actuarialREVIEW

COMING ATTRACTIONS — RESEARCH EDITION

ACTUARIES CLIMATE INDEX
SERVES THE PROFESSION
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actuarial REVIEW

departments

FSC
LOGO

on the cover

editor'sNOTE By GROVER EDIE

Lights. Camera. Action!

This *AR* showcases some of the research activities being "performed" by CAS members and partners, playing off of the theme "coming attractions." The movie buffs out there will easily get the allusions; others of you may have to work harder. We hope you enjoy these film references while getting up to speed on CAS research.

So, in the spirit of our cover story, here are a few trailers[1] for this issue.

In the category of short video, I highly recommend you read about "Attending Your First CAS Meeting." It's clear to me how this fun-to-watch video won the Silver EXCEL Award in the category of "Best Video–Membership." I was blown away knowing that CAS members were involved in such a production. Two thumbs up!

Suspense is fine for a film genre, but when it comes to work, it's really not our thing. Actuaries are known as forecasters, but do we qualify as "superforecasters?" Superforecasting was a hot topic at the last Reinsurance Seminar — some in our midst have even been included in the ranks of superforecasters. To see if you qualify as one, be sure to read the "On the Shelf" column. Thanks to Laurie McClellan for another interesting book review.

If you prefer documentaries, Marco Baratta's Actuarial Expertise piece on "block chain" tells what it is and what it has to do with actuarial work. Actuaries will be hearing a lot more about this trending topic in the months ahead. We are also happy to welcome Baratta as a first-time *AR* contributor.

(Speaking of contributing, we want to know your ideas for feature stories and other *AR* content. Please drop us a line at ar@casact.org and let us know what's on your mind.)

Other highly recommended entries in the issue include CAS President Steve Lowe's thoughts on our education system and Rob Walling's "In My Opinion" on retaining our market value.

I hope you enjoy this issue of *AR*. Thanks and I'll see you at the movies! ●
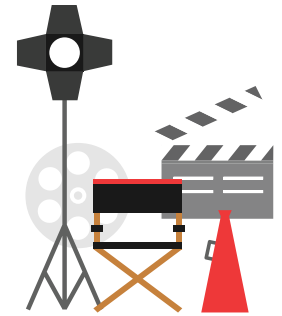
[1] Previews

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Meeting the Future Educational Needs of Actuaries: Is the Profession at a Strategic Crossroads?

The CAS leadership, and especially the Education Policy Committee, has been thinking for some time about the educational needs of the actuary of the future. What new methodologies, approaches and frameworks will be essential arrows in the future actuary's quiver? What will be considered obsolete? Answers to these questions will drive further updates to our syllabus over the next few years.

The CAS is not alone in focusing on this issue; the International Actuarial Association (IAA), the SOA, the Institute and Faculty of Actuaries (IFoA) and most other bodies engaged in actuarial education view this as an important topic, worthy of thoughtful reflection. The IAA has published a "model syllabus" that, while voluntary, can serve as an aspirational target for its member organizations around the world. The SOA has also recently announced syllabus changes that it believes are responsive to the needs of future actuaries.

While most of the focus of the changes involve adding predictive analytics topics to the syllabus, the issue is really broader. Rapidly advancing technology is changing everything, from the data available and the cost of collecting, storing and manipulating it, to the tools that are used to discover insights embedded within the data. For example, who would have thought that 10 years ago the data on every Citi Bike rented in New York City would be routinely captured? Or that this data, covering over 22 million rides (showing the day of the week, the time of day and the stations from which it was signed out and signed back in), would be simple to download into a database at virtually no cost? Or that the data could be easily analyzed at the transactional level, without needing to summarize it to make it more manageable? From this data, an actuary can construct a predictive model of the likely net migration of bicycles, depending on day of the week, time of year, weather conditions and other predictive variables. The actuary can then develop an optimization algorithm identifying the cheapest way for trucks to pick up bicycles from overloaded stations and deliver them back to stations with shortages, so that the probability that a customer would find himself at a station with no bicycles would be sufficiently low. This is the "internet of things," already in full swing.

These technological changes are quite fundamental and will materially alter the way that actuaries do their work and what work actuaries do. As the technology advances, the complexity of the work will increase, making the approaches I used in the middle of my career seem simplistic by comparison. For example, aggregating data into loss development triangles may be completely supplanted by analysis at the claim level, looking at the attributes of claims that are predictive of their future development.

As the complexity of the work

increases, so does the pressure for specialization. This is a truism applicable to most professions. One need only look at the medical field to see the specialization phenomenon playing out, with specialists performing an ever-increasing role in health-care delivery.

I believe this pressure for specialization puts the global actuarial profession at a proverbial crossroads in terms of its future educational strategy. Currently, most other actuarial organizations subscribe to a single, common syllabus for actuarial education applicable to all actuaries, offering practice-specific topics only at the perimeter. This

As the technology advances, the complexity of the work will increase, making the approaches I used in the middle of my career seem simplistic by comparison.

approach is predicated on the belief that it is desirable for all actuaries to have a general understanding of techniques and approaches across all practice areas, so that they are able to shift from one practice area to another. This single-syllabus approach is also inherent in the model syllabus developed by the IAA.

In contrast, the CAS takes the view that life and property-casualty actuarial work have fundamental differences, and that it is therefore better to have a much smaller common core of basic actuarial education with a correspondingly larger set of practice-specific materials. We believe our education program is better suited to the needs of a casualty actuary, with only about four common exam

Home-Sharing:
The Other Way to Stay

The growth of home-sharing services has created new sources of revenue for millions of vacationers and empty-nesters who've turned their temporarily empty homes and spare bedrooms into short-term accommodations for visitors from around the world.

Those same services have also created concerns for insurers who may not be aware of their insureds' activities and could present potential coverage issues for policyholders.

Learn More about Home-Sharing from ISO's White Paper

Download your free copy at
www.iso.com/homesharing

ISO
Verisk Insurance Solutions

topics followed by a substantial body of unique material — covering casualty topics in breadth and depth that cannot be achieved in just an exam or two.

The two viewpoints are illustrated in the figure below.

The distinction that the CAS draws between the two areas of actuarial practice is easy to describe, leading to relatively obvious differences in educational needs. Rather than using traditional terms such as "life" and "property-casualty," one can draw the distinction based on more fundamental characteristics of the cash flows and their risks.

1. The first area of practice (life) focuses on long-duration contingent cash flows, where the principal risk is the time value of money; the cash flows themselves are subject to contingencies that are relatively predictable (people die once and only once, with great regularity, and the contingent payouts are fixed amounts).

2. The second area of practice (property-casualty) focuses on short-duration contingent cash flows, where the principal risk is a variety of contingencies that creates significant uncertainty of the cash flows (for example, drivers of claim frequency and severity, and changing claim development); the time value of money is relatively less important (most claim payments are made within five years, not stretching out over 60).

Most life and pension products fall into the first area, while most property-casualty products fall into the second. There are, of course, exceptions that are the result of historical happenstance. Health fits better into the short-duration category; workers' compensation is a mixture of short- and long-duration cash flows. However, these anomalies do not deny the fundamental point that the work performed by most casualty actuaries is fundamentally different than the work performed by most life actuaries.

The educational implications flow from this distinction. For an actuary to be effective in managing long-duration contingencies, extensive knowledge of assets, asset risk, derivatives, portfolio theory and asset-liability management is required. To be effective in short-duration contingencies, this knowledge is nice to have, but less critical. Similarly,
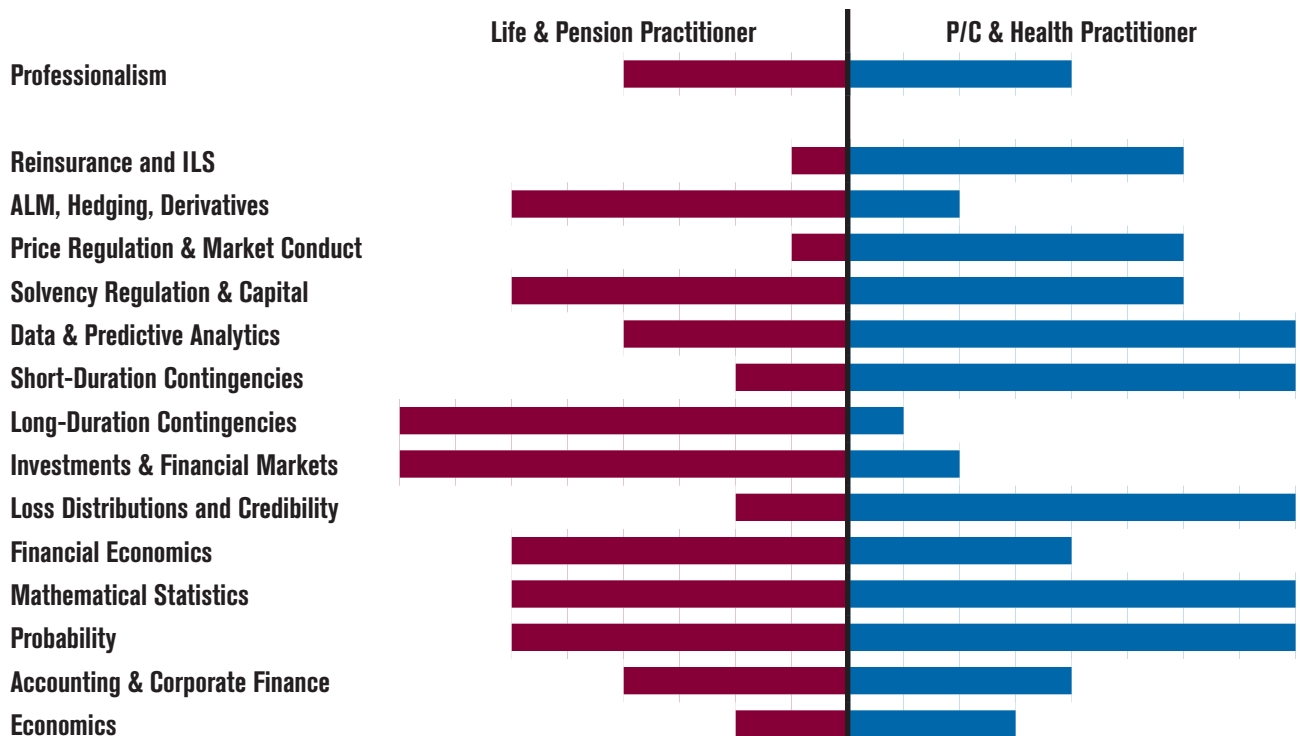
The listed topics and weightings are illustrative.

The two-syllabus approach strikes an appropriate balance between specialist and generalist, introducing sufficient practice-specific concentration to assure the effectiveness of actuaries in their respective practice areas.

to be effective in managing short-duration contingencies, an actuary must have extensive knowledge of liabilities, liability risk, frequency models, severity models and reinsurance — knowledge that is nice to have but not critical to be effective in managing long-duration contingencies. Applying predictive analytics is more important in a short-duration context, so the required breadth of this new material is greater.

The choice of educational strategy is important in a very practical sense. A consequence of the single-syllabus approach will be to add substantial material to the syllabus, in an effort to adequately cover the requirements of both areas of knowledge. In contrast, the two-syllabus approach reduces the pressure to cover everything. In my view, the single-syllabus approach will inevitably increase travel time to untenable levels or reduce the quality of learning on critical topics, or both. It is akin to asking a medical student to be trained in both orthopedic surgery and cardiology: Either the length of time in medical school goes up, or the student isn't fully trained in both areas. Neither students nor employers are likely to favor this approach.

The two-syllabus approach strikes an appropriate balance between specialist and generalist, introducing sufficient practice-specific concentration to assure the effectiveness of actuaries in their respective practice areas. It would be incorrect to interpret the approach as an argument for complete specialization. The two-syllabus approach will still produce actuaries who are generalists in the broader definition of that term.

For these reasons, the CAS has written to the IAA, encouraging them to reconsider the single core model syllabus they have developed in favor of a dual-syllabus approach. I would also encourage other actuarial organizations to consider a dual-syllabus approach as they review their own syllabi. ●

IMAGINE: CONFIDENCE IN THE NUMBERS.

member NEWS

COMINGS AND GOINGS

Pinnacle Actuarial Resources announced that three CAS Fellows have joined the firm as consulting actuaries. **Legaré W. Gresham, FCAS, MAAA**, has over 10 years of experience in the property-casualty practice area. **Jing Liu, FCAS, MAAA**, is a consulting actuary in the San Francisco office; she has over 15 years of experience in property-casualty insurance in actuarial and underwriting capacities. **Radost Wenman, FCAS, MAA**A, is a consulting actuary in the San Francisco office. She has over nine years of experience as a pricing actuary in the personal lines segment.

Capital Insurance Group has promoted **Andrew J. Doll, FCAS**, to vice president and chief operating officer. In his new position, Doll will be responsible for personal, commercial and agriculture lines of business, sales, field operations and customer service. Doll began his insurance career as an actuarial analyst in 1990.

Ben Turner, ACAS, has been named president of Windhaven Insurance, a Texas- and Florida-based company. Turner, who most recently served as senior vice president/chief actuary of Texas Mutual Workers' Compensation Insurance, was Windhaven's first chief actuary. He also held senior actuarial roles at Bristol West Insurance and Farmers Insurance Group.

Capital Insurance Group has appointed **Brian Janitschke, ACAS**, as chief actuary. His responsibilities will include directing the actuarial functions through analysis, evaluation and program development to address all areas of financial risk. Janitschke has over 20 years of experience in the insur-

ance industry in property, casualty and professional liability.

Allen Long, FCAS, was promoted to director, advanced analytics at Amerisure Insurance Co. Long joined Amerisure in 2006 and previously was manager, actuarial predictive analytics.

Argo Group International named **Robert Katzman, FCAS**, as its chief actuary. Katzman will be responsible for leading the Hamilton, Bermuda-based insurer and reinsurer's global actuarial function. Previously, he served as head of global casualty pricing and analytics at AIG. Katzman will succeed **Michael Fusco, FCAS, CERA**, who plans to retire after more than 40 years in the insurance industry.

The General Reinsurance unit of Berkshire Hathaway named longtime reinsurance executive **Kara Raiguel, FCAS**, as its new chief executive officer. Raiguel's accomplishments at the company have included the formation of a large California workers' compensation program and entry into India's reinsurance market. ●

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

IN MEMORIAM

Robert L. "Bob" Sanders (FCAS 1985) 1953-2016

Frank Harwayne (FCAS 1950) 1920-2016

Thank You to 2015-2016 Partners

The CAS appreciates the support of the 2015-2016 Partners.

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TRAVELERS

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

Old Actuaries Never Die ….

The AR *of August 1991 reported results for a silly but fun competition.*

AR Competition No. 1 Results

Judging from the number of responses, *AR* readers had a lot of fun with *AR Competition No. 1*. The contest, which was to complete the sentence, "Old actuaries never die, they just . . . ," drew 100 entries. *AR* editors had a difficult time in choosing a winner, but in the end selected,

"Old actuaries never die, they just develop to ultimate."

David Koegel and Sharon Markowski each submitted entries with the winning ending. Since both entries were received by *AR* on the same day, the contest was declared a tie. For winning, David and Sharon each will receive an official *AR* T-shirt lettered with the winning saying.

Receiving honorable mention are the following entries:

"Old actuaries never die, they are just broken down by sex and age." (From Geraldine Kaye, who said that *Fiasco*, a U.K. actuarial magazine, ran a similar competition several years ago, and that this is one of her favorites from that contest.)

"Old actuaries never die, they just no longer count." (Everett Truttman)

"Old actuaries never die, they just lost statistical significance." (Walt Wright)

"Old actuaries never die, they just average out." (Rich Ernst)

"Old actuaries never die, they just run off." (Steven Goldberg)

Special recognition also goes to Daniel Kligman, who submitted 13 entries including,

"Old actuaries never die, their Bayes just get numbered."

AR thanks everyone who entered the contest. A complete list of entries, with attributions, can be obtained by writing to the *AR*.

Look for *AR Competition No. 2* in the November issue. ●

Meet Kathleen Dean, CMP, Director of Meeting Services

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

- **What do you do at the CAS?**
  I am the director of the Meeting Services Department, and we handle the logistics for all CAS events. We are responsible for event details such as city selection, hotel/venue contracting, arranging of all food & beverage functions, room set up, audiovisuals, any offsite events, and all other aspects of coordinating the hosting of 20 – 1,000+ people in the same place at the same time.

- **What do you enjoy most about your job?**
  An event takes years of planning and tons of moving parts to produce, and I love to see everything come together. My job is definitely what you would call detail-oriented. Our members are rare in that they're incredibly engaged with the Society, and I've had the pleasure to work with some wonderful actuaries on a variety of committees over the years. I also have great coworkers!

- **Hometown:**
  I was born in Erie, Pennsylvania, but we moved to Palm Beach Gardens, Florida, when I was 12. Though I enjoyed my early years living in a fairly rural area, I quickly acclimated to the beach and really consider southeast Florida to be home.

- **College and degree:**
  I graduated from the University of Florida as a business major with minors in education and sociology … and a concentration in Gator football!

- **First job out of college:**
  I got my first taste of nonprofit work as an administrative assistant for the Society of the Plastics
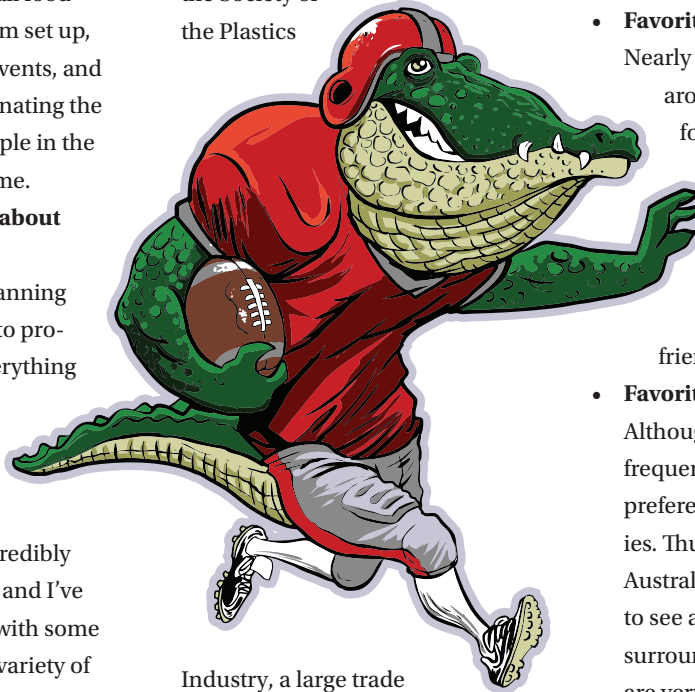
Industry, a large trade association in Washington, D.C. My boss quickly transitioned me into full-time meeting planning, which led me to the CAS, where I've been in the meeting services department for 18 years this September.

Kathleen Dean

- **Describe yourself in three words:**
  Conscientious, genuine, social.

- **Favorite weekend activity:**
  Nearly every weekend revolves around youth sports as we have four active kids ranging from seven to 14 years old. Otherwise, we are typically found participating in outdoor activities by day and socializing with friends and neighbors by night.

- **Favorite travel destination:**
  Although my husband and I frequent the Florida Keys, my preference is to explore foreign cities. Thus far, my favorite is Sydney, Australia, because there is so much to see and do both in the city and surrounding areas, and the locals are very fun and friendly.

- **One interesting or fun fact about you:**
  In addition to being a huge country music fan (heavy on the twang, light on the pop), I'm a Parrothead and have seen Jimmy Buffet live in concert 25 times. ●

Scenes from the CAS Course on Professionalism in Changsha, China
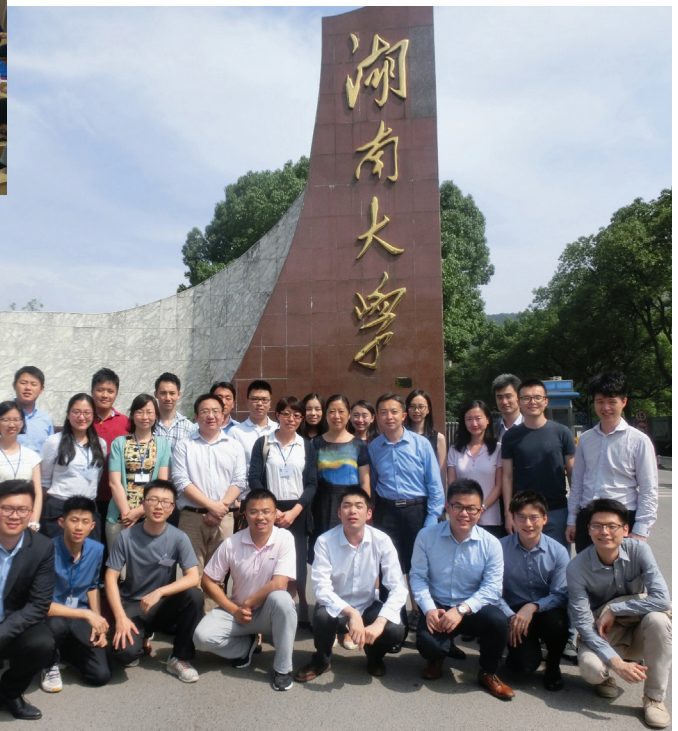
CAS International Manager Michael Chou provided photos from the latest Course on Professionalism (COP) held June 2016 in Changsha, China. Since December 2005, the CAS has offered the COP in Asia to Candidates living there. In 2017 the CAS plans another COP for the region. Past COPs have been conducted in Hong Kong; Singapore; Beijing; Chendu, China; and Kuala Lumpur.
Bottom photo: Chou is pictured standing on the left with Candidates and the instructors.

CAS Wins Award for Hand-Animated, New Member Video

The CAS New Members Committee (NMC) was honored for its innovative member video, "Attending Your First CAS Meeting," which earned a Silver EXCEL Award in the category of "Best Video–Membership." The EXCEL Awards, hosted by Association Media & Publishing, recognize excellence in nonprofit association publishing, marketing and communications. The NMC works to effectively integrate new members into the CAS and pays close attention to new member feedback. "The EXCEL Award shows the dedication of the committee and what we are able to accomplish with just a small, but powerful idea," said NMC Chairperson Shane Barnes (FCAS 2012).

The video's concept sprang from a roundtable discussion for New Associates at the 2015 CAS Spring Meeting in Colorado Springs. Some of the new Associates said that they were not fully prepared for the meeting's demands. Following the conversation, two of

Accepting the award for the CAS is staff member Stephanie Litrenta. The Association Media & Publishing EXCEL Award Gala was held in Washington, D.C.

the roundtable hosts, Paul Grammens (FCAS 2015) and CAS Membership & Volunteer Manager Matt Caruso, summarized the discussion for the NMC. Grammens then showed Caruso a video he had made on his iPhone. Grammens offered to create a video that would better prepare new members for a CAS meeting.

The full NMC enthusiastically signed on to the project and got to work. NMC members drafted and edited a

script and then developed thumbnail sketches for content. Dan Watt (ACAS 2015) was recruited as illustrator. The drawing stage of the video took eight hours of pre-work, with three hours total filming shot in a hand-animated style on Grammens' iPhone. Grammens edited the content in iMovie and performed voice-over narration along with Bill Lewis, a coworker of Grammens and Watt. The end result guides newcomers through the on-site registration process, dedicated new member receptions, class photos and educational sessions.

Winners of the highly competitive EXCEL Awards contest were honored at the EXCEL Awards Gala on June 27 in Washington, D.C.

"The New Members Committee dedicated personal time, creativity and resources to bring this project together," Caruso said. "It is an honor to see that vision rewarded with recognition from this contest." ●

New Members Video: Attending Your First CAS Meeting

A still from "Attending Your First CAS Meeting."

Brener Named Director of The CAS Institute

BY KATE NISWANDER, CAS MARKETING AND COMMUNICATIONS MANAGER

Experienced project management professional is first full-time staff hire for new initiative

The Casualty Actuarial Society (CAS) has named Amy Brener, PMP, director of The CAS Institute (iCAS), a subsidiary of the Casualty Actuarial Society that will offer new credentials and specialized professional education for quantitative professionals. Brener joined The CAS Institute as a project manager on a short-term contract last year, and she was recently hired full-time to run the program.

Brener has a management background in both the corporate world and academia. She most recently spent over a decade at George Mason University in Fairfax, Virginia, serving as communications director for the university's vice president of information technology/CIO and eventually as the director of global IT projects. She also served as deputy director of 4-VA, a statewide initiative dedicated to fostering collaboration among Virginia universities with the goal of improving all Virginians' access to higher education.

"We couldn't be more pleased to have Amy officially leading this new and exciting venture for the CAS," said CAS Board Chair Bob Miccolis, who chairs The CAS Institute Leadership Advisory Council. "With the positive response to our launch of The CAS Institute last fall, having Amy's skill set and thorough understanding of the iCAS mission has been critical to the launch and growth of the program."

"Amy brings an immense number of project management skills to this initiative and has been a critical member of

the CAS team for several months," said CAS Executive Director Cynthia Ziegler. "We are happy to officially welcome her to the staff."

Actuarial Review recently sat down with Brener to discuss her new role.

As director of The CAS Institute, what does your day-to-day work involve?
Since iCAS is a subsidiary of the CAS, much of the work that is currently being done is by CAS members and others whom they have brought into the project. I coordinate several different volunteer groups, including the Leadership Advisory Council, which serves as the oversight board of iCAS, and the Subject Matter Expert Panel, which is designing the curriculum as well as the Experienced Practitioner Pathway

Amy Brener

are working on aspects of iCAS development.

How does your past experience apply to this new director position?
I can think of two specific experiences that have informed my work with iCAS. When I became deputy director of 4-VA, it was just being established. That means I was involved in its organization,

> **"Having Amy's skill set and thorough understanding of the iCAS mission has been critical to the launch and growth of the program."**
>
> **— Bob Miccolis, CAS Board Chair**

for our first credential. Each of these groups has smaller subgroups that are charged with looking at specific areas of the program, including membership, communications, risk and finance. I am also involved in setting up and maintaining strategic partnerships, including the one we announced last fall with The Institutes and several others that are currently in the works. Finally, I participate on half a dozen CAS staff teams that

defining its mission, and developing its strategic and operational plans. So iCAS is technically the second "startup" I have been involved with in the past five years. In my personal time, I serve in a leadership role with Toastmasters International. As the person in the "Number 2" position of the local Toastmasters district, I am responsible for the success of our 3,000 members and 149 clubs. I have a lot of experience

working with volunteers to get our goals accomplished. I use the same skill sets to collaborate with the CAS members and other volunteers who serve on the iCAS Leadership Advisory Council and the Subject Matter Experts' Panel.

What makes the iCAS inaugural credential in data science and predictive analytics so unique?

Two characteristics make our credential unique. The first is the emphasis on P&C insurance understanding and training. The second, and something I'm particularly excited about, is the fact that our certification will involve more than just a multiple-choice test format. I have taken several certification exams myself — in fact, I have taught GRE and GMAT test prep courses at local universities for 15 years — so I know firsthand that it is possible to "study for" and "teach to" a specific test. Our certification in predictive analytics will require candidates to actually demonstrate their ability to perform actual work in this area.

Tell us more about the process for attaining the credential.

The predictive analytics credential will be awarded after a candidate has passed four different assessments. While the formats of the latter two assessments are still under development, the basic outline is already in place. The first three can be defined by their "subject matter": (1) general (P&C) insurance; (2) data management, data exploration, and visualization; and (3) modeling and methodologies. I'm especially excited about this third area because, under the current plan, the exam will require the test takers to run an open-source version of software such as R, SQL or Python against data sets to solve problems

and generate graphical output. We anticipate that the fourth assessment will consist of a project; applicants will complete a project designed to highlight the application of the topics tested in the three exams.

What key things should CAS members know about iCAS?

The first assessment for the data science/predictive analytics credential will require completion of an online course being designed with The Institutes; this course will be followed by a multiple-choice/short-answer examination. Waivers will be given to CAS Fellows and Associates, as well as nonmembers who have taken and passed CAS Online Courses 1 and 2 and Exam 5, since the material it covers is being taken primar-

ily from the syllabi and study materials for these three CAS admissions requirements. A similar exemption will be given to actuaries from Mutual Recognition partners who can demonstrate they have taken the relevant P&C track.

We are also working on an Experienced Practitioner Pathway (EPP) for those who are already experts in predictive analytics for P&C; these experts can receive our credential without needing to complete the assessments. We plan to release the guidelines and process for applying through EPP in October when we announce the release of the first of the four assessments as well as other details about the first credential. ●

CAS University Engagement Committee Establishes a P&C Resource Library for Professors

BY TOM WHITCOMB, VICE CHAIR, CAS UEC AND FORMER CO-CHAIR, UEC ACADEMIC WORKING GROUP

Early this year, the CAS released a new resource for professors who teach actuarial science called the P&C Resource Library, an online resource created to facilitate access to property and casualty materials to incorporate into a university-level course.

I introduced the idea of a resource library for professors because it fit into the broader goal of the CAS and its University Engagement Committee (UEC), which is to promote and facilitate access to property and casualty resources in the classroom so that students can gain exposure to P&C concepts during their university studies. This was a project that personally interested me because, as a former high school teacher, I remember the challenge of creating a new course from scratch. The library was among a number of initiatives introduced by the CAS University Engagement Committee during the 2015-2016 academic year; others include the CAS University Award Program and CAS Case Competition toolkit, both written about in the July/August issue of *Actuarial Review*.

The library is built around three sample syllabi, written by a team of volunteers consisting of academics and practicing actuaries on the CAS University Engagement Committee's Academic Working Group. The syllabi topics include an introduction to ratemaking, introduction to reserving and a combined ratemaking and reserving course. The syllabi follow the basic flow of the ratemaking and reserving texts that underlie CAS Exam 5. The syllabi can be used to develop a new P&C actuarial course, enhance an existing one or incorporate P&C concepts into a broader insurance course.

Beyond the syllabi, the committee gathered a collection of supporting resources that are housed within the library. They fall into four categories:

1.   Articles and Texts.
The reading materials referenced in each of the syllabi can be easily accessed and incorporated into an introductory ratemaking or reserving course.

2.   CAS Resources.
CAS Case Studies. Created specifically for the classroom, these case studies cover a variety of topics such as liabilities, automobile insurance, catastrophe modeling, and can be implemented to enhance a course.

CAS Exams. Sample ratemaking and reserving problems from past exams are available for students to work through. The problems have been linked to specific learning objectives so a professor can easily match problems with the concepts being taught on a particular week.

3.   Industry Resources.
The library has acquired a collection of pertinent data, articles and webpages from the insurance industry that can be incorporated into a P&C course.

4.   University Resources.
Thanks to the support from university faculty like Simon Fraser University Professor Camille Minogue, FCAS, we now have sample syllabi and course materials that can be reviewed for ideas on updating or building a property and casualty course.

The P&C Resource Library is intended to be dynamic, and the UEC plans to make periodic updates and additions to it.

If you have materials to recommend to the library, including presentations, articles and data, please contact CAS University Engagement Manager Tamar Gertner at tgertner@casact.org. ●

Tom Whitcomb, FCAS, is a senior actuary at Travelers in Hartford, Connecticut.

About Academic Central
Academic Central is a program for nonmembers who are involved in teaching actuarial science, mathematics, economics, business or related courses, and who have an interest in CAS activities.

Educators are welcome to register as Academic Central members by writing the CAS, indicating their teaching involvement and their interest.

To learn more about the program or to offer suggestions, questions, or comments, contact Tamar Gertner, University Engagement Manager, at tgertner@casact.org.

P&C RESOURCE LIBRARY

CAS SAMPLE SYLLABI

Introduction to Ratemaking Course Syllabus

Introduction to Reserving Course Syllabus

Introduction to Ratemaking and Reserving Course Syllabus

ARTICLES AND TEXTS

The articles and texts referenced in the sample syllabi can be easily accessed and downloaded according to the specific course topic: ratemaking or reserving.

+ Ratemaking Articles and Texts

+ Reserving Articles and Texts

CAS RESOURCES

CAS resources include a series of property and casualty case studies designed for use in the classroom and information on CAS Exam learning objectives linked to sample problems.

+ CAS Case Study Materials

+ CAS Exams

INDUSTRY RESOURCES

There are a number of industry resources including data sources, industry articles and webpages that you may want to incorporate into your property and casualty course.

+ Data

+ Industry Articles and Webpages

UNIVERSITY RESOURCES

University professors teaching property and casualty courses have been invited to share their course materials, including class syllabi, slides and homework assignments. Submitted materials are housed in this section.

+ University Example Syllabi

+ University Course Materials

CAS Stained Glass Window Unveiled in London

BY MATT CARUSO, CAS MEMBERSHIP AND VOLUNTEER MANAGER

In July 2016, a CAS delegation met with leaders of The Institute and Faculty of Actuaries (IFoA) at London's historic Staple Inn to view a stained glass window commemorating the CAS centennial and the organization's noteworthy role in the actuarial profession. A Tudor building situated on the south side of London, Staple Inn has been home to IFoA offices and events since 1887. The IFoA invited the CAS to commission a window for the Staple Inn to honor the CAS 2014 centennial, joining previously commissioned windows by other actuarial societies including the American Academy of Actuaries and the Canadian Institute of Actuaries.

In 2003 the CAS Board of Directors formed the CAS Centennial Commemorative Subcommittee to design and commission the window. The committee drafted a window brief that was sent to the British Society of Master Glass Painters (BSMGP) with design requirements and a brief history of the CAS. The BSMGP sent its membership the window brief calling for interested artists. The committee ultimately selected Joseph Nuttgens, a Fellow of the BSMGP, to create the window.

Nuttgens is the son of renowned stained glass artist J.E. Nuttgens and has designed and created stained glass windows for many cathedrals, churches and other locations within the United Kingdom. He created the CAS window in The Stained Glass Studio, a workspace that his father built in 1939. (The last window created by the senior Nuttgens in the studio was a commission for Sir Paul and Linda McCartney). Nuttgens designed the window's colors and themes to balance with adjacent stained glass windows in the Great Hall.

The site of the Staple Inn, first known as the Staples, was a London mercantile space established in the 14th century. Following major renovations in the 1580s, stained glass windows were introduced to the Inn's Great Hall. A pillar of resiliency, the Inn survived the great London fire of 1666 with the flames stopping 200 yards away, and the Inn endured major damage from a *Luftwaffe* bomb during World War II in 1944. ●

The CAS window combines traditional heraldic elements of swords and a knight with images designed to illustrate the CAS's unique focus on property-casualty insurance. Symbols representing the hazards of storms, water and fire are woven into the design, with the knight and the original CAS logo in the center serving as signs of determination and strength. The scales of justice were included to represent general liability, and the three gold ellipses symbolize the property-casualty gold standard reflected in the modern CAS logo.

Pictured in front of the stained glass piece left to right are Cynthia Ziegler, CAS executive director; Steve Lowe, CAS president; Nancy Braithwaite, CAS president-elect; Colin Wilson, Institute and Faculty of Actuaries (IFoA) president; Marjorie Ngwenya, IFoA president-elect; Fiona Morrison, IFoA past president; and Derek Cribb, IFoA chief executive.

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MEET THE VEEP

Courchene Nurtures a Global View

*A*R *introduces a new column that gives CAS members a closer look at their leaders. For our first installment, we are pleased to introduce CAS Vice President-International Jeff Courchene.*

What's your current job title and company and what do you do?

I'm a principal and senior consultant with the London office of Milliman. My area of expertise is international property and casualty insurance: particularly reserving, reinsurance analysis, mergers and acquisitions and dynamic financial modeling. I have extensive experience in matters related to both personal and commercial lines of business in the United Kingdom, continental Europe and the Middle East.

I am a frequent speaker for the European Actuarial Academy and a contributing author of a GIRO working party paper titled, "Solvency II Technical Provisions for General Insurers," which won the 2013 Brian Hey Prize [GIRO stands for General Insurance Research Organization and is part of the Institutes and Faculty of Actuaries (IFoA) in the U.K.]. I am a contributing author of the International Actuarial Association's (IAA) monograph "Stochastic Modeling — Theory and Reality from an Actuarial Perspective" and the primary, non-life author of the IAA monograph, "Discount Rates in Financial Reporting — A Practical Guide."

What is your role as CAS vice president-international?

Officially, the function of the international VP is to advocate, coordinate, manage and supervise CAS international activities related to providing services to current and potential future CAS members outside North America. I see my role as having both an inward and an outward focus. Inwardly, I want to ensure that our members working outside of North America receive the same benefits and support as those working in North America. This involves ensuring that committees within the CAS volunteer ranks (admissions, research, professional education and administration) have access to an adequate number of international voices. Outwardly, I pursue opportunities for the CAS to collaborate and cooperate with actuarial associations and other organizations (or act independently) for the betterment of the actuarial profession generally. My preference is to enable our global CAS members to identify and pursue opportunities to increase the visibility of the CAS in their local jurisdictions.

On your road to leadership, what prior CAS volunteer work led to your vice president appointment?

My first volunteer efforts were in the CAS exam system, where I supported a pass mark panel, wrote questions and graded CAS exams. I also volunteered for the European Regional Committee

Jeff Courchene

and the International Issues Committee, the latter of which, among other things, determined the winner of the Charles A. Hachemeister Prize.[1] Along the way, I added a non-North American voice to deliberations for a number of CAS task forces, including Volunteer Issues, Communication to Members, General Insurance Actuaries Network and Professionalism Policy Review. Prior to accepting the VP spot, I chaired the International Member Services Committee.

What are your goals as vice president?

I want to increase the frequency of CAS webinars that are germane to an international audience, and I want to expand our influence by having more CAS members speak at relevant events outside of North America. I would like to have more international articles in *Actuarial Review*. My other goals include furthering the CAS international strategy by helping our ambassadors and regional committees to be even more effective

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[1] The Hachemeister Prize recognizes papers published in the *ASTIN Bulletin*.

in identifying new opportunities and executing new programs.

Share an interesting fact about yourself.

With five out of 10 CAS exams completed, only a few years of direct experience and zero German language skills, I was convinced in 1997 by an actuarial recruiter to accept a position with a reinsurance company in Köln. Though driven more by *Wanderlust* and my interest in soccer, this decision has allowed me to grow professionally and dive deeply into a number of diverse non-life insurance markets.

According to United.com, I have so far accrued 1,574,274 lifetime flight miles — not quite the number that George Clooney's character had in mind in the film *Up in the Air*.

This may be a bit nerdy, but I enjoy identifying and celebrating patterns and symmetry in everyday life. For example, my daughter's birthday (7 August 05) is equal to the difference of my wife's birthday (21 November 77) and my birthday (14 March 72) using non-Y2k compliant formatting.

When you meet new Associates and Fellows at the Spring and Annual Meetings, what information or advice do you try to impart?

I usually encourage them to celebrate their achievement and to seek the right balance of work and play, now that they have additional "free time" on their hands. I remind them that the journey is just beginning and that continuing education requirements are essential to keep their skills sharp. Finally I do try to engage them in a conversation about volunteer opportunities. When new members are ready to volunteer, opportunities come in all shapes and sizes. There is something for everyone and the rewards are plentiful. For me, my initial motivation to join the Exam Committee was to retain knowledge and understanding of difficult concepts from the exams and have a direct link to new syllabus material. More recently, however, I am motivated to expand my global network —committees are a fantastic way to interact with a diverse set of CAS members. ●

COMING ATTRACTIONS — RESEARCH EDITION

SEE LOLA RUN
SAME R, ONLY BETTER

ALPHABET CITY
AL, WC AND THE ACA

THE BIG SHORT
THE ESSENTIALS OF FINANCIAL REPORTING LITERATURE

SAME TIME NEXT YEAR
RAD: THE SEQUEL

In a world where actuarial research is appreciated, even valued… one year stands out: 2016, a year of research premieres, sequels and remakes of old classics….

By ELIZABETH A. SMITH

Summer has its blockbuster movies, while the fall brings more cerebral and potentially award-winning offerings — much like the CAS research projects premiering this last half of the year. These projects are deep and absorbing — the culminations of a lot of time, thought and effort from a number of volunteer committees and task forces as well as external partners. Here's a preview of some new releases.

See Lola Run
Same R, Only Better

For the uninitiated, R is a computer language and environment for statistical computing and graphics that can be quite flexible, enabling users to add and define new functions. R is a free software that can be used for a wide range of functions, including linear and nonlinear modeling, classical statistical tests, time-series analysis and classification and clustering. Other benefits include R's publication-quality graphics and its ability to run on a wide variety of UNIX platforms and similar systems, Windows and MacOS.

Led by Ben Escoto, FCAS, and Brian Fannin, ACAS, the Open-Source Software Committee is working on the R platform with plans to make it run R even better. The committee projects releasing their research in fall 2016. In the meantime, readers can learn more about R from the committee's wiki page at http://opensourcesoftware.casact.org/.

Snakes on a Plane

Although their emphasis has been on R, the Open-Source Software Committee is looking to explore other computer languages. In particular, at least one committee member has an interest in working with Python.

Alphabet City
AL, WC and the ACA

The CAS Health Care Issues Committee has teamed up with the research organization RAND Corporation to study the

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[1] "What's Driving the Claims Severity of Driverless Cars?" and "Future Innovations for Driverless Cars."

[2] "Destination Driverless," *Actuarial Review*, November/December 2015, http://bit.ly/DriverlessAR15NoDe.

[3] "Self Driving Cars: Dealership Opportunities," Car Biz Today, May 2016, https://issuu.com/cbt_news/docs/cbt_may16_pages_/28.

[4] "Restating the National Highway Transportation Safety Administration's National Motor Vehicle Crash Causation Survey for Automated Vehicles," http://www.casact.org/pubs/forum/16sforum/.

impact of the Affordable Care Act (ACA) on workers' compensation (WC) and automobile liability (AL) insurance. WC systems in the U.S. provide tens of billions of dollars in medical care each year, but relatively little is known about how changes in health insurance availability affect the incidence and nature of WC and auto injury claims. Using the ACA's young adult dependent coverage expansion and drawing on millions of hospital records from four large states with distinct WC systems, the researchers measured the effect of health insurance expansions on WC claim frequency and severity.

Some of the results of the AL study were presented at the 2015 Casualty Loss Reserve Seminar and the WC study at the 2016 CAS Spring Meeting. The final reports are scheduled for a late 2016 release, and there will be a webinar highlighting the WC results in late 2016 as well.

The Big Short
The Essentials of Financial Reporting Literature

The CAS Financial Reporting and Analysis Committee is charged not only with financial reporting, but also with evaluating the areas of actuarial work that support preparing, auditing and analyzing financial statement data. The committee has monitored changes and emerging issues in financial reporting and is attuned to research, models or practice methodologies that actuaries use in property-casualty companies, as well as other similar risk-sharing or risk-pooling mechanisms, including government-run programs.

To aid in its work, the committee appointed the Credit Risk Special Interest Section or CRiSIS to oversee putting together the compendium. CRiSIS contracted with Quantact, an actuarial and financial mathematics laboratory based in Montréal, to organize a set of resources on credit risk for the practicing actuary. The resources will be tailored to actuarial applications such as reinsurance credit risk, mortgage guaranty insurance and actuarial modeling of fundamental credit risk of assets/investments for cash flow modeling, intrinsic valuations of structured credits and enterprise risk management purposes.

The compendium includes articles, research papers, books, software and other tools. It will also contain sources for credit risk data that practicing actuaries may use, including public domain resources on default rates and severities/recoveries as well as subscription-based material. Quantact will evaluate the various contributions and present the topics

most relevant for each area of practice. It is to be published in an upcoming issue of *E-Forum*.

Same Time Next Year
RAD: The Sequel

Like a venerated actor who can always be counted on to give an outstanding performance, the CAS Theory of Risk Committee (COTOR) delivers quality work, adding to its oeuvre time and time again. One of COTOR's most ambitious projects, the Risk Assessment Database or RAD, has been updated recently with information affecting non-life risk assessment compiled from 2015.

RAD began in 2010 as a natural extension of the work of the Risk Premium Project (RPP), an extensive, thorough and current analysis of the theory and practice of risk assessment for property-casualty insurance. RPP got its start in 2000 with RPP I, a review of actuarial and finance research done up until 2000. Because of the considerable development in the field, the project grew into RPP II, which extended the findings from RPP I with research done until 2010.

Martin Eling is RAD's developer and administrator who, along with a team of graduate students, updates the database annually. Eling's team is affiliated with the Institute of Insurance Economics at the University of St. Gallen in Switzerland and is funded by the CAS.

The recent update highlights the topics of reinsurance and behavioral insurance, with the objective of finding the relevance between the two topics and improving the efficiency of the reinsurance market and the design of reinsurance contracts.

In addition to classical insurance theories, the updates include practices deviating from the standard prediction that encourages applying behavioral methods. Specifically, the team investigated how people perceive risks differently than how risks actually are and the corresponding changes in insurance. The behavioral results offer more understanding of non-life insurance management.

For Eling's report on the latest update, visit bit.ly/RADUpdate2015. To learn more about the RPP and RAD, visit bit.ly/RPP_RAD. ●

Elizabeth Smith is a movie buff and managing editor for Actuarial Review.

ACTUARIES CLIMATE INDEX SERVES THE PROFESSION AND THE PUBLIC

BY ELIZABETH SMITH

T he Actuaries Climate Index (ACI) will offer online information about climate change for use in risk models and risk management applications, fulfilling not only an actuarial need but a public one as well: Actuaries can use it to account for climatological trends in models, and the public can use it to understand how long-term climate changes can cause extreme weather.

The ACI will be available for use by actuaries, public policy makers and the general public through a website housing the data. The site, which will be available at actuariesclimateindex.org, is scheduled to be launched in late 2016.

The online index was developed in conjunction with Solterra Solutions, the same private firm that produced the first part of the project, "Determining the Impact of Climate Change on Insurance Risk and the Global Community Phase I: Key Climate Indicators." The Phase I report was published in late 2012 and summarizes data from climate change research over many decades. It was prompted by trends showing increases in climatological changes such as higher surface temperatures, decreasing ice cap masses and extremes of heat and precipitation, just to name a few.

ACTUARIES CLIMATE INDEX
INDICE ACTUARIEL CLIMATIQUE

A Coalition Forms

Extreme events (e.g., strong winds, flood and drought) and other factors often have a significant impact on insurance claims. These extreme events, particularly heat and cold, can also affect mortality and health.

Driven by their common interests, the CAS, American Academy of Actuaries, the Canadian Institute of Actuaries and the Society of Actuaries formed a group to address climate change and its implications for the insurance industry. The coalition was also inspired by a need to educate the public about climate change.

The Mechanics

Using a bank of historical data, the index thus far shows increased frequency of extreme weather patterns. For instance, T90, the index for hot days, has been growing since the mid-

cal long-term trends into their mathematical models. Actuaries and others working in enterprise risk management can use the index to quantify risks of increasing claim activity.

Looking Ahead

For now, the ACI will monitor only part of North America, but discussions are underway to expand the project's geographic scope with other actuarial organizations around the world contributing to the index.

In addition, the coalition is developing a separate Actuaries Climate Risk Index or ACRI. This second index will measure correlations between changes in the frequency of extreme events as measured by the ACI and economic losses, mortality and morbidity.

Doug Collins, chair of the CAS Climate Change Committee, characterized the ACI as an example of actuaries using their data analytic skills to shed light in an area not traditionally associated with actuarial science.

New ACI values will be posted quarterly on actuariesclimateindex.org as data for each meteorological season becomes available. The website also features interactive maps and graphs showing the changes in each of the component parts over the years and documents outlining the genesis and development of the project, including the actuarial basis for the index. ●

What's the difference between weather and climate?

NASA has this to say:

"The **difference between weather and climate** is a measure of time. **Weather** is what conditions of the atmosphere are over a short period of time, and **climate** is how the atmosphere 'behaves' over relatively long periods of time." February 1, 2005

See also NASA's video "130 years of Global Warming in 30 seconds" for a graphic depiction of climate data.

1980s. The cold-day index, T10, has been declining. In short, notably hot days are on the rise while notably cold days are fewer.

Initially, the ACI will cover the United States and Canada, splitting the two countries into 12 regions. Each region will have its own set of indices, consolidating measurements taken on grids of approximately 140 square miles. The ACI is a factor of six components: extreme temperatures (high and low), extreme precipitation, consecutive dry days, high winds and sea levels.

Each quarter, the ACI will provide a summary measurement of these statistics in each region and will develop commentary explaining the movements.

Each component will be defined by its measurements during the reference period from 1961 to 1990 and the subsequent changes in those measurements.

For each region, the six components will be combined into one metric, the ACI. Those regional indices will then be pooled into a single index for all of the United States and Canada. Higher index values represent an increase in the frequency of extreme weather events.

Using the ACI, pricing actuaries can incorporate histori-

Actuaries Weigh In on Climate Change

To learn more about what actuarial thought leaders are saying about climate change, read "Essays on the Impact of Climate Change on the Insurance Industry" in the Winter 2014 *E-Forum*.

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ON THE SHELF BY LAURIE MCCLELLAN

Are Actuaries Superforecasting Material?

Superforecasting: The Art and Science of Prediction by Philip E. Tetlock and Dan Gardner (Crown 2015. 352 pp. $28.00)

A bat and a ball cost $1.10 together. The bat costs a dollar more than the ball. Quick: How much does the ball cost?

If you answered five cents, you might be the kind of forecaster that psychological researcher and Wharton School professor Philip Tetlock profiles in *Superforecasting: The Art and Science of Prediction*. Written with journalist Dan Gardner, the book chronicles the four years Tetlock spent running a forecasting contest. By simply keeping score, he was able to find out who made the most accurate forecasts, and more importantly for readers, exactly how the people he calls "superforecasters" achieved such startling results.

The origin of the book dates back to 2010. The U.S. intelligence community was reeling from their prediction — ultimately proved false — that Saddam Hussein had stockpiled weapons of mass destruction in Iraq. Wondering how the art of forecasting could be scientifically improved, the intelligence organization IARPA asked Tetlock to enter a contest with a serious purpose.

The Good Judgment Project

The request led Tetlock to launch the Good Judgment Project with his research partner Barbara Mellers in 2011. They recruited more than 20,000 volunteers to answer questions about international events, such as, "In the next year, will any country withdraw from the eurozone?" Each question had a specific time frame and a closing date, and the volunteers answered with a probability. Over the four years of the tournament, nearly 500 such questions garnered over a million forecasts. Along the way, Tetlock not only studied the results but was allowed to run experiments to try to improve his team's performance.

Tetlock's volunteers were competing not just against each other, but also against other teams in the IARPA tourney — one of which was the U.S. intelligence community. But by the end of the tournament, Tetlock's team had delivered results that no one had predicted. Using volunteers and a few algorithms to adjust their predictions, the team won the tournament, beating even the intelligence professionals (although the margin of their success against the professionals remains classified).

"I was very surprised," says Tetlock. "I was really surprised that the best people were able to do so much better, even than professional intelligence analysts, who had access to classified information." Overall, the superforecasters outperformed the other forecasters in the tournament by 60 percent.

Are Superforecasters Super Smart?

What made the superforecasters so good? The researchers began by looking at test scores. Tetlock found that while the average volunteer scored about 70 percent higher than the U.S. population on tests of intelligence and knowledge, the superforecasters scored about 80 percent higher. They were also comfortable with math and tended to be probabilistic thinkers, although as Tetlock points out, "the basic analytical tools that the best forecasters used to boost their accuracy are accessible to anyone who has very basic, intro college math."
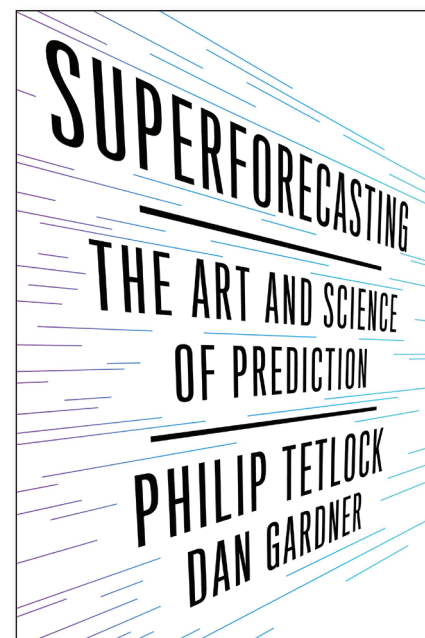
In the end, the researchers concluded it wasn't so much who the superforecasters were, but what they did. "What matters most," Tetlock writes, "is how the forecaster thinks."

To start, the best forecasters were careful. The first thing they were careful

about was falling into the trap of what's called System 1 thinking — the kind of snap judgments that people make automatically to save time.

System 1 thinking is why most people get the bat and ball question wrong. At first glance, it seems obvious that if

To start, the best forecasters were careful. The first thing they were careful about was falling into the trap of what's called System 1 thinking — the kind of snap judgments that people make automatically to save time.

the bat and ball together cost $1.10, and the bat is a dollar more, the ball must cost ten cents. To get the question right, however, you need to slow down and use System 2 thinking — deliberate, conscious thought.

Avoid the Bait-and-Switch

Tetlock found the best forecasters consistently used a handful of methods to enhance their analytical reasoning. The first of these had to do with how they looked at the question itself. To get to an accurate forecast, it turns out, you first have to avoid the bait-and-switch trap.

Bait-and-switch is another automatic process, so it tends to go unno-

ticed until it's too late. The process goes like this: Confronted by a very difficult question, most people get stymied and automatically substitute an easier one instead.

Tetlock recounts how the bait-and-switch problem caused superforecaster Bill Flack to flub the question, "Will Japanese Prime Minister Shinzo Abe visit the Yasukuni shrine in 2013?" Yasukuni honors Japan's war casualties, listing the names of almost 2.5 million people. But among those listed are some 1,000 war criminals, so official visits to the shrine provoke protests from the governments of China and South Korea. Skipping the visit looked like the most rational course of action.

But counter to Bill's prediction, Abe did visit the shrine. Reviewing his process, Bill said, "I think that the question I was really answering wasn't 'Will Abe visit Yasukuni?' but 'If I were PM of Japan, would I visit Yasukuni?'"

Channel Enrico Fermi

How many extraterrestrial civilizations exist in the universe? That's not a question from the forecasting tournament, but rather one posed by physicist Enrico Fermi, who was famous for coming up with estimates for seemingly unanswerable questions. Fermi's secret was to break the question into sub-problems, dividing the knowable from the unknowable. The best forecasters often used Fermi's method, known as "Fermi-izing," to approach tough questions.

As a quick lesson in how to Fermi-ize, Tetlock deconstructs a question Fermi often asked his students: How many piano tuners are there in Chicago? (Remember, this was before Google). To arrive at a good estimate, start by asking another question: What do I need to know to answer this question?

Tetlock keys on in four variables: the number of pianos in Chicago, how often pianos are tuned each year, how long it takes to tune a piano, and how many hours per year the average piano tuner works. By intelligently estimating each sub-question, it's possible to come up with an answer that's surprisingly close to the truth.

First the outside view, then the inside

Like actuaries, the superforecasters tended to answer a question by looking

first for the outside view, in the form of statistics. To illustrate this, Tetlock describes hypothetical four-year-old Tommy Renzetti, who lives in a small house with his dad, a bookkeeper named Frank, and his mom, Mary. Here's the question: Does Tommy have a dog?

If your first thought was look up the percentage of American families that own dogs, you're following in the footsteps of the superforecasters. Only after searching for the best comparison class and locating any data did the best forecasters then proceed to the "inside view" — the specifics of the situation — such as the fact that Tommy is still too young to walk a dog by himself, hypothetical or otherwise.

In putting together a variety of views, Tetlock compares the best fore-

Only after searching for the best comparison class and locating any data did the best forecasters then proceed to the "inside view" — the specifics of the situation.

Tetlock, "and some people find it a bit off-putting." He explains his observation by imagining a superforecaster at a wedding.

"If you were to ask [superforecasters] how likely is it that the couple is going to stay together," he says, "you wouldn't get the usual reaction, which tends to be, 'well, look at how happy they are!' You'd get, 'The right thing to look at is the base rate of divorce in their demographic category.'"

After starting their estimate with data, based on the best comparison class, the superforecasters would then adjust that estimate using any inside in-

ran a side experiment. They randomly assigned several hundred forecasters to work alone, and several hundred others to work on teams. Although the teams didn't meet in person, members could communicate by email or Skype. By the end of the first year, the teams were 23 percent more accurate than the individuals. For the best forecasters, the benefits of becoming part of a team were even clearer: The superforecasters from year one became 50 percent more accurate when placed on a team in year two.

What are the implications of Tetlock's research for actuaries? You might expect actuaries to be excellent forecasters, and Tetlock says that during the tournament, several actuaries did make it into the ranks of the superforecasters. "It's an interesting question of how far the rigor of actuarial thinking can be extended," he says, "into the domains where you don't have well-defined statistical distributions. And I think if there's a big, big surprise, on a philosophical scale; it's that it's possible to take explicit probabilistic reasoning into domains where few people previously thought it possible."

Will forecasting become a more scientific endeavor in the near future, as Tetlock hopes? You can always make a prediction. ●

"Superforecasters . . . have a rather distinctive way of thinking," says Tetlock, "and some people find it a bit off-putting." He explains his observation by imagining a superforecaster at a wedding.

casters to Star Trek's Captain Kirk. When Kirk makes decisions, he usually gets a super-rational opinion from Mr. Spock, followed by a more emotional viewpoint from Dr. McCoy. In the end, he considers both. Likewise, good forecasters synthesize different points of view.

Superforecasters at a Wedding
Synthesizing different perspectives is a skill that many people find counterintuitive. "Superforecasters . . . have a rather distinctive way of thinking," says

formation about the relationship. "So if they happen to know that the groom is a psychopathic philanderer," says Tetlock, "they'll decrease [the probability of staying together] in response to the idiosyncratic information about the individuals involved."

The Wisdom of Crowds
From the start, one of the goals of the project was to find ways to make forecasters better. During the first year of the project, Tetlock and his researchers

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CAS

Amid Tepid Rates and Excess Reserves, Analysts Project the Reinsurance Market BY JIM LYNCH

ower rates, excess capital and dwindling reserve redundancies: What is a reinsurer to do?

A trio of market observers outlined the state of the reinsurance world at the CAS Seminar on Reinsurance in Boston in June 2016, focusing on rates (falling), loss trends (improving) and underwriting (more cautious, to a point).

Raju Bohra, FCAS, an executive vice president at Willis Towers Watson, led a discussion titled "Macro Trends in the Reinsurance Industry — the Analyst and Rating Agency View." The panel featured two equity analysts: Todd Bault, FCAS, a managing director at Citi Research, and Meyer Shields, FCAS, a managing director at Keefe, Bruyette & Woods. Stefan Holzberger, A.M. Best's chief rating officer for global credit ratings, represented the rating agency view.

Panelists agreed that the rates in the reinsurance sector were generally lower, but not declining at the pace of a year ago. Holzberger noted that his firm has a negative outlook for the sector, driven by the relatively low return firms would expect if they booked a normal level of catastrophes this year.

"We would expect rates to continue to trend down," he said, thanks to excess capital in the marketplace keeping rates low. He did note that there are some signs of underwriting discipline. Reinsurers have become more likely to decline to quote business priced too low. Some writers have cut back on catastrophe business, where observers say the market is softest.

Catastrophe models have imposed

some discipline on the market, Shields observed.

"Is the discipline in the right place?" he asked. "That's unknowable. I guess we'll find out." The market is close to "a widespread, consistent breaking point" on rates, he said.

Bault added that there is a reasonable debate as to whether recent price declines are a sign of a cyclical market, or if rates are permanently low. Bault believes that the infusion of new investors — from insurance-linked securities (ILS) and hedge-fund reinsurers — pushed

rates to a permanently lower level a few years ago. More recent declines, he said, are oscillations in a new cycle.

If rates are low now, Bohra asked, what will turn them around? Some panelists suggested it would take more than a record-setting catastrophe in the $50 billion to $100 billion range. The nature of the catastrophe would have to be a surprise, something that the current crop of models don't anticipate.

"It's got to be the event that breaks your model or bangs it up a little bit."

Holzberger, from A.M. Best, said it might take a number of years of large catastrophes, noting that about 30 percent of available reinsurer capital is not being utilized.

Shields added that catastrophe bonds and other new capital structures make it easy for investors to re-enter the market after a disaster. "There is so much supply chomping at the bit waiting to get in the industry" if the opportunity arises.

Moderator Bohra followed up: "So ILS capital is here to stay?"

"That's what they're saying," Bault replied.

Shields commented that catastrophe risk is much better understood now thanks to cat modeling.

Reinsurers have become more likely to decline to quote business priced too low. Some writers have cut back on catastrophe business, where observers say the market is softest.

Holzberger noted that investment markets remain attracted to the fact that insurance risk is uncorrelated with traditional stocks and bonds, so adding insurance risk makes portfolios more efficient.

The competition for property catastrophe business has forced capital into the casualty market, intensifying competition there. The casualty market is in what Bohra called a "benign phase."

Holzberger of A.M. Best said reinsurer results have been strong — combined ratios around 90 and returns on equity above 10 percent — but noted that results were buoyed by a lack of catastrophes and favorable reserve development. Cross those off, he said, and

"You're at a break-even combined ratio at best," without investment income to take up the earnings slack.

Bault said his research suggests that loss trends in casualty have been zero or slightly negative since the 2001 World Trade Center attacks, an event that accelerated a nascent hard market.

The flatlining loss trend is very different from the growth during the generation that preceded it. Underwriters may have grown more risk averse since 9/11, he suggested, and the financial crisis may have extended the life of that trend.

Still, accident year results have been booked with less cushion in recent years, and he predicts that by 2017, the industry overall will be booking deficient reserves. Then the situation could look much like the late 1990s, when companies under-reserved their recent accident years, then spent much of the following decade topping up.

Still, Bault notes, reinsurers socked away considerable redundancy in recent years. His 2014 analysis suggested that reinsurer bookings were three times as redundant as that of their primary company brethren. "That's a lot of ballast" to try to outlast your competitor, he said.

Shields noted that inflation — a scourge to loss reserve estimates — has been limited for a decade and a half, and he worries when loss trends will return to their former levels.

"It's coming, I just don't know when," he said. ●

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

Rates, Capital Create "Challenging" Reinsurance Environment, Actuary CEOs Say BY JIM LYNCH

Bountiful reinsurance capital and some cutbacks in buying by primary insurers have combined to create a challenging environment, a trio of reinsurance executives, all CAS Fellows, told an audience of about 200 at the CAS Reinsurance Seminar in Boston in June.

The executives — Barton Hedges, CEO of Greenlight Re; David Marra, president of Renaissance Reinsurance U.S.; and John Rathgeber, CEO of Watford Re Ltd. — entertained a series of questions from Aaron Koch, a director at Milliman USA, on the state of the reinsurance market. They also gave insights on how they moved from the actuarial shop to the executive suite.

On one hand, the executives agreed, capital is overflowing from the property catastrophe market into other lines of business. Short-tail casualty lines like aviation, marine, energy and agriculture have absorbed more than their share, said Marra.

Rathgeber concurred. "There has been a spillover effect," he said. "All lines of reinsurance are soft unless there has been loss activity." Commercial auto losses have driven rates higher, he noted.

In the absence of major catastrophic events, rates seem unlikely to rise in coming years, though he noted that decreases were smaller at June 1 than in prior years. It has also become more difficult to raise new capital, which could foretell a discipline that could eventually force rates higher.

"Every market seems . . . to be bumping along the bottom right now," he said. "It's going to take a while before the market gets better."

Perhaps the market will improve in the second half of the year, Hedges continued.

While capital has been flowing for several years into the market through insurance-linked securities and collateralized reinsurance, some larger insurance companies have purchased less reinsurance.

Some are creating captive reinsurers to hold their own risk. Several panelists noted that Ace Ltd. (now Chubb)

While capital has been flowing for several years into the market through insurance-linked securities and collateralized reinsurance, some larger insurance companies have purchased less reinsurance.

has moved some of its risks to a captive reinsurer. As one of the largest insurers, Ace's actions could portend a trend, they said.

Recently though, there are signs cedants may be returning to the market, Rathgeber said.

In coming years, Solvency II and changes to A.M. Best's rating model may encourage smaller insurance companies to buy more reinsurance, he said, particularly for companies that might be vulnerable to super-sized catastrophes.

Still, panelists were satisfied with market discipline, particularly in preventing excess capital from accumulating. Reinsurers have been using profits to increase dividends or buy back shares rather than to support new business, which would probably have been written at still lower rates.

It is a market reaction to the new ability to quickly raise third-party capital via insurance-linked securities like catastrophe bonds and collateralized reinsurance, Hedges said.

Moderator Koch asked about how the panelists were managing their asset risk. All insurers and reinsurers earn income on premium while waiting to pay claims and expenses, but two of the

Rathgeber agreed. He took the exams after spending several years underwriting. He said they made him a better underwriter, and later, a better manager.

reinsurers represented on the panel — Rathgeber's Watford Re and Hedges' Greenlight Re — are associated with hedge funds, which sometimes pursue more aggressive investment strategies than reinsurers typically employ.

While most reinsurers pursue conservative investments to complement their underwriting, reinsurers whose assets are managed by hedge funds must work carefully to balance the additional asset risk.

"We have to build a liability portfolio around the asset portfolio, instead of the other way around," Hedges said.

Rathgeber said Watford pursues a

Big data and predictive analytics are likely to change distribution channels by taking expenses out of the system.

fixed-income strategy. Until recently, credit spreads in high-yield had widened, particularly among energy issues — a segment that Watford hadn't pursued heavily. The situation didn't allow the early growth in book value that the reinsurer had hoped for, perhaps, but capital hasn't been destroyed either, and some of the unrealized loss positions have now recovered in value.

"If there's trouble in the high-yield space, we are at risk of suffering sizeable realized losses," he said, but current fluctuations haven't caused such a problem.

A company needs sufficient liquidity to handle the ups and downs, he said.

Big data and predictive analytics are likely to change distribution channels by taking expenses out of the system. Rathgeber agreed with this notion, but

he worried about a potential backlash by regulators and others over privacy concerns.

Reinsurance could be well situated to benefit from the shifting marketplace, said Hedges, of Greenlight Re. Innovative insurers might need more capital quickly, he said, and reinsurers could become the risk takers behind them.

If that happened, Hedges said, reinsurance — "this thing out of the Ice Age that hasn't changed much . . . could take the market by storm."

As members of the CAS, the panelists and moderator had thoughts on the future of the actuarial profession and its practitioners.

The actuarial exams are "a great process," Hedges said. To move to the CEO chair, though, it is important to learn about nonactuarial parts of the business. Many actuaries are figuring that out, he said, based on how many are taking on diverse roles at his company.

Rathgeber agreed. He took the exams after spending several years underwriting. He said they made him a better underwriter, and later, a better manager.

Marra emphasized communication skills to top off the actuarial knowledge — knowing what to say to people and the value of discretion.

"Your job is not to show they might be wrong," he said. "It's just the opposite." ●

DIVERSITY

At the Casualty Actuarial Society, we believe that a diversity of perspectives and life experiences helps to create an actuarial profession that can grow and evolve to meet the needs of tomorrow. Learn more about our commitment to building a multi-dimensional actuarial profession at: casact.org/diversity.

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EXPLORATIONS BY GLENN MEYERS

A Cost of Capital Risk Margin Formula for Loss Reserve Liabilities

Readers of my previous columns (and other works) will know that I have been devoting a lot of effort on predicting the distribution of outcomes for stochastic loss reserve models. From the very beginning, the question that has always been in the back of my mind is "Why do this?"

I have never believed that the actuary's role is to derive a range for a loss reserve, and then support someone else's decision to post a reserve that is somewhere within that range. Instead, I believed that reserve estimates should have some kind of a risk margin.

While the subject was not loss reserving, one can see that line of thought in my 1991 CAS *Proceedings* paper, "The Competitive Market Equilibrium Risk Load Formula for Increased Limits Ratemaking." If one looks at the *PCAS* articles that were written around that time, one will find that risk loading was a very hot topic. There was one article that made a lasting impression on me: the 1990 paper by Rodney Kreps, "Reinsurer Risk Loads from Marginal Surplus Requirements."

While I felt good when I was able to establish that my risk load formula could be viewed as marginal capital formula; I eventually realized that holding capital over time also had a cost. Therefore a "Risk Load as the Marginal Cost of Capital" idea needed refining to take into account how long an insurer needed to hold capital to support that risk. And that problem is relevant when determining a risk margin for loss reserves.

About two decades later, the European Union was in a position to recommend a liability risk margin formula called the Solvency II risk margin, which had many properties of a true cost of capital risk margin formula.

Let's now describe the cost of capital risk margin approach taken by this article.

Initially, an insurer will take a loss triangle and fit a stochastic loss reserve model to calculate its "best estimate" (defined as the present value of its unpaid loss liability) and the amount of capital needed to support that liability. At the end of the next year, more data will come in and the insurer

will update its best estimate and the amount of capital needed to support that liability. Since we expect the best estimate to be more accurate, we expect that the capital needed to support that liability to be reduced, with the excess capital being returned to the insurer's investors. As this process continues, the insurer expects to receive a series of excess capital payments. A cost of capital risk margin reflects the insurer's cost of using their investors' capital.

To model this, let $t = 0, 1, \ldots$ be the time in years from the beginning of the original reporting date of a loss triangle. The examples in this article will be Schedule P loss triangles. Let T_t be a loss trapezoid where T_0 is the original loss triangle, and T_t is the loss trapezoid consisting of the original loss triangle plus data reported through the first t calendar years.

Given T_t, let E_t be the estimate of the expected ultimate loss reported at the end of calendar year t and let A_t be the amount of assets needed to support the uncertainty of E_t. A portion of A_t is supplied by policyholder premiums which we take to be equal to E_t. The remaining portion of A_t, $C_t \equiv A_t - E_t$, must be supplied by the insurance company's investors. C_t is called the insurer's required capital at the end of time t.

Let's assume that the insurer maintains C_t, at each time t, in a fund that earns a risk-free interest rate, i. To compensate for the risk of losing some (or all) of their capital, the insurer's investors will demand a higher return, $r > i$, on their investment, C_t. Let's look at the investor's cash flow.

- At time $t = 0$, the insurer uses the information, T_0, to calculate the required initial capital investment, C_0.
- At time $t = 1$, the insurer uses the information, T_1, to calculate the required capital investment, C_1. It returns $C_0 \cdot (1+i) - C_1$ to the investor.[1]
- …
- At time t, the investor uses the information, T_t, to calculate the required capital investment, C_t. It returns $C_{t-1} \cdot (1+i) - C_t$ to the investor.
- …

The present value, discounted at the risky rate, r, of the

---

[1] Depending on T_t, the amount returned could be negative, resulting to an addition to the insurer's capital.

Figure 1 - Paths of Ultimate Loss Estimates

Future Calendar Year
Best Estimate of the Liability = 4296
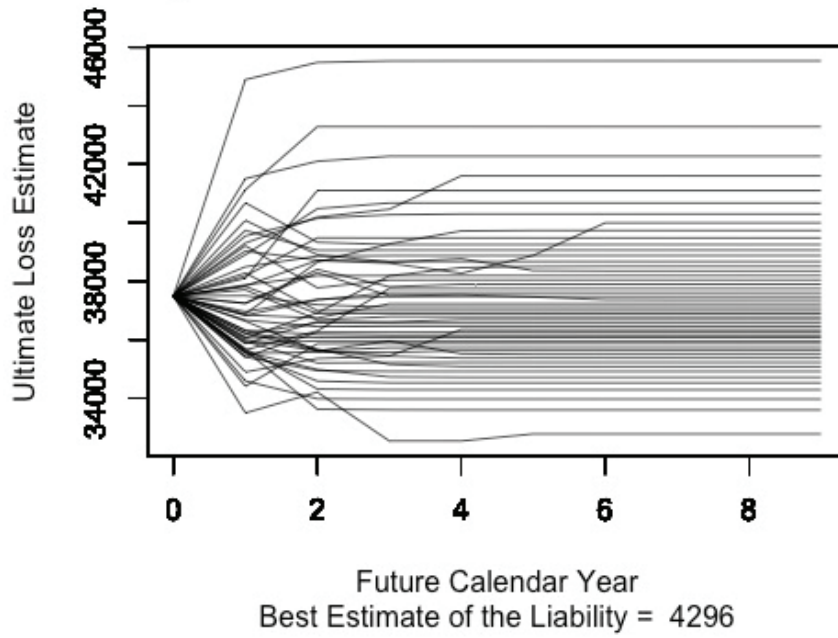
This chart illustrates the general tendency for the ultimate loss estimate to spread out over time.

Figure 2 - Required Capital Paths

Future Calendar Year
Initial Capital = 7849
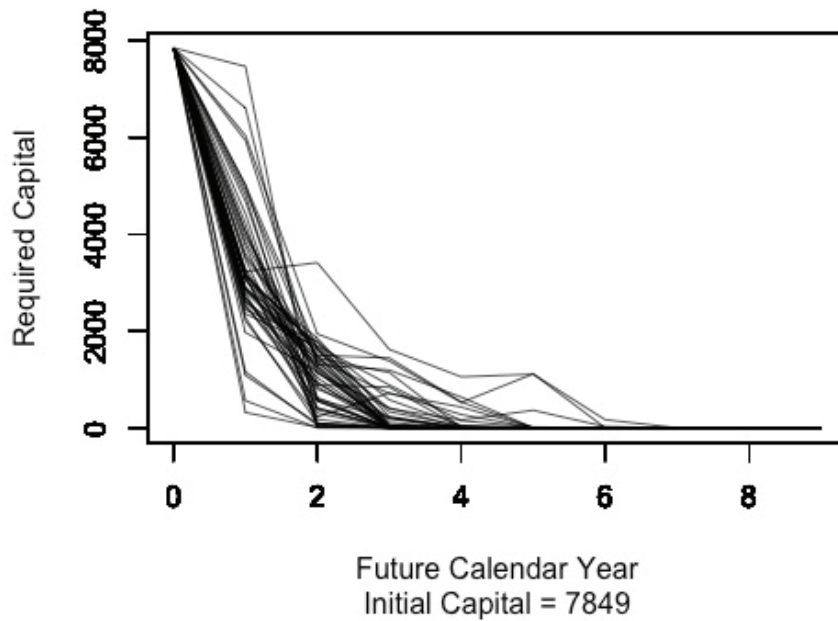
This chart illustrates the general tendency for the required capital to decrease to zero over time.

amount returned, is equal to $\sum_{t=1}^{\infty} \frac{C_{t-1} \cdot (1+i) - C_t}{(1+r)^t}$. Since $r > i$, this present value is usually less than the initial capital investment of C_0. To adequately compensate the investor for taking on the risk of insuring policyholder losses, the difference can be made up at time $t = 0$ by what we now define as the cost of capital risk margin, R_{COC}.

$$\text{Cost of Capital Risk Margin} \equiv R_{COC} \equiv C_0 - \sum_{t=1}^{\infty} \frac{C_{t-1} \cdot (1+i) - C_t}{(1+r)^t}$$

$$= (r - i) \cdot \sum_{t=1}^{\infty} \frac{C_t}{(1+r)^t}$$

with the last equality coming after some algebraic manipulations.

Note that R_{COC} is similar to, but not identical to, the Solvency II risk margin.

$$R_{SII} \equiv (r - i) \cdot \sum_{t=0}^{\infty} \frac{C_t}{(1+i)^t}.$$

The issue that remains is how do we get the C_ts? To do this we make the assumption that we can use the output from a Bayesian MCMC stochastic loss reserve model to represent the set of future loss developments. As an example, let's use the CSR[2] model to generate 10,000 equally likely lognormal parameter sets $\{\mu_{wd}^j, \sigma_d^j\}_{j=1}^{10,000}$ for accident years $w = 1,\ldots,10$ and development years $d = 1,\ldots,10$ of Insurer 353 for the commercial auto line in the CAS Loss Reserve Database. Let's initially assume that we know which parameter set, $\{\mu_{wd}^j, \sigma_d^j\}$, we have. Then the estimate of the expected loss is the total expected loss over all accident years for the latest development period, 10 is given by

$$E_t^j = \sum_{w=1}^{10} e^{\mu_{w10}^j + (\sigma_{10}^j)^2/2} \text{ for } t = 0,\ldots,9.$$

Given j, there is no uncertainty in the loss estimate, E_t^j, so $C_t^j = 0$.

Let's now drop the assumption that we know j.

So given T_t there is uncertainty as to which parameter set, $\{\mu_{wd}^j, \sigma_d^j\}$ generated the losses. Since each parameter set is equally likely, $\Pr[\{\mu_{wd}^j, \sigma_d^j\}|T_t]$ is proportional to the likelihood of T_t given $\{\mu_{wd}^j, \sigma_d^j\}$.

Given these conditional probabilities, there are many ways to calculate E_t and A_t. I chose to take a sample S, with replacement, of size 10,000 from $\{E_t^j\}_{j=1}^{10,000}$ with sampling probabilities $\Pr[\{\mu_{wd}^j, \sigma_d^j\}|T_t]$. We set E_t equal to the mean of S, and A_t equal to the mean of the largest 300 elements of S.[3]

For a given $\{T_t\}_{t=0}^9$, the paths of E_t and C_t for $t = 0,\ldots,9$ can be plotted. Figures 1 and 2 show plots of these paths for several randomly selected $\{T_t\}_{t=0}^9$s from the model.[4] These plots illustrate the general tendency for the $\{E_t\}$ paths to spread out over time, and for the $\{C_t\}$ paths to decrease toward zero over time. One can then calculate a cost of capital risk margin by the above formulas, with $i = 4\%$ and $r = 10\%$, for each of 10,000 randomly selected $\{T_t\}_{t=0}^9$s. The average risk margin for our example was 717.

Under Solvency II, the risk margins for each line are added together, with no recognition of diversification for multiple lines. In my Explorations column for May/June *Actuarial Review*,[5] I argued that the independence assumption for the CSR model was appropriate. In taking the sample $S = S_1$ for commercial auto described above, and a similarly constructed sample S_2 for personal auto, under the independence assumption, I defined $S = S_1 + S_2$ to produce a combined risk margin with S being used exactly as I described above for a single line. The average risk margin for personal auto was 744. The sum of the risk margins in the two lines is 1,461 while the sum under the independence assumption is 1,025, indicating that a sizeable diversification benefit is appropriate for this example.

So, given that there is a sizeable diversification benefit, it would seem appropriate to assign a risk margin for a line that is proportional to the marginal contribution of each line to the insurer's total risk margin. ●

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[2] I used the version of the CSR model that is in my paper on dependencies published in the 2016 Winter *E-Forum*.
[3] This selection sets the C_0 approximately equal to 99.5% Value-at-Risk for the one-year time horizon that is specified by Solvency II.
[4] The "best estimate" of the liability is the average present value of the unpaid loss discounted at the risk-free interest rate, i.
[5] http://bit.ly/ARExplorMJ16

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Insurance Contracts and the Blockchain: A Bold Future Ahead

BY MARCO BARATTA

The modern-day insurance contract has its origins in 14th century Italy. Shipping merchants would obtain a loan to fund their trade; these loan contracts contained a conditional clause stating that, in the event of a shipwreck, the loan would be forgiven. This clause, and the overall loan structure itself, functioned as insurance and premium. As these contracts evolved, the conditional clause became a standalone contract: an insurance contract. This separation of the insurance and financing components allowed more efficient spreading of risk, increasing trade for many years to come.

Over the last 500 years, the insurance contract has grown in complexity, covering a large and diverse set of risks. However, for much of that time, and in many respects, the contract itself didn't change much: a standardized form, written on paper, and describing a contractual relationship. Indeed, the majority of our institutions are built around static, paper-based forms, interpreted and enforced by human principals.

In the 20th century, with the development of computers, contracts have been digitized and shared via computer networks. Technology has allowed for standardized business transactions between organizations, using encryption protocols to secure them, akin to a digital signature. Yet, apart from encryption, these transactions represent a digitized version of the original static form, basically just an extension of the paper-based forms used for hundreds of years, and still enforced by human principals.

With innovations in technology, specifically computer protocols, it is now becoming possible to embed into digital contracts the ability to verify, enforce and execute contract terms — essentially creating a "smart contract." This may seem somewhat farfetched, but smart contracts already exist in various simple guises, such as automated bill payment at banks or a purchase from a vending machine. In both examples, the contract clauses (automatic monthly bill payment or buying a snack, respectively) are executed by electronic protocols, without the direct participation of human principals.

The advent of digital (or crypto) currencies, of which Bitcoin is the best known, has opened up opportunities for more advanced digital contracts. Bitcoin uses the concept of a blockchain, which is an encrypted digital ledger, recording all transactions that have occurred for a specific Bitcoin since its inception. The protocols underlying the blockchain use a distributed peer-to-peer computer network to perform the functions of an intermediary, ensuring that transactions between parties are valid and trusted. Essentially, the blockchain protocols, through cryptography, eliminate the need for a centralized authority, such as a bank, by distributing that function across a computer network of disparate participants, not controlled by any one entity.

The blockchain is the technology underlying Bitcoin, and it is used to capture unique identifiers, protect sensitive data and store a digital payments audit trail. The blockchain is also flexible enough to be adopted by the insurance industry to digitally implement components of an insurance contract. In addition to collecting and storing information, blockchains can be expanded to store contractual clauses, relevant supporting documents, claims forms and invoices. The blockchain can also access third-party information and execute contractual clauses based on specific events. All information is encrypted, and the underlying protocols are intended to ensure that trust and verification are valid, potentially reducing fraud and lowering the costs of issuing and executing an insurance agreement between parties. In effect, the blockchain makes a smart insurance contract feasible.

Let me briefly mention two of the many interesting insurance applications of the blockchain: claims and reinsurance.

Claims handling costs should be significantly affected by the blockchain, through the potential reduction in errors, improvements in transparency and detection of possible fraudulent claims. Both insurance contract and associated claim information could be verified and reviewed using a trusted distributed network that groups of insurers participate in and operate. If multiple claims are made for one accident, all insurers will know of this, as they all have access to the same blockchain, virtually eliminating the potential for fraud.

In reinsurance, the blockchain is already having a dramatic impact. A large German-based reinsurer has successfully used the blockchain to issue catastrophe swaps and bonds.
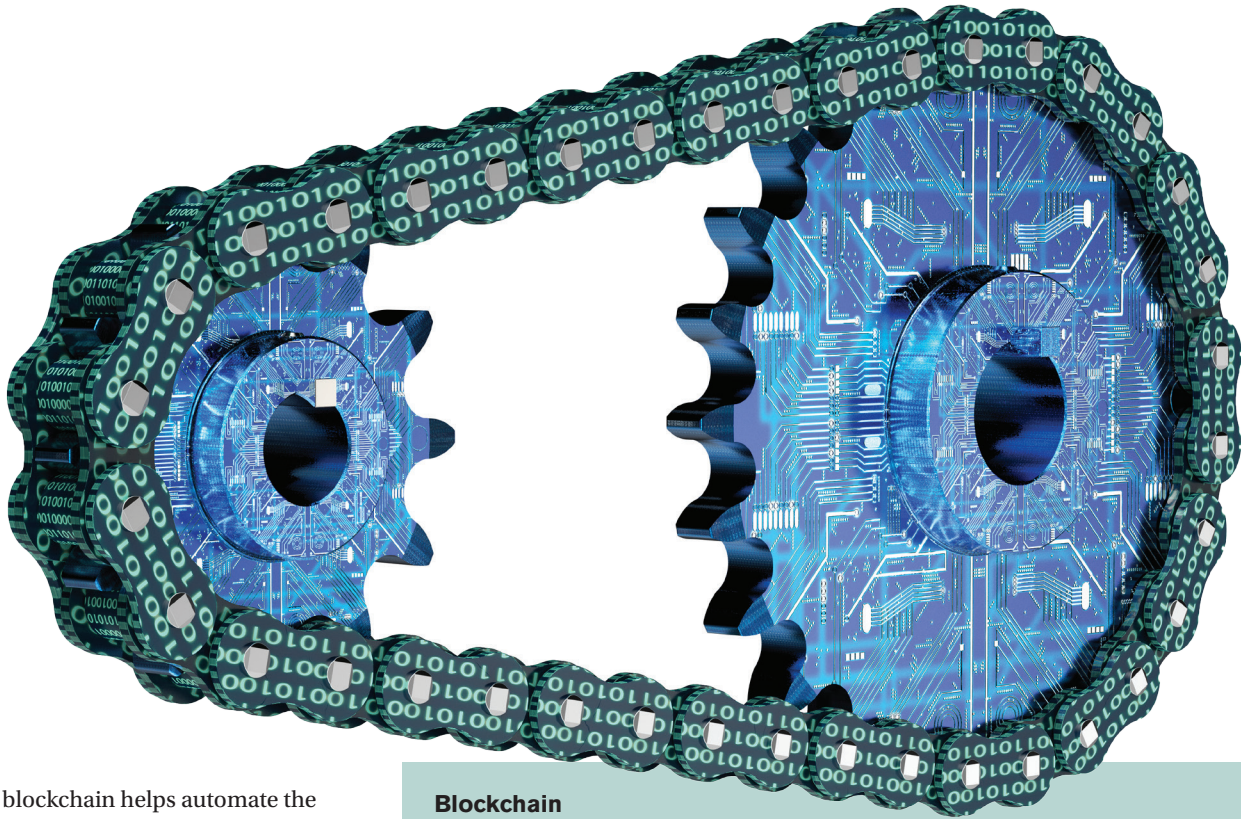
The blockchain helps automate the payments between insurers and investors, reducing payment transaction time. Another potential application is index-based reinsurance contracts: The blockchain can be used to build a smart contract whereby if an event triggers an agreed upon insurance index, a payment will automatically be made between the reinsurer and the insured.

The blockchain has the potential to revolutionize the insurance contract and market, and create opportunities for innovation. The first movers with the vision to seize these opportunities will likely reap the most rewards, in both increased market share and more streamlined and profitable operations. ●

Marco Baratta, FCAS, MAAA, CPCU, has been with Liberty Mutual Group since 2010, working in various actuarial roles in ratemaking, pricing and reserving for both personal and commercial lines. Prior to joining Liberty, he worked for over 10 years in senior engineering and management positions in the semiconductor industry.

Blockchain
Resource Guide

For more on blockchain, check out these articles:

Deloitte, "Block Chain Applications in Insurance," 2016, https://www2.deloitte.com/content/dam/Deloitte/ch/Documents/innovation/ch-en-innovation-deloitte-blockchain-app-in-insurance.pdf.

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IN MY OPINION BY ROBERT J. WALLING III

How Do Actuaries Preserve Their Market Value?

I recently presented the Casualty Actuarial Society (CAS) Board Update at the Midwestern Actuarial Forum (MAF) Spring Meeting. The presentation addressed several strategic initiatives currently underway within the CAS. The most actively discussed initiative was The CAS Institute (iCAS).

Established in late 2015 as a CAS subsidiary, iCAS will provide credentialing and professional education for quantitative specialists who are closely aligned with property-casualty actuaries. The initial types of specialties identified will include predictive analytics, catastrophe modeling and capital modeling. The CAS Institute will also focus on creating communities in which actuaries and quantitative specialists with common areas of practice can collaborate on

New data sources and monitoring devices with insurance applications seem to pop up daily, whether we want them or not — kind of like the dandelions in my yard.

research, advance specialized applications of new technology and develop continuing educational opportunities. Another exciting feature of iCAS is the partnership between the CAS and The Institutes, the risk and insurance knowledge group. The CAS and The Institutes are developing educational content for credentials to be offered by iCAS as well as professional education for the end business user. This may be the most important CAS initiative undertaken during the course of my career.

Of course, change can create uncertainty and sometimes fear. While at the MAF meeting, I was asked several questions that translated to, "How does an actuary preserve his or her market value when compared with an iCAS-certified predictive modeler?" This question is not new. In the 1990s, we wondered how actuaries would preserve their market value when competing with product managers. In the 2000s, some wondered if CFAs would encroach upon our territory. Others viewed the SOA general insurance track as a danger. Today, data scientists are our newest "threat."

There are two fundamental facts to keep in mind. First, we live in the most data-driven environment the world has ever known. New data sources and monitoring devices with insurance applications seem to pop up daily, whether we want them or not — kind of like the dandelions in my yard. The demand for the skills we are developing in CAS members has never been higher, and we are not fully meeting it. Predictive ana-

lytics jobs all over North America remain unfilled and the high demand brings lucrative compensation to those capable of meeting it.

Second, and perhaps most importantly, we are in an actively competitive market to provide these services. Gone are the days when actuaries were virtually a protected class of employee. ("Oh, nobody else can do the mystical stuff the actuaries do.") If we don't meet the demand to provide data-driven solutions to our customers, there is an increasingly long list of alternatives now available to them. This means that CAS members need to be proficient not only in the technical aspects of our work, but also in their business applications. There has never been greater demand for actuaries who are able to not only translate the technical details, but also be part of the team developing and implementing the business solutions.

So how do we actuaries preserve our market value in this ever-changing, data-driven world? In short, *we earn it*. We earn it the same way actuaries always have: by demonstrating our risk analysis skills, by thinking critically in applying models and analytics and by communicating effectively our data-driven, value-added insights to our customers. ●

Robert J. Walling, FCAS, CERA, is a principal & consulting actuary for Pinnacle Actuarial Resources, Inc. in Bloomington, Illinois, and a CAS Board Member.

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IT'S A PUZZLEMENT BY JON EVANS

Crack the Code

Can you decode the message below?

"NQV ARC RMWQLP ATX-PROCMN FOC R YOMMOQC KQMMRXL OU NQV LPRXP FOPH QCT KQMMRX RCK YTP R LWRMM TCQVIH UXRAPOQC TCQVIH POWTL."

This message was encoded by replacing each letter using a one to one map of the set of 26 letters of the alphabet onto itself.
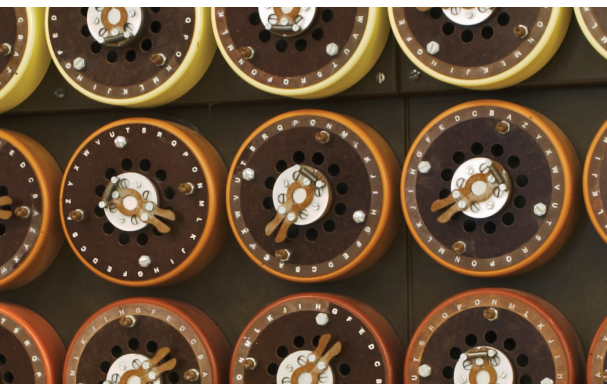
Bacterial Population Growth

In this problem $P(t)$ is the population of the bacterium at discrete time periods (measured in seconds) $t = 0, 1, 2,...$ and $P(t+1) = P(t) + P(0) \text{Exp}[-P(t)/P(0)]$. So $P(1) = 137\% P(0)$, $P(2) = 162\% P(0)$. You are asked to determine the "cap" or "equilibrium level" for the maximum population (as a multiple of $P(0)$), at what time (t) the population reaches 50 percent of this cap and, hypothetically, what the population (as a multiple of $P(0)$) would be after a trillion (10^{12}) years of growth.

Here is a simple solution to the

first two questions based on an idea in a solution submitted by Brad Rosin. If $L > 0$ is the least upper bound for $P(t)$, the $P(t)$ converges strictly monotonically to L. So for any $\delta > 0$, it is possible to find a t_1 such that $L - \delta < P(t) < L$ when $t > t_1$. Consequently $P(t+1) - P(t) = P(0) \text{Exp}[-P(t)/P(0)] < \delta$. Taking logarithms results in $\text{Log}[P(0)] - P(t)/P(0) < \text{Log}[\delta]$ and it follows that $P(t) > P(0) (\text{Log}[P(0)/\delta])$. So, for any $L > 0$, if we pick $\delta < P(0) \text{Exp}[-L/P(0)]$ then $P(t) > L$. So, $P(t)$ has no upper bound and increases toward infinity.

For an explicit estimate of $P(t)$, it turns out that $\text{Log}[t+e]$ asymptotically converges to $P(t)/P(0)$ for large t.

t	$P(t)/P(0)$	$\text{Log}[t+e]$
10	2.60875	2.54304
100	4.65028	4.63199
1,000	6.91349	6.91047
10,000	9.21103	9.21061
100,000	11.51300	11.51300
1,000,000	13.81550	13.81550

A trillion (10^{12}) years is 10^{12} x 365 x 24 x 60 x 60 = 31,536,000,000,000,000,000 and $\text{Log}[31,536,000,000,000,000,000 + e]$ = 44.8977. So, although the population increases to infinity without an upper bound, it grows incredibly slowly.

Although intuitively sensible, to prove this requires some real analysis. Let $y(t) = P(t)/P(0)$. It follows that $y(t+1) - y(t) = \text{Exp}[-y(t)]$. Consider the analogous differential equation $z'(t) = \text{Exp}[-z(t)]$ and boundary condition $z(0) = 1$, which has the solution $z(t) = \text{Log}[t + e]$. Also note $y(t)$ can be extended to

a continuous function for all $t \geq 0$ as the solution to the differential equation $y'(t) = \text{Exp}[-y(\text{Floor}[t])]$, where $\text{Floor}[t]$ is the greatest integer $\leq t$ and boundary condition $y(0) = 1$. Let $a(t) = y(t)-z(t)$. $y(1) = 1 + e$ and $z(1) = \text{Log} [1 + e] < 1 + e$ and therefore $a(1) > 0$.

Consider what happens between t and $t+1$ for any integer $t \geq 1$ if $a(t) > 0$. Since $y(t) > z(t)$ it follows that $z'(t) > y'(t) > 0$. For u in the interval $(t, t+1)$ if $z(u) > y(u)$ then $z'(u) < y'(u)$. So $z(u) < y(u)$ since if $z(u)$ were to exceed $y(u) < y(u)$ it would grow more slowly than $y(u)$. By induction from $t = 1$, it follows that $y(t) > z(t)$ and hence $a(t) > 0$ and $a(t+1) < a(t)$ for $t > 0$.

Suppose that $a(t)$ has a lower bound $L > 0$ for integer values $t > 0$. Then $y(t) \geq z(t) + L$ and for integers t it follows that $y(t+1) - y(t) \leq \text{Exp}[-L]/(t+e)$. Since $z(t+1) - z(t) > 1/(t+e+1)$, consequently $a(t+1) - a(t) < \text{Exp}[-L]/(t+e) -1/(t+e+1) < \text{Exp}[-L] /(t+e)-1/(t+e+1)$. The sum of $\text{Exp}[-L]/(t+e) -1/(t+e+1)$ from $t =1$ to k is, by grouping terms differently, equal to $\text{Exp}[-L]/(1+e) + [\text{Sum from } t = 2 \text{ to } k$ of $(\text{Exp}[-L]-1)/(t+e)] - 1/(k+e+1)$. Since $\text{Exp}[-L]-1 < 0$ and the sum of $1/(t+e)$ diverges to infinity as k increases, [Sum from $t = 2$ to k of $(\text{Exp}[-L]-1)/(t+e)]$ diverges to negative infinity. This leads to the contradiction that $a(t) < 0$ for t large enough. So, the greatest lower bound of $a(t)$ must be 0. Since $a(t)$ is strictly decreasing with increasing, it asymptotically converges to 0 and hence $z(t)$ asymptotically converges to $y(t)$.

Solutions were also submitted by Bob Conger and Rob Kahn. ●

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