top priority. During her presidency, she oversaw significant CAS initiatives that have advanced our examinations' content (the MAS I & II Exams that test predictive analytics) and delivery systems (Technology-Based Exams). The CAS Institute has also grown tremendously under her leadership. She is a brilliant and hardworking leader, who has also been an effective goodwill ambassador for the CAS with other actuarial organizations throughout the world.

These individuals are just a small sample of the many dedicated women of the CAS. There are so many more women to celebrate, but I must recognize two more: my colleague at Milliman since 1992, Lori Julga — there is no one at Milliman I trust more — and CAS Executive Director Cynthia Ziegler — she has assembled an extremely dedicated and talented staff who make CAS leaders' jobs so much easier.

So what is it about all these women and that makes them so successful? They are always striving for a better way to do things. They are role models to all and strong advocates for women. They are counselors, team players and model developers. They are CEOs, COOs, presidents, researchers and regulators. They are distillers of complex actuarial concepts.

They are 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.*

COMINGS AND GOINGS

Charles Angell, FCAS, is a recipient of the 2017 Robert Dineen Award, awarded by the National Association of Insurance Commissioners for outstanding service and contribution to the state regulation of insurance. Angell joined the Alabama Department of Insurance in 2008 as a casualty actuary and was named deputy commissioner in September 2009.

Christian Fournier, FCAS, has been appointed to the position of president and COO of Québec insurer La Capitale Général's P&C division. Fournier joined La Capitale Général in 2011. Prior to joining La Capitale, Fournier was vice president at The Co-operators, and vice president actuary at the Union Canadienne.

Bradley Parent, ACAS, has been appointed to the position of assistant vice president/actuary at BMS Re U.S. Parent was most recently a consulting actuary for the Christopher Gross Consulting Group, where he worked in reserving, pricing, reinsurance, predictive modeling and software development.

John Hsu, FCAS, has been appointed to assistant vice president of enterprise risk management at Selective Insurance Group. Hsu joined Selective in July 2017. Prior to that, he served as chief reserving actuary at Hallmark Financial Services.

Captive Review has included CAS Board Director **Robert J. Walling III, FCAS, MAAA, CERA**, among its "Power 50" list for the second year in a row. Walling is a principal and consulting actuary for Pinnacle Actuarial Resources, Inc. He has been consulting in the captive insurance space since 1997.

Bill Mech, FCAS, RIMS-CRMP, has been appointed vice president of enterprise risk control for Connexus Credit Union, a large multi-state credit union with more than 300,000 members. Mech formerly served as the CRO at GuideOne Insurance. With his new assignment, Mech has taken on the task of adapting the insurance industry's Own Risk & Solvency Assessment processes to the financial services industry's ERM needs. He will be speaking on this topic at the Risk Management Society Annual Conference in San Antonio in April.

Scott Sobel, FCAS, has won Tennis Hackathon, a competition launched January 2018 by Tennis Australia that has attracted machine-learning scientists from around the world. Over 2,700 entries were received for solutions to automate calling forced and unforced errors in professional tennis. For details on Sobel's win, visit http://on-the-t.com/2018/02/19/ao-hackathon/.

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

Want the latest on CAS member activities? We post real-time news on our social media channels. Follow us on Twitter, Facebook and LinkedIn to stay in the know!

CALENDAR OF EVENTS

May 13-16, 2018
Spring Meeting
Boston Marriott Copley Place
Boston, MA

June 4-5, 2018
Seminar on Reinsurance
New York Marriott at the Brooklyn Bridge
New York, NY

June 26-27, 2018
Underwriting Collaboration Seminar
InterContinental New Orleans
New Orleans, LA

September 5-7, 2018
Casualty Loss Reserve Seminar (CLRS) & Workshops
Anaheim Marriott
Anaheim, CA

November 11-14, 2018
Annual Meeting
Caesars Palace Las Vegas
Las Vegas, NV

June 3-4, 2019
Seminar on Reinsurance
Fairmont Southhampton
Hamilton, Bermuda

Demand for P&C Actuaries Takes a Dramatic Upturn in Malaysia

BY BRIAN BROWN, MICHAEL CHOU, BOB CONGER AND WEE KEAT KENNY TAN

The Annual Joint P&C Actuarial Seminar in Malaysia on December 11-12 2017, was a great opportunity for us to visit our members and candidates in Kuala Lumpur, check in with the regulator and several universities, and generally update ourselves on insurance and actuarial market conditions in Malaysia.

From all fronts, we heard a clear, loud and urgent message: The insurance companies in Malaysia need and want a dramatic increase in the number of property-casualty actuaries. This message was much stronger than what we have heard in past years. The source of the need is marketplace changes, which in turn have been triggered by two very significant regulatory changes.

Actuarial Society of Malaysia President Gary Hoo, FCAS, (left) and CAS President Brian Brown, FCAS.

First, in July 1, 2016, property-casualty rates began being detariffed in controlled stages, whereas the pricing for new motor and property products were not subject to the prevailing tariff rates. Following that, policies effective July 1, 2017, provided that two of the existing motor products could deviate from tariff rates within a threshold specified by the regulator. The progress and impact of the changes will be evaluated to determine future stages beyond 2018.

Seminar speaker Steven Glickstein, FCAS, makes a presentation.

While companies are permitted to continue using the preexisting insurance rates and products (some companies are doing so as an initial posture during the first phases of detariffication), many expect that natural competitive forces will soon yield significant rate activity and product innovation. The impact is likely to be particularly important for property insurance, where loss ratios have been low and underwriting profits high for many years, and a majority of residents historically have not insured their property.

Another significant feature of the current marketplace is the strong control of agents, brokers and other channels (e.g., auto dealers and mortgage lenders) over much of the business. Several insurance companies have also expressed a strong appetite to begin direct internet marketing. Insurance companies want actuaries who can work on pricing, predictive analytics, product development and more. The regulator, Bank Negara Malaysia (BNM) will require that each company have an internal pricing actuary be responsible for the actuarial pricing work.

Second, BNM is implementing appointed actuary requirements for P&C insurers: The appointed actuary will be responsible for signing off on loss reserves and issuing a broader annual financial condition report of the company. Ultimately, this role will be filled by a different person than the pricing actuary.

Employers recognize that they will need to build substantial actuarial teams to support the two lead positions. Of the approximately 30 general insurance or takaful companies making up the marketplace, many currently do not have staff actuaries. Add these new roles to the growing number of consulting, regulatory and academic jobs, and the message is clear: Credentialed P&C actuaries will be in great demand in Malaysia.

BNM views the company actuarial function as vital to sound management

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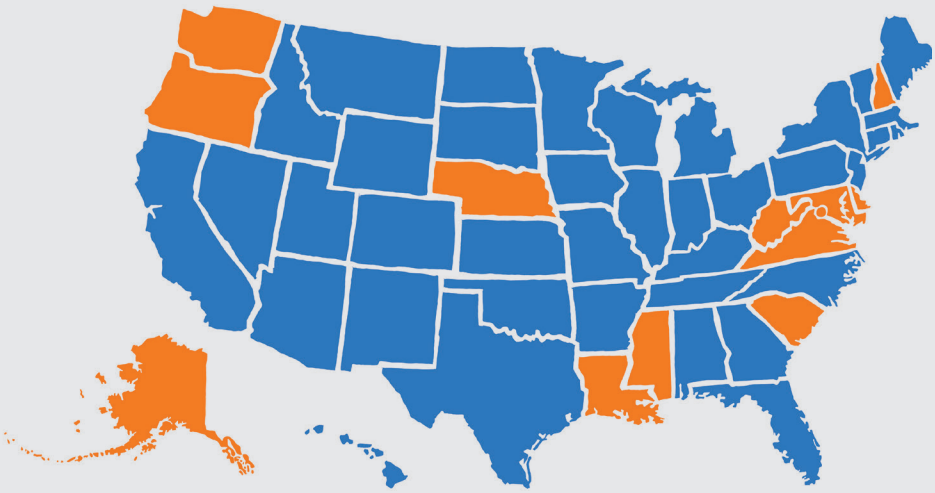

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Used in Underwriting & Rating	37

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A panel of local CEOs speak to attendees at the joint P&C Actuarial Seminar in Kuala Lumpar, Malaysia.

and regulation of insurers. Increased demand for experienced actuaries is accelerating the return of actuaries to Malaysia, and BNM would like to foster more of this. Several local universities have long-standing actuarial programs and are gearing up to produce a large number of actuarial graduates, but that won't fill the need for experienced P&C actuaries in the immediate future.

Clearly, the insurance and takaful industry and the P&C actuarial profession are entering a dynamic era. We are excited at the prospect of the CAS continuing collaboration with the Actuarial Society of Malaysia in supporting the industry and the profession, particularly as the number of CAS members and candidates in Malaysia continues to grow in the future. ●

CAS Fellows Gary Hoo and Jim Guszcza (right).

Brian Brown, FCAS, currently serves as CAS President and is a consulting actuary for Milliman, Inc. Michael Chou is the CAS international relations manager and is working in Hong Kong. Bob Conger, is currently a CAS international ambassador and a past president. Conger is a consultant with Willis Towers Watson.

Meet Up in Malaysia

The 2017 Joint P&C Actuarial Seminar drew more than 100 people and was organized jointly by Actuarial Society of Malaysia, Casualty Actuarial Society, U.K. Institute and Faculty of Actuaries, and Australian Institute of Actuaries. This year's seminar focused on property insurance, flood risk (by far the dominant catastrophe peril here) and detariffication. Speakers were local and from nearby Singapore as well as IFoA, IAAus and the CAS — Board Director Jim Guszcza and President Brian Brown both spoke.

An especially compelling session was a panel of local CEOs talking about detariffication's impact on their companies. Their remarks echoed other statements on the importance of actuaries to the future success of their companies.

An interesting add-on to the seminar was an optional field trip to the control center for the Stormwater Management and Road Tunnel or SMART Tunnel. This innovative engineering feat was developed to combat flash floods. The SMART Tunnel is used for automobile traffic most of the time but, during major storms, is converted to divert and channel flood water.

Wee Keat Kenny Tan, FCAS, is the newly appointed CAS ambassador to Malaysia. He recently returned to Malaysia after 14 years in the U.S. to become chief actuary with AmGeneral Insurance.

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TWENTY-FIVE YEARS AGO IN THE *AR* BY ELIZABETH A. SMITH, *AR* MANAGING EDITOR

The Oakland Fires Remembered

In October 1991, fires in Oakland, California, were estimated to have caused $1.2 billion in damage to insured property. At the time, it was considered the third worst fire in U.S. history, following fires caused by the 1906 San Francisco earthquake and the Great Chicago Fire of 1871. The following excerpt from the February 1993 AR highlights a session at the 1992 CAS Annual Meeting. The panelists agreed that the Oakland fires were not a one-off disaster and warned it could happen again. Today, Oakland is ranked the second most destructive wildfire in California after the ones that swept through Sonoma County in October 2017.[1]

Insurers tell of lessons learned from Oakland, Calif., fires

... Joseph Meyer, senior vice president, Western Region, United Services Automobile Association (USAA), said the issue of underinsurance was his company's biggest problem in nearly all total losses suffered in the Oakland fire by USAA policyholders.

He said the insurance industry's apparent willingness to underinsure property is not right and that companies and insurance agents have to stop this practice that is causing claims-handling and image problems for the industry.

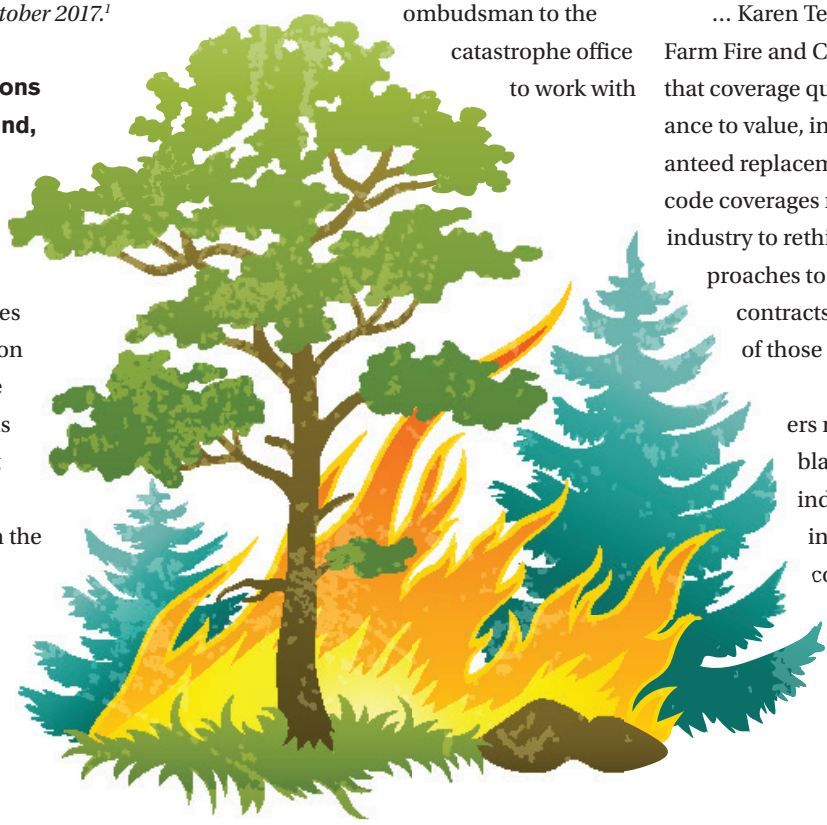
... Meyer added, his company gave the claims-handling process the highest priority, held meetings with policyholders, published special policyholder newsletters, assigned an ombudsman to help settle disputes and kept its adjuster-to-file ratio at five per adjuster in order to give its policyholders greater personal attention and better service.

"The greatest thing we did," he pointed out, was to assign "an ombudsman to the catastrophe office to work with policyholders who were experiencing problems during the lengthy and complicated claims process."

Tom Morrison, property lines director-claims for Allstate Insurance Company ... said the lessons his company learned were that normal methods in handling such large catastrophes create controversy, that it is important for insurers to create a partnership atmosphere with their policyholders, that insurers need to do a better job of managing customer expectations and that, most importantly, insurance companies must be attentive to customer needs.

... Karen Terry, an actuary for State Farm Fire and Casualty Company ... said that coverage questions such as insurance to value, inflation coverage, guaranteed replacement cost, and building code coverages may cause the insurance industry to rethink its traditional approaches to formulating insurance contracts and the proper pricing of those insurance policies.

She warned that insurers now may be pricing a blank contract because the industry paid for losses in Oakland beyond the contractual limits of policies. Many losses were added as the result of the reformation of policy limits.



[1] http://www.fire.ca.gov/communications/downloads/fact_sheets/Top20_Destruction.pdf

HUMOR ME BY MICHAEL ERSEVIM

Noted Comparisons between Insurance and the Waste Industry

Life actuaries can tell you how many people will die in a year; the waste industry can show you where the bodies are.

Both industries can help you clean up after a disaster strikes.

A mountain of losses is like a landfill — a good cover can make both smell a lot better.

Always be careful when you ask for a data dump.

Actuaries are always backing into things — so are garbage trucks.

Both can have "containment issues."

Kids always run to the window when the insurance truck comes around on Thursday mornings.

Michael Ersevim, ACAS, is a data scientist with Waste Management in Windsor, Connecticut.

The Actuarial Foundation Gives Back

By HOLLY MONAHAN

"The concept of a profession carries with it the idea of service to the public." —James C. Hickman, ACAS, FSA, MAAA

The Actuarial Foundation brings Hickman's words to life on a daily basis by providing programs and resources to improve math and financial knowledge for all. The giving spirit of actuaries is what makes the profession great and makes the work of The Actuarial Foundation possible. Whether it's donating, serving on a committee, reviewing programs or mentoring, the Foundation has been able to consistently count on actuaries to make a difference in our communities.

Actuaries can also be counted on to mobilize and help when there is a natural disaster, as demonstrated through Rebuild Math Classrooms, a Foundation initiative that has helped numerous schools affected by natural disasters over the years by providing funds to replace damaged or destroyed math resources. The Rebuild program was originally established in 2005 in response to Hurricanes Katrina and Rita. Since then, over $300,000 has been raised to replace and restore math materials in classrooms all over the country. Most recently, Rebuild was reinstated to assist schools affected by Hurricanes Harvey, Irma and Maria. The money raised will be distributed equally to the Houston Independent School Foundation, the Consortium of Florida Education Foundations (CFEF) and the Foundation for Puerto Rico. Each of these organizations has committed to distributing Rebuild funds to schools in need.

Many Florida local education foundations operate free stores where teachers can select items their students need to be successful in school. In hurricane-impacted areas, demand has increased for both basic necessities and expensive items like graphing calculators.

CFEF President Mary Chance says they have seen an increase in student population with over 10,000 new students relocating and enrolling in Florida public schools in central and south Florida from Puerto Rico and the U.S. Virgin Islands as a result of Hurricane Maria. This is the area of Florida with the biggest need, with 16 school districts affected. Many schools suffered water damage. One school burned to the ground because of a power surge. Schools that were left standing after the storm became hubs for evacuated families, including pets! Hundreds of schools were quickly converted to emergency shelters with school leaders and staff hosting evacuees for the duration of the storm. One returning teacher commented that it looked like a stampede had been through her classroom.

The Actuarial Foundation's support will mean that more vulnerable Florida students will be able to graduate college career-ready by successfully completing higher level math coursework.

Many displaced students arrived in Florida by ship or plane with only the clothes on their backs. Several local education and teacher resource stores in affected areas, many of which are operated by foundations, have seen a dramatic increase in personal hygiene items and other basic needs to assist these students and their families. These teacher resource stores offer items ranging from hygiene products and backpacks to the school supplies students need to be successful. Mary Chance says there is a waiting list for expensive calculators for high-level math. "If these kids impacted by natural disasters have limited family resources, this shouldn't be a barrier to their access to the resources to achieve in high-level math classrooms," Says Chance.

The Rebuild Math Classrooms effort gives actuaries a chance to help communities affected by natural disasters in a meaningful, immediate way. Providing the high-level calculators for the students in Florida reflects the giving spirit of actuaries — seizing the opportunity to do something special in a way that reflects actuarial capabilities and the benefits of being a member of the actuarial profession. We can't predict every natural disaster, but as the Rebuild Math Classrooms effort demonstrates, we can depend on actuaries to make a difference when it matters.

Holly Monahan is the marketing and communications specialist for The Actuarial Foundation.

THE SLR FACTOR

As Sea Levels Rise, the Flood Risk Equation Changes

By ANNMARIE GEDDES BARIBEAU

Failure to factor in sea level rise is risky business.

The evidence is irrefutable. The world's sea level is rising at the fastest rate in human history, threatening human lives and property.

The current speed of sea level rise is about 2.8 to 3.6 mm annually, up from an average of 1.9 mm per year during the 20th century, says Dag Lohmann, a physicist and CEO of KatRisk, a catastrophe modeling company.

Along the coasts of the United States, there is about $6.88 trillion in exposure potential, he explains. Given no changes in flood mitigation, sea level rise costs about $20 million more in insurance losses every year — or about $60 million per centimeter sea level rise, he adds. And Lohman predicts that primary insurance premiums would have to rise on average an additional 0.4 percent a year to pay for the expected higher losses.

Just as driverless vehicles will be disrupting personal and commercial auto insurance, higher sea level rise will challenge traditional assumptions for underwriting property risk, says Rade Musulin, vice president, casualty, for the American Academy of Actuaries. "This is not your mother's homeowners ratemaking, because risk is changing and extreme event likelihood is increasing," he says.

In other words, sea level rise and warming water will cause more mega-losses such as hurricanes Katrina and Sandy, Musulin explains. Furthermore, many places are also experiencing land subsidence, he adds, and sinking land makes rising sea levels an even larger threat to property.

The question is: Will the coasts of the United States be ready to face that future? Stuart Mathewson, a retired property insurance actuary who contributes to the Actuarial Climate Index (ACI), warns that if appropriate measures are not taken, the effect of sea level rise on insurers — whether private or public — could be analogous to the unanticipated financial burden of asbestos claims.

Actuaries should start considering sea level rise — also known as the SLR factor — which touches multiple lines affected by flood risk. "For actuaries, consideration of sea level rise is an emerging development that will impact pricing and underwriting," observes Stephen Kolk, president of Kolkulations, an extreme-catastrophe modeler and ACI contributor. "The SLR factor is a risk multiplier that can't be ignored," he says.

Most directly, the SLR factor will impact flood-specific coverage, including the U.S. National Flood Insurance Program (NFIP), residential and commercial carriers, excess insurers, state-specific flood risk pools and the reinsurers that back them. While the effect may not be as significant for business interruption, workers' compensation

SLR factor will impact flood-specific coverage, including the U.S. National Flood Insurance Program (NFIP), residential and commercial carriers, excess insurers, state-specific flood risk pools and the reinsurers that back them.

and personal and commercial automobile, actuaries working with these lines should also be aware that the SLR factor is growing in importance.

Significant Vulnerability

Higher sea levels are due to rising temperatures melting enormous glaciers primarily located in Antarctica and Greenland, explains John Englander, an oceanographer and author of *High Tide On Main Street: Rising Sea Level and the Coming Coastal Crisis*. Combined, those two landmasses are 50 percent larger than the United States, he says, and their ice sheets would cover the country to a depth almost 10,000 feet high or 2 miles. He uses that to help visualize the amount of ice and the difficulty to estimate exactly how quickly it will melt, which is what mostly raises sea level.

Some believe that the melting icebergs and ice cap around the North Pole add to sea level, but they have no effect because they are floating in the ocean. Only the melting of ice on land can add to ocean height.

Englander adds that many people are confused about the basics of sea level rise. For example, some believe that the melting icebergs and ice cap around the North Pole add to sea level, but they have no effect because they are floating in the ocean. Only the melting of ice on land can add to ocean height.

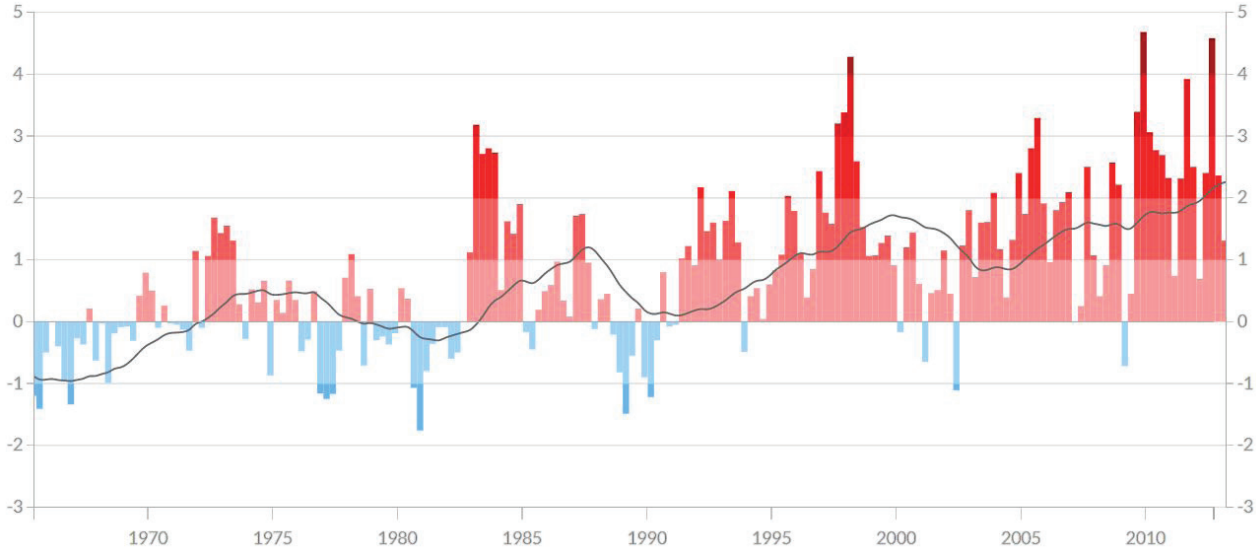
Even modest increases in sea level can exacerbate the other causes of flooding, observes Englander, who is also president of the International Sea Level Institute. The combination of what he calls "the five flood factors" — storms, rain, runoff, high tides and sea level rise — determines frequency and severity. While each factor has very different causes, characteristics, impact areas and recovery, the fifth factor — sea level rise — is "special," he explains. Because it is slow and more incremental than the other factors, sea level rise "won't go down for at least a thousand years, raising the base for all the others," he explains. In addition to melting of ice on land, sea level is increasing somewhat from thermal expansion directly due to the slight increase in volume as the ocean warms, he notes.

Location, Location, Location

From an insurance point of view, *where* sea level rise will affect policyholders is what matters most. Already, many locations in the United States are experiencing a tipping point, Mathewson says. That is, the sea levels in those places have reached levels where flooding is already occurring without storms.

The incidence of flooding along the property-laden East Coast is growing

Chart 1



This Actuaries Climate Index (ACI) chart shows that sea level around the 48 contiguous United States rose from 1990 to 2016, according to the Actuaries Climate Index sea level rise module. Chart courtesy of Stu Mathewson.

without coastal storms or even a drop of precipitation. Called nuisance or "sunny day" flooding, it occurs when higher sea levels in local areas produce high or "king" tides due to the sun and moon's predictable simultaneous pull on the earth. The underlying force causing these extreme tides, which continue to break records, is rising sea level, explains Englander.

The National Oceanic and Atmospheric Administration (NOAA) estimates that nuisance flooding frequency in U.S. coastal communities has grown from 300 percent to 900 percent in the past 50 years.[1] Around Miami Beach, for example, high tide events rose 400 percent since 2006, according to the 2016 study, "Increasing flooding hazard in coastal communities due to rising sea level: Case study of Miami Beach, Florida."[2] This is due to Southeast Florida's average sea level increase, which grew from 3 ± 2 mm per year before 2006 to 9 ± 4 mm annually since then, the study notes. "That unusual surge in this area is an example of a regional variation, still being analyzed to understand the factors," Englander explains. "Causes might relate to changes in the Gulf Stream or changes in Atlantic wind patterns."

Less obvious, but as potentially dangerous, is sea level rise in places susceptible to hurricane storm surge, Mathewson says. Due to growing sea levels, the damage will extend substantially farther inland, he adds, citing flooding from Hurricane Sandy, which "would not have gone as far inland if sea level was lower."

Sea level is expected to continue to rise around New York City. For the 2020s, the low-range projection is 2 inches, and the middle range is to 4 inches to 8 inches, according to "Preliminary Climate Resiliency Design Guidelines for New York City."[3] For the 2050s, the low range estimate is 8 inches and 11 inches to 21 inches is the middle range, the report notes. Released in April 2017, the report also features maps that rank flood vulnerability by street.

To see the effect of rising sea levels by various scenarios and location, Englander recommends Climate Central's website Surging Seas Risk Finder at https://riskfinder.climatecentral.org. (Climate Central is an independent organization made up of leading scientists and journalists who research and report facts about climate change and its public impact.) Consider Norfolk, Virginia, which flooded in late 2016. The site predicts that a 4-foot flood is 60 percent likely by 2020 and 100 percent likely into the year 2050. Flood days there have more than quadrupled over the past 30 years — from 14 days

[1] https://oceanservice.noaa.gov/facts/sealevel.html
[2] http://www.sciencedirect.com/science/article/pii/S0964569116300278
[3] http://www1.nyc.gov/assets/orr/images/content/header/ORR_ClimateResiliencyDesignGuidelines_PRELIMINARY_4_21_2017.pdf

between 1975 and 1984 to 70 days between 2005 and 2014. The site estimates that a 5-foot flood would cover 3.1 square miles in Norfolk, having a property value of $1.7 billion. These values exclude areas that could be protected by levees or other features.

The land near New Orleans is also experiencing sea level rise and subsidence; some areas will be too costly to rebuild after the next major storm surge. Lohmann sees this as an example of what is coming for other vulnerable coastal areas in the United States.

Musulin points out that another significant challenge is that building codes generally reflect current conditions, but future conditions will change. "If you build things with a design life of 50 years," says Musulin, "you better have building codes that consider conditions in 50 years."

Rising sea level, Englander says, can affect areas 5 miles to 10 miles inland from the coast, which are often lowlands. In many cases, these areas are lower than the dune line or "beach berm" just behind the shoreline. From Texas, around Florida and up to the Carolinas, there are vast marshes and swamps that will become shallow marine environments, he observes, which are pushing the boundary between land and sea farther inland. Tidal rivers will be affected as sea level rise affects cities within 200-500 miles from the ocean such as Sacramento, Washington, D.C. and Hartford.

Factoring SLR

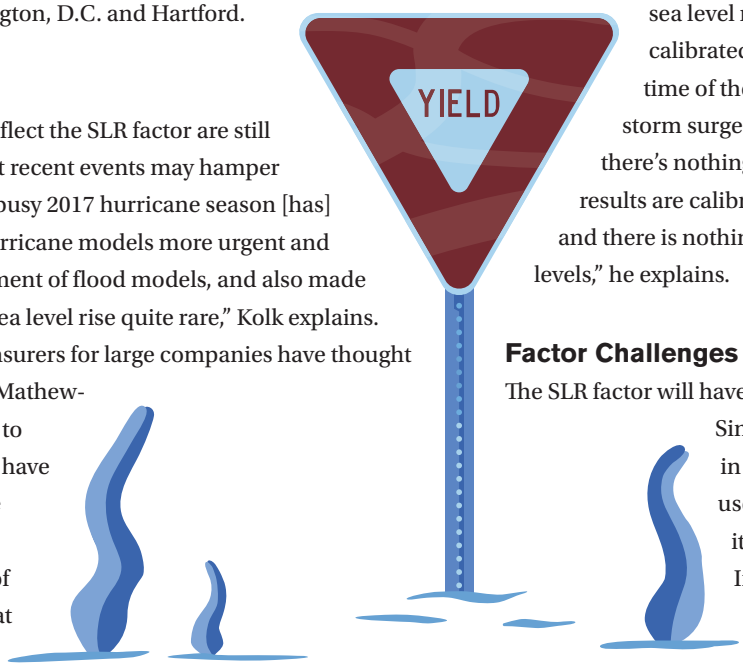
Flood models that reflect the SLR factor are still being developed, but recent events may hamper their progress. "The busy 2017 hurricane season [has] made the issue of hurricane models more urgent and has slowed development of flood models, and also made paying attention to sea level rise quite rare," Kolk explains. While commercial insurers for large companies have thought about sea level rise, Mathewson observes, small- to medium-sized firms have not given it the same consideration.

The ACI is one of the few resources that currently includes the impact of sea level rise, Mathewson says. Its sea level rise component shows that, around the United States, SLR has increased substantially from 1990 to 2016. (See Chart 1.)

Including sea level rise in catastrophe models is becoming an industry best practice, Lohmann says. KatRisk LLC's SpatialKat catastrophe model, which includes the SLR factor, also features multi-peril correlations between inland flood, hurricane wind and storm surge.

Catastrophe models, Lohmann says, "exist because weather and climate models are too coarse in spatial resolution and do not have enough scenarios of realistic extremes." What actuaries really want, he says, is to have the "knobs in cat models" to adjust climate change scenarios at the property level to fine-tune rates. His company is working on it, but it will take years to fully develop and then to be used across the industry.

Meanwhile, many actuaries look at the current state of rising sea levels without considering future projections, Musulin says. "Generally, insurers ignore the problem because they have a one-year time horizon," he adds. This is a mistake, he warns, because "we have seen examples where insurers get locked into prior underwriting decisions through rate regulation or non-renew moratoriums."



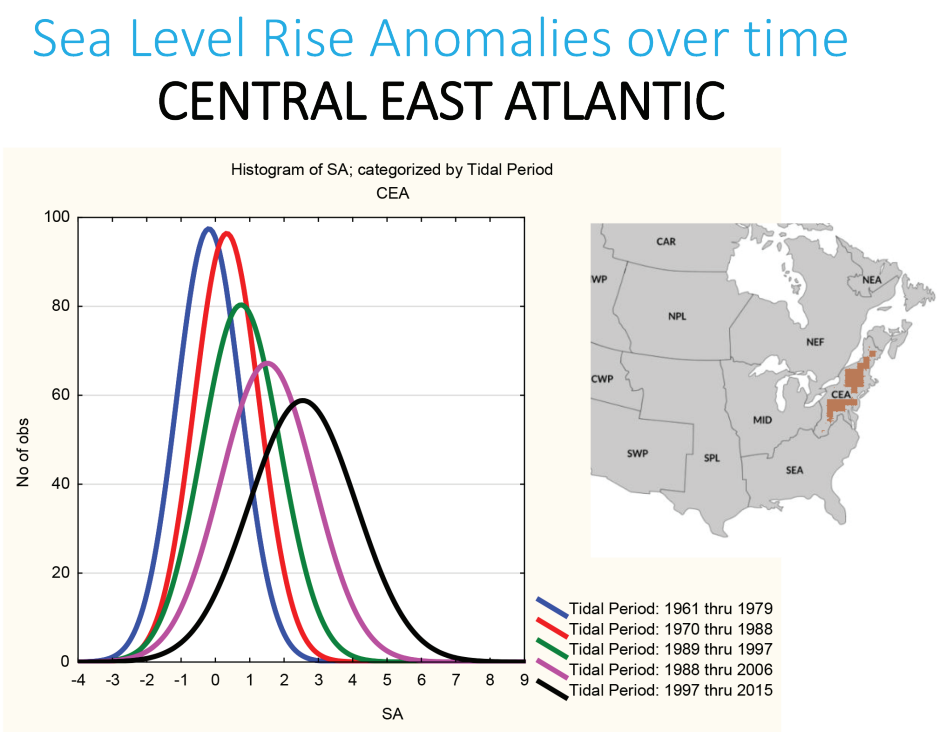
Hurricane models do include the effect of sea level rise on storm surge, but they are calibrated to what the sea level was at the time of the storm, Mathewson says. "In the storm surge portion of a hurricane model, there's nothing for future rises in sea level; results are calibrated to actual historical storms, and there is nothing to bring them up to current sea levels," he explains.

Factor Challenges

The SLR factor will have greater weight in the long term. Since sea level is swelling faster than in the past, historic data loses its usefulness for future predictability. "Warming of the Oceans and Implications for the (Re)insurance Industry,"[4] a report of the Geneva Association, observes: "... traditional approaches, which

[4] https://www.genevaassociation.org/research-topics/extreme-events-and-climate-risk/warming-oceans-and-implications-reinsurance-industry

Chart 2



The Gumbel distribution fits the Actuaries Climate Index (ACI's) sea level rise standard anomaly data for the Central East Atlantic region. Chart courtesy of Steve Kolk.

are solely based on analyzing historical data, increasingly fail to estimate today's hazard probabilities." Therefore, the 2013 report notes, "A paradigm shift from historic to predictive risk assessment methods is necessary."

This shift is complicated because the rate of sea level change is expected to accelerate. Further, a look at sea levels for the past 20,000 years reveals that sea level change does not follow a smooth or even curved line, Englander explains. Rather, there have been several sudden changes or inflection points in the slope of the line.

The growing frequency of extreme weather events makes it more important to look beyond simple averages to also pay attention to tails of distributions. Extreme value theory should be applied to quantify risks of the SLR factor, flood and other extreme weather events, Kolk says.

"Most insurance risk data is non-normal and exhibits a skewed shape," he explains, and actuaries on the cutting edge are looking into these skewed distributions. Kolk explored the ACI's sea level rise data with data scientist and statistician Danny Stout. Their analysis tested a variety of distributions and revealed that ACI sea level rise data "fit a Gumbel beautifully," referring to the extreme value tail model. Fitting the Gumbel distribution to moving 19-year tidal periods of sea level data — to eliminate noise and strengthen sea level rise risk signals — revealed increasing Gumbel skewness, which, Kolk says, demonstrates "that sea level rise risk is getting worse really fast."

The SLR is hitting the eastern side of North America hardest, Kolk says. As shown in Chart 2, the Gumbel distribution fits the ACI's sea level rise standard anomaly data for the Central East Atlantic region, which includes New York City. Other East Coast climate regions show a similar accelerating skewness.

The Actuarial Game Changer

The insurance industry is making efforts to encourage flood mitigation and educate property owners through organizations such as the Insurance Institute for Business and Home Safety.

Insurance plays a critical role in informing policyhold-

ers of the true cost of risk, observes Robert Hartwig, professor and co-director of the University of South Carolina's Center for Risk and Uncertainty Management. In the case of flood insurance through the NFIP, that message is currently diluted or obscured by federal policies.

"People are actually encouraged to build (and re-build) in areas more vulnerable to flooding," he points out, citing NFIP's subsidies, the Federal Emergency Management Agency providing disaster aid and a federal tax code allowing uninsured flood damage as a write-off.

Insurer rate levels must reflect risk during the policy period, meaning they will not reflect the long-term risk that will be necessary to prepare for future losses, Musulin says. "Experience in other lines, like hurricane and wind, indicates that regulators and the private market have had great difficulty reaching a consensus on rates in lines subject to catastrophic losses, where risk perception changes," he adds, citing hurricanes in Florida and earthquakes in California as examples.

Conclusion

Rising sea levels, especially around the U.S. East and Gulf Coasts, will affect multiple lines of property-casualty insurance in the near and distant future. As actuaries consider the ramifications, they will also need to acquire new skill sets to account for the rising tides.

It is difficult to convince politicians and voters to invest money into problems that are decades away, especially when rising sea levels are too often mired in the politics of global warming.

Thankfully, catastrophe models will continue to grow in sophistication, allowing actuaries to assess the true risk of flooding. As the actual risk increases, there will likely be affordability challenges for property owners and their insurers. In places like New Orleans, people have already lost their property due to rising sea levels, which hints at what is to come in future decades.

While the burden to protect the coast lines will fall on the government at local, state and federal levels, the larger question is whether the nation will be ready when sea levels become an issue too important to ignore. It is difficult to convince politicians and voters to invest money into problems that are decades away, especially when rising sea levels are too often mired in the politics of global warming.

Since actuaries quantify the actual cost of risk, they can play a critical role in demonstrating how the SLR factor will impact the future while preparing insurers for the expected onslaught of losses. In return, lawmakers and regulators will need the courage to support that reality for the sake of future generations.

Annmarie Geddes Baribeau has been covering insurance and actuarial topics for more than 25 years. Find her blog at www.insurancecommunicators.com.

Spring Meeting

May 13-16, 2018
Boston Marriott Copley Place
Boston, MA

ETHICAL ISSUES

Strong Actuarial Analysis or Unethical Data Use?

Ethical Issues is written by members of the CAS Committee on Professionalism Education (COPE). The column's intent is to stimulate discussion among CAS members. Therefore, positions are sometimes stated in such a way as to provoke reactions and thoughtful responses on the part of the reader. Responses are welcomed. The opinions expressed by readers and authors are for discussion purposes only and should not be used to prejudge the disposition of any actual case or modify published professional standards as they may apply in real-life situations.

Sam Ismal, FCAS, has been the principal of his own independent actuarial consulting practice for the last 18 years. Most of Sam's clients are small insurance companies without in-house actuaries and without a lot of claims experience. Thanks to a great friendship with an old colleague, Sam also maintains a relationship with a much larger consulting firm, Hugist Associates, where he often works as a subcontractor on particularly large projects and provides peer-review assistance when needed.

Working with Hugist has helped Sam immensely with his own client work — he has not only learned lessons from working with the data and experience of larger clients but has also benefited from having access to their comparison factors. As is typical for small firms, obtaining industry/comparison data and factors is a challenge for Sam and can often be prohibitively expensive. Thanks to Hugist, Sam has access to factors that are based on the experience of Hugist's larger client companies. Those factors have been invaluable to Sam when reviewing the limited experience of the smaller but similar firms in his client base.

A new client has reached out to Sam. Weirneu Insurance entered a new market a few years ago and has asked Sam to evaluate its loss experience to date and analyze its current rates for the new product. Weirneu has provided Sam with considerable detail about the product including claim and market data. Sam believes that this product line has the potential to be fairly long-tailed, and despite the decent number of claims available for his evaluation, the experience data do not appear credible enough for development without supplemental factors. The market share analysis provided to Sam reveals that the company with the largest market share by far is Numeruno — a Hugist client that Sam has provided peer review for in the past.

Thanks to the peer review, Sam has access to Numeruno's comparison factors. Numeruno's analysis is extensive and includes account-specific development factors, claim reporting patterns, trends and other quantitative assessments. This information will allow Sam to very accurately project Weirneu's expected loss costs. In fact, because Sam's evaluation will be very reliable, Weirneu can confidently break into the market and attempt to take considerable market share away from Numeruno. Assuming Weirneu follows Sam's recommendations, it could easily grow into a more substantial company and potentially become Sam's largest client.

Assuming Sam does not disclose the source and the underlying data, is it acceptable that he considers Numeruno's factors when evaluating Weirneu's current rates?

Yes

According to the CAS Code of Professional Conduct, precept 9, as long as Sam does not disclose any specific proprietary information related to Numeruno's data, there are no confidentiality issues. It is acceptable for him to utilize the data of a competitor. In fact, this is customary practice for small consultancies since they have limited access to more substantial industry data. Utilizing competitor's factors allows a consulting actuary to provide a more accurate, quality work product.

No

Precept 1 of the CAS Code of Professional Conduct states that an actuary shall "act honestly, with integrity and competence, and in a manner to fulfill the profession's responsibility to the public and to uphold the reputation of the actuarial profession." Utilizing Numeruno's data, regardless of whether it is identified or identifiable, to assist a potential competitor is clearly improper and lacks professional integrity. Further, ANNOTATION 1-3 of Precept 1 indicates

"An Actuary shall not use a relationship with a third party… to attempt to obtain illegal or materially improper treatment from one such party on behalf of the other party." Utilizing Numeruno's data is a moot point — Sam has a conflict of interest and should simply decline to do the work for Weirneu.

Maybe

If Numeruno was Sam's client instead of Hugist's client, does your answer differ?

If Sam had helped with Numeruno's full evaluation, rather than provide a peer review, does your answer differ?

Precepts 7b and 7c, indicate that an actuary can knowingly perform actuarial services even if a potential conflict of interest exists as long as his ability to act fairly is not impaired and "(b) there has been disclosure of the conflict to all present and known prospective Principals whose interests would be affected by the conflict and (c) all such Principals have expressly agreed to the performance of the Actuarial Services by the Actuary." Is Sam required to get approval from Hugist to take on Weirneu? Does either firm need to notify Numeruno?

New Report Holds Keys to Diversity and Inclusion: Five Barriers Revealed

In a new study conducted on behalf of the Society of Actuaries (SOA), the Actuarial Foundation, the Casualty Actuarial Society (CAS), and the International Association of Black Actuaries (IABA), respondents were asked to consider the statement "The actuarial profession is not as diverse as it should be." The majority of respondents — 83 percent of African-American and Hispanic respondents and 55 percent of respondents from other racial backgrounds — agreed.

That might sound like progress. The majority of people in the profession recognize that diversity issues need to be addressed. To turn that statistic on its head, however, 45 percent of respondents who are neither African-American nor Hispanic believe diversity in the actuarial field is just right.

Now consider that a mere 2 percent of actuaries are African-American. Another 2 percent are Hispanic.[1] Yet, a sizable number of actuaries do not see diversity as a problem that needs to be corrected.

There may be several reasons for this, but one common argument is that the actuarial field is a meritocracy: If you can pass the exams, you can be an actuary. The findings of the new report, "Diversity and Inclusion Research Initiative," indicate minorities experience the pathway to becoming an actuary in a different way, challenging the meritocracy concept.

Barriers at Each Stage of the Career Pipeline

With planning beginning in 2015, the study was conducted by C+R Research in three phases from fall 2016 through summer 2017. Based on the data they collected, the researchers identified five segments of the "actuarial career pipeline" where African-Americans and Hispanics face barriers to a greater extent than Caucasians:

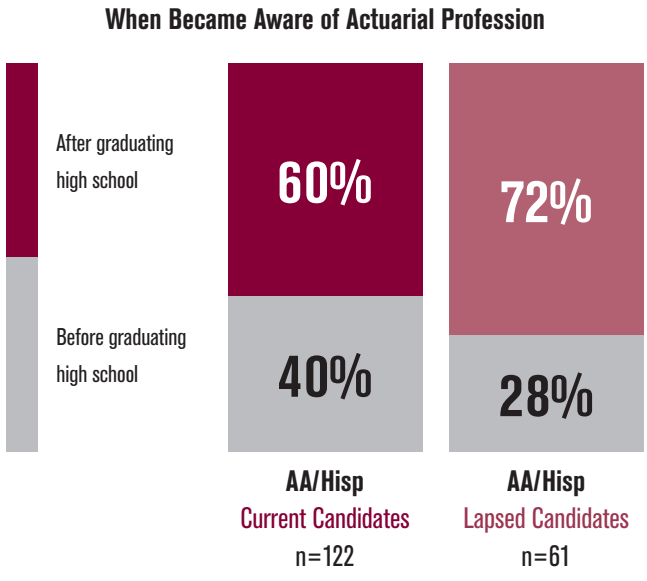
1. Awareness of the field.
2. Consideration of actuarial science as a viable profession.
3. Preference over other science, technology, engineering and math (STEM) professions.
4. Intent to take and pass the exams.
5. Employment and retention.

The barriers at the start of the pipeline tend to compound those at each consecutive stage. Lack of awareness is the most basic problem. Just 12 out of 100 African-American or Hispanic college freshmen surveyed had heard of the actuarial profession. That's less than half of the rate for other groups. A full 72 percent of lapsed minority candidates indicated they learned about the profession after high school (Figure 1).

This discrepancy has a resounding impact. With lower awareness comes less preparation for the course work once a student decides to pursue actuarial studies, a later start date to begin taking exams, and fewer connections within the field. All of these factors make passing exams, connecting with mentors and landing internships and jobs much more difficult.

After awareness, the next hurdle on the career pipeline is for students to consider actuarial science a viable option. Of minority lapsed candidates who

Figure 1



[1] Barry McKeown, "Diversity in the Actuarial Profession," *Expanding Horizons*, April 2014, https://www.soa.org/News-and-Publications/Newsletters/Expanding-Horizons/2014/april/Diversity-in-the-Actuarial-Profession.aspx.

learned about the profession later in life, 36 percent reported that they did not feel they could invest the time and money required to become an actuary. Older students often cannot afford to put off getting a full-time job while they study and sit for the exams. Without enough preparation time, they are less likely to pass the exams. Aware of this — and unaware of financial support that may be available to them — many minority students do not even begin down the road to becoming an actuary.

Beyond those challenges to entry, students must develop a preference for the actuarial profession over other STEM fields. This represents the third stage of the career pipeline — and another barrier. "Drawing minority students into the profession requires positioning the career as meaningful, attainable, rewarding, prestigious and secure," the researchers note. Without those attributes, top-performing minority students are more likely to show a preference for one of the more familiar STEM fields, such as medicine, computer science or engineering.

Students who overcome the first three barriers now must take the relevant courses and pass the exams. Although many in the actuarial field have argued that the credentialing process is an objective step that levels the playing field — either you pass the tests or you don't — the current research complicates that argument.

To obtain credentials, candidates need appropriate academic preparation, a support network, and financial support. Yet, a lack of academic preparation and little or no financial support in college are both more prevalent in minority populations than in other groups. Indeed, 32 percent of lapsed minority candidates felt they were not well prepared academically to take the exams, compared to 25 percent of other respondents (Figure 2). More than half of lapsed minority candidates indicated financial support for exam fees was insufficient to meet their needs, and 31 percent of the same demographic cited the cost of exams as a reason they stopped pursuing a career as an actuary (Figure 3).

The very nature of the exams is cited by participants from all groups as deterring potentially good candidates. One

Figure 2

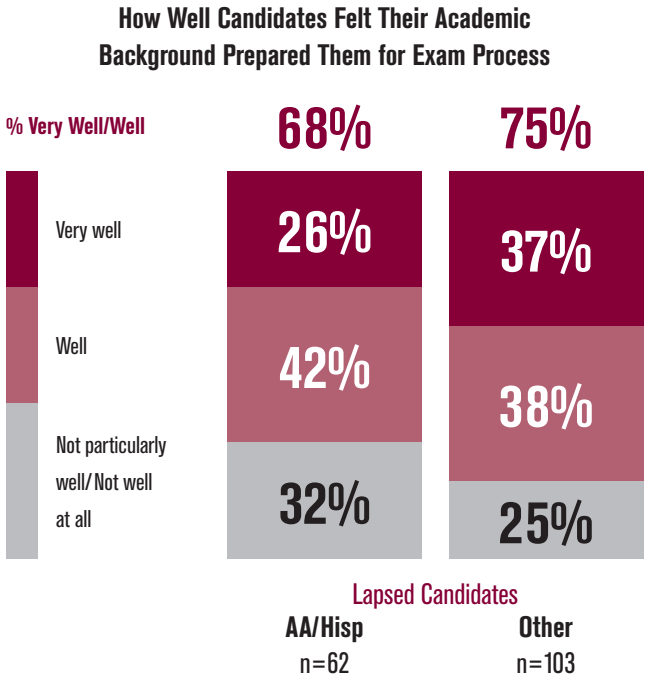
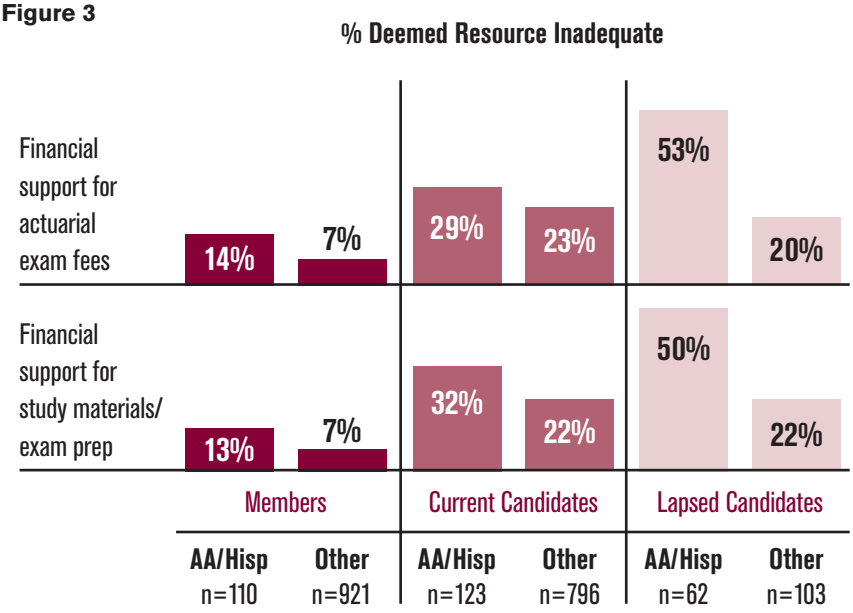


Figure 3



college sophomore who participated in the study stated, "I think…there might be people who are not as good as others when it comes to being examined but… they have the potential to be the best in the field if given the chance."

Candidates who fail an exam have the opportunity to retake it. While 70 percent of "other" lapsed candidates took exams three or more times before dropping out, just 45 percent of minority lapsed candidates lasted that long. Perhaps more telling, 36 percent of lapsed minority candidates dropped out after just one failed exam, compared to 13 percent for lapsed candidates of other races and ethnicities (Figure 4).

The researchers posit a "confidence gap" as one reason behind these statistics. The discouraging effects of failed exams may be more acute for minority students who often lack mentors and advisors to build their confidence with insight that many candidates within the profession fail exams. This leads minority students to falsely conclude that they are not cut out for this profession. Interviewees also indicated that having to pay to retake the exam was burdensome, and this likely also contributed to the lapsing of some candidates.

Like all potential actuaries, African-American and Hispanic candidates are impeded and discontinue pursuing the career at each stage of the pipeline, but at a much higher rate.

The last hurdle may also be the most difficult to address: bias in hiring practices and work environments. The researchers outline three main areas where minorities are at a disadvantage at this stage:

1. Screening and stereotyping of resumes based on name, appearance and college.
2. A racially homogeneous community that has a "secret society" feel.
3. Workplace culture that can involve subconscious discrimination.

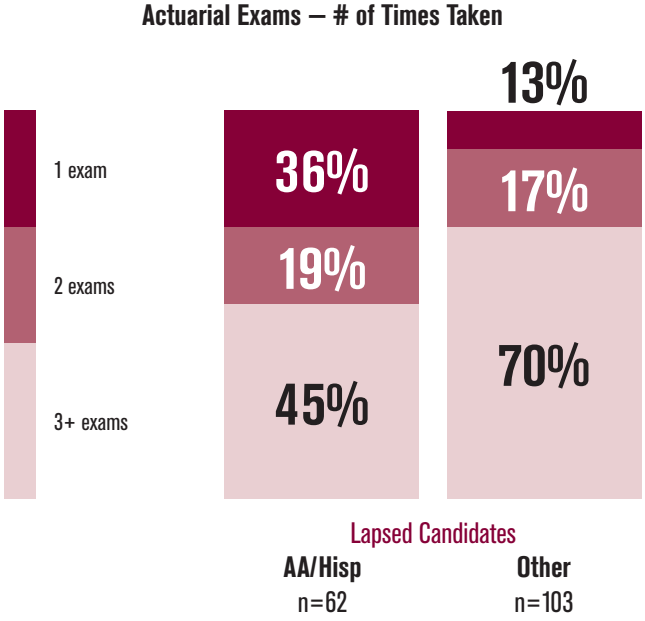
More than half of the African-American and Hispanic respondents who were current candidates or members said they had heard of or experienced racial or ethnic discrimination in the actuarial field.

Regardless of whether discrimination is present, a lack of diversity can make an office seem unwelcoming to minority candidates. Tenesia McGruder, the president of IABA and herself African-American, says, "The importance of having someone who looks like you [in the office] cannot be downplayed."

She continues: "I think that if you are a person of color and you fail an exam, without mentors or a network, you might think you just are not cut out for it. You don't know that everyone is failing exams." Conversely, seeing someone like you who is successful, "That's very motivational," McGruder says.

The results of the study make one thing clear: Like all potential actuaries, African-American and Hispanic candidates are impeded and discontinue pursuing the career at each stage of the pipeline, but at a much higher rate.

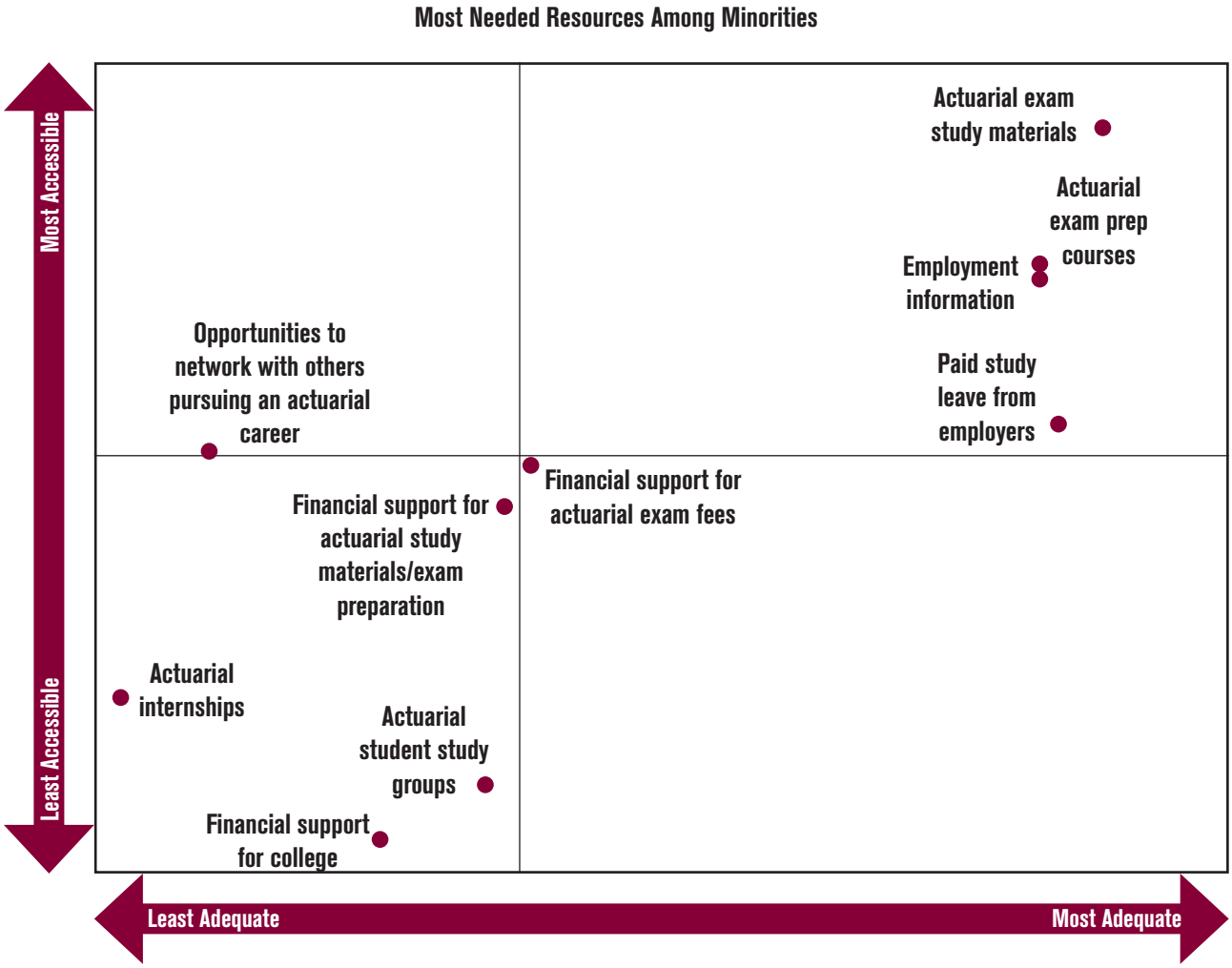
Figure 4



The Path to Real Change

For those who have been working toward a more diverse workforce, the findings of the report support the anecdotal evidence they have heard for many years. McGruder says, "To actually have numbers and empirical data behind what we had already gauged as issues is very helpful because it helped us hone in on what we should focus on for next year."

Figure 5



Supporting the Individual

Looking at the findings, three strategies with potentially huge implications for improving diversity emerge (Figure 5):

- Increasing awareness of both the profession and available assistance.
- Expanding financial support for exams.
- Building students' networks.

All three have been identified by the participating organizations as new or renewed initiatives.

To the first point, McGruder says, "We're going to make sure we're doing those high school visits and doing those career fairs so that we can reach the diverse population early on." To support these efforts, IABA will provide its affiliates with contacts and materials to make the career fairs and high school visits more effective.

John Robinson, former president of IABA and current member of the CAS/SOA Joint Committee on Career Encouragement and Actuarial Diversity, believes the whole report represents areas for improvement. "If we're going to handle this, we have to do something that we've never done before," he says. When the organizations reach the students sooner, they can head off many of the barriers that the study identifies.

To improve the image of the actuary, Jason Leppin, the executive director at The Actuarial Foundation, says, "I like the idea of having more specific stories of what particular actuaries do." McGruder agrees, noting that the actuarial field is broader than just insurance companies, as many outsiders believe. "It's important for us to brand ourselves and show exactly what actuaries do. I know actuaries who work at Uber and Google." By better articulating what the profession does, actuaries can move students

"We have a lot of work ahead of us and I think everyone knows that. Diversity isn't something you can fix in one year, but we are really excited about having concrete information from which to build." — Mallika Bender, Chair of the CAS Diversity Committee

from awareness to preference.

The, SOA, the Foundation, IABA and CAS are also essential to growing the students' support networks. IABA Executive Director Kate Weaver notes, "The majority of these black students that are pursuing the profession probably don't know another black actuary." With a larger network, the confidence gap cited by the researchers is diminished. More internship and job opportunities open up, and a feeling of fitting into the culture grows.

The SOA, the Foundation, IABA and CAS are interested in expanding exam support as well. Several scholarships for minority candidates are already in place, but awareness of their existence is low. Again, outreach will play a key role in resolving this problem.

Changing the Culture

Arguably the most stubborn part of improving diversity is changing the culture. How is that accomplished?

Some initiatives are already in the works. For example, the IABA's scholarships and the Actuarial Diversity Scholarship from The Actuarial Foundation connect recipients with the companies that sponsor the scholarships. Leppin says this can help companies understand the challenges that minorities face. "Employers don't necessarily understand all the hurdles that many of these kids have in their life. Maybe they are trying to support mom and dad, maybe they are trying to support a sibling financially." Companies that understand the backgrounds of their employees may be better equipped to hire and retain minorities.

Employers are also changing their recruiting practices. In the past, some employers have indicated that they prefer to look to certain schools for their candidates, and rarely are these universities focused on serving minorities. Olga Jacobs, the 2017 chair of the SOA's Inclusion and Diversity Committee, notes, "If you only hire from the same schools … how do I get that diversity of thought that we need to really solve the humongous problems that we have in our country?" To correct the problem, Weaver says companies have begun to shift their recruiting timelines and hold internship spots for IABA scholarship winners. The companies that make these kinds of accommodations, she says, have been most successful in recruiting international and African-American actuaries.

But what about those companies that don't make such accommodations? What do you say to people who still maintain that the actuarial field is a meritocracy?

"One thing you do hear is that the exam process is this great equalizer … And I think in some ways that's true," says Mallika Bender, chair of the CAS Diversity Committee. "But there are these other factors and costs and support that we don't take into account … I think bringing that to light will make people more and more open to this concept."

Leppin hopes these holdouts will read the comments from study participants. "Hopefully people will listen and understand that that person's perception is their perception, and it may differ from yours but they have those perceptions for a reason and we need to take a look at what those reasons are. Because we need to change those perceptions … We can't just discount what people say in this survey. We can't just discount the data."

Robinson concludes, "My number one concern is whether the SOA and CAS are willing to take on this challenge. Are they willing to make that investment?"

According to representatives of the SOA and CAS, they are. Says Jacobs, "I see that passion, I see the desire and commitment to make that happen."

And Bender says, "The CAS is taking this very seriously. We have invested significantly in this monetarily but also we are planning to invest a lot of time and effort into addressing what has come out of this report. We have a lot of work ahead of us and I think everyone knows that. Diversity isn't something you can fix in one year, but we are really excited about having concrete information from which to build."

It is going to take time, but changes are coming to the actuarial field. This new report has spurred that change.

To view the original announcement about the barriers to entry research study and download the executive summary of the findings, go to http://bit.ly/2FMmWgN.

DIVERSITY

At the Casualty Actuarial Society, we know that a diversity of perspectives and life experiences will help build an actuarial profession that grows and evolves to meet the needs of tomorrow. Learn more about our commitment to this multidimensional picture at casact.org/diversity.

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

Chefs and Actuaries

The holiday season has passed, and many of us spent a lot of time in kitchens — in our own and in those of friends and relatives. When our two sons and their families come over to our home, the kitchen is a focal point of a lot of our activities. When we visit them, it is the same. The kitchen is not only where we prepare meals, munch and talk, but also where we play card and board games. But what do kitchens have to do with actuarial work? Baking and loss reserving don't sound like they are related. It is a stretch to try to relate rising bread dough to loss development.

Kitchens and actuarial work do have at least one thing in common: Both are "project work." Both have ingredients, tools, procedures and an outcome. Both projects have deadlines. And there is often an "experience requirement" for both.

There are also different rules for different kitchens. Some have a recycle bin; others do not. Some keep bottles for a cash refund; in other states, bottles go into the recycle bin or go out with the trash. I put the forks into the dishwasher basket tines down; others place them tines up. I do it because I am tired of poking myself with the tines when I empty the basket; others do it tines up because it gets them cleaner.

When it comes to actuarial work, until someone else gets to see and digest the results of our analysis, it's all an exercise in futility. And in the kitchen, it doesn't count until the dish is served, the cake is cut, and the diners get to enjoy the fruits of the chef's efforts. Both products need to be properly prepared and digestible.

Standards of Practice

Kitchens have Kitchen Standards of Practice (KSOPs) just like actuaries have Actuarial Standards of Practice (ASOPs). As with actuarial work, there are some things you "just do," or should do, in the kitchen. Failure to comply with such "rules," written or not, brings consequences. Leave the milk out of the refrigerator overnight and it spoils. Leave knives within reach of a three-year-old, and the consequences can be dreadful. Leave flour in an unsealed container and you might have additional guests for dinner in the form of ants (or worse). Leave powdered sugar where a two-year-old can get it and you may have a real catastrophe.

Knives are kept out of the reach of the little ones but within reach of the adults. The silverware is placed in the basket in the dishwasher, not just thrown into it. Some households put the china into the dishwasher; others do not. The same applies to certain coffee mugs and select skillets.

These rules are not there just to be there; they are there to:

- Protect those in the kitchen, whether they are workers (adults) or not (children).
- Allow for the smooth flow of activities within the kitchen.
- Provide safe storage for the ingredients.

Language

You call it a colander, someone else calls it a sifter, another a strainer, and the grandkids call it "that green thing with holes in it." I never did get the spatula thing — is it the rubber thing you use to scrape out the last of the peanut butter, or the thing that you flip pancakes with? It seems both are a spatula, which adds to my confusion.

"Blend," "whisk," "incorporate," "fold," and "mix" have different meanings in the kitchen. Failure to understand the difference can result in a flopped cake. Common naming of procedures is important so people know what you are talking about. Different companies, managers and even different projects may have their own languages: Be careful whether it's a kitchen or an actuarial project.

When it comes to actuarial work, until someone else gets to see and digest the results of our analysis, it's all an exercise in futility.

Ingredients

Good ingredients, and the proper ones, are necessary to have success in the kitchen.

You wouldn't brew coffee with swamp water, and you shouldn't try to do an analysis with "dirty data." The re-

sults are much the same: an awful cup of java or an erroneous actuarial analysis.

ASOP 23 deals with data quality. KSOP 23 deals with ingredient quality: Milk goes into the refrigerator; so does the jelly and other perishable foods. Vegetables and chicken are washed, but not together. Flour and sugar go into sealed containers, and so forth. Trying to cook with spoiled ingredients is like trying to perform an actuarial analysis with dirty data. Fresh ingredients and current data are best.

If you don't have the (credible) ingredients called for by the recipe, some substitutions can make it work. This statement could apply to an actuarial analysis as easily as it does to an apple pie. KSOP 25 deals with substitutions when you don't have enough of the proper ingredients, just as ASOP 25 deals with what you do when your data is not credible.

Procedure

Some people boil water in a kettle, some microwave it and others have a nearly-boiling-hot water spigot at their sink. How you get there has a lot to do with the tools and ingredients or data available.

Documentation of actuarial work is covered in ASOP 41, and KSOP 41 deals with recipes, a form of documentation. Recipes can come from cookbooks, newspaper and magazine clippings, recipe cards and a host of other physical sources. Increasingly, they come from the web or an electronic application. I have a friend's cookbook in a PDF. (Thanks, Wendy Germani.) Actuarial "recipes" come from articles, textbooks, *Variance*, the *CAS E-Forum* and other sources. Documentation — that is, recipes — can come in a variety of formats and at differing levels of instruction for the preparer. There are kids' cookbooks, expert chefs' cookbooks and everything in between. This year, Kristi, our daughter-in-law, made a birthday cake for my wife, Diane. I'd like to say it was due to the excellent documentation I did in the form of a recipe for Texas sheet cake, but it was a printed recipe from a magazine. It was excellent and tasted just like the ones I have made in the past. It enabled me to work on an equally important task, which was playing a board game with one of our grandsons! Proper documentation is a must in properly delegating a task and enables you to perform alternate tasks.

Whether it is actuarial work or cooking and baking, standard procedures enable a quality, repeatable result.

IT'S A PUZZLEMENT BY JON EVANS

Public Key Decryption

Alan has sent you a text message, including only letters and blank spaces, encrypted by the following algorithm:

1. Each letter in the message is turned into its numerical order in the alphabet, with a blank space being set at 0, and then multiplied by 27 raised to the position of the letter in the message, counting from the right with the rightmost letter having position 0. For example, "I am" is turned into $9 \times 27^3 + 0 \times 27^2 + 1 \times 27 + 13 = 177{,}187$.

2. The result from step 1 is raised to the power 3,038,795,305 and then divided by 2,853,926,939,827,803,391. The remainder of the division calculation becomes the encrypted message. For example, 177,187 is converted into 405,673,963,959,368,185 by performing these operations.

The encrypted message Alan sent you was 69,176,418,906,672,230. Can you decode this message? (Hint: It will almost certainly require some computer calculation. If you can do it by hand, then you are very talented. If you can do it in your head, then you are a superhero and deserve your own comic book!)

Design a New Casino Game

In this puzzle, you work at a casino owned by Sheldon. Sheldon presents you with a roulette-like machine that spins around and randomly stops at a number from 1 to n, where n is fixed, each number having equal probability. Sheldon asks you to design a new game where the probability of winning is p. Can you do this? If so, explain how. If not, explain why not.

Here is a simple algorithm that works for all values of p in the interval (0, 1):

1. Expand out p in base n representation. This can be done one digit at a time for any p, even if it is irrational or, worse yet, transcendental.
2. Use the gambling machine, one digit at a time "moving rightward from the decimal point," to generate the base n expansion of another number in the interval (0, 1) in base n representation. For example, if the machine lands on a value k, then the digit can be taken as k-1.
3. At each step, if the digit randomly generated is:
   a. The same as the corresponding digit of p, then continue to generate the next digit of both the original number p and the random number, respectively.
   b. Greater than the corresponding digit of p, then stop and declare a loss.
   c. Less than the corresponding digit of p, then stop and declare a win.

There is p probability of stopping at some point with a win and 1-p probability of stopping at some point with a loss. It is possible that the game could continue forever by generating the exact base n representation of p, but the probability of this is 0. In fact, the probability that the game will go on for more than a few digits is very low.

Solutions were also submitted by Patrick Allen, Xunchi Chen, Bob Conger, Ian Deters, Clive Keatinge, Robert W. Peterson, Brad Rosin and Edward "Ned" Tyrrell. ●

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

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