actuarial REVIEW

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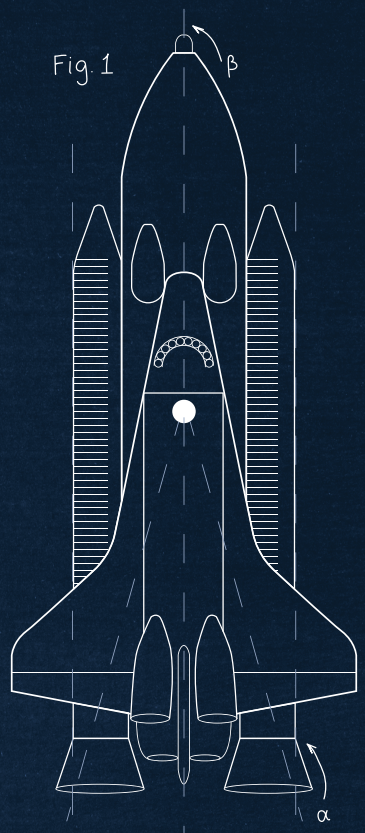
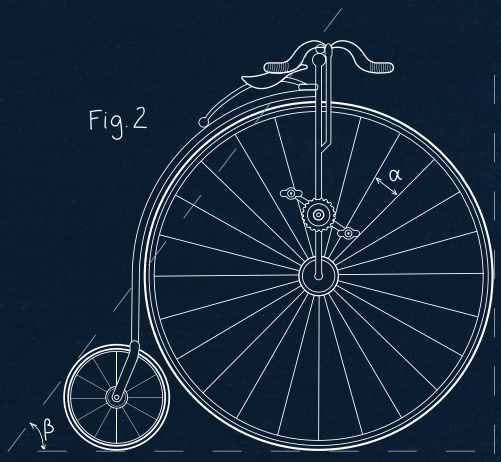
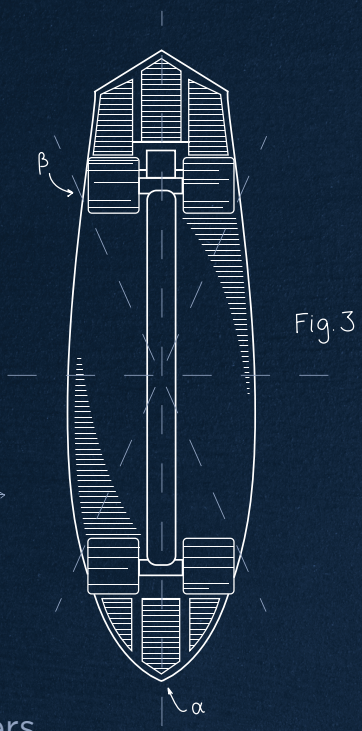
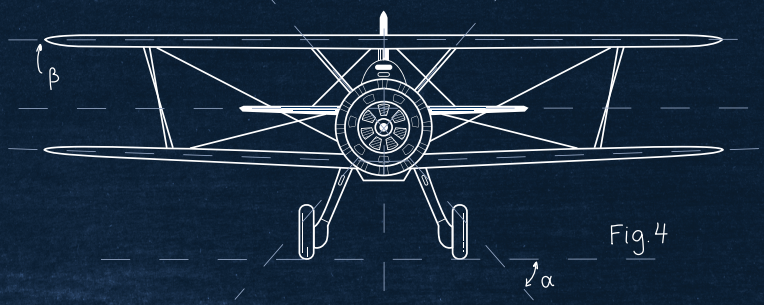


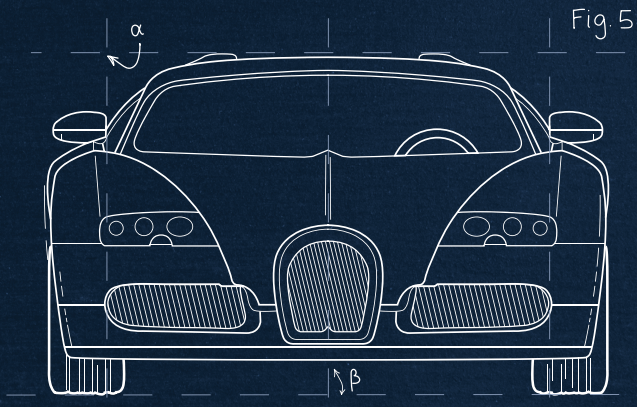


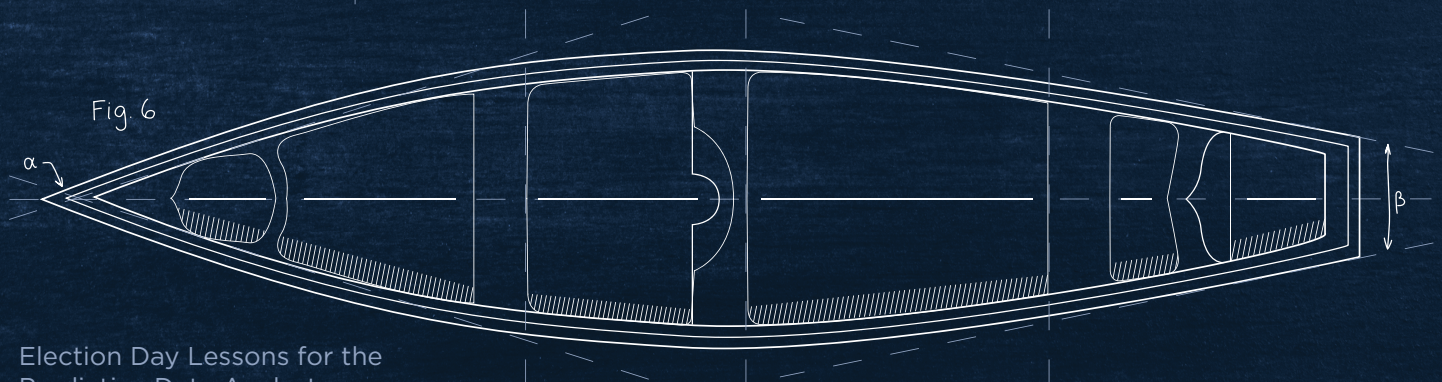


Predictive Modeling:

Actuaries Blaze New Analytical Frontiers







Election Day Lessons for the Predictive Data Analyst

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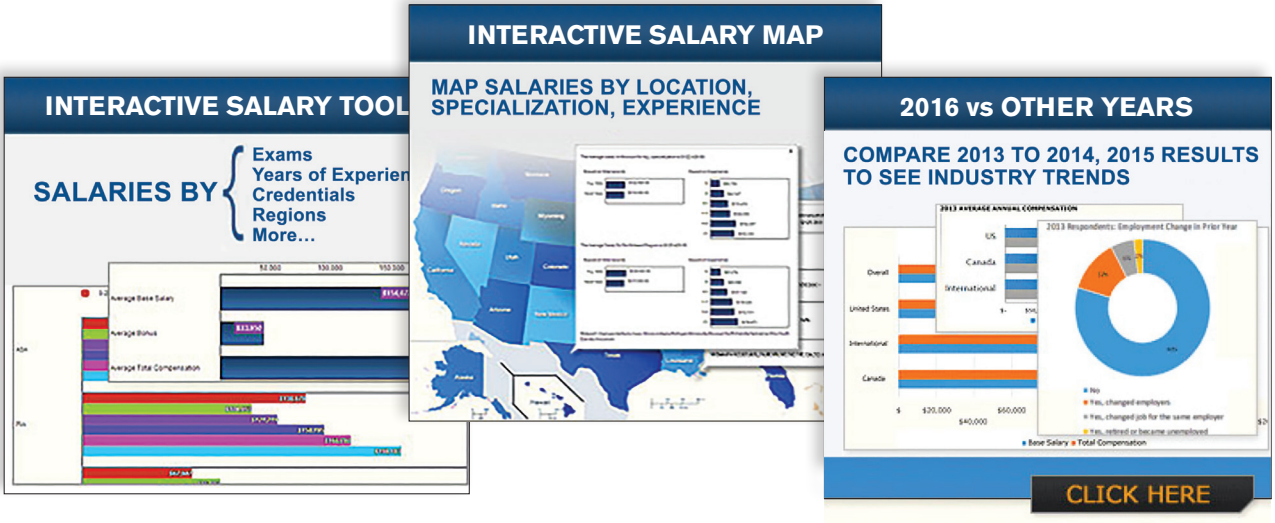

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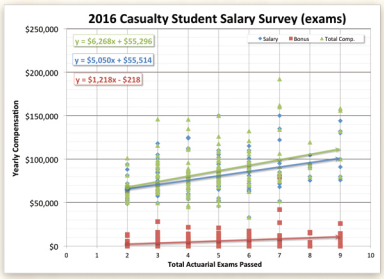

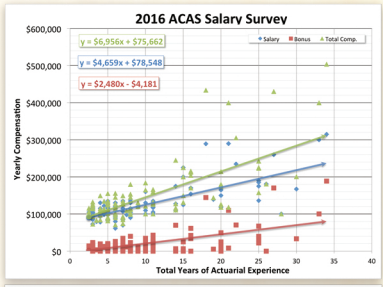

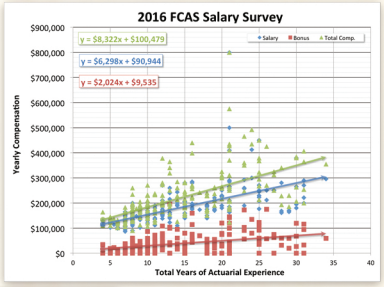

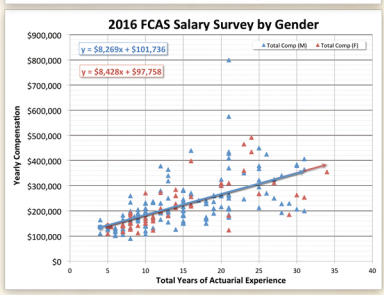

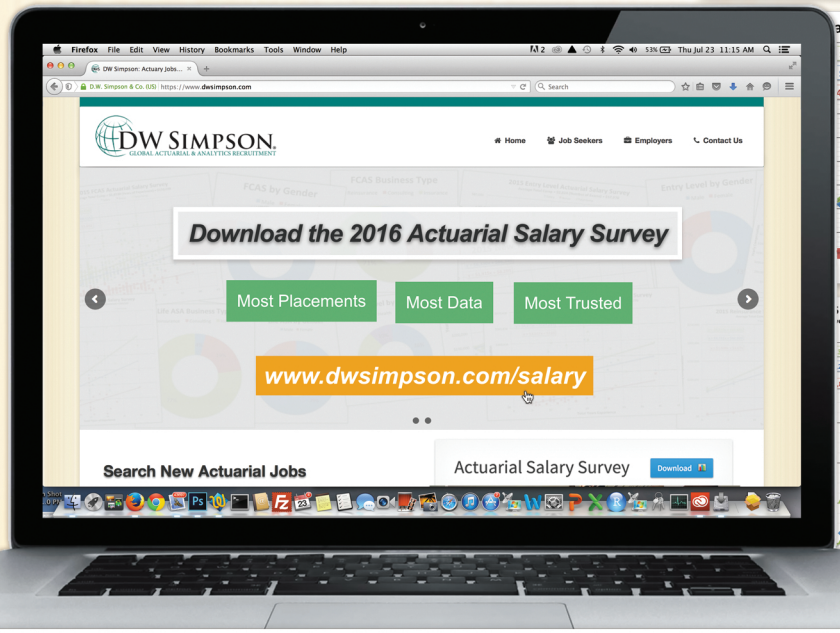

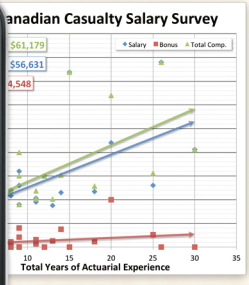

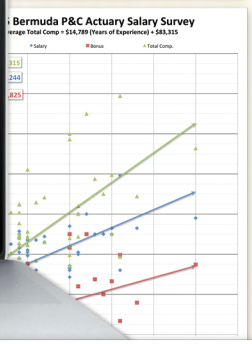

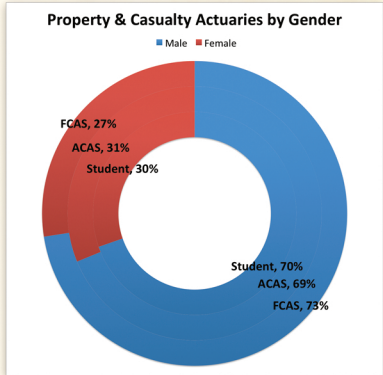

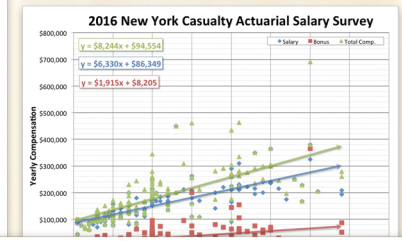

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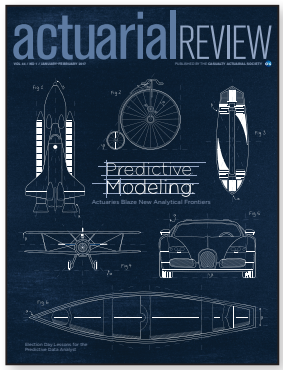

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How Could the Polls Get it So Wrong?

Steve Mildenhall explores the coming revolution in actuarial modeling vis-à-vis the 2016 U.S. election. Grover Edie and Jeffrey Baer also weigh in with their thoughts in ViewPoint.

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actuarialREVIEW
The magazine of the
Casualty Actuarial Society

Poll Positions

In case you've been living off the grid, there has been a bit of a kerfuffle about the outcome of the U.S. presidential election — so much so that a few of our members felt compelled to write about it. One author even submitted an article the day after Election Day at around noon U.S. Eastern Time!

Said author, Stephen Mildenhall, writes in the Actuarial Expertise department on just how the data could be so wrong about the final outcome. He creates a scenario (involving dinner plans, of all things!) in which an inquisitive CEO keeps prodding a dedicated employee to dig deeper.

Mildenhall is the newest member of our *AR* Explorations team. Mildenhall's research interests include risk theory, capital determination, allocation and optimization, and applying statistics to reserving and ratemaking problems. He is a two-time winner of the CAS Woodward-Fondiller Prize for the best research paper by a new Fellow. We are so fortunate to have him on board, along with Glenn Meyers, Don Mango and Jim Guszcza.

AR Editor in Chief Grover Edie and *AR* Committee member Jeffrey Baer also opine on the parts data and polls played in the election in the ViewPoint department.

In other news, Annmarie Geddes Baribeau continues with her second story in the series on data — this time focusing on the models in play. Look for her final article in the series in the March/April issue.

CAS President Steve Lowe offers some words of advice as a Random Sampler. The column features excerpts of his Address to New Members, which he gave at the 2016 Annual Meeting in Orlando.

This issue also features the first column by CAS President Nancy Braithwaite who, in a brief aside, marvels at the growing CAS membership. Offered as Exhibts A-M are the group photos of new CAS Fellows and Associates on pages 16-22.

Correction

In the print edition of the November/December 2016 *AR*, CAS Associate Gloria Gilliam's last name was misspelled as Gillam in a photo caption for the story "Scenes from the 2016 International Association of Black Actuaries Annual Meeting."

Actuarial Review always welcomes story ideas from our readers. Please specify which department you intend for your item: Member News, Solve This, Professional Insight, Actuarial Expertise, etc.

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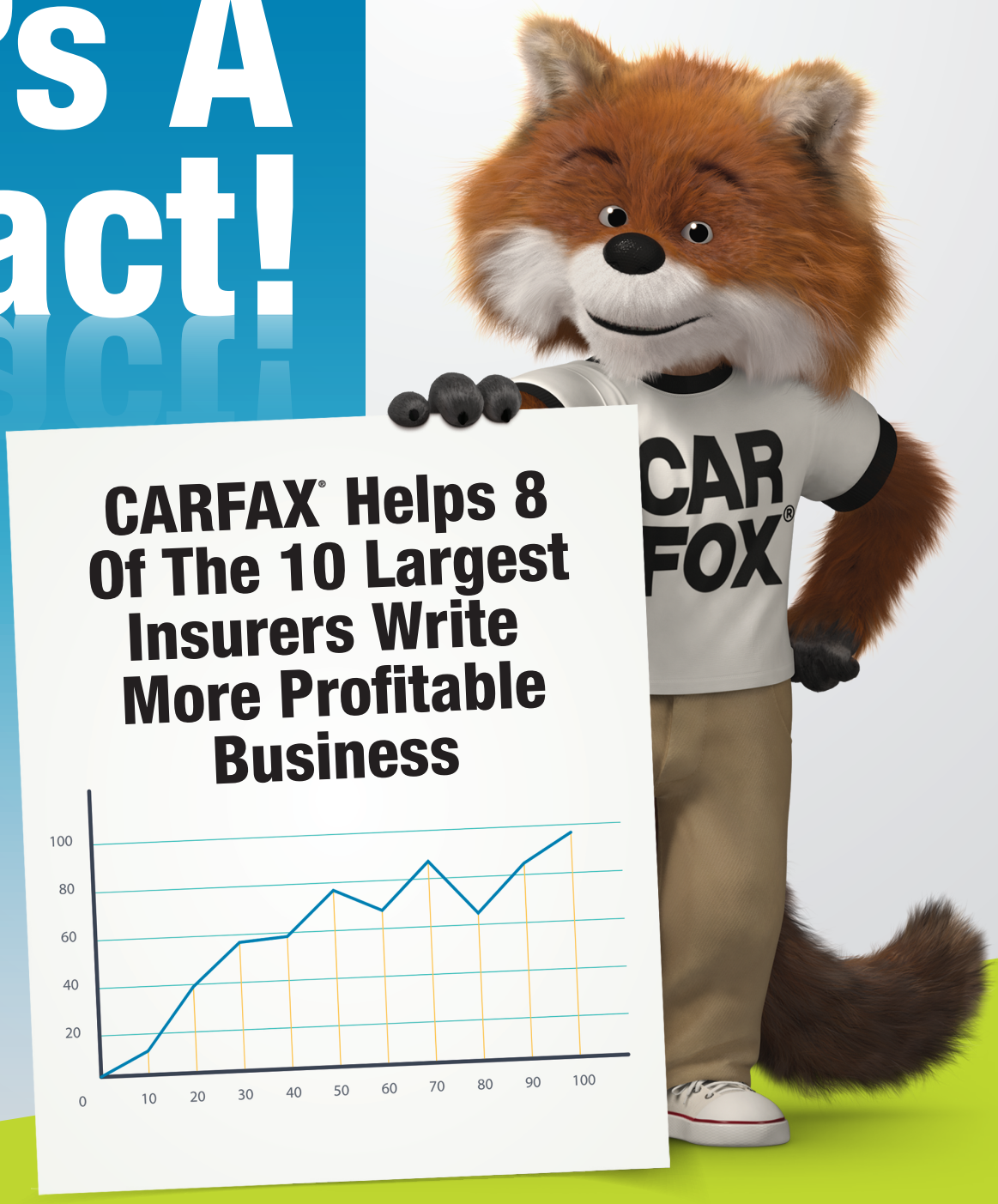

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Strategic Planning in a World of Constant Change: The More Things Change, the More They Stay the Same

As I approach my presidential year, I look forward to the work we must do on a full scale review of the CAS Strategic Plan. Historically, we've taken a deep dive into our plan every five years. Five years have passed, and what a five years they've been!

Have you looked at our induction of new members? Have you noticed how many there are?! I think we all have. But have you connected the dots to note that a full 33 percent of our membership achieved their last designation within the past five years? Twenty-seven percent of our membership is under the age of 35 (born in 1982 or later).

We often hear about differences in how different generations approach work, and how they approach volunteerism. Volunteerism and community are core CAS values. How does this demographic shift affect the CAS and what should we do in response?

Depending on where you work, you may have noticed another shift. The actuarial function may be called the analytics function, and the person next to you, or even your boss, may no longer be an actuary. More than ever we are working side by side with other professionals and people who have different skill sets from our own. Collaboration is another of our core values. Collaboration takes on a greater importance in this working environment where the people we work with have new skills. A failure to collaborate can lead to these other professionals taking over areas where we have historically been leaders.

The actuarial function may be called the analytics function, and the person next to you, or even your boss, may no longer be an actuary. More than ever we are working side by side with other professionals and people who have different skill sets from ours.

Delivery of educational material and methods of verification of knowledge have changed significantly, and they continue to change. Have we kept up? Actuarial education is what we do. Continual improvement is a core value that requires us to consider and embrace changes in education. What we need to know changes constantly; how we deliver it needs to take advantage of all of the new opportunities — from individualized learning concepts like the Khan Academy, to computer-based testing, to accepting university credit for basic knowledge.

Continual improvement also goes hand in hand with exploring new areas for research, whether that research involves new tools and methods or new areas to apply traditional methods. We are faced with an increasing exposure to cyberrisks. As smart cars and houses and the internet of things become more prevalent, how are we affected and how do we react? As we become more international, other frameworks for addressing catastrophe risks need to be explored. Flood insurance may be administered by the government in the U.S., but should it be? Are there implications of climate change on agriculture? Agriculture has never been a big focus for us in the U.S.

These are just some of the things that have changed in the last five years. And we can be sure that the next five years will bring more interesting challenges into our consciousness.

When I think about planning — considering all that is happening — I do get a little overwhelmed. But then, I stop and think about what the CAS is and why it exists, and I realize that our core values and our mission really haven't changed. As we look to our future, our goals don't really change much. The actions we undertake to achieve those goals may change radically, but the things we need to excel at remain very much the same.

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COMINGS AND GOINGS

Business Insurance magazine has named **Kathy Antonello, FCAS, MAAA**, to its annual "Women to Watch" list that recognizes outstanding women in the insurance and risk management sectors. Antonello is chief actuary at the National Council on Compensation Insurance and is the first woman in NCCI's 100-year history to lead its actuarial team. Her department includes more than 100 actuaries, researchers, economists and support staff who generate state workers' comp advisory rate and loss cost filings, legislative analyses, actuarial products, analytics and research.

Linda K. Brobeck, FCAS, MAAA, has joined Pinnacle Actuarial Resources as a senior consulting actuary in the group's California office. Brobeck has specialized in P&C insurance since 1986; she has also been an actuarial consultant since 2011. Her areas of focus include ratemaking and predictive modeling for several lines of insurance including personal and commercial automobile, homeowners and professional liability.

Doug Smith, FCAS, MAAA, CPCU, will serve as executive vice president of product and sales for Erie Insurance. In this role, Smith will oversee Erie's three product lines — personal, commercial and life insurance — a position he has held in an interim capacity since July 2016. Smith has spent the last eight years — half of his Erie tenure — as senior vice president of personal lines. Prior to that position, he served as a leader in Erie's actuarial division.

Terrence D. Wright, ACAS, MAAA, has joined Pinnacle Actuarial Resources Inc. as a consulting actuary in the firm's Atlanta office. Wright has been in the insurance industry since 1998 and has 14 years of consulting experience. His consulting and insurance career has focused on medical professional liability, workers' compensation, commercial automobile, general liability, product liability, personal automobile and management liability.

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

ACTUARIAL REVIEW *LETTERS POLICIES*

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

CALENDAR OF EVENTS

March 6 - 7, 2017
Underwriting Collaboration Seminar
Crowne Plaza Chicago O'Hare
Rosemont, IL

March 27 - 29, 2017
Ratemaking and Product Management (RPM) Seminar & Workshops
Marriott Marquis San Diego Marina
San Diego, CA

May 21 - 24, 2017
Spring Meeting
Sheraton Centre Toronto Hotel
Toronto, ON

June 5 - 6, 2017
Seminar on Reinsurance
Fairmont Washington, DC
Washington, DC

September 10 - 12, 2017
Casualty Loss Reserve Seminar (CLRS) & Workshops
Loews Philadelphia Hotel
Philadelphia, PA

November 5 - 8, 2017
Annual Meeting
Fairmont Austin
Austin, TX

The CAS Grows Up

The February 1992 edition of the AR summarized the Presidential Address given by Charles "Chuck" Bryan at the November 1991 membership meeting. His comments provide a concise history of the maturing of the CAS and a good prescription for future success. Following are excerpts from the summary of his speech.

The Maturing of the CAS

The Presidential Address of Charles Bryan

For five years, I have been privileged to serve as an officer and have seen what makes this Society work so well. And this year as president has given special insight into how we have matured and what our destiny will be.

How has the CAS matured? Our infancy was from 1914 to 1929. We were small — 14 charter members. We were very dependent on others — the members contributed their own money for many projects and companies sponsored items like nametags at meetings.

The next step was our childhood — 1929 to 1969. We started in 1928 with 150 members and ended with 600 members in 1960. By then, we had developed some facility with our own languages, such as credibility, indicated rates, required surplus and so on.

Our adolescence was from 1960 to 1990. Those of us who have raised teenage children know these years are characterized by an effort to learn more, act independently and idealism. During these years, we helped found the [American Academy of Actuaries], put in place our current examination process, began our newsletter *The Actuarial Review*, established Regional Affiliates, promulgated statements of principles, published a textbook, and became accepted as the experts in loss reserving and ratemaking. The culmination of our adolescent period came with the NAIC actuarial opinion requirements in the United States and the appointed actuary requirements in Canada. Many of you participated in the battle to win these requirements.

We have now reached full maturing — a strong, healthy, intelligent elite group of 1,809 people who have reached adulthood at age 77 ...

As we look to the future as a mature organization, we will be most successful if we have an articulate action plan that we follow ... I am convinced we must do the following:

(1) Become fully committed to the global viewpoint ...

(2) Adopt the attitude that actuaries should actively guide the insurance mechanism ...

(3) Demand more of ourselves, and then demand even more. We live well, have good reputations, are well paid, and command considerable prestige. But that privileged position will end someday. To Hugh Scurfield's speech as president of the British Institute of Actuaries, "What you have inherited from your fathers, earn again for yourselves or it will not be yours." We, you and I, are the only people that can save our profession from the atrophy that always threatens success. You and I must do it — no one else can, no one else will.

Registration Opens for iCAS Predictive Analytics Credential, Membership and Experienced Practitioner Pathway Programs

The CAS Institute (iCAS), a new subsidiary of the CAS offering specialty credentials for quantitative professionals, has opened registration for the first requirements of its Certified Specialist in Predictive Analytics (CSPA) credential and the application to earn the credential through the Experienced Practitioner Pathway (EPP). Membership in an iCAS practice community is now open to all interested professionals in advanced analytics and data science.

The first credential requirement, "Property-Casualty Insurance Fundamentals," is administered by The Institutes and covers core principles underlying property-casualty (P&C) insurance and risk management. CAS Fellows and Associates, as well as individuals who have passed CAS Online Courses 1 and 2 and CAS Exam 5, may receive a waiver for the first CSPA requirement once they have joined iCAS as members. For more information on obtaining waivers, visit TheCASInstitute.org.

The CAS Institute is also now accepting applications for the CSPA credential via EPP, a program that allows individuals to earn the credential through an application process, without completing the required courses or exams. EPP applicants must first join iCAS as members and then complete the EPP application, which includes providing details on skills and experience in predictive analytics and data science as they pertain to the P&C insurance industry.

As an added perk of membership, iCAS members can join a practice community focused on predictive analytics and data science — with other practice area communities to follow. Dues for 2017 are waived for those who join through September 30, 2017 (considered charter members), after which time annual membership dues will be $250. CAS members are encouraged to join now.

The CSPA credential provides evidence of applied knowledge in predictive analytics, modeling and data science as used in data-intensive sectors. Initially the CSPA requirements involve applications in P&C insurance, but other areas of application are planned.

For more information, please visit TheCASInstitute.org.

Seated are panelists for "The CAS Institute Has Launched," a CAS Annual Meeting concurrent session. Left to right are James Merz; Todd Lehmann; CAS President-Elect Brian Zucker Brown; and CAS Immediate Past President Bob Miccolis. Standing are Peter Bothwell and iCAS Director Amy Brener. Bothwell, Lehmann and Miccolis are iCAS subject matter experts. All are members of the iCAS Leadership Advisory Council.

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CAS Honors Award Winners BY SHELBY WOLFF, CAS VOLUNTEER AND COMMITTEE COORDINATOR

Each year more than a third of CAS members volunteer. Some of them have gone "above and beyond" for a focused and finite project over the course of a year. Some are new to volunteering and to the CAS but have exhibited outstanding leadership. Others are long-time volunteers who have devoted their time and energy throughout their careers to elevating and advancing the actuarial profession. The CAS honors 12 such exceptional CAS volunteers.

The Above and Beyond Achievement Awards

This award recognizes short-term volunteer contributions during the previous year.

Jonathan Charak (FCAS 2013) was awarded a 2016 ABAA for his wide ranging work as a member of the CAS Automated Vehicles Task Force, serving as both the vice chair and the head of its communication team since the group's inception. "I started volunteering with the CAS after receiving my Fellowship," recalled Charak. "My involvement really picked up when the CAS was forming the Automated Vehicle Task Force. I felt this was an interesting area as I enjoy reading about new technology as well as cars." Charak serves as the task force's spokesperson for this issue, doing interviews with several outlets and presenting the group's mission at events since 2014. "I really enjoy helping the CAS shape the conversation for an emerging risk that will have significant impact on the industry."

Jonathan Charak

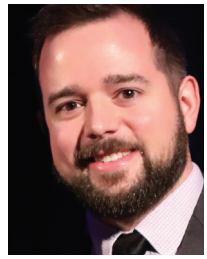
Christopher Styrsky (FCAS 2004) was awarded the ABAA for his work with the Syllabus and Examination Committee, specifically his responsibilities of overseeing the development of a new grading program. His job required him to work closely with the vendor, coordinating extensive user testing and code development, before finally providing documentation and training to exam committee members. The new program met all expectations for a successful Spring 2016 grading session. "Being an actuary has affected my life in so many positive ways, from providing a challenging career to meeting interesting people — some of whom would become my closest friends," said Styrsky. "Volunteering allows me to give back to the profession that has been so influential in my personal and professional life."

Christopher Styrsky

Paul Kinson (FCAS 1998) was nominated for his role as chair of the University Liaison Working Group as well as his contributions across the University Engagement Committee. "The quality and consistency of new ideas, activities and resources that he has contributed to his leadership role have surpassed that which would be expected of a typical chair," wrote his nominator. "He is laser-focused on incorporating innovations, improvements and hard work into everything he does." Kinson became chair in 2013 and has since doubled the size of University Liaison volunteers, reaching more than 400 volunteers in his tenure. "It has been gratifying to see students go on to enter the profession and earn their CAS credentials," said Kinson of his mentoring.

Paul Kinson

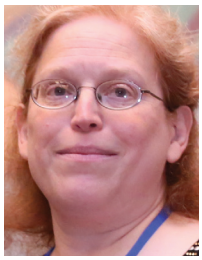
Paul Grammens (FCAS 2012) received his ABAA for his work on the New Members Committee. Grammens led the video project *Attending Your First Meeting*, which was created after new members expressed that they were not fully prepared for their first CAS meeting. The fast-moving, animated video received a Silver EXCEL Award from the Association of Media and Publishing. "I enjoyed being able to put forward an idea on how to communicate with new members — seeing that idea come to fruition has reassured me of the importance of individual volunteer contributions to the CAS," said Grammens.



Paul Grammens

Ginda Fisher (FCAS 1997), **Jeremy Shoemaker** (FCAS 2003), and **Amy Waldhauer** (FCAS 2004) comprised a working group established within the Strategic Subcommittee of Education Policy. This group received the ABAA for their evaluation of methods for content delivery and assessment for CAS Basic Education. After conducting research over the course of five months, they

offered a report that challenged existing protocols and encouraged the CAS to explore new ways of delivering educational content. One board member noted that this would set the course for basic education over the next several years. "The CAS has offered me a great opportunity to work with people who are very good at what they do, and I am continually challenged to bring my best to my work with them," said Waldhauer about her experience.



Top to bottom: Ginda Fisher, Jeremy Shoemaker, and Amy Waldhauer.

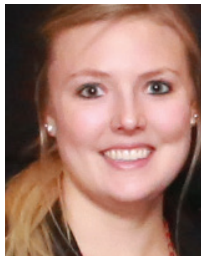
The New Members Awards

This award recognizes volunteer contributions during an individual's first five years from their most recent credential.

Kevin Donnelly (FCAS 2012) received his NMA for his involvement in the RPM Seminar Planning Committee. After joining in 2014, he quickly became involved by organizing new health care sessions for the 2015 RPM Seminar and volunteering to lead roundtables when track leaders left. "Kevin has always been willing to go above and beyond by helping serve on tracks and leading when we had needs," Donnelly's nominator wrote. "His work was very valuable in having a successful seminar." Donnelly became the committee vice chair in 2016. "Volunteering makes me feel a part of the organization," said Donnelly. "As volunteers, we can help guide the Society into the data revolution and ensure that we stay current, relevant and valuable."

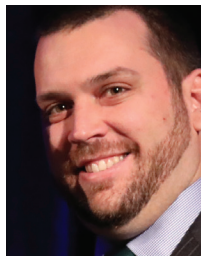
Kevin Donnelly

Sara Hemmingson (FCAS 2014) was honored for her service on the Interactive Online Education Committee (IOEC) where she volunteered to lead a course team within the committee. As a team leader, she organized calls and worked regularly with CAS staff, vendors and subject matter experts. She effectively led the team through the launch of two successive courses. Her success as team leader resulted in her accepting the role of IOEC vice chair. "I really love learning from and meeting other actuaries," said Hemmingson when asked about the benefits of volunteering. "I've found that hearing and understanding viewpoints different than mine while volunteering continually grow my own ability to think in a holistic manner at work, which is a big asset."



Sara Hemmingson

Walter Matthews (FCAS 2013) was awarded his NMA for his involvement on the Examination Committee. He began writing unique and challenging questions for an exam and stepped into the role of vice chair, increasing his involvement on the committee after just a year. "I began volunteering to better improve the exam process for future actuaries," said Matthews. "I never anticipated the great relationships I would build with other volunteers; these relationships have kept me coming back." Though it is not required of the vice chair, Matthews continues to write and grade exam questions. His nominator wrote, "Walter produces high-quality questions, brings meaningful contributions to our pass mark panel and maintains a great attitude throughout all of our work!"



Walter Matthews

The Matthew Rodermund Memorial Service Award

The Matthew Rodermund Memorial Service Award annually acknowledges CAS members who have made considerable volunteer contributions to the actuarial profession over the course of their career.

Richard Fein (FCAS 1978) received the Rodermund Award for his continued years of service among a diverse list of committees, with a large focus on CAS publications. Reflecting on the importance of volunteerism, Fein said, "The input of working professionals keeps the organization current and flexible enough to reflect the changing ways in which P&C actuaries' work requirements evolve. The diversity of people's experiences and points of view are a significant strength that can't be overstated."

Richard Fein

David Menning (FCAS 1986) started volunteering in 1987 on the Examination Committee, where he has since served several terms as vice chair and a term as chair. His service has also included time on the Future Education Task Force, Education Policy Committee and Education Consultant Task Force. "With my teaching and coaching background, I felt it was important to get involved with the education of property & casualty actuaries," said Menning. "I had a passion to help educate actuaries to become quality professionals and therefore I spent most of my volunteer time in the Admissions area." From 2008-2011, Menning served on the CAS Executive Council as vice president-admissions.

David Menning

Get to Know the 2016 CAS Trust Scholarship Winners BY ARNULFO MORENO, CAS MARKETING AND COMMUNICATIONS COORDINATOR

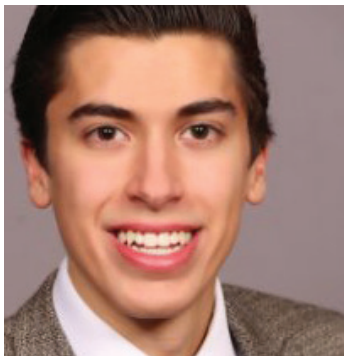
The CAS Trust Scholarship Committee is excited to announce this year's winners of the CAS Trust Scholarship: Chase Yetter, Chloe Marshinski and Sarah Rumon.

Chase Yetter, a rising senior at Lebanon Valley College double majoring in actuarial science and mathematics, was this year's recipient of the $10,000 CAS Trust Scholarship. "When I was a student in high school, I knew I wanted to pursue a career that would challenge me, and I wanted it to involve both mathematics and business," said Yetter. Chase is excited about pursuing a career in the property and casualty industry and has already been able to attend multiple industry events, including the Spring 2015 and Fall 2015 Casualty Actuaries of the Mid-Atlantic Region (CAMAR) meetings, as well as the 2015 CAS Annual Meeting as part of the student program. "I hope to quickly become a Fellow of the Casualty Actuarial Society (FCAS) and a Chartered Property Casualty Underwriter (CPCU) ... I also hope to become one of the first to earn the predictive analytics credential that arises from the partnership between the CAS and The Institutes."

Yetter gained industry experience at XL Catlin as a Global Claims Actuarial Intern; his responsibilities included supporting the Global Claim Actuary and CFO, analyzing operational performance metrics and emerging claim trends, and assisting in the development of a claim handler staffing model. This summer he will intern for The Hartford's P&C Student Program. "My drive to succeed will continue to motivate me, and I look forward to an exciting, innovative career supplemented by the education and guidance of the CAS."

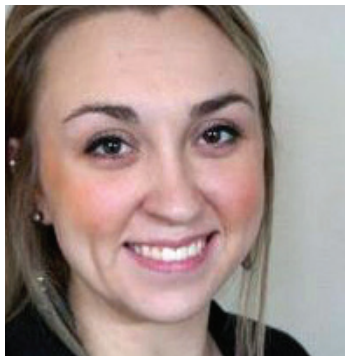
Chloe Marshinski, a senior at the University of Illinois at Urbana-Champaign majoring in actuarial science and statistics, was awarded a $5,000 CAS Trust Scholarship. "Knowing my work is contributing to a field that helps our

society function and grow gives me motivation and purpose," said Marshinski. "I am specifically interested in the property-casualty industry because it encompasses so many different types of risk and is constantly faced with new challenges." Marshinski interned this past summer with CNA, where she completed two pricing reviews consisting of pulling and organizing data and making loss ratio selections, and performed comprehensive pricing analysis of the umbrella book of business. She also presented findings and recommendations on future business strategies to underwriting. Before that Marshinski interned with a State Farm agent, researching products, communicating with customers about their product interests, and calculating auto insurance quotes for online leads. "While the data and the numbers are important during an analysis," she said, "it's being able to communicate your findings and recommendations to others that makes the analysis worthwhile."



Chase Yetter

Chloe Marshinski



Sarah Rumon

Sarah Rumon is an actuarial science major and rising junior at the University of St. Thomas in St. Paul, Minnesota. She was awarded a $5,000 CAS Trust Scholarship. Rumon is the founding member and president of Gamma Iota Sigma Beta Pi Chapter at the University of St. Thomas and was voted the international student representative for Gamma Iota Sigma at the annual Gamma Iota Sigma Conference last year. Rumon has also taken part in the Travelers Insurance Actuarial Summer Student program as well as their Actuarial and Analytics Leadership Development Programs, where she summarized and presented aggregate review results to the loss analytics department, and learned about public sector products. "I have come to realize that being an actuary is so much more than passing tough exams and being skilled with using Excel," said Rumon. "To me, a successful actuary has three distinct sets of skills — analytical skills, business acumen and knowledge — but also soft skills such as leadership, communication, time management and more.

NEW FELLOWS ADMITTED IN 2016

Row 1, left to right: *Alex Jurhs, Ethan Kang, Charles Hagedorn, Kimberly Lippincott,* **CAS President Stephen P. Lowe**, *Nicole Hackett, Xingyun Liao, Christina Lutz, Han Jiang.*
Row 2, left to right: *Andrew Martinez, Julie Melnick, Laura Hemmer, Ryan Foo, Daniel Falkson, Thomas Fischer, Jin Liu, Nicholas Hartmann.*
Row 3, left to right: *Stephen Brumley, David Mamane, William Uffenbeck, Gage Caligaris, Kevin Kerr, Mark Lockwood, Scott Keim.*

Row 1, left to right: *Elizabeth Storm, Winnie Li, Jennifer Aschenbrenner, Lin Huang,* **CAS President Stephen P. Lowe**, *Cyprian Juma, Christopher Manhave, Shelley Schad, Sean Kiernan.*
Row 2, left to right: *Weiwei Cao, Thomas Zdon, Anna Antonova, Megan Klein, Yan He, Chun Lam, Bradley Henderson.*
Row 3, left to right: *Kyle Kinkade, Nicholas Gullo, Andrew Yuhasz, Brett Foster, Kyle Ryan, Garret Hepburn, Brett Hall, Daniel Latinsky.*

Row 1, left to right: *Christopher So, Ekaterina Clark, Jacqueline Micheller, Wenwen Salerno,* **CAS President Stephen P. Lowe**, *Diana Tse, Eric Cheung, Jessica Yeh, Katherine Wilson.*
Row 2, left to right: *James Englezos, Blake Fuchtman, Jonathan Carmine, Jeffrey Mond, David Morin, Joseph Falandays, Kathlyn Herrick, Jennifer Yeh.*
Row 3, left to right: *Dennis Wong, Yair Bar-Chaim, Peter Reggiannini, John Avitabile, Caleb Wetherell, Daniel Collins, Brian Faber, Robert Balmer.*

Row 1, left to right: *Timothy Greeno, Yaoxi Xiong, Wenyi Zhang, Bihling Wu,* **CAS President Stephen P. Lowe**, *Katrine Pertsovski, Amanda Gesseck, Lison Gravel, Justin Bartoszek.*
Row 2, left to right: *Jared Thompson, Eric Xu, Binbin Xing, Cheuk Tam, Guoqing Sun, James Bedford, Nicholas Leofsky, Rohin Bepat.*
Row 3, left to right: *David Hibbard, Francis Gorg, David Tolusso, Maxim Proulx-Rivard, Alexandre Leclerc, Francois-Luc Dallaire, Philippe Gagnon-Guerard, David Herson.*

NEW FELLOWS ADMITTED IN 2016

Row 1, left to right: *Olena Voloshyna, Amanda Weihe, Yitian Qin, Kelly Dietrich,* **CAS President Stephen P. Lowe**, *Christina Coppage, Abby Popejoy, Pauline Philip, Phong Pham.*
Row 2, left to right: *Nicholas Irwin, Joshua Brady, Gabriel Vachon-Marceau, Alex Prajescu, Charles Beaudin, Gabriel Plano, Jing Gong, Richard Derr.*
Row 3, left to right: *Olivier Brown, Charles Bernier, Andrew Parr, Tobias Schuler, Daniel Dillon, Steven Honcharik, Scott Jensen.*

Row 1, left to right: *Deepa Nair, Thomas D'Onofrio, Andrew Nonnweiler, We Lia Tan,* **CAS President Stephen P. Lowe**, *Yi Wang, Darrin Most, Matthew Berry, David Ellis.*
Row 2, left to right: *Christopher Reich, Robert Olshefski, David Nye, Jon Schultz, Jonathan Statman, Nicholas Principe, Robert Smith, Sarah Ryan, SiYao Gu.*
Row 3, left to right: *Eric Blancke, Jeremiah Richardson, Kyle Osborne, Danielle Rinaldi, Carly Rowland, Zachery Ziegler, Andrew Otto, John Osteen, Samuel Nicholas Charters.*

New Fellows not shown: *Daniel Ajun, Eduard Alpin, Julia Blyumin, Peter Brinck, David Broomhead, Bradley Bykowicz, Steven Chamberlain, David Dai, Sarah Dallmann, Fruma Gewirtz, Anthony Giangreco-Marotta, Yue Hou, Frank Huang, Mark Kalothi, Kien Weng Koh, Charles Lamb, Hugo Latendresse, Hao Li, Ying Li, Wenyi Li, Jun Liu, Stephanie Lynn, Suh Sin Moo, Matthew Moran, Matthew Morris, Benjamin Permut, Anthony Pragovich, Forrest Preston, Kevin Puzzele, Andrew Raynes, Jeremiah Reinkoester, Paige Roland, Jonathan Schroeder, Jenna Shatek, Justin Smith, Laura Smith, Caitlin Tatarzyn, Raksa Wimonsutthikul, Hong Xuan Yee, Gang Yin, Xiaoxia Summer Zhou, Li Zhu.*

NEW ASSOCIATES ADMITTED IN 2016

Row 1, left to right: *Myung Yoo, John Nordgren, Caitlin Allen, Xunchi Chen,* **CAS President Stephen P. Lowe**, *Benjamin Chanzit, Zachary Renschler, Julie Wood, Rebecca Baldyga.*
Row 2, left to right: *Brian White, Barry Siegman, Mohammed Siddiqui, Jeremy Jacko, François Bornais-Doucet, Samuel Sauvageau, Norberto Namkoong, Elton Kwan.*
Row 3, left to right: *Alexander Swanton, Conor Caldwell, Alex Leitheiser, Gregory Dietzen, Richard Tyson, Clayton McFerran, Ross Tulloch, Daniel Fujitaki.*

Row 1, left to right: *Catherine D'Astous, Andreanne Cantin, Melanie Dufour, Kimberly Neugent,* **CAS President Stephen P. Lowe**, *Wen-Hsin Hsu, Katelyn Hildebrand, Caroline Muegge, Megan Baker.*
Row 2, left to right: *Kirsten Newton, Kimberly Lukens, Karl Boettcher, Katherine Urso, Lily Chou, Daniel Tevin, Jennifer Leach, Sandeep Grewal.*
Row 3, left to right: *Kurt Jager, Marla Koch, Stefan Zepernick, Yu Jin, Joseph Hruzek, Mark Doering, Amanda Morgan, Samantha Cotter.*

NEW ASSOCIATES ADMITTED IN 2016

Row 1, left to right: *Danielle Gilmour, Peter Yoon, Kalev Maricq, Aung Naing,* **CAS President Stephen P. Lowe**, *Mary Preeti Andrews, Julie Huth, Renee Henderson, Geoffrey Udell.*
Row 2, left to right: *Christina McNamara, Sergey Tsitlenko, Kasey Ostarello, Taylor Krebsbach, Kimberly Miller, Joe Hsieh, Chunsu Li, Sunde Schirmers.*
Row 3, left to right: *Andrew Kelliher, Garen Sargsyan, Joseph Jenkins, Joe Fang, Kevin Kuo, Justin Malmgren, Robert Freimarck, Victoria Marciano.*

Row 1, left to right: *Huixian Xie, Angel Lam-Goon, Judy Chiu, Ik-kyeom Kim,* **CAS President Stephen P. Lowe**, *Steven Sulkin, Si He, Shuang Bi, Robert Pope.*
Row 2, left to right: *Sarah Rice, Wenwen Hu, Daniel Teuma, Joshua Adler, Cameron Custis, Clayton Franklin, Albert Tran.*
Row 3, left to right: *Steven Chanlok, Daniel Siu, Corey Alfieri, Chase Beck, Theron Teter, Troy Klingler, Canaan Van De Mark, Ryan Thornton.*

Row 1, left to right: *Blair Freeman, Chia Ling Chiang, Yuyang Wang, Ryan Patterson,* **CAS President Stephen P. Lowe**, *Anderson St. Hill, Jennifer Ho, Luchen Wang, Cullen Maricque.*
Row 2, left to right: *Robert Tromans, Kam Tam, John Bae, Vincent Paradis, Richard Granville, Samantha Clayton, Kean Kuan.*
Row 3, left to right: *Tyler Hendry, Jonny Chung, Min Kang, François Dumont, Jeffrey Lanza, Raymond Tobias, Talal Arimah, Jeremy Vinson.*

Row 1, left to right: *Zuhaib Chughtai, Jennifer Do, Andre Gauthier, Brycin Wong,* **CAS President Stephen P. Lowe**, *Cheuk Yin Lau, Sarayyah Baksh, Mohan Sivapatham, Hanna Komlos.*
Row 2, left to right: *Samir Mullick, Diana Aulisa, Daniel Swain, Stephanie Jackson, Justin Mangiaracina, Tannis Wiebe, Brigitte Scheffer, Amber Anseeuw.*
Row 3, left to right: *Eric Chen, Nicholas (Nick) Russel, Geoffrey Tims, Jacob Burger, Kyeongmi Bang, Kyungphil Lee, Gregory Coffman, Thomas Schlund, Chengwei Wang.*

NEW ASSOCIATES ADMITTED IN 2016

Row 1, left to right: *Qun Wong, Ya Tang, Carlos Muñoz, Bingfeng Xu,* **CAS President Stephen P. Lowe**, *Joseph Harkman, Bingkun Cai, Katie Kerckaert, Iliyana Stancheva.*
Row 2, left to right: *Madhu Rao, Jonathan Bisschop, Matthew Shugrue, Tyler Roe, James Kim, Karissa Brodhagen, Lucia Batista, Tao Qi.*
Row 3, left to right: *Nicholas Alicea, Nataliia Stern, Alejandra Zaparolli, Kyle Bartee, Spencer Larson, Alan Tomo Oldiges, Vladislav Gantman, Guillaume Champagne.*

New Associates not shown: *Gloria Asare, Shawn Balthazar, Heather Bethel, Samuel Brunell, Sarah Cardin, Yat Fung Chan, Jessica Chen, Xiaoming Chen, Christopher Chirico, Sang Cho, Katherine Dalis, Christopher DiNicola, Romela Elaine Duan, Max Feldman, Kimberly Feucht, Matthew Fredette, Leslie George, Devan Griffith, Weiyue Gu, Fei Hao, Man Lok Eric Ho, Gregory Kim, Hans Kist, Kylie Knorr, Joseph Kuran, Dong Gil Lee, Shea Ling Lee, Eliezer Lesser, Hoi-Lam Leung, Chenxin Li, Xin Xin Li, Jerrison Li Liu, Yingxian Lin, Promise Lohse, Weijie Mao, Di Nan, Rose O'Hara, Krishna Patel, Amy Peters, Tory Peterson, Vincent Pomo, Alice Popova, Mathieu Prud'homme, Ellen Raushel, Evan Saline, Corey Sarcu, Nicholas Sciallo, Reena Shanker, Nicole Sidebottom, Tavpraneet Singh, Daniel Sisson, Ryan Solyntjes, Bouabre Tape, Evan Teitelbaum, Aaron Ting, Darby Wallis, Qian Wu, Duo Xu, Gang Yin, Wanchen Zhang, Amy Zimmerman.*

2016 CAS University Award Winners Recognized

At the 2016 CAS Business Session on November 16 in Orlando, outgoing CAS President Steve Lowe recognized the winners of the 2016 CAS University Award: Illinois State University; University of California, Santa Barbara; University of Connecticut; and University of Illinois at Urbana-Champaign. Lowe presented representatives from each university with a plaque. Winning schools had each received a $5,000 award prior to the start of the academic year to further enhance their programs.

The schools were selected in June 2016 to receive the inaugural award for exemplary work in preparing students for a career in the property-casualty insurance industry. During an Annual Meeting session, the school representatives shared their insights and best practices for conducting university actuarial programs.

The CAS is now accepting applications for the 2017 CAS University Award Program through March 15, 2017. Please contact CAS University Engagement Manager Tamar Gertner with questions at tgertner@casact.org.

Krzysztof Ostaszewski, Actuarial Program Director and Professor of Mathematics, Illinois State University

James Trimble, Director, Actuarial Science Program, University of Connecticut

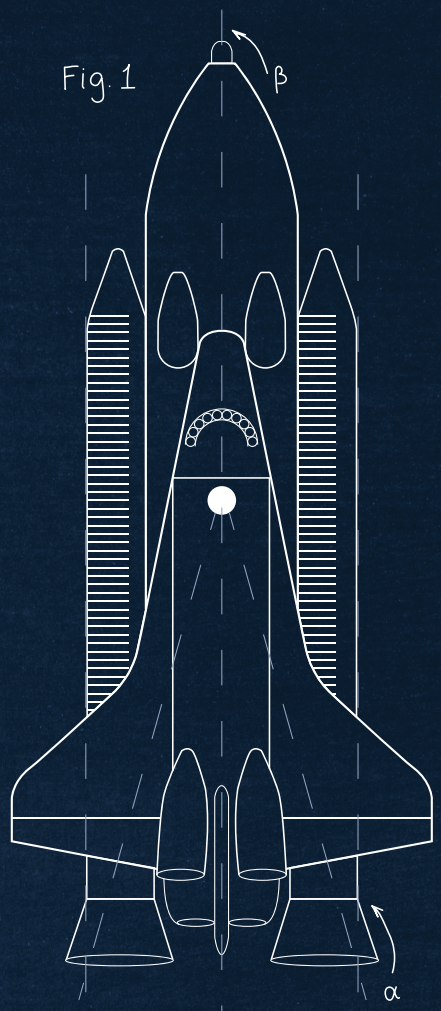
Roger Hayne, FCAS, Faculty, University of California, Santa Barbara

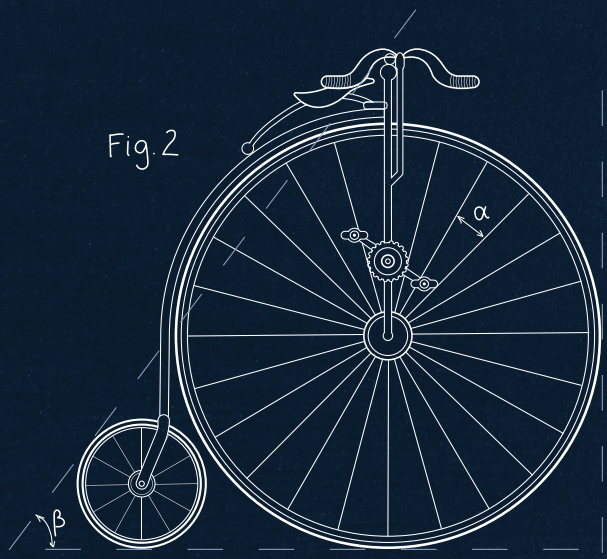
Runhuan Feng, Interim Director, Actuarial Science Program, The University of Illinois at Urbana-Champaign

Scenes from the CAS 2016 ANNUAL MEETING

1. *Moderator Dustin Loeffler (right) joins Fred Karlinsky and Lori Nugent, who were presenters for the CAS Annual Meeting General Session titled, "Data and Cybersecurity: Legal and Regulatory Developments." Karlinsky and Nugent are shareholders in the law firm Greenberg Traurig. Photo credit: Elizabeth Smith.*
2. *The Spiderman ride at Universal's Islands of Adventure. Photo credit: Matt Caruso.*
3. *New Fellow Nicholas Gullo (right) and his family pose with CAS President Steve Lowe.*
4. *Members of the CAS Executive Council are recognized during the Annual Business Session.*
5. *Simon T. Bailey, author of Release Your Brilliance, was the CAS Annual Meeting featured speaker.*
6. *CAS President Steve Lowe (left) poses with new CAS Fellow Phong Pham (second from left) and Pham's parents.*
7. *Mixing and mingling in the exhibit hall.*
8. *CAS President Steve Lowe (left) congratulates Chase Yetter (right) as Sarah Rumon looks on, holding her extra-large check. Yetter and Rumon, along with Chloe Marshinski, are 2016 recipients of the CAS Trust Scholarship (see story, page 14).*
9. *New CAS Associates stand and are recognized during the Celebration of New Members on November 14.*
10. *Attendees check in with exhibitors.*

Photos by Craig Huey, unless otherwise indicated.

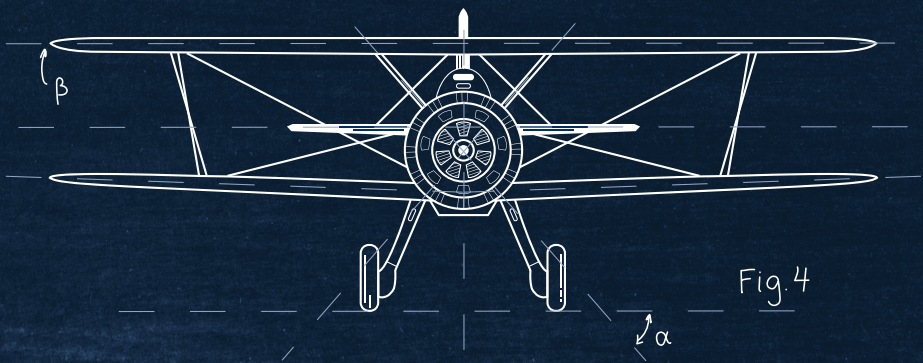


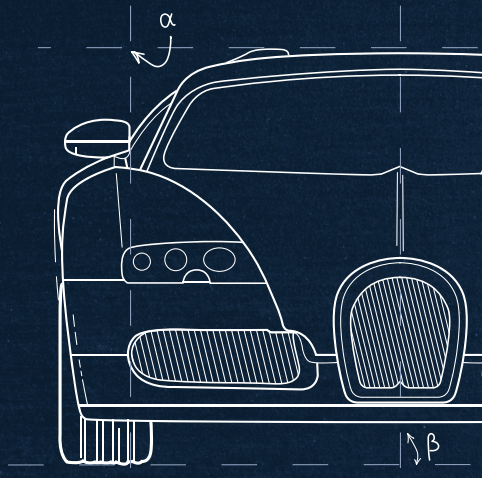


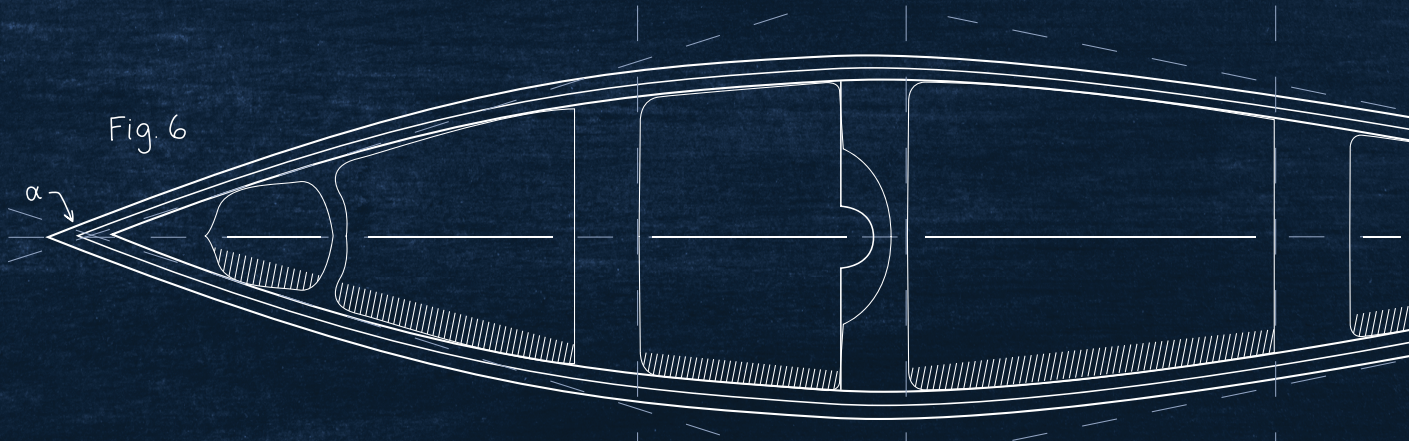
Predictive Modeling:

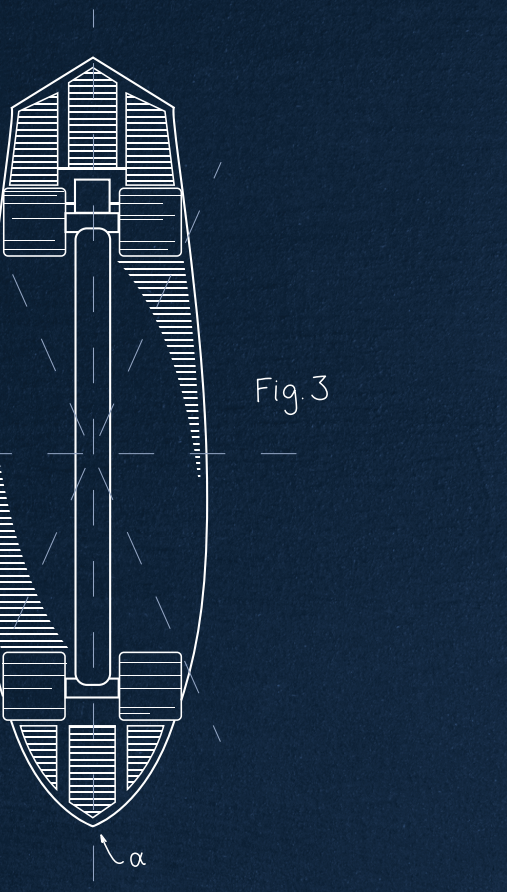
Actuaries Blaze New Analytical Frontiers

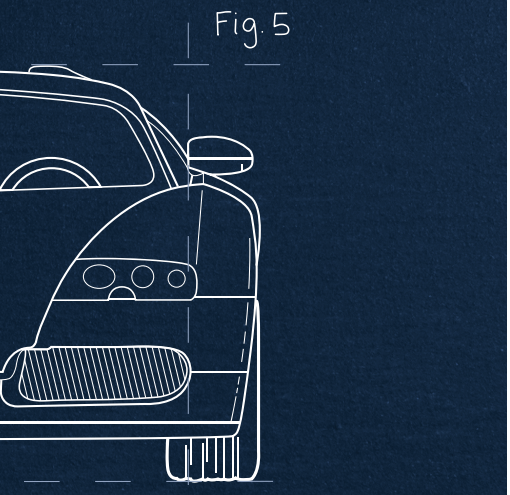
By ANNMARIE GEDDES BARIBEAU

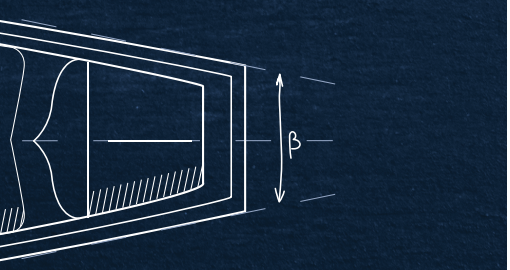












From solving insurance challenges through new applications for GLM to expanding into machine learning and other types of models — there is a lot of experimentation going on.

Even before credit scoring began revolutionizing personal auto insurance pricing, carriers have been on the hunt for more predictive modeling techniques and applications to outfox their competitors.

By relentlessly experimenting with combinations of analytical approaches and new data sources, actuaries are discovering insightful correlations for practical implementation. As generalized linear models (GLMs) are steadily expanding beyond pricing applications, other models promise new advantages.

Taking a closer look into the latest in predictive modeling requires examination of applications, types of models gaining acceptance, modeling approaches and other trends.

With all of these applications, there is plenty of experimenting taking place. When successful, experimentation leads to emerging innovation, which gains acceptance and gradually becomes common practice. Potential applications for predictive modeling are also exciting.

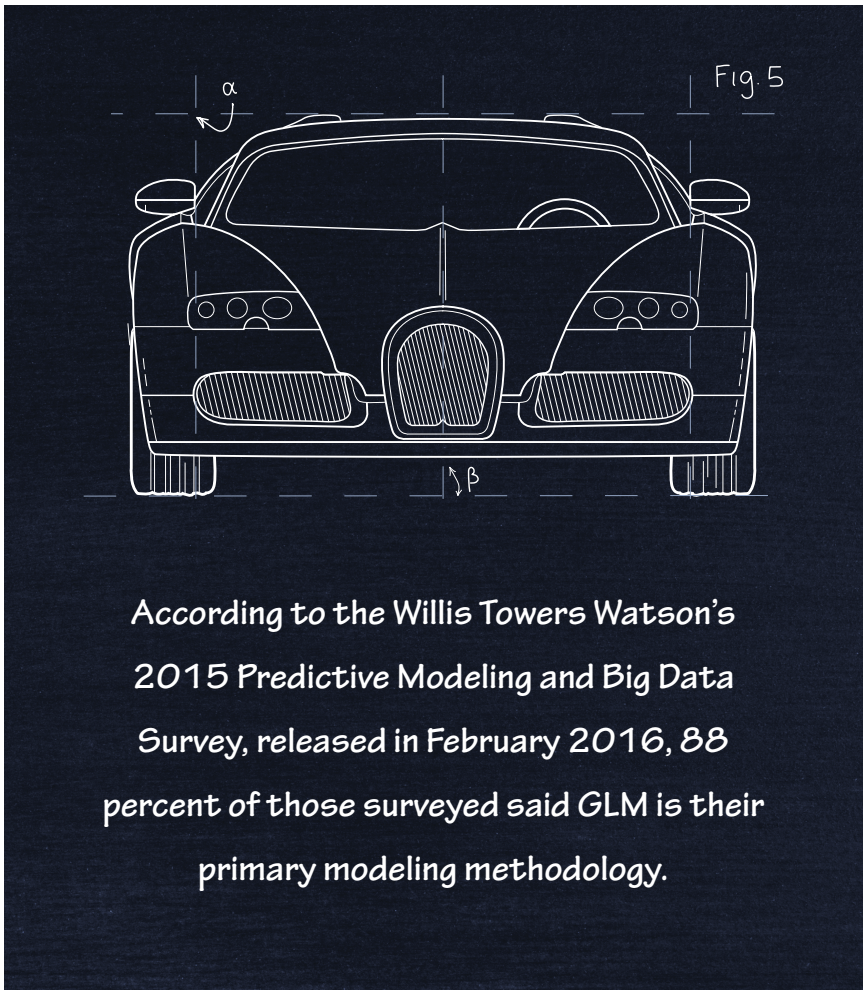
Many models that have been applied in other industries are new approaches in the insurance industry. The growing actuarial interest in predictive modeling represents one important trend, sources observed. Actuaries have become much more interested in predictive modeling than they were five or 10 years ago, said Christopher Monsour, vice president of analytics at CNA. "I remember being told 12 years ago that no one was going to pay for a more accurate reserve estimate," he added. "Times have changed."

Serhat Guven, Willis Towers Watson's P&C sales practice leader for the Americas, offers some possible reasons why predictive modeling is growing. As actuaries become more educated, they are finding more modeling options beyond GLMs. These include the R programming language, vendor software and greater data access.

As predictive modeling evolves, nomenclature also matures. Currently, models are difficult to categorize. The same model can have different names. Terms such as "advanced analytics" or "more sophisticated models" can have different meanings. For this article, these terms refer to models beyond basic GLMs or decision trees such as unsupervised models and machine learning.

GLMs and Decision Trees

Employing GLMs for pricing is the only predictive modeling application that has truly become common practice so far. For application and deployment, actuaries are using basic GLMs in most cases for additional applications, Guven said.



According to the Willis Towers Watson's *2015 Predictive Modeling and Big Data Survey*, released in February 2016, 88 percent of those surveyed said GLM is their primary modeling methodology. As for approaches they plan to use in the next two years, 19 percent of respondents plan to use GLMs for the first time or in other operational areas.

A model advances according to insurer interest in its application. For instance, mobilizing GLMs to project claim settlement amounts is saving insurers "real dollars," said Roosevelt C. Mosley, principal and consulting actuary for Pinnacle Actuarial Resources, so its adoption is progressing toward becoming a common practice.

Meanwhile, using GLMs for claims triage, which assigns claims to the appropriate examiners according to predictable severity, has been around for a while but adoption has been gradual, said Louise Francis, founder of Francis Analytics and Actuarial Data Mining, Inc.

Using GLMs to operationalize the claims triage model is a new development, Guven said. Applying stochastic loss reserving with GLMs for loss reserving is also emerging.

Actuaries are also working with sophisticated kinds of GLMs — such as double or hierarchical GLMs and non-parametric GLMs, observed Peggy Brinkmann, a principal and consulting actuary for Milliman, Inc. "We are not at the end of the line with GLMs," she added.

Brinkmann noted that decision trees are gaining greater use by actuaries who are not necessarily predictive modelers. "Decision trees have gone mainstream. There are more uses for them than just making loss cost models," Brinkman said. Decision trees are also effective for finding patterns, anomalies or errors for exploring data. Their growing popularity is reflected in the Towers Watson Survey, which reports that 31 percent of respondents are using decision trees, with another 26 percent planning to use them in the next two years.

In the claims arena, some insurers are finding decision trees helpful for automating the detection of claim subrogation potential to make it more objective, Francis said. "They take the insurer's history and look at what kinds of claims are subrogated and the outcome and use it to create a system to flag subrogation potential," she explained.

Decision trees have been assigning claims to the appropriate examiners according to claims severity for quite a while, Francis said. They are being applied in personal auto, workers' compensation and business interruption coverage, Guven said, and they also detect potentially fraudulent claims.

According to Mosley, decision trees also are effective for optimizing report ordering, which is commonly used for underwriting. "These models use the characteristics of the policy to predict whether there will be actionable information in the external information obtained," he added. This helps deter-

mine the benefits of ordering reports such as property inspections and motor vehicle reports to reevaluate policyholders.

Advancing Analytics

GLMs are good for loss distribution analysis of insurance products, but do not necessarily work for all types of questions, said Mary Jo Kannon, an adjunct instructor at St. Joseph's University. As a result, "actuaries are now working in nontraditional areas to use predictive analytics to solve different problems," she added.

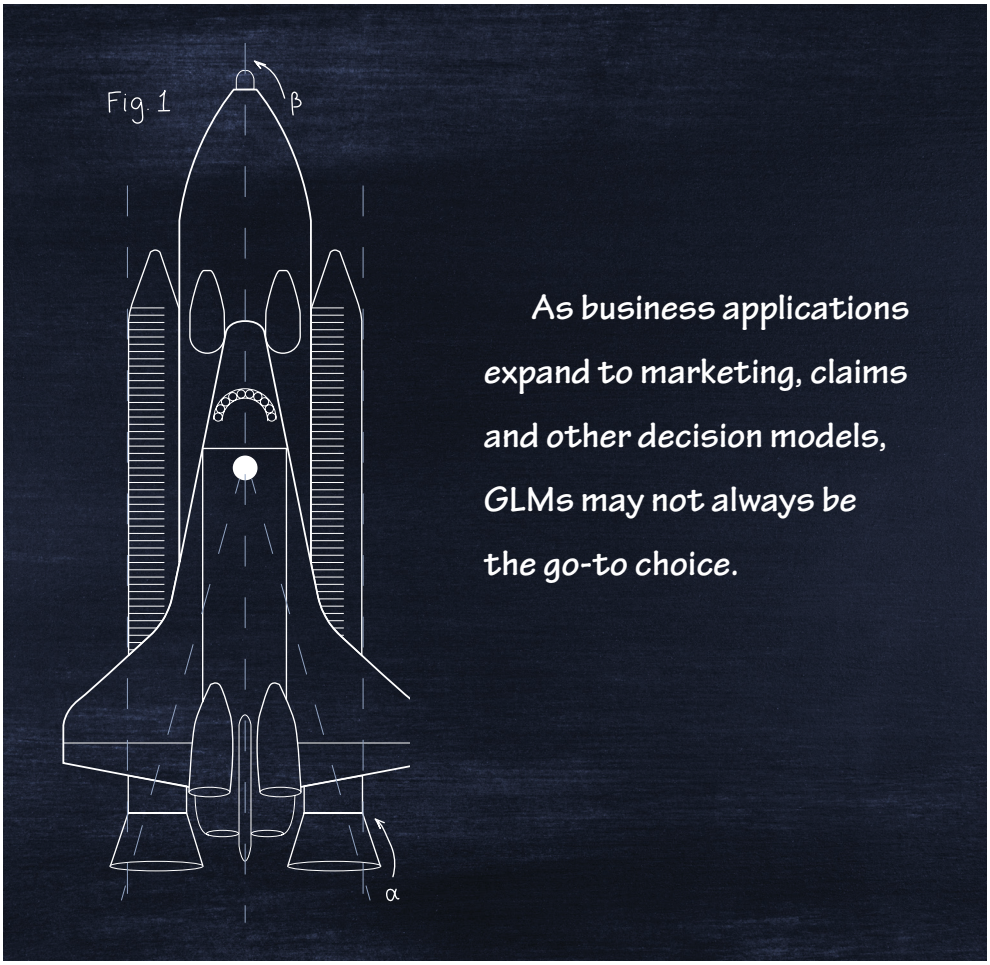
Applying advanced analytics is slowly starting to grow, Guven said. "There are more and more case studies around product teams deploying sophisticated analytics solutions beyond GLMs," he added.

Only three percent of respondents in the Towers Watson survey said they were currently using "other" methods such as vendor products and non-GLM multivariate methods, though greater use is expected. Actuaries "are always testing for potential of other types of models," Kannon said. However, Kannon has yet to observe a lot of models built out that are not GLM being used for actuarial projections.

Advanced analytics, which range from unsupervised models to machine learning, offer several benefits. In general, Guven said, they can provide better accuracy and are more difficult for competitors to copy. Formula-driven algorithms, rather than table-driven ones, can be easier to program in downstream systems.

As business applications expand to marketing, claims and other decision models, GLMs may not always be the go-to choice. "There's no particular reason to stay with GLMs as opposed to other types of models. People often don't — even for pricing models," said Monsour. "There's no compelling reason to use GLMs if you model frequency and severity separately," he added.

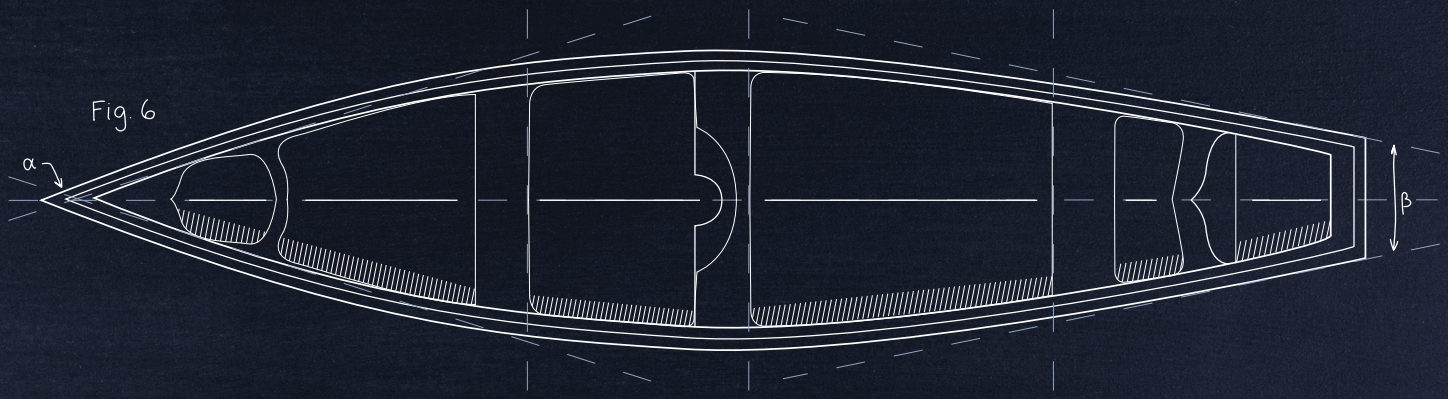
In pricing, there is definitely more experimentation with advanced analytics taking place, Guven said. This is especially true for personal auto and major insurance lines including workers' compensation, commercial auto and businessowners' policies (BOP).



Applying sophisticated models for segmenting markets to improve marketing is also gaining popularity, Mosley said. "This is a fairly hot topic and gaining more momentum," he added.

Such models are being used for looking at the expected likelihood of writing and retaining a client, competitive position and expected market profitability. In the past, Mosley explained, marketing was more judgment-driven, but as more data becomes available, market segmentation is improving.

Unsupervised models



The most frequently cited predictive model by sources is the GBM [gradient-boosting method], which is also called stochastic gradient boosting. A GBM "selects" the right approach by using hold out samples as the primary means of testing to realize the best of different approaches to drop the worst, Guven said.

such as clustering analysis, association discovery, sequence discovery and market basket analysis are also emerging. "There is a movement toward applying unsupervised models that employ clustering techniques to understand the nature of the data and how the data aligns," Mosley said. Guven is seeing greater use of unsupervised models for factor identification and feature selection.

Since unsupervised models do not require a target variable, they are effective for identifying suspicious claim indicators or outliers. Mosley explained that they also are useful for detecting fraud potential, though this approach is not yet widely used.

Learning via Machine

Machine learning, another burgeoning insurance industry predictive model, concurrently applies several different modeling techniques to discover the best answer, Guven explained. This does a better job of identifying data signals compared to GLM and decision trees. There are hundreds of machine-learning models, including neural networks, gradient-boosting methods (GBMs), genetic algorithms and random forests.

"What is new is [that] actuaries are trying more techniques beyond GLM to improve the lift of the claims model," Guven said, "and a small percentage are attempting to optimize machine learning for putting an algorithm out there that can learn on a daily basis as new data comes in."

Willis Towers Watson's survey reports that 12 percent of respondents are using machine-learning techniques with another 43 percent planning to do so in the next two years.

The lift is usually framed in a business context such as closing claims more quickly, improving satisfaction surveys and reducing claims costs, Guven said. Models are supposed to improve the business and the lift in the model is a measure (both prospective and retroactive) of that improvement, he explained.

The most frequently cited predictive model by sources is the GBM, which is also called stochastic gradient boosting. A GBM "selects" the right approach by using hold out samples as the primary means of testing to realize the best of different approaches to drop the worst, Guven said. "The key advantage is it produces more accurate predictions," he added.

Since GBMs can process through different layers of potential variables, Guven said, they help actuaries identify a more homogenous risk segment at a deeper level of sophistication than GLMs.

Brinkmann cites several uses for GBMs. "If you are starting with a blank sheet of paper (for) a new model, there are a lot of new variables to evaluate and GBMs are useful … because they do not have all the assumptions and preprocessing as a GLM does," Brinkmann said. GBMs also can identify new variables or develop new scores that can be used as variables, she added.

Artificial neural networks, generally called *neural networks*, are another form of machine learning that is enjoying greater experimentation. Neural networks are nonlinear models that mimic how the brain works to estimate or approximate[1] functions that can depend on a large number of input variables to answer a question.

They step from layer to layer through a series of models applied from within the different layers, Mosley said, and are

more powerful and flexible than other types of models.

"The ultimate goal is the network helps you, theoretically, more accurately predict the outputs based on the inputs you have," Mosley said. Some neural networks have been used for pricing to an extent, Mosley said, and are also being used for claims triage because of their more flexible structure. These applications, along with retention and conversion analysis, remain in the experimentation phase with limited adoption, he added.

With so many exciting developments in predictive modeling, a model's complexity does not assure its effectiveness for an application. Guven noted that choosing the correct model to use depends on many factors (see sidebar).

[1] https://en.wikipedia.org/wiki/Universal_approximation_theorem

So Many Techniques, So Little Time

With so many models to choose from, actuaries should consider several factors for selecting and working with predictive models.

When it comes to modeling, there are two ways to get a better prediction, explained Peggy Brinkmann, a principal and consulting actuary for Milliman, Inc. "You can try to use a different algorithm and/or add new variables to the model," she said. "My experience is a good variable adds a ton of lift."

Serhat Guven, Willis Towers Watson's P&C sales practice leader for the Americas, recommends that modeling should not be viewed in isolation but rather through the process life cycle. "When you talk about modeling or product decisions, you have to think about it as the spectrum of how it impacts everything." He stressed that "We cannot think of modeling in isolation of everything else."

First there is the foundational component of gathering and collecting data, which must be in good quality and offer a depth of information, Guven said. "It's not just about what you want to do but what data you have available that will shape what modeling techniques you take on," said Jo Ann Kannon, an adjunct instructor at St. Joseph's University. "If you have oodles and oodles of data," Brinkmann said, "there are more options available to you."

Model selection is next. This includes determining the model's goal and understanding the business problem the model is to solve. The modeler's preference and the software also play a role in the decision, said Louise Francis, founder of Francis Analytics and Actuarial Data Mining, Inc.

A simpler model is often preferred when modeling process is first being attempted, Francis said, because it is easier to explain to management and for deployment purposes. For some applications, Guven said, GLMs are still the best approach, as long as actuaries are using robust and quality data, because they are simpler and easier to explain than advanced models.

If management is most interested in accuracy, Francis explained, "They will go with an ensemble (or advanced) model, which requires substantial IT resources especially in the deployment phase."

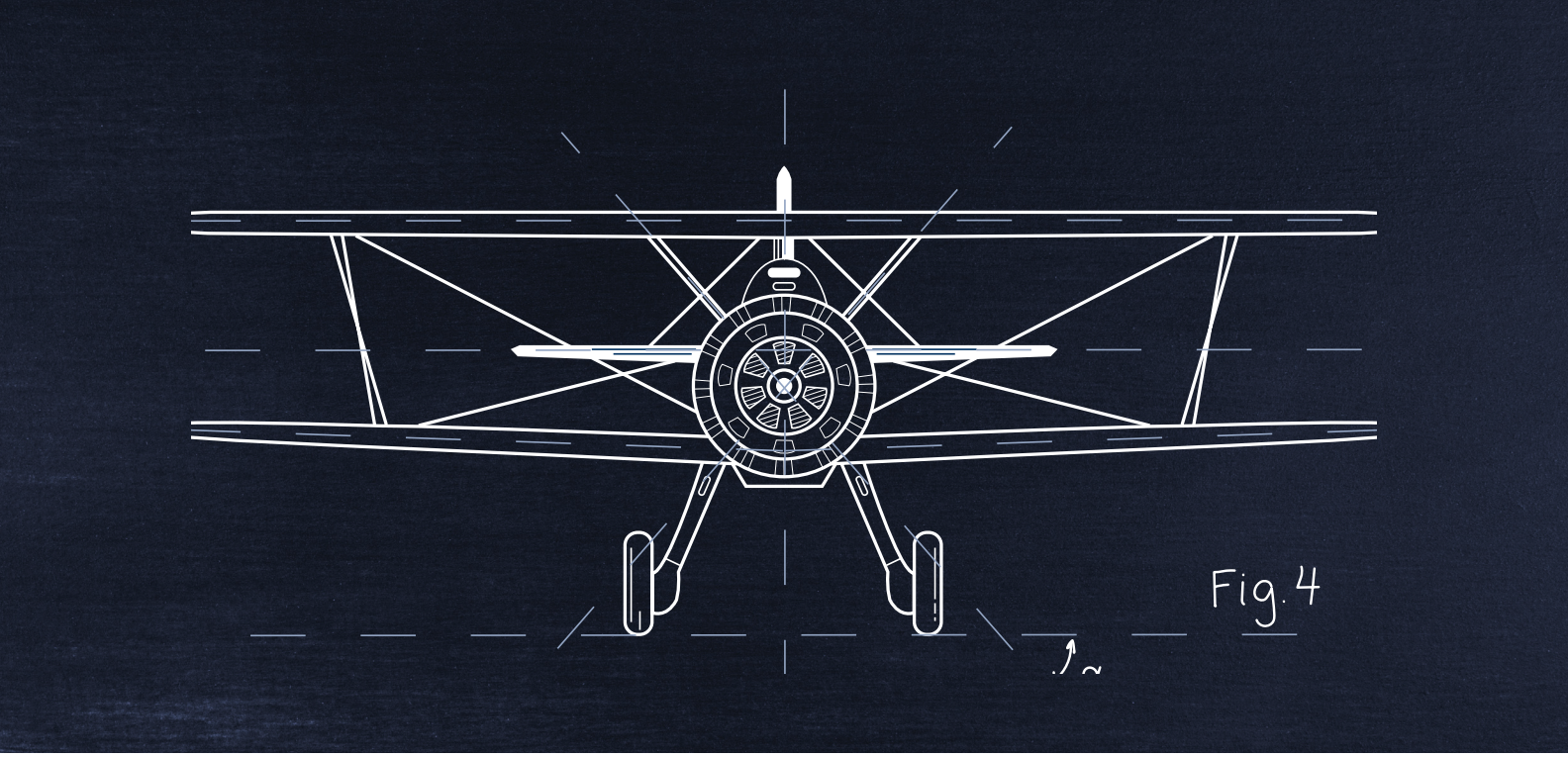
The third step is making a decision from the results. At this point, the question Guven asked is, "Should the product team trust the model wholeheartedly?" Pricing requires more of the expected impact from the model because if it is wrong, there is a lengthier process to change it, which includes regulatory approval. "Contrast this with operational claims models because [they] do not require external approval," he added.

For advanced analytics, the product team needs to weigh the benefit of the added lift compared to the need for transparency, Guven said. Since advanced models are very technical and therefore less transparent, their use can depend greatly on how well the actuary communicates about them.

Finally, there needs to be consideration for how the model will be deployed. "A lot of resources are required," Francis said. "Cost is involved in developing the model and there can be substantial additional cost when you deploy it," Francis said.

"The real innovation requires change management," Kannon concluded.

The cost of the delivery is not just in implementing a model but also should be considered in evolving the model, Guven said. "One of the responsibilities of the actuary is to be able to both prospectively assess and retroactively monitor how the improvement from the models outweigh the costs," he added.



Disadvantages

While approaches beyond GLMs and decision trees are alluring, they also come with downsides, sources said. It takes time and experience to use the proper model that will help make a signal discernible and valuable, said Stephen J. Mildenhall, a professor at St. Johns University's risk management and insurance department. "You are fine-tuning down to quite a granular level," he said, which requires experience to know the difference between an actual signal and a spurious one.

Although advanced analytics are powerful for detecting data noise for the particular segment being modeled, they are not flexible to changes, Guven said. "Formula-driven approaches can be awkward to use when making minor tweaks compared to tabular-driven GLM approaches," he added.

Guven remarked that machine-learning algorithms are not introspective, so they do not indicate why they are generating a bad risk. "The more sophisticated the model, the greater the complexities of the resulting segmentation," Guven said.

For personal automobile insurance, as an example, segmentations of greater degrees make it more difficult to determine what will happen to premium when a customer moves from one segmentation group to another as his or her customer characteristics change. "If you want to stay in your market footprint, (machine learning) can be a great tool," Guven said. "But if you want to grow into new market footprints, machine learning struggles," he observed.

Actuaries have access to more data, more sophisticated techniques and a better infrastructure, but it is essential to communicate a model's purpose and benefits to internal and external stakeholders, Guven said. This is difficult because greater sophistication also makes the reasons behind the results less transparent and harder to explain. "Product teams need to weigh the benefit of the added lift versus the need for transparency," Guven said.

When models are difficult to explain to information technology professionals, implementation can be difficult, Francis said. However, visualization techniques can help explain more complex models, she added.

Conclusion

Thanks to greater data sources, technological improvements and experimentation with modeling techniques and applications, actuaries are venturing into new frontiers of innovation to boost predictive accuracy.

GLM and decision tree applications continue to expand and gain popularity. Advanced analytics promise greater levels of accuracy, yet their complexity is challenging to master and to communicate to users internally and externally.

While predictive modeling experimentation shows great promise, there are other considerations that will affect which strategies will move forward and stand the test of time. The third installment of *Actuarial Review*'s look into the latest in predictive modeling will cover topics including regulation, data ethics and the future data-and-analytics-driven insurer.

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

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Actuaries Explore Emerging Risks and Insurance Coverage Issues for Drones BY BILL DAVIS

The emerging technologies of unmanned aerial vehicles (UAV), also known as drones, is presenting new liability risks and evolving insurance coverage for both the drones and any associated liabilities, attendees at last month's Casualty Actuarial Society's (CAS) Annual Meeting were told. The actuaries heard panelists discuss the UAV issues during a CAS concurrent session entitled "Attack of the Drones."

"There have been a lot of changes, or different regulations, on drones for commercial and private uses," said Carl X. Ashenbrenner, FCAS, principal consulting actuary at Milliman and panel moderator. The Federal Aviation Administration (FAA) just recently put out its regulations on drones, effectively splitting the market into "flying for fun" and "flying for work," Ashenbrenner explained. Flying-for-fun drones have to be registered if they are over 0.55 pounds, must stay at least five miles away from airports and operators have to maintain a visual line-of-sight, Ashenbrenner said, pointing out that the operator is required to register but does not need to have a pilot's license. If used for work, a drone operator must also register and obtain a pilot airman's certificate that requires passing an exam, he stated.

"Drones have a lot of different usages, including agricultural, inspections, architecture, construction, but since there is a visual-line-of-sight limitation, they can't be used for deliveries yet," Ashenbrenner said. The FAA had 300,000 drone registrations during the first 30 days after its regulations were put into place, with commercial sales of the UAVs predicted to grow from 600,000 to 2.7 million, depending on the cost of the drone and accessories. And if a drone crashes, or is involved in an accident, the operator is required to file a report with the FAA.

Igor Pogrebinsky, FCAS, principal-commercial casualty at ISO, outlined potential drone exposures, associated coverage implications, rating and underwriting considerations, as well as some of the coverage options developed by ISO.

The FAA just recently put out its regulations on drones, effectively splitting the market into "flying for fun" and "flying for work," Ashenbrenner explained.

He said that in addition to the FAA regulations, more than 30 states have passed drone related legislation, mostly around safety and privacy issues.

"Drone exposures can be generally grouped into three categories: those related to the drones themselves, those related to drone operators and those related to the drone flying environment," Pogrebinsky said. But since drones are still such a new technology, not all potential exposures have yet been identified, he cautioned.

In the liability area, property damage or bodily injury from a drone crash, as well as defects in drone design and manufacturing, could potentially result in lawsuits, Pogrebinsky pointed out.

Limited data is also a key issue that impacts the pricing of different insurance considerations surrounding the use of drones. "Historical crash information is very limited," Pogrebinsky said. And he warned that drone crashes are likely to become more prevalent as they are more widely used. Drone operator experience and training will likely have a significant impact on the potential for loss, he said.

Among the underwriting considerations, potential issues related to ownership might be an important consideration. Are the drones owned and operated by the insured, or are the drones and operators hired? "For example, if the insured is operating a non-owned drone, what liability, if any, did he assume contractually if the drone malfunctions and crashes?" he asked.

Drone coverage is available in the aviation insurance market and in the standard lines of insurance. "At ISO we developed several coverage options for drones, with some already released and plans for others also in the works," he said. Coverage forms and endorsements that would allow insurers the flexibility to tailor the level of coverage to their risk appetite for drones have been released for ISO's general liability, commercial umbrella and excess, commercial inland marine, commercial property and business owners programs, he said.

Speaking on "Drone Insurance

— The Aviation Market Perspective," Michael Falcone, FCAS, executive vice president for reinsurance, actuarial and compliance at Global Aerospace, Inc., said that while the aviation insurance market represents only one-third of one percent of the worldwide property and casualty insurance market, it has taken the lead in writing drone coverage.

Falcone noted that the biggest exposure for the aviation market is with the vehicles themselves and the potential liability that they can create. The general aviation underwriting skill set translates very well onto the drone side. He also noted that aviation insurers will put up sizeable limits that show their commitment to the drone business.

Falcone also noted that "Drone manufacturers are beginning to seek insurance coverage, because there is a general expectation that there is going to be a lot of litigation in this area as events occur," with manufacturers, in some measure, getting roped in.

The main challenges to the aviation market moving into the drone market, Falcone explained, include handling the volumes while trying to learn how to rate these policies in a more streamlined manner, building the rating models, particularly to cover the many different types of hull vehicles, and exploring distribution channels as much of this business will not be coming in through the specialist aviation brokers.

Falcone concluded that while drone regulations are still evolving and the future of drones is still not completely seen, when drones start operating properly and autonomously in the airspace, the insurance market will continue to evolve and provide new challenges and opportunities for insurers.

William J. "Bill" Davis is a regional representative for the Insurance Information Institute, responsible for III activities in a number of southeastern and south central states. Prior to joining the Institute in 1982, he served as a regional manager of corporate communications for United Airlines, as a city government public information officer and as a radio and TV news reporter and anchor.

Actuaries Delve into Opportunities and Risks to Insurance Industry from Automated Vehicles BY BILL DAVIS

The impact of automated vehicles on society and the insurance industry presents opportunities as well as risks, members of the Casualty Actuarial Society were told at the group's recent 2016 Annual Meeting in Orlando, Florida. The general session "Automated Vehicles: For Whom the Bell Tolls?" explored the subject from the auto industry's perspective and the implications for insurers and actuaries dealing with the automated vehicle market's projected growth.

Giving the automobile industry's view, Matthew Carrier, ACAS, principal at Deloitte Consulting, LLP, listed a number of forces that are driving the changes: continuing advances in battery and fuel cell technology, as well as GPS technology. "These things are becoming cheaper and more cost effective, as well as the vehicles' ability to communicate with each other and the infrastructure," he said.

Although autonomous vehicles are not yet ubiquitous, Carrier noted that it's only a matter of time until they become available on a wide scale. Looking at this kind of transformation, there are two points of view that can be taken: (1.) an insider view that there won't be a dramatic change but a small, natural evolution in the major companies that produce vehicles, and (2.) a disruptive view that there will be big changes that may not unfold in a year, or even over 10 or 15 years, but they will make a significant impact on travel.

"The big questions are how fast is the change going to happen, when is it going to happen and to what magnitude is it going to happen; all of which are open to debate," Carrier said. "I don't think there's any doubt that change is coming," he added.

This involves a $2 trillion "ecosystem," with the big players being the auto manufacturers, the suppliers, fuel and the financial and insurance components; but, one area that isn't as widely discussed is the public sector and tax revenue — licensing fees and road tolls, Carrier said. All of those components generate revenue for government entities and, as the dynamics shift, they are going to have to replace that revenue stream in a different fashion, he noted.

Panel moderator David Cummings, FCAS, who is senior vice president of insurance operations and analytics at ISO Solutions, said that many senior insurance company officials have long taken the long view but now are starting to shift in their views. Senior leadership understand that automated vehicles are somethings they really need to be concerned about as one of the more interesting and significant emerging issues.

From the insurance perspective, consumers are interested in knowing the discount they will receive when purchasing an automated vehicle, said Jonathan Charak, FCAS, assistant vice president and actuary–operations lead for Zurich North America. Charak is also vice chair of the CAS Automated Vehicle Task Force.

"If we overprice automated vehicle insurance, we can make this life-saving technology actually unaffordable to some consumers, which is obviously not what we want to do," said Charak. "But … we don't want to underprice it and force a cross-subsidy from the standard vehicle insurance market," he said.

The industry and actuaries really need to understand whether pricing models actually work now for this new technology or if a complete paradigm shift is in order, where insurers must rebuild current models work for pricing auto insurance, he said.

"Calculating the liability costs involved with automated vehicles is an extremely complex process … with many costs that need to be taken into account. But whatever decisions are made, I believe it is very important that actuaries, the insurance industry and people who know how to quantify the risks will be at the table with the people who are making those liability decisions, so this technology will not be hindered by a system that may not make the most sense," he concluded.

Michael Stienstra, vice president & actuary at Chubb and chair of the CAS Automated Vehicles Task Force, agreed with Cummings on the immediacy of the risk for insurance companies. He cautioned against focusing on using personal automobile loss costs as an indicator for when the industry will be impacted. A long adoption curve, severity increases and exposure changes — such as an increase in distracted driving or miles driven — can offset and delay any impact safety-enhancing advanced technology has on personal automobile loss costs.

Instead, Stienstra argued that the industry will be affected first by capital shifts away from the personal auto insurance market. Even if the first fully automated vehicle can only operate in a single city and is introduced in the early 2020s, with a personally owned, fully automated vehicle following 10-15 years later, the industry could begin undergoing changes in the next few years. The expectation of an eventual change in liability, from personal automobile insurers to commercial insurers or even auto manufacturers, might force personal automobile insurers into new markets to reduce their reliance on automobile insurance premiums. As the new entrants chase premium, established players may see margins deteriorate. In this way, Stienstra noted, automated vehicles' impact can be widespread and can be felt well before automobile loss costs begin to change.

Diversity and Inclusion Initiatives are Key to Employee Recruitment and Retention BY BILL DAVIS

Diversity and inclusion initiatives have become increasingly important to strengthening employee retention and engagement, boosting recruitment and fostering innovation, according to a panel of company representatives who shared their views on diversity in the insurance industry at the 2016 CAS Annual Meeting in November.

The panel emphasized how cultivating diverse actuarial and analytic units within organizations improves financial performance and supports more effective communication and collaboration across functional areas.

Panel moderator Alejandro Ortega, FCAS, a former regional and chief actuary with AIG Latin America, outlined reasons for making diversity an important part of the industry conversation. Ortega pointed out that the number of women joining the CAS has grown over the decades, but that growth has leveled off in recent years. He reported that in the 1970s, only about 10 percent of the CAS's new members were women; in the 1980s, women made up about 20 percent of new CAS members; and in the 1990s, the number of women becoming

CAS members was up to 30 percent. "It has gone up to about 35 percent by the middle of last decade," Ortega said, "but it has maintained that level for the last 10 years."

Ortega also pointed out an area of membership that needs more growth. While the number of Hispanic and African-American members is larger than it used to be, he said, the figures continue to be low. These low numbers are the reason that the profession needs to find ways to increase diversity.

Kofi James, senior actuarial associate with New York Life Insurance, spoke about the importance of CAS leaders continuing to champion diversity efforts and support them with funding. "We want to represent people from multiple classes or groups, including groups that have been traditionally well represented in our profession ... by finding exceptional talent wherever it exists," James said.

Developing more relationships with math and science professors and making them aware of the actuarial profession can result in recruiting more high-performing math and science students to the actuarial profession, James explained. "It's going to take ... playing the long game by building relationships with institutions, building relationships with students — so, if something doesn't work immediately, you can't view it as a failure," Kofi said.

Seeing diversity reflected in executive and management positions can signal to current and potential employees that the company is truly invested in having diverse influence, James said. "Senior leadership also needs to actively participate in diversity initiatives by committing resources," he added.

Diversity isn't just good business, said panelist Kelly Lewis, FCAS, second vice president and actuary at The Travelers Companies Inc. Employees at diverse companies are going to innovate more and make better decisions, form stronger relationships and have more overall success. Companies that can create a culture in which all unique abilities are valued and all employees feel that their opinions matter are going to be at an advantage.

Companies that can create a culture in which all unique abilities are valued and all employees feel that their opinions matter are going to be at an advantage.

Lewis spoke about a program at Travelers called Diversity Networks, which are voluntary organizations that are open to all employees and help foster a diverse and inclusive work environment. Each Diversity Network has a senior leader who serves as the executive sponsor. These Diversity Networks can be vital for retaining and developing successful employees, Lewis said.

Kieran Welsh-Phillips, a manager at the actuarial recruiting firm of D.W. Simpson, touched upon some of the trends and challenges in recruiting diverse talent. "We're seeing more and more companies making the effort to attract and retain diverse talent with a two-fold goal of not just ... getting them in the door, but also ... making sure they'll stay with the organization," she said. Welsh-Phillips is observing more companies, usually larger ones, with full diversity and inclusion (D&I) teams. Smaller firms are also committing to have D&I teams.

She spoke about employee resource groups and their efforts to ensure that a company can retain diverse talent through support and career development. Companies are also becoming more active in actuarial groups and are reaching out to area universities to inform students about the actuarial profession.

Although there's been an increase in companies looking for diverse talent, companies are still focusing on years of experience, exams or designations, product exposure and actuarial skills-sets, Welsh-Phillips noted.

Mary Gibbon, FSA, senior consulting actuary at Willis Towers Watson, ended the session with an examination of "unconscious bias." "With 11 million pieces of information coming at you every minute," said Gibbon, "the only way you can deal with all that information is to have some unconscious processes that take it all in and leave you with 40 or 50 pieces that you pay conscious attention." We have to be aware of bias, so we can shift our unconscious bias and lessen it in our everyday lives, Gibbon said.

Gibbon also pointed to evidence that diversity breeds success. "Companies that have significantly more women in leadership positions perform better financially," she stated.

In addition, with one baby-boomer retiring every nine minutes, Gibbon said that there isn't a skilled talent pool to back-fill — unless there is an effort to go other parts of the world to bring skilled talent into the insurance business.

EXPLORATIONS BY STEPHEN MILDENHALL

The Coming Revolution in Actuarial Modeling — Election Day Lessons for the Predictive Data Analyst

In November, Late Last Year …

Kim Hypothetical, FCAS, is a pricing actuary in the Large Accounts department at Hypothetical Insurance (no relation). It is just before lunch. Kim wonders, "Is traditional actuarial work the best choice for me? Maybe I should be a predictive modeler." Kim makes a note to investigate the new iCAS credential …

Hypothetical's Chief Enabler of Opportunities walks over to Kim's tiny open-plan solution conception pod. A rush project has just come in from their favorite broker at Gal Benmeadow. Lectral College, a large claims administration client of Gal's and Hypothetical's, is worried about its aggregation risk. Lectral has locations in every state and a substantial total exposure. The broker wants to structure an aggregate stop loss attaching "in the middle of the distribution." Good news: The account has wonderful data, some of it stretching back to the Declaration of Independence — although it may not all be relevant today. The CEO asks Kim to work up some numbers to review before the end of the day.

Over lunch, Kim ponders the assignment. Straightforward. The claim history will be enough to build a frequency and severity model. The frequency of claims: Poisson. Trend and develop historical losses; use Kaplan-Meier to handle limited claims and fit an unlimited severity distribution. Then frequency-severity convolution applying the prospective limits profile. Throw in the Heckman-Meyers method to impress the CEO, Kim thinks. No need to change my dinner reservation, I will be done before six. The hardest part will be translating what the broker meant by "in the middle of the distribution."

Back at the solution conception pod, Kim opens the submission and begins investigating the data. It is true there is an extensive claims history; Kim cannot recall having seen better data. A couple of clicks and Kim has a summary of historical claim frequency by state. It turns out Lectral has only one location per state, and almost all of its locations have had a claim at one point or another. There are so many years of data it is hard to know how much of the data to use. Kim settles on using losses since 1972.

Claim severity contains a surprise. Lectral's losses are all full-limit losses. There is just a single partial loss in the history, in 2008, and that was a small loss. I can think of it as a stated amount policy, Kim thinks. That will simplify the analysis. The broker has even provided a prospective limit profile, which can be used in place of severity. Dinner's a lock, Kim thinks.

Kim summarizes the probability of loss p_s and the stated-amount l_s for each state s (Table 1). Aggregate losses $L=\sum_s l_s B_s$ where B_s is a Bernoulli random variable with parameter p_s. Kim's first thought is to simulate the distribution of L, but then Kim has a better thought: fast Fourier transforms.

With a few lines of Python, Kim writes a function *agg* taking inputs p_s and l_s and returning the full distribution of losses.

After less than an hour on the project, Kim has the full distribution of aggregate losses (Figure 1, Table 2) and is ready to price whatever structure the broker proposes. The mean loss is just above the midpoint. In fact, there is a 77.1 percent chance of a loss greater than 50 percent of the aggregate limit. Next step: Review with the CEO.

Hypothetical Insurance prides itself on its sophisticated pricing methods. It is particularly proud of its profit load algorithm, the PLA. The PLA was developed by a famous actuary many, many years ago. Central to the PLA is the idea of splitting account-level risk into process and parameter risk components and charging separately for each. Hypothetical believes all risk should be compensated and even applies a charge to process risk, unfashionable though that may be. The CEO likes to point out that Hypothetical was spared a New Zealand earthquake loss by the PLA-enforced pricing discipline. Rating agencies are impressed with its risk management. In line with modern financial thinking, Hypothetical also understands systemic parameter risk is more significant and so it is given a much larger weight in the PLA.

Table 1: Loss Severity and Chance of Loss by State for Lectral College

State	Loss	Chance
Alaska	3	0.231
Alabama	9	0.002
Arizona	11	0.257
Arkansas	6	0.005
California	55	0.999
Colorado	9	0.721
Connecticut	7	0.950
Delaware	3	0.900
Dist. Of Columbia	3	0.999
Florida	29	0.475
Georgia	16	0.169
Hawaii	4	0.990
Idaho	4	0.007
Illinois	20	0.979
Indiana	11	0.021
Iowa	6	0.268
Kansas	6	0.021

State	Loss	Chance
Kentucky	8	0.003
Louisiana	8	0.005
Maine	4	0.773
Maryland	10	0.999
Massachusetts	11	0.998
Michigan	16	0.759
Minnesota	10	0.808
Mississippi	6	0.016
Missouri	10	0.029
Montana	3	0.032
Nebraska	5	0.015
Nevada	6	0.486
New Hampshire	4	0.609
New Jersey	14	0.961
New Mexico	5	0.813
New York	29	0.997
North Carolina	15	0.482

State	Loss	Chance
North Dakota	3	0.002
Ohio	18	0.327
Oklahoma	7	0.001
Oregon	7	0.914
Pennsylvania	20	0.741
Rhode Island	4	0.914
South Carolina	9	0.103
South Dakota	3	0.051
Tennessee	11	0.018
Texas	38	0.044
Utah	6	0.027
Vermont	3	0.977
Virginia	13	0.817
Washington	12	0.968
West Virginia	5	0.002
Wisconsin	10	0.774
Wyoming	3	0.008

Table 2: Distribution of aggregate losses *L* from the base model, showing Pr(*L*≥270)=77.1%, and the revised distribution *L'* with mixing, showing Pr(*L'*≥270)=65.1%.

l	Pr(*L*=*l*)	Pr(*L'*=*l*)	Pr(*L*≥*l*)	Pr(*L'*≥*l*)
210	0.00011	0.00228	99.9%	94.2%
220	0.00038	0.00306	99.7%	91.5%
230	0.00112	0.00400	98.9%	87.9%
232	**0.00119**	**0.00401**	**98.7%**	**87.1%**
240	0.00272	0.00506	97.2%	83.5%
250	0.00529	0.00603	93.4%	78.1%
260	0.00877	0.00695	86.9%	72.0%
270	**0.01185**	**0.00745**	**77.1%**	**65.1%**
280	0.01398	0.00774	64.5%	57.8%
290	0.01391	0.00738	50.5%	50.2%
300	0.01383	0.00769	36.4%	42.6%
310	0.01140	0.00712	23.9%	35.2%

The CEO reviews Kim's exhibits. "Full marks for working efficiently and nice use of the FFT! I'm glad you saw so quickly you do not need to worry about severity — I forgot to mention that to you. But what about the risk loading?"

Kim is annoyed. How could I have forgotten about the risk loading? Think fast!

"It is predominantly process risk. Clearly there is no claim severity risk: It is a stated amount policy. But each state uses a Bernoulli variable for claim occurrence, so the process risk of the Bernoulli coin toss swamps out any parameter risk."

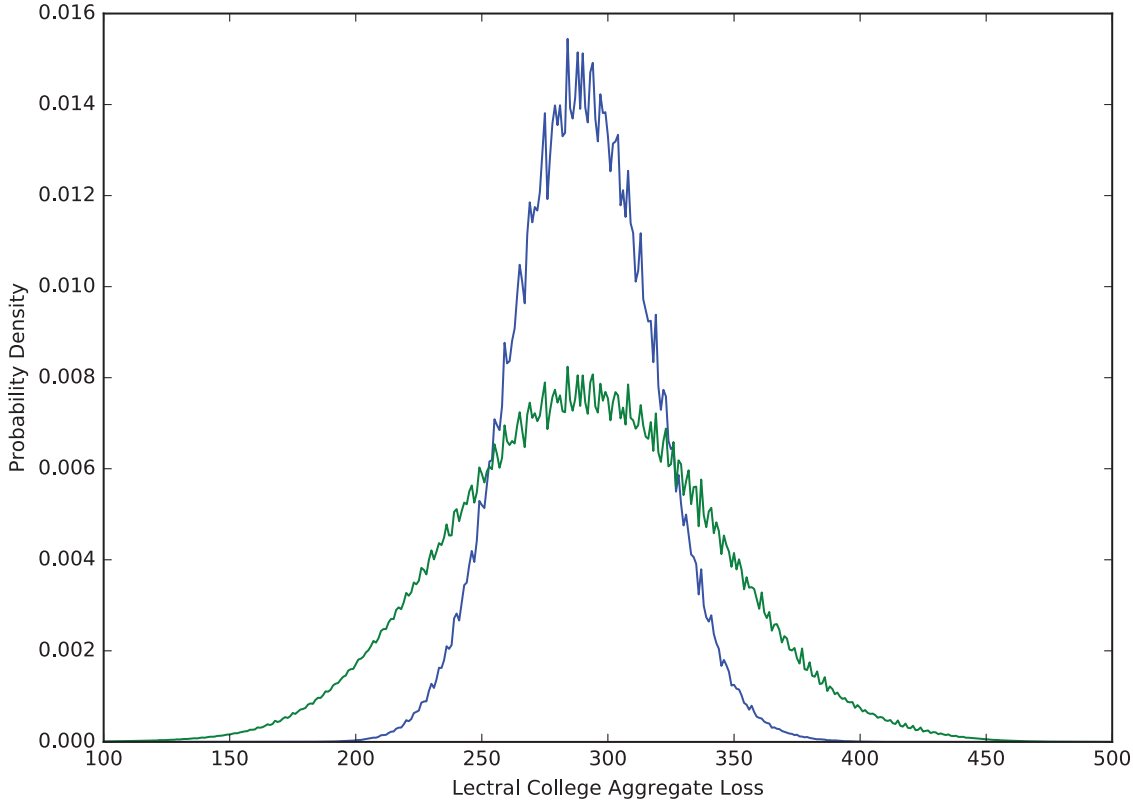
"But what is the parameter risk? How did you come up with these probabilities?" asks the CEO. Kim's next step: Build a model of the state-by-state probabilities p_s to provide the inputs for the PLA. Maybe I should become a predictive modeler, Kim thinks for the second time that day.

Poring through reams of historical state-level data, which the broker had conveniently scanned into PDF format from the original spreadsheets, Kim creates a one-parameter model for each state and estimates the parameter $\hat{\theta}_s$, $0 \le \hat{\theta} \le 1$. The data shows $\hat{\theta}_s$ is related to the experience-based loss probability p_s. When $\hat{\theta} < \theta_r$ then p is very small and there is no claim. When $\hat{\theta} > \theta_d$ then p is close to 1 and there is a claim. In between is a gray area. The data shows $\hat{\theta}_s > 0.5$ generally corresponds to a claim. The data indicates values $\theta_r = 0.40$ and $\theta_d = 0.60$ and even suggests the form of the S-functions linking $\hat{\theta}$ to the probability of a claim.

Kim's state-by-state models provide an explicit quantification of parameter risk because they provide estimated residual errors $\hat{\sigma}_s$ for each state. Kim is pleased. But the $\hat{\theta}_s$ values for most states fall in the critical range $[\theta_r, \theta_d]$, indicating parameter risk is important for the proposed Lectral cover. Kim turns back to the data.

Kim notices there is a postmortem analysis after each loss included in the submission. It contains more accurate measures of the variables Kim used to estimate $\hat{\theta}_s$. With enough effort and enough money, the new information could have been known *prior* to the loss, and so it seems reasonable to use it in the model. Kim recalculates each model parameter with the more accurate input

Figure 1: The original *L* (blue) and revised *L*' (green) probability densities for the Lectral College's aggregate losses computed using FFTs.



variables, getting $\bar{\theta}_s$.

Hello, predictive modeling nirvana: By using $\bar{\theta}_s$, the model has become perfectly predictive! In every case, for every state and every year, when $\bar{\theta}_s$>0.5 there is a claim, and otherwise not. Once computed using the best possible information, the relationship between $\bar{\theta}_s$ and p_s is a step function: $p_s=R(\bar{\theta}_s)=1$ if $\bar{\theta}_s$>0.5 and $p_s=R(\bar{\theta}_s)=0$ if $\bar{\theta}_s$<0.5. Kim is relieved that a value $\bar{\theta}$=0.5 has never been observed but is not surprised since all the variables are continuous. (Kim passed measure theory in college.) Time is passing and Kim needs to get back to the CEO. Next step: how to build in parameter risk?

I have an unknown parameter θ_s for each state that perfectly predicts loss, Kim thinks. I have a statistical model estimating θ_s: $\theta_s=\hat{\theta}_s+\hat{\sigma}_s Z_s$, where Z_s is a standard normal. Hence $\hat{\theta}_s$ is unbiased. I know there is a claim when, and only when, the true parameter θ_s>0.5. Therefore using the results step function, I can account for parameter risk by modeling with $\hat{p}_s=E(R(\theta_s))=\Pr(\hat{\theta}_s+\hat{\sigma}_s Z_s>0.5)=\Phi((\hat{\theta}_s-0.5)/\hat{\sigma}_s)$. The probability of dinner on time just increased sharply: The new $\hat{p}_s$ agree almost exactly with the original experience-based p_s.

Kim can go back to the CEO and report that the original model included parameter risk all along! And the results are the same. Just the interpretation needs to change.

In the original interpretation, the model flipped a coin with a probability p_s of heads for state *s* and then called a claim on heads. The risk was all in the coin flip: It was all process risk.

In the new model, the coin for each state is either heads on both sides (a claim) or tails on both sides (no claim). There is no coin-flip risk. Based on the estimate $\hat{\theta}_s$, Kim has a prediction about each coin: $\hat{\theta}_s$>0.5 corresponds to a claim and $\hat{\theta}_s$<0.5 corresponds to no claim. When $\hat{\theta}_s$>0.5, then Kim believes that the true θ_s is also greater than 0.5 (because $\hat{\theta}_s$ is unbiased) and that there will be a claim. Kim's confidence that the true θ_s is greater than 0.5 is $p_s=\Phi((\hat{\theta}_s-0.5)/\hat{\sigma}_s)$>0.5. And when $\hat{\theta}_s$<0.5, Kim has confidence 1-p_s>0.5 that the true θ_s<0.5 and that there will not be a claim. If σ_s=0, then the predictions would all be perfect and all the risk disappears. For very large σ_s, the predictions are useless and the model has the same risk as the old coin toss model; but the new model has converted process risk into parameter risk.

If we could replicate the experiment many times then, obviously, the claims *experience* would be the same each time — there is no uncertainty in the coin toss when the coin has the same face on both sides! But the *predictions* would vary with each experiment and each state would be called correctly a proportion $\hat{p}_s$ of the time. Where the old model would say, "There is an *x* percent chance the total loss will be greater than *l*," the new model says, "I am *x* percent confident the total loss will be greater than *l*." Kim feels ready to review with the CEO.

The CEO looks over Kim's new workpapers. "These look very similar to your original analysis."

"That's true," Kim replies. "Except now I see all of the risk in the cover is parameter risk and none of it is process risk. PLA indicates a far higher risk load." Kim explains to the CEO how the meaning of the parameters has changed.

"Excellent work!" The CEO ponders a moment longer. "There's still one thing bothering me. I understand you are modeling $\hat{p}_s$ as an expected value to allow for uncertainty in the estimate of θ_s, but you have treated each state independently. We need the full distribution of aggregate losses, which will depend on the multivariate distribution of all the estimates $\hat{\theta}_s$. How are you accounting for possible dependencies between the $\hat{\theta}_s$?"

A crestfallen Kim contemplates canceling dinner. How could I have forgotten correlation?

Kim knows statistics could help give a multivariate error distribution, but Kim modeled each state differently. The $\hat{\theta}_s$ were not produced from one big multivariate model. Different combinations of variables were used to model each state; some of the variables are common across all states, but many are not. Theoretic statistics will not provide an answer.

Kim realizes a mixing distribution is needed. The presence of some common variables in each state model indicates there may be underlying factors driving correlation between the estimates $\hat{\theta}_s$. Kim decides to model uncertainty as though it were perfectly correlated between the states. That means modeling losses with $\hat{\theta}_s+T$, where T is a normally distributed, shared-error term.

In a few more lines of Python code, Kim extends the original *agg* program to allow for perfectly correlated errors, producing the revised columns in Table 2 and the revised green density in Figure 1. The probability of a loss greater than 50 percent of the aggregate limit has dropped from 77.1 percent to 65.1 percent. "Wow! Quite a difference," Kim notes. The new aggregate density has a higher standard deviation. The aggregate stop loss looks more promising.

Kim realizes there is a real chance of executing a profitable deal and goes off for a last meeting with the CEO that day in a more upbeat mood. It was

worthwhile spending the time to understand the modeling of the Lectral College account. After all, bonuses depend on executing profitable deals.

Adding the E and the O

Kim has, of course, been modeling the **E**lect**o**ral College. Variations on Kim's original model, which produced a 77.1 percent chance of a Clinton victory, were common prior to November 8. Poll-related headlines were overwhelmingly about the high probability of a Clinton victory. A *New York Times*[1] article from November 10 said:

> Virtually all the major vote forecasters, including Nate Silver's FiveThirtyEight site, *The New York Times* Upshot and the Princeton Election Consortium, put Mrs. Clinton's chances of winning in the 70 to 99 percent range.

Table 1 shows the state-by-state probabilities of a Clinton victory ("chance" columns) on Sunday morning, November 6, as reported by FiveThirtyEight. These probabilities correspond to the p_s in Kim's model. The "loss" columns correspond to the number of Electoral College votes. FiveThirtyEight[2] quoted a 64.2 percent chance of Clinton winning — very close to the 65.1 percent estimate from Kim's revised model. The exact calibration of the base and revised models will be described in a forthcoming online *E-Forum* article.

What is missing from Table 1 are the actual proportions of voters intending to vote for Clinton, the values $\hat{\theta}_s$ from Kim's model. The relation between p and θ turns out to be the model's weak link — it is very sensitive around the critical 50/50 mark. Actual election modelers had enough information to estimate the relationship and should have been attuned to the sensitivity. Kim's postmortem θ is obviously the actual proportion of Clinton voters in each state, which, with heroic effort, could have been known (just) prior to the election.[3]

There are at least two arguments for using a mixing distribution as Kim did. First, there was the possible reticence of Trump supporters to publicly affirm their candidate; these supporters may have been systematically hard for pollsters to find. And second, there was a miss overall in the polling. *The Economist*, in the article "Epic Fail," wrote:

> As polling errors go, this year's misfire was not particularly large — at least in the national surveys. Mrs. Clinton is expected to [be] … two points short of her projection. That represents a better prediction than in 2012, when Barack Obama beat his polls by three.[4]

These comments are consistent with Kim's revised model. The actual outcome, with 232 votes for Clinton, is the 13th percentile of the outcome distribution (Table 2). It was the 1.3 percentile for the base model.

There are a number of important lessons for actuaries in how the election was modeled and how the results were communicated. Here we will focus on the communications issues. The more technical modeling issues will be discussed in the companion *E-Forum* article.

Communicating Risk

In our post-truth world,[5] we must remember that words have consequences; they influence behavior and outcomes.

Unfortunately, the goal of simple and transparent communication rarely aligns with a compelling headline. And "Election Too Close to Call: Get Out and Vote!" is not a compelling headline. On November 6, polls showed Clinton with a total of 273 Electoral College votes in states where she led (Table 1) — almost the thinnest possible margin. After "sophisticated modeling," her thin lead turns into a far more newsworthy 77 percent probability of winning. I think most readers would be surprised that Clinton's 80-90 percent probability of victory was balanced on a point-estimate of just 273 votes.

Headlines such as "273 votes …" and "80 percent …" are consistent with

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[1] "How data failed us in calling an election," http://www.nytimes.com/2016/11/10/technol-ogy/the-data-said-clinton-would-win-why-you-shouldnt-have-believed-it.html

[2] http://projects.fivethirtyeight.com/2016-election-forecast/, accessed November 6, 2016.

[3] Modeling a social phenomenon is always difficult because the system reacts to how we understand it. Press reports claiming "Clinton victory certain" paradoxically *increase* doubt about her victory by changing the behavior of voters. We have seen a similar phenomenon in the housing markets and dot-com stocks: Once people believe the prices can only go up they buy at any price and create an environment where a crash is inevitable. Trying to model these intricacies is beyond the scope of the paper. In spirit, in a simplified world, where voters know their own minds in advance of visiting the polling stations, θ could *theoretically* be determined somewhat in advance of the actual election. We are also ignoring third-party candidates.

[4] "How a mid-sized error led to a rash of bad forecasts," http://www.economist.com/news/united-states/21710024-how-mid-sized-error-led-rash-bad-forecasts-epic-fail, *The Economist*, November 12, 2016.

[5] **Post-truth** *adj*. Relating to or denoting circumstances in which objective facts are less influential in shaping public opinion than appeals to emotion and personal belief:

"In this era of post-truth politics, it's easy to cherry-pick data and come to whatever conclusion you desire."

"Some commentators have observed that we are living in a post-truth age."

Post-truth was named 2016 word of the year by Oxford Dictionaries (https://en.oxforddictionaries.com/definition/post-truth).

the facts, yet they paint different pictures in readers' minds and could drive different actions by registered voters. They are headlines with consequences in the real world. The analysts who created them have an obligation to ensure they are fair and accurate — though, unlike actuaries, they have no professional standards to ensure they do.

The more newsworthy "80 percent" headline paints a deceptive picture. Its precision is designed to impress yet destined to mislead. The fragility of the underlying model is exactly the same as the fragility plaguing the models of mortgage default used to evaluate CDOs and CDSs: unrecognized correlations. Have we learned nothing from the financial crisis?

Actuaries write headlines about risk. We have a responsibility to ensure our headlines communicate risk completely, that our models reflect what we know and what we do not know, and that the sensitivities of our conclusions are clear. These are important considerations: Our results will be relied upon by users and will influence behavior — the ASOP requirement for an actuarial report. We must avoid misleading those who rely on our work. The first required disclosure in ASOP 41, "Actuarial Communications,"[6] concerns uncertainty or risk:

> The actuary should consider what cautions regarding possible uncertainty or risk in any results should be included in the actuarial report.

The standard also requires a clear presentation:

> The actuary should take appropriate steps to ensure that each actuarial communication is clear and uses language appropriate to the particular circumstances, taking into account the intended users.

Many, perhaps most, headline reports were not consistent with these requirements. We will never know if the misleading presentation of the election had an impact on the result, though it is possible.

Back Story

I teach a risk management course at St. John's University in New York called "Applications of Computers to Insurance." On the Monday before Election Day, the class used VBA to program a simple Monte Carlo model to produce a histogram of potential election outcomes, similar to those being reported in the press, and the same as Kim's first model. We then estimated the probability of Clinton winning and left over-confident in a Clinton victory. The article you have just read is the result of my attempts to understand what was actually going on. I think the full story turns out to have important lessons for actuaries as we pivot to a predictive modeling perspective on risk.

Stephen Mildenhall, FCAS, FSA, MAAA, CERA, is an assistant professor in the School of Risk Management, Insurance and Actuarial Science at St. John's University in New York. He was previously global CEO of analytics for Aon plc, based in Singapore, and head of Aon Benfield Analytics. Prior to joining Aon, he worked at Kemper Insurance and CNA Insurance. He is a new contributor to the AR *Explorations team, which is made up of Glenn Meyers, Jim Guszcza and Don Mango.*

[6] http://www.actuarialstandardsboard.org/asops/actuarial-communications/

Actuaries Climate Index Launched BY MIKE BOA, CAS CHIEF COMMUNICATIONS OFFICER

Index Measures Changes in Extreme Weather Events and Sea Level

The Casualty Actuarial Society, along with other organizations representing the actuarial profession in the United States and Canada, launched the Actuaries Climate Index™ (ACI), which provides a quarterly measure of changes in extreme weather events and sea levels. The ACI is available online at ActuariesClimateIndex.org.

The ACI was developed by the Climate Change Committee, which is a joint effort of the CAS, American Academy of Actuaries, Canadian Institute of Actuaries and Society of Actuaries.

The index is based on analysis of quarterly seasonal data for six different index components collected from 1961 to winter 2016, compared to the 30-year reference period of 1961 to 1990. The educational tool was designed to help inform actuaries, public policymakers and the general public about climate trends and their potential impact.

The ACI looks at the continental United States and Canada, placed into 12 different regions. Higher index values indicate an increase in the occurrence of extreme weather events. The latest ACI values show an increase in the impact of extreme weather events, such as high temperature, heavy precipitation and drought.

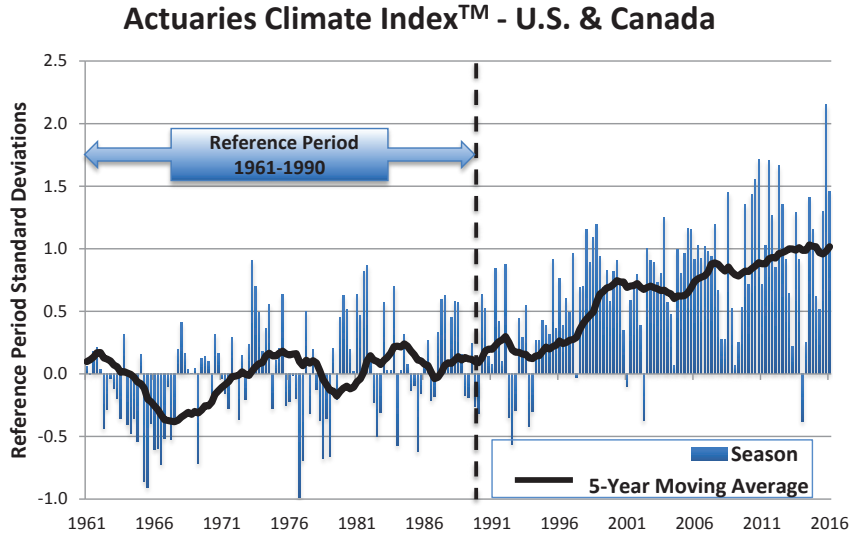
The risk that the ACI measures is relative to the average frequencies during the reference period of 1961 to 1990, which have an index value of 0.0. The data is from neutral, scientific sources that generate objective, evidence-based results on extreme weather events. According to the data analysis, 1.02 is the current five-year moving average value for the ACI. The index value remained below 0.25 during the reference period, reached a value of 0.5 in 1998, and first reached 1.0 in 2013.These values indicate a sustained increase in the frequency of extreme weather occurrences and changes in sea levels.

"Actuaries are experienced in the assessment and mitigation of the financial consequences of risk," said Doug Collins, chair of the Climate Change Committee. "We have developed the index for analyzing the climate."

ACI values for the most recent periods show:

- For the U.S. and Canada combined, the value for winter 2016 was 1.46, the sixth highest level below the peak reached in the fall of 2015. The high value was caused primarily by high temperatures in the northeastern U.S. and eastern Canada as well as heavy precipitation in many locations.
- The current highest five-year average values by region are in the Northwest Pacific (British Columbia and Yukon Territory), Northeast Atlantic (New Brunswick, Newfoundland and Labrador, Nova Scotia, Prince Edward Island) and Southern Plains (Kansas, Montana, North Dakota, Nebraska, Oklahoma, South Dakota, Texas and Wyoming).

Updates for values will be posted quarterly on ActuariesClimateIndex.org as data for each meteorological season becomes available. The organizations are also developing a second index, the Actuaries Climate Risk Index (ACRI), which will measure correlations between changes in the frequency of extreme events as measured by the ACI and economic losses, mortality and injuries.



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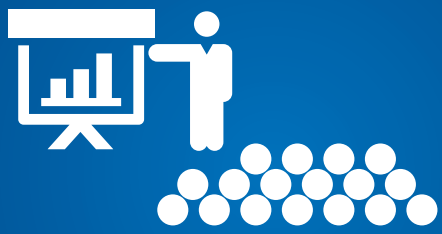

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IN MY OPINION BY JEFFREY BAER

The Toll of the Polls: An Actuary's Perspective

Like many election watchers, I was shocked by the results of the 2016 U.S. presidential election. After reading article after article trumpeting Hilary Clinton's lead in the polls, and reviewing reputable Election Day forecasts that proclaimed a 99 percent probability of a Clinton victory, who can fault such a reaction?

In the aftermath of the election, much blame has been cast on pollsters' near-universal projections of a Clinton victory. Pundits have been quick to toll the polling industry's death knell. Wading through the post-election polling discussion, I found myself wondering why so much attention was being paid to the polling methodology and so little to how polling results were communicated to the average voter. Pollsters — and the media that report on poll results — are misleading the public as to the certainty of their forecasts, resulting in a complacent and unprepared electorate.

A poll is intended to reflect the voting preferences of a representative sample of likely voters within a larger population. In a typical telephone poll, a pollster will canvass responses from 1,000 to 2,000 randomly selected households. The pollster then decides whether to adjust the weight of each response so that the sample is representative of likely voter demographics. These demographics — race, age, education, etc. — received substantial attention in the U.S. election coverage.

Can an electoral poll of 1,000 be used to predict the votes of over 100 million? Yes, but only with caution. To the pollsters' and media's credit, most published polls indicate which candi-

date is in the lead, by how much, and by what margin of error. For example, a poll might put Clinton in the lead by 4 points, with a margin of error of +/- 3 percent, 19 times out of 20.

The mystical "margin of error" is based on the confidence interval of a binomial probability distribution. Put simply, a margin of error of +/- 3 percent, 19 times out of 20, means that the pollsters are 95 percent confident that the candidate's actual lead is within 3 percent of the lead reported in the poll.

Most national polls of the U.S. election reported margins of error of 2 to 4 percent. When polls are combined into a "poll of polls," the margin of error decreases further, assuming the polls are independent. For instance, aggregating 20 national polls of 1,000 respondents each yields a best case margin of error of 0.7 percent for the U.S. electorate. With Clinton's lead in the national polls averaging 3 to 4 percent on Election Day, the media were quick to anoint Clinton the next president, even factoring in the vagaries of the Electoral College.

However, the margins of error calculated by pollsters represent only a portion of the true error associated with polling. Pollsters exclusively quantify sampling error: the error from choosing a sample size that is smaller than the entire population.

Pollsters calculate margin of error as if they are flipping a fair coin 1,000 times and using the observed proportion of "Heads" (say, 53 percent) to predict the actual probability of a head (50 percent). But the U.S. population is not comprised of hundreds of millions of identical voters — the equivalent of fair coins. There is a great risk in projecting that the 1,000 respondents sampled are representative of the electorate, regardless of the demographic weightings used. Determining who is likely to vote, and who to stay home, is fraught with uncertainty. Adding undecided voters — the coins that land on their side when flipped — and the potential for respondent dishonesty into the mix strengthens the cocktail of unpredictability.

To use actuarial terms, the margin of error quantifies the "sampling error" portion of *parameter risk*: the risk that model parameters are not suited to the phenomenon being modeled, as described in Venter and Sahasrabuddhe's "A Note on Parameter Risk" (2012). The margin of error does not consider *data bias* — the risk that experience period data cannot be used for predictions without first being adjusted — nor *model risk* — the risk that the selected model poorly represents the modeled phenomenon.

These additional sources of error are never included along with poll results. The net result is that the *true* margin of error of the polls is systematically under-reported.

How large is the additional, unreported error? Popular forecasting site FiveThirtyEight.com estimates that the average poll would still be off by 2 percent if no sampling error was present. In a less scientific assessment of the model error, the *New York Times* gave five well-regarded pollsters identical data from a poll of 867 likely voters in September 2016. After applying judgmental adjustments to the data, the pollsters' forecasts ranged from a 4 percent Clinton lead to a 1 percent Trump lead.

Compounding this problem is "herding" — the practice of adjusting anomalous poll results to be more in line with those reported by other pollsters, or not publishing such polls altogether. Herding falsely increases the perceived certainty of a candidate's lead and threatens polls' independence. Evidence of herding has been found in several recent election polls.

As an actuary who makes a living from interpreting statistics, I understand the difficulty for even a trained professional to draw the correct conclusions from the data. We cannot expect the voting public to understand the real level of uncertainty underlying the polls without the help of pollsters and the media.

We need to convince pollsters to report the true margins of error of their polls, including error due to data bias and model risk. We need to encourage news media to spend less time talking about one candidate's lead in the polls, and more about the uncertainty of the forecasts. We need to decrease focus on individual polls and to increase focus on estimates of a candidate's victory probability accounting for all sources of polling error and poll dependence, such as that calculated by FiveThirtyEight.

Inflation of the certainty of poll forecasts contributes to voter complacency and leaves the general public unprepared for an upset on Election Day. Let's guard against these consequences by equipping the average voter with an understanding of the uncertainty of election results.

Jeffrey Baer, FCAS, is manager, advanced analytics for Economical Insurance Group in Waterloo, Ontario, Canada. He is also a member of the AR *Committee.*

IN MY OPINION BY GROVER EDIE, AR EDITOR IN CHIEF

"Taking a Poll? I'd Like to See Some Credentials!"

I started writing this on Election Day 2016. I am still amazed that we can, using modern data collection and compilation tools, find out the result of elections within hours, sometimes minutes, of the polls closing. About two weeks later, while editing this piece, I realized that Michigan still has not declared a winner, which reminded me that there is more than technology involved in these processes.

But the data collection and analysis that went on before the election was a different matter. I watched the various polls predict who would be the winner and noticed that those polls disagreed with each other and were also changing almost daily. This happened during the primaries as well. Consistent or not, polling results often caused candidates to revise their travel schedules to try to move the results back into their favor. The results of these predictions caused changes in how time and money were spent — two precious commodities that only increased in value as the primary or general election drew closer.

I wondered if pollsters are subject to the same codes as we actuaries are. Is there a "code of ethics" for pollsters? Are there standards in place for them? Is their work peer-reviewed? How does one train to become a pollster, anyway? Are there exams?

Thinking about the roles pollsters and other predictors have in today's society, I noticed an email from an economist group predicting how they think the economy will do in 2017. I thought it was interesting, as they didn't hedge their predictions based on the outcome of the election.

I realize we aren't the only profession that predicts using mathematical methods, so I went online and found that there are some professional organizations for pollsters and that some do have a code of ethics. But there is no formal set of qualifications, no prescribed course of study, no formal licensing requirements and no exams. A search of "how to become an economist" resulted in a similar result.

As I consider my options for my future retirement, predictions of my life expectancy based on the population as a whole can help me make decisions, but they have to be "credibility weighted" with what I know about my own health and the health and longevity of my relatives. Trends in health care and longevity also need to be factored in.

I started to think about these predictions: Are the forecasters, like the pollsters, predicting the mean, the median, the mode or something else? Are they accurate? Are they unbiased? What are the assumptions made and weights used to finalize their predictions? Am I using the results of the predictions properly or for something they are not intended to be used for?

I wondered if pollsters are subject to the same codes as we actuaries are. Is there a "code of ethics" for pollsters? Are there standards in place for them? Is their work peer-reviewed? How does one train to become a pollster, anyway? Are there exams?

Do we ask questions about polls and forecasts that we ask ourselves about the work we do?

I like our examination process, which ensures that each credentialed actuary has a basis of knowledge that is common to other credentialed actuaries. I take comfort in the fact that we are subject to standards of practice — they provide guidance as well as a defense for our work. Peer reviews are crucial and help prevent errors in approach as well as arithmetic. In my opinion, ours is the best way to ensure the quality of the work of our profession.

In Consideration of Change and Existence

The following is an excerpt of the Presidential Address of Stephen Lowe given November 14, 2016.

> We are in an era of transition. Technological advances are making feasible the search for new information that, as recently as a decade ago, would have been prohibitive in cost to secure.
>
> —Harold Curry, November 1966

CAS President Harold Curry … was talking about the advancing capabilities of mainframe computers and FORTRAN, not the exploding capabilities of big data and predictive analytics.

So we can see clearly that, while the specifics do change over time, the fundamental issues are immutable. Technology inexorably advances and the actuary must evolve in an ongoing effort to keep up. I have faced this challenge throughout my career over the last 40 years; when I started my career there were no personal computers, no cell phones, no internet or email. I submit that you will face the same challenge to change over the next 40 years as well — different in specifics, but not different in fundamentals.

One of my favorite books is *The Singularity is Near* by Ray Kurzweil, one of the world's leading futurists. His thesis is that humans project future technological advancement linearly, while in reality advancement is exponential. It's human nature to think linearly. This causes us to miss the major disruptions and tipping points that come with fast-paced change.

In the book, Kurzweil makes the case that, at the current pace of advancement, computer intelligence will surpass human intelligence within the next 20 years. Computers will be able to emulate human brain function and achieve consciousness (the singularity); eventually computers will exceed the natural limits of brain function, allowing them to perform analysis and solve problems that are beyond human capacity.

While Kurzweil is a little bit of a crazy person, the case he makes is detailed and quite strong, with implications that are worth considering. He envisions a future in which artificial intelligence technology allows us to transcend our biological limitations. For example, if our bodies fail us, our brains can be downloaded onto a computer, as in the Johnny Depp movie, *Transcendence*. In addition to being thought-provoking … the book … is an optimistic view of the future.

One can only wonder what the role of the actuary will be in the world Ray Kurzweil envisions. The point for all of us is that we need to consider the possibility that, well before our careers are over, change will fundamentally alter what we do and how we do it. Insurance coverage will be different; insurance companies will be different; data, tools, and actuarial techniques will be different. And when I say "different" I don't mean incrementally different. That is the trap of linear thinking. In an exponential world "different" means radically different.

I'd like to now shift gears a bit and talk about the role of the CAS. While I was serving as your president-elect, I led a subgroup of the board of directors that tried to address the questions of "why?" — Why do casualty actuaries exist? Why do professional bodies such as the CAS exist? And why does the CAS exist as a distinct body?

The impetus for the project was the work of Simon Sinek, who suggested that most organizations naturally define themselves by starting with what they do, and then progressing to how they do it. For example, we could say that one reason the CAS exists is to provide continuing education by hosting meetings like this one. This plays to the rational and analytical side of the brain, and is a natural and easy way to define the role an organization plays.

Sinek points out, however, that inspirational leaders and inspiring organizations start with "why?" rather than "what?" or "how?" He points to companies like Apple and Disney, that aren't really defined by their products, but rather by their deeper motivation. Apple is about "cool stuff"; Disney is about "family fun." The question of "why?" plays to the instinctive, emotional side of the brain, where feelings such as loyalty and trust are formed. It is a harder, but more fruitful, way to define the role of an organization …

The CAS Board committee ultimately came up with three reasons why the CAS exists.

The first reason is to ensure that CAS members have the necessary specialized analytical skills and experience to develop and communicate sound advice relating to risks and uncertainties.

This brings us back to Kurzweil and

the future. We have made great progress in updating our education programs to address new techniques relating to predictive analytics, which is the current wave of change that is taking place today. Going forward, however, one of the primary ongoing challenges for the CAS will be to stay ahead of the technological curve. We were a bit slow in responding to predictive analytics; we will need to be quicker in responding to the next big change …

Change isn't limited to the tools and techniques we use in our analysis; it also affects the risks we are asked to evaluate, such as the introduction of driver assistance technology. Even if we don't get to fully autonomous vehicles for a while, we are certainly at the doorstep of widespread use of incremental assistance. This will change auto insurance in fundamental ways, altering driver behavior and the causes of accidents. It will also introduce a systematic element to the risk, as the cars will all be connected …

In addition to addressing predictive analytics through changes to basic education through the new Exam S, we have also created a new predictive analytics credential, the Certified Specialist in Predictive Analytics (CSPA), to be offered by our subsidiary, the CAS Institute (a.k.a. "iCAS") …

Our goal with the creation of the iCAS and the CSPA credential is not just to provide employers with a benchmark that demonstrates the skills and knowledge to perform effectively in the predictive analytics arena. We also recognize that practice communities play a central role in supporting education and career growth, and we are therefore opening membership in iCAS to interested data science professionals … Because data science is so aligned with actuarial science, we expect that ultimately the iCAS data science community will sit alongside, and overlap, with the CAS actuarial community …

A second reason the CAS exists is to foster a global community of casualty actuaries.

There are two key words here: *global* and *community*. Fostering a strong sense of community is perhaps the most important reason for the existence of CAS. It is an area where I think we have outperformed our peers, and I am hopeful that we will continue to do

so. A strong sense of community is an essential element of a vibrant profession, as it facilitates a collaborative, collegial culture. Community is important partly because it fosters loyalty; I believe that our membership feels a strong sense of loyalty towards the CAS.

Building a strong sense of community is easiest when the members share common interests and work together on common problems. In contrast, a strong sense of community is harder to achieve where the professional and business interests of the membership are diverse. This is perhaps the reason why the CAS has been so successful: Our members all share a common interest in property and casualty issues. Our meetings aren't cluttered with pension and life insurance, practice areas with which we have very little affinity …

Many of our members question the need for the CAS to be global and wonder what our global aspirations should actually be. These are good questions and deserve a thoughtful response. I'll start by relaying a conversation I had early in my presidency with the chief actuary of a large multinational insurer. We were discussing Latin America and the diversity of actuarial designations there. He expressed frustration at this situation and asked whether the CAS would support offering its exams throughout the region. From a talent management perspective, his preference would be to use our ACAS and FCAS designations to qualify candidates for hire or promotion, because they assure a level of capability and competence that he can rely on in hiring and promotion decisions …

I don't advocate for a global CAS because I seek world domination; I do so in the belief that a global presence is important to many of our stakeholders now and will become important to many more stakeholders as we go forward …

A third reason the CAS exists is to assure that the profession is respected and trusted by all parties at interest, so that the parties will rely with confidence on the advice being offered.

The perceptions of our stakeholders are critical to our success as a profession. First, all parties at interest must trust us, so that the parties will rely with confidence on the advice being offered. We must be perceived as ethical. Our advice must be perceived as an objective assessment by a competent professional, supported by rigorous analysis and expert judgment, reflecting business acumen as well as technical expertise. The CAS (and the ACAS and FCAS designations) all serve as the tangible representation of our brand as specialist professionals; the CAS must therefore be vigilant regarding the brand attributes I have just articulated above.

The CAS maintains, monitors and continues to advance the CAS brand. Since brand attributes like trust are earned, the CAS does not generally promote these attributes directly; rather, members are encouraged to exhibit these attributes in all of their work. I think we are doing a good job here, particularly with the many outreach programs we have to employers, universities and other stakeholder groups. However, like a sentinel at his post, this work is never-ending.

From what I have said, I believe the case is very strong for the existence of the casualty actuarial profession and the existence of a professional organization to support the profession. However, it is not evident (at least not to me) that

CAS President Steve Lowe

the existence of the CAS as a distinct independent organization is necessary. While this view will be blasphemy to some, I think we need to be open-minded on the subject, focusing on what is best for the profession. It is important to remember that the existence of the CAS is quite possibly an historical accident. According to the long-standing though unverified legend, if the Actuarial Society of America (ASA) had not rebuffed the small group of workers' compensation actuaries who were looking for a professional home in 1914, we would have ended up as a section within what would eventually become the SOA.

Earlier, I talked about the strength of the community that the CAS has fostered and the loyalty to the CAS among our members that are the envy of our peers. These are strengths that I would be unwilling to sacrifice in any potential restructuring of the profession. So any consideration of the alternatives to CAS independence should be limited to those under which our community remains intact. This would be a major challenge, but perhaps it is not an insurmountable one. I certainly don't have a solution, but I would encourage future leadership to give the question further consideration, with an open mind.

IT'S A PUZZLEMENT BY JON EVANS

Malware Versus Anti-Malware

A computer virus is programmed to make three identical copies of itself and then delete itself. Network anti-malware software has a probability P of destroying any given copy of the virus before it can make the three copies. A single copy of it is introduced into the network. What is the minimum value of P so that there is 99 percent chance that the virus will be completely eradicated eventually? What is the minimum value of P for a 100 percent chance of eventual complete eradication?

Crack the Code

The coded message was:

"NQV ARC RMWQLP ATXPROCMN FOC R YOMMOQC KQMMRXL OU NQV LPRXP FOPH QCT

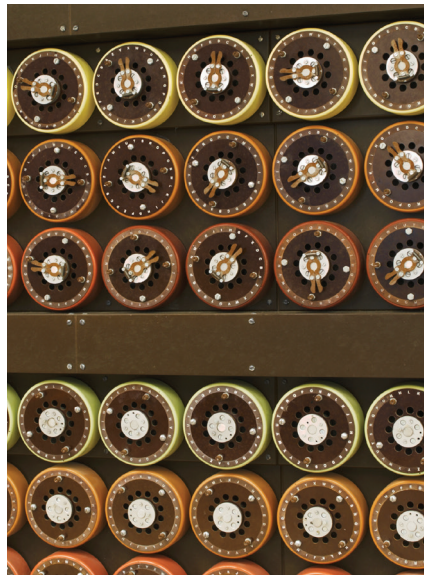
KQMMRX RCK YTP R LWRMM TC-QVIH UXRAPOQC TCQVIH POWTL."

It decodes to:

"YOU CAN ALMOST CERTAINLY WIN A BILLION DOLLARS IF YOU START WITH ONE

DOLLAR AND BET A SMALL ENOUGH FRACTION ENOUGH TIMES."

Decoding this is a matter of educated guesswork, process of elimination, and focusing on decoding the vowels in short words. Generally, the first step is to notice that the one letter coded word "R" must decode to either "A" or "I." Since it appears twice in the middle of the message "A" is a better guess. That limits the possibilities for the vowels in the two letter and three letter words.



Solutions were also submitted by Patrick Allen, Neil Bethel, Peggy Cheng, Lance Clevenger, Bob Conger, Todd Dashoff, George De Graaf, Mario DiCaro, Daniel Eklove, Joey Janzen, Rob Kahn, Sze Qi Lai, Luc Langlois, George Levine, Kristain Lindemann, Daniel Mackey, Sharon Markowski, Juan McNamara, Jim Muza, Richard Newell, Dave Oakden, Jeff Prince, Damon Raben, Dave Schofield, Gregory Scruton, Bruce Spidell, Tony Strazzara, Marla Strykowski, Jeff Subeck, Kathleen Tierney, Sonja Uyenco, Leslie Vernon and Walt Wright.

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

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ILLINOIS – DATA SCIENTIST

For Position 73653, our Chicago client has an immediate need for a Senior Property and Casualty Insurance Data Scientist. FCAS or ACAS actuary ideal for this role. Must have exceptional statistical modeling expertise. SAS or R programming skills required.

PENNSYLVANIA – ACTUARIAL ANALYST

Property and casualty actuarial analyst sought by Pennsylvania insurer for Position 73855. Must have at least one year of property and casualty actuarial experience. Some exposure to insurance pricing preferred. SAS or R or SQL or C++ programming skills ideal. High profile pricing and profitability analysis role.

NEW YORK – CONSULTING ACTUARY

For Position 72958, our New York client is searching for an FCAS for their open consulting actuary opportunity. Assignments may include predictive modeling, ERM, reinsurance studies, fraud studies, statistical modeling, pricing, product development, reserving, financial reporting, financial forecasting and special projects.

FLORIDA – ACTUARIAL ANALYST

For Position 72828, a Florida insurer seeks property and casualty actuarial analyst. Requires 1 to 5 years of experience. R or SAS or SQL programming skills ideal.

NORTHEAST USA – SENIOR ANALYST

Northeast USA professional liability insurer plans to hire a senior actuarial assistant for Position 73599. Must have at least four years of property and casualty actuarial experience. Some commercial lines experience ideal. Reserve studies, insurance pricing, product development, predictive analytics, reinsurance analysis and other assignments.

SOUTHEAST USA – WORKERS COMPENSATION ACTUARY

For Position 73233, an ACAS is needed by a commercial lines insurer. WC pricing, product development, rate analysis and supervisory role. Work closely with claims, underwriters, statistical analysts, financial professionals and state insurance departments.

CONNECTICUT – SENIOR DATA SCIENTIST

For Position 73717, a Connecticut insurer plans to hire a senior data scientist. Apply advanced statistical methods (including predictive modeling applications) to property and casualty insurance claims data. SAS or SQL or R programming skills ideal. Must have at least three years of experience with insurance claims data.

OHIO – ACTUARIAL ANALYST

Ohio insurer seeks an actuarial analyst for Position 73732. 1 to 5 exams. Reserve analysis, modeling, pricing, product development and business strategy role.

SOUTHEAST USA – CONSULTING ACTUARY

For Position 73404, a Southeast consulting firm is hiring due to anticipated heavy growth. FCAS with some consulting experience required. This is a small office and you will be paid for performance. Organization prefers that this actuary bring a book of business with them. Captives, self–insurance, data management, financial analysis, reserve studies, risk management and other projects.

NEW JERSEY – RESERVING ACTUARY

For Position 73707, a New Jersey client seeks a reserving actuary and manager. Manage staff. ACAS preferred. Requires management experience and reserving experience.

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