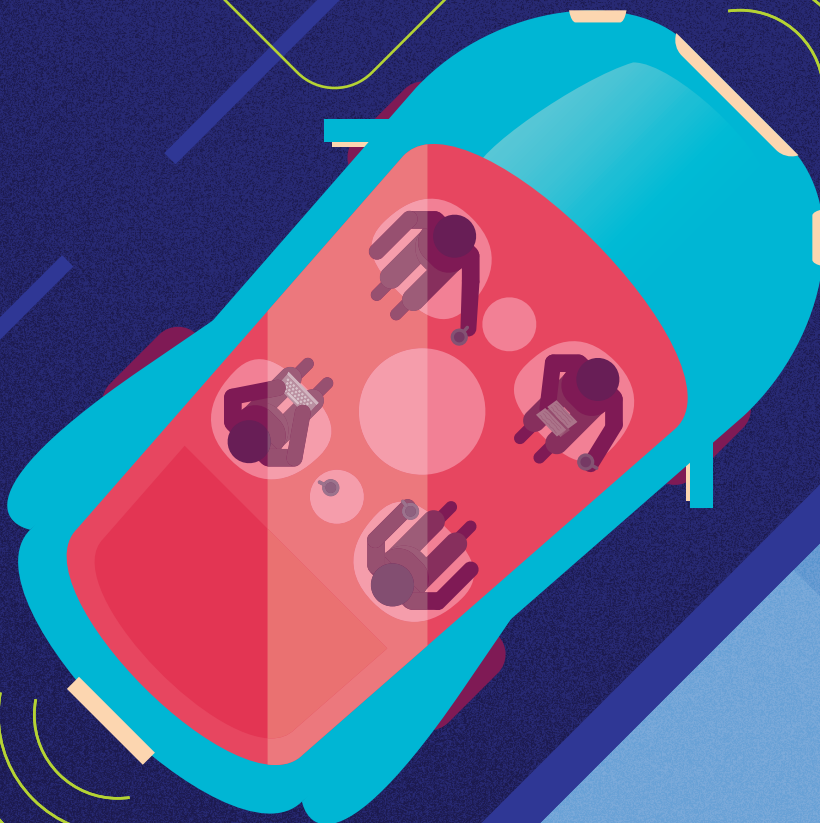


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DRIVERLESS UTOPIA



2018 Predictive
Analytics Marketplace

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2017

Salary Survey

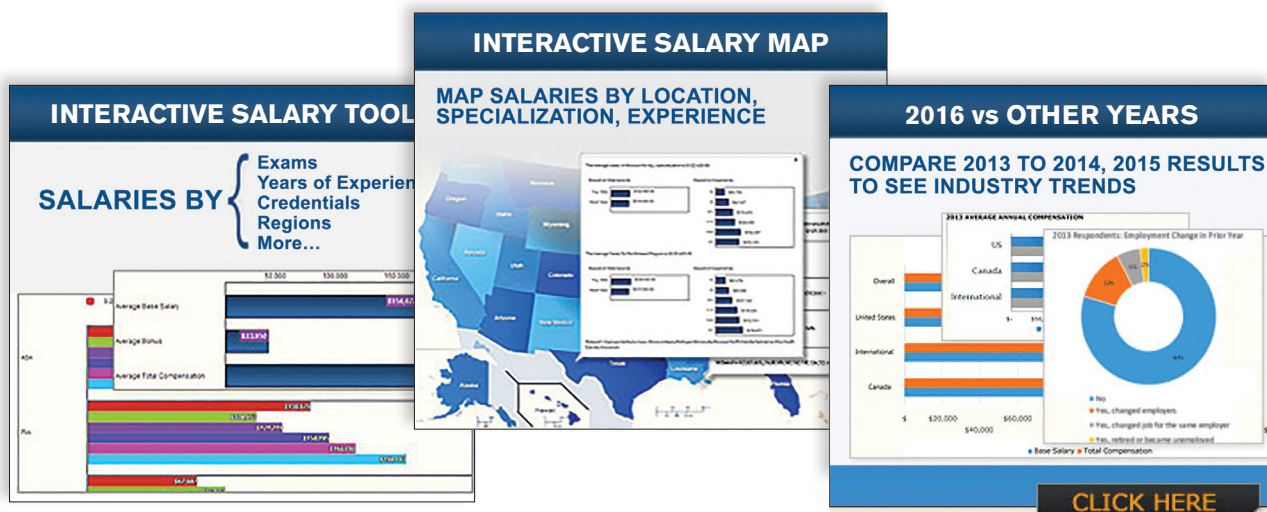
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This year our results represent responses to questionnaires we sent to more than 40,000 actuaries, others who volunteered to participate, and from information we gather from candidates and the companies we recruit for.

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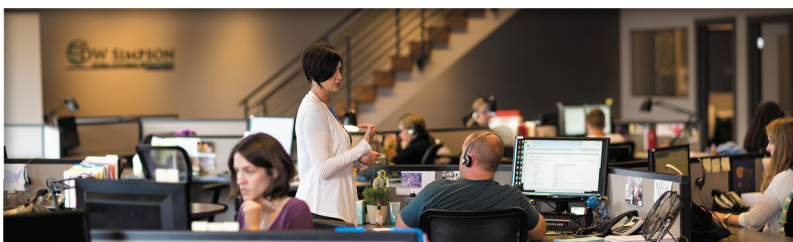
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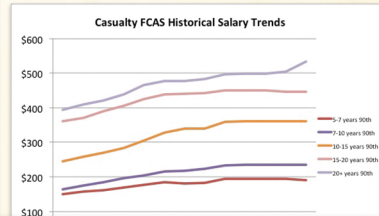
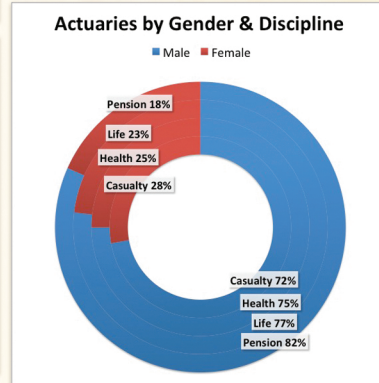
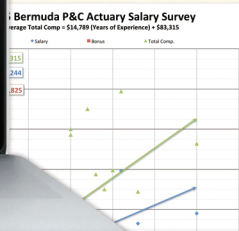
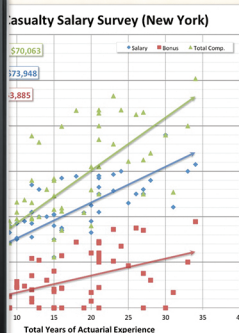
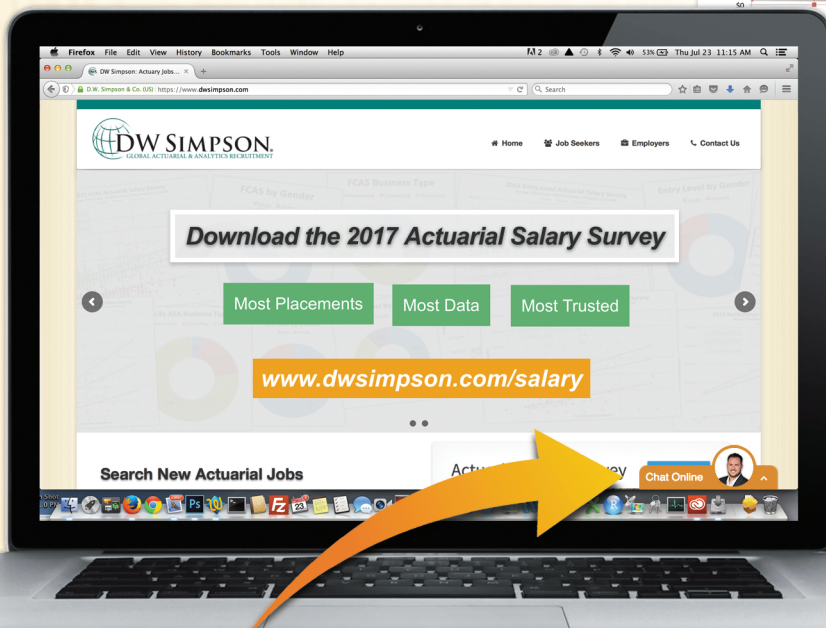
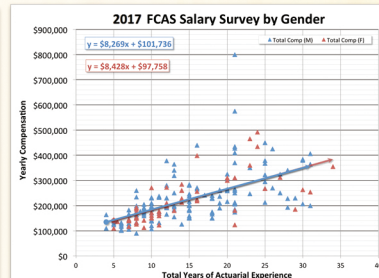
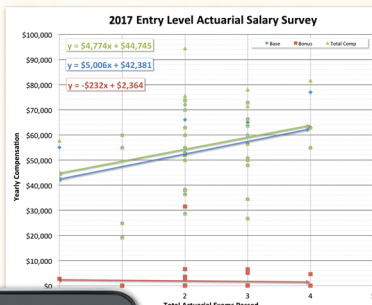
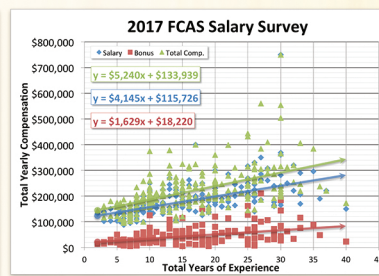
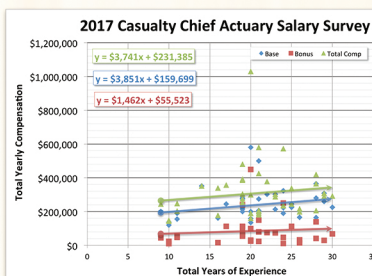


Download the **2017 Actuarial Salary Survey** which includes information at all levels of experience, from Entry-Level through Fellowship, and with all disciplines including Life, Health, Pension, Property & Casualty and non-traditional areas.

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Driverless Utopia

BY ANNMARIE GEDDES BARIBEAU

Automated vehicles, drivers and insurers are dealing with the present state and looking ahead to the future.



2018 Predictive Analytics Marketplace

A Supplement to *Actuarial Review*

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editor'sNOTE By GROVER EDIE, AR EDITOR IN CHIEF

Useful Things

Once again we have put together a pretty good issue, filled with lots of tools that actuaries can use.

For the second year in a row, the May/June *AR* includes a Predictive Analytics Marketplace that is geared toward those who work with predictive analytics. (For those who don't, what are you waiting for?)

In "25 Years Ago in the *AR*," Jerry Tuttle is quite an enthusiastic advocate for the new-fangled technology of electronic mail. Email, as we call it today, has not yet gone the way of the dinosaur, but it's not the only way to communicate.

So, email got me wondering: Will driverless cars be the norm in 25 years or will they be considered a quaint form of transportation?

This *AR* features two articles on the increasingly familiar topic. Much has changed in the short time since we first reported on autonomous vehicles for our cover story in *AR* November-December 2015. The risk models being developed for these vehicles have real life-and-death implications. Will we actuaries have it all figured out in 25 years? Are driverless cars a trend, a season, a cycle or something else?

With new opportunities come risk

— and our exam process is no different. Guest columnist Agatha Caleo points out some perils of the new CAS initiative Technology-Based Exams in "Cheaters Gonna Cheat." I welcome Ms. Caleo to *AR*'s elite group of contributors. She is a CAS candidate who works on *Future Fellows* and is a member of the Candidate Liaison Committee.

Finally Don Mango delves deeper into insurtech, analyzing how and why it may disrupt what insurers have to do in order to bring valuable goods and services to the market. If you aren't certain if insurtech is a trend, a paradigm shift or something else, perhaps this Explorations column will help you decide.

Please enjoy this issue of *Actuarial Review*.

Correction

In the March-April *Actuarial Review*, a photo accompanying the article "Demand for P&C Actuaries Takes a Dramatic Upturn in Malaysia" contains an error. In the picture captioned "Seminar speaker Steven Glickstein," the correct name should be Steven Glicksman, FCAS. Glicksman is an actuary with Glicksman Consulting. ●

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.

SEND YOUR COMMENTS AND SUGGESTIONS TO:

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It's a Great Time to Be an Actuary

As I have traveled the world, it is apparent that actuaries are working in new areas and the demand for people with technical skills is increasing. Those with skills in predictive analytics who also have insurance expertise are in extremely high demand.

Predictive Analytics Opens Doors

Greg Hayward, assistant vice president & actuary at State Farm, manages a group of actuaries and data scientists specializing in predictive analytics. He observes that actuaries are using analytics to help claims adjusters better manage claims, marketing personnel improve the customer's experience, IT departments manage peak demand cycles, as well as several other areas. Greg has never seen actuaries with analytics skills in higher demand.

Claudine Modlin says actuaries are bringing more and more value to claims departments. Claudine, a former consultant and leader in Willis Towers Watson's group working in predictive analytics, is now the new head of strategic planning & competitive intelligence for Farmers Insurance. Powerful analytics tools help claim adjusters better identify fraud as well as salvage and subrogation opportunities. These tools also provide more information to better manage claim outcomes. They can mine the notes of claim adjusters, nurses and doctors, turning unstructured text into meaningful data that can be used to lower claim costs. Claudine says that predictive analytics tools can ultimately be used to improve the customer's experience.

Advancing to Senior Levels

Actuaries are expanding beyond their traditional roles at insurance companies into senior management. Currently, we have 114 members whose job title is president or CEO. This is not surprising as actuaries are very bright and understand insurance operations very well.

If a CEO is an actuary, he or she understands the value of actuaries and is more likely to hire actuaries to work in many nontraditional actuarial roles. I spoke with three such actuaries who are senior officers: Janet Katz, executive vice president and CEO at American Agriculture Insurance Company; Brian Duperreault, president and CEO at AIG; and Charlie Goldie, CEO, P&C, at Partner Re. They have all elevated the roles of actuaries at their companies.

"The breadth of knowledge learned on the actuarial exams helps prepare actuaries for executive roles," says Charlie.

If a CEO is an actuary, he or she understands the value of actuaries and is more likely to hire actuaries to work in many nontraditional actuarial roles.

He further adds that actuaries need to develop excellent communication skills, be able to understand their audience and tailor their presentations for them.

Janet also acknowledges the value of rigorous testing. "Actuaries are well suited to be in senior roles as the exams expose them to the detailed entries on financial statements as well as all of an insurance company's operations (claims, underwriting, finance, etc.)," she says. She offers three pieces of advice for actuaries aspiring to be senior leaders:

1. Remain curious — keep learning; 2.

Work with other departments (claims, underwriting, etc.); and 3. Understand yourself — know what you are good at what you are not good at, and work to improve your skills where you identify a shortcoming.

Brian believes that at its basic level "good insurance practice is to use data to make good decisions." Actuaries have always used data to solve problems. With more data and tools becoming available, actuaries with the right skill sets will be in very high demand.

"Realize that you cannot do everything and need to rely on your staff," Brian advises. "A great manager is someone who can ask the right questions to evaluate people's abilities," he says. "You also need to become comfortable with taking risk and owning the risk instead of advising someone else on whether they should take a risk."

A Global Need

Detariffication or pricing deregulation is spreading throughout the world — China, Saudi Arabia, Malaysia and Turkey are just a few examples — and as countries move away from tariffs, companies need actuaries to help devise new rating plans. Companies with well-designed rating plans will have a clear competitive advantage. Detariffication also means that regulators see a strong need for actuaries to be involved in financial statements. Many countries

President's Message, page 8

JUNE 4-5, 2018

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NEW YORK MARRIOTT
AT THE BROOKLYN BRIDGE



President's Message

from page 6

are requiring actuaries to play a role in financial statement attestation.

Kenny Tan, a chief actuary at Am-General Insurance Berhad, moved back to Malaysia a year ago. He said that the regulators are now requiring each company to have a qualified actuary perform an independent review of the financial condition and provide a report to the board. Companies are adding actuaries to develop prices in the new competitive market. Adding to all of these changes, the International Accounting Standards Board's IFRS 17 will also increase the demand for property-casualty actuaries to help companies meet these new accounting regulations.

Novel and Conventional Markets

Actuaries are also making inroads into banking and insurtech as well as the familiar mortgage insurance market. In banking, Scott Hallworth, chief data officer & chief model risk officer at Capital One Financial, drives the company's data strategy and leads the advancement and management of models, enabled in part by enhanced methods and tools. He thinks it is an ideal time for more actuaries to work in banking. Banks are required to develop models and manage their on-going performance in a transparent manner across all of their functions (e.g., risk segmentation, capital modeling, forecasting, marketing). Scott says that actuaries are well suited for this work due to their combination of deep analytic skills, rigor in providing evidence to support development choices, and comfort with managing large, unstructured datasets. With the help of the Actuarial Society in South

Africa, the CAS is also working to expand our member's footprint into banking. About 10 percent of the credentialed actuaries in South Africa work for banks, thus offering the CAS a guide on getting more CAS members into this industry.

Sheri Scott, a consultant at Milliman specializing in insurtech, predicts that the demand for actuaries will expand tremendously in the next several years. Insurtech companies are run by incredibly smart people, Sheri says, but many of these companies do not have backgrounds in insurance and the concept of state regulation of rates is very foreign to them. They need actuaries to help them understand the insurance rating and regulation.

CAS Board Director and Uber Chief Actuary Frank Chang agrees that the demand for actuaries in insurtech is growing, mainly to keep up with the explosion of start-up insurtech companies. The insurtech market has gone from a \$1.4 billion investment with 144 companies in 2015 to a \$4 billion investment with 328 companies in 2017. Frank currently manages a group of 15 actuaries at Uber, and he believes that most or all insurtech companies will need actuaries to help price and analyze products.

Actuaries are also doing more work around mortgage default risk. Our members have traditionally worked for mortgage insurers and are required by the NAIC to give actuarial opinions on mortgage insurers' reserves. Recently, Freddie Mac and Fannie Mae have been deleveraging their balance sheets by selling bonds backed by mortgages and entering into reinsurance agreements with P&C companies to limit their risk. Many of our members have been pricing and reserving these new reinsurance structures.

Ben Walker, senior managing director at Aon Benfield, says that in 2013 only a couple of companies were active in mortgage transactions. Currently, however, more than 40 companies are active with actuaries working on evaluating mortgage risk — work that can translate into other areas. "Actuaries can export the mortgage skills to related financial credit products (e.g., student loans, auto loans etc.)," Ben says.

Conclusion

In traveling to visit CAS members throughout the world, I have heard a very clear message in many countries: We need more P&C actuaries, and we need them now!

The news at home is also very encouraging: Glassdoor, the jobs and recruiting site, rated data scientist as the number one job. Without a doubt, the CSPA credential will provide actuaries and others with the new skills to flourish in today's job market. It is certainly an exciting time to be an actuary. ●

ACTUARIAL REVIEW LETTERS POLICIES

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

COMINGS AND GOINGS

Steven Hunke, ACAS, has been appointed to the position of department actuary in the newly expanded data and actuarial science department at Distinguished Programs. Hunke previously worked at Zurich, where he spent 10 years on supporting the organization's programs businesses.

Bruce Gifford, FCAS, has been appointed to the newly created role of chief data and analytics officer at the Travelers Companies. Gifford previously served as senior vice president and chief actuary for the company's bond and specialty insurance segment, while also leading the enterprise business intelligence and analytics function.

Amy DeHart, FCAS, has been appointed to vice president-chief actuarial officer at Wisconsin-based SECURA Insurance. DeHart joined SECURA's actuarial team in 2000 and oversees the company's pricing, reserving, strategic planning and related functions.

Gregory Kushnir, FCAS, has been appointed to senior vice president and chief actuary at AmeriTrust Group. Kushnir joined AmeriTrust in February

2018.

Julia Chu, FCAS, has been appointed to the newly created position of chief global ceded reinsurance officer at Markel Corporation. Prior to joining Markel, Chu served at reinsurance broker Guy Carpenter as managing director of strategic advisory.

H. Elizabeth Mitchell, FCAS, has been appointed to the board of directors at Selective Insurance Group. Mitchell was a former president and chief executive officer of Renaissance Reinsurance.

Marc Grandisson, FCAS, has been promoted to president and chief executive officer at Bermudian reinsurer Arch Capital Group. He has also been appointed to its board of directors. Prior to his current role, Grandisson was president and chief operations officer with the same company.

Douglas Min, ACAS, has been appointed the office of president and chief executive officer of American International Group Korea. Min has over 20 years of experience in the field and joined AIG in June 2014. He has previously served senior roles at Meritz Fire & Marine Insurance and Gen Re.

Susan Rivera, FCAS, has joined Tokio Marine as executive vice president and chief operations officer. Rivera was a founding shareholder of V3 Insurance Partners in Newtown, Pennsylvania from 2009 to earlier this year. ●

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

CALENDAR OF EVENTS

June 4-5, 2018

Seminar on Reinsurance
New York Marriott at the
Brooklyn Bridge
New York, NY

June 26-27, 2018

Underwriting Collaboration
Seminar
InterContinental New Orleans
New Orleans, LA

September 5-7, 2018

Casualty Loss Reserve Seminar
(CLRS) & Workshops
Anaheim Marriott
Anaheim, CA

November 11-14, 2018

Annual Meeting
Caesars Palace Las Vegas
Las Vegas, NV

June 3-4, 2019

Seminar on Reinsurance
Fairmont Southhampton
Hamilton, Bermuda

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MEET THE VEEP

Meet CAS Vice President-Professional Education Justin Brenden

Our Meet the Veep column introduces our members and candidates to the CAS vice presidents who serve on the Executive Council (EC), the governance arm of the CAS that oversees the operations of the organization. It consists of the president, president-elect, executive director and six vice presidents in charge of different functional areas.

In this installment, we are pleased to introduce the CAS Vice President-Professional Education Justin Brenden, FCAS, CERA, FIA, who is at the mid-point of his three-year VP term.

What is your day-to-day job?

I'm the chief reserving actuary for Third Point Reinsurance Company Ltd. in Bermuda.

What is your role as the CAS Vice President-Professional Education?

My job is to make sure that we are providing the best possible continuing education and professionalism education to CAS members. Our most popular offerings are the Spring and Annual Meetings, seminars, webinars and the Course on Professionalism, but we are always looking for new events and formats.

The full credit for the work we do in delivering education to our members goes to the outstanding volunteers and staff who serve on the various program committees that design our events, and the speakers who present the sessions. I

support the volunteers and staff and try to make sure that we are doing our part to meet the CAS's strategic objectives.

What volunteer work had you done for the CAS that led to your appointment as VP?

My primary qualifications for this VP role were my terms on the planning committees for the Casualty Loss Reserve Seminar (CLRS) and Ratemaking, Product and Modeling Seminar.

After serving on the CLRS committee for three years, I was asked to serve as vice chair, and then a year after that, I was asked to serve as chair. At the end of my three-year term as chair, I was asked to step into the VP position.

I really enjoyed my time on the planning committees. I found that it was a way to contribute to the profession while learning and expanding my professional network. I also liked the fact that on those committees we were working towards a clear and definite goal in the near future, because those seminars are held annually.

What are your goals as the CAS Vice President-Professional Education?

I think of my goals as a VP as falling into two categories:

First, for existing programs, I want to help the committees to continue providing the high-quality education that we have delivered in the past and



Justin Brenden

improve it even further. I measure this not only by attendance at events but also by closely tracking the attendees' evaluations. We take the results of those evaluations very seriously, so please complete them after you attend an event!

Second, in addition to what we have typically done in the past, we are always looking for new ways to meet our members' educational needs. We are expanding our use of technology to offer new programs, looking to offer more educational options outside the U.S., and testing new educational formats that line up with the latest best practices in adult education.

Could you share an interesting fact about yourself?

My wife, Eunice Loi, is also an FCAS, and she works at a different reinsurance company in the building that is next door to mine — this probably only ever happens in Bermuda!

We have a one-year-old son who attended his first CAS Annual Meeting when he was two months old. We brought him to the new Fellows' reception, where then-CAS President Steve

Lowe generously awarded him an FCAS “by mutual recognition” — though we haven’t received the diploma yet!

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

I encourage them to take the initiative

to get involved in the CAS by volunteering. Volunteering is obviously good for the CAS itself, but I try to appeal to their own interests as well, as I was taught to do when trying to persuade anyone to do anything!

For instance, I can honestly say that my time volunteering at the CAS has been a great investment in terms

of the benefits it has given me, such as building my network, developing skills, and broadening my perspective. My career thus far has been more satisfying and successful as a result. The positive benefit of giving back to the profession is icing on the cake. ●

CAS Issues Call for Monographs on Predictive Modeling of Individual Claims

The CAS Monograph Committee is looking for monographs on predictive modeling of individual claims in P&C insurance. The call’s purpose is to develop literature that emphasizes the educational and professional needs of actuaries to improve the estimation of ultimate losses in P&C actuarial practice and to generate publicly available models and methods.

This call covers both modern pricing and reserving methods, but it should be limited to typical actuarial functions. Models may include both indemnity and expenses, as well as correlations between the two.

Monographs in this series can range from a compendium of techniques in P&C insurance to detailed notes on one or more of the methods for predictive modeling of individual claims. The authors may discuss one or a small number of methods in great detail or provide a survey of the various methods of predicting individual claims, elucidat-

ing the pros and cons of each method and connections between them.

Some examples of specific questions these monographs may address include:

1. Can stochastic models leveraging more detailed information on individual claims outperform current traditional methods that only utilize aggregate data?
2. Are there readily available variables external to a typical insurance company that help explain the amount of future loss to be paid?
3. What are some useful applications of the aforementioned models? Can these models be incorporated into a pricing model as a more accurate target variable? How best to handle IBNR?

All monographs are expected to either be accompanied by tools or code that allow the techniques discussed to be implemented, or include links to open source software and code for this purpose.

Topics noted in this call may also be of interest to the CAS Syllabus Committee. The Monograph Editorial Board especially welcomes proposals that enrich material currently used to train P&C actuaries. Submissions that are highly readable and structurally amenable to having questions set from them are preferred. Authors are encouraged, but not required, to include examples and exercises that help teach the concepts being explained.

Authors must submit their work in accordance with the Guidelines for Submission of Monographs. Monograph submissions will be subject to peer review prior to final acceptance. Monograph authors whose submissions are accepted within the defined timeline may be invited to present their work at a related CAS seminar or meeting.

For more information on submission guidelines and timeline, visit http://bit.ly/CASMono1_18. Any questions on this call may be addressed to Donna Royston at droyston@cas.org. ●

CAS STAFF SPOTLIGHT

Meet Krystal Taylor, Actuaries' Resource Center Coordinator

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

- **What do you do at the CAS?**

I'm in charge of coordinating and delegating the work of the ARC department. I also process membership dues, meeting and seminar registrations and refund requests.

- **What do you enjoy most about your job?**

I like assisting the members of our association. My background is in customer service, which serves me well in the ARC.

- **What's your hometown?**

Fort Washington, Maryland — the home of actor/comedian Martin Lawrence, White House Plumbers Chief Operative during the Watergate scandal G. Gordon Liddy and two-time heavyweight boxing champ Riddick Bowe.

- **Where'd you go to college and what's your degree?**

I went to Frostburg State University in Frostburg, Maryland, located one hour away from Hagerstown in the Maryland panhandle (yes, Maryland has a panhandle). My degree is in business administration with a concentration in marketing.

- **What was your first job out of college?**



Krystal Taylor

I had an internship with Share Our Strength doing grassroots fundraising. Share Our Strength, or SOS, is a national organization that is working to find long-term solutions to the problem of childhood hunger in the United States.

- **Describe yourself in three words.**

Creative, honest and patient.

- **What's your favorite weekend activity?**

I enjoy going to brunch with friends and family. No dishes!

- **What's your favorite travel destination?**

The Caribbean. I recently traveled to Cuba and was taken with the country's culture and cuisine and the warmth of the people.

- **Name one interesting or fun fact about you.**

I like DIY projects. My creations to date are a wooden picture frame, a floor length mirror, ladder-style bookshelves and a counter-height craft table (I'm using it to organize shoes). ●



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

He's Onto Something ...

Jerry Tuttle, FCAS, saw the future in May 1993!

Random Sampler: Electronic Mail — A Better Way to Communicate By Jerry Tuttle

I am an unabashed fan of Electronic Mail ("E-Mail"), and I am encouraging my friends to jump on the E-Mail bandwagon. E-Mail gives you the ability to send mail from your computer directly to the other person's computer. Someday we will all have E-Mail both for business and at home, and it will change the way we communicate.

Compared to a telephone call, E-Mail avoids playing telephone tag ... and you can send a confidential or lengthy message without giving it to a third party. ... You don't have to walk over to a

fax machine and wait until it is free, and you can send E-Mail messages to several people at once with just a single outgoing phone call ...

The E-Mail is sent without human intervention, and it is sent fairly quickly. E-Mail can be received with complete privacy, unlike normal mail or facsimile, or it may be read by a designated person such as a secretary.

After making 15 consecutive calls to my son's Little League team or to a PTA committee, I envision the day when we will all have personal E-Mail at home and I can send those 15 messages with a single outgoing phone call. ●

Walt Wright, FCAS, is the former editor in chief of Actuarial Review.

CERTIFIED SPECIALISTS IN PREDICTIVE ANALYTICS RECOGNIZED IN MARCH 2018



Seated, left to right: Jingfei Li, Allen Long, Linda Brobeck, Laura Maxwell, Natalie Barth, Edmund Bouchie, Sheri Scott, Dorothy Andrews, Bill Stergiou, Sheri Holzman, Dylan Wienke.

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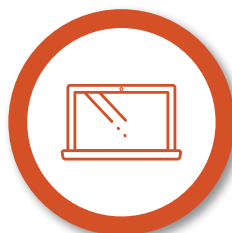
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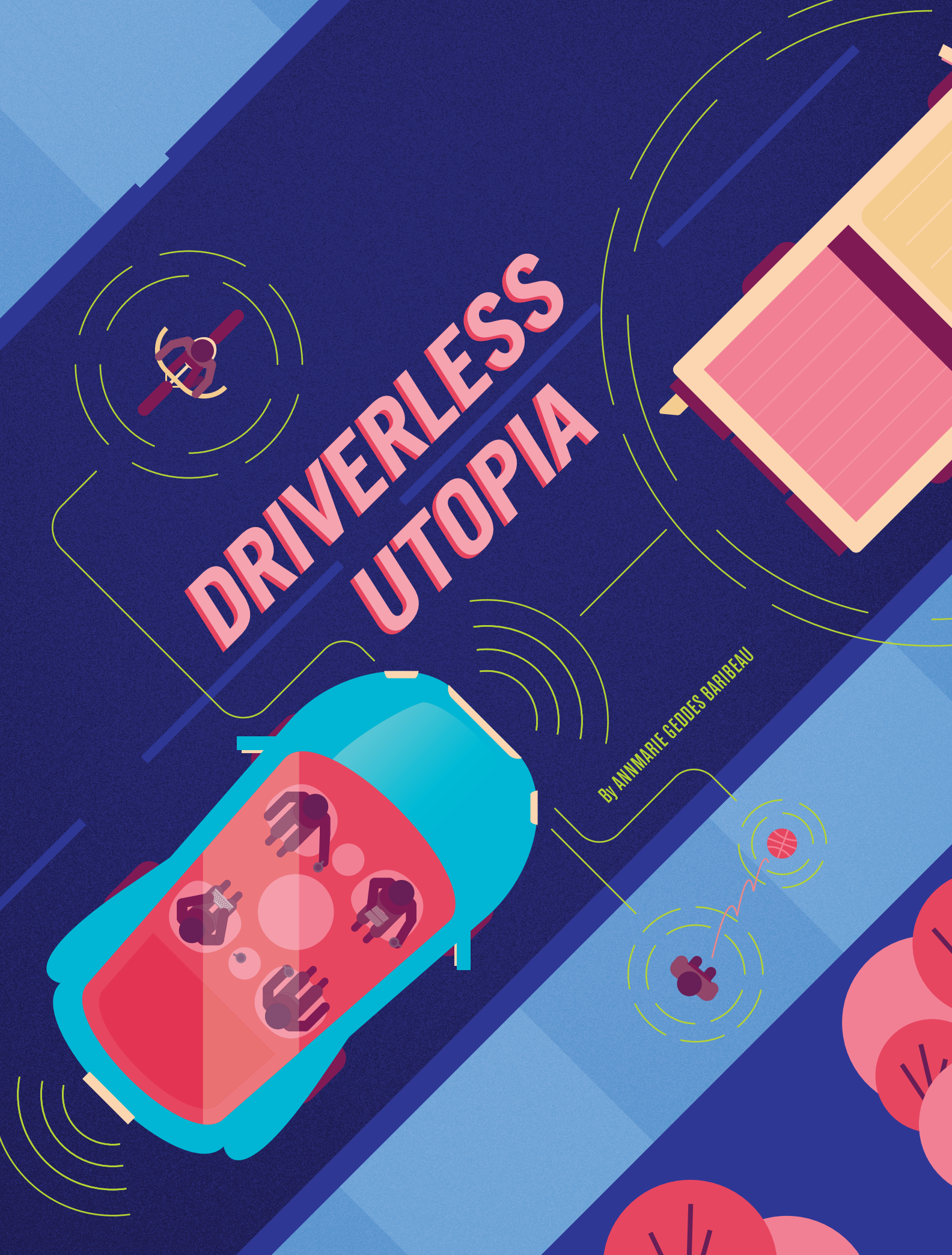


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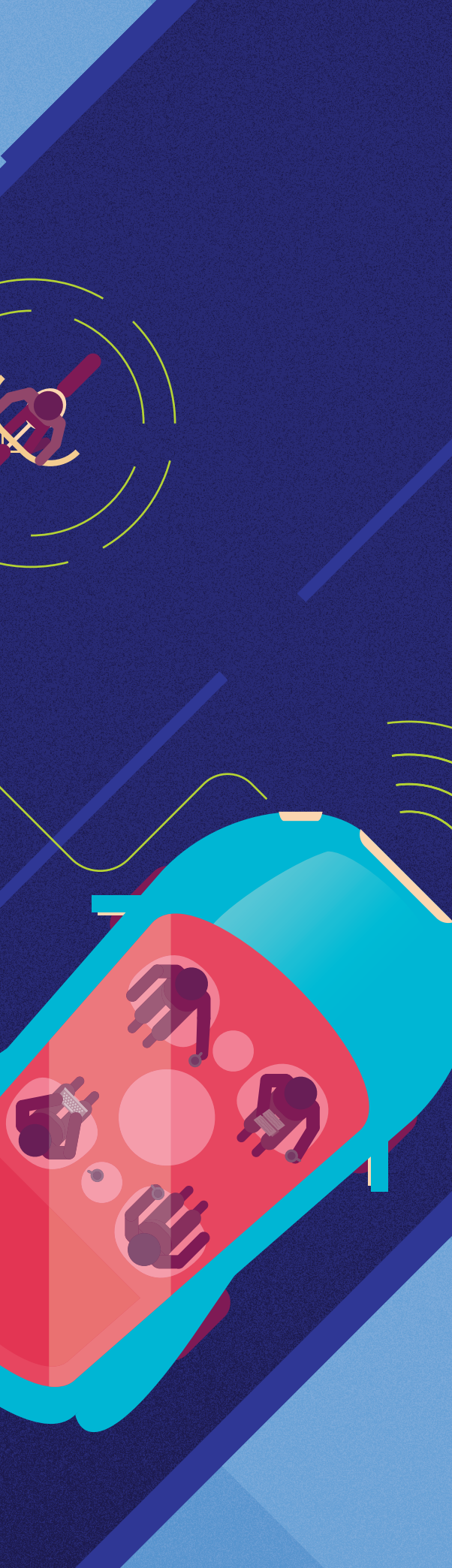
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DRIVERLESS UTOPIA



By ANIMARIE GEDDES BARBEAU



Automated vehicles, drivers and insurers are caught between the now and the not yet.

There is an oft-quoted statistic that presents misleading assumptions about the safety potential of driverless cars. The figure is parroted with the presumption that when fully automated vehicles are doing the driving, accidents will become comparatively rare.

The statistic — that 93 percent of accidents are caused by human error — originated in a decade-old National Highway Transportation Safety Administration (NHTSA) study. More recently, a NHTSA report that offers guidance for automated vehicles and related development reiterated that 9 out of 10 “serious roadway crashes” are due to “human behavior.”¹

Although there is evidence that automation can help humans drive more safely, says David Zuby, chief research officer for the Insurance Institute for Highway Safety’s (IIHS) Vehicle Research Center, “there is no proof whatsoever that automated driving is going to be safer.”

There are also signs that in some instances and circumstances, automated technology can introduce new accident risks, such as greater hacking vulnerability or insufficient warning when the vehicle tells the driver to take the wheel. But since little relevant information is available about current automated

vehicle features on the market and those being tested, it is pretty tough to gauge their safety today, let alone the distant tomorrow.

Automated vehicles, human drivers and insurers are caught in the now and the not yet. In the now, some cars have “Level 2” automation capability (see Figure 1). Driverless utopia — when automated vehicles are always or nearly always doing the driving — is in the not yet. Reaching “Level 5” could still take decades to become a reality for a high population of drivers.

Meanwhile, how driverless cars will affect everything from safety to premiums to liability and even perhaps the structure of insurance are on the table. These are discussed in great detail in the Casualty Actuarial Society’s Automated Vehicle Task Force’s recently released report, “Automated Vehicles and the Insurance Industry: A Pathway to Safety: The Case for Collaboration.” This article focuses on safety and liability.

Statistical Deconstruction

The CAS Automated Vehicle Task Force’s first report, released in 2014, had already deconstructed the NHTSA statistic. It concluded that driverless cars could only address 78 percent — not 93 percent — of accidents if they could not overcome weather, vehicle errors and inoperable traffic control devices. (AR November/December 2015).² The

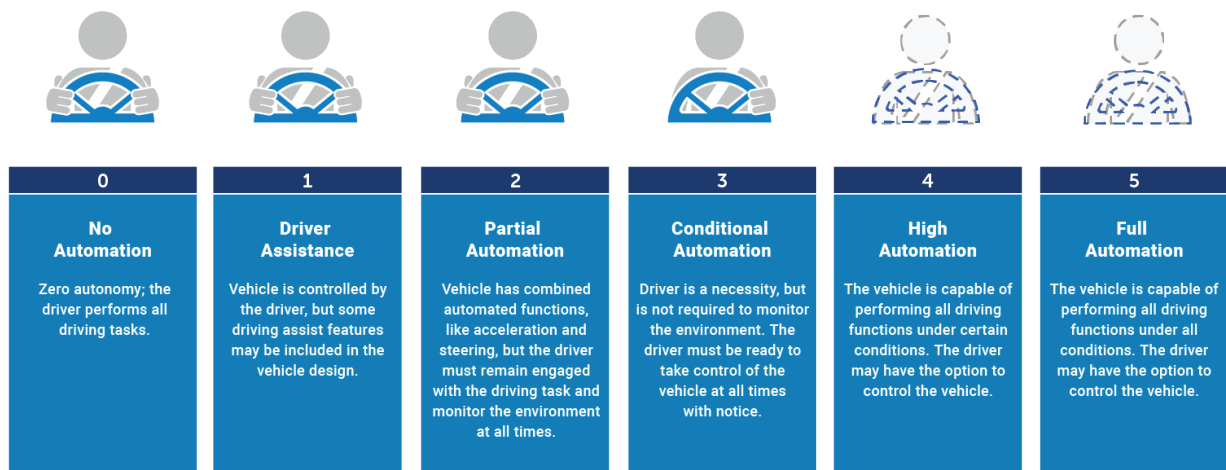
¹ NHTSA, “Automated Driving Systems 2.0: A Vision for Safety,” https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/13069a-ads2.0_090617_v9a_tag.pdf

² “Restating the National Highway Transportation Safety Administration’s National Motor Vehicle Crash Causation Survey for Automated Vehicles,” The CAS Autonomous Vehicle Task Force, December 2014.

Figure 1.

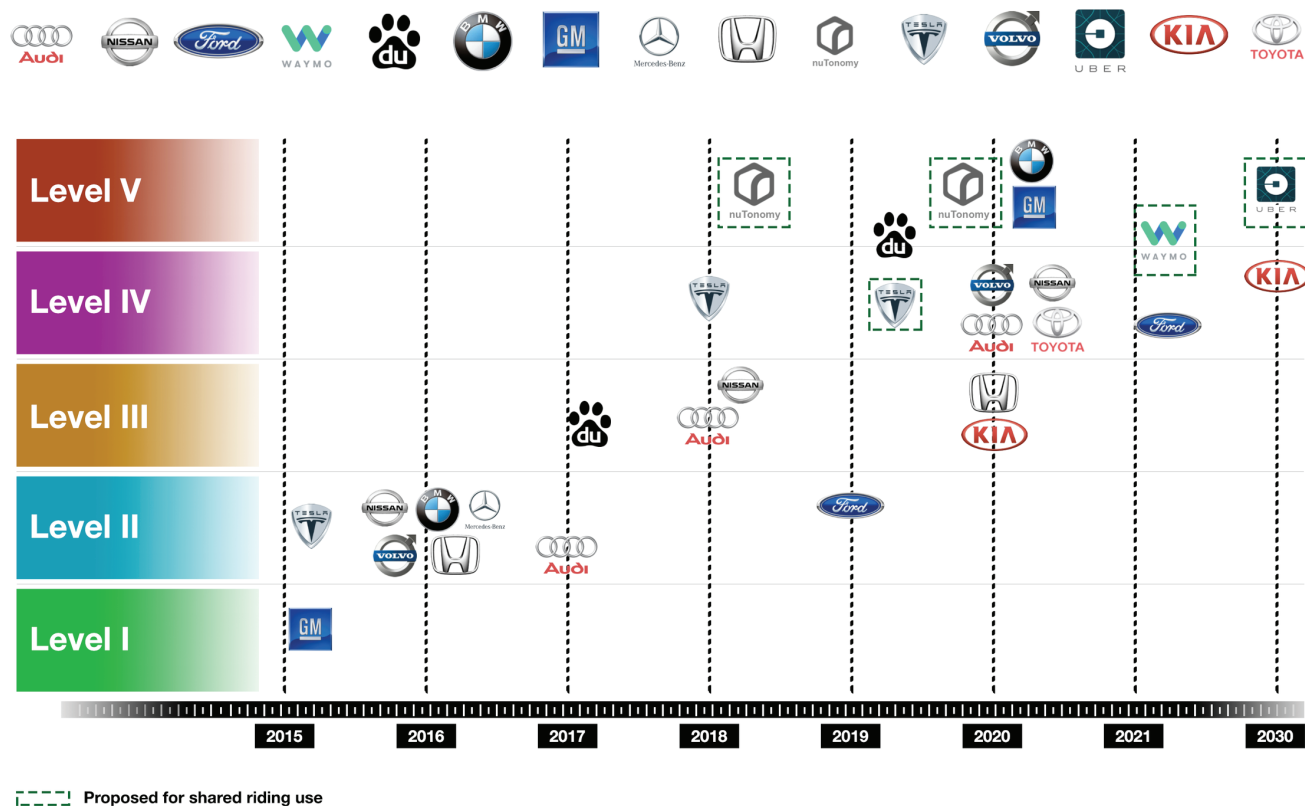
SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) AUTOMATION LEVELS

Full Automation



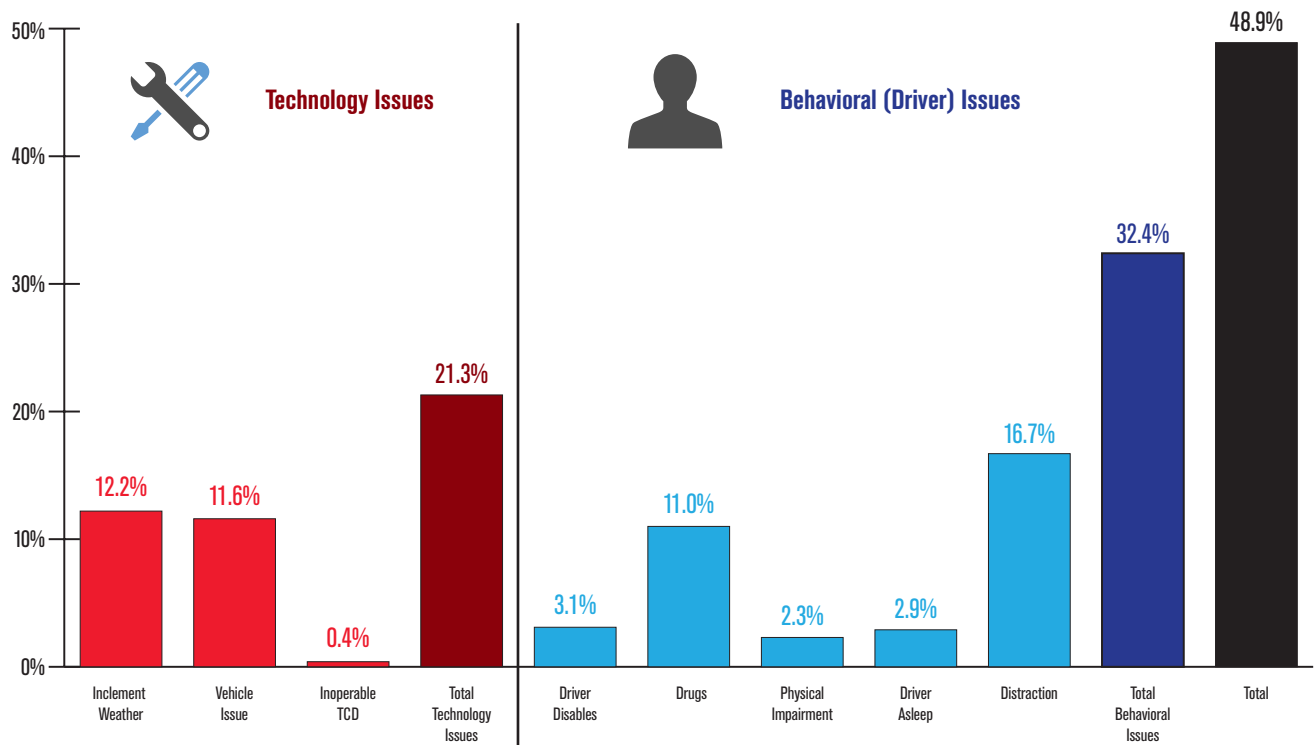
Source: National Highway Traffic Safety Administration, <https://www.nhtsa.gov/technology-innovation/automated-vehicles-safety>

Figure 2.



Source: Favaro FM, Nader N, Eurich SO, Tripp M, Varadaraju N (2017) Examining accident reports involving autonomous vehicles in California. PLoS ONE 12(9): e0184952. <https://doi.org/10.1371/journal.pone.0184952>

Figure 3.



Source: NHTSA.

National Motor Vehicle Crash Causation Survey (NMVCCS) notes that the other seven percent of accidents to close the 93 percent gap were caused by vehicles, environment and “unknown critical reasons.” The survey was based on 6,950 police-reported crashes from 2005 to 2007, before automated technology became available on the market.

According to the 2014 task force report, 32.4 percent of accidents are caused by human behavior while 21.3 percent relate to “technology issues.” These percentages do not add to 100 percent to reduce duplication of accidents with multiple causation. (See Figure 3.) The 2014 report also states that the CAS task force “has re-evaluated the NMVCCS in the context of an automated vehicle world. It found that 49%

of accidents contain at least one limiting factor that could disable the technology or reduce its effectiveness.”

Certainly the 2008 NHTSA figure mentioned earlier, that 93 percent of accidents are due to human behavior, deserves an update especially given safety features that have been introduced since 2007. What insurers find vexing, however, is the lack of information about automated features in cars entering the market and driverless cars being tested.

Information about driverless car safety and accidents is not publicly available in a national clearinghouse. Trying to find out something as basic as how many people suffered injuries related to more fully automated vehicles being tested is a time-consuming endeavor.

Driverless Utopia, page 41

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Actuaries and Data Scientists: An Evolution in Teamwork

BY JIM LYNCH, FCAS

The lion and the lamb. Burr and Hamilton. Patriots fans and everyone else on the planet. No. The rivalry between actuaries and data scientists is not as intense as these.

Nor should it be. But there is a natural tension between the two disciplines, as actuaries have had to cede some portion of their mantle of analytics guru to a new profession.

Overcoming the all-too-predictable challenges between the professions was the theme of a session appropriately titled “Effective Collaboration Between Actuaries and Data Scientists” at the Casualty Actuarial Society’s Ratemaking, Product and Modeling Seminar in Chicago in March.

There, an actuary (Jeff Kinsey) and a data scientist (Jeffrey Rambole) presented their employer, State Farm, as a case study in how to structure the two jobs (and the world around them) to maximize value.

The emergence of data scientists has helped the actuarial profession, Kinsey said. Ten years ago, actuaries were “a bit more in the department,” i.e., compartmentalized in the organization. Now they find themselves in leadership positions

throughout the company: underwriting vice presidents, IT leaders or leading new, disruptive companies.

The inevitable question: What is a data scientist? “If you ask 10 people what a data scientist is, you’ll probably get 15 answers,” Kinsey said.

The job is an unusual merger of computer science, statistics and business acumen, he said. Rambole chimed in: “It’s perceived to be a unicorn. You don’t see it very often.”

Actuaries are a similar, unique blend.

Data scientists and actuaries have similar skills (data acumen, computer science, business savvy), but usually their strengths differ, said Kinsey.

Actuaries usually have stronger business acumen. They know the mathematics behind insurance: loss reserving and business statistics.

Data scientists typically have deeper data and computer science skills, Kinsey and Rambole said. They are stronger in the discipline of statistics. They have deeper understanding of machine learning and coding.

Kinsey and Rambole took a live poll of the audience of mainly actuaries on what the most important skill of a data scientist is. Data wrangling and statistical knowledge were the top choices. Both were selected by more than a third of those voting.

For each project there is an appropriate proportion of actuaries and of data scientists. The trick is to find it. State Farm does that by creating a centralized/decentralized structure for its analysis teams. Teams come from one of three areas:

- P&C actuarial teams make pricing models. These teams are overwhelmingly made up of actuaries but also include data scientists.
- P&C underwriting teams create underwriting models. They are composed of a more balanced mix of both actuaries and data scientists. In these, business knowledge is critical.
- Advanced analytics teams are predominantly made up of data scientists. “They are doing a lot to move the analytic needle in insurance companies,” Rambole said.

But they still need actuaries, whose understand-

Ten years ago, actuaries were ... compartmentalized in the organization. Now they find themselves in leadership positions.



ing of proven techniques (think credibility) and their ability to explain the complex come in handy.

The actuary can break the complex math down into digestible bits. This helps executives, underwriters and, sometimes, regulators understand what a model does.

Challenges may span different areas, such as:

- **Terminology:** Both data scientists and actuaries have their own terminology that can have a bit of a learning curve to understand. This is compounded when the same term can have different meanings in the two disciplines.
- **Software:** Actuaries have traditionally worked in Microsoft Office-based products, proprietary software or GUI-based modeling tools. Data scientists operate in Python, R and H2O. This can make it difficult for one profession to review the code of the other.
- **Computing environments:** Actuaries work on the laptop. Data scientists work on distributed environments, including the cloud.
- **Strategies:** Models that actuaries have traditionally been responsible for require transparency to both internal and external audiences. This has generally meant that an actuary's go-to model is linear-based. The go-to model for a data scientist may not have the same level of transparency (think neural network), which may limit its applicability for production-based models.

"It's really easy to get territorial," Rambole said, "but working together is essential to increase the analytic function of our organization." 

James P. Lynch, FCAS, is chief actuary and director of research for the Insurance Information Institute. He serves on the CAS Board of Directors.



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Overcoming Predictive Modeling Stumbling Blocks in Small Commercial Insurance

BY MATHEW STORDY, DIRECTOR OF COMMERCIAL INSURANCE

While predictive modeling has proven itself to be an invaluable risk assessment tool in personal lines insurance, adoption of predictive modeling has been relatively slow in commercial insurance. Particularly for carriers writing small business policies, the lag in adoption is due to a lack of resources. Other times, it's because an insurer doesn't understand how to build an effective model. Or, there may simply be concerns about engaging the organization in the process.

Leveraging from the product development life cycle

To overcome the paralysis, a few best practices make implementing predictive models achievable for any carrier, regardless of their expertise level. Creating and using an effective predictive model can be likened to following a four-stage product development lifecycle process: ideation, design and development, implementation, and monitoring.

The following is a simple, yet proven, best practices framework for integrating predictive modeling into a workflow to better predict risk and improve business outcomes.

Step 1: Ideation

The success of any predictive modeling initiative requires strong executive sponsorship to ensure all the right resources will be applied, and it requires a committed cross-functional team to bring the idea to reality.

In the ideation phase, the team begins by showcasing the benefits of predictive modeling to establish buy-in from key stakeholders across the organization. They must identify and prioritize the key problems to be solved through predictive modeling, determine the cost and ROI of the project, and figure out how to integrate the predictive model into the underwriting workflow, including measurable success benchmarks.

Step 2: Design and development

While predictive models can be used for risk selection, pricing, claims fraud detection, claims subrogation potential and

so on, within small commercial insurers, there's a growing movement to use predictive modeling for risk assessment and pricing by building insurance scores that rank order risks in terms of loss propensity. Designing and developing this type of model is a very iterative process: It begins with data exploration, followed by training and validating the model, and finally, ensuring that the model complies with any applicable regulatory requirements.

Data exploration requires a team of business analysts, statistical modelers, IT resources and regulatory experts. Third-party data, including commercial credit, consumer credit and public records, should be evaluated to further enhance the risk assessment performance of your predictive model.

Building a model to predict loss propensity requires a large amount of data. Data is partitioned as either training data or validation data. Of course, all data sources and attributes used within the model must comply with

any applicable regulatory requirements.

There is good news

Effectively applying predictive modeling is a structured process that any organization can follow. In fact, there are a number of techniques or best practices that can help carriers make the most of predictive modeling to improve their business outcomes.

Step 3: Implementation

Once a model has been designed and proven, it's ready to be implemented within the workflow. Because implementation impacts so many parts of the operation, the team needs to identify and document the impact to existing business rules and procedures, such as rating and underwriting. They also must determine the IT requirements for building the model, application workflow changes, and storing the score and whether it's used or overridden.

Other requirements for implementation include making sure that any applicable customer dispute process is supported. Training all stakeholders and impacted parties comes next and then the team creates a rollout plan.

Step 4: Monitoring

With all the hard work completed, the last step is ensuring your model works as designed. Monitoring lets you know if the model is meeting performance expectations. There are two key parameters to monitor: usage tracking and model efficacy.

Regarding usage, score overrides can provide valuable insights into limitations, score adoption, and opportunities for improvement. Monitoring for model efficacy reveals if the model is meeting performance expectations. If it's not, a deeper dive into the underlying causes is needed. Sometimes all it takes is a minor recalibration.

Putting it all together

Embracing predictive modeling can be intimidating for small commercial insurers because there are so many moving parts, diverse constituencies, and often a mindset shift to be made. Mirroring the four-step process of a product development lifecycle provides a best practices blueprint for overcoming the many obstacles. By integrating predictive modeling into their workflows, insurers will be more successful in protecting and growing their book of business.

For more on the topic of predictive modeling, please

see our whitepaper, "Making Predictive Modeling Work for Small Commercial Insurance Risk Assessment," at risk.lexisnexis.com/MakingPredictiveModelingWork. 

Mathew Stordy is Director of Commercial Insurance for LexisNexis Risk Solutions.

He is responsible for requirements assessments and the design of data solutions and services that streamline commercial insurance processes and provide insights about entities through the use of data, analytics, and software. He has more than 20 years of experience focused on insurance software and specializing in P&C insurance systems. Stordy has worked in all phases of the systems-development lifecycle.

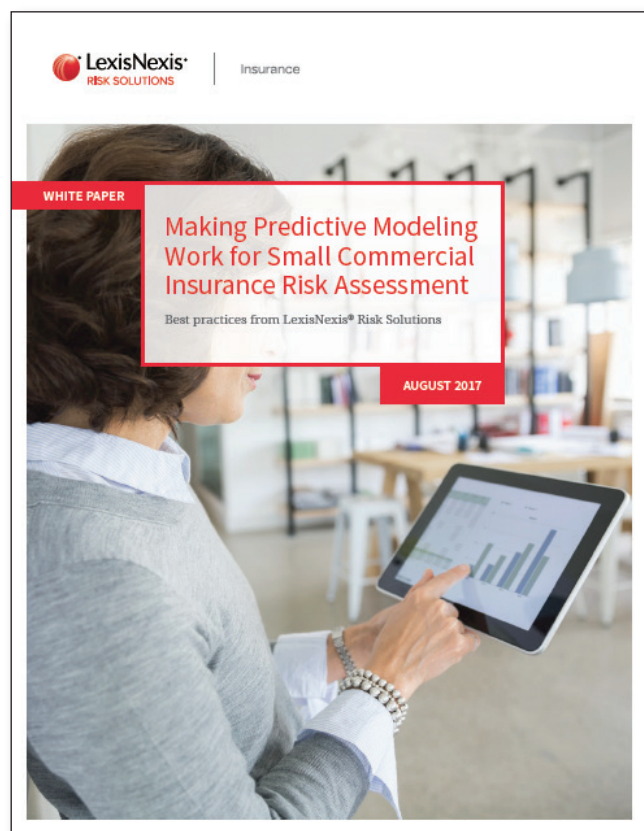


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Best Practices to Improve Business Outcomes

While predictive modeling has proven to be an invaluable risk assessment tool in personal lines, adoption within commercial lines is not as pervasive. Why? Often carriers lack the appropriate resources to build this capacity and/or they do not understand where to begin in applying a predictive model.

When an insurance carrier hesitates to integrate predictive modeling into the business, it's usually because of either a lack of resources or a lack of understanding about how to build an effective model.

But integrating predictive modeling into small commercial insurance is easier than many might think. Whether carriers choose to enlist the help of a solution provider or build a predictive model themselves from scratch, following a few best practices can make all the difference in achieving a successful outcome when using predictive models for risk assessment.

Download the white paper at risk.lexisnexis.com/MakingPredictiveModelingWork.



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Insurers Probe New Analytics Frontiers

BY J.J. IHRKE

Emerging data sources and advanced analytics provide an expanding universe full of promise for insurers — if they can navigate it effectively.

In a short space of time, data and advanced analytics have become new frontiers for transforming insurance company operations. A recent Willis Towers Watson survey of U.S. property and casualty (P&C) insurers' attitudes has confirmed that many have already embarked on this voyage of discovery and plan to probe deeper into it.

Priority areas

In terms of priorities, three areas dominate: the customer experience, claims management and applications of telematics data.

With customer expectations increasingly set by online retail environments, better customer centricity is a major focus. Big leaps in how insurers plan to use customer data (49% to 76%), surveys (43% to 69%) and auto telematics (24% to 57%) are seen as the main facilitators of faster, smoother and more personalized customer experience over the next two years.

Insurers also see huge unexplored potential for advanced analytics in claims. Key applications over the next two years are expected to be fraud prevention (82%) and triage to identify complex claims (80%), together with the evaluation of claims for both litigation and subrogation potential.

Expectations for the wider use of telematics data are similarly very high, mainly in pricing and underwriting but expanding also into customer management, claims and loss control over the next five years. Beyond the auto market, 43% of respondents see a significant role for telematics in homeowners' insurance within this timeframe.

Ring the changes

But carriers acknowledge that changes will be needed to turn these ambitions into reality.

This is reflected in the data sources that insurers see as useful and that they will need to interrogate over the next two years (Figure 1).

The analytics environment is also under scrutiny. The volumes, variability and lack of structure associated with new data types and are becoming increasingly difficult to manage using internal capacity, networks and processing systems. So, insurers are actively exploring technologies to help them manage big data — principally the cloud and Hadoop.

Attitudes towards modeling techniques are also evolving.

Figure 1: Top-growing new data sources insurers plan to use two years from now



Personal lines		Now	Two years
Smart home/smart building data		0%	52%
Usage-based insurance/telematics		26%	70%
Social media		26%	52%
Unstructured internal claim information		39%	61%
Unstructured internal underwriting information		30%	52%
Images		13%	35%
Commercial lines		Now	Two years
Unstructured internal claim information		46%	92%
Other unstructured customer information		11%	54%
Unstructured internal underwriting information		25%	39%
Usage-based insurance/telematics		11%	47%
Web/clickstream/phone/email customer interactions		11%	36%
Images		3%	39%

Backing up the generalized linear models that three quarters of companies already use, a quarter of companies surveyed are looking to add artificial intelligence and machine learning techniques over the next two years. These are also seen as important for streamlining operations and making cost savings. Many companies are also focusing on improving what 83% of carriers categorize as “moderate” or “limited” levels of understanding of advanced analytics outputs within the business.

Staying on course

The course seems set for a future where insurers aim to use data and advanced analytics to better quantify risk, streamline processes and improve customer experience — or a combination of them all.

Each company's journey will be different, but our experience points to the benefits of three guiding principles.

Concentrate on data first. New (or better) experience data, predictors and customer response information will always trump new methods being thrown at the same data.

More data, in depth analysis and new insights aren't the end game. They have to be able to be translated into something the business can understand, implement and monitor and from which it can derive and offer value.

Stay on top of the technology. Legacy company systems and networks will make it increasingly difficult to conduct business effectively in the advanced analytics age. New technologies that enhance analytical capability and system connectivity, including those coming out of the insurtech movement, will have a greater role to play.

For more information, email jj.ihrke@willistowerswatson.com. 



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Are Actuaries Competitive in Data Science?

It has been said that actuaries were the first “data scientists,” but can we still describe ourselves as such, asks Colin Priest, an actuary turned data scientist at DataRobot. Colin comes with 30 years of experience working with many insurance companies globally.

A data scientist exists in the intersection of three skill sets: coding/programming, mathematics and statistics, and domain knowledge. Coding allows data scientists to manipulate data and create algorithms. Mathematics and statistics allow them to use data to predict future outcomes. Then data scientists need to understand people and business rules to solve practical business problems. People with all three of these skills are rare and valuable.

Does actuarial training stack up?

In recent years, when I started teaching data analytics to actuaries, I discovered, to my surprise, that it was no longer compulsory to learn programming. And while actuaries learn statistics and mathematics, their education is narrowly focused. But actuaries do know a lot about insurance — the law and regulations, underwriting, claims management and product design.

The worry is that this gap is negatively affecting the employment prospects of actuaries. Actuarial employers are increasingly expecting their staff to have the same skill set as data scientists. In its most recent survey of actuarial employers, the Singapore Actuarial Society reported that almost half expected new actuaries to write code, manipulate data and use statistical software.

A further theme in the employer feedback was that actuaries need to “improve on programming skills.” In the U.S., data scientists have increasingly been hired for roles that were traditionally actuarial.

Historically, actuaries have adapted to new techniques and technologies. In the 17th century, actuaries developed deterministic methods for managing life insurance. In the early 20th century, they applied probabilistic methods to general insurance. And, in the early 21st century, actuaries were among the first to adopt enterprise risk management. Now, in the 2010s, it's time for actuaries to further improve their skills. Here's what actuaries need to learn:

- Data manipulation and joining tables.
- The theory of machine learning (training versus testing,

overtraining).

- Machine learning algorithms.
- Mathematics and statistics: missing value imputation, optimisation, numerical estimation.

The good news is that modern technology makes this easier than ever. Data manipulation doesn't need to be a time-consuming manual process: Modern drag-and-drop software allows you to visually design data pipelines that manipulate data and merge data sources. There are free online courses

about learning from data that teach machine learning theory. And you don't need to learn dozens of arcane algorithms or spend months writing code to implement them.

The latest technology is automated machine learning — expert software that automatically finds the best algorithms for your data, applies best practices and avoids overtraining.

With these technological tools, actuaries can step up and be competitive in data science. Actuaries' business knowledge and communication skills can give them a competitive advantage.

This article was originally published in The Actuary: <http://www.theactuary.com/opinion/2017/12/are-actuaries-competitive-in-data-science/>.

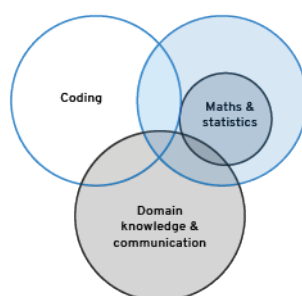
About DataRobot:

For a 21st-century insurance company, AI & machine learning have to be core capabilities. From Distribution, Marketing, Underwriting to Claims & Operations — AI applications are driving profitable growth for companies

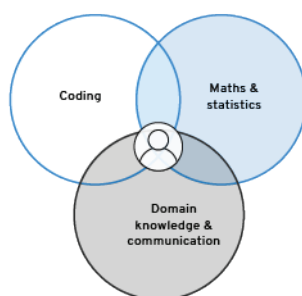
*through better and faster decisions and making their customers highly satisfied. With the DataRobot platform, organizations develop, integrate and operationalize AI applications across all core functions. Founded in 2012 and built by insurance veterans with more than 100+ years of combined experience from several F100 companies, DataRobot raised \$125 million in funding, grew to a 300+ organization, and amassed a customer base that covers a large number of global F500 companies from a variety of industries. **Fun Fact:** DataRobot chief data scientist, Xavier Conort, is an actuary who was Kaggle's #1 data scientist for more than a year!*

Become a practicing data scientist — attend the highly sought-after DataRobot University for Actuaries at <https://www.datarobot.com/education/>.

What is an actuary taught?



What does a data scientist do?



Competitive Intelligence — An Insurance Policy for Pricing

BY KATHRYN A. WALKER, FCAS, MAAA, CSPA, CPCU, CONSULTING ACTUARY

Insurance carriers are continually looking for a competitive advantage through initiatives such as new product offerings, unique customer segmentation, innovative rating variables and deeper market knowledge. Each of these is a stepping stone to growth and profitability. However, insurers are challenged to connect these into a cohesive business strategy. The decentralized core processes of rating, product development, underwriting and marketing have created competing goals and disconnected views of the business.

As companies strive to become more innovative and add increased analytics and metrics to their operations, the need for more comprehensive data is even greater. Insurers seek to make more confident decisions as they continue to work through existing system, operational and regulatory time constraints. Carriers are focused on continuously monitoring and synthesizing results given the perpetual flow of information now available.

Consumer shopping data has become a valuable addition to traditional insurance data sources for these very reasons. Insurers are desperate to understand factors driving sales and retention, and they want to make more informed decisions to avoid costly implementation mistakes. Key data elements

about the quotes, including quoted premium amounts and policy, driver and vehicle characteristics, are compiled into robust market basket datasets that can be used for analytics purposes. These data sets reflect real consumers shopping for insurance and the real pricing for the risk at that point in time.

Consumer shopping data can be used for a number of different applications, such as:

- **Filling existing information gaps** — Insurance companies face information gaps in various situations, such as entering a new state or product line or adding a new variable, discount or surcharge to their rating plan. By incorporating comparative rater data, insurers can overcome these information gaps. Further, with information about the consumers in the new state, the insurer is able to set realistic sales goals, develop benchmarks and create monitoring reports. By better understanding their competitive position, insurers will have increased confidence in their rating plans and are better able to work with agents to target profitable business.
- **Validating business decisions** — Insurers concurrently seek rate adequacy, battle competitive challenges and



strive to align their programs with regulatory requirements. As rating plans are refined, the view of the competitive landscape provides additional insights on expected performance for retention and conversion. This information is extremely valuable when setting

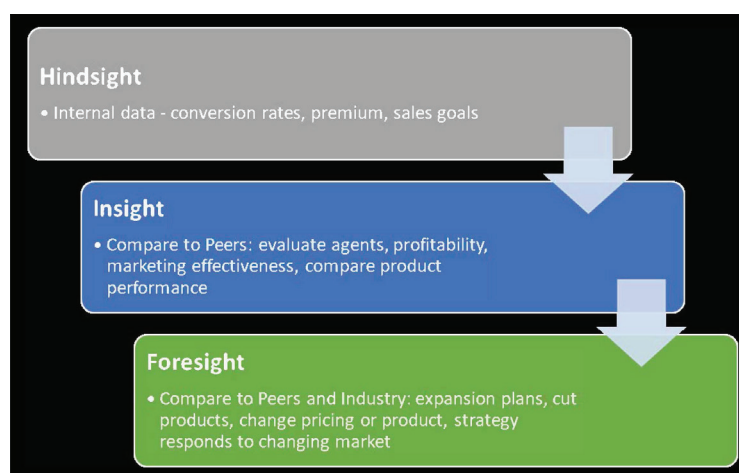
internal business goals related to conversion, retention, average rate levels and agent response.

- **Identifying shopping trends** — Traditional target marketing methods have focused on identifying an “ideal” customer who is less prone to loss based on certain risk characteristics. Unfortunately, there is not always an abundance of these “ideal” customers in the shopping population. By reviewing characteristics of recent insurance quotes, an insurer will soon realize that these customers make up only a fraction of a percent, and thus will be forced to develop a more realistic view of the shopping population.
- **Creating benchmarks and metrics** — Like most companies, insurance companies have growth and profitability goals. The measurement of those goals is often on a calendar-year view to align with budgets and contingency plans. To actively manage business performance, insurers need to create dynamic business plans and monitor standard metrics, such as frequency and severity, in more meaningful ways.

Future Applications

As competitive data becomes more prevalent and available, there are a number of current analyses that can be enhanced with this behavioral element. Rating plans can be designed using the loss costs intrinsic in premiums available in the market. Policy lifetime value can be analyzed when the shopping triggers are known, and insurance affordability can be better understood by including available premium quotes.

As the pace of change continues to accelerate, conventional wisdom will continually need to be challenged. Insurers will need to be able to make decisions in the future that currently take hours to weeks in real time.



Conclusion

As insurers continue to seek competitive advantages to profitably grow their business, they will rely on innovative applications of data, analytics and metrics. Including competitive data and behavioral information will supplement traditional pricing, underwriting and marketing practices, and allow the

insurers to make more intuitive business decisions.

Traditionally, most companies have created plans and goals using historical information and then developed action plans to achieve those goals. With more information available today, the sequence is beginning to reverse such that insurers will be able to gather information related to the individual policy risks and create more accurate and insightful forecasts. This information can then be used to drive strategic plans related to growth, retention and profitability, and to create tactical plans and metrics.

The most successful insurance companies have maintained a broad view of the industry and focused on creating additional segmentation and increased pricing accuracy. Utilizing a perpetual flow of information related to the competitive landscape allows these companies to continuously monitor results and make strategic changes as needed. Further, these adjustments are often related to the underwriting and marketing of the program rather than modifying the rates. 📊

Katey Walker is a Consulting Actuary in Pinnacle Actuarial Resources, Inc.'s Chicago office and has over 17 years of experience working in the property/casualty industry. She has extensive loss reserving and pricing experience in personal, commercial and specialty lines of business, including managing the implementation of predictive models. Katey has considerable experience in the development and monitoring of key metrics, attestation and management reporting, data governance and trend analysis. She currently serves on the Casualty Actuarial Society Board of Directors.



Public Records Attributes Boost Predictive Modeling Effectiveness

BY PRINCE KOHLI, ACAS; JIAPEI WANG; AND KELLY RUSH

The search for the next big data source

The access and use of public records across a broad spectrum of services and industries in the United States has dramatically increased over the past 30 years. At the same time, insurance carriers have significantly ramped up investments in their internal analytical resources and capacity. Carriers are now looking to leverage these investments across more decision points in all areas of their business.

This initiative is fueling a greater demand for more data to analyze, in an easily digestible format, in order to answer specific questions about risks and exposures that are not fully explained by current models. Public records attributes have emerged as the next big data resource for the insurance industry and can be leveraged to provide benefits across the insurance continuum.

The lift that public records attributes can offer above and beyond current insurance models may be the difference between a carrier making a profit or losing money.

Public records as a predictive modeling enabler

As data analytics have become more sophisticated, predictive modeling has evolved to enable the analysis of increasingly complex data environments. Depending on the predictive modeling approach, these new methods and environments drive three primary data needs:

1. *Much more data.* Some new predictive modeling methods require substantially more data than previous methods. For example, the data needs for assessing comparable confidence intervals differ greatly for linear regression as compared to non-linear regression.
2. *Data that is “new” or “orthogonal” to existing data.* Utilizing data to predict behavior that is already explained is redundant and a waste of resources. The preferred approach is to use new or different data that explains behavior beyond what existing variables provide and is not dependent on or related to existing variables or attributes.
3. *Data that is prioritized.* The amount of data that can be obtained in the modern connected world includes a massive amount of duplicative or spurious explanation. Understanding of true relationships is an absolute necessity in highly regulated business lines. Legal discoverability heightens the need to justify industry methods within a public forum.

Public records data meets all of these needs.

LexisNexis public records data offerings have been supporting these industries since 1999 through data, attributes and report products. When it comes to public records, LexisNexis is a data expert. We aggregate 65 billion records from more than 10,000 data sources to provide detailed information on individuals, businesses and other entities. Our robust public record coverage includes bankruptcy filings, felony convictions, real property ownership, professional licenses, suits, liens, evictions and judgments, voter registration, watercraft and aircraft ownership, education records, published business associations and phone records. In total, our public records footprint covers 95% of the U.S. population.

Using attributes in predictive modeling

Attributes add value to data by allowing it to be interpreted in a way that answers specific questions. Each attribute represents a piece of information, or a data point, about some specific “thing.” That thing could be a person, a building, a business, a vehicle identification number (VIN), a geography and so on. By using attributes, a statistical modeler can separate out all the singular pieces of information within a data source and reform them to answer a question such as, “How long has it been since this person applied for credit?”

Well-designed attributes free the modeler from time spent analyzing the raw data to put more focus on gaining insights. Attributes also simplify the programming process by vastly reducing the time required for the IT team to program and test underlying data.

Lastly, and very importantly, attributes enable the customization that can help carriers develop unique solutions that will stand out against the competition.

Meeting carrier needs

Building upon our extensive expertise in data and credit attributes and one of the industry’s largest collections of public records and other alternative credit data sources, LexisNexis has developed more than 250 public records-based attributes to give carriers a more holistic view of consumer risk.

LexisNexis® InsurView™ Attributes are based on public, institutional and other alternative credit sources not reported to national credit bureaus. According to our internal data analysis, the solution can provide accurate insurance risk as-

assessment on 95% of credit-active consumers and on approximately 75% of consumers with no credit history.

We used these same attributes to develop scores and realized a lift of 20 points when comparing the most-risky and least-risky quintiles in a 14 million record validation dataset, using a control model that included credit, age, gender, territory and property ownership. The overall top-to-bottom ratio for the InsurView™ model for decile groupings is 1.31. These attributes are truly predictive.

These attributes and the score offer carriers a number of advantages, including:

- The ability to expand risk assessment beyond traditional scoring to gain a more complete view of a broader range of risk variables.
- More effective risk segmentation, which can lead to improved volume and profitability.
- A more holistic view of target markets that enables faster and more thorough risk assessment, thereby avoiding adverse risk selection.

Putting it all together

The insurance marketplace is a hyper-competitive environment. The ability to differentiate from the competition is critical. InsurView Attributes supports this differentiation by allowing carriers to easily ingest and use public record information to create effective predictive models that drive improved decision making and provide a competitive edge. 🚀

InsurView™ Score Quintiles	Relative Adjusted Loss Cost
Best	0.90
Good	0.95
Average	0.98
Poor	1.01
Worst	1.10

Source: LexisNexis internal data analysis

For more information, call **800.458.9197**, email insurance.sales@lexisnexisrisk.com, or visit risk.lexisnexis.com/insurance.



HARNESS THE POWER OF IoT DATA

95% of carriers that collect IoT data aren't using it.

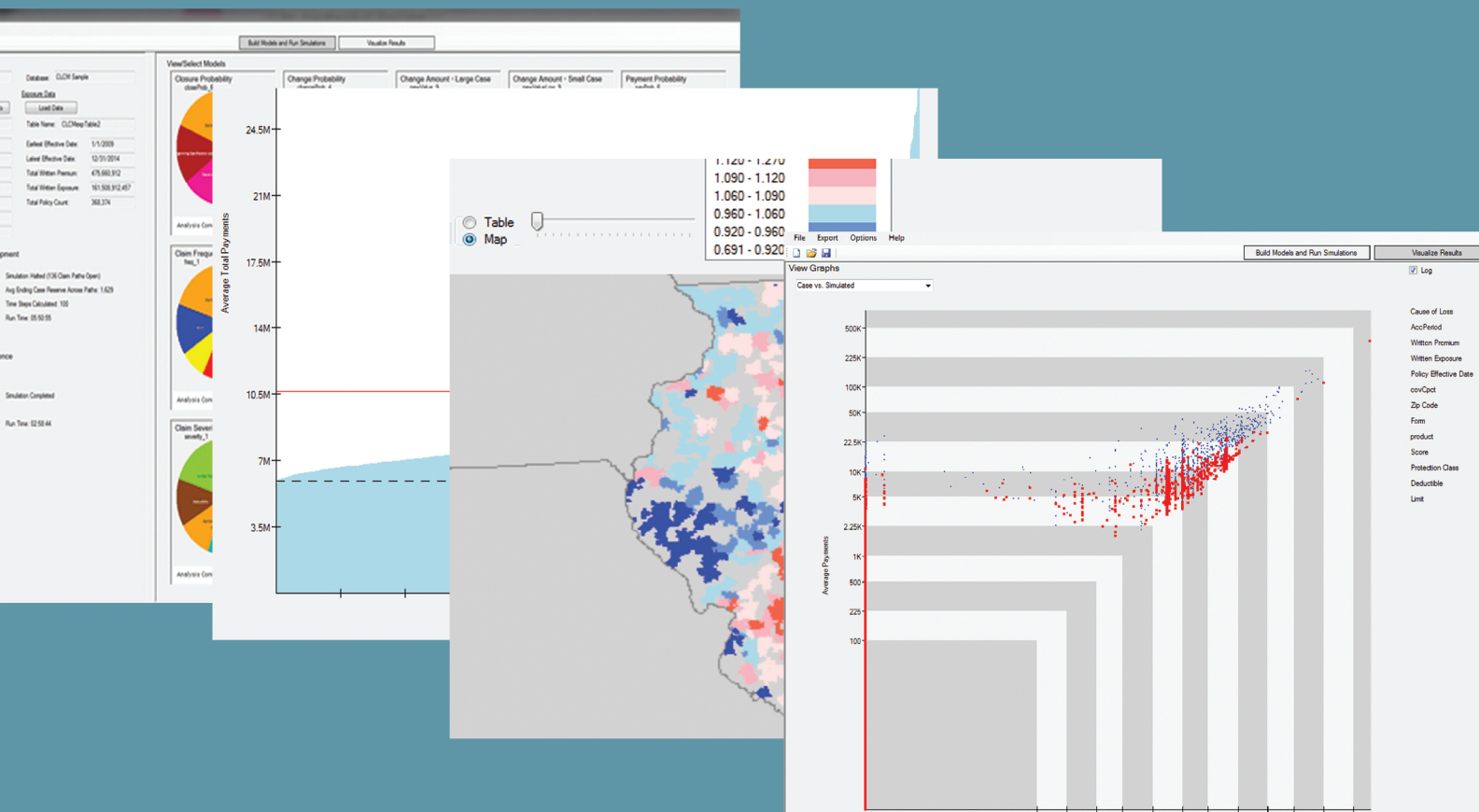
Find out why.

Download the study at
www.risk.lexisnexis.com/IoT2018Study





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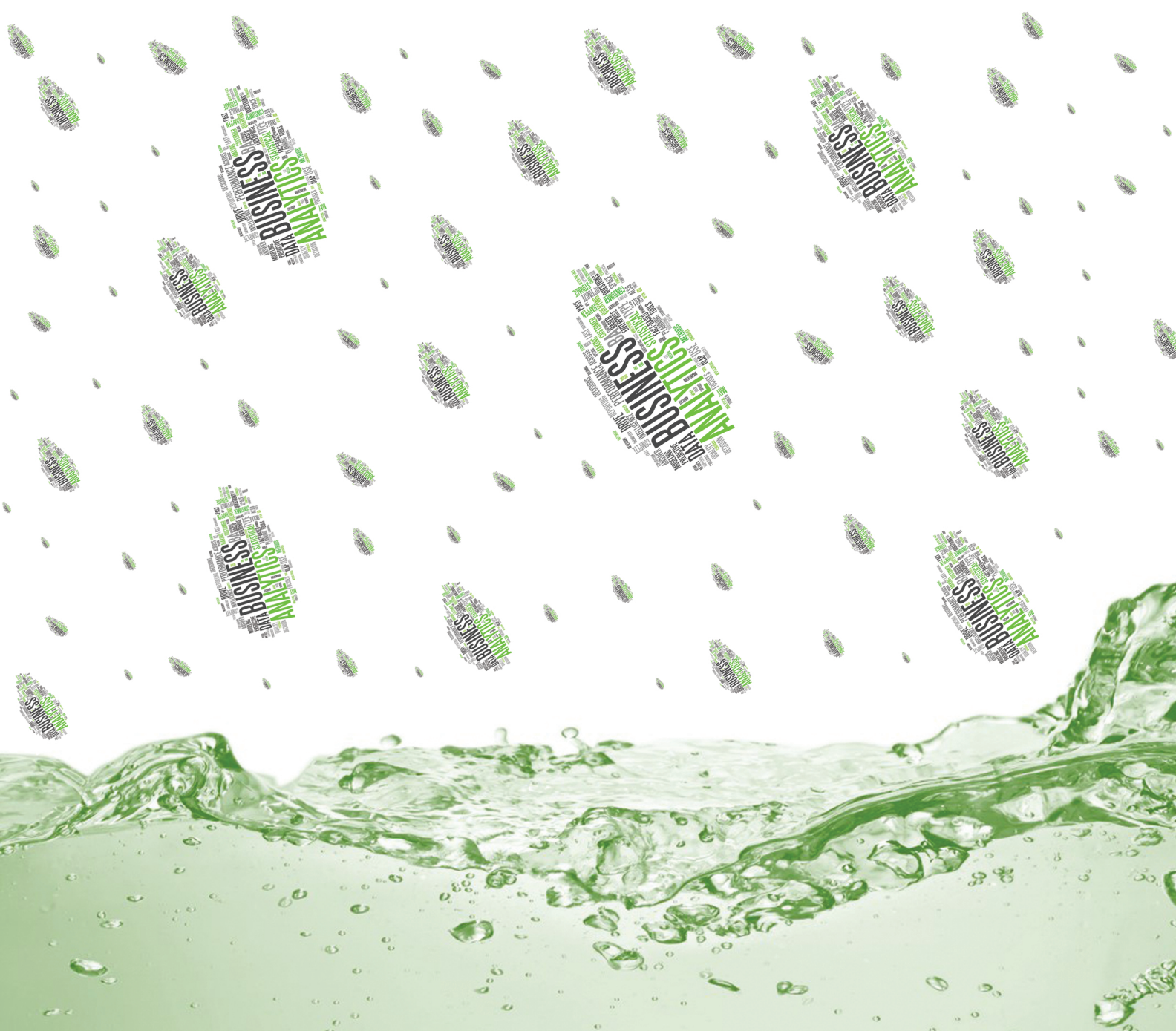
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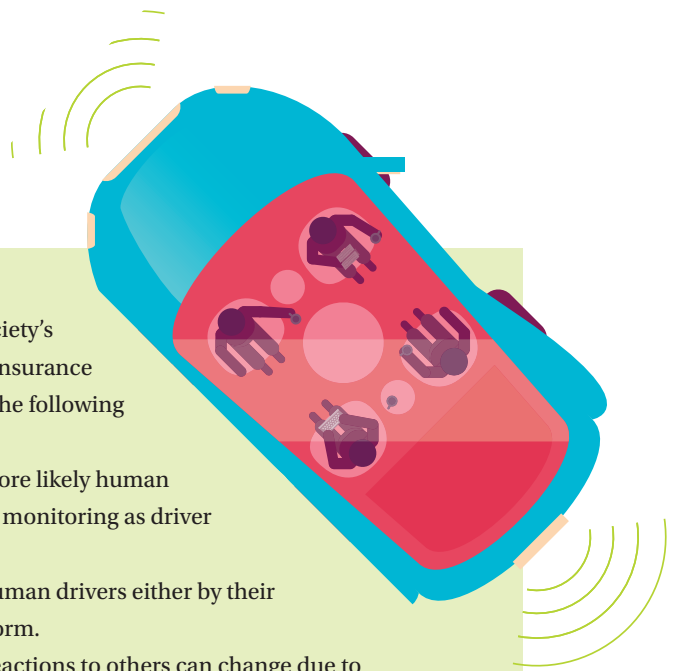


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A Call for New Datasets

To measure the risk potential of driverless cars, the Casualty Actuarial Society's Automated Vehicle Task Force's latest report, "Automated Vehicles & the Insurance Industry: A Pathway to Safety: The Case for Collaboration," recommends the following datasets for collection:

- **Driver Skill Deterioration.** The more technology is in control, the more likely human drivers will become out of practice. The dynamic risk needs constant monitoring as driver proficiency may change over time.
- **Pass-Off Risk.** This occurs when technological control transfers to human drivers either by their choice or when the vehicle encounters a scenario it is unable to perform.
- **Other Interaction with Drivers, Pedestrians and Bikers.** Drivers' reactions to others can change due to age, experience, technology familiarity, mood, etc.
- **Animal Hits.** Animals may be even more unpredictable than people. State Farm, for example, estimates that accidents involving vehicles and deer cause more than 1.2 million collisions annually. Meanwhile, the National Highway Transportation Safety Administration's 2008 "National Motor Vehicle Crash Causation Survey" lists animals as the cause in 1.0 percent of police-reported accidents.
- **Hacking.** The more technology in the vehicle, the greater the potential vulnerability to hacking.
- **Random Errors.** The task force assumes technological errors will still occur.
- **Unknown.** It is important to include a placeholder for unpredictable events.
- **Incident Severity Risks.** By dividing the automated vehicles into their respective risk components, actuaries can create a risk management structure that minimizes severity of unpreventable incidents. These data measures include speed, pedestrians, location and vehicle design.

Driverless Utopia

from page 20

Most of what is known about driverless cars comes from a smattering of investigations, independent studies and manufacturer reports to states. And for the most part, driverless car experiments have been operating in ideal driving conditions where the vehicles might not be ready to be tested in real-world chaotic situations.

Not surprisingly, approaches and conclusions about the safety of driverless cars vary considerably. IIHS reviewed two studies, both of which accounted for the underreporting of human crashes to police but used different methods. A University of Michigan study found the Google crash rate was *higher* than the human crash rate although the

autonomous cars were rarely at fault. A Virginia Tech study, which also compared naturalistic driving studies with Google-reported incident information, concluded Google cars were *safer* than human motorists.

IIHS took another approach, comparing Google's automated cars with human drivers in conventional vehicles around Mountain View, California. Zuby says that IIHS found that the Google car rate of police-reported crashes was one-third that for human drivers in Mountain View and that the driverless-car involved crashes were less severe.

To reach the closest apples-to-apples comparison, IIHS looked at the difference between Google cars and human drivers in the area where Google did most of its testing during the com-

**For the most part,
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Manufacturers are simply not used to handing over what they consider to be proprietary information. As a result, there is not enough information on Level 2 cars already on the road, including automated features and body specifications.

parison period. This way, geography, traffic density, other drivers, weather and additional factors were similar. IIHS sorted through all Google car crashes that met the characteristics of human crashes typically reported to police. Notably, three-quarters of the crashes involving automated vehicles occurred when a person rear-ended the driverless car, which occurs at a lower rate for incidents involving conventional vehicles reported to police in Mountain View, Zuby adds.

Insurers still don't know much about the automated technology currently available to consumers. Manufacturers are simply not used to handing over what they consider to be proprietary information. As a result, there is not enough information on Level 2 cars already on the road, including automated features and body specifications. "You can't tell from a VIN which vehicles have automated driver assist or auto braking," said Robert Passmore, assistant vice president of personal lines policy for the Property Casualty Insurers Association of America (PCI).

Last October, PCI advocated for a bipartisan provision that would require manufacturers to share more information about the vehicles they make. This was added to U.S. Senate Bill S. 1885, the American Vision for Safer Transportation through Advancement of Revolutionary Technologies (AV START) Act, which is intended to encourage development and deployment of highly automated vehicles in a safe and respon-

sible manner.³ However, in February 2018, three Senators blocked the full bill due to safety concerns about automated vehicles.⁴

Identifying New Risk Factors

Part of the CAS task force's objective is to encourage greater collaboration. "Depending on the problem we're looking to solve, we will need unique types of collaboration models. A data clearinghouse on automated vehicle data will assist in proper ratemaking and pricing of a risk," says Jonathan Charak, assistant vice president at Zurich North America and vice chair of the CAS Automated Vehicle Task Force. "Further collaboration across the legislature, engineers, manufacturers and risk management professionals can lead to the safest possible introduction of automated vehicles to the public."

To that end, the task force's recent report offers some dataset suggestions for assessing the risk potential. (See sidebar, "A Call for New Datasets.") Three of the datasets recommended by the task force — random errors, hacking and "pass-off" risk — are particularly relevant because they highlight how technology can also be a source of accidents.

Since technology is not perfect, "random errors" take place as new technology continuously evolves and learns from itself. In 2016, an Uber semi-driverless car ran a red light on its own on a busy San Francisco street.⁵ The same thing happened in Phoenix.⁶ In both

³ <https://www.gpo.gov/fdsys/pkg/CRPT-115srpt187/pdf/CRPT-115srpt187.pdf>

⁴ <http://www.thedrive.com/sheetmetal/17962/federal-autonomous-car-legislation-blocked-in-senate>

⁵ <https://www.nytimes.com/2017/02/24/technology/anthony-levandowski-waymo-uber-google-lawsuit.html>

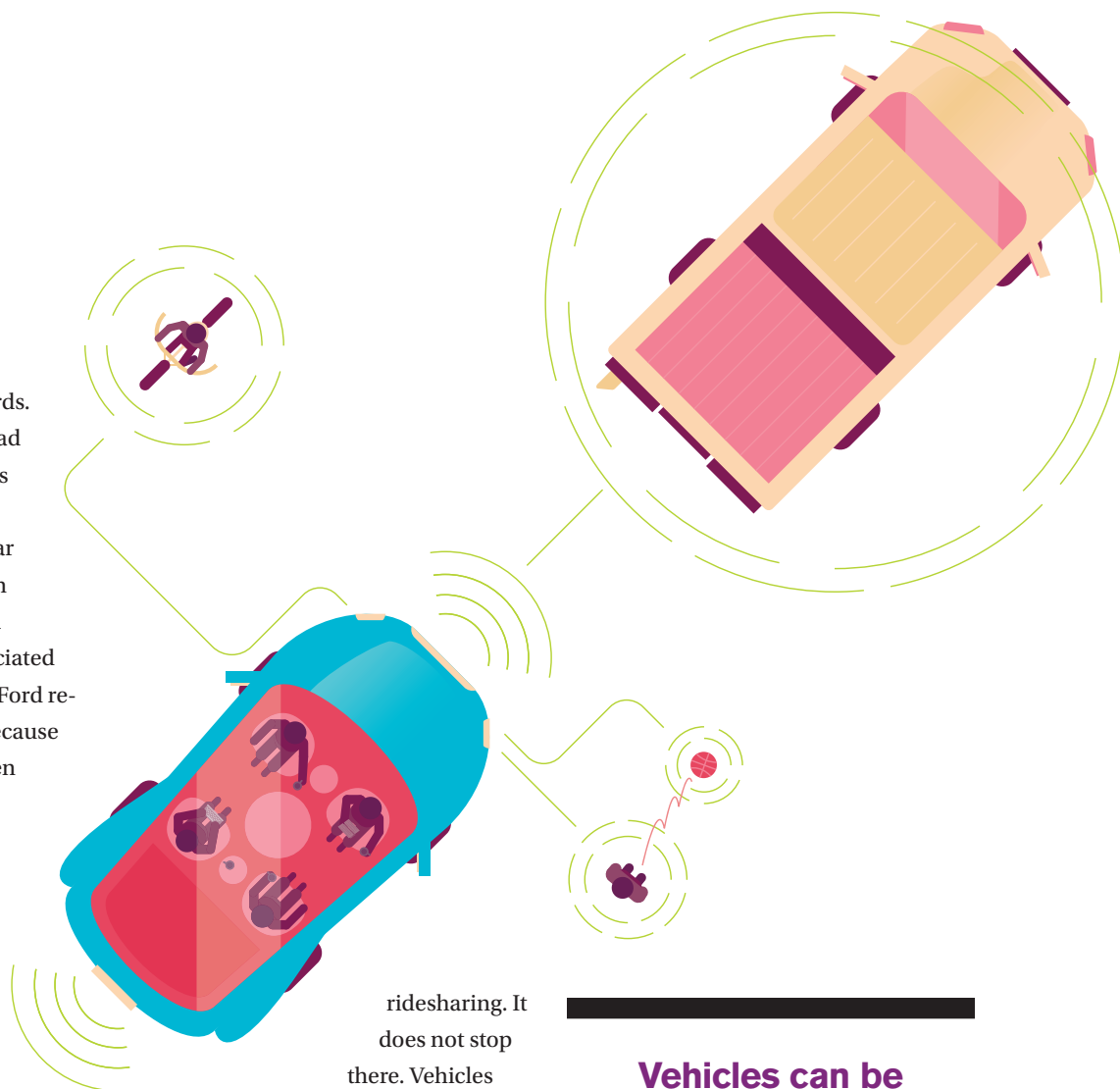
⁶ https://www.washingtonpost.com/news/innovations/wp/2017/03/29/we-know-more-about-that-crash-involving-ubers-self-driving-car/?utm_term=.c4bc56675710

cases, the professional drivers had no time to respond.

Even in conventional vehicles, new technology can introduce unanticipated hazards. In 2015, for instance, Toyota had to recall 31,000 full-sized Lexus and Toyota cars because the automatic braking system radar mistook steel joints or plates in the road for objects ahead and deployed the brakes, the Associated Press reports. That same year, Ford recalled 37,000 F-150 pickups because the vehicles stopped even when nothing was in the way.⁷

Another potential technology-related cause of incidents is vehicular vulnerability to hacks. It is a very serious issue that has already been demonstrated in conventional cars. “Autonomous vehicles are at the apex of all the terrible things that can go wrong,” Charlie Miller, one of the masterminds behind the hacks inflicted on a Toyota Prius, Ford Escape and Jeep Cherokee, tells *Wired*.⁸ That is because in a driverless car, the computer controls everything.

“Cars are already insecure, and you’re adding a bunch of sensors and computers that are controlling them ... If a bad guy gets control of that, it’s going to be even worse,” adds Miller, who worked at Uber and other companies before securing a position at Didi, a Chinese company working on autonomous



ridesharing. It does not stop there. Vehicles can be hacked and remotely hijacked using internet-connected devices that are illegally plugged into the vehicles’ on board diagnostic ports.⁹

There is also “pass-off risk” that can arise when a human driver either chooses or is forced to take control from the technology. Further, the task force report warns that drivers can become too reliant on the cars and more prone to distraction. It is also possible that motorists might not respond quickly enough to the car’s warning system.

Machine vs. Man

Pass-off risk is a gray area where the

Vehicles can be hacked and remotely hijacked using internet-connected devices that are illegally plugged into the vehicles’ on board diagnostic ports.

⁷ <https://apnews.com/ee71bd075fb948308727b4bbff7b3ad8>

⁸ <https://www.wired.com/2017/04/ubers-former-top-hacker-securing-autonomous-cars-really-hard-problem/>

⁹ <https://www.wired.com/2017/04/ubers-former-top-hacker-securing-autonomous-cars-really-hard-problem/>

The report stresses the responsibility of states to allocate liability, to determine who must carry vehicle insurance and to consider rules and laws allocating tort liability.

technology, the driver or both can blur accident cause, which complicates liability issues.

Experimental studies show that automated driving assistance systems unexpectedly stop functioning in common driving situations. “Typical scenarios include heading uphill when lane markers on the other side become obscured, going around certain bends and sections where the number of lanes increase or decrease,” Zuby says, noting that the reason this is a concern is that if the driver’s hands are not on the wheel with eyes on the road then he or she may not be able to keep the vehicle from crashing. “One of the big unanswered questions about partial automation is how to design it in a way that the human driver knows or understands the system’s limitations as well as his or her own responsibilities.”

The need for “immediate interaction between drivers and the vehicle could prove problematic,” observes Chris Nyce, a principle with KPMG. Nyce is a coauthor of the consulting firm’s report, “The Chaotic Middle: The Autonomous Vehicle and Disruption in Automobile Insurance,” Nyce says.

“Many in the automobile industry are considering whether that phase should be skipped over, in favor of more immediate introduction of Level 4 technology, self-driving within boundaries.”

The first fatal semi-automated car accident demonstrates how both the driver and the technology can contribute to causation. (See sidebar, “Fatal Lessons.”) How this affects liability when accidents occur presents a new host of questions.

NHTSA, which offers guidance for automated vehicle development, has

changed its emphasis on liability. In 2016, its “Federal Automated Vehicles Policy” took the position that liability will depend on whether the human operator or the automated system is primarily responsible for monitoring the driving environment.¹⁰ However, in its 2017 “Automated Driving Systems Report,” the U.S. Department of Transportation put questions of liability back in the hands of states, which regulate insurance. The report stresses the responsibility of states to allocate liability, to determine who must carry vehicle insurance and to consider rules and laws allocating tort liability.

“Ultimately the courts will guide the process of assigning financial responsibility for collisions involving automated vehicles,” Charak says. The CAS Automated Vehicles Task Force report looks deeply into the advantages and disadvantages of personal auto and product liability and how it will affect drivers, manufacturers, insurers and other parties. It includes an exploration of legal costs and potential insurance approaches to coverage, such as no-fault insurance, as well. More exploration is needed to determine how commercial auto, workers’ compensation and cyber coverage will come into play.

“An additional worry I have is that if product liability becomes involved in routine automobile accidents,” Nyce says, “the ability of the legal system to promptly compensate accident victims may become less timely, as products cases tend to take much longer compared to automobile liability cases.”

Perhaps the “saving grace is that the vehicle gathers a lot of data,” says PCI’s Passmore. “In order for the legal system

¹⁰ <https://www.transportation.gov/sites/dot.gov/files/docs/AV%20policy%20guidance%20PDF.pdf>, page 10.



FATAL LESSONS

The first driverless car fatality provides insight into the complexities of causation and pass-off risk.

By several accounts, Joshua D. Brown of Canton, Ohio was a driverless car enthusiast. On May 7, 2016, the former Navy SEAL and founder of Nexu Innovations¹¹ was relying on the autopilot feature of his 2015 Tesla S 070 while driving near Williston, Florida.

When a white tractor-trailer was crossing an intersection lacking a traffic light, the car and the drivers were unable to detect the pending crash. The automobile, which was purportedly set at 74 miles per hour on cruise control,¹² proceeded to barrel under the truck, which sheared off its roof, before continuing through a drainage culvert and two wire fences, breaking a utility pole and finally landing in a residential front yard.¹³

The observations and conclusions of two federal agencies showcase the complexities of determining causation in accidents involving automated vehicle technology and human drivers.

The National Highway Traffic Safety Administration's (NHTSA's) incident inspection report emphasizes the need for drivers to pay constant attention to traffic conditions to respond to potential incidents when the advanced driver assistance system (ADAS) is operating, according to the January 2017 report. Among its findings, National Transportation Safety Board (NTSB)'s September 2017 investigation also noted that the truck driver and Brown had sufficient time to prevent the crash.

The NHTSA investigation did not identify defects in the autopilot system's design or performance, but allowed for potential safety defects of the car. However, the NTSB report determined that the forward collision warning system did not provide "an alert and the automatic emergency braking did not activate."¹⁴ Further, Tesla's autopilot's operational design allowed prolonged driver disengagement and for the driver to use the automation inconsistently with the automaker's guidelines and warnings.¹⁵ These factors were also noted as part of the accident's probable cause.

For its part, Tesla has since upgraded the software to depend more on radar instead of cameras to improve its accuracy in detecting hazards. The update also adds a feature that disables Autopilot if the driver repeatedly ignores requests to hold the steering wheel.¹⁶

The incident also highlights the "pass-off risk" discussed in the Casualty Actuarial Society's Automated Vehicle Task Force's latest report, "Automated Vehicles and the Insurance Industry: A pathway to safety: the case for collaboration." Unless an automated vehicle can successfully navigate all the potential hazards that arise when driving, pass-off risk will play a role in accident cause and, potentially, liability.

In 2018, two women have died due to driverless car technology. Like Brown, a California woman died while her Tesla Model X was in autopilot mode.¹⁷ Another woman was hit by an Uber self-driving car while crossing the street.¹⁸

¹¹ <http://www.legacy.com/obituaries/triblive-murrysville-star/obituary.aspx?n=joshua-d-brown&pid=179986286&fhid=9878>

¹² http://www.abajournal.com/magazine/article/selfdriving_liability_highly_automated_vehicle

¹³ <https://www.nts.gov/news/events/Documents/2017-HWY16FH018-BMG-abstract.pdf>, page 1.

¹⁴ <https://www.nts.gov/news/events/Documents/2017-HWY16FH018-BMG-abstract.pdf>, page 2.

¹⁵ <https://www.nts.gov/news/events/Documents/2017-HWY16FH018-BMG-abstract.pdf>, page 3.

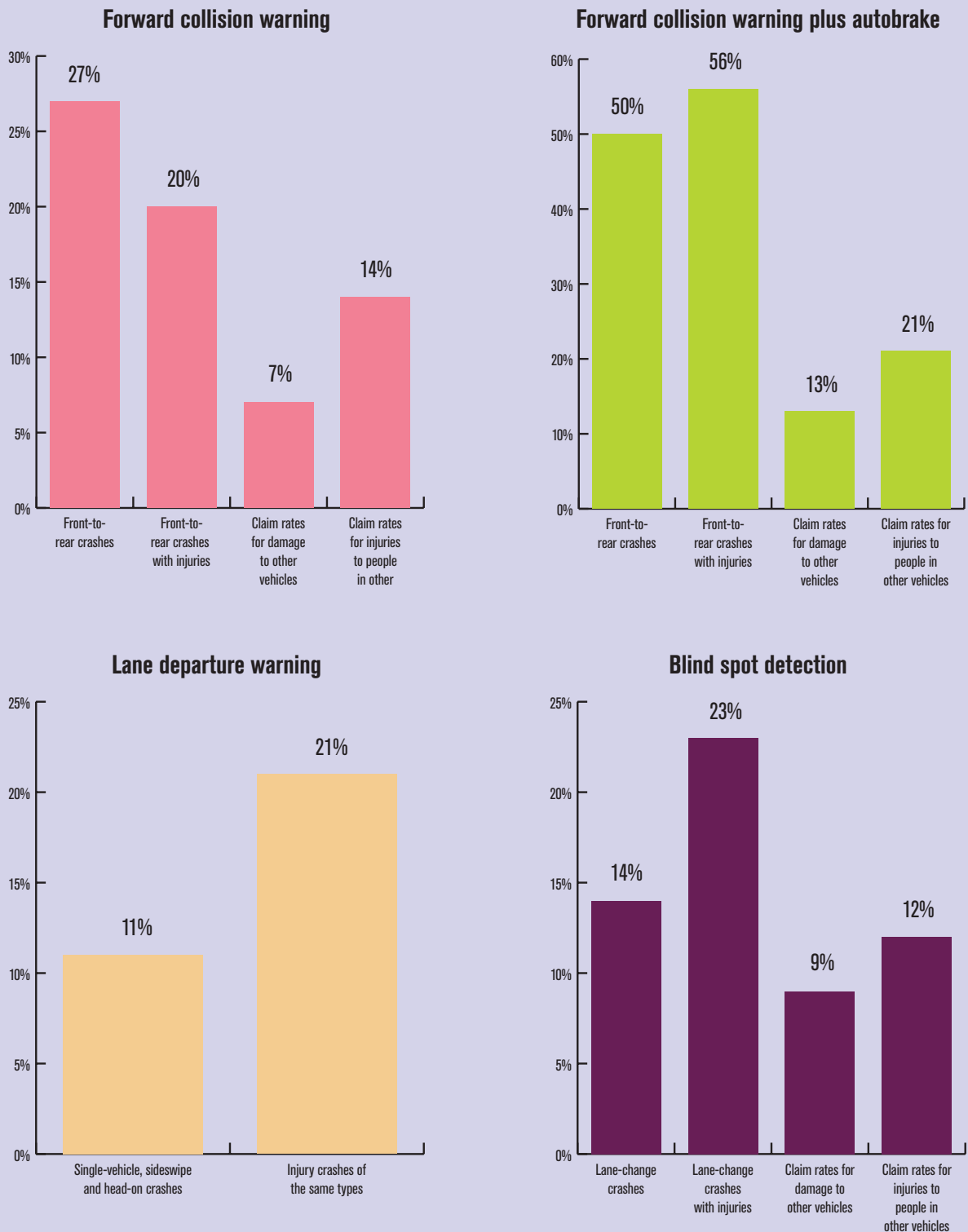
¹⁶ <http://www.iihs.org/iihs/sr/statusreport/article/51/8/1>

¹⁷ <http://www.bbc.com/news/world-us-canada-43604440>

¹⁸ <https://www.scientificamerican.com/article/uber-self-driving-car-fatality-reveals-the-technologys-blind-spots1/>

Figure 4. Real-world benefits of crash avoidance technologies

HLDI and IIHS study the effects of crash avoidance features by comparing rates of police-reported crashes and insurance claims for vehicles with and without the technologies.



© 2018, Insurance Institute for Highway Safety, Highway Loss Data Institute, 501(c)(3) organizations. Used with permission.

to adapt to the change in the nature of driving risk, that data is going to be accessible in reasonable terms.”

Most cases will be pretty clear because the vehicle will or will not have violated the vehicle code, says Robert W. Peterson, a recently retired law professor who specialized in torts and product liability at Santa Clara University’s School of Law in California.

Peterson also sees room for other types of insurance coverage. For example, if a trucker drives the truck into a tree, workers’ compensation may be the only legal remedy. “If the truck drives the truck into a tree, now there is a fully compensable tort claim against the OEM (original equipment manufacturer).” Cyber attacks may spawn OEM liability as well.

Conclusion

While there is evidence demonstrating the safety advantages of automated technology, there is also proof that safety features in conventional cars are already making a difference in reducing potential accidents. For example, automatic braking systems reduce rear-end crashes involving conventional vehicles by about 50 percent, while forward collision warning systems reduce them by 27 percent, according to the IIHS study, “Effectiveness of forward collision warning and autonomous emergency braking systems in reducing front-to-rear crash

rates,” published in 2017 in *Accident Analysis and Prevention*.

“Unfortunately, the discussion (about automated vehicles) is way ahead of the technology,” Zuby says, when enforcing existing laws and making proven safety features standard would go a long way to reducing crashes.

Driverless utopia, the vision that fully automated vehicles will safely transport distracted and tired people from place to place, remains a long way off. Until then, pass-off risk will complicate causation.

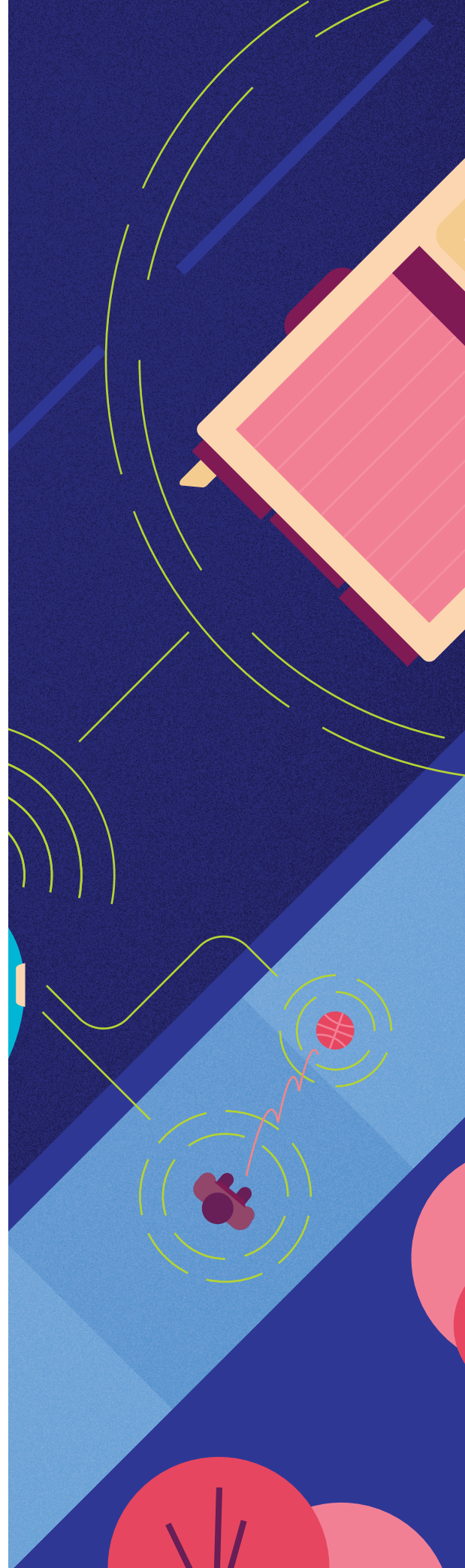
The CAS task force call for more data so insurers can adjust to automated technology is important. “Pricing a risk appropriately will ensure a potentially lifesaving product will reach the market in the most efficient manner — too expensive

and it may hinder vehicle sales, while not charging enough will lead to conventional vehicles subsidizing a new hazard on the road. As an actuary, data collection is crucial for proper pricing,” Charak says.

Until manufacturers, insurers, lawmakers, regulators, researchers and others can be better informed, the automated car dialogue will continue to be plagued by hopeful statistics of a truly uncertain future. ●

Annmarie Geddes Baribeau has been covering insurance and actuarial topics for more than 25 years. Her blog can be found at www.insurancecommunicators.com.

The vision that fully automated vehicles will safely transport distracted and tired people from place to place, remains a long way off.



Driverless Cars: The Continuing Story BY JIM LYNCH

What is left to say about driverless cars? The innovation has lots of promise and (certainly) lots of hype. They promise to change the world. Someday. Maybe soon.

Or maybe 20 years from now. Maybe never — though that seems unlikely.

As the autonomous future unfolds, there are lots of predictions. Some of the smartest ones were front and center at the Casualty Actuarial Society Ratemaking, Product and Modeling Seminar in Chicago in March.

There, CAS Fellow Donald Mango, a principal at Innovensure Advisory Solutions, led a session called “Auto Insurance: 2028.” The session tapped the expertise of Matthew Moore, senior vice president at the Highway Loss Data Institute; Chris Mullen, the director of technology research at State Farm; Thomas Karol, general counsel at the National Association of Mutual Insurance Companies; and CAS Fellow Alexander Timm, who founded Root Insurance, an app-driven auto insurer.

The discussion that followed was both wide-ranging and focused. The scope was wide because driverless technologies could change much more than just who is or is not behind the wheel.

The focus came from a tragedy just days before: The first pedestrian struck and killed by a self-driving car occurred March 18. It appears that the autonomous system failed to see Elaine Herzberg as she walked her bicycle across several lanes of traffic. The backup driver behind the wheel also

allegedly failed to react in time.

Moore, from the Highway Loss Data Institute, noted that autonomous vehicles rely on a suite of detection devices to figure out what surrounds them. The systems are not all well-suited to detect pedestrians.

Radar uses sound waves to detect potential crash partners. Radar systems listen for echoes. Large solid objects like cars and trucks create strong echoes. Humans are soft and do not echo very well.

LIDAR (Light Detecting and Ranging) systems emit laser beams and watch for their reflections. Shiny new cars reflect light very well. People do not.

Cameras need pedestrians to be visible and to move in a predictable manner, so the computer can recognize the image it encounters. Human movements can be hard to predict.

Computers in the vehicle have to take a mountain of tiny bits of data and turn all of that data into a go/no-go decision in a split second.

“Pedestrians are the most vulnerable road users,” Moore said. “They are also the hardest to detect and they are the least predictable.”

Hence the first question: What effect would the accident have on the development of driverless vehicles?

For Chris Mullen of State Farm, the accident shows how important consumer trust will be in the move to autonomous vehicles. The technology may need to improve before people are ready to use it. “Are they ready for the technology?” she asked. “Are they going to use it? Is this going to scare them? People want to see research and they want to know they have systems and redundan-

cies in place to keep them safe.”

NAMIC’s Karol predicted the accident would have states reconsidering policies that give autonomous vehicle designers “unfettered access” to public roads.

And Mango cited research that suggests that people will accept 1,000 times more risk voluntarily than if it is forced on them. Autonomous vehicles, of course, force all risk onto pedestrians and passengers — the hope being that the risk they impose on people is much less than what people now bear.

The 1,000x rule, however, means autonomous vehicles start at a big deficit, Mango said.

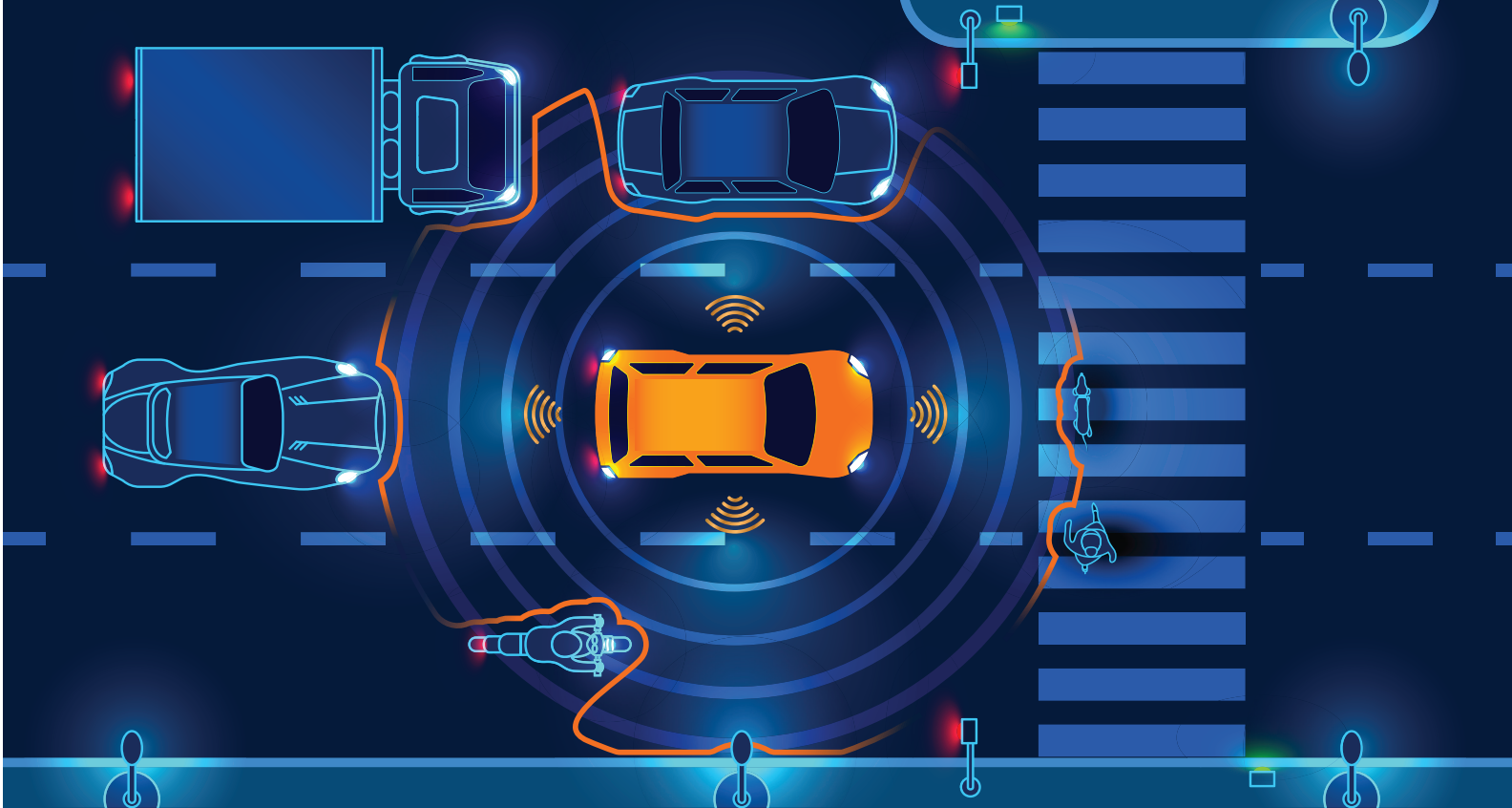
What will the next few years look like?

Mullen worries that drivers will struggle if they own two or three vehicles, each with its own safety system. This seems likely to happen, she said, as people hold onto cars longer (the median vehicle has been on the road more than 11 years) and each new model year brings a new safety feature.

Cars are already becoming more sophisticated, she said, and most people don’t really understand all their new car can do.

Emerging technologies are already changing driving patterns, said Moore. Newer cars have built-in backup cameras. People stare at the cameras as they back up, he said, often forgetting they need to know what the front of the car encounters even as the vehicle moves in reverse.

How will insurers manage the explosion of data that new



technologies will be measuring?

Timm, Root Insurance's founder, noted that in the transitional period — when machines drive sometimes and humans drive sometimes — could be a challenge. How can insurers know which is at the wheel when?

The challenge, he said, will be two-fold. Companies will have to figure out how to get the data (second by second). Then they will have to figure out how to model it.

In pricing insurance, he also predicts that the data will be better handled if actuaries push past the classic general linearized model and embrace techniques like random forests.

Moore noted that it is difficult to harvest data without manufacturer help; that data needs to be managed to let it serve the insurance industry and the general public. That's not easy now, he said. Insurers know which models include options of safety packages, but they often don't know whether a particular vehicle actually has that option package.

In the future, Mullen said, insurers will need to know which new features

work to price policies properly. "Right now no one knows which data and how much of it" is needed, she said.

What about pedestrians?

If, as Moore suggested, autonomous systems struggle to recognize pedestrians, what can we do? Put a chip in them so the cars will see them?

Moore himself was skeptical that this would be popular. He suggested chipping bike helmets or running shoes, if that became necessary.

Timm was confident driverless technologies will solve the pedestrian problem. "I don't know how it doesn't get a lot better really quickly."

Who will be liable for accidents in the driverless future?

Karol, of NAMIC, predicted that as long as the driver has some authority in the car (even an emergency stop button), they will bear some responsibility.

If the driver isn't responsible, an auto accident could become an "incredibly complicated" product liability claim. In the pedestrian accident a few days before, the auto was a Volvo that Uber had

retrofitted; it would likely be expensive to litigate, Karol said.

The United States hasn't sorted out the liability question, he said. The United Kingdom and Canada have proposed systems in which injured persons receive care immediately, while the manufacturers engage in what is likely to be a protracted legal battle.

Will people continue to own their own cars?

Less car ownership implies less personal auto insurance premium and threatens the stability of the largest property-casualty line of business.

Timm suggested that within 10 years the insurance industry may contract. Insurers will move to other lines of business.

Mullen and Moore noted that if cars crash less, people will own cars longer — a tendency that has been growing for some time. "Ten years is not that long," said Mullen.

Moore is a skeptic: "We are going to continue to want to own cars a long time ... We aren't good sharers in this country." ●

A Recipe for Modeling Success BY JIM LYNCH

Spaghetti and marshmallows — I wouldn't recommend it for dinner, but it did make for a winning tutorial on how to build a successful predictive model at the Casualty Actuarial Society Ratemaking, Product and Modeling Seminar and Workshops in Chicago in March.

These mismatched foods were two ingredients in a team exercise that about 30 people participated in as part of a session called, "Getting Impact from Predictive Analytics: You Have a Model. Now What?"

The lesson to be learned: How the right kind of teamwork can create successful predictive models.

The Experiment

The audience divided into about a half dozen groups of five or six people. The challenge: In 15 minutes, build the highest tower of spaghetti that is strong enough to support a single marshmallow.

Each team got one marshmallow, 20 strands of spaghetti, a roll of masking tape and twine. Timekeeper was David

Wang, FCAS, a data solution consultant at Zurich North America.

We fiddled with the materials for a bit — none of us were architects. We knew the spaghetti would break easily, so we created stronger spaghetti poles by doubling them up.

We turned the roll of tape on its side to make a base. One team member tore off strips of tape first, so we could use them later to lash the spaghetti together.

We started with a tepee, leaning three spaghetti poles into each other



An impressive structure.

a third story, this time a right-side up tepee. The apex of the third tepee created a tiny cradle to hold the marshmallow.

But the marshmallow didn't want to stay still. It bowed the weakest spaghetti

We knew the spaghetti would break easily, so we created stronger spaghetti poles by doubling them up.



Working together.

and taped together where they met near the top. Then we made another tepee and turned it upside down. It nestled into the original tepee's top. This gave us a two-story tepee, with the inverted tepee on top, its spaghetti poles extended wide. Then we added

poles, and, while it never broke the structure, it wasn't too sturdy or too pretty. The Pritzker Committee won't be calling any of us soon.

Still, our tower was 24 inches tall, pretty close to what most of the other teams constructed. The tallest was 33 inches.

Timekeeper Wang says most groups build towers around 20 inches tall. Success, he says, depends on understanding that the spaghetti is fragile and the marshmallow is surprisingly heavy.

Lessons Learned

The key takeaways from this challenge are:

1. Many hands make light work. “If you put capable people together, you are much more likely to pool insights and arrive at a better solution,” Wang says.
2. Sometimes you can have too many people. The largest group at our session — about eight people — seemed to succumb to that problem. In a real-life project, they may end up creating meetings to go over unimportant details “that make you go to sleep.”
3. Successful groups collaborate. Teams should have diverse skill sets and be seeking a common goal, Wang says.

The best tower builders revealed that they quickly broke into separate duties. Two or three were builders. One person did nothing but cut tape. Another only cut string. “It was a group dynamic,” one of them said. “We worked pretty well together.”

Too often, a Big Project has a Big Buildup, and then becomes a Big Failure.

Real-World Projects

Building a predictive model is a lot harder than constructing a spaghetti tower, but it can fall prey to the same pitfalls. Projects tend to have people with similar skills. They huddle in low-efficiency meetings. Their responsibilities tend to be ill-defined.

Too often, a Big Project has a Big

Buildup, and then becomes a Big Failure. The other presenter, Jessica Leong, FCAS, lead data scientist at Zurich North America, laid out a typical predictive modeling project:

- Spend a few weeks scoping the project, talking to stakeholders to learn what needs to be done.
- Clean up the entire data set so no data issues emerge.
- Do a one-way analysis to find variables that could potentially drive the model.
- Build the model carefully.
- Roll out the model.

If the rollout is a failure, she says, it is often because some of the most important lessons were learned during the construction process — the equivalent of learning that the marshmallow is too heavy for the spaghetti poles.



Nothing to it. On to real-world projects.

lean startup method, which goes something like this:

- Start with a quick and dirty business plan — maybe one page long.
- Create a minimum value product — one that covers some of the bases but has obvious shortcomings.
- Launch that product (at least internally).
- Get feedback and return to step 1.

The method recognizes that the job isn't to build the most awesome predictive model. “The job is to solve business problems using predictive analytics,” Leong says. ●

Recognizing that the first stab at success rarely succeeds, Leong said a better approach has emerged from Silicon Valley in recent years — the



China Risk-Oriented Solvency System Phase II: Resailing

BY XIAOXUAN (SHERWIN) LI AND QIAN (RITA) TAO

The China Insurance Regulatory Commission (CIRC) launched the China Risk-Oriented Solvency System (C-ROSS) in March 2012.

In February 2015, CIRC released 17 regulatory rules covering the major technical standards of C-ROSS as the in-

insurance industry entered the transitional period from the first-generation solvency system to C-ROSS. On January 1, 2016, C-ROSS was officially enacted, greatly enhancing the risk management ability of insurance companies. In order to further improve

the framework of the new-generation solvency system, CIRC decided to implement Phase II of C-ROSS and issued the Plan of C-ROSS Phase II Construction in September 2017.

In the Plan of C-ROSS Phase II Construction, CIRC identified three major tasks: the improvement of regulatory rules, the perfection of enforcement mechanisms, and the strengthening of regulatory cooperation.

The first task encompasses 15 points, including the revision of Regulations on Solvency of Insurance Companies and the establishment of prudential regulation of insurance groups, mutual insurers and captive insurers. In addition, C-ROSS Phase II will make some adjustments to the valuation of actual

capital and improve upon standards of market risk, credit risk and insurance risk. Some regulatory rules will also be improved covering stress testing, liquidity risk, Integrated Risk Rating (IRR), Solvency Aligned Risk Management Requirements and Assessment (SARMRA)



as well as Pillar III of C-ROSS (market discipline mechanism).

The second task covers six points, including tracking the development trend of fintech, establishing a system for analyzing and monitoring solvency risk, improving the regulatory information system of C-ROSS, and setting up the advisory experts committee of solvency regulation.

The third task contains five points, including cooperation with financial prudential regulators, the establishment of an assessment scheme equivalent to that of C-ROSS, the assessment of potential impacts of the change in insurance accounting standards, and the engagement of international insurance regulatory rules setting.

The Plan of C-ROSS Phase II Construction issued by CIRC also refers to the principles of implementation of C-ROSS Phase II. The regulator will form several different working groups studying those points, and will release findings within around three years.

In December 2017, CIRC established the Advisory Experts Committee of Solvency Regulation. Seventy experts, including one of the authors of this article, were honored to be appointed as the first members of the committee.

With the completion of those preparatory works, it is expected that C-ROSS Phase II construction will be running in 2018, ushering the insurance industry of China into a new era. ●

Xiaoxuan (Sherwin) Li, FCAS, FIA, FCAA, CCRA, ARA, MCSE, is the appointed actuary of China P&C Reinsurance Company Ltd. in Beijing, and he serves as the chairman of the CAS Asia Regional Committee as well as a member of the CAS Education Policy Committee.

Qian (Rita) Tao, FCAS, is the senior actuarial manager of China P&C Reinsurance Company Ltd. in Beijing, and she serves as a member of the CAS Asian Regional Meeting Coordination Committee.

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EXPLORATIONS BY DONALD F. MANGO

Actuarial Threat Assessment of Insurtech and Digital Disruption

The news is filled with stories about insurtech, innovation, digital disruption, telematics, connected home, connected worker, connected everything, data science, unstructured data, machine learning, artificial intelligence — it can all be a bit overwhelming. Actuaries have varying opinions on the nature, scope, degree and timing of the impact of all these changes on the profession. What we do know is major employers of actuaries (insurers, reinsurers, consultancies, intermediaries), as well as technology companies and even venture capital firms are investing significant time, effort and money into disrupting the insurance value chain. If the value chain is disrupted, we actuaries will be disrupted. It's a matter of when, how much and what, if anything, we can do to survive and thrive these turbulent times.

I am moderating a general session on this topic at the upcoming CAS Spring Meeting in Boston. Our panel will be performing a full SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis of the actuarial profession during this disruption. For those unable to attend, this column will give you highlights of some of the threats.

It will be helpful in this threat assessment to separate the impact of insurtech into three distinct waves, each with its own timing and characteristics:

1. Digital modernization.
2. Automation and augmentation.
3. Loss elimination.

1. Digital Modernization

This first wave focuses on applying existing technology to areas of insurance that are highly comparable to other industries, such as consumer banking and online retail. Examples include digital and mobile customer acquisition, seamless digital customer experiences, and application of new data sources or analytic methods for customer segmentation. Think of this as modernizing the insurance interface by using established technology that appears “new and innovative” from the perspective of the insurance industry. These technologies and approaches will disrupt business-as-usual and require investment and change management. Over the past few years, this has been the low-hanging fruit that insurtech companies have gone after first because knowledge of historical insurance industry practice has not been particularly necessary nor helpful. Motivations for insurers to invest include breadth of digital footprint, expense savings, scalability and ease of doing business, including response time. This first wave is well underway, and insurers need to make progress soon or face potential adverse selection in distribution and market access.

Actuarial threat assessment: MINIMAL. We don't generally get involved in customer acquisition or engagement technologies.

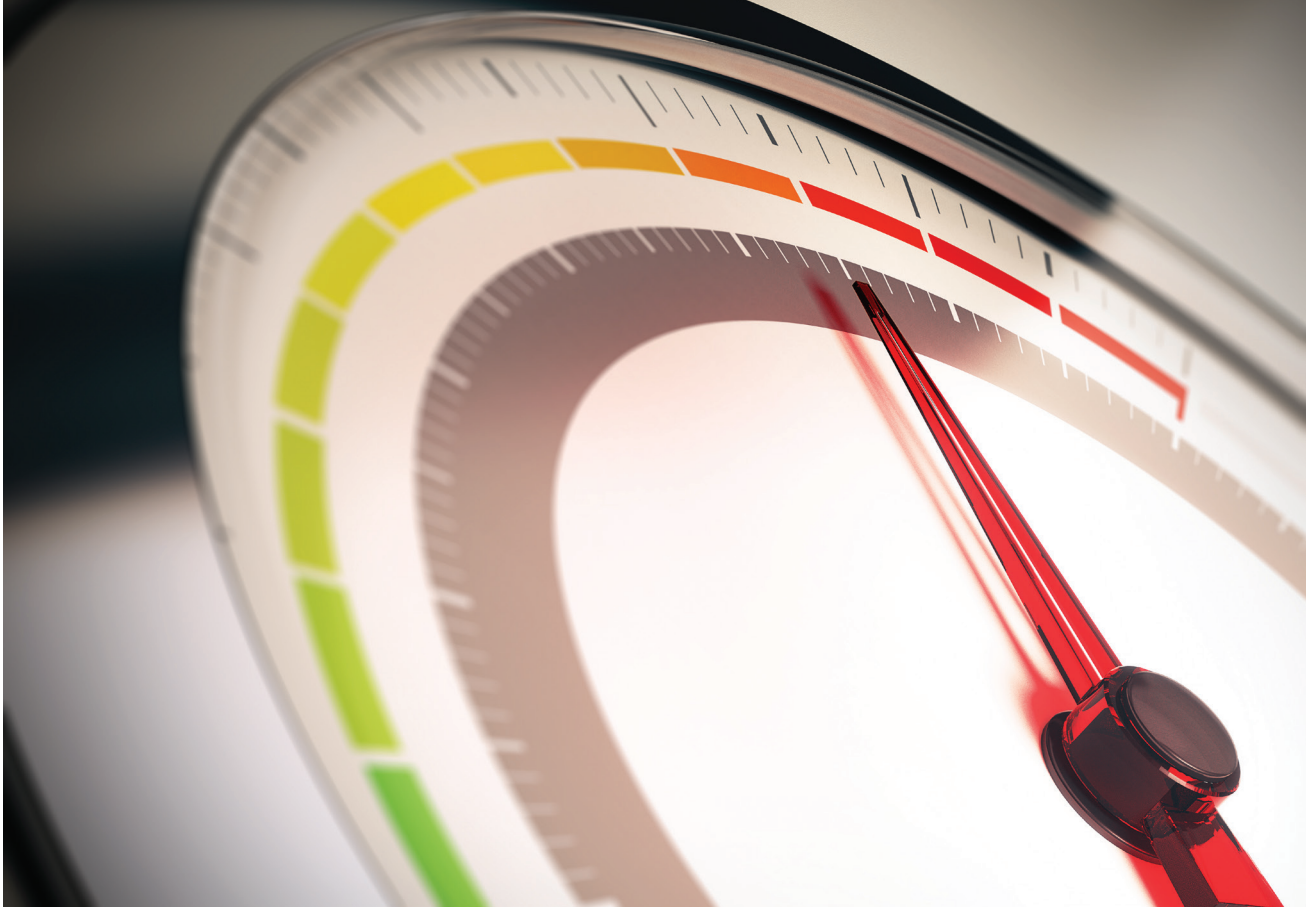
2. Automation and Augmentation

This second wave centers on applying new technology to core, proprietary areas of insurance — from rate/quote/bind to underwriting and pricing, from claims to traditional actuarial functions. EY recently put out “Robots join the team,” a report that discusses specific applications of robotic process automation (RPA) in actuarial functions.¹ EY highlights promising target areas for RPA in P&C and health insurance, such as data preparation (extraction, reconciliation and formatting); reserving analysis, including rules-based selection; standard report preparation; pricing and rate monitoring; rate filing and rating quotes; experience monitoring and trend analysis; and data visualizations.

The new technology is made up of automation replacing human effort through such items as machine learning in claims triage as well as augmentation through the use of supplementary underwriting information with artificial intelligence.

Wave two will be more deeply disruptive than the first wave. It will require hiring and training staff with new skills into many core departments like IT, claims and actuarial. Also, current leadership cannot necessarily rely solely on

¹ [http://www.ey.com/Publication/vwLUAssets/EY-robots-join-the-team/\\$FILE/EY-robots-join-the-team.pdf](http://www.ey.com/Publication/vwLUAssets/EY-robots-join-the-team/$FILE/EY-robots-join-the-team.pdf)



the assessment of their existing experts as to the impacts and investment priorities, because they “don’t know what they don’t know.” The timing of wave two is just starting, but insurers need to start making targeted investments in proof-of-concept projects, either on their own or partnering with consultancies, brokers or reinsurers.

Actuarial threat assessment:

SIGNIFICANT. We should be on top of this second wave or run the risk of being overwhelmed by it.

3. Loss Elimination

The third and most disruptive wave will bring causal analytics via the internet-of-things (IoT). Wave three will be massively disruptive to the insurance industry because of elimination of previously insured events that produce claims. The IoT model will look a lot like equipment breakdown insurance (e.g., Hartford Steam Boiler, FM Global), with

insurance integrated with engineering, inspection and preventive maintenance. The IoT revolution will mean more lines of business can be integrated with monitoring and prevention, supported by sensors, embedded intelligence, connectivity and AI engines to process the information. See my presentation “Actuarial Engineering and Preventive Analytics” for more on this.²

The insurance impact will be felt in reduction of “attritional” claims — smaller claims that in aggregate make up a substantial portion of the overall loss volume. The premiums associated with supporting these attritional claims pay for a lot of an insurer’s overhead expenses. We will be seeing a material reduction in premium volume, along with an increase in volatility for the remaining premium, as the mix of claims shifts to a higher percentage of larger claims. There will also be an accompanying increase in the “cyber-as-a-peril” component of all

lines of business. For example, a factory that automates with IoT sensor systems and AI-powered preventive analytics will proportionally reduce physical staff. An internal network outage will effectively shut down the entire operation, because the manual operation option is no longer feasible. That means cyber incidents that disrupt the network could turn into contingent business interruption events.

Actuarial threat assessment:

EVOLUTIONARY, for both actuaries and their employers. This will change the very nature of risk measurement, management and transfer.

Next Time: What are the Opportunities?

In a future Explorations column, we will look at the opportunities for the actuarial profession in this exciting evolutionary landscape. ●

² <https://www.dropbox.com/s/sz9zqatg0yqbt5y/Actuarial%20Engineering%20and%20Preventive%20Analytics.pdf?dl=0>

IN MY OPINION BY AGATHA CALEO, CANDIDATE REPRESENTATIVE, CAS CANDIDATE LIAISON COMMITTEE

Cheaters Gonna Cheat

Editor's Note: This article first appeared in the March 2018 issue of Future Fellows.

"I would prefer even to fail with honor than to win by cheating." — Sophocles

One of the biggest issues candidates seem to have with Technology-Based Examination (TBE) is the potential for cheating. In conversation after conversation with friends and colleagues, the same questions keep coming up: How will they prevent this? How can they keep people from doing that? I have to admit I am somewhat baffled by this phenomenon. This is the last thing I expected to be on people's minds when they heard about TBE!

After all, actuaries are known for being highly ethical. The CAS has codes of ethics for both members and candidates, by which we are all bound. If I adhere to that code, why should I suspect others of breaking it? When I was a high school teacher, I would tell all new students the same thing: "I trust you until you give me reason not to." I would still catch them cheating, of course; high school students are terrible cheaters. They're also *high school students*, and I'd like to think that most actuarial candidates are more mature with a better-developed moral code than your average teenager.

But I know that it does happen, even in our profession. In fact, there

was recently a small group of actuaries overheard talking about cheating on exams — in the presence of other actuaries! A pair of people discussed knowing that one of their colleagues was going to cheat on an upcoming exam. One man said he would definitely cheat on an exam if his job were at stake. He said he would cheat rather than put his mortgage and family at risk and that no code of ethics was going to stop him. I heard about this secondhand and am still appalled at the audacity of people who would speak so flippantly about cheating — in public, no less!

If someone did choose to cheat, what risks would they face?

The punishments can be severe, as



they are not limited to disqualification of the exam paper. The Examination Discipline Policy, which contains a list of examples of improper conduct, specifies that candidates caught cheating are subject to “consequences determined by the Vice President-Admissions ... [which] may include a temporary or permanent ban from sitting for CAS Examinations.” If you’re working to attain your Associateship, you are subject to the CAS Rules of Procedure for Disciplinary Actions Involving Candidates. If you’re an ACAS taking exams to attain Fellowship, you’re subject to the same disciplinary process as any other members, including review by the ABCD. Are you really going to risk a disciplinary hearing? The damage to your reputation? Your career?

Hopefully the answer is no. You’re an upstanding citizen of the actuarial community! You’re not going to write formulas on the bottom of your shoe or text a friend for help under the table.

But what about “micro-cheating”?

No, I’m not talking about the latest dating buzzword. (Google it.) I’m talking about actions you may not immediately think of as cheating but in hindsight actually give you (or someone else) an unfair advantage on an exam. Even if you didn’t do it with malicious intent, it still counts as cheating! This includes situations like:

- Katja takes the exam in the morning and struggles her way through a problem requiring Harwayne’s method. Later that day she tells Prem, who has yet to take the exam,

“I should have studied more of those obscure complements of credibility.” Katja just gave Prem an unfair advantage on his exam because he can now focus his review on that topic before he takes it. She should not have spoken about the exam to anyone until after it was released to the public. (See examples of improper conduct #1 and #17 in the Examination Discipline Policy.)

- Terrence takes a bathroom break during the exam. On his way back to the exam room, his coworker Susan asks how his exam is going. Terrence says he’s really struggling with the Berquist-Sherman question. Susan reminds him that if you’re doing both the incurred and paid adjustments, there’s an additional step. With this small hint, he will be able to solve the problem. While he didn’t directly solicit this “consultation,” Terrence is still at fault as he should not have discussed the exam while outside the exam room. (See example of improper conduct #11.)

Both of these examples would count as cheating and subject you to the same disciplinary process as, say, manipulating the vendor software to allow you to search the internet during the exam. More importantly, if you agree with Sophocles (see quote at the beginning of this article), you will want to make sure that you don’t engage in the above activities.

However, it’s the malicious cheating

that my friends and colleagues seem to be most concerned about. As far as that goes

I think that TBE will close more loopholes than it opens. If cheating is already happening, it’s happening in a paper-and-pencil environment, with a very large candidate-to-proctor ratio. TBE is going to shrink the candidate-to-proctor ratio significantly, and cheaters will have to adapt to the new technology. Whereas they are currently (much-appreciated) volunteers, the more numerous proctors will now be professionally trained. And with TBE, rather than relying on witness accounts, the CAS will have video, audio and digital evidence to reference after the exam to help investigate accusations of cheating.

I don’t think anyone who wasn’t going to cheat before will suddenly decide to cheat now because they see a new opportunity to do so. It’s the same small group of unethical people who were already looking for ways to cheat with paper and pencil who will be looking for ways to cheat with TBE, but there will be more well-trained eyes on them and a permanent record of their actions, so it will be harder for them to cheat.

In the end, the benefits of TBE outweigh the risks. And isn’t risk what we’re all about? ●

Agatha Caleo is an actuarial consultant for Aon Global Risk Consulting in New York City. She sat for Exam 6 in spring 2018.

IN MY OPINION BY GROVER EDIE

A Trend, a Season, a Cycle or Something Else?

I started writing this on February 11, 2018, after stock markets all over the world had a tumultuous two weeks. Some pundits called the huge swings in the stock indices everything from a signal of doom, to a correction, to the product of rogue robot trading. Others claimed it was due to the unsold USA treasury bills, the new tax law and more. One analyst even predicted another “Crash of ’29!” If you have a favorite reason I didn’t mention, add it to the mix.

As I resumed writing this several weeks later, the markets were still volatile, but the huge swings in values had subsided. But late March saw another round of large equity market swings. Were we looking at another crash like that seen in 1929? (And no, I don’t remember it.) Was the period from January 26, 2018, to February 8, 2018, the abnormality, or was the run up prior to January 26, 2018, the anomaly? Look at a graph of any of the indices, and the period of time you select can change your perspective on your answer.

Is this recent phenomenon a trend, a seasonal adjustment, a market correction or something else? If you know the answer, you can make a lot of money in the next few weeks. If you THINK you know the answer and are wrong, you can LOSE a lot of money in the next few weeks. Of course, you won’t win or lose unless you are playing the game. Or unless you have investments in your 401(k). Or unless your company runs into good times or bad times and it affects your job

or salary. Or unless market forces trigger massive deflation or inflation. Well, I guess we are all “in the game” to some extent.

But how does the recent stock market volatility influence what we do professionally? Certainly, those of us who work with economic capital models realize that it has an impact on the asset side of our models and that it will likely have an impact on the economic scenario generators we will use in the future. Since the drop happened after year-end 2017, assets for companies holding stocks might be down considerably from what they reported in their Annual Statements.

What does the stock market performance have to do with the economy? Is stock market performance a lagging indicator, a leading indicator, random variation or just noise?

The answer to the first question will have a bearing on what we select as exposure trends, and the answer to the second will determine just how much of a bearing it will have.

I throw in a third question: Are there other, less-publicized indices we should be watching that have a higher correlation to the work we do than the widely publicized stock indices?

The stock indices get a lot of attention when they “go wacky” and are largely ignored when they are stable and boring. Is there a potential for the index you are using for ratemaking or loss reserving to have a wacky period as we saw in stocks? If so, what do we do?

What if the “something else” has to do with the process or product’s life cycle? Remember PalmPilots? Or Newtons, an even earlier version of the personal digital assistant? They had states of early adoption, early majority, late majority and some laggards. Now, the entire cycle has been run, and you can no longer buy a new PalmPilot. And some of you are wondering what a “Newton” was (https://en.wikipedia.org/wiki/Apple_Newton). Does a drop in employment in a manufacturing process indicate expected declines in production or mask increased production due to increased automation?

Many of us have seen what initially appeared to be an aberration in the data, only to find out that it was actually a change in process. I recall seeing defense and cost containment payment counts drop precipitously while the average amounts were multiples of their previous values. “Nothing has changed,” was the answer from the claims department when I asked for a cause. Later, I found out that instead of paying attorney fees when presented, they required the outside attorneys to bill them on a periodic basis. The total costs did not change much, but the frequency and severity certainly did.

As I continue to work on pricing, loss reserving and economic capital model projects, I need to ask myself: Is it a trend, an aberration, a new level of activity or something else? We all need to ask those questions and take a moment to ponder every time we use trends. ●

IT'S A PUZZLEMENT BY JON EVANS

Day Trader

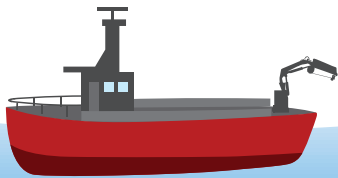
Martha only invests in Stock A or in Stock B, and only in one of these stocks at a time. The market for each of these stocks, respectively, only trades at a single price for each day, which is — with equal probability — either 105 percent or 95 percent of the previous day's price for that stock. There are no sequential autocorrelations or sequential cross-correlations between price changes, and no cross-correlation for price changes on the same day. Whenever the stock Martha holds goes up five percent and the other stock goes down five percent on the same day, Mar-

tha sells the stock she holds and invests all the money in the other stock. Assume that fractional shares are allowed, that there are no dividends, no bid/ask spreads and no commissions, and that Martha has no insider information. Martha starts with \$10,000 invested entirely in Stock A. After 1,000 days of trading, what is the expected value of Martha's stock? What are the 5th and 95th percentiles of the value? What would the answers be if the same-day price changes for the two stocks have a +50 percent cross-correlation? What if the cross-correlation is -50 percent?

Buoyancy Water, for the most part, behaves like an incompressible fluid, with its density independent of how much pressure it is under. So, it is reasonable to expect water to have about the same density from sea level all the way to the bottom of the Mariana Trench. Air is clearly less dense than water, but behaves mostly like a highly compressible fluid. It is general knowledge that air rapidly gets thinner with increasing altitude, until it becomes effectively a vacuum in space, several hundreds of kilometers above the Earth. Consequently, it is reasonable to expect that:



- Sphere A, with density 10 percent lower than the density of water at the bottom of the trench, should float on the surface of the ocean.
- Sphere B, with density 10 percent higher than the density of water at sea level, should sink all the way to the bottom of the Mariana Trench.
- Sphere C, with density 10 percent higher than the density of air at altitude 100 km (official boundary of space), should float in the air lower than 100 km, but not dramatically lower — maybe at 80 km or 90 km.
- Sphere D, with density 10 percent



lower than the density of air at sea level, should float in the air, but not dramatically higher than sea level — maybe at a few hundred meters or so.

Googling a little bit reveals that water at the bottom of the Mariana Trench is only about 5 percent denser than at sea level, where its density is about 1,000 kg/m³. Similarly, the density of air at sea level is about 1.225 kg/m³. So, our intuition about Spheres A and B is exactly correct. Furthermore, the density of air at 1,000m is about 10 percent lower at about 1.112 kg/m³. So, Sphere D should float at around 1,000m altitude, about in line with intuition.

The density of air declines roughly exponentially. At altitude 70 km it is about 0.00008283 kg/m³, and at 80 km it is about 0.00001846 kg/m³. So given the rate of exponential decline at these high altitudes, to get to 10 percent higher density than at 100 km, we need to use the constant $a = \ln(0.00001846/0.00008283)/(10,000 \text{ m}) = -0.00015/\text{m}$ and then solve for $1.1 = e^{-0.00015d}$. This leads to $d = -635 \text{ m}$, which is the approximate descent from 100,000 m to get a 10 percent increase in density. So, Sphere C should float around a little bit above 99 km, quantitatively higher than our intuition but qualitatively about the same.

All this would suggest that controlling the altitude of an airship should be much easier than controlling the depth of a submarine. A big

change in the density of an airship only leads to a relatively small change in altitude and, consequently, its altitude should be very stable. However, a submarine's depth is so unstable that a 5 percent increase in its density would cause it to sink all the way to the bottom of the deepest part of the ocean.

However, this intuition is completely in opposition to the historical outcomes for these technologies. Despite the constant difficulty of keeping a stable submerged depth for a submarine, submarines are still in widespread use (mainly by the military, who spend days or weeks at a time submerged) more than a century since their initial development. Some of these military submarines are powered by nuclear reactors and are enormous, such as the 24,000 ton Russian *Typhoon* submarines. However, submarines have experienced relatively few incidents of accidental sinking.

In contrast, the gigantic airships of the early 20th century, like the ill-fated *LZ 129 Hindenburg*, which was almost three football fields long, proved to be extremely difficult to control. They almost invariably crashed and were almost totally withdrawn from civilian and military use prior to World War II. A few dramatically smaller, simpler blimps remain in service today, typically used in short distance low altitude advertising roles. Even these blimps have to make emergency landings occasionally due to control problems.

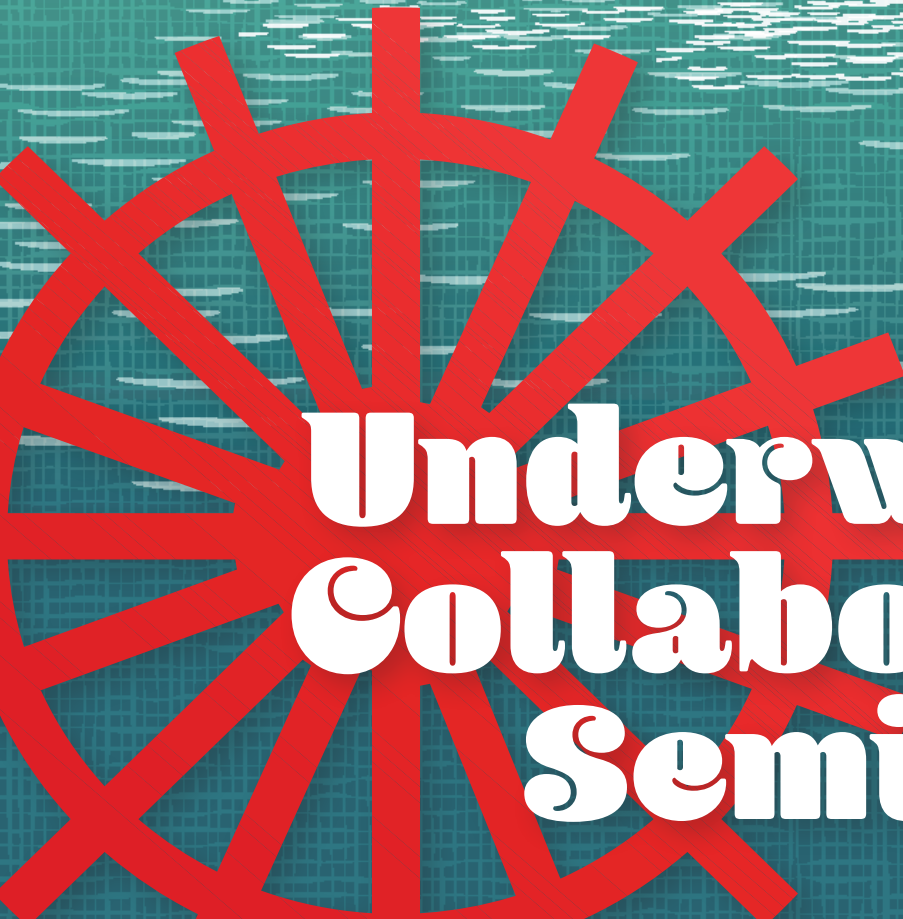
A solution was submitted by Chris Norman. ●

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