actuarial REVIEW

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PUBLISHED BY THE CASUALTY ACTUARIAL SOCIETY

THE NEW CYCLE OF PRICING PERSONAL AUTO

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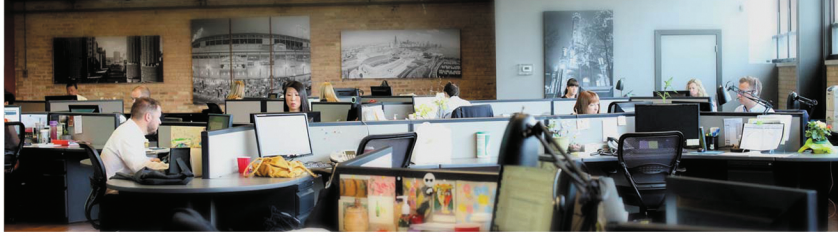

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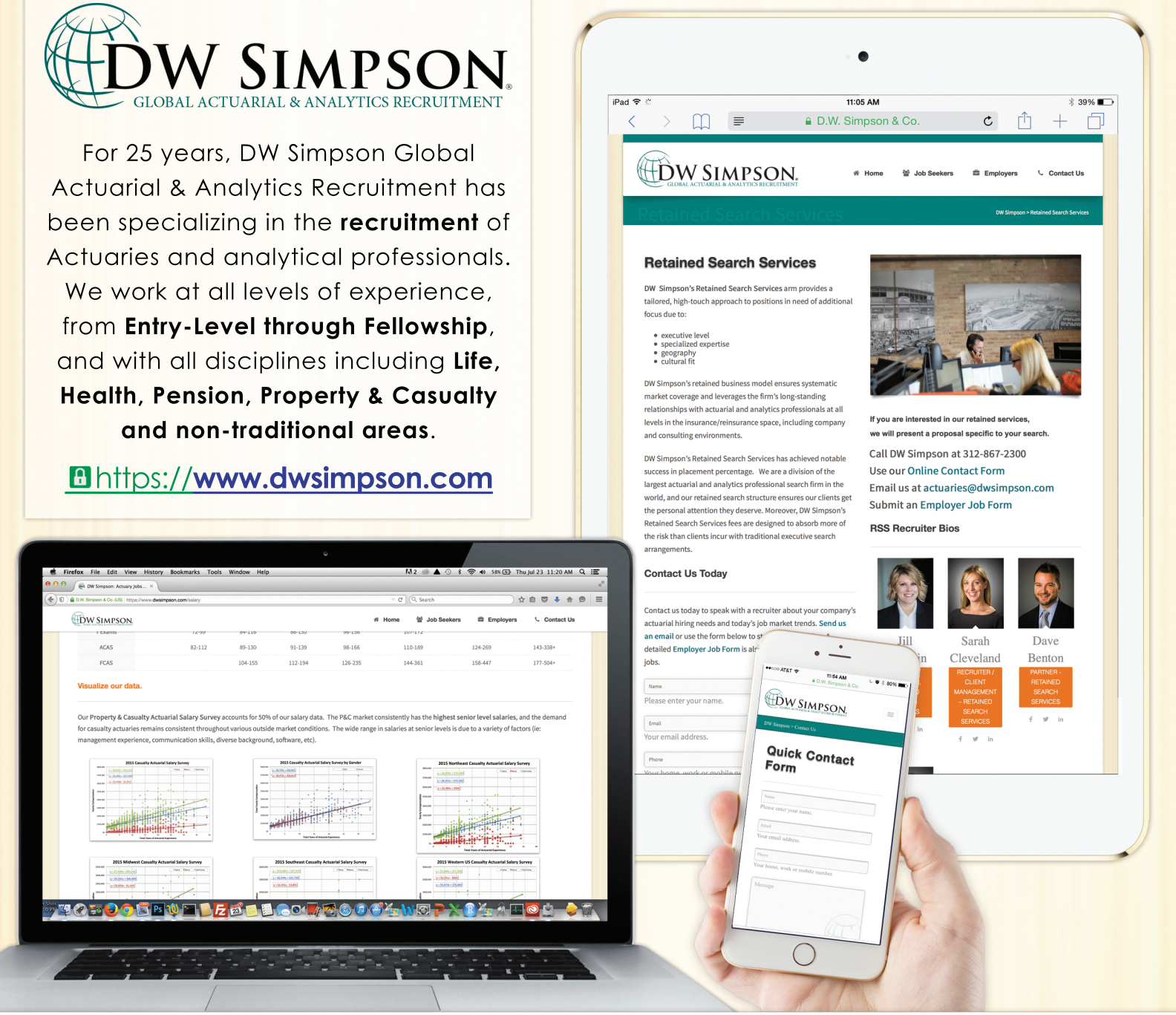

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The New Cycle of Pricing Personal Auto

BY ANNMARIE GEDDES BARIBEAU

Since the Great Recession, pricing personal auto is no longer the same.

2016 CAS Election

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Polls open on August 1 for CAS Fellows to vote on a slate of candidates for president-elect and board of directors.

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actuarialREVIEW
The magazine of the
Casualty Actuarial Society

Changes

Everybody's talking about changes in this *Actuarial Review*.

CAS President Steve Lowe writes about how the CAS is responding to a changing marketplace and offers up a name change for the Society.

Our cover story author, Annmarie Geddes Baribeau, relates how pricing personal automobile insurance has changed since the Great Recession.

Jim Lynch reports on how actuarial research has had a strong impact on the insurance industry, changing it for the better.

In "Explorations," Don Mango throws out the idea again of actuarial scientists teaming up with engineers.

Wayne Fisher's "Random Sampler" is an address to new members that lays it out for newly-minted FCAS and ACAS: Prepare for changes.

Even "25 Years Ago in the *Actuarial Review*" is about change. It highlights the Society's decision to establish its own office, moving from New York City to Arlington, Virginia. This idea was pretty radical at the time, but it was necessary. The CAS was on the rise and it needed its own infrastructure. It needed to provide more services for its growing membership.

In those 25 years, the CAS office has moved from that original location and recently expanded its current office space for new staff. Back in 1981, you could count the number of CAS staff on one hand. We now have 35 staff members, including an international manager in Hong Kong and the newly created positions of staff actuary and data analyst.

No surprise here, but our vocabulary is also changing. We are learning new meanings to old terms ("Disruption," anyone?). Breadcrumbs are now digital — and we're leaving them behind anytime we use our smartphones.

So you can count on change, but it's not the only thing.

You can also count on the dedicated group of intellectually curious professionals who make up the CAS to adapt to a changing marketplace and, in doing so, make it better.

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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Perhaps the CAS Should Change Its Name to the Data Analytics Actuarial Society (DAAS)?

Technological innovation is disrupting the traditional insurance company business model and the professions that serve the industry. Not surprisingly, insurance professionals of all disciplines are finding they must adjust to the changes to remain relevant. Our profession is not immune from this disruption.

While the historic business model is based on intuition, experience and judgment, the emerging one is driven by coordinated intra-organization data and analytics made possible by three technological advancements.

The first is that data storage and computation costs are much more affordable than in the past. This is due to innovations such as cloud storage and computation.

Second, there's more data availability than ever. Our digitally mediated lives leave breadcrumbs of data including: who we know; how we drive, exercise and sleep; and, what we buy, eat and read. These and other data bits are providing market segmentation insights, determining premium and more.

Third, the modern analytical applications and tools have become very powerful and handle a seemingly infinite amount of data, even on a transactional level. Gone are my old days, working with summary data sets, which was the best actuaries could do given the system limitations. In fact, the models are also changing from descriptive to predictive and ultimately, to prescriptive.

Analytics Changing the Actuarial Profession

Actuaries have been the insurance industry's original data scientists and innovators of insurance predictive modeling since the profession's beginning. The early predictive models developed by actuaries were, of course, constrained by available data and technologies. Here's a quick timeline:

- In 1880, life actuaries realized that attained age was predictive of life expectancy. (While this seems obvious today, it was actually controversial at the time.)
- When states began adopting workers' compensation laws more than 100 years ago, actuaries determined in 1915 that occupation was predictive of claim costs, developing work classifications and data systems to predict variations in costs.
- By 1963, age, gender, marital status and vehicle use were already reliable predictors of auto accident costs. Soon after, the first minimum bias multi-variable rating plan was developed in 1965.
- The American Insurance Association, in 1975, sponsored development of an industry financial database, including carriers that had failed; using that database, actuaries helped to develop a linear discriminant model to predict future insolvencies.
- During the early 1990s, innovative companies found a relationship between individual credit scores and accident predictability.
- Ten years later, predictive modeling had already taken root in other insurance lines including homeowners and small commercial.

From the timeline above, what is clear is that the actuarial role in building predictive models is a constant; what has changed is the technology.

While actuaries are the original architects of insurance predictive modeling, data scientists and statisticians have played a significant role in expanding modern predictive analytics. In a sense, at least in the context of insurance, the data scientists may be trying to reinvent the actuarial profession.

Actuarial employers have been telling CAS leadership that there is a talent shortage of professionals who offer three critical skills: data science, modern analytics skills and deep knowledge of the insurance industry. There are certainly some casualty actuaries who have all three skill sets. These individuals have often been working quietly behind the scenes to develop innovative pricing and risk selection models in auto and homeowners, and have been leading efforts to expand predictive modeling in other areas.

What is most important is that, candidly, employers are telling us that actuaries lack expertise in the first two skill sets. The advanced degree data scientists offer the first two skill sets but lack what actuaries have: the understanding necessary to apply models correctly.

For now, insurers are building teams from both disciplines to satisfy their needs, but there is a lag time in seeing results because it takes a lot of

President's Message, page 8

Special Call for Cyber Insurance Data

ISO has issued a special call for cyber insurance data asking insurers to contribute data that will help address a major issue facing today's insurance market: the need for more detailed underwriting and rating information about cyber risk.

As part of the call, we'll collect premium and loss data for cyber-related first-party and liability coverages written between 2010 and 2014. The data will be aggregated and analyzed and will be available to insurers that submitted data.

Submit your data!

Deadline

The due date for responding to the Special Data Call is September 30, 2016

Participate today

If you have questions, you can e-mail CyberSpecialCallRequest@verisk.com

All insurers, regardless of whether they currently report data to ISO, are invited to submit data. For more information, please visit the ISO Cyber Solutions site at http://www.iso.com/cyber

President's Message

from page 6

training to get both professions up to speed. Employers would prefer to hire professionals who embody all three skill sets — the center of the Venn diagram.

The sooner quantitative professionals satisfy their skill set deficiencies, the better positioned they will be for success in the emerging business model.

Responding to the Need

The CAS is responding to that need for all quantitative professionals to have these three skill sets.

First, we are aggressively pursuing changes to the actuarial curriculum to add topics on data management and contemporary analytics techniques to better align actuaries with current and future insurance company needs. The CAS has already introduced an entirely new statistics exam focused on the foundational material that underlies modern predictive analytics.

Further additions to the syllabus are under development, e.g., to address data management. By upgrading coursework and exams to be more focused on analytics, the CAS is already providing actuaries a path forward into the center of the Venn diagram.

Second, we have substantially increased our continuing education directed towards data and analytics. In 2015, the CAS offered more than 160 hours of continuing education directed towards data/analytics topics. In 2016, we are on track to exceed that figure.

Third, and perhaps most importantly, we announced the formation of a wholly owned subsidiary, The CAS Institute, at our annual meeting last November.

Informally called iCAS, the program will offer a separate credential in data science and predictive analytics. Curriculum development for this credential is nearly complete and will include requirements in the three skill sets later this year.

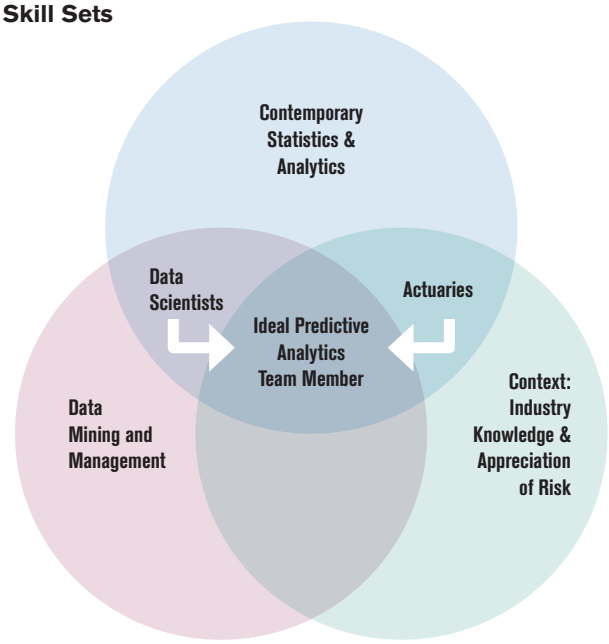
Employers verify the need for a credential such as the one to be offered by iCAS because it offers assurance that potential hires have a baseline level of the three skills sets. Unlike traditional actuarial credentials, the iCAS credential is highly recommended but optional.

Currently under development, the first credentials will focus on predictive analytics and data science. Over time, iCAS will be offering training in catastrophe model analytics, capital modeling and quantitative reinsurance analysis. To learn more, please visit http://bit.ly/266bO4W.

Since data scientists are also interested in being in the center of the Venn diagram, iCAS is available to them as well. While some believe that data scientists are a threat to the actuarial profession, I do not see a "turf war" between both professions. Instead, I believe iCAS is one way to invite data scientists into a bigger CAS tent.

I am excited about iCAS because it will provide an opportunity for actuaries to grow into the profession's present and future. I hope you are too.

Building an Effective Predictive Analysis Capability: **Converging Around Three Key Skill Sets**



ACTUARIAL REVIEW *LETTERS POLICIES*

Letters to the editor may be sent to ar@casact.org or the CAS Office address. 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. Announcement of events will not be printed.

COMINGS AND GOINGS

Great American's Property and Casualty Group has promoted **Lisa A. Hays, FCAS, CPCU**, to vice president and chief actuary. Hays has over 25 years of industry experience in the areas of pricing, reserving, reinsurance, product management, strategic planning and predictive analytics.

Terri Dalenta, FCAS, has joined Grange Insurance as executive vice president, CFO. In this role, Dalenta will lead Grange's financial management, enterprise risk management and investments, as well as maintain the company's financial strength. Dalenta most recently served as SVP of property product management for Allstate Insurance in Chicago. Prior to Allstate, Dalenta served as EVP and chief risk officer for Aviva North America and as chief risk officer and corporate chief actuary for Safeco Insurance.

Main Street America has appointed **Daniel D. Blau, FCAS**, as an assistant secretary in its Jacksonville headquarters. Blau is responsible for defining and directing actuarial efforts to achieve Main Street America's desired loss ratio, production, profit and growth objectives in personal lines through pricing and rate structure strategies. Blau joined Main Street America in 2014 from Hartford Financial Services where he led research, product development and pricing efforts in personal lines.

Jamie Shooks, FCAS, MAAA, has joined Milliman, Inc. as a consulting actuary in the Philadelphia office. Prior to joining Milliman, Shooks worked at The RiverStone Group, supporting merger & acquisition due diligence and analysis of long-tail lines. He previously held positions in the risk management department of PulteGroup, Inc.

Longtime reinsurance executive, **Kara Raiguel, FCAS, MAAA**, has been named CEO for the Gen Re Corp. unit of Berkshire Hathaway Inc. Ajit Jain, who oversees Berkshire Hathaway Reinsurance Group, describes Raiguel as his "secret weapon" for ten years and a "true renaissance woman in the insurance and reinsurance industry." Raiguel's work includes the creation of a large California workers' compensation program and a foray into India's reinsurance market. Her first priority is to decide how best to add business without sacrificing underwriting discipline and business integrity.

Dustin Loeffler, FCAS, has been promoted to director with Aon Benfield. Loeffler is based in Aon Benfield's Chicago office and has been an associate director with the reinsurance broker since February 2013. He provides analytic support to clients to aid in their reinsurance purchasing decisions with primary responsibility on all of Aon Benfield's surety placements. Loeffler previously worked for CNA Insurance in Chicago and Horace Mann Insurance in Springfield, Illinois.

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

IN MEMORIAM

James A. Faber (FCAS 1969)
1935-2016

CALENDAR OF EVENTS

Interactive Online Courses
"Understanding CAS Discipline Wherever You Practice"
"Introduction to Predictive Modeling"
"Statistics for Reserve Variability Series"
www.casact.org/education/interactive/

September 18-20, 2016
Casualty Loss Reserve Seminar (CLRS) & Workshops
Hyatt Regency O'Hare
Rosemont, IL

October 6-7, 2016
Enterprise Risk Management for the P&C Actuary
Hotel Sofitel Philadelphia
Philadelphia, PA

October 27-28, 2016
In Focus: The Gathering Storm — Digital and Climate Disruptors
Marriott Montréal Chateau Champlain
Montréal, Québec

November 13-16, 2016
CAS Annual Meeting
Loews Royal Pacific Resort
Orlando, FL

TWENTY-FIVE YEARS AGO IN THE *AR* BY WALTER WRIGHT

New Digs: The CAS Gets Its Own Place

In August 1991, new CAS Executive Director Tim Tinsley announced the move of the CAS office from New York City to the Washington, D.C. area.

CAS Office in Virginia Opens for Business

As anticipated by CAS President Charles Bryan in the February 1991 issue of *The Actuarial Review*, the CAS office has relocated from New York City to the Washington metropolitan area. This was accomplished in March and the transition process was completed in July.

During the New York years, while the CAS was leasing space at the National Council on Compensation Insurance, receptionist/switchboard and office services (including the mail room) were provided by the NCCI. The office has already begun the process of relieving the committees of various copying, printing, and mailing burdens ...

I was pleased to join the CAS office on May 13 and to assume responsibilities as executive director. With our current staff and planned additions, we will be seeking to implement and exploit the enhanced capability of the CAS office to provide a higher level of membership services. A prime objective will be to assume the administrative aspects of the volunteer committees, thereby leveraging the actuarial related efforts of these committees. Another priority will be to support, at the staff level, the evolving requirements of the interorganizational Working Agreement of the North American Actuarial Groups.

Meet Jennifer Walton, IT and Online Services Manager

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

- **What do you do at the CAS?**
  I manage our websites, the membership database, the office network and all the audio visual equipment that goes to our events.
- **What do you enjoy most about your job?**
  Any time we launch a new online service or web tool for our members is quite satisfying. Also, I really enjoy meeting members, especially the ones with whom I've worked on committees.
- **Hometown:**
  Downingtown, Pennsylvania
- **College and degree:**
  Shippensburg University, BS in Computer Science.
- **First job out of college:**
  I worked as a business support analyst at Unisys developing internal web pages and web-based, database-driven applications.
- **Describe yourself in three words:**
  Happy. Patient. Fun.
- **Favorite weekend activity:**
  I like going geocaching with my husband and our dog, which usually involves hiking and exploring new places.
- **Favorite travel destination:**
  Any of the U.S. National Parks.

Jennifer Walton

- **One interesting or fun fact about you:**
  I love rugby! I learned to play in college and continued after college on a competitive U.S. women's rugby club. Now I play rugby socially and team up with friends in fun tournaments all around the U.S.

The CAS Participation Survey is Available in July 2016

With approximately one in three CAS members volunteering, the CAS boasts a rich culture of volunteerism. The annual Participation Survey is the primary means of staffing CAS committees.

Find Your Ideal Volunteer Opportunity

Whatever your interests or talents, there is a CAS volunteer opportunity waiting for you.

Working on CAS Committees is a great way to meet other CAS members with similar interests and to develop interpersonal and time management skills. Many volunteer opportunities offer a chance to become involved in pioneering fields of actuarial practice. You're not limited by geography — participation by members outside the U.S. and Canada is strongly encouraged. And if you're limited on time, there are some short-term commitments available.

The CAS Commitment to Volunteers

The CAS leadership is committed to seeing that everyone who is interested in serving on a CAS committee gets an opportunity to do so. Committee chairs will contact anyone who indicates on the form that they are "very interested and intend to serve if asked" on a particular committee.

Get Involved!

Volunteering not only benefits the Society, but the volunteer, too.

To browse a listing of committee descriptions and search for volunteer opportunities, visit http://bit.ly/28NOUHq.

The Participation Survey must be completed by July 31, 2016. If you have questions about the Participation Survey, please contact Matt Caruso at mcaruso@casact.org.

MEMBER PROFILE BY MATT CARUSO, CAS MEMBERSHIP AND VOLUNTEER MANAGER

By Emulating Her Parents, Erdfarb Gives Back

Adina Erdfarb, FCAS, MAAA, CPCU, grew up in Highland Park, New Jersey, with career aspirations that were far from actuarial. An avid sports fan with a strong interest in writing, she regularly read *Sports Illustrated* and *The New York Times* sports section cover-to-cover. She was inspired by reporters who transcended sports through the power of their writing and aspired to do the same. She wrote for several print and online platforms before sensing a shift in the world of journalism and turned her attention to mathematics.

Erdfarb first learned about the actuarial career during her senior year at Bruriah High School in Elizabeth, New Jersey. She was drawn in by its focus on quantitative and critical thinking skills. "I knew I was pursuing a career as an actuary," she said, "but at the time, I had no idea that I was embarking on a job as an insurance industry professional."

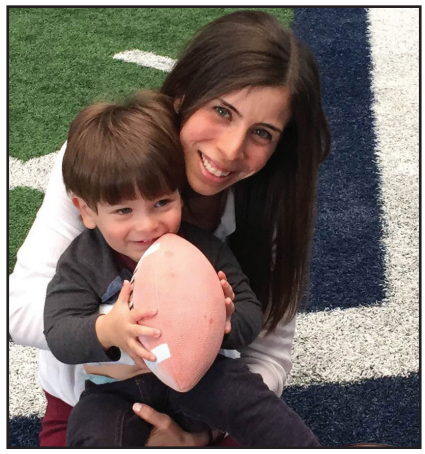
Her first job out of college was at Chubb, where she interned after her junior year at Yeshiva University in New York. She started in the loss reserving department and, after several years, rotated to her current role in commercial property/liability pricing. "Loss reserving provided me with a broad yet focused view of the company, as well as a solid foundation of actuarial concepts," she said. "In my pricing role, I have rounded out my perspective of the organization and the industry as a whole."

Within a month of starting full-time at Chubb, Erdfarb saw a posting on the CAS website for candidate representatives to the Candidate Liaison Committee (CLC). She jumped at the opportunity. "I was raised in a household that put a heavy emphasis on volunteering for local organizations and community institutions," she said. Growing up, she regularly saw her parents end their long workdays with a school board meeting or neighborhood function, and she pledged to emulate this worthy attribute.

Erdfarb was further encouraged by the fact that her voice was truly being heard and that her opinions were having a positive impact on CAS candidates. The CLC's quarterly publication of *Future Fellows* also gave her the opportunity to tap into her journalism background and to write and edit articles on a regular basis.

Upon becoming an ACAS and an FCAS, Erdfarb remained on the CLC as a committee member and also branched out to volunteer on the Committee on Professionalism Education and the New Members Committee. She is now vice chair of the Committee on Online Services, for which she has largely focused on CAS social media engagement.

Erdfarb uses CAS participation to employ and improve her written and oral communication skills, whether by authoring blog posts for CAS Student Central or presenting at CAS meetings. She now serves as a CAS University Liaison to Yeshiva University and has coordinated CAS mentoring programs in the past. She has also pursued professional growth outside the CAS, completing the CPCU credential last year.



Adina Erdfarb

Erdfarb has maintained her keen interest in sports and is an avid fan of the New York Yankees, Rangers and Giants. In her free time, she choreographs, dances and participates in community dance outreach activities. She is also an ardent traveler whose most recent trip was to Alaska's Inside Passage.

Throughout her career, Erdfarb has maintained her goal of well-roundedness. She aims to look beyond the traditional confines of the actuarial profession and incorporate perspectives of underwriters, claims professionals and others in the insurance field. She strives to further the actuarial profession by mentoring up-and-coming actuaries. in both formal and informal settings. "While a CAS-based actuarial education is of utmost importance in the P&C industry, it's often the non-actuarial experiences that enhance our value proposition as a profession and that will keep us relevant for years to come."

CAS Introduces a Case Competition Toolkit

BY MELISSA TOMITA, UNIVERSITY ENGAGEMENT COMMITTEE (UEC) CHAIR, AND ERIN OLSON, UEC WORKING GROUP CHAIR

Competitions Held at Arizona State University and University of Texas at Austin

Step into an Arizona State University (ASU) classroom on a typical Saturday morning and you might find empty desks and a blank chalk board. This was not the case on March 19, 2016. On this particular Saturday, the first annual ASU Property & Casualty Case Competition was taking place. After working through the case materials for the last couple weeks, each team had the morning to finalize its solutions. Students had the help of six experienced actuaries to answer any last questions. One team was planning the flow of its presentation, another was listening to a volunteer explain the considerations needed for prospective trends, and yet another was documenting its Excel workbook. Presentations would be held after lunch and each team wanted to make sure everything was just right. There were not only bragging rights at stake, but award money for the winning team, thanks to the joint sponsorship of the competition by the ASU School of Mathematical and Statistical Sciences and the CAS.

A similar scene took place on a Saturday two weeks later at The University of Texas at Austin (UT-Austin). In the week leading up to this school's case competition event, participants from five teams met twice, first for a kickoff presentation to receive the case materials and then again a few days later for an opportunity to meet and to ask questions of two volunteer CAS members who provided insights on the case based on their real-world experience. After a whirlwind week of learning some fundamental actuarial concepts, researching the details of the case from resources such as the Highway Loss Data Institute, and preparing a professional presentation, the student teams reconvened on Saturday, April 2 to give their final presentations to a panel of four judges and compete for first and second place in the competition.

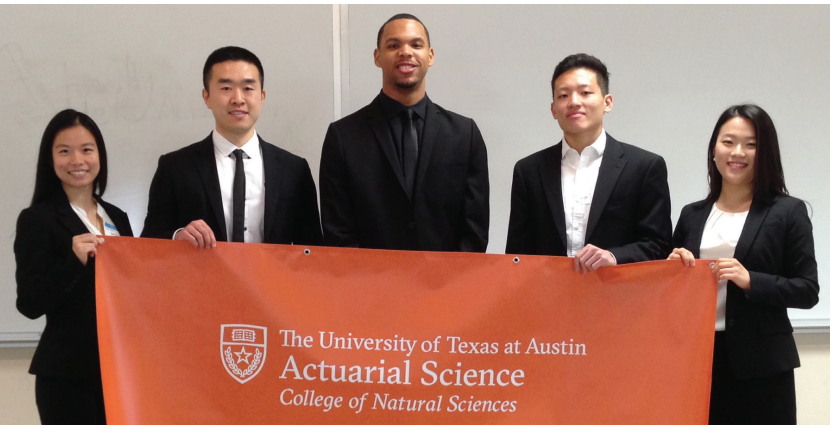
Both ASU and UT-Austin used case competition materials created by the CAS University Engagement Committee (UEC) to facilitate planning and running a case competition for university students. The materials center around an auto safety features case and are part of the CAS Case Competition Toolkit, which contains:

(1) A facilitator guide.
(2) An introductory presentation.
(3) A case study.
(4) An Excel workbook.
(5) A grading rubric.
(6) An award certificate.
(7) Promotional material.

The Auto Safety Features Case is the first in a series of property-casualty cases that will be released in the coming year. The next case to be released focuses

Arizona State University students pause for a photo opp during the case competition.

ASU's winning team, Game Time, are (from left to right) Yimin Tang, JuliaTang, Hieu Tran and Alex Sabrowksy.



The winning team at UT-Austin, Risk Pool, are (from left to right) Jenny Guo, Tianxi Ji (TJ), Justice Washington, Michael Huang and Elin Kim.

Student participants, faculty and CAS volunteers at the case competition held at the University of Texas at Austin.

on workers' compensation and will be available this fall.

Five teams presented at each school. Afterwards, the students were left to wait anxiously as the judges determined the winners. The deliberations were tough for judges at both schools, given so many well-thought-out, unique approaches by the competing teams.

The winning team at ASU was Game Time, consisting of Alex Sabrowksy, Julia Tang, Yimin Tang and Hieu Tran. They will present their solution at the Casualty Actuaries of Desert States' meeting in June. The other competing teams will each present a different section of the overall presentation (introduction, research, methodology and marketing).

The winning team at UT-Austin was Risk Pool, made up of Tianxi Ji (TJ), Jenny Guo, Michael Huang, Justice Washington and Elin Kim. Risk Pool will present at the next meeting of UT-Austin's Actuarial Science Club.

The ASU and UT-Austin faculties were pleased with the support that CAS volunteers provided for the case competitions.

"Reflecting on the day, both the students and the faculty at ASU found this to be an invaluable experience," said Jelena Milovanovic, ASU actuarial science coordinator. "Exposing students to a real-life scenario gives them an opportunity to learn about the actuarial profession whilst highlighting the importance of teamwork."

Alisa Walch, FCAS, assistant director-actuarial program at UT-Austin, coordinated the case competition, which was the first ever hosted by the UT actuarial program. Walch said that the students benefited from the chance to network and get advice from the actuaries participating. "The competition . . . helped [the students] to start thinking like actuaries, leaving behind the idea that every problem has only one solution," said Walch. "The competition was a success, and we're hoping to do it again next year. A big thank you to the CAS for doing a lot of the work for us and putting together the case competition toolkit."

"Exposing students to a real-life scenario gives them an opportunity to learn about the actuarial profession whilst highlighting the importance of teamwork."

—Jelena Milovanovic, ASU actuarial science coordinator

The CAS toolkit materials are easily customizable for any competition. The toolkit was released in March 2016 to CAS University Liaisons and Academic Central Members and is available to CAS members who contact Tamar Gertner, CAS University Engagement Manager, at tgertner@casact.org.

In addition to providing the Case Competition Toolkit, the CAS is available to provide support and guidance with case competitions for university students, including volunteer recruitment and event promotion. Please contact the CAS University Engagement Committee for more details!

Melissa Tomita, FCAS, is an E&S director for Nationwide Insurance Company in Scottsdale, Arizona. Erin Olson, FCAS, is auto pricing director for United Services Automobile Association in San Antonio, Texas.

The CAS Grants First University Awards

Illinois State University, University of California, Santa Barbara (USCB), University of Connecticut and University of Illinois at Urbana-Champaign Share Honors

This June the CAS recognized four schools through its first-ever University Award Program: Illinois State University; University of California, Santa Barbara; University of Connecticut; and University of Illinois at Urbana-Champaign. These schools are awarded for their achievements in exposing students to the property-casualty insurance industry through curriculum, research, engagement and innovation.

Universities play a unique role in advancing the body of knowledge of actuarial science and preparing the actuaries of the future. The CAS University Award Program was created to facilitate the promotion and sharing of ideas around property and casualty curriculum and research within academic communities.

The CAS University Engagement Committee spent nearly two years developing the award program. In January 2016 the program was announced to the public, and schools were invited to be nominated. The positive response to the call for nominations was overwhelming; the CAS received over 70 nominations for 24 schools throughout North America, Asia and Australia. The nominations came in from alumni, current students, professors, administrators and CAS University Liaisons.

"The selection process was a challenge because there are so many schools doing really exciting work," said Chris Coleianne, FCAS, who chaired the CAS University Award Program. "It is clear that with the evolution of the property and casualty industry, colleges and universities have made significant efforts to ensure that their students are fully prepared for a career in the industry."

Following are brief descriptions of the 2016 CAS University Award winners.

ILLINOIS STATE UNIVERSITY
Illinois' first public university.

Illinois State University

Led by Krzysztof Ostaszewski and consisting of 12 faculty and 210 actuarial students, Illinois State University counts a significant number of P&C actuaries among its alumni: During the program's 20-year history it has produced 58 Fellows and 48 Associates of the CAS. Illinois State stood out for its industry engagement and innovations such as the Pinnacle University initiative, which, since 2014, has paired actuarial students with analysts from Pinnacle Actuarial Resources to solve case studies. Students are able to gain real-world P&C industry experience through internships, case studies, and case competitions made available through the actuarial science program. In terms of scientific study, Illinois State's faculty has consistently produced research on P&C insurance topics; its students also have opportunities to conduct research in this area. Property-casualty insurance concepts are built into the actuarial science curriculum with specific courses that cover CAS Exam S at the undergraduate level and CAS Exams 5 and 9 at the graduate level.

The current actuarial club leadership at Illinois State University.

Student volunteers from UCSB Actuarial Association.

University of California, Santa Barbara (UCSB)

Co-directors and professors Raya Feldman and Michael Ludkovski head up this program of five actuarial faculty including two FCAS and 266 students. Highlights of UCSB's program include a commitment to incorporating property-casualty studies into the actuarial science curriculum, with topics covering material on CAS Exam S, property and liability coverages, and pricing and reserving methods. Other standouts include hosting the 2014 Actuarial Research Conference

In a standing-room-only crowd of UConn students, UConn Adjunct Professor Pat Teufel, FCAS, discusses the opportunities awaiting property-casualty actuaries. Teufel is a past president of the CAS.

that had several P&C sessions; offering opportunities for students to work directly with P&C companies on research projects; and holding innovative events like Actuary Day and the California Actuarial Student Conference that expose students to the P&C insurance industry. At Actuary Day in 2015, more than 100 students were engaged in a reserving project. Students also gain additional industry exposure through participation in case competitions and P&C events hosted by the CAS and the Southern California Casualty Actuarial Society, a CAS Regional Affiliate.

University of Illinois at Urbana-Champaign Actuarial Science Club Members.

University of Connecticut (UCONN)

In existence for 40 years, UCONN's actuarial science program has several P&C insurance course offerings — ratemaking, loss models and risk theory, among others — which all make this school an outstanding award recipient. The program, led by director James Trimble, serves 450 actuarial students taught by six full-time faculty in actuarial science and 12 adjunct professors. UCONN faculty and students regularly attend meetings held by the local CAS Regional Affiliate Casualty Actuaries of New England; the goal is to expose undecided students to P&C actuarial work. UCONN also sponsors a strong internship program supported by all major P&C insurers, consulting and audit firms in New England. Additionally, through the Goldenson Center for Actuarial Research on campus, students and faculty have an opportunity to conduct research projects with P&C industry professionals.

University of Illinois at Urbana-Champaign

The University of Illinois has 430 students in its actuarial science program, with two full-time faculty members, Professor Runhuan Feng and Professor Shu Li, teaching actuarial science courses exclusively, and several other faculty members across the departments of mathematics, statistics and finance dedicated to the teaching of the program. Robust P&C courses and topics are incorporated into the actuarial science curriculum, including courses titled "Casualty Actuarial Science and Property and Liability Insurance," as well as courses covering material on CAS Exam S. The University has strong connections to the P&C insurance industry, as reflected by campus visits in fall 2015 by 15 P&C companies. Students are able to participate in research with industry partners such as through the Axis Student Challenge, organized by Axis Capital. The University has also partnered with State Farm to offer student internships with State Farm's research office in Champaign as well as scholarships and other research opportunities.

Congratulations to the Winners

The four winning schools will each receive a grant of $5,000, and will be honored at the 2016 CAS Annual Meeting in Orlando this November. The CAS is excited and enthusiastic to promote these schools for the work they are doing in preparing the next generation of CAS property-casualty actuaries!

The CAS Institute Announces Requirements for Inaugural Credential

The CAS Institute has announced the requirements to earn its inaugural credential, which is a certification for those working in data science and predictive analytics.

The CAS Institute is a newly-formed subsidiary of the Casualty Actuarial Society that will provide specialty credentialing and professional education to quantitative specialists in selected areas. Last November, the CAS Institute announced that the first credentials to be granted will focus on data science and predictive analytics, with other specialty areas to follow.

The organization has now released the general requirements necessary to attain this first credential. Candidates will be required to complete four components, which will demonstrate their knowledge and competencies in data science and predictive analytics. (See Chart 1.)

Chart 1. The CAS Institute Criteria for First Credential.

Topic	Assessment Method
1. P&C Insurance Principles	Online module and exam
2. Data Concepts, Tools, and Visualization	Computer-based exam
3. Predictive Modeling – Methods and Techniques	Computer-based exam
4. Predictive Modeling Application Project	Individual project with advisor and review panel

The requirements were established by a panel of data science and predictive analytics subject matter experts charged with developing the specific program characteristics for the credential. The panel's continued work will include outlining learning objectives for each topic, creating the curriculum, directing development of educational materials, setting the competency levels, and overseeing examinations and scoring.

The panel will also define the experienced practitioner program, which will allow for the granting of credentials to those working in data science and predictive analytics who are recognized as having the requisite knowledge, practical experience, and evidence of achievement as accomplished professionals in the field.

The CAS Institute's programs are designed for professionals seeking recognition through a credential in specialized quantitative practice areas and looking to distinguish themselves from other professionals through evidence of expert, specialized knowledge. It is expected that professionals holding the credentials can leverage this recognition to secure additional job duties, attract premium compensation and advance their careers.

Additional details about the inaugural credential, including detailed learning objectives for each topic, will be released later in 2016.

For more information, visit TheCASInstitute.org for CAS Institute announcements and a set of Frequently Asked Questions.

ERM for the P&C Actuary

October 6-7, 2016

Hotel Sofitel Philadelphia

Philadelphia, PA

NEW FELLOWS ADMITTED IN MAY 2016

Row 1, left to right: *Megan Anne Meier, Kari A. Palmer, Wenyuan Wu, Giorgio Alfredo Spedicato,* **CAS President Stephen P. Lowe**, *Cunhua Shi, Jennifer W. Louie, Katherine Williamson, AJ Markham.*
Row 2, left to right: *Carrie F. Miller, Alyssa Lyn Mansolf, Oneida Charrett, Eric James Wunder, Isaac Mostov, Lai-yue Sam Luo, Alexander Esmail Alimi.*
Row 3, left to right: *Matthew Grayton Murphy, Scott Nelson Applequist, Sarah Dupuis-Carrier, Xiao Xu, Alex Wesseling, Xin Guo.*

Row 1, left to right: *Joel Aaron Pepera, Marla E. Strykowski, Ying Yuan, Ian Colan Mui,* **CAS President Stephen P. Lowe**, *Chuan-Wei Wu, Abby L. Sternberg, Erin Olson, Christian Hammond.*
Row 2, left to right: *James Coyle, Mitchell Lee Underwood, Daniel Moskala, Brad Thomas Neilson, Michael Daniel Wallace, Waley Chun, Nadya Kuzkina, Nicole Cathryn Dikun.*
Row 3, left to right: *Jonathan R. Mesagaes, Easter H. Namkung, Jeffrey S. Stehlgens, Michael Brandon Synowicki, Joseph Buehner, Esaie Djossou, Jean-Michel Belanger.*

Row 1, left to right: *Jimmy Houng, Vincent Li, Pamela Hughes, Alexandre Dionne,* **CAS President Stephen P. Lowe**, *Qianxin Deng, Zhengzheng Yang, Kenneth Lee, Haseeb Rehman.*
Row 2, left to right: *Guang-Yu Hu, Bryan M. Pack, Erik Peter Olson, Alvin Tan Jin Kuan, François Bellavance, Farhan N. Chaudhry, Guy Rabinowitz, Charles Hammal, Vera Sakalova, Christina Pop.*
Row 3, left to right: *Qi Wang, Andrew J. Draper, Weiming Hong, Jianbin Liu, John Russell Rose, Jesse Carroll, Derrick Chen, Drew R. Russell, Kai Kwan Yeung, Yi-Wei Teo.*

New Fellows not shown: *Wesley Arai; Samuel Nicholas Charters; Erin Gerber Davidson, CERA; Robert Kenneth Dohner; Gilbert Grady Jr.; Bradley M. Henderson; Chan Hoon Lee; David Mamane; Benjamin Isaac Mermelstein; Andrew D. Otto; David Jeremiah Whalen; Dennis C. Wong; Bihling Wu; Andrew Ryan Yuhasz; Thomas Nelson Zdon.*

NEW CHARTERED ENTERPRISE RISK ANALYSTS

Derek Parker Chapman, FCAS
Dengxing Lin, FCAS

NEW FELLOWS BY MUTUAL RECOGNITION

Oliver Graham Bale
Zurich Insurance Company
Fellow of the Institute and Faculty of Actuaries, U.K.

Berna Beekman
Deloitte Consulting, LLP
Fellow of the Institute and Faculty of Actuaries, U.K.

James Coyle
Willis Towers Watson
Fellow of the Institute and Faculty of Actuaries, U.K.

Wai Fong Yip
Allianz Global Corporate & Specialty
Fellow of the Institute and Faculty of Actuaries, U.K.

NEW ASSOCIATES ADMITTED IN MAY 2016

Row 1, left to right: *Stephanie Heiser, Tamara Georgeievna Mihaelyan, Andrew Williamson, Nicholas Stone Mancini,* **CAS President Stephen P. Lowe**, *Matthew S. Blumenthal, Constanza S. Giordano, Katelyn Crunk, Erik Charles Miller.*
Row 2, left to right: *Daniel K. Nishimura, Eugene Itskovich, Weixin Wu, Erin B. Lachen, Aleksey G. Vulf, Brian H. Stein, Allison Marie Salisbury, Kelsey Marie Thraen*
Row 3, left to right: *Elizabeth A. Casazza, Helen Y. Zhao, Christopher Craig Cortner, Cherity A. Ostapowich, Ken Jeremy Hawkins, Zach Espe Dietz, Zachary Andrew Fischer*

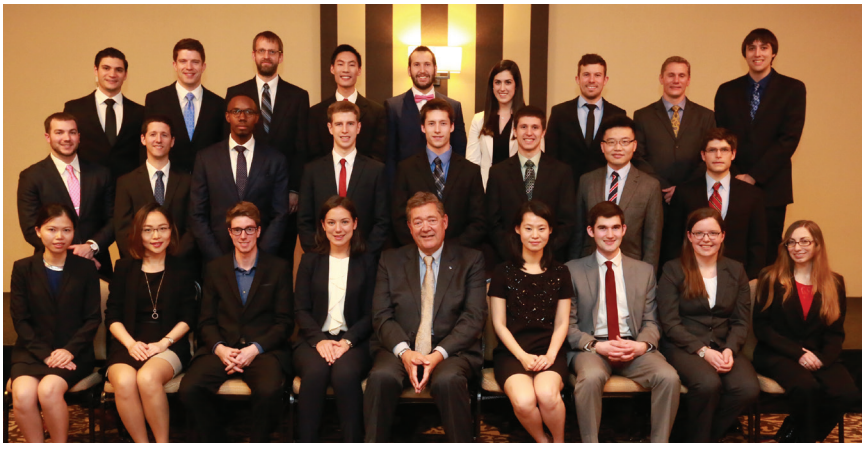
Row 1, left to right: *Pamela Brittany Biewer, Lok-Yi R. Kwok, Gloria Amakobe Gilliam, Yisi Lu,* **CAS President Stephen P. Lowe**, *Alex James Harris, Claire Wei, Yitian Qin, Jose Angel Torres.*
Row 2, left to right: *Eric T. Smith, Hyunmook Cho, Marjorie Rebecca Kitchen, Michelle Ting, Hugh Lee, Hong Shen, Erin Elizabeth Fogarty, Ian David Mackenzie.*
Row 3, left to right: *Yi Wu, William J. Thorsson, Maighdlin R. Wright, Jon Beaver, Jeffrey R. Slocum, Dustin Schneider, Austin R. Mitchell, Geoffrey D. Hackman.*

Row 1, left to right: *Jingting Yi, Yanzhu Chen, Chrisma Leysen Manuel Juan, Dongmei Han,* **CAS President Stephen P. Lowe**, *Theresa Kamykowski, Deborah R. Volstromer, Shu Li, LiBin Guo.*
Row 2, left to right: *Adam Joseph Braithwaite, Lauren Campbell, Ryan J. Ferguson, Lauren K. Albury, Andrew A. Duhancioglu, Paul Donald Rosing, Andrew J. Herrmann, Ross V. Fernwood, Adam Lewis.*
Row 3, left to right: *Vinaya Adusumilli, Alyssa Martin, William Frank Nichols, Brian Wiest, Martin Surovy, Matthew J. Stephenson, Homero Gongora, Ethan Yisung Kang.*

Row 1, left to right: *Kyle L. Mathews, Douglas Fry, Justin Sherwin, Bruce H. Yang,* **CAS President Stephen P. Lowe**, *Brian C. Settle, Russell Andrew Linder, Kelsie A. Paquin, Max Unger.*
Row 2, left to right: *Lingxiao Li, Sue Ann Loo, Wen Wang, Michael Golding, Tony Li, Scott Andrew Macneil, David E. Herson, Jordan Richard.*
Row 3, left to right: *William Christian Johnson, Bao Anh Duc Nguyen, Emily K. Donatelli, Matias Galker, Daniel H. Kwon, Anuttama Sheela Mohan, Kamolphan Weeraklaew, Andrew J. Brady, Colin J. Heydorn.*

NEW ASSOCIATES ADMITTED IN MAY 2016

Row 1, left to right: *Ryan H. Hoffman, Samantha J. Andrews, Katelyn M. Jeffreys, Timothy Frank Mankowski,* **CAS President Stephen P. Lowe**, *Kyle P. Wurtz, Brian T. Schwartz, Matthew York Berry, Jonathan M. Statman.*
Row 2, left to right: *Matthew J. Gentile, Michael D. Anderson, Chen Chen, Corey Grover Berg, Kenneth Bruce Poole, Zoe Pictor Lester, Ellen E. Ruppert, Nancy Anne Narisi, Regina Tze Sin Chan.*
Row 3, left to right: *Aaron D. Dahlke, Weimiao Guo, Courtney Zhu, Lulu Ji, Yu Shi Feng, Benjamin Thomas Woods, Tyler A. Kroetsch, Kamran Lakhany, Maya Abou Rjeili, Moshe Preiserowicz*



Row 1, left to right: *Saiying He, Heesun Lee, Maxim Proulx-Rivard, Nicole Elizabeth Van Allen,* **CAS President Stephen P. Lowe**, *Chen Wang, Nicholas Hamwey, Melanie Modrick, Victoria Rose Krueger.*
Row 2, left to right: *Brandon S. O'Hara, Robert V. Demarco, Temar T. Richards, William Chabot, Vincent Roy, Stefan Ray Ciszewski, Xin Wang, Carl Joseph Raimond.*
Row 3, left to right: *Nicholas A. Cerminara, Conner A. Billings, Ryan Lyle Hansen, Wesley Jenq, Pierre-Luc Legresley, Amelie Fournier, Etienne Beland, Eric Kitchens, Brett R. Hall.*

Row 1, left to right: *Caitlin Dorothy Simmons, Jaison Lehoux, David Morin, Nikola Petkov,* **CAS President Stephen P. Lowe**, *Mohammed Moussaïf, Marc-André Clermont, Hugo Houde, Jacob B. Lain.*
Row 2, left to right: *Marikym Hebert, Melissa A. Anderson, Patrick Desjardins, Steven M. Burak, Melissa Ann Rudisaile, John William Michael, Kevin T. McInturff, Ryan Shivy, Dhimal Vagh.*
Row 3, left to right: *Brandon S. Smith, Marc-Olivier Menard, Steven Ma, Jeffrey M. Feder, Martin Ho, Brendan G. Callahan, Ziyu April Li, Andrew Hutchinson, Christopher Wetzel.*

Row 1, left to right: *Anna Wu, Daniel Mena-Martinez, Bradley Frost, Michelle Rutman,* **CAS President Stephen P. Lowe**, *Diana Shen, Qian Cui, Thomas M. Foster, Erica C. Griest.*
Row 2, left to right: *Adwaita D. Bhagwat, Enrique Moran, Ann Vu, Cara Wyrostek-Jarman, Yue Xi, Erin C. Campbell, Amanda Funk-Hoag, Long Huynh, Albert J. Hsueh, William Litner.*
Row 3, left to right: *Andrew Austin Hefte, Sumit S. Koli, Richard Avonti, Julie Ann Frechette, John Joseph Clark, Misha S. Rajcoomar, Scott H. Will, Nan Wu, Michael L. Alfred.*

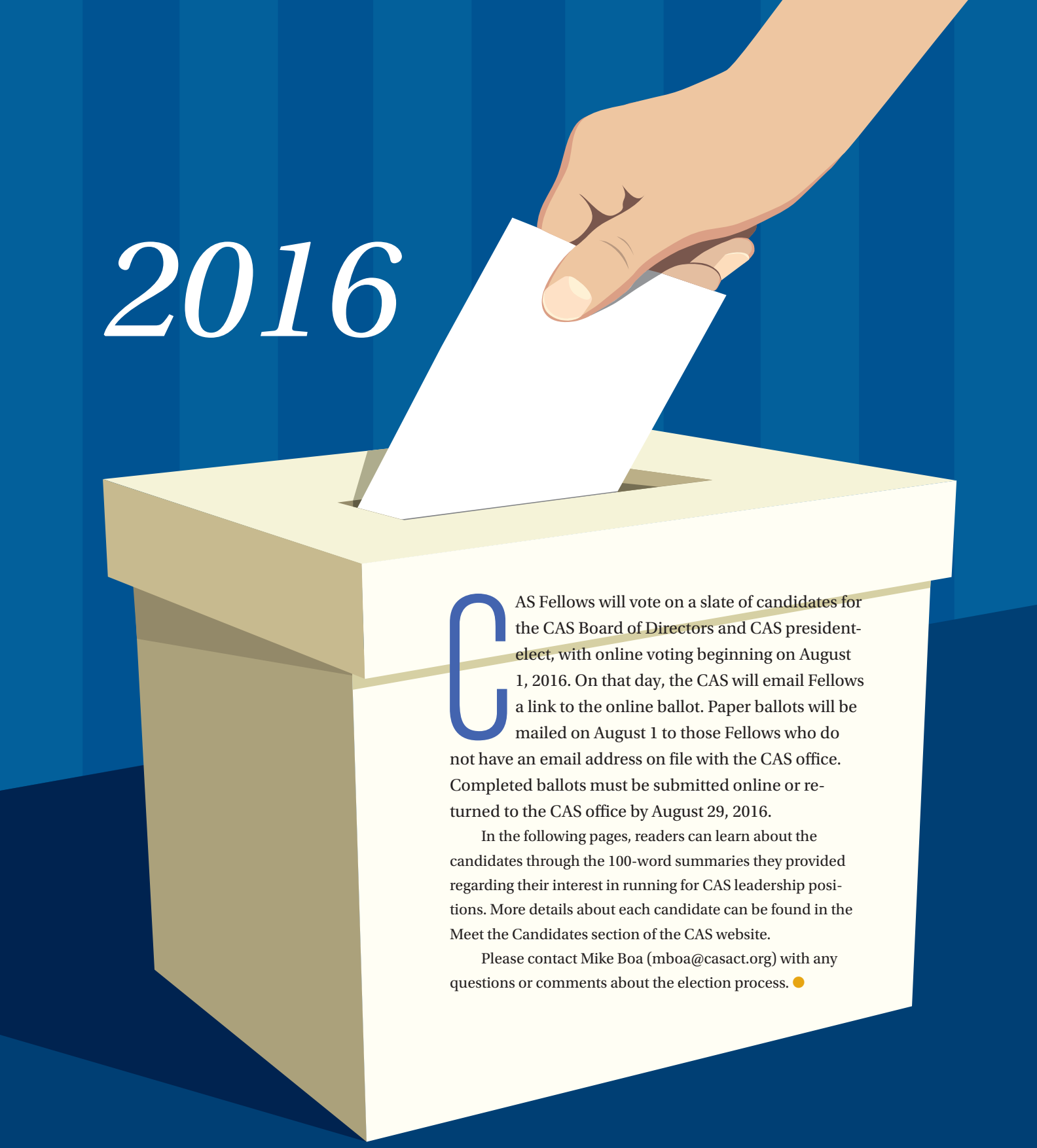
New Associates not shown: *Justin Ahn, Benjamin A. Armstrong, Jie Bao, John A. Bertino, Bingkun Cai, Chi Yu Chan, Eric Cheung, Judy Chiu, Bryn Louis Clarke, Gregory Coffman, Patrick Digan, Mark R. Doering, Seth Jacob Ehrlich, Zhou Fang, Roman Fedoseev, Daniel Joseph Forsman, Christine L. Garvey, Kanwal Hameed, Richard B. Houston, Joe Hsieh, Kelsey M. Hunke, Andrew Iden, Lingmin Jiang, Kyle Kamer, Spencer Lewis Kantner, Kevin A. Keebler, Ryan D. Kimber, Kyungphil Lee, Haonan Li, Teng Li, Jin Fan Lim, Mei Hong Lin, Jacqueline Jie Liu, Brandon Lord, Courtney Alyse Luongo, Kun Ma, Cullen Lee Maricque, Jacqueline Nyokabi Mathenge, Yecheng Meng, Brian Mittleberg, Stuart W. Montgomery, Charlene A. Myers, Yiannis Psiloyenis, Tao Qi, Guy Rabinowitz, Marie Angelique Scaglione, Thomas William Schlund, Joshua K. Simon, Anderson St. Hill, Iliyana Stefanova Stancheva, Emma Josephine Stokes, George Stonecipher, Douglas Michael Stromberg, Garry Steven Sui-Tit-Tong, Clive Thompson, Melinda K. Vasecka, Xiaoye Wang, Caixia Yang, Zhen Ye, Peipei Zhou.*

2016 Spring Meeting

May 15–18, 2016 ▪ Sheraton Seattle Hotel ▪ Seattle, WA

1. *New Fellow Farhan N. Chaudhry (center) poses with his wife, Christine, and CAS President Steve Lowe. Photo credit: Craig Hughey.*
2. *New Associates Marjorie Rebecca Kitchen and Emily Donatelli enjoy a moment in the sun. Photo credit: Matt Caruso.*
3. *Robert Stephens, founder of The Geek Squad and former CTO of Best Buy was the featured speaker at the 2016 CAS Spring Meeting. Photo credit: Craig Hughey.*
4. *Pictured left to right, Kyle Wurtz, Helen Zhao and Elizabeth A. Casazza celebrate becoming new Associates. Photo credit: Craig Hughey.*
5. *CAS President Steve Lowe (at the podium) addresses those attending the reception for New Fellows. Photo credit: Craig Hughey.*

Background: A sailboat meanders down Seattle's Elliott Bay. Photo credit: Matt Caruso.



2016 CAS ELECTION

CAS Fellows will vote on a slate of candidates for the CAS Board of Directors and CAS president-elect, with online voting beginning on August 1, 2016. On that day, the CAS will email Fellows a link to the online ballot. Paper ballots will be mailed on August 1 to those Fellows who do not have an email address on file with the CAS office. Completed ballots must be submitted online or returned to the CAS office by August 29, 2016.

In the following pages, readers can learn about the candidates through the 100-word summaries they provided regarding their interest in running for CAS leadership positions. More details about each candidate can be found in the Meet the Candidates section of the CAS website.

Please contact Mike Boa (mboa@casact.org) with any questions or comments about the election process.

Meet the *Candidates*

President-Elect Nominee

Brian Zunker Brown

FCAS 1988

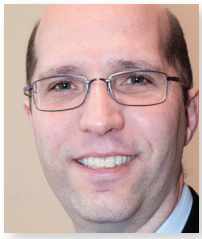
I'm a proud FCAS who has served in 15 roles on various CAS committees, spoken at 20 meetings, published 16 papers and currently work as Milliman's Global Casualty Practice Director. I frequently speak at events around the world and am passionate about using my skills and experience to strengthen the CAS's already stellar reputation as the premier educational and accrediting body for casualty actuaries. As president, I would promote diversity, expand in-person and online continuing education offerings, provide more training in written and oral communication and support The CAS Institute as it creates new credentials recognizing expert casualty knowledge.

Board Director Nominees

Avraham Adler

FCAS 2007

I am a second-career actuary who most enjoys the problem-solving elements of actuarial practice. I am grateful to the Society and its members for the collective time and effort they have donated, affording all of us continued opportunity in this great profession, and I want to express that gratitude by further giving of my time and experience to the Society. I am very excited about the state of the profession and of the potential to broaden the horizons of actuarial practice. I would be honored and privileged to help the CAS enhance the value of actuaries through education and awareness.



Michel Dionne

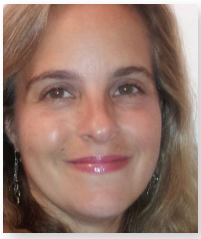
FCAS 1993

With 25 years of experience in the largest and one of the most successful Canadian insurance groups, I wish to bring a unique Canadian perspective of the current challenges facing the CAS. The rate of change in the Society has never been faster and will likely keep accelerating. I wish to concentrate specifically on climate change, regulatory changes and technological advances in order to provide unique and challenging opportunities for all CAS actuaries. This will help the CAS to grow and to remain the first and logical choice for P&C training.

Andrew J. Doll

FCAS 1997

I am honored to be a member of the CAS, and am indebted to the Society and the profession for what has transpired in my career. As a board member, I will continue to pay off this debt. The CAS is at a crossroads with how the Society will look and perform going forward. The role of the board is to work with the staff and dedicated volunteer-based committees to shape the future and pick the correct fork in the road. The road to travel is the one of being proactive and building upon our foundation, creating an incredible dwelling.



Leslie Marlo

FCAS 1996

It is an honor to be nominated for a position on the CAS Board. I have served on or chaired numerous CAS committees throughout my career, because I think it is important to give back to the organization that has shaped my career so well. I think it is critical to make sure that those just starting out have the same types of opportunities for success that I have had. The ability to serve on the Board would be a tremendous opportunity to help realize the CAS strategic vision and position us, as a community, for success going forward.

Mark R. Shapland

FCAS 1989

I have had a long career of supporting the CAS in various capacities. My father and uncle were both actuaries (FSAs), and I developed a commitment to give back to the profession from a young age. Having a wide variety of experiences both inside and outside of North America will add to the depth and breadth of leadership on the CAS Board. While I am also an FSA, my first priority is, and always has been, to the CAS, but being from a family of FSAs, this will also help me to rebuild a cooperative spirit with the SOA.

Ed Ford

FCAS 1979

I owe a great deal to the CAS and want to add to my current roles in the education and international arenas by serving on the board. My wide-ranging experience, as both an actuary and CAS volunteer over many years, will allow me to help the CAS face its future challenges and grasp the opportunities that arise. Our challenges include emerging technical topics to be mastered consistent with our unique practical focus, and our opportunities come from our leadership position and demand for our skills across the globe.

Claudine Modlin

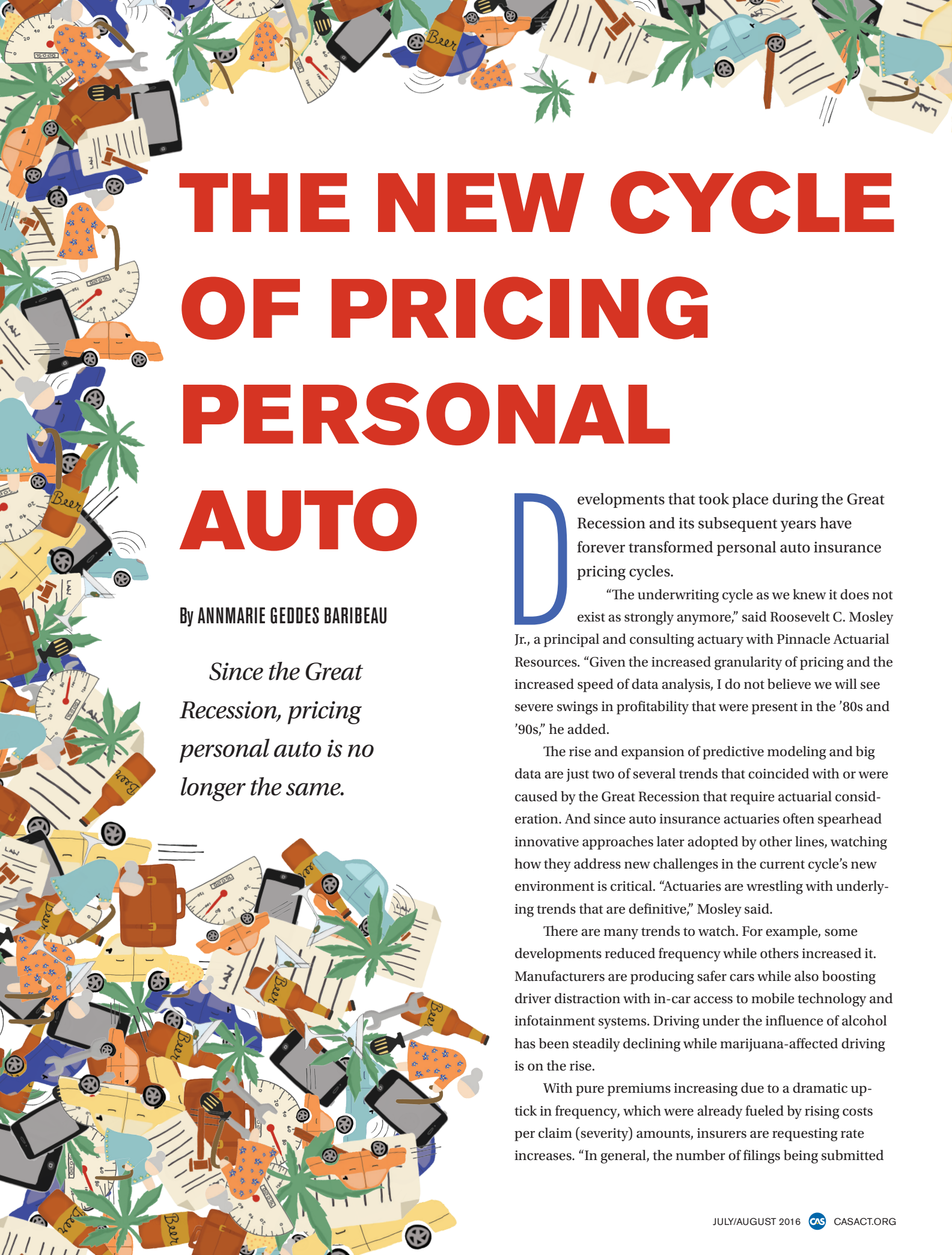
FCAS 1999

I value the opportunity to serve on the CAS Board of Directors to help formulate strategy and guide our efforts in education, research and credentials within both the CAS and iCAS to ensure our members continue to meet market demands. In my 20+ year career, I have worked within large, sophisticated companies, and as a long-time consultant to a diverse array of P&C insurers. I am recognized as one of the early evangelists for predictive analytics in the insurance sector, a role that continues to energize me. I am impassioned about actuarial education and the global presence of the CAS.

William B. Wilder

FCAS 2002

The CAS has provided me with the path to a fulfilling vocation, a sense of community and an opportunity to develop my professional and leadership skills. So, I was honored by the nominating committee's selection. But I was also grateful for the opportunity to continue making a meaningful contribution. As a board member, I will focus on maintaining and developing our relationships with other actuarial organizations, assuring that our basic education structure remains relevant and leveraging our partnership with The Institutes. I'm also eager to explore the possibilities that our first-ever staff actuary position can bring.



THE NEW CYCLE OF PRICING PERSONAL AUTO

By ANNMARIE GEDDES BARIBEAU

Since the Great Recession, pricing personal auto is no longer the same.

Developments that took place during the Great Recession and its subsequent years have forever transformed personal auto insurance pricing cycles.

"The underwriting cycle as we knew it does not exist as strongly anymore," said Roosevelt C. Mosley Jr., a principal and consulting actuary with Pinnacle Actuarial Resources. "Given the increased granularity of pricing and the increased speed of data analysis, I do not believe we will see severe swings in profitability that were present in the '80s and '90s," he added.

The rise and expansion of predictive modeling and big data are just two of several trends that coincided with or were caused by the Great Recession that require actuarial consideration. And since auto insurance actuaries often spearhead innovative approaches later adopted by other lines, watching how they address new challenges in the current cycle's new environment is critical. "Actuaries are wrestling with underlying trends that are definitive," Mosley said.

There are many trends to watch. For example, some developments reduced frequency while others increased it. Manufacturers are producing safer cars while also boosting driver distraction with in-car access to mobile technology and infotainment systems. Driving under the influence of alcohol has been steadily declining while marijuana-affected driving is on the rise.

With pure premiums increasing due to a dramatic uptick in frequency, which were already fueled by rising costs per claim (severity) amounts, insurers are requesting rate increases. "In general, the number of filings being submitted

by companies has surged recently as [frequency and severity] trends increased within the last 12-18 months compared to recent history," said Paul D. Anderson, a principal and consulting actuary for Milliman.

Considering the multiplicity of trends and new unknowns that have accelerated since the Great Recession, insurers are requesting rate increases in an environment of greater scrutiny. The advent of price optimization has been met with much criticism.[1] There is also the Federal Insurance Office started by the Great Recession-inspired Dodd-Frank Wall Street Reform and Consumer Protection Act, which monitors potentially unfairly discriminatory rating factors.[2]

In the midst of abundant considerations, personal auto insurers are also concerned about the financials. A low interest rate environment, coupled with a fiercely competitive market, continues to challenge profitability — the very incentive for selling auto insurance in the first place.

Statistical Realities

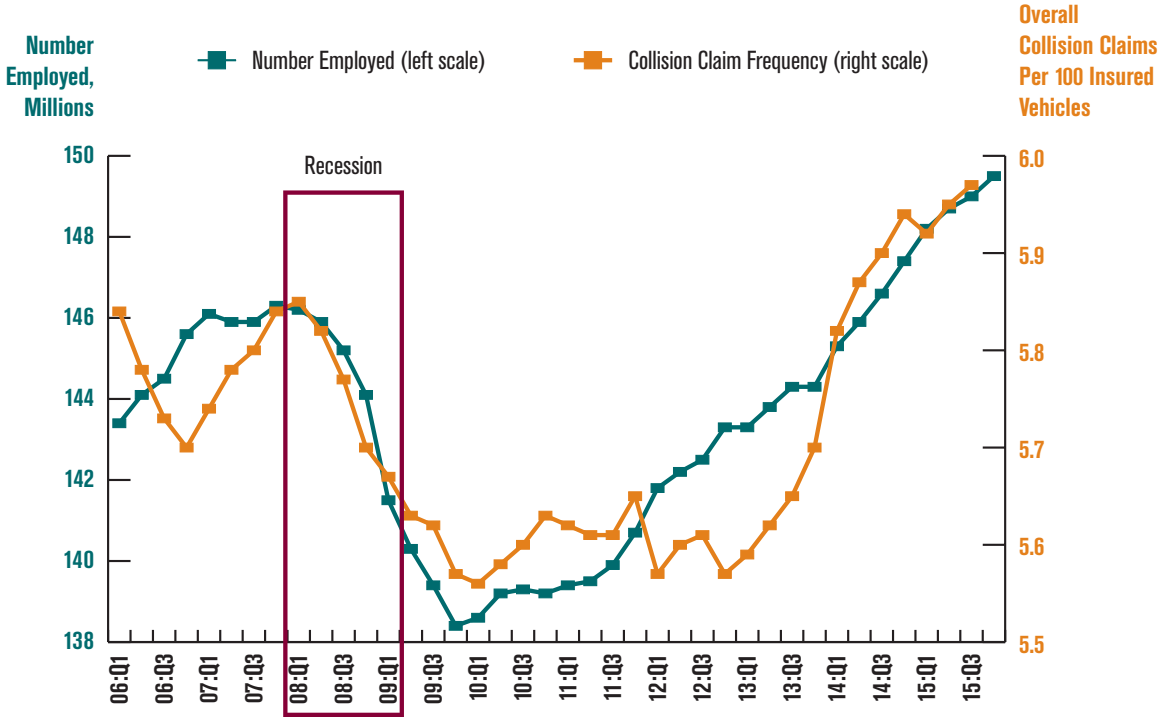
Beginning with frequency, ample evidence demonstrates the close relationship between employment numbers and accident rates, said James Lynch, chief actuary and vice president-data and information services of the Insurance Information Institute (III).

According to analysis by the III, when looking at collision coverage, claim frequency rises and falls with the job market (See Chart 1).

"As employment recovered, claim frequency had risen, almost in lock-step," Lynch said.

By the third quarter of 2015, employment increased to

Chart 1. Frequency: As More People Work, They Get in More Accidents



When people are out of work, they drive less. When they get jobs, they drive to work, helping drive claim frequency higher.

Sources: Seasonally Adjusted Employed from Bureau of Labor Statistics; Rolling Four-Qt Avg. Frequency from Insurance Services Office; Insurance Institute for Highway Safety; Insurance Information Institute.

[1] "Price Optimization and the Descending Confusion," *AR*, September/October 2015, http://bit.ly/1VBEG1H.
[2] "Demystifying the Regulatory Web," *AR*, March/April 2016, http://bit.ly/1X2Iv0W.

149 million workers and collision frequency had risen 5.97 per 100 vehicle-years. Both were higher than pre-Great Recession numbers.

Lynch pointed out that the number of miles driven falls during a recession, since a laid-off worker has no job to drive to. Frequency falls as well. When the recession ends, miles driven rises again; frequency does too.

As frequency has increased, so have traffic fatalities. The National Safety Council (NSC) preliminarily estimates that motor vehicle deaths jumped eight percent in 2015 from 2014, which marks the largest year-over-year percent increase in 50 years. For the year 2015, the NSC estimates 38,300 people were killed and 4.4 million were seriously injured, likely making 2015 the deadliest driving year in the United States since 2008.

Similarly, NHTSA reports that traffic deaths in 2015's first nine months were 9.3 percent higher (26,000) than the first three quarters of 2014 (23,796).

But there is good news. In the long term, as autos and highways get safer, Americans clock a greater amount of miles but the number of crashes continues to decline, Lynch noted.

Other Frequency Factors

Other trends and new developments since the period beginning with the Great Recession are reducing crashes while others stand to increase them.

Vehicles have become safer. Front crash prevention, lane departure warning, blind spot detection, adaptive headlights, park assist and backover prevention are boosting vehicle safety, according to "Crash Avoidance Technologies," on the Insurance Institute for Highway Safety (IIHS) website. Electronic stability control, which became standard in 2012, lowers the risk of a single fatal vehicle crash by about half and risk of fatal rollover by as much as 80 percent.[3]

"Another positive development is graduated driver licensing (GDL)," Anderson of Milliman said. All states and the District of Columbia have a three-stage GDL system. Adopting GDL laws will lead to "substantial" reductions of crashes for this age group — from 20 percent to 50 percent.[4]

Conversely, new trends that began during the period starting with the Great Recession are also contributing to higher frequency. "There are certainly more distractions than five or 10 years ago," Lynch observed. "It is possible that automobile crashes might have decreased even more if it had not been for the increase in distracted driving," he added.

Consider mobile devices. "Technology has gotten so small and portable; the timing happened to line up with the Great Recession," Anderson said. Before the Great Recession, mobile phones had already become ubiquitous and texting while driving was already a public safety concern.

Then Apple's iPhone introduced smartphones with irresistible consumer appeal in 2007. For the first time, consumers could easily access the internet and enjoy apps at a finger touch, helping to fuel smartphone adoption. Deemed the fastest growing technology in history, 68 percent of Americans owned smartphones in July of 2015, up from 35 percent in 2011, according to Pew Research Center (PRC) numbers.

Useful apps that can direct motorists away from congestion and accidents, such as Google's Waze — a Global Positioning System (GPS) app featuring real-time traffic navigation with gamification can inspire drivers to pay more attention to traffic patterns than the actual road ahead.

Auto manufacturers have also boosted attention-diverting features, Anderson said, including screens offering climate

[3] "Crash Avoidance Technologies," IIHS, http://bit.ly/1Uftjr3 (viewed April 6, 2016).
[4] "Teen Drivers — Graduated Driver Licensing," NHTSA website, http://1.usa.gov/1spmDjY (viewed April 20, 2016).

control, audio control, maps, directions, summaries of vehicle performance or trip information. "While these types of controls may be similar to [those found on] older generation vehicles, presenting them on a high-quality screen with multiple pieces of information visible or available seems to increase the tendency to distract the driver," he added.

One in four car crashes involve cellphone use, according to the NSC's 2015 edition of *Injury Facts*. Since automobile manufacturers have also boosted in-car access to mobile technology and infotainment systems, however, these added distractors also need consideration. As a result, the NSC has suspended calculating its estimates on cell phone crash prevalence until there is more data on the impact of in-car access to mobile technology and in-vehicle infotainment systems, explained Kelly Nantel, the NSC's vice president of communications and advocacy. "We want to make sure there is more data to really understand the risk," she added.

Many consumers do not realize these modern systems can be just as distracting as cell phones. Fifty percent of respondents to the NSC's "Distracted Driving Public Opinion Poll," released in March 2016, believe infotainment dashboards and hands-free technology must be safe if the auto manufacturers installed them.

There are also signs that frequency is going up due to the growth of states relaxing their marijuana laws since 2008 even though the federal government classifies it as a Schedule I (illegal) drug. Of the eight states with the largest increase in auto accident frequency, seven have liberalized their marijuana laws, according to research by the Property Casualty Insurance Association of America.[5]

NHTSA's "Results of the 2013-2014 National Roadside Survey of Alcohol and Drug Use by Drivers" reports that the number of weekend nighttime motorists with marijuana in their systems was nearly 50 percent higher in 2014 than in its 2007 survey. Marijuana users are about 25 percent more likely to be involved in a crash compared to those not under the influence, according to NHTSA's "Drug and Alcohol Crash Risk" study, released in 2015. The agency is aware of the growing concern with possible marijuana-related fatalities in crashes and intends to include it in the future fatality analysis reporting.

Fatalities from driving under the influence of alcohol during the weekend nighttime, meanwhile, declined by nearly one-third since 2007, according to NHTSA's "Roadside Survey." The federal agency's "2014 Motor Vehicle Crashes: An Overview," released in March 2016, reports that 31 percent of vehicular deaths in 2014 (9,967 out of 32,675) were caused by driving while under the influence of alcohol, which is lower than previous years.

Fifty percent of respondents to the NSC's "Distracted Driving Public Opinion Poll," released in March 2016, believe infotainment dashboards and hands-free technology must be safe if the auto manufacturers installed them.

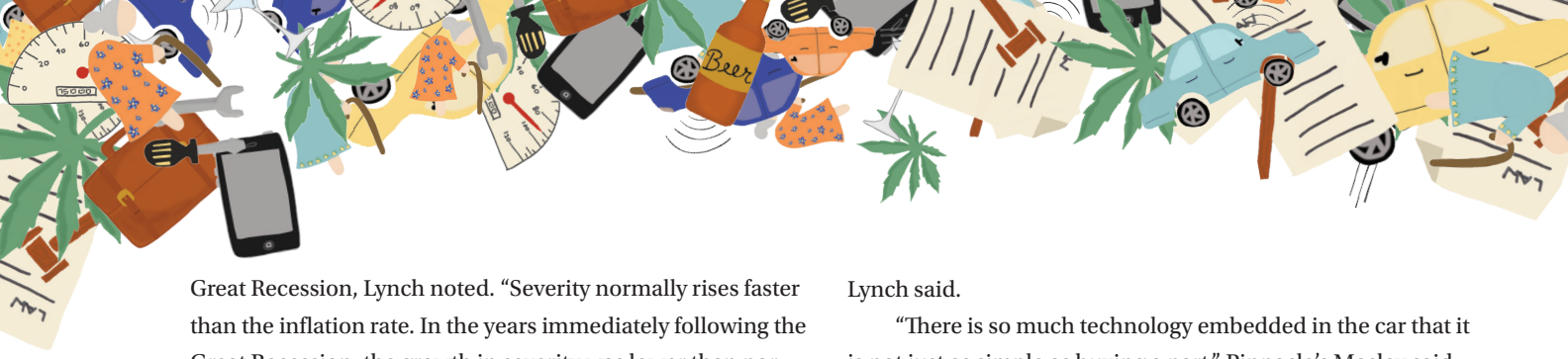
Speeding continues to be a top cause of fatalities, and yet, states have continued to raise speed limits. In 2013 alone, fatalities from higher speed limits resulted in 1,900 additional deaths, essentially canceling out the number of lives saved by frontal airbags that year, according to an IIHS report.[6] Today, six states have 80 mph limits, and drivers in Texas can legally drive 85 mph on some roads, according to the IIHS report.

Demographic changes might also contribute to rising frequency. During the period starting with the Great Recession, baby boomers were still in the safest driving age, the 50s and 60s, but around 2014, they started entering older ages when driving becomes more risky, Anderson said. Meanwhile, research by Highway Loss Data Institute (HLDI), reveals that from 2012 to 2014, more teenagers — the least experienced and most risky drivers — found jobs and got on the road after a period of decline from 2006 to 2012.[7]

Rising Severity

Severity also looked different in the period starting with the

[5] "From El Niño to Legalized Marijuana, New Answers Behind the Rise in Car Crashes," http://bit.ly/1UxfAPl, (viewed April 17, 2016).
[6] "Speed Limit Increases Cause 33,000 Deaths in 20 Years," IIHS, April 12, 2016, http://bit.ly/1pFfUAw.
[7] "Teens Get Back in Driver's Seat as Economy Picks Up," PR Newswire, February 4, 2016, http://prn.to/1ToXy3m.



Great Recession, Lynch noted. "Severity normally rises faster than the inflation rate. In the years immediately following the Great Recession, the growth in severity was lower than normal. More recently, it has returned to the norm and is rising faster than inflation," he added. (Chart 2.)

Several factors explain the increase of costs per claim. The average cost for repairing an automobile has become far more expensive due to the rising costs of parts. According to the U.S. Bureau of Labor Statistics consumer price index data, the cost of auto body repairs rose 20.9 percent from 2007 to 2015, Lynch said.

"There is so much technology embedded in the car that it is not just as simple as buying a part," Pinnacle's Mosley said. "That part may now have some technology imbedded in it or placed near it that will now be impacted by the repair."

Labor cost is also more expensive. "The way cars are made now, it takes more time to get the necessary parts — that grows the labor charge," Lynch said. "Open the hood of a car now, it is much smaller and parts are harder to get at, so if you have to replace a part it takes more time."

Chart 2. Severity Rate Comparisons.

[i] Cost of claims by type: Insurance Research Council, *Trends in Auto Injury Claims – 2015* based on Insurance Services Office Fast Track Data.
[ii] PIP figures based solely on states with PIP coverage.
[iii] Average cost per claim: ISO Fast Track Data provided by III.

The Insurance Research Council (IRC) identified other new developments actuaries need to watch, such as the growth in claim severity driven by increased utilization of medical services, said David Corum, the organization's vice president.

The increased use of medical services goes hand in hand with growth of attorney involvement, according to IRC's 2014 study, "Attorney Involvement in Auto Injury Claims." After examining 35,000 closed claims for claimants with neck or back strains with fewer than 10 days of restricted activity, the study found greater utilization of chiropractic treatment, MRIs and pain clinics for personal injury protection (PIP) claims (Chart 3) and BI claims (Chart 4).

The study also found that the percentage of lawyer-represented claimants rose to 36 percent of PIP claims in 2012, up from 31 percent in 2007. For BI claims, the rate of attorney involvement has been flat, with 49 percent involvement in 2007 and 50 percent in 2012.

In 2012, PIP attorney-associated claims cost an average of $8,457 compared to $3,297 without an attorney (Chart 3). For BI claims, average cost per claim was nearly two-thirds more expensive at $9,619 with an attorney compared to $3,365 without one (Chart 4). "Since attorneys may get about one-third of claimant's financial compensation, claimants sometimes receive a smaller net claim payment," Corum said.

There is also a steady increase in the appearance of claim abuse, according to IRC's study, "Fraud and Buildup in Auto Injury Insurance Claims, 2015 Edition," released January 2015. Claim abuse is fraud, defined as material misrepresentation of an accident's facts or loss while buildup — or "soft fraud" — is the inflation of an otherwise legitimate claim.

The appearance of abuse for paid PIP claims rose from 13 percent of claims in 2002 to 15 percent in 2007 and to 18 percent in 2012. "BI claims have had a higher level of abuse but there is not as much of a clear trend," Corum said. Nineteen percent had an appearance of abuse in 2002; this increased to 24 percent in 2007 and lowered to 21 percent in 2012.

The Financials

In the period beginning with the Great Recession, profitability for auto insurers began to significantly reduce, according to the National Association of Insurance Commissioners (NAIC).

In 2007, the combined ratio for liability and collision coverage was 101.8 and 93.4, respectively. For 2014, the combined ratio deteriorated to 103.8 for liability and 100.2 for collision, according to SNL Financial LC figures posted on III's website.

Return on net worth for personal auto insurance also declined since the Great Recession began, according to data from the NAIC. In 2014, the return on net worth was 3.6 percent, a substantial decline from 8.3 percent in 2007, according to the NAIC's "Profitability by Line by State 2014,"[10] released in December 2015.

One factor directly related to the Great Recession is eroding interest rates by the Federal Reserve to spur economic growth. Yields for 10-year U.S. Treasury notes in 2007 were about four percent, dropping to 1.75 percent in 2008 when the severe impact of the Great Recession was getting started and even below one percent in 2009. "Yields have been essentially down five percent for a full decade," Lynch said.

Another significant reason for lower profitability is the intense competition among personal auto insurers, which had to contain rates to maintain market share despite upturns in severity. According to the NAIC's "Auto Insurance Database Report 2012/2013,"[8] combined average premium was $954.30 for 2013 and close to $959.76 in 2004.[9]

Much of the rise in competition was made possible through the growth in predictive modeling. "There has been a revolution in rating variables," Lynch said. "Credit scoring allows policies to be priced more accurately and most people benefit. Actuaries have gotten better and better at pricing and identifying who are at the greatest risk of being in an accident."

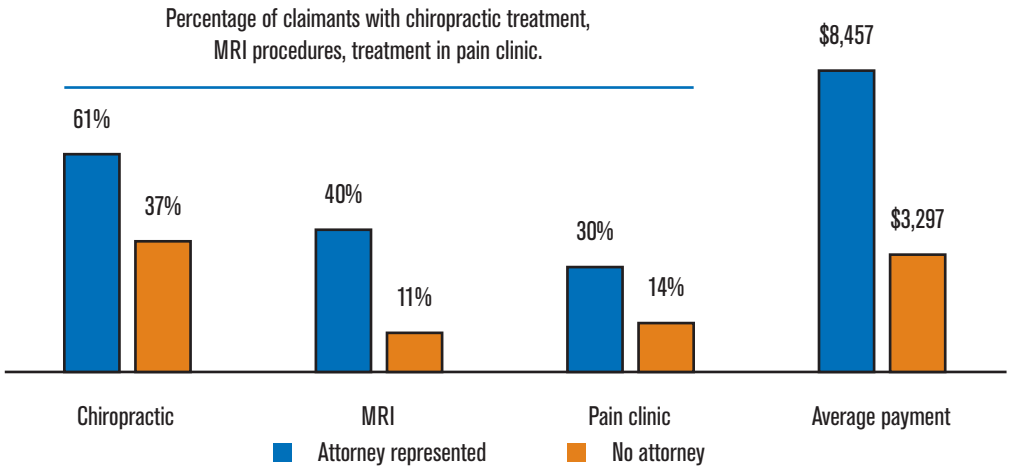
The advent of predictive modeling occurred more than 20 years ago, but during the period beginning with the Great Recession, it transitioned from a competitive strategy to a busi-

[8] http://bit.ly/1RC9lWn
[9] "Auto Insurance Database Report 2003/2004," NAIC, http://bit.ly/1PrdKkb.
[10] http://bit.ly/28leTQA.

Chart 3

Medical Utilization and Total Claim Payment by Attorney Involvement

Personal Injury Protection (PIP) claimants with neck or back sprains or strains as their most serious injury and with fewer than 10 days of restricted activity. Claims closed in 2012.

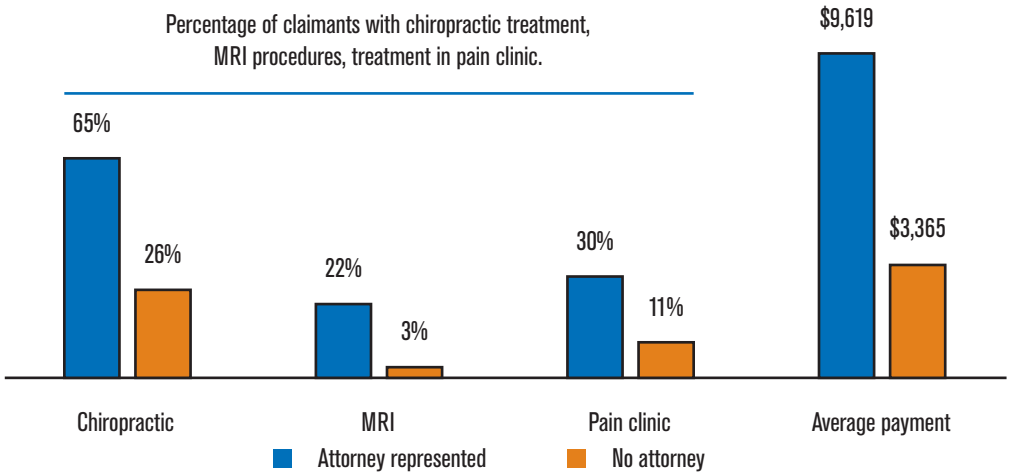


Source: Insurance Research Council.

Chart 4

Medical Utilization and Total Claim Payment by Attorney Involvement

Bodily Injury (BI) claimants with neck or back sprains or strains as their most serious injury and with fewer than 10 days of restricted activity. Claims closed in 2012.



Source: Insurance Research Council.

ness necessity. "[There is a] large percentage of auto premium set with predictive modeling," Anderson said.

The growth of predictive modeling during the Great Recession and subsequent years is apparent. In 2009, when Towers Watson began its annual predictive modeling survey, 76 percent of personal auto carriers were using predictive modeling for underwriting/risk selection and/or rating/pricing. By 2015, virtually all — 97 percent — reported the same, according to Willis Towers Watson's "2015 Property & Casualty Insurance Predictive Modeling Survey," released in February 2016.[11]

Predictive modeling, Lynch said, does tend to keep rates lower because insurers can more accurately understand the risk they are taking. "That means the insurer can allocate less capital to the line, which in turn means fewer dollars of profit will get them to the needed return on capital," he added. Predictive modeling also boosts profitability, affirmed 83 percent of the total property-casualty insurers in the Willis Towers Watson study.

Predictive modeling, Lynch said, cannot "overwhelm the spike in frequency." However, what it can do, Mosley said, is respond more quickly and tactically to frequency and severity trends compared to prior pricing cycles.

In the early 2000s, Mosley explained, the industry had to react strongly to frequency and severity triggers. "Insurers would see trends shooting up, prices would go up and they would shut off the underwriting valve and be more careful about customers," he added.

"We are past those fluctuations. We get data quicker and we can react to things that we could not do historically," Mosley said. "Companies are smarter and more comfortable with how they increase or decrease prices due to specific trends in the marketplace," he added.

If anything, because insurers are "segmentation smart" with pricing and underwriting, "they cannot pull the price trigger as hard anymore due to the risk of anti-selection issues," he explained.

"Actuaries have gotten better and better at pricing and identifying who are at the greatest risk of being in an accident."
—Jim Lynch

Wildcards

While insurers brace themselves from the effect of rising premiums, there are also wildcards — future innovations becoming available that could affect future frequency and severity and potential public policy changes.

The number one wildcard is technology itself, sources agreed, and it is difficult to anticipate.

The potential growth in telematics for improving driving behavior and providing insurers with richer risk data is one wildcard that could affect personal auto insurance pricing in the future.

From a regulatory standpoint, the stage is set for telematics. All but five U.S. jurisdictions allow these devices, according to an NAIC Center for Insurance Policy and Research (CIPR) study[12] released last year. Household-name insurers are offering varying telematics programs to their customers.

The results of telematics are also favorable. "Telematics can change driving behavior and that is a good thing," Corum said. More than half (56 percent) of motorists participating in an IRC public opinion survey made changes to their driving behavior since installing a telematics device, according to the report, "Auto Insurance Telematics: Consumer Attitudes and Opinions," released in November 2015.[13]

Eighty-two percent of device users said they receive information from their insurance company about their driving and of those, 81 percent said they reviewed the information and 88 percent of those who reviewed the information said they found it helpful.

But there are also hurdles to overcome. Nearly half (47 percent) of the 1,135 respondents said they were unlikely to accept a telematics device due to privacy concerns. "It means the industry cannot assume that everyone is going to allow (the devices) to be put in their cars," Corum said. This "strong opposition" may delay the impact of telematics devices until a positive track record has been established, he added.

Meanwhile, telematics has been reflected in the prices

[11] "P&C Insurers' Big Data Aspirations for Advanced Predictive Analytics," http://bit.ly/1UDLcD1
[12] "Usage-Based Insurance and Vehicle Telematics: Insurance Market and Regulatory Implications," March 2015, http://bit.ly/1P5yDOE.
[13] http://bit.ly/1NBCxyU

of most large insurers, but Anderson said there is uncertainty around how long it will take for medium-sized companies to implement it, he said. "Telematics provides a large source of data, but unlike personal credit information, you can't buy telematics data for individual policyholders," he explained, "Insurance companies have to collect their own telematics data and copying other carriers is difficult because most of the large carriers use their own approach."

Anderson noted that there is also the possibility that real-time feedback intended to change driving behavior has the potential to be distracting.

Another wildcard is how well insurers will be able to use predictive modeling and big data to improve pricing and insurance operations. The Willis Towers Watson survey indicates that many of the property-casualty carriers surveyed are already using big data to reduce costs from litigation, fraud and claim management or plan to do so in the next two years.

Specifically, 17 percent of respondents are currently using predictive modeling for claim triage, but more than half (52 percent) intend to do so in the next two years. While 10 percent already use modeling for evaluating litigation potential, half (51 percent) plan to do so in the same time period. "Carriers clearly see predictive models adding value across all lines of business, with personal lines continuing to lead the way," the survey said.

There is conjecture that transportation network companies such as Uber and Sidebar could affect losses, but neither Anderson nor Mosley see a real effect. Mosley wondered if personal automobile insurers unknowingly pick up claims for drivers who do not have insurance riders or commercial auto coverage. "We now have Uber drivers behaving like taxi drivers and they do not have taxi training," Mosley said.

Driverless cars are another wildcard destined to affect the industry, but its near-term effect is difficult to predict. Technology can move fast, but how automated vehicles will be regulated and their commercial availability for the average American is uncertain.[14] Experts agree it will also take time for the American vehicle fleet to turn over once driverless cars become a commercial reality. It took 20 years for 95 percent of the cars on the road to have anti-lock brakes, Anderson said.

Public policy changes are another wildcard. From the growing role of the Federal Insurance Office to the coming presidential election, even more unfathomable changes could be ahead.

Experts agree it will also take time for the American vehicle fleet to turn over once driverless cars become a commercial reality. It took 20 years for 95 percent of the cars on the road to have anti-lock brakes, Anderson said.

Conclusion

The impact of the Great Recession and developments during its subsequent years forever changed the personal auto insurance landscape. Technological advancements have improved pricing and expanded data and have challenged driver behavior for the good — with telematics — and the bad — by adding more driver distractions.

During this period, public policy changes also challenged the status quo. On the federal level, the Great Recession-inspired Dodd-Frank Act introduced additional regulation and scrutiny. Economic recovery-motivated low interest rates and tight competition continue to challenge profitability.

Keeping an eye toward evolving developments while determining and focusing on relevant trends are perhaps the greatest challenges personal auto actuaries face. Since personal auto insurance is often the petri dish for actuarial innovation, how actuaries address these challenges will influence the course for other property-casualty insurance lines in the future.

Annmarie Geddes Baribeau has been covering actuarial topics for more than 25 years. Her blog can be found at http://annmariecommunicatesinsurance.com

[14] "Destination Driverless," *AR*, November/December 2015, http://bit.ly/25zxyFY.

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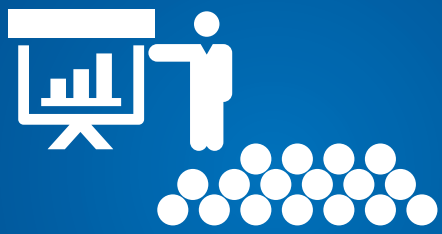

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For a Quarter Century, Actuarial Research Has Led the Insurance Revolution BY JIM LYNCH

Remember 1991?

Two hundred fifty million people lived in the United States. Three hundred twenty million do now.

The Dow Jones Industrial Average sat at 2,500. Now it is more than 17,000.

Dan Quayle was vice president.

Looking back a long way, it is easy to see how much has changed. The actuarial profession has changed, too.

There were 1,808 credentialed casualty actuaries in 1991. Now there are more than 7,000.

The profession has done more than just grow. Its research has remade the way that insurance companies price and monitor risk. Three actuarial veterans summarized the changes at the CAS Spring Meeting in Seattle in May in a session titled, "Twenty-Five Years of Actuarial Research: Success and Open Problems."

Stephen Mildenhall, FCAS, chairman of analytics at Aon Benfield, laid out four areas in which actuaries have made great strides. Veteran researchers Stephen Lowe, FCAS, a senior consultant at Willis Towers Watson, and Stephen D'Arcy, FCAS, a retired University of Illinois academic, added their insights.

Lowe likened the emergence of actuaries to the popularization of new data-driven insights that drive analyses as widely varied as baseball scouting and wine selection. "We are data-driven," he said. "Others have clinical judgment." In recent years, the analysts have beaten the clinicians. The *Moneyball* models outscout the baseball scouts.

According to Mildenhall, actuaries have made great strides in four areas: pricing, loss reserving, catastrophe risk modeling and the combined areas of enterprise risk management (ERM) and capital allocation. Of the four areas, Mildenhall credits ERM and capital allocation with enhancing the understanding of risk.

Pricing

The most significant advance, Mildenhall said, was moving pricing from univariate to multivariate analysis. Though the distinction sounds technical, it has affected insurance profoundly.

Univariate analysis measures how one variable changes the results; e.g., a young driver is more likely to be in an accident than an older one.

In the early 1990s, most insurance was priced by a series of univariate analyses. In auto insurance, for example, actuaries looked at how age affected driving records or how much discount to give for increasing a deductible. But each variable was examined in isolation.

Multivariate analysis would look at all three and take into account how the variables are related to each other; e.g., young drivers might deserve a different credit for raising a deductible than older drivers would.

Multivariate analysis, made possible by the growing power of computers and computer language, improved the ability of actuaries to understand and price risk, Mildenhall said. The growing automation helped eliminate subtle, unconscious biases that could creep into rates when they were set judgmentally.

But "it is an equivocal good," Mildenhall said. He warned against embracing analysis that abandons the human touch.

"I hope we don't move all the way to machine learning — to just throw it in the machine and see what comes out," he said.

Loss Reserving

The biggest change, Mildenhall said, is the emphasis that the reserve estimate is an *estimate* — that it exists within a range, and actuaries often use stochastic models to develop that range. Actuaries are also better able to test how well different reserving methods work.

In the future, he said, actuaries are likely to look at how macroeconomic trends affect reserves, such as how falling gasoline prices in 2014 appear to drive up the frequency of auto claims.

D'Arcy also noted that research should examine how inflation affects how losses emerge.

Catastrophe Risk Modeling

In 1991 modeling catastrophe risk was in its infancy. Some models existed, but few used them because most companies used their historical data to price risk. The next year, Hurricane Andrew, with its enormous losses, caught the industry by surprise. The methods in use at the time failed to capture the damage such a storm could inflict.

"It was the best possible advertisement for cat models," said Mildenhall. Actuaries quickly folded them into their standard pricing tools.

There was a side benefit, Milden-

Stephen Mildenhall, foreground, makes a point during the 2016 Spring Meeting session "Twenty-Five Years of Actuarial Research: Success and Open Problems." In the background (left to right), are panelists CAS President Steve Lowe and Steve D'Arcy and moderator Benoit Carrier.

hall said. The models required detailed, accurate data. Reinsurers — who were most at risk from a catastrophe — insisted on high-quality data, and they surcharged risks that lacked it. That spurred a data cleanup from which actuaries everywhere benefit.

In the future, he predicted, actuaries will expand the use of catastrophe models, particularly adopting them to handle new or nontraditional risks, like cyber liability.

D'Arcy agreed and added that the industry should focus less on perfecting property catastrophe models and more on modeling casualty catastrophes.

ERM and Capital Allocation

Most of the basics of understanding risk were in place in the early 1990s, but few people knew them, Mildenhall said.

Today, actuaries and other risk professionals have a better understanding of how providers of capital — shareholders — need to be compensated. That, in turn, has helped the industry focus on diversification from the perspective of shareholders, policyholders and regulators.

In the future, Mildenhall said that research will look at the difference in tolerance between catastrophe risk and other risks, as understanding both will help company management strike a better balance between the two.

Capital allocation is the key to effective ERM, D'Arcy said. For now there is no universally accepted method of allocating capital. He recommended that actuaries look at several methods, then use their judgment to recommend a final allocation.

25 Years of Actuarial Research — A Summation

Mildenhall used the CAS research database, DARE (Database of Actuarial Research Enquiry), to see which areas dominated actuarial research since 1990. He looked separately at actuarial research on tasks and methods.

The tasks that actuaries performed, not surprisingly, were dominated by reserving and ratemaking. Dynamic risk modeling, capital management and ERM showed the biggest increases.

Papers on statistical and stochastic methods, simulation and risk measures are the methods that have grown the most.

The fastest-growing topics, he said, were generalized linear modeling and capital allocation. There was a big decline in articles on loss trend and increased limit factors.

He noted that today the individual actuary is far less likely to do research. The number of pages of research per CAS member has dropped 83 percent in a quarter century.

All the panelists recommended that actuaries pursue research. D'Arcy recommended actuaries follow research and chip in where they believe an actuary can make a difference: "Read research and get involved in research. . . Find [a paper] you think you can do better and write a comment of that paper."

Lowe said it helps to find a writing partner. "Focus on the issues and get in the game. It's actually fun and quite rewarding." Mildenhall pointed to understanding risk tolerance for non-catastrophe lines, the use of transactional data in loss reserving, and multi-year considerations in capital modeling as potentially fruitful areas of research.

James P. Lynch, FCAS is chief actuary and director of research and information services for the Insurance Information Institute.

Actuaries Explore How to Keep Companies in High Regard BY JIM LYNCH

Who steals my purse steals trash . . . But he that filches from me my good name robs me of that which not enriches him, and makes me poor indeed.

—William Shakespeare, *Othello*

Casualty actuaries know risk, and at the May CAS Spring Meeting three of them focused on a substantial but hard-to-quantify risk: an insurance company's good name.

The actuaries drew on their own experiences to outline how enterprise risk managers can minimize the chance that their insurer ends up with its reputation sullied. Unlike many actuarial discussions, this one was virtually numbers-free, but it is an example of how casualty actuaries are using their skills to help chief risk officers manage their responsibilities.

All three actuaries work at Allianz, the global insurer. William von Seggern, risk coverage officer for Allianz SE, and Daniel Roth, a vice president of product development for Allianz Global Assistance, are Fellows of the Casualty Actuarial Society. Stephen Wilcox, chief risk officer of Allianz UK, is a Fellow of the U.K.'s Institute and Faculty of Actuaries. The speakers approached the topic in a methodical fashion.

First, they defined the risk. Von Seggern stated that reputational risk is the loss of value because of an event. It may stem from a direct, conscious activity, such as insuring a highway that transects an environmentally sensitive area or insuring a shipment of arms from Ukraine to Sudan. It may also stem from an indirect risk — examples include a security breach, a customer complaint going viral or a market conduct issue.

The direct risk peaks in global accounts, he said, and often involves environmental, social and governance issues — "ESGs" in the parlance. Typical risks high in ESG issues include casinos, mining activities, defense industries and financial services. Advocacy groups and nongovernmental organizations are very interested in ESG issues, he said.

It is important to understand all of the permutations of the organization being insured, von Seggern said. He gave as example a hypothetical gold mine in an African country. The government owns 30 percent of the mine. The country is not politically stable, and civil unrest is not uncommon. The loss control report cites nothing unusual. The mining process uses cyanide, which is stored in a lake, and there are villages downhill from the lake. Soldiers guard the mining site.

From a traditional insurance standpoint, von Seggern said, the policy is not unusual, but is rife with reputational risk. There are things to consider outside the standard loss control report — issues that, if they went awry, could damage an insurer's good name: The cyanide could

Ways to Manage Reputation Risk

The session panelists offered ideas on what to consider in managing reputation risk.

- Align the interests of the insurer with customers and business partners.
- Check products and practices worldwide against all regulators that might become concerned about them.
- Be aware of how each nation's cultural norms will react to a product. The percentage commission that is common in Asia, for example, might seem uncommonly high in Europe; this discrepancy could jeopardize the insurer's reputation.
- Evaluate reputational risk, account by account:
  - Identify the risks likely to endanger reputation. (Allianz, for example, has 20 industries it considers sensitive.)
  - Evaluate those risks. One way would be to give underwriters guidelines to follow.
  - Have a decision-making process where the underwriter can work with an expert sensitive to reputational issues.
  - Have an appeals process to ensure that all decisions were entered prudently.

leach downstream into the village water supply, endangered species could be living near the mine, the government's share of profits could be used to oppress the country's citizens, the government soldiers could be preventing trespassers but also be holding workers in what essentially is a prison. "These are some of the issues you have to think about when you write a policy," he said.

Wilcox, the U.K. actuary, focused on conduct risk. U.K. regulators, he said, "do have the customer's interest at heart," and they say the company should put customer protection above profit.

A company has leeway in what it can sell, but to satisfy regulators, it has to sell in what would be considered the proper fashion.

There are principles to consider; they ensure the company treats customers fairly. And the company must also think about the outcomes to the consumer: "Do customers think I'm being fair?"

Wilcox also worked with a case study on mobile phones. In the U.K., as in the U.S., many people have collapsed their existence into their phone. "It's my friends; it's my life" was how Wilcox put it.

"The more you think about it, the phone is like a bit of a pet," he said.

Britons buy pet insurance; likewise, they want to protect their phones, so they seek out insurance. The insurance could be sold through the phone retailer as a product add-on, Wilcox said. Alternatively, it could be distributed through banks, which like to offer valuable add-ons to strengthen their customer relationships.

The choice of distribution — retailer vs. banker — is a good example of considering reputational risk in doing business. The retailer, Wilcox noted, trains staff to sell phones, not insurance. The insurer might struggle to make sure the retailer acts according to U.K. financial regulations. But the bank has the same regulator as the insurer, and therefore its interest in pleasing that regulator coincides with the insurer's.

Travel insurance is another example, said product manager Roth. The insurance reimburses a person forced to cancel a trip if someone gets sick. Most people buy moments after they book their trip, checking a box within a solicitation that offers coverage. "The entire conduct between the company and the customer is in that box," Roth said.

The insurer has to construct that box carefully. For example, he said, the offer must be phrased so it is not "an inducement to sell," which might be an issue with regulators. Additionally, the policy is intended to cover broadly, Roth said, but might not cover a preexisting condition — such as having a parent already in the hospital when the policy is bought. Sometimes the policy excludes existing medical conditions; other times the policy offers an exception to the exclusion.

But people deciding to buy coverage "don't have the time" to think through all of that, Roth said. One solution is to offer the customer 10 days to review and cancel the policy, he added. The cancellation is better than the potential blow an unhappy customer can deliver to the insurer's reputation.

"What happens . . . when they do have an unfavorable experience?" Roth said. "They don't tell two friends. They tell 20,000 via Facebook."

Or they complain to the state insurance department.

What Would Disruption Look Like in P&C Insurance? BY JIM LYNCH

The property-casualty industry is abuzz with the threat of disruption — that high-tech interlopers will find a way to take over the business of insurance.

What would disruption look like? Actuaries articulated three visions in a presentation called, "Disruptive Forces Facing the Insurance Industry" at the CAS Spring Meeting in Seattle in May.

The presentations covered three types of potential disruptions: underwriting small commercial risks, marketing via online distribution and developing innovative products, of which insurance is only a part.

Carolyn Yau, FCAS, is director of commercial actuarial at Homesite Insurance, a company that is trying to find a way to underwrite small businesses efficiently and profitably online. She was the first actuary and the seventh employee at AssureStart which sells small business insurance under the Homesite brand as part of American Family Group.

Yau likened the commercial market to where personal automobile was 15 years ago: There are lots of insurers and expenses are relatively high. She cites a McKinsey study stating that traditional carriers may not be ready to address small commercial products. But tech investors seem to see the potential. There were 55 tech investments in insurance startups in 2015. A year earlier there were 24. Before that, there were never more than five. Examples include Lemonade, a peer-to-peer insurer, and Metromile, which offers pay-as-you-go auto insurance.

Small business risks, she said, are not exactly like personal auto, where drivers and cars are fairly similar. Personal auto insurance is more like a commodity, at least compared to the wide array of risks businesses must insure against.

Every business faces unique risks. A bakery, she notes, needs spoilage insurance, something other shopkeepers don't need to worry about. Owners have often sought expert advice, and that has come from an agent. "A small business owner is more likely to want to talk to someone to make sure they get what they need," she said. And there are usually several agent-insured conversations before a policy is bound.

That may be changing, Yau said. "We don't necessarily want to interact as much anymore," she said. "We want to use Uber to get a taxi. I don't want to call the restaurant for a reservation — I want to use Open Table."

The high-touch rate drives expenses higher. More than a third of the premium in a traditional business owners' or general liability policy pays for expenses. For personal auto, it is a sliver under one-fifth, she said. A company that can lower that business operating profit (BOP) expense ratio can succeed.

The goal, Yau said, is to reduce the "high-touch" underwriting. Any policy application has a lot of questions; some may not be necessary. She offered the following underwriting question as one example: Do you break down cardboard boxes at night? The question is intended to determine if the person keeps a tidy marketplace, which shows a diligent work ethic and thus a better risk.

Overall risk quality may be assessed more efficiently by obtaining financial responsibility information from an outside source, she said. By streamlining the application process, the applicant could obtain a quote to bind coverage in five minutes.

Other high-tech companies have found a way into the small business niche. Intuit handles taxes, payroll and bookkeeping "and makes it simple," Yau said. "We believe we can do this with insurance as well," she added.

Keith Moore, chief executive officer of CoverHound, a site known as an insurance aggregator that allows people to search for, compare and buy auto and property insurance online, says that consumers want choice and fulfillment when they shop. That means they want multiple quotes from one place and the ability to complete the transaction right away.

In insurance, that process can break down. The rates aren't as precise as, say, the price of a watch on Amazon. And consumers seek quotes, but the insurer may have to follow up with them considerably later with that number. These are things to try to avoid, Moore said. "We want the rates that consumers see to be as close to the bindable rate as possible," he said. Moore compared the situation to the online mortgage business. In the 1970s and 1980s, Bankrate made its name by gathering mortgage rates from around the country and showing customers how to get in touch with them.

Online, that model doesn't work today. Lending Tree succeeded by matching customers to banks and used its own experience with the lenders to guide customers to the lenders that would be most likely to accept them.

Moore laid out what he sees as principles of the "digital agency of the future":

Consistency in fulfillment. Customers get what they want, and "the delivery of that product is exactly the same every single time."

The ability to transition across carriers. His site shows the best four matches for a consumer, and those four could vary for the same customer for a different line of business.

Measurement of success via a metric known as the net promoter score, or NPS. The score is derived from a one-question survey: On a scale from 1 to 10, he said, "Will you recommend us to a friend?"

A person giving a 9 or a 10 is a promoter. Everyone else is a detractor. The NPS is promoters less detractors, divided by total respondents. The company works to maximize its score.

Moore also predicts four trends:

1. Mobile technology will grow, and the insurer needs to focus on the point of sale of whatever it is that they intend to insure. "We want to be where people are shopping for cars," he said. "Shopping for homes … Getting loans."
2. Customers want rates that can be bound on digital platforms.
3. They want a single transaction binding auto, home and umbrella coverage — even when that coverage comes from more than one carrier.
4. Customers are looking for highly integrated purchase options, and that means the aggregator becomes a trusted adviser. Look to Amazon, he said, for an example of how a website operator "curates choice" by narrowing options to a manageable few. "They provide a halo," Moore said, that can boost a company in its marketplace.

"If you're not one of the top six represented," he said, "it is hard to build a product."

James Guszcza, FCAS, chief data scientist at Deloitte Consulting, sees big data as a force of both potential disruption and innovation that can enable the insurance industry to shift from a largely product-centric orientation to a more customer-centric one. He pointed out that much of the "big data" collected is data about people's behavior. Data from credit cards and supermarket scanners are early examples of behavioral data that can be repurposed to predict insurance risk behavior. Today, capturing behavioral data has accelerated, thanks to the ubiquity of smartphones, self-tracking devices and connected cars.

"We leave behind digital breadcrumbs," Guszcza said. These breadcrumbs tell the story of a person's life. Such data can be put to surprising uses. For example, researchers have used mobile phone metadata (who calls when and for how long) to predict with surprising accuracy the key personality traits of the phone owner.

Guszcza noted that while such examples highlight crucial issues of privacy and data ownership, as well as potential for abuse, big data and connected customers also raise the possibility of societally valuable innovations.

For example given appropriate risk scores and information about social network ties, one can imagine small groups of connected people banding together to "act like underwriters at Lloyd's," he said. The implication is that new insurers don't have to be tethered to the traditional insurance company.

As the amount of data available to analyze mushrooms, another societal revolution is taking place: the prominence of behavioral economics. This branch of economics understands that people are not the hyperrational machines posited by traditional Econ 101 textbooks.

Behavioral economists understand that the amount of food you take at a buffet depends on the size of the plate you are handed. People don't consume goods in a vacuum; they compare their consumption to their neighbors'. People don't want infinite choices; they often sign up to be nudged in the right direction with customized menus of choices and smart defaults. This insight and the emergence of big data can revolutionize insurance (and a good chunk of the rest of the world).

Guszcza cited a company called Opower as an example. Opower uses big data as well as behavioral economics to help utilities interact with customers in ways that provide customers valuable information and simultaneously nudging them to moderate their use of energy.

For example, the utility might tell customers that they are using more electricity than the average person in their neighborhoods. Once they realize that, they are likely to consume less. "People don't like to violate social norms," Guszcza stated. For the utility, the result is a lower electric bill as well as a stronger customer relationship.

An insurance analog is telematics: Collecting real-time driving data helps many insurers rate policyholders more accurately. But an "Opower for insurance" would also use the data to make policyholders into better drivers by showing them the specific actions that make their driving hazardous.

"Rather than trying to make people more rational," Guszcza said, "make it easy for people to become better drivers."

Actuaries Grapple with Emerging Technologies BY JIM LYNCH

Usually actuaries look at the past to predict the future, but sometimes they look at future risks that don't resemble the past.

Such was the case at the 2016 CAS Spring Meeting in Seattle in May. At the final general session, titled, "Insuring the Future: How Emerging Technologies are Changing the Face of Risk," a panel of experts parsed the insurance issues surrounding a half-dozen topics, from vehicles that drive themselves to nanotech particles of submicroscopic size. Each panelist addressed two topics.

The actuaries also got a glimpse of their own take on emerging risks, as moderator David Cummings, a CAS Fellow at ISO Solutions, revealed results of a poll of actuaries on which are the most important emerging risks.

The poll was unveiled in the format of a 64-team playoff bracket, with various risks pitted against each other. From a final four of Cybersecurity, the 2016 Presidential Election, Climate Change and Global Pandemics, the eventual "champion" was Cybersecurity.

Cyber insurance is growing very quickly, said Michael Doyle, director of specialty lines actuarial at ISO Solutions and a CAS Fellow. Most estimates suggest between $1 billion and $2 billion in policies were written in the United States last year, and in five years premiums will surpass $5 billion.

Most insurers are helping hacked companies notify their customers, in compliance with laws in 47 states, Doyle said. Swift notification also helps reduce the chance of a lawsuit, he said.

For actuaries, the risk is difficult to price for want of data. The data that exist can't be coddled into pricing an insurance product. Government and industry groups are trying to create databases to monitor the risk, but Doyle said actuarial guidance will be necessary to make the information useful to insurers.

A topic that was "one-and-done" in the emerging risk bracket was Autonomous Vehicles, a fact that surprised Charlie Kingdollar, vice president of emerging issues at Gen Re. It is, he said, "the most important emerging issue facing the property-casualty industry."

When computers take over the wheel, he said, it will "do wonderful things for society." And it will happen soon, he predicted.

Driverless cars are being tested in a handful of states, and manufacturers will have cars take over some functions in the next year or so. Several say they will have a driverless car within the next decade.

Driverless cars will have fewer accidents, which suggests that $100 billion in auto premiums will disappear in the next 20 years.

Other insurance lines will be affected, Kingdollar said. Personal and commercial umbrella policies protect autos as well as other exposures. Ride-sharing companies like Uber and Lyft are likely to move to driverless cars to avoid the potential that their drivers will be classified as employees, an action that would require the companies to purchase workers' compensation insurance.

"If you think this is far away, you are not thinking correctly," Kingdollar said. "Companies need to set themselves up to address this."

Another emerging issue that could reduce claim frequency is the internet of things. Kevin Bingham, a principal in advanced analytics and modeling at Deloitte Consulting, described the concept as the leveraging of all the data that falls out from the interconnectedness that the mobile phone age promises.

As people use smartphones and other devices to record their activities and monitor their homes, they leave a trail of "digital footprints," he said.

"We as actuaries should be really excited," he said, over all the new data wanting analysis.

The information could be used in loss control. For example, a home monitor could notify the homeowner if it detects excessive moisture inside the home.

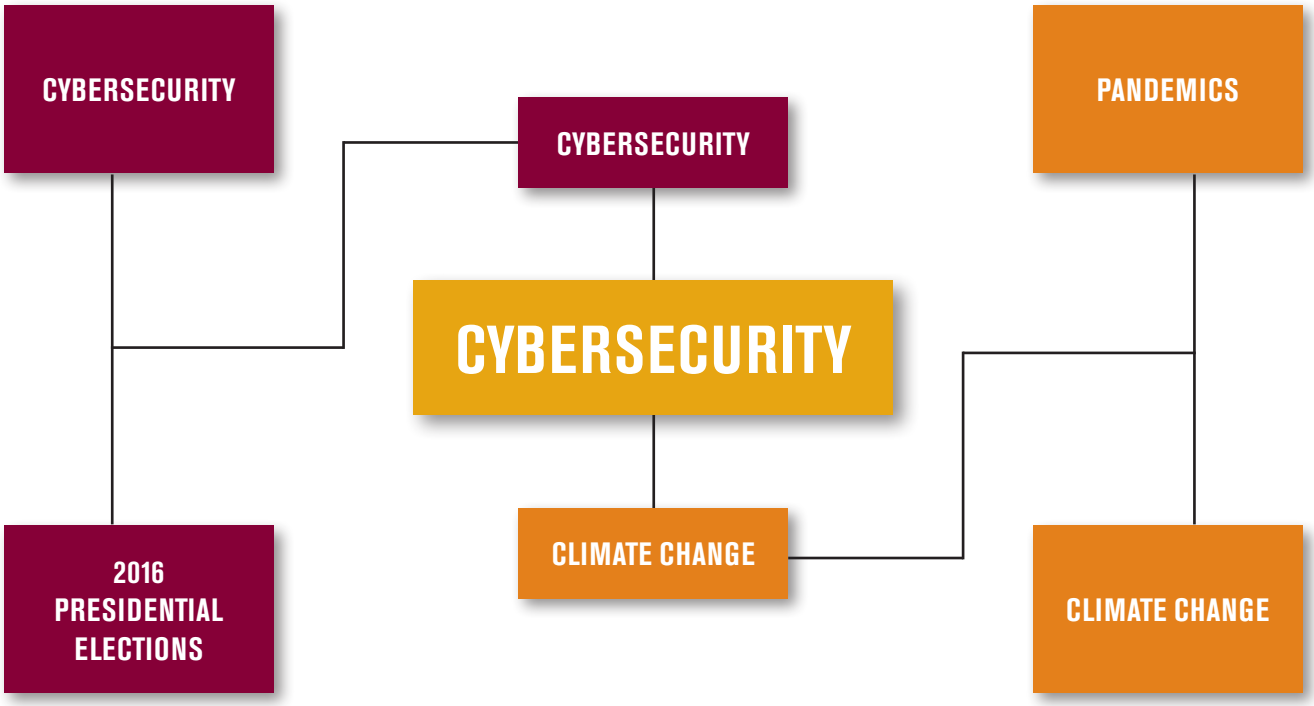
"You won't have to worry about burst pipes anymore," Bingham said, eliminating a particularly expensive claim and qualifying the policyholder for a discount.

He said that the issue could turn ominous for insurers if they aren't ready. The ubiquity of data points to lots of opportunities to buy insurance in new ways, departing from the traditional method of contacting a company or one of its agents.

The home protection product could include some sort of homeowners policy. There is a significant possibility, Bingham said, that the combination of new technology and data could change buying patterns, creating new forms of insurance.

ISO's Doyle outlined another emerging issue that has elements of the old cloaked in new technology: social engineering. He also called it "human hacking," the efforts to get people to divulge information.

Emerging Issues Bracket 2016



"In simple terms it is called duping them," he said.

Perhaps the oldest dupe, he said, was the Trojan Horse rolled into Troy in the ancient world. Today it takes more technological forms, and they are more sinister financially.

The state of the art, he said, is the business email compromise, often known through its abbreviation, BEC. Criminals spend months learning a company's culture, its processes and its chain of command. Then it spoofs an email from the CEO that orders a check be sent to a certain party, pronto.

The recipient is part of the scam and vanishes with the money.

Such efforts are big and bold. Gen Re's Kingdollar described a potentially huge issue buried in the tiniest of things: nanotechnology.

Scientists have found that the physical properties of elements change when they are assembled at close to the atomic level. And they can reassemble the material back into the everyday world while keeping the properties held in the nanotech world.

In the everyday world, Kingdollar said, silver is somewhat toxic. A silver chalice was prized because it killed bacteria, he said. At the nanotechnology level, silver is 45 times more toxic.

Nanotech is not new, he said, but insurers have all but ignored the exposure.

It is "potentially a huge issue," Kingdollar said. The market value of current nanotech products is around $20 billion, encompassing everything from medicine capsules to building materials.

"We have no idea what the safety and health implications of nanotechnology are," he said.

Many of the products are manufactured outside the United States, he said. So any lawsuits (read: insurance claims) if a product is harmful will probably draw in distributors and retailers.

The exposure could mimic asbestos, he said, though it would not be as severe, he said. "We are faster and more nimble than we used to be," Kingdollar said. Still, "nano has been around for 16 years, and we're still not asking a single question" about it. "If we're not asking questions, we don't even know if we have that exposure."

An air of mystery also surrounds the sharing economy, which Deloitte actuary Bingham outlined as a central part of the experience of the Millennial Generation.

Millennials, he said, are saddled with college debt, and this is framing their choices on what to own and how to live. "They don't have cars anymore," he said. Instead they live in cities, sharing bicycles and autos. They don't own homes. Instead, they rent. And the homeowners among them act as hoteliers, renting a spare room through Airbnb.

The implications for personal lines insurers, which protect homes and autos, are obvious. Among them is the promise or threat of autonomous vehicles, which Kingdollar discussed in depth earlier.

Summing up, moderator Cummings said: "Risk is everywhere, but risk may be changing." Actuaries, he said, "need to be aware, be involved."

EXPLORATIONS BY DON MANGO

Cause and Effects Modeling (a.k.a. Actuarial Engineering, Part Two)

In my November/December 2015 Explorations column, I discussed both the threat and opportunity of the internet of things as well as causal (as opposed to financial effects) analysis and asked, "Should we explore partnership with engineers?" I believe the answer is yes and that there are potential benefits for both sides. Each profession needs the other's expertise, insights and solutions in order for us to jointly synthesize *cause and effects modeling*. Digital disruption is forcing the consolidation of risk analysis and financing, and neither profession on its own is sufficient.

In Part Two, I will now highlight areas where engineers can help actuaries in the risk modeling space: simulation modeling in engineering; verification, validation and uncertainty quantification (VVUQ); and multi-attribute tradespace exploration (MATE).

Simulation Modeling in Engineering

I recently dusted off my BS in mechanical engineering to join the American Society of Mechanical Engineers (www.asme.org). One recent member communication was a call for papers for a special issue of ASME's *Journal of Mechanical Design* on "Simulation-Based Design Under Uncertainty." The special issue would be published in conjunction with the 2016 ASME Design Automation Conference. Some of the topics of interest include:

- Computational techniques for uncertainty quantification and propagation.
- Model verification, validation and calibration.
- Modeling, analysis and design of time-dependent problems involving stochastic processes and random fields.
- Simulation-based design decisions under uncertainty.

We actuaries could certainly bring expertise, insights and solutions to many of those problems and even learn a thing or two while we are at it. Simulation modeling has been standard practice in engineering for 10 years or more. Perhaps the watershed moment was the "virtual rollout" of the Boeing 787 Dreamliner in 2006.

According to the press release:[1]

"Today's virtual rollout illustrates the future of manufacturing, showing how accurate, intuitive 3D models can be the primary means for communicating design and production planning information throughout a program. Such 3D-based simulations of production processes enabled Boeing and its partners to optimize the Dreamliner production system and avoid the costly late-stage errors that can occur with untested designs and production planning."

Bottom line: Engineers are leaders in causal modeling.

Validation and Uncertainty Quantification (VVUQ)

If we are now flying around in airplanes designed and manufactured based on computer models, how do we know that those models are right? To answer this critical question, the National Research Council (NRC) of the National Academy of Sciences (NAS) in 2012 produced "Assessing the Reliability of Complex Models: Mathematical and Statistical Foundations of Verification, Validation and Uncertainty Quantification (VVUQ)."[2] This seminal report was published by the Committee on Mathematical Foundations of VVUQ, under the direction of the Board on Mathematical Sciences and their Applications, itself under the direction of the Division on Engineering and Physical Sciences.

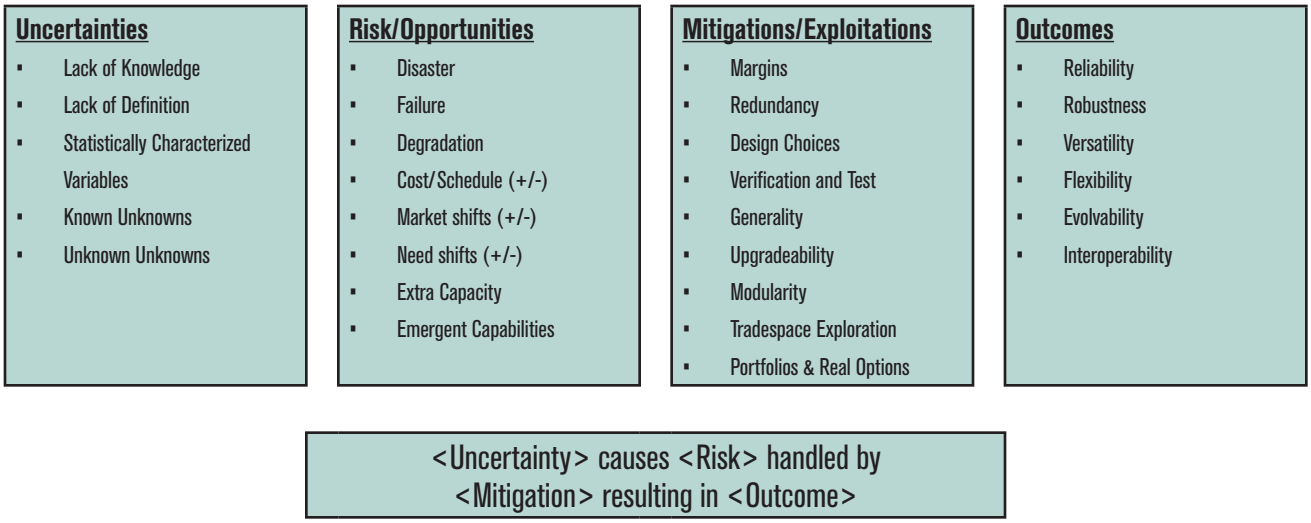
According to the report summary:

"In recognition of the importance of computational simulations and the need to understand uncertainties in their results," several entities[3] requested that the NRC research the mathematical sciences foundations of VVUQ and suggest measures leading to improved VVUQ capabilities. The statement of tasks is as follows:[4]

"• A committee of the National

[1] See http://bit.ly/28N6TTA.
[2] At 312 pages, it's not for the faint of heart. It's available for free here: http://bit.ly/28LI6OD.
[3] The Department of Energy (DOE) National Nuclear Security Administration, the DOE Office of Science and the Air Force Office of Scientific Research.
[4] Page S-2 of the above report.

Figure 1. Framework for handling uncertainties and their effects.



Source: "A Framework for Understanding Uncertainty and its Mitigation and Exploitation in Complex Systems," by Daniel Hastings and Hugh McManus, 2005.

Research Council will examine practices for VVUQ of large-scale computational simulations in several research communities.

"• The committee will identify common concepts, terms, approaches, tools and best practices of VVUQ.

"• The committee will identify mathematical sciences research needed to establish a foundation for building a science of verification and validation (V&V) and for improving the practice of VVUQ.

"• The committee will recommend educational changes needed in the mathematical sciences community and mathematical sciences education needed by other scientific communities to most effectively use VVUQ."

Given our work in capital, predictive and catastrophe modeling, shouldn't actuaries have been involved in these efforts? Why weren't we? The National Academies of Sciences, Engineering and Medicine all lack actuarial representation. We could chalk this up to a membership policy restricted to just the physical sciences. Unfortunately, this would be contradicted by the NAS division of Behavioral and Social Sciences and Education (DBASSE),[5] a group that performs research on aging; economy and the workforce; humans, systems and technology; law, crime and justice; population and demography; and society and the environment. Those research areas sound awfully core to the actuarial brand, yet somehow we were not deemed relevant or critical enough to merit inclusion. Concerned?

Harkening back to Part One[6] of my actuarial engineering column, another question I posed was, "Can actuaries adapt and expand our brand to include causal analysis?" Based on our alarming lack of professional stature in the eyes of the broader scientific community, the most likely answer unfortunately is no. We could attempt to lobby for a spot in DBASSE, but given our practical (as opposed to rigorous scientific) focus, we stand a far better chance of joining forces with the engineers, *who have their own academy*! Such an affiliation would elevate our professional stature and help expand our brand beyond our traditional practice areas, with increased access to and participation in critical research and public policy analysis.

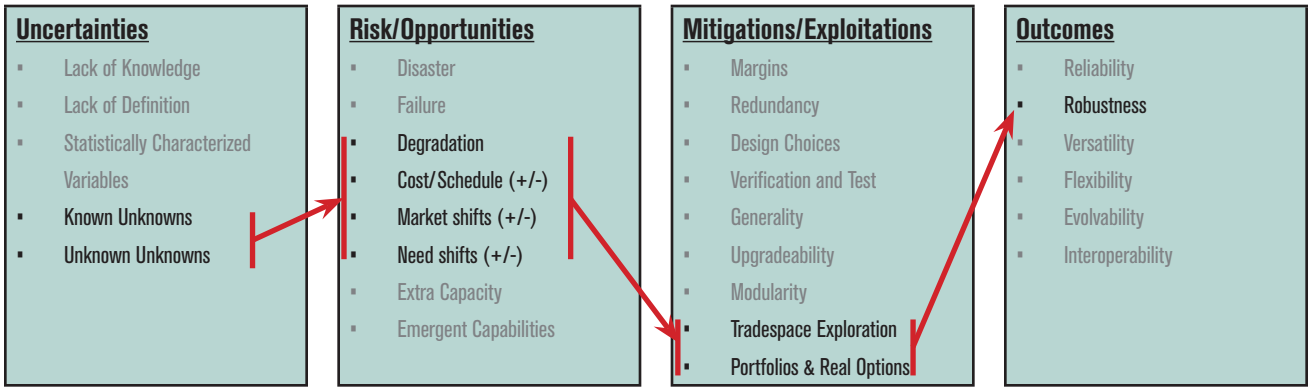
Bottom line: Joining forces with the engineers would get us access to critical research efforts and help expand our future employment horizons.

A Framework for Understanding Uncertainty

One example of that critical research is "A Framework for Understanding Uncertainty and its Mitigation and Exploitation in Complex Systems" by McManus and Hastings.[7] The authors, who are

[5] See http://bit.ly/28LDwOc.
[6] http://bit.ly/28N6BuG.
[7] Available here: http://bit.ly/28L2rzr.

Figure 2. Use of tradespace exploration to deal with uncertainty, including "unknown unknown" future events.



Source: McManus and Hastings , 2005.

space systems engineers, propose the framework for handling uncertainties and their effects shown in Figure 1.

McManus and Hastings use this framework to evaluate current engineering industry practice in the risk arena, including risk analysis, designed safety margins, reliability engineering and risk management. All are found to be limited special cases of the general framework. For example, reliability engineering involves:

- Uncertainties: statistically characterized variables and known unknowns.
- Risks: failure.
- Mitigations: redundancy (typically).
- Outcomes: reliability.

The authors then outline the next evolutionary step in uncertainty mitigation and exploitation, MATE, which is a solution-generating and decision-making framework that applies decision theory to model-based design. They write that MATE is:

"A tool for analyzing systems architectures with the goal of maximizing or trading various system attributes, rather than meeting specific requirements. It is not itself an uncertainty analysis tool, but rather allows the technical analysis of system concepts including the effects of uncertainties in various parameters.[8]"

MATE systematically applies quantified stakeholder utility functions to a range of all plausible design architecture options (the "tradespace") using simulation modeling. The goal is to give decision-makers a clear and quantified sense of the costs and benefits of options before the project advances too far down the road. MATE improves design robustness resulting from variability in future funding (a big issue for space systems), user requirements and competitive capabilities. Figure 2 from McManus and Hastings shows how MATE maps onto their framework.

Take note of "Portfolios & Real Options" in the Mitigations/Exploitations column; this a big opportunity for us to offer actuarial expertise, insights and solutions. We might call MATE "advanced product design under uncertainty using quantified stakeholder value functions," making it highly relevant for both our current practice and potential evolutionary needs in cause and effects modeling.

Bottom line: The engineers appear to have some solid groundwork in place for understanding and mitigating uncertainty.

Stay Tuned for Part Three

It is clear that we have just scratched the surface of commonality between our professions. An engineering partnership — really an *actuarial re-branding as a branch of engineering* — represents both a defensive and offensive strategy, one that will pay dividends now and in the future. It may well prove essential to our profession remaining valued and employed in this increasingly disrupted world.

In Part Three, I will discuss how actuaries have already helped engineers, referencing the actuarial work of engineers Sameer Vittal and Thomas Wendling.

[8] McManus and Hastings, page 11.

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Three Considerations for Career Opportunities BY WAYNE H. FISHER

Following is an excerpt of Wayne Fisher's Address to New Members given at the 2016 CAS Spring Meeting on May 16 in Seattle, Washington. Two new CERAs, 253 new Associates and 76 new Fellows were recognized during the CAS Business Session.

Think of someone climbing, say, Mt. Rainier. It's hard. It takes lots of training. You don't give up. You rely on a team to provide supplies along the way, and experienced teammates to give you advice on routes and setting ropes, and to be by your side through the journey. You've no doubt had such support on your CAS journey.

Achieving these milestones opens up lots of opportunities. You are at the top of the mountain. You have a seemingly endless, 360-degree view. That's where you are now. With your CAS credential and expertise, you have opportunities in every direction. You will do best in your careers if you pick the path that you find personally challenging, that you will take pride in doing every day, and, of course, one with good career prospects!

I offer three considerations as you reflect on career opportunities.

1. **"Disruption" in our industry will continue and will do so at an exponential pace.**

Some of these disruptions will take the form of technology firms entering the insurance space. Nearly $3 billion was invested in such firms last year alone. Disruption will also continue from consolidations, alternative sources of capital and larger data pools. Disruption in our traditional arena includes increasing use of analytical tools in all areas of our industry, including pricing, reserving and documenting portfolio diversification benefits.

Analytical tools are evolving, and we have to evolve with them so we can continue providing meaningful insights to our businesses and clients. We must be resilient for ourselves as individuals, for the CAS and for our firms.

2. **Risks are evolving.**

From severe storms to drought to rising sea levels, we are seeing more and more risk associated with climate change; this risk is occurring gradually. Cyberrisk, on the other hand, changes every second. Actuaries are not only challenged with pricing and reserving for policies now entering the market, but they also have to determine how to measure aggregate exposure. Increasingly, actuaries will need to be innovative and adaptable.

3. **The best opportunities may be outside the traditional actuarial focus.**

We can't all be the chief actuary, but we can use our training and technical skills to add value in underwriting, claims, risk and data management, human resources and other functional areas. Strive to achieve leadership levels in these areas and use your technical and communication skills to become the decision makers. By doing so, you can expand opportunities for yourself and our future members.

To take full advantage of these prospects, you must continue developing your business, technical and communication skills.

I am going to risk mentioning more exams, but I highly advise going for a CPCU, CFA or the CERA. These credentials will give you entrée into these functional areas, allowing you to add value and achieve leadership positions. Be willing to take some risk. Ben Bernanke once noted: "No one likes to fail, but failure is an essential part of life and of learning. If your uniform isn't dirty, you haven't been in the game."

Our new initiative, the CAS In-

Newly-minted CAS Fellows line up and prepare to walk across stage for their diplomas at the 2016 CAS Spring Meeting.

stitute, is perfectly aligned with these career opportunities. Predictive analytics will be the first specialty area, and the syllabus and exams will provide you demonstrated, technically solid, real-world applicable skills to use on the job and create value for you and your firms. I encourage you to pursue this credential when the CAS begins to offer it.

On another note, volunteering is an important aspect of CAS membership, both for the organization and you personally. It's the life blood of the CAS. We need you for all manner of committees and leadership positions, ranging from the exam and research committees to Regional Affiliates. We need you to research and write papers and read and review them. We need you to share your knowledge through participating on meeting and seminar panels.

Your volunteering helps the organization, but, most importantly, you also benefit. Committee involvement allows you to build your experience in a supportive, safe environment. Since much of the activity is team-based, you can develop leadership and communication skills and, of course, create an important network with peers …

Professionalism and the Legacy of CAS Membership

Professionalism goes beyond our colleagues and employers — it extends broadly to society. Stan Hughey was the CAS President when I received my Fellowship in 1975. In his Presidential Address, Stan made this comment about Social Security, pensions and Medicaid:

"In our enthusiasm for providing security for all, we must not overlook the need to finance these programs, lest we leave to future generations the framework for disaster. There is an obligation and an opportunity actuaries should not miss to help clarify alternatives and to help others make better informed decisions."

How's that for being prescient 41 years ago?

Today, as we go about our business developing models, identifying, assessing and quantifying risk, how will our professional advice be perceived 41 years from now? The myriad implications of climate change and our opportunity as actuaries to influence the public debate is one example that is worthy of reflection.

Collectively we control our future. As members of the CAS today, each of us benefits from the legacy left by former CAS members. These members carefully built the CAS reputation for technical excellence, ethics and integrity. Our Code of Professional Conduct is our guide, but following the rules isn't sufficient; each of us has a responsibility to nurture and grow that legacy — we owe it to ourselves, our employers and society.

Thank you and best wishes for the future to each one of you.


PREMIER
The Casualty Actuarial Society provides today's risk professionals with the skills and knowledge to rise above the crowd. Our education and credentials are unmatched for their rigor, integrity, and relevance – attributes that are valued by companies and regulators across the globe. For over 100 years we have been THE professional society for property and casualty actuaries. Learn more about our highly respected credentials and educational programs at casact.org/premier.
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casact.org

IN MY OPINION BY GROVER EDIE

Creating Markets

The CAS has expanded its scope from workers' compensation to every non-life line of business. We, the CAS, are now involved in insurance and other risk management alternatives to insurance. Self-insured programs, captives, risk retention groups, catastrophe bonds and more are now within the purview of the casualty actuary. Our visibility and presence at the recent RIMS convention was quite evident of that fact.

We have expanded our geographic scope, from an almost exclusively USA/Canadian society to an international one. An effort to expand the ethnic diversity of our organization is now an official focus of the CAS. We are growing well beyond our roots.

Actuary has been one of the top professions for so long that now we have an unprecedented number of new entrants into the field, and more universities are establishing actuarial degrees every year. But how long before the supply of actuaries outstrips the need? It doesn't have to if we expand the demand for actuaries faster than the supply grows.

We need to further expand the scope of our operations, but in what arenas? Following are a few ideas.

Supply Lines

Take, for example, electrical transmissions. What can prior power outages tell us about the likelihood of additional outages in the future? Can we use our skills to help other industries determine the most effective expenditure of time and money on maintenance and loss prevention? Transmission line age, probability of high winds, variations in electrical usage, age of transformers and more could be used as "classifications" to "rate" the likelihood of future losses. These classifications could also enable the electrical company to minimize outages by retrofitting the components most likely to fail or to fail with the greatest damage. This is an insurance hazard rating of a different nature and could apply to water companies and petroleum pipelines as well.

Logistics

We are skilled with handling hazard risk, but what about such risks relating to the on-time delivery of goods? Train and ship wrecks, truck accidents or breakdowns, and other disruptions occur to varying degrees. I once heard of some actuaries going to work for a trucking firm; I wonder if that story is true and, if so, how it's working out. Our directory lists some actuaries working in "nontraditional" roles, and I applaud them. Should casualty actuaries be the "professional of choice" in that important activity? Can we use our understanding of risk classification, including the potential for severities, to reduce the risk for those services?

We need not limit our thinking to hazard events. I have heard of actuaries going to work for investment firms and other asset management organizations. That is great, but I wish we saw more of it. Are there other related financial services roles we can play?

"The best way to manage your market is to create it."*

These are just a couple of my ideas. I would like to hear from readers to correct and complete this "starter list." In my opinion, it is time we expanded our professional activities even more so than we have in the past. We need to create new markets. My future doesn't depend on it, but yours might.

Postscript

I attended a Michigan Actuarial Society meeting, where Craig Reynolds, president of the SOA, was the speaker. He spoke of the SOA's entry into the "general insurance" space, why they were doing it, and their progress to date, which he described as "slow but well." He also mentioned the SOA's strategy to enter other areas of practice. Their recent emphasis on predictive analytics is one avenue they seek to use to involve their members in non-insurance activities. Last year, the SOA paid for two college interns to work for two non-insurance companies at no charge to the companies. This year they plan to have six to nine interns in similar situations. The SOA is putting their money into the process of expanding their scope.

They are concerned that the increasing volume of college graduates with actuarial degrees is flooding the market, and the SOA is trying to increase *its* market scope.

* My variation of the Peter Drucker quote, "The best way to predict the future is to create it."

IT'S A PUZZLEMENT BY JON EVANS

Truth versus Politics

Nine candidates are running for president of the country Tierra de Los Mentirosos. The key issue is taxes. One of the nine candidates will lower taxes, and each of the others will either raise taxes or leave taxes unchanged. The candidate who will lower taxes always tells the truth. Any candidate who will raise taxes always lies. Any candidate who will leave taxes unchanged sometimes lies and sometimes tells the truth. The candidates are numbered 1 through 9, and here is a statement made by each:

1. Either 3, 5, 7, 9 or I will lower taxes.
2. I will leave taxes unchanged.
3. Either 5 is telling the truth or 7 is lying.
4. 1 is lying.
5. Either 2 or 4 is telling the truth.
6. 3 is lying.
7. 1 is not going to lower taxes.
8. I will raise taxes, and 9 will leave taxes unchanged.
9. I will raise taxes, and 6 is lying.

You are given confidential information that lets you know whether candidate 8 will leave taxes unchanged. With this information, you are also able to determine which candidate will lower taxes. Which candidate will lower taxes?

People Power

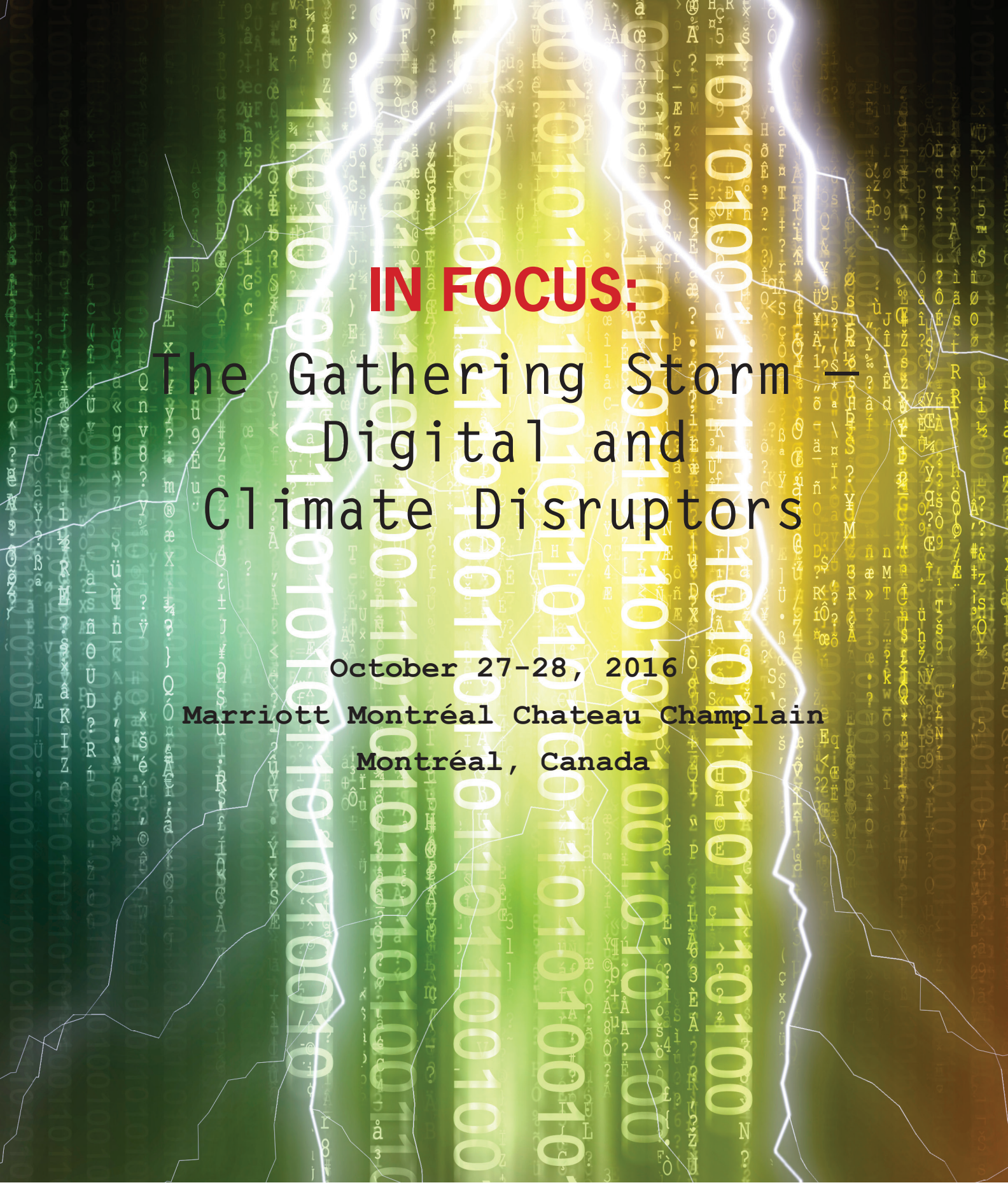
Hans said that the total physical power output level, in watts, for the population of humans on Earth as biological machines, exceeds the total wattage of all of the nuclear power plants on Earth. Ivana did a slightly different calculation and found that the nuclear plants had about the same or higher total wattage. How might Hans and Ivana, respectively, have done their estimates and who is right?

There are about 7.4 billion people on Earth today. Humans get effectively all of their energy from food, and on average the rate of food energy intake is equal to the total rate of expenditure of energy. You can find various estimates of world average daily caloric intake per person, but a reasonable, somewhat high estimate would be around 3,000 calories/day, which is about the intake of China, and about 800 lower than the highest countries like the United States. Food calories are approximately equal to 4,200 joules of energy. So, the total daily gross energy output of humans is about 7.4 billion humans x 3,000 food calories/day x 4,200 joules/food calorie = 9.324×10^{16} joules/day. A watt is a joule/second and there 24 hours/day x 60 minutes/hour x 60 seconds = 86,400 seconds/day. So for humans, we get (9.324×10^{16} joules/day)/(86,400 seconds/day) = 1.08 trillion watts. It could be argued that some of this energy is wasted heat and should not be counted, e.g., humans are about 20 percent to 40 percent efficient at producing mechanical energy. This could lead to an estimate ranging from 216 billion to 432 billion watts. On the other hand, maintaining body temperature is important to life, and it could also make sense to count all of this thermal energy.

There are about 440 commercial nuclear power reactors in the world, accounting for virtually all of the production of nuclear energy. Commercial nuclear reactors typically produce about 1 billion watts each when operating and operate most of the time. One source places total annual nuclear electric energy production at about 2.5×10^{15} watt-hours/year. There are 365 days/year x 24 hours/day = 8,760 hours/year. So, these numbers give (2.5×10^{15} watt-hours/year)/(8,760 hours/year) = 285 billion watts. Note that nuclear reactors only convert about 30 percent of heat energy into electricity. So, the total thermal power is closer to 285 billion electrical watts/ (0.3 electrical watts/thermal watt) = 950 billion thermal watts.

The most likely difference between Hans and Ivana is how much human thermal power is counted as useful or meaningful power: Hans might have estimated 432 billion watts for humans, Ivana might have estimated 216 billion watts, and both might have used the 285 billion watts of nuclear electric power. It would not make much sense, but another possibility is that Ivana might have compared total nuclear thermal power to total human mechanical power. Alternatively, they might have both used total thermal power, but Ivana might have used a somewhat lower average daily caloric intake, like 2,500 food calories/person-day. In any case, the truly remarkable thing is that, however things are accounted for, the total biological power of humans on Earth is roughly equal to the total production of nuclear power on Earth.

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



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OHIO – PRODUCT ANALYST

Product analyst is needed by an Ohio property and casualty insurer for Position 71127. One to five years of auto actuarial experience ideal. Requires SAS or SQL programming skills.

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For Position 70923, a Massachusetts insurer plans to hire a property and casualty senior actuarial analyst. 2 to 8 years of property and casualty actuarial experience required.

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For Position 70211, growing USA client seeks FCAS or ACAS or near-ACAS with 3 to 12 years of commercial lines or reinsurance experience. International travel. You must be able to present to internal and external clients. Your communications skills should be outstanding. Very unique opportunity for a casualty actuary who is interested in the next step in their career.

CONNECTICUT – REINSURANCE ACTUARY

For Position 70784, a prominent Connecticut reinsurer plans to hire a reinsurance actuary. 6 to 16 years of P&C actuarial experience. ACAS or FCAS. Reinsurance reserve analysis role. Work closely with Chief. Requires at least two years of reserving experience.

CALIFORNIA – SENIOR ACTUARY

For Position 70437, Ezra Penland seeks a Senior Actuary for our California client. Must have 13+ years of P&C actuarial experience. FCAS or ACAS. Requires considerable predictive analytics experience. Experience with reinsurance or consulting a definite plus. Client prefers broad actuarial training, including modeling, reserve analysis, pricing studies, statistical analysis and some exposure to underwriting.

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