

THE

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# Actuary

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# THE Actuary

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# Actuarial transformation

BY MARK BIRDSALL

**M**any years ago, I took an organizational behavior class from Stephen R. Covey, Ph.D., author of *The Seven Habits of Highly Effective People*. He wanted his students and readers to understand and experience the influence of mental models on the ways we communicate and act.

One phrase he used to describe this phenomenon was “the map is not the territory.” In other words, the mental model we have in our minds is a map—and not reality. In some cases, we need to experience a “paradigm shift” in our mental model, which he illustrated through a simple demonstration. He showed readers and students a line drawing of an image for which two possible visual interpretations could be made, and asked, “What do you see?” One interpretation was the image of the back of a fashionable young woman’s head and shoulders. The other image was the face of an old woman tilted downward. (See the image on page 8.)

At first it was easy to see one of the images, but sometimes help was needed to see the jawline, eyes and so forth of the second image. Eventually, it became easier to flip back and forth between the two images. Dr. Covey pointed out that when there are two individuals, each of whom “sees” only one of the images, communication about the line drawing becomes very difficult, and the individuals may even begin to question the integrity of the other person. Have you ever been unable to see another’s perspective or effectively communicate what you see?

Another author and teacher, Clayton Christensen, has introduced a term of art into the business lexicon: disruption. In the preface to *The Innovator’s Dilemma: When New Technologies Cause Great Firms to Fail*, Christensen states: “... two principles of management taught in business schools: that you should always listen and respond to the needs of your best customers, and that you should focus investments on those innovations that promise the highest returns. But these two principles, in practice, actually sow

the seeds of every successful company’s ultimate demise ... That’s why we call it the innovator’s dilemma: Doing the right thing is the wrong thing. This dilemma rears its head when a type of innovation that we’ve termed disruptive technology arises at the low end of the market, in the simplest, most unassuming applications.”

Are there disruptive factors emerging in actuarial work that we hope we will not need to adopt, and instead are we relying on the mental models we’ve developed throughout our careers?

In referencing these two thought leaders in the business world, I would like to draw attention to some of the mental models we may possess as actuaries and describe some technologies we may need to embrace in order to thrive as a profession in the future.

The following is a partial list of possible mental models life insurance actuaries may have that could benefit from fresh consideration:

- ❶ | I am free to use almost any assumption in asset adequacy testing and other modeling that seems reasonable to me as an experienced actuary, because I can indicate in my documentation that I am using actuarial judgment.
- ❷ | I can use industry average experience in setting my assumptions and be confident that I am not mispriced or underreserved.
- ❸ | Asset adequacy analysis is purely a regulatory exercise. Sensitivity testing is a necessary part of the documentation for asset adequacy analysis, but generally it is not used for making decisions.
- ❹ | Policyholder behavior functions are educated guesses, and as long as the direction and magnitude of change by scenario look “reasonable,” that is the best that can be expected.
- ❺ | To develop a company’s target surplus formula to use for pricing, I can use a multiple of regulatory risk-based capital (RBC) requirements, then do a top-down

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allocation of target surplus to lines of business and product types, and that will be close enough.

- ⑥ Regulatory “guardrails” using implicit margins that “stack” levels of conservatism in different individual assumptions are an inevitable part of statutory reserve calculations.

In general, with how many of these statements do you agree?

The objectivity of assumption-setting by company actuaries is a subject discussed frequently by regulatory actuaries. Unfortunately, my experience as a regulator caused me to become more doubtful of the objectivity of some company actuaries. However, new tools are becoming available that could improve the objective measurement of risk through the use of multirisk scenario generators in cash flow projections; provide for the objective development of margins at a moderately adverse level; build more useful policyholder behavior functions using predictive models and cluster analysis; develop measures of target capital from the bottom up, based on specific product risk profiles; and provide the basis for new regulatory guardrails that are founded on understanding of risk rather than mistrust.

This issue of *The Actuary* examines a range of issues and tools related to actuarial transformation. Cluster analysis will be used to develop customer clusters for variable annuities with guaranteed living withdrawal benefits. Actuarial transformation for health insurance actuaries, the basic education of new actuaries and the continuing education of experienced actuaries also will be discussed.

George Bernard Shaw is quoted as stating: “You see things; and you say ‘Why?’ But I dream things that never were; and I say ‘Why not?’”

With new tools and better data, as actuaries we can explore possibilities that were not practical before. We can reshape experience studies to include new predictors. We can develop practical methods to approximate the fully stochastic distribution of the present value of future cash flows. We can bring meaningful risk analysis to smaller organizations. We can disrupt our mental models and renew our profession for the future, and provide great value to the organizations and people we serve as professional actuaries. Why not? ■



“My Wife and My Mother-in-Law,” a famous optical illusion by illustrator W.E. Hill, has two possible visual interpretations.

**Mark Birdsall, FSA, MAAA, FCA, MBA,** is a vice president with Lewis & Ellis in Overland Park, Kansas. He has previously served as chief actuary for the Kansas Insurance Department, and as a life insurance company chief actuary, appointed actuary and illustration actuary.

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BY CRAIG W. REYNOLDS

Craig W. Reynolds, FSA, MAAA, is president of the Society of Actuaries.

from the **PRESIDENT**

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# Cooperation, connections and communication

If you follow the news of the actuarial profession in North America, you certainly know that relationships among some of the actuarial organizations have been under some strain in the past few years. My desire to work on improving these organizational relationships was a significant factor in my decision to run for the office of president of the Society of Actuaries (SOA). During my SOA Listening Tour visits, both locally and around the world, the most frequent question I am asked is, “How is it going with the other organizations?” I am pleased to report that the situation is much improved.

Casualty Actuarial Society (CAS) President Steve Lowe recently wrote a column for the *Actuarial Review*<sup>1</sup> about the relationships among the organizations. I encourage you to read it. He shared a view largely consistent with my own. Both of our organizations are committed to being the best we can be and are dedicated to delivering the best service that we can provide to members. We also are both working hard to support the profession globally. We can and do compete, but in a way that drives us to be our best.

The SOA’s strategic plan calls for us to “set the global standard for a complete actuarial curriculum.” An SOA education provides a solid baseline grounded in all areas of actuarial practice, including general insurance (property and casualty), life, health, risk, group and investments. We

want to broaden actuaries’ perspectives, provide the tools to address problems and also to help them develop a practice specialty. The SOA is committed to all of our specialty tracks, including general insurance, as we continue to support our members and the actuarial profession globally. The world is big enough for many actuarial organizations. The choice offered by multiple organizations should make the world better for actuarial students, credentialed actuaries and actuarial employers.

Meanwhile, we continue to work on improving relations with the American Academy of Actuaries (the Academy) through regular communication and joint projects. The Academy and the SOA developed the Actuaries Longevity Illustrator, an online calculator for the public. We also work closely together on life, health and pension topics within the National Association of Insurance Commissioners’ various working groups. Several SOA staff actuaries participate in the Academy’s practice councils, providing important links between our work and theirs. These are essential connections we are making together.

On a multiple-organization level, we are working with the Academy, the CAS and the Canadian Institute of Actuaries (CIA) to jointly produce the Actuaries Climate Index and the Actuaries Climate Risk Index, which look at the impact of severe weather. These projects are prime

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## from the **PRESIDENT**

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examples of how much we can accomplish when the organizations work together. Other areas in which the four organizations come together include work with various committees and task forces of the International Association of Actuaries (IAA) and the North American Actuarial Council (NAAC). And, of course, we collaborate to support the Actuarial Board for Counseling and Discipline (ABCD), the Actuarial Standards Board (ASB) and the Joint Discipline Council (JDC).

A key to strengthening and maintaining these relationships is improved communication. I speak at least monthly with Tom Wildsmith and Steve Lowe, my counterparts at the Academy and CAS, respectively. Jerry Brown, SOA president-elect, also has regular conversations with Bob Beuerlein and Nancy Braithwaite, his counterparts. We regularly meet in person at meetings of the NAAC and the IAA. Furthermore, I shared a draft of this very article with my counterparts at the CAS and the Academy before it went to press. I wanted to ensure the material was accurate and that each organization's president was informed of this communication in advance, and had an opportunity to comment. Nonetheless, this article should be viewed as my personal opinion, and I do not mean to imply that they have endorsed or agreed with anything I say herein.

Some of our members remain puzzled by the subject of competition, believing that we should all be working together for the benefit of all members and the profession,



“ I will seek opportunities where all four organizations can work together. I encourage all of the organizations to help focus on this unified approach in representing the profession.”

the three of us do not agree on everything, I am personally committed to strengthening our great profession—and I know they are, too. If we are to succeed, we need your help. Thank you. ■

and that somehow this is inconsistent with the idea of competition. In fact, we **ARE** all working for the benefit of the profession. However, each organization must work at its own pace, style and approach to achieve its own strategy. I assure you that our organization's strategy focuses on growth of the profession in representing you, our membership.

At times, we may have overlapping projects with other actuarial organizations and different ideas on how to approach related topics. Realistically, such organizational overlap is inevitable when multiple organizations exist to represent the same profession. Elsewhere in the world, there tends to be one professional organization per country, or region, to represent actuaries. However, we are not there yet. Until then, I will seek opportunities where we all can work together to strengthen relationships. I encourage all of the organizations to help focus on this unified approach in representing the profession.

Please share your ideas with me, as I appreciate hearing your perspective. I encourage you to also share your ideas with Steve Lowe and Tom Wildsmith. While

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#### Reference

<sup>1</sup> [http://ar.casact.org/actuarialreview/january\\_february\\_2016?pg=8#pg8](http://ar.casact.org/actuarialreview/january_february_2016?pg=8#pg8)



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# Making connections

## A ROUNDUP OF NEWS FROM THE GLOBAL COMMUNITY

Whether you travel the world or never leave your home country, you are affected by global organizations, international requirements and the increasingly international nature of the actuarial profession itself. Here is some news from around the world.

### FIRST EXECUTIVE TRAINING EXCHANGE PROGRAM

In April, the Society of Actuaries (SOA) hosted chief actuaries and actuarial department heads from China as part of an executive training exchange program with the China Association of Actuaries (CAA). Members and staff from the CAA participated in a variety of meetings with the SOA in New York, Connecticut and Washington, D.C.

“Actuarial work grows increasingly global each year, and actuaries can benefit from learning more about actuarial issues and practices in other countries,” says SOA President Craig Reynolds, FSA, MAAA. “This program was designed to facilitate an information exchange that can strengthen the profession in both countries, while simultaneously solidifying relationships between the SOA and the CAA.”

The exchange program participants met with actuarial employers, organizations and institutions, including St. John’s University, Aetna, AIG, MetLife, Prudential, the Federal Reserve, the Federal Insurance Office, Columbia University, University of Connecticut, Haven Life, TIAA-CREF, Milliman, Willis Towers Watson, Anbang Insurance Group and the American Council of Life Insurers.

“This exchange program will help enhance relationships and cooperation [among] actuaries from companies in China and United States, and the industry,” says Chen Dongsheng, president of the CAA. “The discussions from this program will help in understanding developments within the international insurance market.”

SOA members will be able to participate in a similar program held in China in 2017.

### NEW OFFICE IN BEIJING

The SOA is proud to announce the establishment of its China office in Beijing. With more than 750 member actuaries in the area, China is an important market for the SOA, where it continues to serve a key role in the development of the actuarial profession and the insurance industry.



Participants of the first executive training exchange program closed the two-week event with a dinner at the National Museum of Mathematics in New York.

To commemorate the new office, Wei Cui, the general manager of Willis Towers Watson, acted as master of ceremonies at the opening reception. Speakers at the event included Genghui Wu, chairman of the International Committee of the SOA; Shirley Shao, chairman of the China Committee of the SOA; Jiangang He, deputy director of the CAA Health and Life department and mortality investigation office; Ling Ling Wang, deputy chief actuary of Ping An Insurance (Group) of China; Lan Wu, professor at Peking University; and Ann Henstrand, senior director of the International department at the SOA.

“With the China office and the expertise of the SOA’s staff in China, and Jessie Li, the SOA’s lead China representative, the SOA will be able to enhance the connection with members, candidates and partners; provide high-quality professional service; and promote the development of the Chinese actuarial industry through a joint effort with partners,” explains Ann Henstrand, SOA senior director, International.

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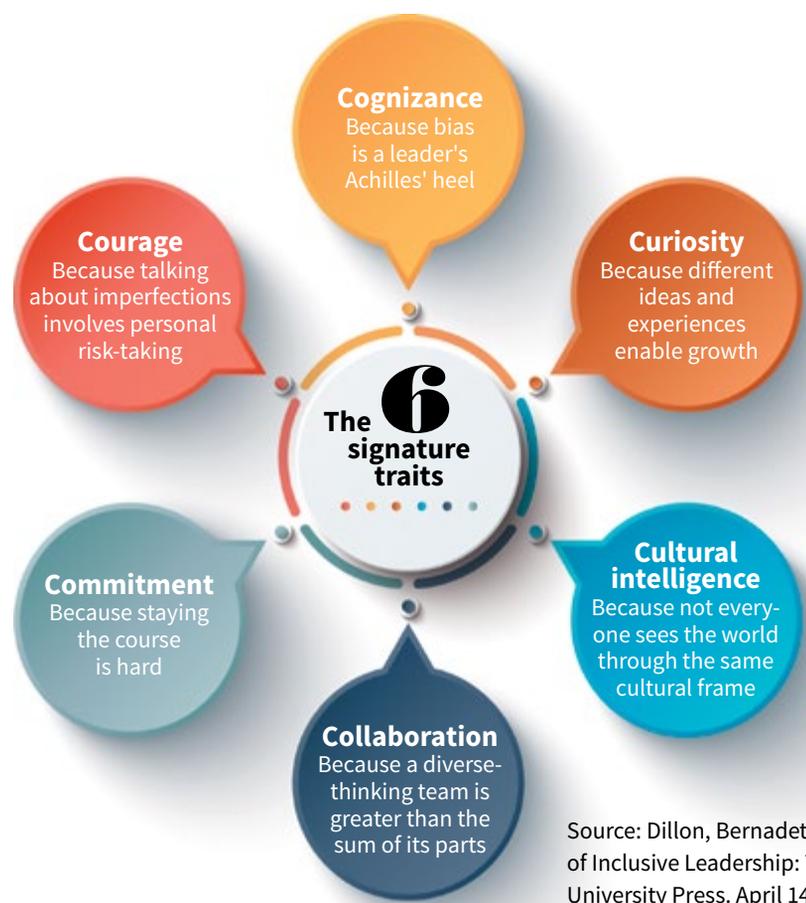
## INCLUSIVE LEADERSHIP

What will it take to be a great leader in the future—in five, 10 and even 15 years? *Deloitte University Press* recently published a report about the future of leadership and thriving in a diverse new world. Diversity of markets, customers, ideas and talent is driving the need for inclusion as a new leadership capability. In **FIGURE 1**, read about the six attributes of leaders who display the ability to embrace individual differences. Then, check out the related link for how to potentially leverage them for competitive advantage.

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**FIGURE 1** THE SIX SIGNATURE TRAITS OF AN INCLUSIVE LEADER



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Source: Dillon, Bernadette, and Juliet Bourke. "The Six Signature Traits of Inclusive Leadership: Thriving in a Diverse New World." Deloitte University Press. April 14, 2016. Accessed May 20, 2016. <http://dupress.com/articles/six-signature-traits-of-inclusive-leadership/>.

## PATIENTS AND PREDICTIVE ANALYTICS

*Harvard Business Review* covers predictive algorithms and other aspects of predictive data analysis to improve patient care. Additionally, the publication looked at the dramatic spread of electronic medical record adoption. This trend is heavily linked to predictive analysis directly benefiting patients.

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## HOW WILL A STRONG LA NIÑA IMPACT THE UNITED STATES?

As it stands now, it's too early to tell exactly how strong of a La Niña we could see by fall—or how long it could last—but based on the past, the pattern could develop along a few different paths.

It could swing sharply into a record-breaking La Niña. This is what happened in 1988–1989, after the strong, double-peaked El Niño in 1986–1987. It may produce another multiyear La Niña, like the ones that occurred following the sharp, very strong El Niños in 1982 and 1997. It also could result in a combination of the two—a record or near-record event in both strength and duration.

### RELATED LINK

- ➔ [bit.ly/2016Nina](http://bit.ly/2016Nina)



## RISK MANAGEMENT AND THE CFO PERSPECTIVE

While actuaries are well versed in enterprise risk management (ERM), getting the perspective of others, especially CFOs, can be insightful. *CFO.com* recently highlighted challenges with budgeting for unknown risks and the emergence of more strategic processes with incorporating ERM.

### RELATED LINKS

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## UBER HIRES MORE ACTUARIES

Uber Technologies Inc. now has a four-member actuarial team that Gus Fuldner, head of insurance at San Francisco-based Uber, plans to double this year.

As Uber builds insurance products in an environment where there often is little loss history, it is very important “to have a really strong actuarial team that can produce estimates and analyses with relatively limited information,” Fuldner says.

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# ADJU

BY REBECCA OWEN

# MAKING STATEMENTS

## A PERSONAL HISTORY OF PRICING AND MODELING IN THE HEALTH INSURANCE FIELD

**W**hen I was an undergraduate majoring in mathematics and physical chemistry (lo, a long time ago), there was a requirement that we take a programming class—but not that we do much with it. I took my class, which was more of a language learning exercise than an effort to really understand data structure or the development of algorithms, and I enjoyed it. But then I went back to my comfort zone of matrices, differential equations and proofs.

I found I needed to pay rent, and for that a job as an actuary was my best bet. I learned from my mentors that actuarial work all started with a need to use the past to predict the future, and the past comes in the form of data and reports. My abstract education was a sufficient, although not excellent, preparation for actuarial exams. But for my daily chores of pricing and reserving work, I needed to spend a lot of time learning how to use a spreadsheet—a useful skill my theoretical background had neglected to develop.

My first job featured a terminal. The department programmed in a language called QuikJob, which was aged even then. There were COBOL, DOS and FORTRAN if we wanted to be adventurous. Actuaries dealt with hand coding and scheduled programming times. It was somewhat fun, but no one could say it was elegant.

Pricing and reserving work were straightforward. Reserve cells used factors, and perhaps a little bit of macro code in Lotus 1-2-3 to develop the factors. Judgment and estimates took care of the most recent months, and the work was done at a very high level. Of course, we exercised care, examined

runout and had seasonal estimates. However, our data came from a routine mainframe report, and often we didn't even get it electronically, but rather on green and white barred printouts, which we then had to enter manually into the model spreadsheets. This was time-consuming, and much of the attention was focused on not making errors, leaving little time for detailed analysis before the financial statements were due. It is hard to feel the glory of an advanced degree when you are doing 10 key. The amazing thing was not that we did it manually, but that the numbers were so good.

The modeling for pricing also was done with less detail than today, but senior actuaries applied some hard-earned insight to adjust history for bumps and diversions. Factors from national sources were incredibly important, and again there could be a lot of manual entry from factor sheets. I remember how exciting the advent of drop-down boxes and VLOOKUP was.

**A SHIFTING FIELD**

Many of the adjustments used now aren't that different in nature from the ones we used then, although they are developed at a more granular level. For example, the adjustment value of a \$5 copay change isn't conceptually different from the actuarial value adjustments in the Affordable Care Act (ACA) models, although there is greater acknowledgement now that \$5 to someone earning \$24,000 per year is more significant than \$50 to someone earning \$125,000 per year. One of the most arcane and debatable sets of factors was the set of volume and complexity (V&C) factors used in the Health Care Finance Administration (HCFA) adjusted community rate (ACR) process. These were factors, at a very high level, meant to adjust commercial experience to the Medicare population, and although they had many significant figures, it is debatable if even the first digit applied well to some of the smaller population experience results (see **FIGURE 1**).

**FIGURE 1** TRENDS FROM A MORBIDITY AND MORTALITY WEEKLY REPORT

Cost Category	Average Initial Rate (Percentage of Total)	Average Utilization Adjustment Factor	Average Projected Medicare Rate (Percentage of Total)
Hospital inpatient services	\$22.95 (36.0%)	5.72	\$129.61 (50.0%)
Physician care	\$25.58 (40.0%)	2.90	\$75.44 (29.0%)
Hospital outpatient care	\$4.01 (6.0%)	2.99	\$13.61 (5.0%)
Skilled nursing facilities	\$0.24 (0.4%)	46.23	\$5.82 (2.0%)
HHA services	\$0.30 (0.5%)	20.08	\$3.65 (1.0%)
Laboratory services	\$2.08 (3.0%)	2.17	\$5.80 (2.0%)
X-ray	\$2.18 (4.0%)	2.19	\$6.78 (3.0%)
Emergency room	\$1.68 (3.0%)	2.34	\$4.92 (2.0%)
Miscellaneous medical	\$4.38 (7.0%)	5.00	\$15.00 (6.0%)
Total medical costs	\$63.40 (100.0%)	4.11	\$260.64 (100.0%)

Source: Morbidity and Mortality Weekly Report

**ACTUARIES HAVE BOTH THE TECHNICAL ABILITY TO WORK WITH THE MOST CURRENT DATA TO CREATE CUTTING-EDGE MODELS, AND THE ABILITY TO ADOPT THE LONG, WIDE VIEW TO PUT THE MODEL RESULTS INTO PERSPECTIVE.**

There were always some irritations when the actuarial and finance systems were separate. Pricing and modeling didn't always agree, something no one enjoys remembering now. There were so many unanswered questions, especially in pricing. Incorporating information from publications and studies into the local framework was difficult. We knew inpatient services were shifting to outpatient settings, but by how much and how fast in one specific instance was hard to estimate. There was never enough information, time or resources.

Pricing at this high level was particularly scary because there were some seriously high trends during the 1990s and 2000s, when things like the HMO backlash were making pricing dicey.

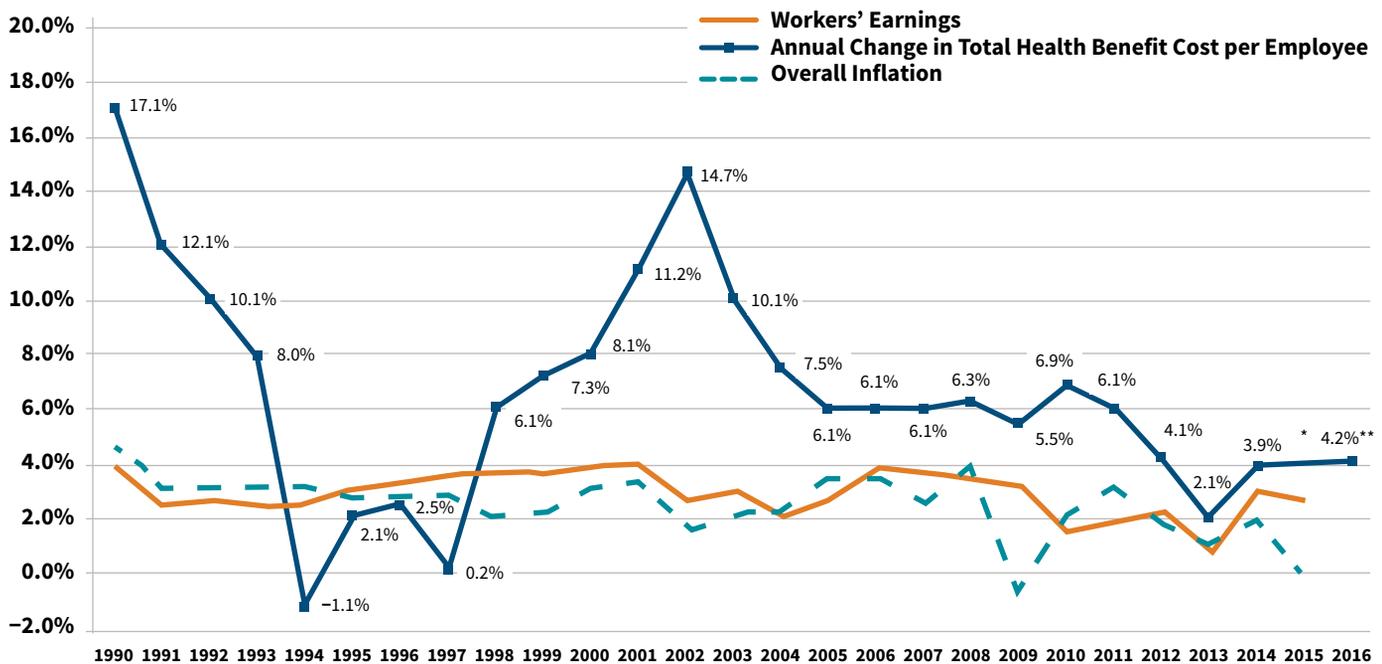
### AN INFLUX OF DATA

You can imagine that trends like the ones in **FIGURE 2** created an intense need for a better understanding of the drivers, which fueled a need for more data—but the data needed to be on an actuarial basis. This did not necessarily overlap with the institutional data processes, and actuarial questions were mired in lists of needed reports scheduled for completion later, usually during the “third quarter of next year.” There was nothing for actuaries to do but to construct actuarial databases and grow actuarial programmers, even though this meant there were often several sources of truth that did not always agree. We learned new terms: extract, transform, load (ETL); flat file in a CSV format; data dictionary. Once actuaries had their own data, they wanted to produce better, more sophisticated reports and models, which resulted in some actuaries becoming coders.

At first we produced descriptive reports, a lot like the ones that “actuarial” had received before, but with more detail and at a higher frequency. There would be dollars by month by service category, which would be divided by the member months to determine per member per month (PMPM) costs. The reserves matched the pricing exactly, because the same programs and systems produced both at the same time. Pricing models included estimates of how well the medical care provided to the population was managed, sometimes by specific service line. Provider reports improved, and it became possible to see how some providers had an outsized impact on overall cost structure. Spotting fraud often was based on serendipity or tip-offs. Our insight was better, but we had so much information we weren’t using, not to mention the growing need to price continual changes in coverage mandates for specific benefits.

So we learned to understand the components of claims and more new terms, like diagnosis-related group (DRG), Current Procedural Terminology (CPT), Bill-Type, Revcode and Modifiers. We could analyze services at incredible detail. We thought about ICD-9 codes and

**FIGURE 2** AVERAGE HEALTH BENEFIT COST PER EMPLOYEE PROJECTED TO RISE BY LESS THAN 5 PERCENT FOR THE FIFTH STRAIGHT YEAR

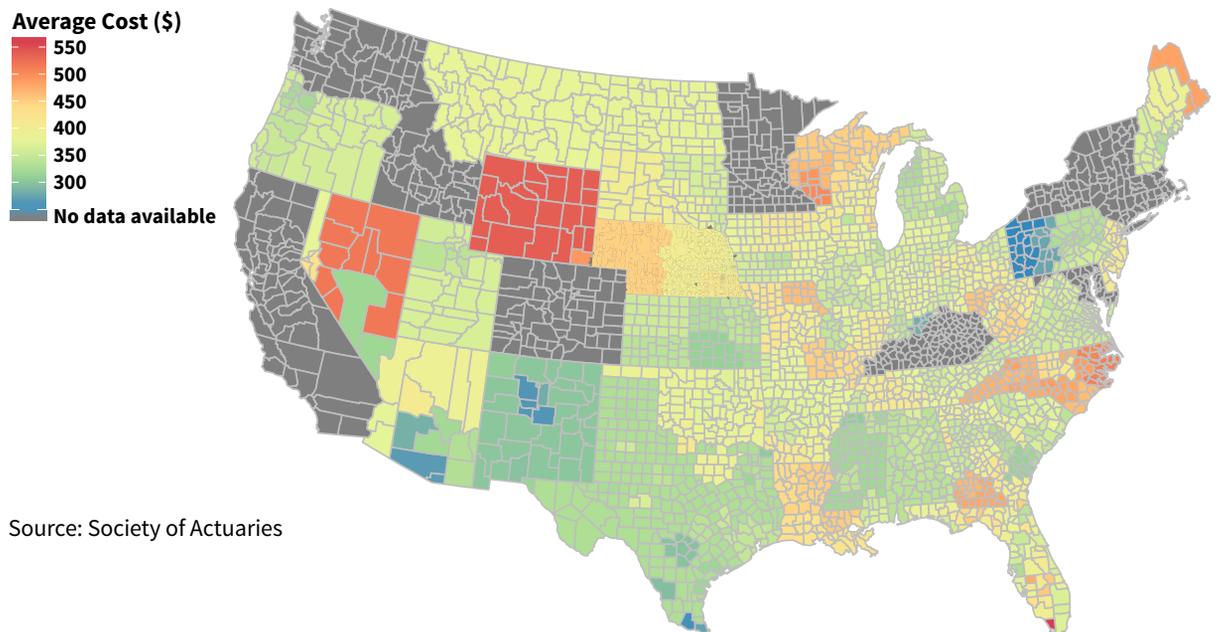


\*The actual cost increase for 2015 will be available later this year

\*\*Projected

Source: Mercer's National Survey of Employer-Sponsored Health Plans; Bureau of Labor Statistics, Consumer Price Index, U.S. City Average of Annual Inflation (April to April) 1990–2015; Bureau of Labor Statistics, Seasonally-Adjusted Data from the Current Employment Statistics Survey (April to April) 1990–2015.

**FIGURE 3** EXAMPLE OF DATA VISUALIZATION: AVERAGE INDIVIDUAL PREMIUM RATES



Source: Society of Actuaries

whether they were present on admission (POA). Drugs were brand or generic, mail order or retail. The names of chronic diseases like chronic obstructive pulmonary disease (COPD) or end-stage renal disease (ESRD) became familiar, and the pricing models reflected the ability to address the care needs of these populations effectively. Actuaries spent more time with provider contractors, pharmacists and nurses. The needs for different analyses and the ability to do them made health actuaries, particularly the analytical ones, more specialized.

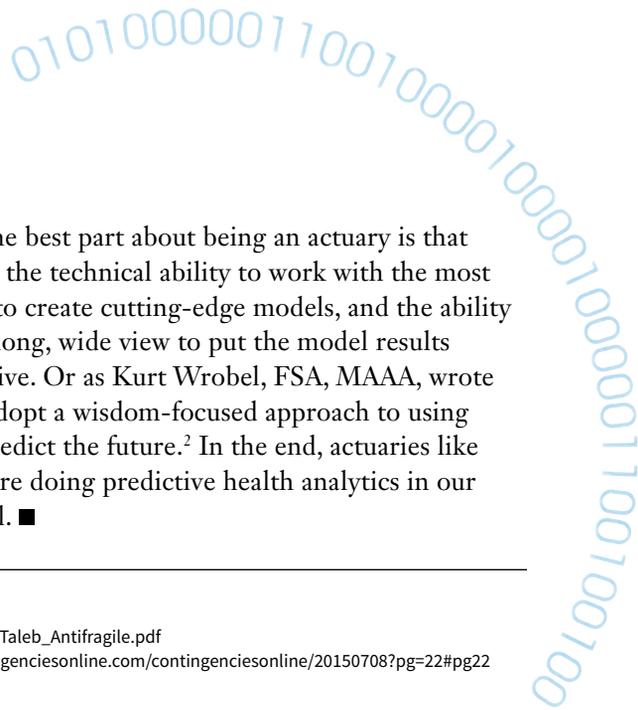
While all of this was happening, benefits became more complex, markets fractured, the technology of medicine burgeoned and new products emerged. Patient profiling was not just for the nurses doing care management, but it was needed to understand outliers, reinsurance, preferred provider arrangements and risk sharing. Risk adjustment was getting used more generally, enough so that the Society of Actuaries commissioned the first article comparing the different methods. Titled “A Comparative Analysis of Claims-based Methods of Health Risk Assessment for Commercial Populations,” the article, written by Robert B. Cumming, FSA, MAAA; David Knutson; Brian A. Cameron, FSA, MAAA; and Brian Derrick, was published in May of 2002. Although the principal inpatient diagnostic cost group (PIP-DCG) adjustment for Medicare+Choice came about in 2000, risk adjustment wasn’t used much in commercial pricing until later. We learned more new

terms: relational database, query structure, hierarchical conditions, episode grouping, bundled payment and prospective adjustment.

The health delivery system began to transform, and actuarial data analytics kept up. For a price, comprehensive, centrally-located data repositories were available, but in-house analytics still was a core function for actuarial departments. Data mining tools made things easier, and certainly the graphics and report outputs became more polished and colorful (see **FIGURE 3**). We needed to “bend the cost curve,” a phrase that entered the popular vocabulary in about 2008 and still describes much of what actuaries are trying to do with all of these models. There were more terms: accountable care organizations (ACOs), coordinated care organizations (CCOs), medical homes—all of which are not the same as HMOs, as many posts and blogs explain. Concepts like hot-spotting, in part thanks to Atul Gawande’s seminal article in 2011, and behavioral finance moved from non-actuarial disciplines into our pricing and forecast models. Data visualization made actuarial work even a little bit colorful.

### CONCLUSION

Now the models are adding information from electronic medical records (EMRs), lab values, Twitter feeds and survey results—all data elements of a completely different sort than the types we have used in the past. We are



awash with data, and there are exceptionally well-trained actuarial data scientists using sophisticated and powerful tools to make the most of it.

But with every additional data element, there are more opportunities to make an unintentional mistake. Differing data sources do not meld well together without a lot of oversight, and the results can be unexpected due to the butterfly effect. Using data at this detail and in this volume is an expensive undertaking, and often involves purchasing expensive tools or access.

The problem is that a lot of information means a lot of bad information without the comfort of the single source of truth, nor the comfort of “paid means paid,” which meant we had a cash financial statement number for a surety. With our fast and slick tools, we are at risk of being distracted by epiphenomena. As N. N. Taleb tells us, “Falsity grows faster than information.”<sup>1</sup>

And yet, Taleb also tells us to embrace the uncertainty and jump into the pool. The combination of tools, data and training has come together to form a complex, interconnected, transformative, swirling, exciting

discipline. The best part about being an actuary is that we have both the technical ability to work with the most current data to create cutting-edge models, and the ability to adopt the long, wide view to put the model results into perspective. Or as Kurt Wrobel, FSA, MAAA, wrote recently, to adopt a wisdom-focused approach to using the past to predict the future.<sup>2</sup> In the end, actuaries like you and me are doing predictive health analytics in our own way. Still. ■

#### References

<sup>1</sup> [http://cpor.org/af/Taleb\\_Antifragile.pdf](http://cpor.org/af/Taleb_Antifragile.pdf)

<sup>2</sup> <http://www.contingenciesonline.com/contingenciesonline/20150708?pg=22#pg22>

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Exams



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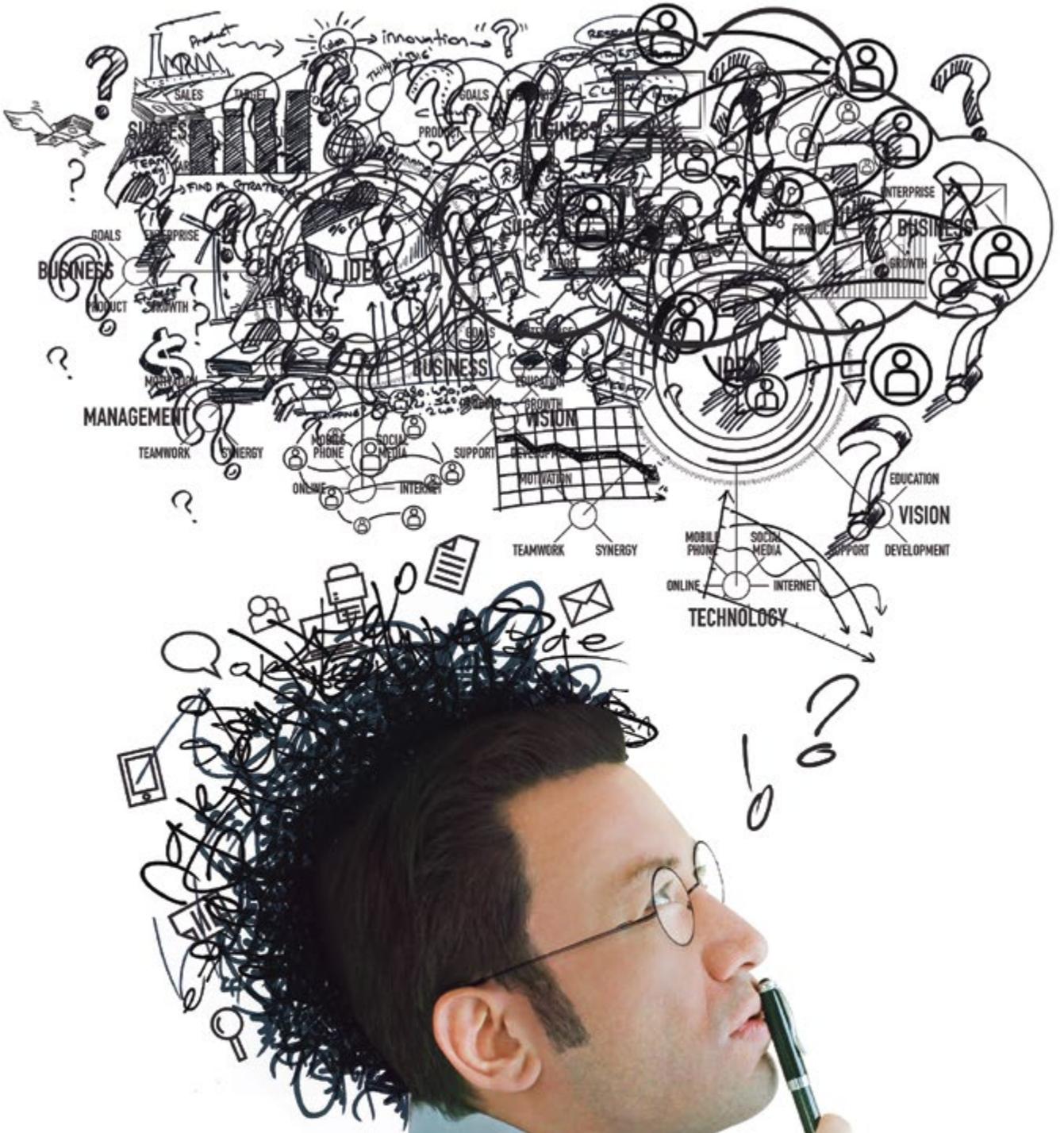
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**FEATURE**  
TEACHING FUTURE ACTUARIES



# LEARNING TO

# UNTANGLE

## TRAINING ACTUARIES TO SOLVE PROBLEMS WITH DATA

BY BRIAN HARTMAN

**A**s a professor, I spend a lot of time thinking about how to best prepare students to make an impact in their careers, families and communities. While there are many skills essential to building a solid career in actuarial science (e.g., communication, leadership, diligence, empathy), for this article I will focus on the skills that better enable students to solve problems with data. Data is everywhere and growing rapidly. It is a large part of an actuary's job currently, and it will only become more important in the future.

Seeing this trend, we at Brigham Young University have worked to organize our curriculum to prepare our students to use data to solve problems (as have my colleagues at many other universities). For example, our data science class is a two-semester class during which the students become familiar with the software (R, Python, Spark, etc.) and machine learning methodology (trees, neural nets, support vector machines, etc.) to analyze large data sets in the first semester. Then in

the second semester, companies give seminars on compelling problems, and the students gather in groups to work on the issues using real data.

In addition to the coursework, we work with companies to solve large problems together. We have partnered with companies in property and casualty, health, life, and long-term care insurance. This arrangement benefits the companies, students and faculty alike. Employers get access to cutting-edge methodology, academic experts and bright students. Our students gain experience solving actual problems and dealing with real and messy data. As faculty, we are able to keep our research and teaching connected to current industry practice.

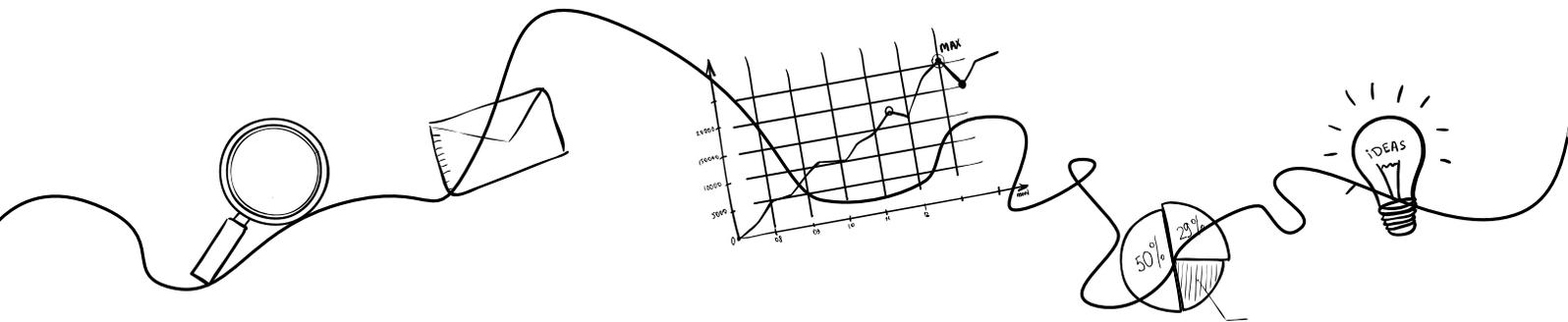
Overall, we take a holistic approach and build the students' skill sets in four major areas essential to solving these problems effectively. First, they need to understand the data and the business problem. Second, they need to understand enough statistical methodology to be able to know the right tools to use in a particular situation. Third, they need to be able to

implement those methods efficiently. Finally, they must be able to communicate their results effectively.

### UNDERSTANDING THE DATA AND THE BUSINESS PROBLEM

The first step is understanding the data and the business problem. Statistician John Tukey once said, "Far better an approximate answer to the right question, which is often vague, than an exact answer to the wrong question, which can always be made precise." Without truly understanding the business problem and the data, you may gather a poor data set where results cannot be trusted, or you may build an incredible model that doesn't answer the main question (or potentially any others).

While it is true that statistical methods are very transferable and "data is data," the results are not valuable without the proper context. Many of our courses include a culminating project in which the students need to find and validate data to solve a problem. For the final project in our first regression course, they need to solve



a problem of their choice by finding applicable data and using many of the methods they learned in class to analyze it. Before starting the project, the students often assume the analysis will take the most time. While a solid analysis does take a good deal of time, finding dependable and applicable data often takes far longer.

**UNDERSTANDING STATISTICAL METHODOLOGY**

Second, students need to understand the methodology used to perform the analysis. We try to balance our time between exposing them to a large number of statistical techniques and helping them gain a strong statistical foundation, which makes it much easier for them to learn new techniques when necessary. More important than knowing how to apply any particular method, we help them to understand the assumptions, strengths and shortcomings of various methods so they can properly apply what they know and look for a better method when they need one.

For example, the error term in standard linear regression is assumed to be normally distributed, meaning that the predicted values (and the associated uncertainty in those predictions) are going to be continuous, symmetric, and possibly include both positive and negative numbers. To illustrate this point, in some applications, like modeling the total claim cost for a given personal auto policy next year, this normality assumption may be

questionable. Total claim cost is likely right-skewed, positive, has a positive probability of being exactly zero and could have a very heavy tail. Understanding the assumptions and shortcomings of the model allows students to look for improvements or alternatives. Changing the error distribution, say through a generalized linear model (GLM), can add skew and require the costs to be positive. Certain error distributions can account for the heavy tail. You can incorporate a two-part model to account for the probability of no claims.

As another example, consider the case when a data set is very large, though vary sparse (meaning most of the data is missing). While linear regression (or a standard GLM) will not work well in such cases, you can find different shrinkage models (e.g., LASSO or elastic net) to better solve your problem. While it may not be reasonable to teach students all of the current methods, it is nonetheless important for them to understand the weaknesses and limitations of the methods they learn. Doing so will allow them to know when they should try to improve upon the methods they understand and when they should seek alternative methods.

When one of my students and I worked with a major health insurer, we examined one of those assumptions and came to an interesting conclusion. We were modeling claim severity for a large portion of its business (9 million policyholders, 32 million claims).

“More important than knowing how to apply any particular method, we help them to understand the assumptions, strengths and shortcomings of various methods.”

The insurer was interested in better severity models to price a new product line and wanted us to do a better job fitting a gamma model to its data. We also checked how well the gamma distribution fit the data. It turned out there were many distributions, some commonly implemented in software, which greatly outperformed the gamma distribution in terms of model fit. By challenging commonly-held assumptions—not only in the company but throughout the industry—we were able to better understand the future claims costs and help the company model and manage its risk.



**UNDERSTANDING THE ASSUMPTIONS AND SHORTCOMINGS OF THE MODEL ALLOWS STUDENTS TO LOOK FOR IMPROVEMENTS OR ALTERNATIVES.**

### **IMPLEMENTING THE METHODOLOGY**

Third, students need to be able to implement the models efficiently, especially with rapidly growing data sets to analyze. Understanding the models to fit and the assumptions to challenge will not help you actually solve the problem unless you can implement them in a reasonable amount of time. In the health insurance example, the first method we tried on a small subset of the data was rather slow computationally. It would have taken four weeks to implement it on the entire data set. We developed a new method, based on random forests,

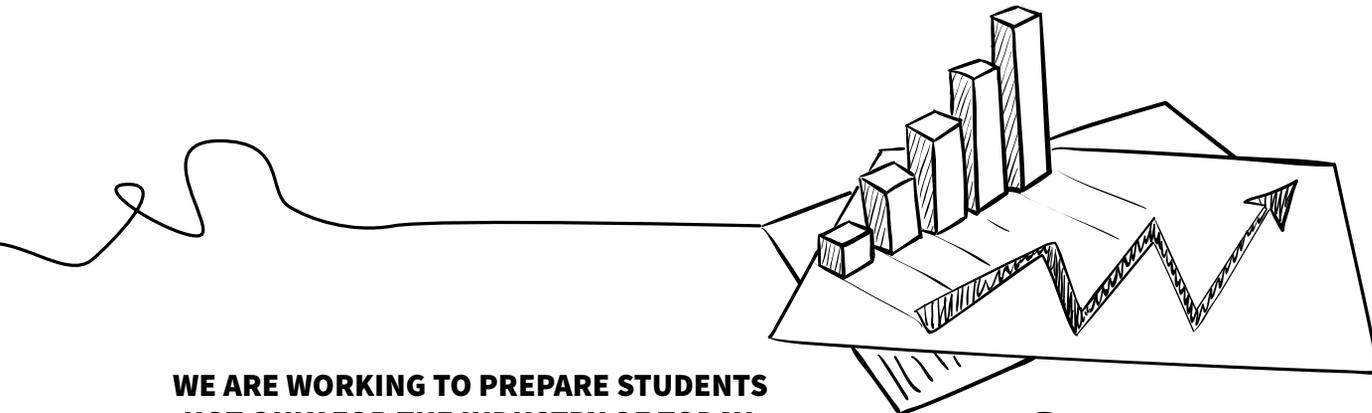
which only took a few minutes to run on the entire data set.

### **COMMUNICATING RESULTS**

Finally, students need to be able to communicate their results. The best models and results cannot bring an appreciable change to the business without proper communication. They need to be able to tailor and present information to both technical and nontechnical audiences, to audiences both inside of their departments (with a solid understanding of the business) and outside. To help our students improve their communication skills,

many of our classes require a written project and oral presentation. While they are graded on their application of statistical methodology, a large portion of the grade is determined by their communication, both oral and written. Students also are required to take a course in business communication, during which they learn how to convey technical information to many different audiences.

Most of our projects with companies involve our students. At the University of Connecticut, a group of students was involved in a series of projects with a major long-term care insurer.



**WE ARE WORKING TO PREPARE STUDENTS NOT ONLY FOR THE INDUSTRY OF TODAY, BUT ALSO THE INDUSTRY OF THE FUTURE.**

# STRATEGY

The students met with the client to define the business problem, worked together to analyze the data and then led the presentations of the work to the client. Not only was that experience valuable for the students, helping them to learn and develop all the skills mentioned so far in this article, but the company was able to see potential in the students and made full-time job offers to some of them.

## DEVELOPING WELL-ROUNDED ACTUARIES

Additionally, it is very important for students to be well-rounded and curious. We are in a very competitive market and can be left behind if not working hard to stay current. Even if we had the time to teach students most of the cutting-edge models currently in use, we wouldn't be able to predict the problems they will need to solve in 10 years, let alone 20, when they will be running their departments.

The International Actuarial Association (IAA) has updated its curriculum to include more analytics. In the United States, both the Casualty Actuarial Society (CAS) and the Society of Actuaries (SOA) see the value in students learning and being tested on their data analytics skills. The SOA has a module in its fellowship requirements entitled "Applications of Statistical Techniques."

The CAS recently added exam S to its associateship curriculum, which covers basic applied statistics (e.g., inference, estimators, goodness-of-fit, GLMs and time series). The CAS also is considering adding one or two advanced statistics exams (at one time tentatively called S2 and S3) to the fellowship requirements. What's more, CAS plans to launch an additional credential in predictive analytics and data science. There likely will be further innovations in the future.

For my students, the actuarial exams are important and constantly on their minds. They know they need to pass the exams in order to land internships and full-time jobs, but often it is hard to see that the exams actually occupy only a small part of their careers. Top students today graduate in their early 20s, having passed two to four exams. Many will have their fellowships in five to 10 years. Assuming a normal retirement age (though actuarial salaries allow for much earlier retirement, but that is another subject) means they have "only" 30–35 years left in their careers without any exams. Plus, the majority of the first five to 10 years will be spent working on projects tangentially related to the exams, requiring a good bit of additional study and work to be successful. Without internally-motivated curiosity, they will be unable to perform at the

highest possible level. With resources like Coursera and edX, anyone with the desire and diligence is able to improve his or her skill sets. It has never been easier to acquire new skills: As of April 2016, a search for "data" in the Coursera course catalog returns 294 courses and specializations at varying levels of expertise.

By building our students' skill sets to understand the business problem, properly choose and implement the methodology, and communicate the results, we are working to prepare them not only for the industry of today, but also the industry of the future. Actuaries with strong data skills naturally can impact not only the insurance industry, but many others, such as health care, finance and marketing, as well. It is a great time to be an actuary. ■

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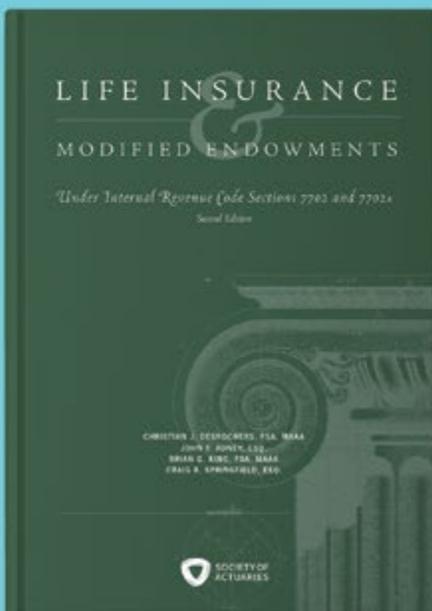
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# REINVENTING

**OUR ABILITY TO UNDERSTAND AND MANAGE RISKS, SOLVE BUSINESS PROBLEMS, AND CREATE BUSINESS SOLUTIONS NEVER STOPS EVOLVING**

BY TIM CARDINAL

**S**eizes business opportunities faster than a speeding bullet. Persuasion more powerful than a locomotive. Able to leap over risk crises in a single bound.

Look, up in the sky! It's a bird! It's a plane! It's a Super Actuary!

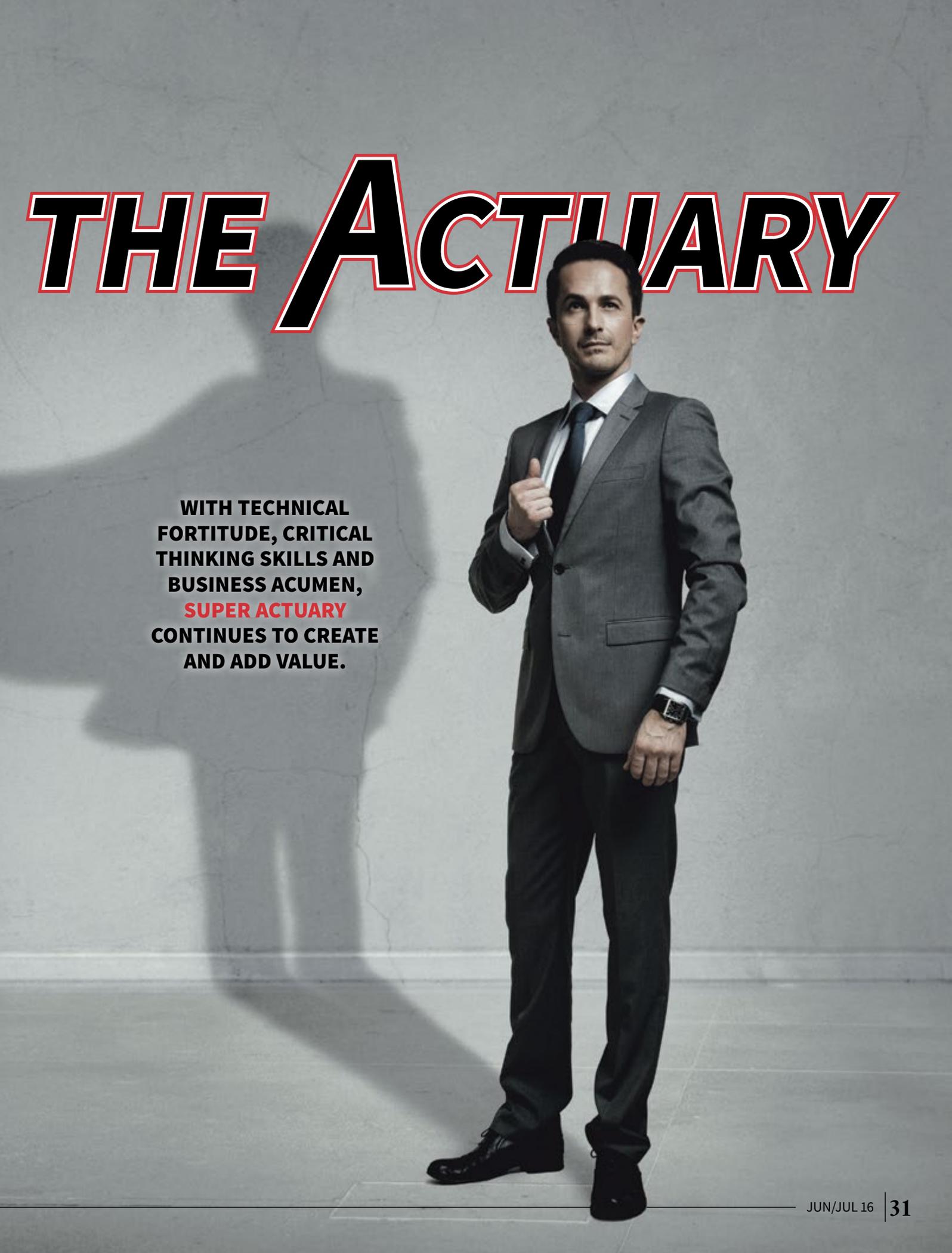
When we consider other professions, there is little question that today is different than yesterday. We don't hold their pasts against today's capabilities. Yet, sometimes actuaries are judged on yesterday's capabilities—either as individuals or as a profession—which is a fallacious appraisal.

Doctors, scientists and engineers do not dwell on the fact that their past theories and tools would be inadequate for today's challenges. They fully expect yesterday's ideas will yield to the ideas of today and tomorrow—that their domains perpetually evolve. We assert the actuarial profession is no different.

How is the perpetually-reinventing actuary created? The answer is quite simple: through lifelong learning, individually and collectively.

“Reinventing” is a popular buzzword in today's business world. Companies must reinvent themselves continuously—products, operations, markets—or competitors will push forward and upward, leaving complacent and stagnant companies behind. Sometimes reinvention is forced upon an organization due to recent struggles.

# THE ACTUARY



WITH TECHNICAL  
FORTITUDE, CRITICAL  
THINKING SKILLS AND  
BUSINESS ACUMEN,  
**SUPER ACTUARY**  
CONTINUES TO CREATE  
AND ADD VALUE.

### SOA VISION

The Society of Actuaries' (SOA's) vision—"establishing actuaries as business leaders who measure and manage risk"—as stated in the 2013–2016 Strategy Map, is paraphrased as:

- Developing actuaries as technical experts, business professionals and leaders.
- Equipping actuaries and the organizations they serve to effectively measure and manage risk.
  - Enhancing their ability to address complex business problems.
- Setting the global standard for a complete actuarial curriculum. Learning focused on technical excellence and business acumen.
  - Improving skills ranging from business leadership and communication to technical actuarial and analytical skills, as outlined in the SOA Competency Framework.
- Strengthening existing and developing new opportunities with employers.
  - Enabling actuaries to find greater opportunity for career mobility and leadership positions.
  - Developing new relationships with employers in other sectors (such as commercial and investment banking).
- Cultivating innovative and practical ideas.

### EXAMS

Candidates often groan at the news of updates: The syllabus is changing or the exams are being restructured. The world, business, markets and technology—all are developing and evolving rapidly. Exams are changing constantly to stay in front of the curve. The SOA Curriculum and Exam Committee members are C-level (senior) officers, managers, consultants and others from a broad range of functions and disciplines. We don't ask what junior actuaries need to be able to do in their current or near-future jobs; instead we ask what actuaries will need to know to succeed throughout their careers—not only in insurance, but in the risk management and predictive analytics spaces in any industry. Each track is undergoing reviews and updates; the ASA path is being redesigned.

Foundational career skill sets are developed in attaining our credentials—a first step in a long career path. Actuaries develop a solid foundation of business management fundamentals, and leadership, communication and strategic thinking skills help candidates grow and succeed in their careers. As actuaries progress in their career paths, the unique value of the actuarial toolkit in the risk evaluation and strategic decision-making arenas is honed and put to full use.

The number of actuarial science programs and students at universities has skyrocketed. The next generation is eager to learn what, how and why actuaries evolve into Super Actuaries.

### CRITICAL THINKING SKILLS AND BUSINESS ACUMEN

Exams teach more than critical thinking skills and business acumen. The true value proposition for actuarial education is an actuary's foundation regarding risk management approaches, concepts, business strategies, team processes, understanding key drivers, placing problems in a business context and communication styles that enable actuaries to:

- 1 | Apply these concepts to real world problems.
- 2 | Differentiate successful strategies from less successful strategies.
- 3 | Improve understanding of business and corporate environments.
- 4 | Formulate problems, develop strategic alternatives, select the "best" approach and decide on an implementation plan for the selected strategy.
- 5 | Think strategically regarding problem definition and anticipation of competitors' reactions.
- 6 | Concisely and clearly communicate ideas to top management.
- 7 | Improve communication skills, including persuasion and thinking "on their feet."

### CONTINUOUS LEARNING

Imagine going to a hospital with technology stuck in the 1990s. Or seeing a doctor without current know-how, who stopped evolving with practices. Medicine, as practiced today, is not the same as it was 10 years ago. Technology has played a large role. The same is true of data—its collection, tools and analysis. Advances and practices not possible 10–15 years ago are being replaced with even newer methods. Similarly, technology and data have played a large role in shaping the actuarial profession. Our ability to understand and manage risks, solve business problems, and create business solutions never stops evolving. But increasing our abilities doesn't just magically happen. Like preparing for exams, it requires considerable effort. Learning occurs through experience on the job, new opportunities, challenges, collaboration and (hopefully, not many) mistakes.

### MORE THAN MERE TECHNICIANS

X-ray technicians are experts at using the machine. With the help of other technicians, they deliver accurate and

useful intelligence regarding the patient to the doctor. But a technician is limited in creating value or helping the patient. The doctor uses multiple tools and multiple sources of intelligence to interpret and diagnose the patient's condition, consider alternatives, make recommendations, gain the patient's acceptance and implement a solution. Patients in need of services go see the doctor, not the technician.

*Actuaries' roles should be analogous to the role of doctors. We are not mere technicians.*

John Keegan's stages of making intelligence useful are explored in "ERM, Lessons from WWII Codebreakers."<sup>1</sup> The five stages are:

- ① | Acquisition
- ② | Delivery
- ③ | Acceptance
- ④ | Interpretation
- ⑤ | Implementation

## **THE NEXT GENERATION IS EAGER TO LEARN WHAT, HOW AND WHY ACTUARIES EVOLVE INTO SUPER ACTUARIES.**

How do actuaries fare in this process of making intelligence useful? Exams help actuaries develop solid technical skills. How well do they help develop the ability to deliver intelligence and get it accepted by decision makers? Actuaries are well-positioned for a big data world. Data, technology and data tools have become BIG. There is more data—more "dots" to connect—and the data comes at everyone faster. But in this glut of data, someone still needs to think critically; look at the right data; and analyze, interpret and understand drivers to make the connections. The ability to connect the dots better than your competition creates value for your organization and its stakeholders.

Actuaries, among many things, have an affinity for solving problems and challenges—for developing solutions for businesses and society. As challenges become more complex, interconnected and move faster, actuaries have been at the forefront. Although risk and risk management have been around for millennia, the past decade has made all facets of business and government acutely aware of risk—and the value risk managers provide. As stated in the SOA's vision, risk is at the heart of being an actuary. Coupled with technical fortitude, critical thinking skills and business acumen, the perpetually-reinventing actuary continues to create and add value.



**CONTINUING EDUCATION**

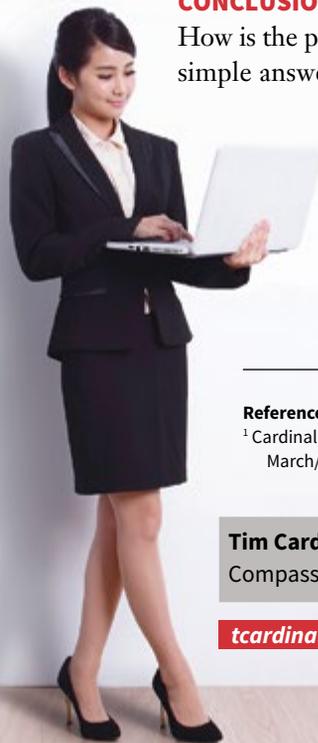
One aspect of continuous learning is continuing education. The profession has taken a proactive approach to educating actuaries in this rapidly evolving and competitive risk management environment. There are a staggering number of ways to keep abreast of changes in market trends, industry and demographic forces, regulations, technology and products.

Industry meetings, such as the SOA Annual Meeting, always have provided great opportunities for peer-to-peer discussions with many engaged participants who have broad perspectives. However, these sessions have evolved. Compare a meeting agenda from the early '90s to today. The content, focus and delivery have changed: teaching sessions; workshops; "Ask the Experts;" longer sessions, such as the Chief Actuary Forums; buzz-groups; and many more. The Innovation Series is an example of a series of related sessions allowing wide, broad, and more substantive content and discussion.

There are boot camps and intensive one-day seminars on topics such as product pricing, risk management, reinsurance, business analytics and economic capital. Seminars often are based on meaningful case studies. Five years after adoption, the 2015 AG43 Seminar sold out and received high evaluations by participants. When's the next one?

Online education is here, be it free Massive Open Online Courses (MOOCs) or commercialized offerings. There are scores of webinars that offer convenience and affordability, and they reach large audiences. There are e-Learning modules. Online offerings were once new, but today online continuing education is commonplace.

“The demand for continuing education is evidence that as individuals and as a profession, actuaries have embraced perpetual reinvention and the value organizations place on developing their actuarial leaders.”



Our path to personal growth—and the path to take business leadership roles in any industry—is via developing stage four (interpretation) and stage five (implementation) skill sets. For example, being able to analyze ambiguous data and gain insights into the big picture by recognizing patterns or connecting the dots. And being able to manage change, collaborate, lead, prioritize and adapt using the right communication and management styles and methods. Soft skills can be studied, but there is no substitute for experience when honing skills. You are fortunate if you have a mentor or champion who provides development opportunities. More often than not, you have to make things happen—take on a new role, embrace change, etc.

One significant and effective means to grow is through volunteerism. I've been amazed at the rich discussions with colleagues from various industry committees and section councils over the past several years. Broad perspectives. Diverse work experiences. Subject matter experts. Much more than one could learn in isolation versus being engaged with fellow professionals. There also are enormous benefits derived from volunteering in any local nonprofit or activity that interests you. Early in your career, your company might not let you lead a project, but small organizations always need go-getters and achievers. What better way to learn managerial experience than by studying and doing?

The demand for continuing education is evidence that as individuals and as a profession, actuaries have embraced perpetual reinvention and the value organizations place on developing their actuarial leaders.

**CONCLUSION**

How is the perpetually-reinventing actuary created? The simple answer is through lifelong learning—individually and collectively. The ability to perpetually reinvent oneself takes planning and intentional effort. But in the actuarial profession, the perpetually-reinventing actuary has become the norm—not the exception. Which is the way Super Actuary becomes an everyday actuary in every industry. ■

**Reference**

<sup>1</sup> Cardinal, T. and Li, J. "ERM, Lessons from WWII Codebreakers." *Contingencies*, March/April 2011.

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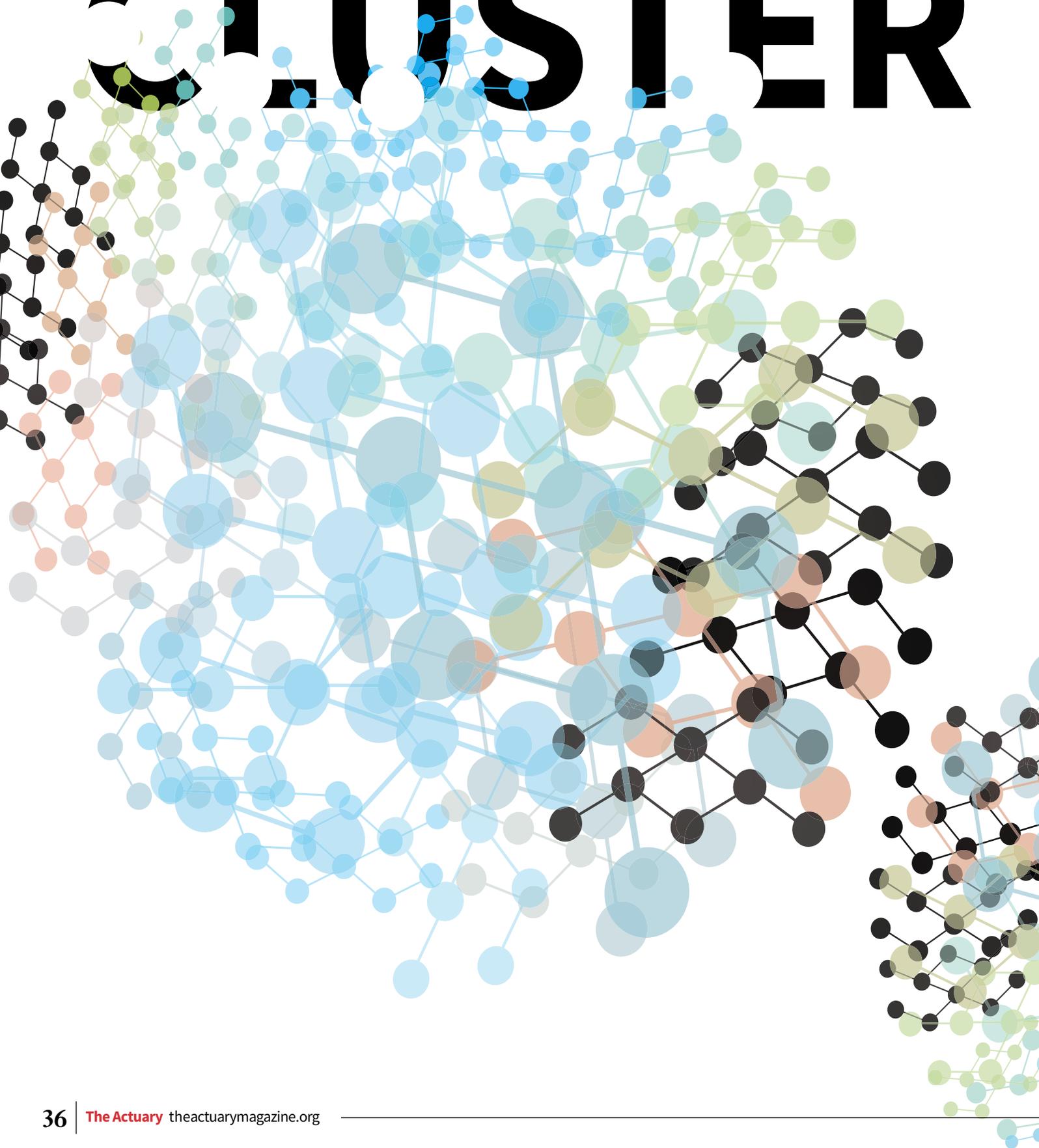
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# CLUSTER



# ANALYSIS

## APPLICATIONS IN EXPERIENCE ANALYSIS AND ASSUMPTION-SETTING

BY MARIANNE PURUSHOTHAM

**C**luster analysis is a statistical technique that has been used extensively by the marketing profession to identify like segments of a target buying population for a particular product. Cluster analysis can be used to reduce the complexity of a particular population by identifying subpopulations that naturally group together in terms of socioeconomic, psychographic and behavioral criteria.

The goal of clustering techniques in the sales and marketing setting is to identify and understand similarities (and differences) among groups of potential customers, allowing companies to develop more customized sales and marketing approaches for these different groups.

This article explores the potential for applying cluster analysis as an additional tool to support the experience analysis and assumption-setting process in actuarial work using a sample population of variable annuity (VA) contracts with guaranteed living withdrawal benefits (GLWBs).

### THE CLUSTER ANALYSIS METHODOLOGY

There are two general categories of cluster analysis: agglomerative hierarchical methods and distance methods. Agglomerative hierarchical clustering is a process that begins by defining one cluster for each record in a particular data set or population. Clusters then are combined iteratively by defining and calculating the “distances” between existing clusters, and then successively merging those that are “closest.” This process continues until there is only one cluster left, and then an analysis is performed to select the optimal cluster structure for the particular data set.

On the other hand, distance clustering starts with a “seed” for each of the maximum number of clusters as defined by the user. Then each record in a data set or population is assigned to the nearest seed (based on a calculation using a defined distance method) to form a cluster.

The original seeds then are replaced by the means of the current set of clusters, and the process continues to iterate until there are no longer changes in the means of the current cluster arrangement. The approach used for the VA example presented in this article falls into this second category of cluster analysis methods and is called K-mean Euclidean Distance Method. This particular approach tends to work well on larger data sets and therefore is a good method for an initial analysis.

### A CASE STUDY: VA CONTRACTS WITH GLWBs

Let's explore possibilities for applying cluster analysis to support the experience analysis and assumption-setting process.

- 1 | *Serve as an independent check of the results of a predictive modeling process.*

Cluster analysis can be thought of as a tool similar to factor analysis. While factor analysis identifies key variables in the data that impact a particular outcome (and therefore are the most likely candidates for a predictive modeling exercise), cluster analysis identifies key groups of cases (e.g., contractholders) at the individual record level.

For example, let's consider a group of VA contractholders who have elected a GLWB. Suppose we have developed a predictive model for full surrenders for this group. We then could apply a cluster analysis algorithm to the same population and compare the full surrender behavior of members of the clusters identified by this independent approach to the predictive model variables identified as having strong association with full surrender activity.

- 2 | *Provide a possible method for developing actuarial assumptions for new product designs where little or no experience is available yet, but where the design shares similarities with an existing product with more available experience.*

In this case, an actuary could apply a cluster analysis to a new design (Product 1) based on characteristics of the current population of contractholders to determine like groupings. These groups then could be compared to the cluster analysis results for the existing product design (Product 2), and where there are similarities in cluster characteristics, the actuary might feel more comfortable applying the experience results (modified for actuarial judgment as appropriate) for Product 2 to the Product 1 like cluster(s). For segments of the Product 1 population that don't overlap with segments of the Product 2 population, we still would need to rely on industry-level experience where credible, as well as reasonable judgment. However, this approach might provide a more mathematically sound basis where there are segments of overlap in the underlying inforce population clusters.

Let's go into a bit more detail on the example of the VA contractholders mentioned. LIMRA and the Society of Actuaries (SOA) have partnered for several years on

annual industry experience reporting for VA contracts that have elected some form of guaranteed living benefit. The published reports include regular updates on full surrender activity, as well as utilization experience for each of the common guaranteed living benefits. Using a random sample of experience data for 2012, LIMRA developed a preliminary predictive model for full surrenders on contracts with GLWBs. A summary of the results of that effort is provided:

#### Data Description:

- Experience Year 2012
- Contracts that have elected a GLWB
- Includes both policy and product design data as potential predictive variables

**Model Selection:** Several different modeling approaches were examined, including generalized linear model (GLM) forms, decision trees and survival models. For purposes of this discussion, we will refer to the results of the GLM with a logit link function and binomial distribution assumption.

Based on the final determination of this model, the **key predictive variables** were:

- Utilization status
- Policy duration
- Market
- Attained age of policyholder
- Distribution channel
- Policy size (account value, cumulative premiums paid)
- In-the-moneyness range
- Surrender charge level

#### Cluster Analysis: Application 1

*Serve as an independent check of the results of a predictive modeling process.*

For purposes of performing the cluster analysis on the VA population, a K-mean Euclidean Distance Method was used with parameters set for a k=3 up to k=10 clusters successively. This methodology measures distances using numeric (continuous) variables. This is because the *Euclidean distance* is measurable only for numeric variables. There are distance measures that allow for both categorical and continuous variables; however, these methods are not as manageable with extremely large data sets. As a result, the approach taken here is to determine clusters using key numeric variables and then describe those clusters using all variables (including categorical).

**THE FORMULA FOR THE EUCLIDEAN DISTANCE BETWEEN POINT X (X1, X2, ETC.) AND POINT Y (Y1, Y2, ETC.) IS:**

$$d = \sqrt{\sum_{i=1}^n (x_i - y_i)^2}$$

The next step is to select the optimal number of clusters based on an analysis of the degree of differentiation provided by each potential cluster arrangement and the relative sizes of each. The following statistics are commonly used to measure the distinctness or significance of a particular set of population clusters.

- CCC (cluster convergence criterion)
- Approximate expected overall R-squared
- Pseudo-F statistic

The object here is to maximize the value of each statistic, while taking into consideration the additional complexity created by a larger number of clusters.

The values of these statistics for cluster groups of sizes k=3 up to k=10 for the VA population under consideration are shown in **FIGURE 1**. The trend to observe in this table is where the Pseudo-F and CCC statistics peak and the increase in the R-squared statistic is diminishing—because R-squared always will continue to increase as the number of clusters increases.

# background



## CLUSTER ANALYSIS MEASURES OF FIT

**PSEUDO-F STATISTIC** is the ratio of between-cluster variance to within-cluster variance.

**CLUSTER CONVERGENCE CRITERION FOR CCC** is the statistic calculated based on minimizing the within-cluster sum of squares.

**APPROXIMATE EXPECTED OVERALL R-SQUARED** is the approximate expected value of the overall R-squared under the uniform null hypothesis, assuming that the variables are uncorrelated.

**FIGURE 1** CLUSTER ANALYSIS STATISTICS: DETERMINING THE NUMBER OF CLUSTERS

Number of Clusters	Pseudo-F Statistic	CCC	Approximate Expected Overall R-Squared
3	2,572,494	379.1	.667
4	2,853,543	569.2	.812
5	2,963,005	616.2	.857
6	3,558,955	892.8	.900
7	3,562,978	884.1	.915
8	3,930,625	1,027.0	.933
9	4,058,380	1,068.4	.943
10	3,657,865	905.5	.944

Based on the data presented in **FIGURE 1** on page 39, the biggest jump in cluster significance occurs in moving from five to six clusters. Then there are relatively large increases in moving from seven to eight clusters. Also note the peak values of the Pseudo-F statistic and the CCC occur at k=9 clusters. This analysis indicates that a k=8 or k=9 are reasonable choices for the number of clusters for this population. Given that the R-squared also appears to begin to taper off in terms of relative increase around cluster 8, we begin by assuming this number of clusters.

In making the final decision, though, we also should examine cluster size. **FIGURE 2** shows the relative size of the cluster using eight cluster groups.

**FIGURE 2** CLUSTER SIZE

Cluster	Cluster Size
1	12,341
2	51,599
3	263
4	590,622
5	271,722
6	890,721
7	132,500
8	2,072
<b>Grand total</b>	<b>1,951,840</b>

Based on the relative size of clusters 3 and 8, it was determined that a six-cluster structure combining clusters 3 and 8 into their closest “neighbor groups” would provide for a reasonable cluster significance/complexity trade off.

Based on the final six-cluster structure, each of the six groups is then examined in detail—to identify the defining characteristics of each based on all descriptive data available, including categorical variables. **FIGURE 3** displays the key characteristics of each cluster based on an analysis of the cluster population by key data factors.

Note that seven of the eight key factors identified as highly predictive for full surrender behavior as part of the predictive model development exercise are also key factors in distinguishing the six clusters of the population identified by cluster analysis techniques.

This result provides an additional degree of comfort in the preliminary predictive model developed, because the

results of the independent cluster analysis process appear to be consistent with the results of the predictive model selected.

**Cluster Analysis: Application 2**

*Provide a possible method for developing actuarial assumptions for new product designs where little or no experience is available yet, but where the design shares similarities with an existing product with more available experience.*

Now let’s consider a product like fixed-indexed annuities (FIA) with guaranteed lifetime income benefits (GLIBs). These are newer product offerings than the guaranteed living benefits choices on VA products, and therefore there is little or no credible experience available for assumption-setting purposes at this time.

However, given the similarity in design between the FIA product GLIB and the VA GLWB, there may be a way to extend the results of our cluster analysis work to enhance the actuarial judgment considerations in setting and updating assumptions for these newer FIA plans.

Let’s consider the following possible approach:

- 1 | Gather data on inforce FIA contracts with GLIBs, including as many of the data fields as possible that were identified as critical for the VA contracts from predictive modeling and cluster analysis work (i.e., account value size, policy duration, benefit utilization status, surrender charge level, etc.).
- 2 | Perform an independent cluster analysis on the FIA population to determine which (if any) clusters identified as significant may overlap with those identified for VAs.
- 3 | Where there are overlaps, use the surrender results for the VA cluster as a starting point for the associated FIA cluster, and make any adjustments that may be needed based on actuarial knowledge of the underlying target market, product design or intended use of the policy by customers.
- 4 | Monitor these clusters over time and make further adjustments to assumptions as experience develops. Eventually, emerging experience will become credible and allow for more detailed analysis of the FIA population itself.

Note that more subjective approaches will need to be applied for clusters that emerge for the FIA population that do not have an associated cluster in the VA population. However, for at least a portion of inforce business, this

**FIGURE 3** CLUSTER DESCRIPTIONS: DISTINGUISHING CHARACTERISTICS OF EACH CLUSTER

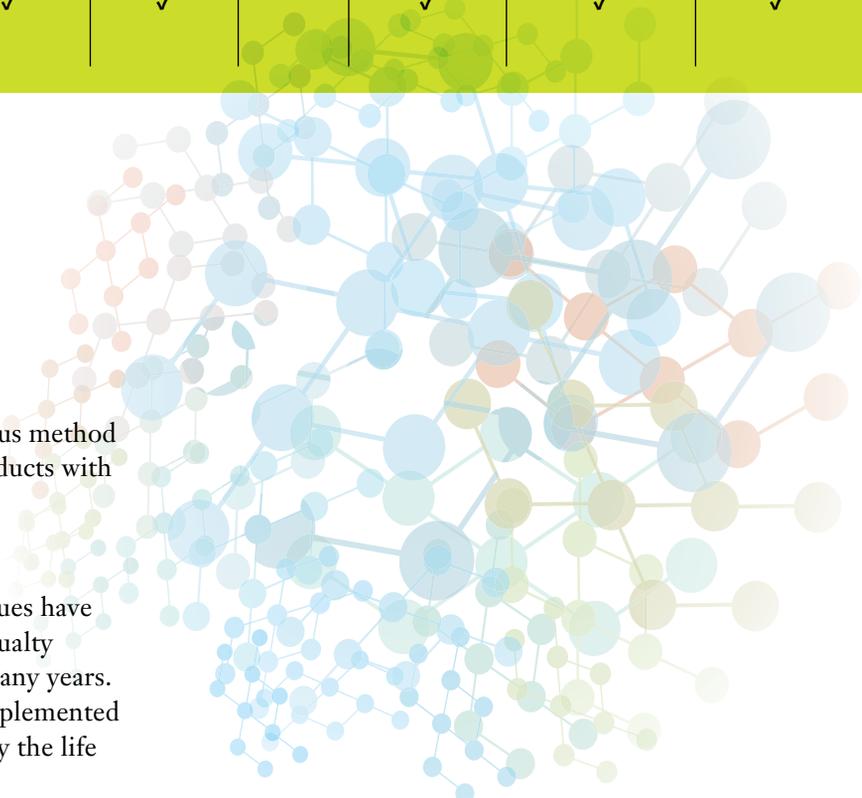
Cluster	Account Value Size	Age of Policy (Duration)	Benefit Utilization Status	Surrender Charge Level	Gender	Distribution	In the Moneyness	Age of Policyholder
1	Largest		Greater utilization		More male	Bank/NBD	Greater ITM (150%+)	
2		Older	Greater utilization		More male	Ind/Bank/NBD	Greater ITM (150%+)	
3				No SC		Career/Ind	Lower ITM (less than 100%)	
4			Greater utilization	Higher SC		Bank/NBD	Lower ITM (less than 100%)	Under 60
5	Smallest		Low utilization/low withdrawals	Higher SC	More female	NBD	Lower ITM (less than 100%)	Under 60
6		Older	Greater utilization	No SC	More male	NBD	Greater ITM (150%+)	
Primary predictors for full surrender	✓	✓	✓	✓		✓	✓	✓

process suggests a more mathematically rigorous method for justifying current assumption bases for products with minimal historical experience available.

**CONCLUSIONS**

Data analytics and statistical modeling techniques have been critical in the credit and property and casualty markets of the financial services industry for many years. However, to date, these tools have not been implemented well in other areas of the industry, most notably the life insurance and retirement industry sectors.

As the financial services industry continues to refine and improve products to better serve customers, these techniques should be included in our technical toolbox as potential methods to analyze and forecast how products will perform. ■



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# Q&A

## MODEL MASTER

### Q&A WITH MICHAEL EWALD, PREDICTIVE MODEL BUILDER AT THE HARTFORD

**Q:** Tell us about your background. How did you make the decision to become an actuary?

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**A:** The probability of me becoming an actuary was very low. Having completed the bulk of my math requirements in high school, I graduated from The College of Charleston with a degree in economics and a minor in finance without taking any substantial math. After four years in the South, I returned home to be closer to my girlfriend, Katie, who is now my wife. I began working at a large, multinational Italian construction company and was responsible for analyzing the profitability of one of the company's U.S. subdivisions. Like many jobs at most companies during the Great Recession, the work was nothing short of exciting. As construction spending dwindled in 2009, I was tasked with developing a restructuring strategy. Although the math seemed relatively straightforward, I quickly learned that you couldn't blindly follow the numbers. I learned about the need to balance expenses, talent retention, employee morale, stress and a slew of other items you can't learn from a textbook.

During this time I passed my first two CFA examinations and began to think about a new career path. Katie, following in her father's footsteps, was taking actuarial exams.

A man with a beard and short hair, wearing a dark suit, white shirt, and patterned tie, stands in a modern office environment. He is smiling slightly and looking towards the camera. The background features a ceiling with recessed lights and a wall with a geometric pattern.

“ In the long term, I don’t see there being a huge distinction between actuaries and those who perform predictive analytics.”

**Michael Ewald, FSA, CERA, CFA**, is a director at The Hartford, where he has been responsible for building predictive models for the Group Benefits division.

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@JANE SHAUCK

Because I already was taking exams in my spare time, she told me to consider a career as an actuary. My knee-jerk response was “that sounds boring,” but she pushed me to at least consider the profession. I learned that an actuary’s career options are seemingly limitless. For someone who thrives on change and learning about new areas, I decided this was the career for me. During the first half of 2010, I finished my CFA exams and passed the first two actuarial exams. In July 2010, I started my first actuarial job in The Hartford’s Executive Actuarial Training program, working in the financial reporting department of the company’s Japan variable annuity block.

**Q: How did your work history segue into your interest in predictive analytics?**

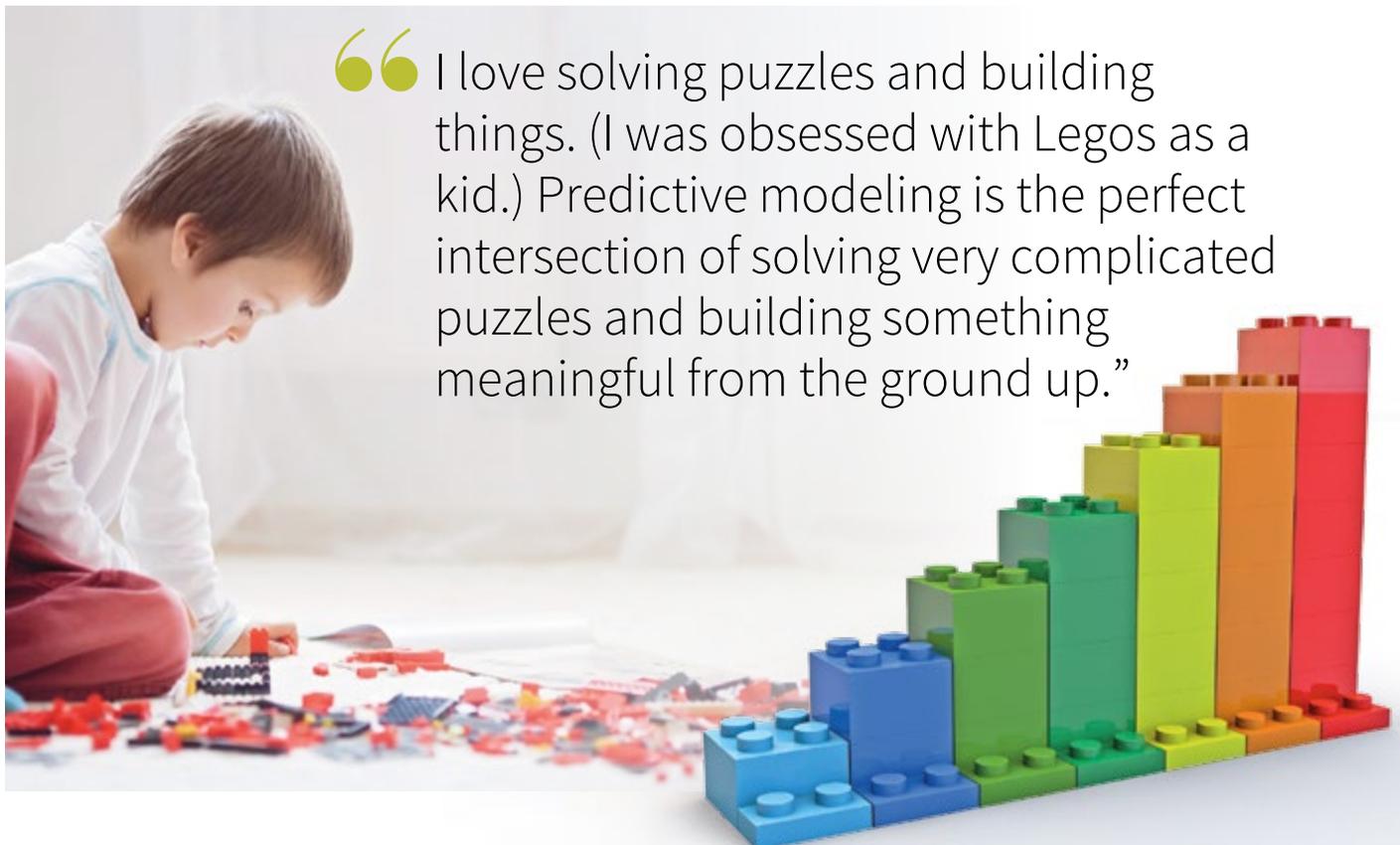
**A:** In March 2012, The Hartford announced it would focus on property and casualty, group benefits and mutual funds, and stop new annuity sales in April 2012. Working in fixed-indexed annuity pricing, my work abruptly halted; however, I transferred within The Hartford to a new predictive analytics position in the Group Benefits division. With predictive analytics well established within The Hartford, the position provided the necessary resources to support robust training.

The Hartford was one of the first group benefits carriers to develop a predictive analytics program. Because we were developing first-generation predictive models, most projects were blank canvases. What I liked about my new role was the level of creativity needed. It was similar to that of my product development role. I love solving puzzles and building things. (I was obsessed with Legos as a kid.) Predictive modeling is the perfect intersection of solving very complicated puzzles and building something meaningful from the ground up.

The first project in which I used predictive analytics was building a long-term disability termination model. I quickly found a niche facilitating communication between the modelers and the actuaries. Having substantial experience manipulating and aggregating large amounts of data, I helped with data preparation. I was able to leverage the skills developed in other areas, while honing my predictive analytics abilities.

**Q: How did your professional experience lead you to a career in predictive analytics?**

**A:** I don’t have any preconceived notions around what my career is supposed to look like. Four years ago I wouldn’t have expected to be working in predictive analytics, and



“I love solving puzzles and building things. (I was obsessed with Legos as a kid.) Predictive modeling is the perfect intersection of solving very complicated puzzles and building something meaningful from the ground up.”

seven years ago I barely knew what it meant to be an actuary. Having an open mind and a willingness to try new things naturally will lead actuaries to career paths in different areas.

### **Q: What are some challenges in working in predictive analytics?**

**A:** One of my friends likes to say, “We can do a lot of cool stuff, but that doesn’t mean we should.” I think of this statement in two ways:

- ❶ | Does our work pass *The New York Times* test?
- ❷ | Does the marginal benefit of a more sophisticated model outweigh the marginal costs?

The first question asks how your work would be perceived if it were to be published in *The New York Times*. This will be asked more often as new data sources arise. Companies risk reputational damage if they do not properly protect their policyholders’ private information. We also need to understand whether the use of predictive analytics has legal ramifications, and how regulators will view these new methods. Finally, I think we have an ethical obligation to ask if we should do something, even if we know we can.

The second question tries to get at the optimal amount of time to spend on predictive models. I could spend months building a model using the most advanced statistical techniques available. However, I may have been able to develop an answer that is easier to explain and just as effective in a fraction of the time. The point is I have seen projects fail because the timeline couldn’t be met or the output of the models couldn’t be explained. To paraphrase Albert Einstein, if you can’t explain your model to a 6-year-old, you don’t understand it yourself.

### **Q: How did you learn the tools and techniques of modeling?**

**A:** As a property and casualty company, The Hartford has a tremendous amount of predictive modeling expertise. I developed the foundation of my knowledge by working directly with the P&C actuaries and data scientists. I spent an enormous amount of time reading (and re-reading) articles, papers and textbooks. I asked a lot of questions.

Learning the mechanics of building a model can happen relatively quickly. Correctly interpreting the model, understanding the implications of the outputs and identifying

anomalies takes years. Modeling is so much more of an art than an exact science. My manager always says it takes about a year before modelers get their feet under them. It takes even longer to develop an expertise.

### **Q: What are the main skills actuaries need for work in predictive analytics?**

**A:** Actuaries have all of the skills necessary to perform predictive analytics—they just need to learn a different set of tools. I am a golfer, so I like to use a golf club analogy. For generations, most golfers utilized a 3-iron. In the last 10 years, technological advances produced a club called a hybrid. The hybrid replaced the low-numbered irons in most golfers’ bags because it is more versatile and easier to use. Golfers still played the same game; they just had a better club. Predictive analytics is a new club that the actuary needs to learn to swing. The irony in this analogy is that I still use a 3-iron, but I am thinking about making the switch!

It is important to recognize that predictive analytics is just a single club in an actuary’s golf bag. We have numerous other skills that are complemented by predictive analytics.

Ultimately, some actuaries will need to be as comfortable with advanced analytics as they are with Microsoft Excel. Other actuaries only will need to understand it at a high level. It all depends on your role and the business challenges you are trying to solve. Generally speaking, I believe actuaries will be at a competitive disadvantage if they cannot do the following:

- Manipulate large amounts of data
- Perform advanced statistical techniques
- Simplistically communicate the not-so-simple

### **Q: So, we have the basic skills. How do we learn the tools?**

**A:** For a tactical answer, learn a software. There are so many free resources online that you don’t need to spend money to learn predictive analytics. While not endorsing any particular resource, Google has made its introductory Python course available online for free. Kaggle has a great introductory course that explains how to use R, Python or Excel to predict the likelihood of dying on the Titanic. If you prefer more structure, Coursera has a number of advanced analytic classes you can take; however, not all are free.

I find that a simple Google search is the best place to start. Last weekend, I decided I wanted to analyze car prices at dealerships across New England. A few Google searches later, I built a program that scrapes the internet, aggregates car prices at selected dealerships and models where I would get the most favorable price. There is so much information at our fingertips that with a little drive and some time, an actuary can learn a lot about predictive analytics.

**Q: Where do you see opportunities for actuaries in the predictive analytics arena?**

**A:** In the short term, companies are building out predictive modeling teams, and they need actuaries to bridge the gap between the traditional business and cutting-edge analytics. In the long term, I don't see there being a huge distinction between actuaries and those who perform predictive analytics. Again, I think predictive analytics is a club we all should have in our golf bags.

For the creative actuary, opportunities exist wherever there is a substantial amount of data. The usual suspects like lapses, mortality, cross-selling, up-selling, client retention, marketing, etc., are well-documented, so I am not going to belabor the point. Actuaries are the natural facilitators of data analysis because they understand the business. One of my employees recently built a model in which we were seeing lapses drop dramatically at a given duration. The phenomena passed validation, so it must be real, right? As hard as we tried, we couldn't rationalize why this was occurring. We sliced and diced the data, and eventually we found a flaw that resulted in us throwing away a large chunk of the data. Without business context, it would have been easy to take the indications at face value and run with the model.

Actuaries and statisticians can learn a lot from one another. There is talk of competition for these jobs. Diversity of thoughts and ideas is imperative for a company's success. Why wouldn't we want to have statisticians and actuaries working together to solve a company's most complex problems? Data is only going to get more complicated. Insurance companies are going to need very technical people to manipulate and model the increasing amount of data, and the field is only going to grow. Our predictive analytics department at The Hartford has doubled in size in the last three years. These are new jobs that are being filled by both actuaries and statisticians. Companies are going to need strong communicators to bridge the gap between the technical analytics and business leaders. Actuaries have the

background to choose where in the process they want to be involved.

**Q: What are some of your best professional experiences as an actuary?**

**A:** Aside from sitting in my dining room for weeks at a time studying with my wife? As twisted as it may sound, I actually do miss those days.

We are very fortunate as actuaries to work with some of the most talented, dedicated, intelligent and genuinely good people in this world. I have fond memories and lifelong friendships that are a result of my day job. That being said, we all *have* to go to work, so I will focus on other rewarding aspects of this career.

I am very proud of the research that my colleague and I published with the Society of Actuaries (SOA). The paper, "Predictive Modeling—A Modeler's Introspection," details how to build generalized linear models by describing a long-term disability pricing project. Those interested in learning more can download the paper at [SOA.org/files/research/projects/2015-predictive-modeling.pdf](http://SOA.org/files/research/projects/2015-predictive-modeling.pdf).

I also spoke at various industry conferences and joined the SOA's Predictive Analytics Advisory Group. The advisory group is identifying opportunities to train actuaries on this critical skill. As mentioned, I believe this skill set is very important, and I am happy to be involved in educating the greater actuarial community.

Working with the SOA's Candidate Connect, I have spoken with aspiring actuaries about my career path. Given that many of the Candidate Connect attendees are career changers, I hope my path can help provide guidance on how to leverage unique backgrounds to land a career in an actuarial student program.

I also am very involved with the Actuaries' Club of Hartford/Springfield. The committee organizes semi-annual meetings for almost 400 local actuaries, hosts networking opportunities and provides support for our local universities. We also provide support to the local Actuarial Bootcamp, an organization that educates high school students on the actuarial field. This position has allowed me to meet industry leaders, such as the Connecticut Insurance Commissioner and the chief actuary of the U.S. Social Security Administration.

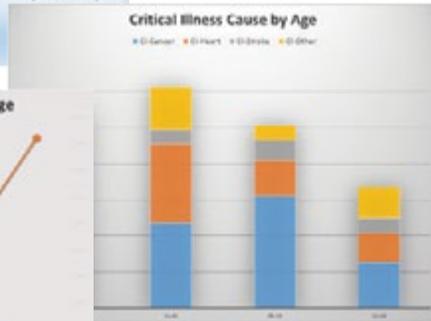
The best advice I can give is don't just get involved, but get involved in areas in which you are passionate. If you are passionate about a topic, it becomes less like work and more like a hobby. To have a hobby that opens career doors is an easy way to expand your network and have some fun. ■

# INSIGHT ENTERPRISE ...EXPERIENCE STUDIES for Insurance



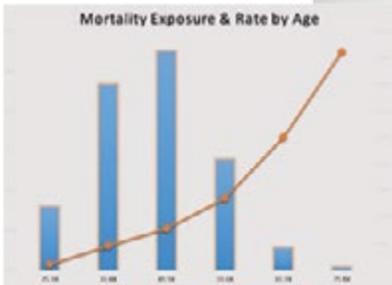
The Insight Enterprise suite includes dynamic, interactive studies as part of a flexible, modular analytical system built on data warehouse technologies. It can be implemented as an enterprise solution including operational reporting and financial management, or more locally as a stand-alone actuarial system. The system includes full set of audits; tracking data through the system, integrity, job execution and error reporting. Visit our website for more information, call us for a demo or email us at [info@insightdecision.com](mailto:info@insightdecision.com)

Mortality by Date						
	2013	2014	2015	2015		Total
				2015-Q1	2015-Q2	2015-Q3
Exposure	55,750	57,051	14,439	14,525	14,620	156,395
Actuals	281	332	57	78		
Expecteds	201	212	54	55		
A/E	140%	157%	105%	141%		

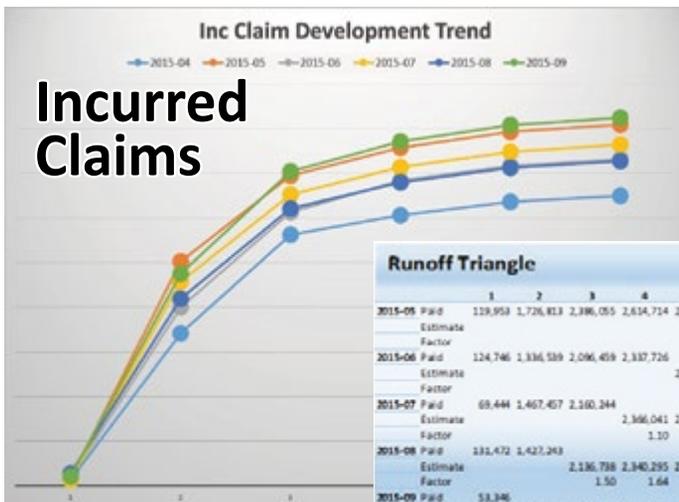


## Insured Risk

Persistency by Issue Date								
	2011	2012	2013	2014	2015	2015		2015 Total
						2015-Q1	2015-Q2	2015-Q3
Y1	88.38%	88.19%	87.91%	88.14%	89.94%	91.61%	90.04%	90.28%
Q1	96.96%	96.63%	96.16%	97.06%	96.68%	97.35%	97.41%	97.11%
Q2	94.61%	94.47%	93.81%	94.96%	94.48%	95.97%		95.22%
Q3	91.91%	91.44%	91.18%	91.77%	92.16%			92.89%
Q4	88.35%							
Y2	77.79%							
Y3	70.90%							
Y4	65.72%							
Y5	60.67%							



## Persistency



## Incurred Claims

Runoff Triangle						
	1	2	3	4	5	6
2015-05 Paid	129,953	1,726,813	2,396,055	2,614,714	2,732,365	2,780,825
Estimate						2,780,825
Factor						1.02
2015-06 Paid	124,746	1,336,589	2,096,459	2,337,726		
Estimate				2,448,368	2,491,873	
Factor				1.05	1.07	
2015-07 Paid	69,444	1,467,407	2,160,244			
Estimate			2,366,041	2,478,023	2,522,055	
Factor			1.10	1.15	1.17	
2015-08 Paid	131,472	1,427,243				
Estimate		2,136,738	2,340,295	2,451,059	2,494,612	
Factor		1.50	1.64	1.72	1.75	
2015-09 Paid	53,346					
Estimate	753,679	1,128,311	1,235,822	1,294,312	1,317,311	
Factor	14.13	21.15	23.17	24.26	24.69	



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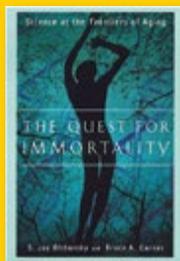
## AHEAD OF THE CURVE

Looking to be a leader in your workplace or in your profession? Here are some resources that can help you in that quest.

### BOOK

**THE QUEST FOR IMMORTALITY: SCIENCE AT THE FRONTIERS OF AGING**  
By S. Jay Olshansky and Bruce A. Carnes

S. Jay Olshansky, Ph.D., senior research scientist at the University of Chicago and keynote speaker at the Society of Actuaries' 2016 Life



Insurance Conference in Las Vegas, has focused his research on estimates of the upper limits to human longevity. Dr. Olshansky has explored the health and public policy implications associated with individual and population aging; forecasts of the size, survival and age structure of the population; and pursuit of the scientific means to slow aging in people.

In this book, Dr. Olshansky and Carnes—experts on aging—explore the preoccupation of humankind with youth throughout history and present an overview of the aging process, addressing recent advances to enhance longevity.

**BUY NEW OR USED**

### APP

#### MANAGE SOA EVENTS

EventPilot conference app is your full featured guide to manage your SOA conference attendance. Stay informed about hot issues, event program changes, your upcoming sessions and organizer messages. Browse the entire event program to build your personal schedule, bookmark sessions or speakers, or access session handouts as available.



[bit.ly/SOAEventPilot](http://bit.ly/SOAEventPilot)

### VIDEO

#### TED TALK WITH DAN BUETTNER How to Live to be 100

“The calculus of aging offers us two options: We can live a shorter life with more years of disability, or we can live the longest possible life with the fewest bad years. As my centenarian friends showed me, the choice is largely up to us.” Dan Buettner, a National Geographic fellow and multiple *New York Times* bestselling author, has explored the world in search of the highest concentration of healthy centenarians.

In this Ted Talk, Buettner shares what he found in what he calls the world’s “Blue Zones,” five places where people live to be 100 and do so with full use of their physical and mental capabilities. Buettner shares nine diet and lifestyle habits common to people who live in these five places.

[TED.com/talks/dan\\_buettner\\_how\\_to\\_live\\_to\\_be\\_100](http://TED.com/talks/dan_buettner_how_to_live_to_be_100)



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# TAKE THE PLUNGE

WHATEVER YOUR MOTIVATION, THERE ARE MANY BENEFITS OF VOLUNTEERING

BY BRIAN L. LOUTH

**V**olunteers are helping hands. Their efforts help improve the quality of life for individuals and communities at large.

The community of actuaries benefits significantly from the myriad activities and efforts of countless volunteers, and I am proud to be one of them.

Ever since I can remember, volunteering has been a part of my world. When I was growing up, my mom was deeply involved with the church and the local hospital. My dad now embraces the volunteer spirit in his retirement. These role models motivated me to get involved and become a volunteer. Coaching hockey, delivering meals to the elderly in high school and assisting a visually impaired person in college were just the starting points of my volunteer efforts.

Recently, my volunteer energy has been focused on the actuarial community. I hope my efforts with the Society of Actuaries' (SOA's) Education Committee have supported the SOA's commitment to the education and development of new actuaries, and encouraged and influenced the personal growth of the volunteers involved in the SOA Education system.

We all have our reasons or motivations for volunteering. In some cases it is driven from a personal experience or connection to a specific problem, illness or cause. The best volunteering tends to involve a desire to help others, but it is OK to gain some personal benefits. When you see the benefits to the recipient and yourself, it tends to strengthen your commitment.

My observation is that the reasons that motivate you to get involved may not be the ones that motivate you to continue volunteering. As long as your efforts are appreciated, and you are accomplishing something and making a difference, you are more likely to continue. And it really helps when you are able to have some fun and enjoy the personal connections with the volunteers with whom you work!

## WHAT MAKES A GOOD EDUCATION VOLUNTEER?

Being dependable and willing to undergo training to meet the volunteer commitment standard are essential attributes. With the SOA Education system, you are expected to complete time-sensitive assignments to the best of your ability. You are part of a team that is investing in you.

## action

### SATISFACTION THROUGH ACCOMPLISHMENT

Results from an informal survey of the motivations and reasons some people volunteer:

#### Contribution to a community

- ➔ Help in a meaningful way
- ➔ Share skills
- ➔ Demonstrate commitment
- ➔ Stand up and be counted

#### Personal development

- ➔ Learn something new or do something different that leverages skills
- ➔ Gain leadership skills
- ➔ Be involved in something different than your job
- ➔ Bring a fresh perspective back to work
- ➔ Seek satisfaction through accomplishment

#### Social activities

- ➔ Make new friends
- ➔ Be part of a team
- ➔ Get to know a community
- ➔ Feel needed
- ➔ Give in to the pressure from a friend
- ➔ Keep busy



**Brian L. Louth, FSA, FCIA**, is senior vice president of business development and chief marketing officer, RGA Life Reinsurance Company of Canada, in Toronto.

[BLouth@rgare.ca](mailto:BLouth@rgare.ca)

However, don't overburden yourself. Don't overcommit. Don't forget your day job. And remember that it is always helpful to be patient and diplomatic.

What insights have I gained from my volunteer roles?

- ❶ I have been very fortunate to get to know actuaries from across North America—actuaries I might never have had the opportunity to meet because of their job focus or where they work. I have developed some long-lasting friendships, and there are some grading partners I have known for over 20 years.
- ❷ I learned to play poker, but not very well.
- ❸ It reduces stress (well, maybe). I have read that volunteers have better mortality and health. I have yet to see this make its way through predictive analytics into the underwriting selection process, or to lower premium rates for preferred volunteers.
- ❹ SOA presidents are approachable and interesting to talk to. I have had the opportunity to meet many of the SOA presidents during my time on the Education leadership team. I remember one exam review session that included the president-elect of the SOA. He felt that one question and answer did not properly represent the intentions of the syllabus material. We had an extensive discussion, and the president-elect decided the only way to resolve the matter was to call the author of the study note. He laid out the issue and explained his position to the author. When he finished the call, he told us we were right and that we should move on to the next question. That impressed me!
- ❺ Teamwork and collaboration can accomplish a lot more than individuals working on their own. There are a lot of really bright actuaries who can contribute and more, if you stay out of their way and let them.

When I look back today, I am really pleased with the choice I made to get involved with the Education Committee. It has been a long journey that included exam grading, writing questions, writing pass mark reports, approving pass mark reports, training item writers and graders, and reviewing discipline cases. I learned something from every role, but I think developing exam questions for fellowship exams has been one of the most rewarding roles.

Volunteering at the SOA has provided me with the opportunity to make a meaningful impact on the actuarial profession. I have grown personally by gaining new skills that I now leverage at work and in my personal life. That same experience is waiting for you. Enlist, sign up, step forward and take the plunge! ■

# MORTALITY DATABASE RESEARCH AND EXPLORATIONS IN LONGEVITY

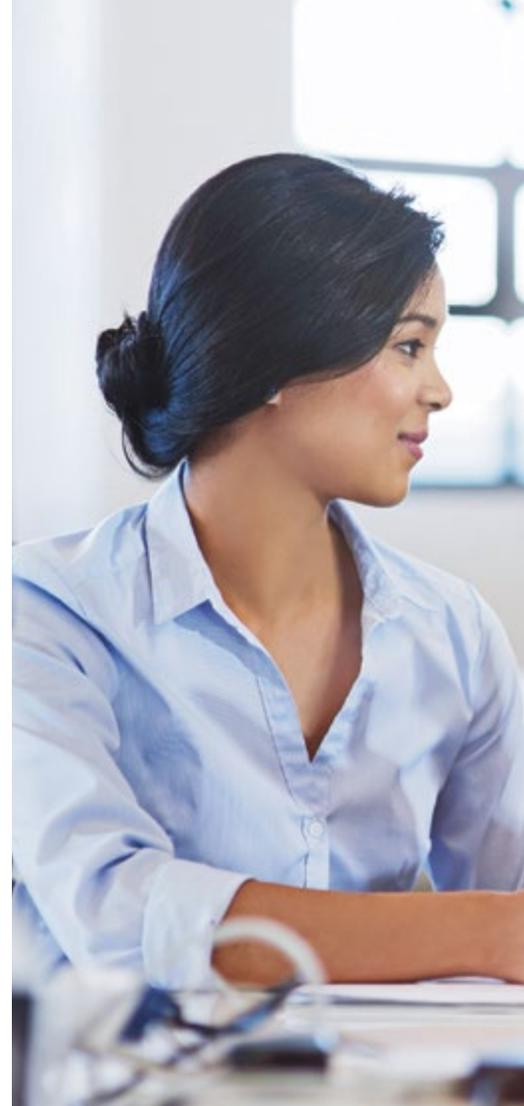
BY R. DALE HALL

**M**ortality research is an area we continue to review, refine and revise based on mortality improvements. You probably are aware of the 2014 pension plan mortality tables and the 2015 mortality improvement scale. We continue to work with our Retirement Plans Experience Committee on future tables and improvement scale updates to better serve our members, employers and the public at large.

As part of our ongoing experience studies research on mortality, we will support a major undertaking with new work on the Human Mortality Database (HMD), which is accessible at [mortality.org](http://mortality.org). The HMD spans 38 countries and provides detailed mortality and population data to researchers, students, journalists, policy analysts and others interested in the history of human longevity. The University of California, Berkeley, the Max Planck Institute for Demographic Research and the Society of Actuaries (SOA) are working together

on the new HMD developments. We have provided a grant to the university to create a historical time series of mortality tables specific to causes of death for eight populations (United States, Japan, England and Wales, France, Sweden, Norway, Canada and Chile). Another sponsored project will analyze U.S. life table series at a state level from 1959–2013. We look forward to the completion of these projects by year-end.

On the topic of mortality, there are two important events in development. We will co-host *Longevity 12*, the 12th International Longevity Risk and Capital Markets Solutions Conference. It takes place this Sept. 29 and 30 in Chicago. In January 2017, we will host the Living to 100 Symposium in Orlando. Our global symposium brings together actuaries, academics, gerontologists, and many other researchers and experts involved with longevity. Keynote speakers include Nir Barzilai, M.D., who will speak about “how to die young at a very old age,” and Judith



Campisi, Ph.D., who will present on age suppression and extending longevity. Visit [livingto100.soa.org](http://livingto100.soa.org) for more information.

We also want to mention that the American Academy of Actuaries and the SOA developed the Actuaries Longevity Illustrator to provide individuals with perspectives on longevity risk—the uncertainty of how long an individual and his or her spouse or partner might live. Take a look at the free tool at [longevityillustrator.org](http://longevityillustrator.org).

We encourage you to visit [SOA.org](http://SOA.org) for more research on mortality and aging. ■

**R. Dale Hall, FSA, CERA, MAAA**, is managing director of Research at the Society of Actuaries.

[dhall@soa.org](mailto:dhall@soa.org)



# action

## GOOD RESEARCH READS

### HEALTH RESEARCH EXAMINES PRESCRIPTION DRUG USE

The Society of Actuaries (SOA) released a new paper examining pharmaceutical use from Affordable Care Act (ACA) individual plans in Kansas during the 2014 calendar year. To better understand how enrollment timing was related to relative costs, the population was divided into three categories based on enrollment date (continuing, first quarter and later enrollees). There appears to be a marked difference between the continuing enrollees, first-quarter enrollees who signed up for care during the initial enrollment period, and later enrollees who signed up for care.

[bit.ly/SOAPrescription](http://bit.ly/SOAPrescription)

### RETIREMENT CONCERNS IN CHINA FOCUS OF STUDY

The SOA and LIMRA released the first in a series of studies on retirement risks and opportunities in China. This study examines the retirement attitudes, beliefs and behaviors of consumers in China. This research looks at retirement risks, savings, available options, retirement goals, strategies for managing risks and how financial advisers are used in the marketplace.

[bit.ly/SOACHinaRetire](http://bit.ly/SOACHinaRetire)

## RELATED LINKS

Mortality Improvement Scale  
MP-2015

[bit.ly/SOA-MP-2015](http://bit.ly/SOA-MP-2015)

Human Mortality Database  
[mortality.org](http://mortality.org)

Longevity 12  
[bit.ly/Longevity-12](http://bit.ly/Longevity-12)

Living to 100 Symposium  
[livingto100.soa.org](http://livingto100.soa.org)

Actuaries Longevity Illustrator  
[longevityillustrator.org](http://longevityillustrator.org)

Research-At-A-Glance  
[bit.ly/At-A-Glance](http://bit.ly/At-A-Glance)

Research Opportunities  
[bit.ly/SOAResearchOpportunities](http://bit.ly/SOAResearchOpportunities)



Visit [SOA.org/Research](http://SOA.org/Research) for the latest updates on new research opportunities, data requests, experience studies and completed research projects.

# TAKE CHARGE

Continue the cycle of continuous improvement and identify new experiences to pursue. Attend a meeting or seminar. Tune in to a podcast. Take an e-course. These are great ways to take charge of professional development and can help you:

- 1 | Develop leadership skills
- 2 | Stay up-to-date with current business trends
- 3 | Expand your network base
- 4 | Make meaningful contributions to your company, your team and the profession

## MEETINGS

### 51st Actuarial Research Conference (ARC)

July 27–30

Minneapolis/St. Paul

ARC provides an opportunity for academics, researchers and practitioners from around the world to meet and discuss actuarial problems and solutions. Topics will include longevity, agricultural insurance and climate change, big data and predictive modeling, investment risk analytics and more.

[bit.ly/SOA-ARC](http://bit.ly/SOA-ARC)

### Underwriting Issues & Innovation Seminar

July 31–Aug. 2

Chicago

This unique seminar provides information on the hottest underwriting topics, and the opportunity to network and problem-solve with other life insurance professionals. Explore topics such as practical

considerations in building a predictive analytics model, the latest on accelerated underwriting and protective value studies.

[SOA.org/2016UnderwritingSeminar](http://SOA.org/2016UnderwritingSeminar)

## PODCAST

### Numbers and Narratives

How do storytelling elements like emotion, conflict, imagery and character help insurance companies sell their product to consumers or facilitate working with business partners? In this podcast—sponsored by the Marketing and Distribution Section—Andrew Steenman, FSA, MAAA, interviews Nathan Worrell, who explores the idea of using a story to frame insurance concepts.

[bit.ly/SOANumbersPod](http://bit.ly/SOANumbersPod)



Visit [SOA.org/calendar](http://SOA.org/calendar) for the full complement of professional development opportunities.



## Knowledge On-the-Go

### SOA Podcasts

The SOA releases free podcasts each month, designed to help busy professionals find the time to gain insight and hear different perspectives. Recent podcasts explored topics ranging from how nonqualified annuities are taxed to how to be an ethical leader.

[SOA.org/Podcast](http://SOA.org/Podcast)



# LIVING to 100

SOCIETY OF ACTUARIES  
INTERNATIONAL SYMPOSIUM

Jan. 4–6, 2017  
Orlando, Florida



## Save the Date

Registration for the [2017 Living to 100 Symposium](#) will open soon. This prestigious event on longevity brings together a diverse range of professionals, scientists and academics to discuss:

- How and why we age;
- Methodologies for estimating future rates of survival;
- Implications for society, institutions and individuals;
- Changes needed to support an aging population increasing in size;
- Applications of existing longevity theories and methods for actuarial practice.



Learn more at [LivingTo100.SOA.org](http://LivingTo100.SOA.org).



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- Governance and controls are easier to define and maintain.
- PolySystems' unparalleled auditability facilitates model validation of all VM-20 calculations.
- Our VM-51 utility can easily be incorporated to generate experience results in accordance with the prescribed format.
- PolySystems' actuarial consulting team and our ALM software are the optimal resources as you implement PBR.

PolySystems can help you prepare for all aspects of PBR from running an impact study, advising on VM-20 interpretation, reviewing VM-20 assumption development, and preparing VM-50/VM-51 experience reports.

Contact us today to start taking advantage of partnering with PolySystems for PBR.

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Jason Kehrberg, Vice President  
312-332-8646 • [jkehrberg@polysystems.com](mailto:jkehrberg@polysystems.com)



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