VOLUME 14 ISSUE 1

THE Actuary

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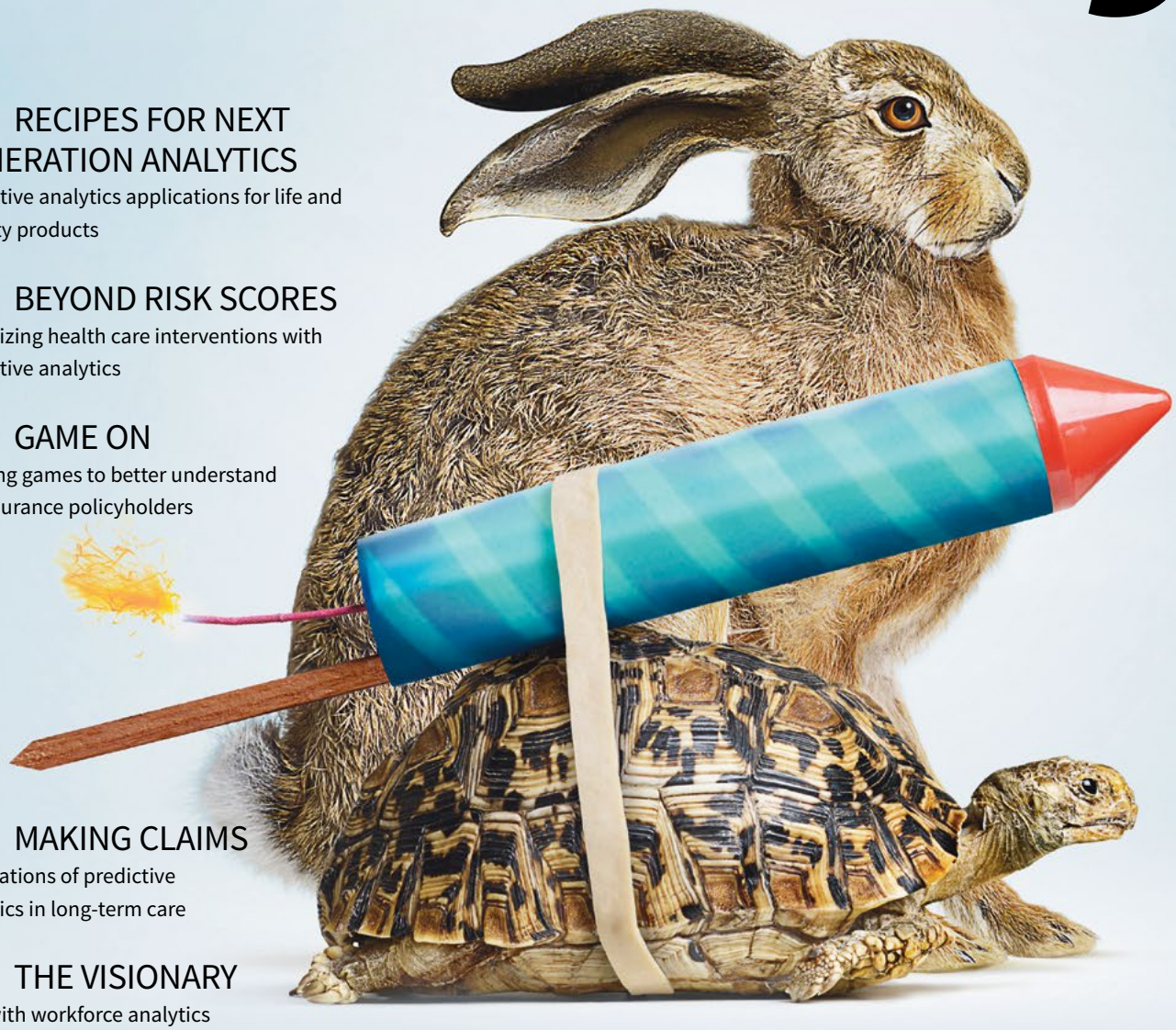

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FEATURES

AWARD WINNER

We are pleased to announce that *The Actuary* was recognized for editorial and design excellence by the Folio: Eddie & Ozzie Awards. It received the Ozzie Award for redesign and an honorable mention for overall design. It received an Eddie Award honorable mention for a single article in the April/May 2016 issue, "Understanding Social Security's Long-Term Fiscal Outlook." *bit.ly/TheActuaryFolio*

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Predictive analytics:
A growing opportunity for our profession

BY ANDY FERRIS

The theme of this issue of *The Actuary* is big data and predictive analytics. These are buzzwords we hear daily, in multiple professions and industries, and topics about which I am passionate.

A LARGE OPPORTUNITY SET

My practice area is life insurance, and the opportunities for life insurance companies to improve core business operations by deploying applications of predictive analytics are vast, strategic and impactful. Colleagues who work with applications of predictive analytics in other practice areas and industries repeatedly tell me the same is true for their business operations. In this issue of *The Actuary*, we have a collection of articles covering a diverse set of these opportunities, written by actuarial leaders across multiple practice areas, industries and business functions. A common theme in these examples is that predictive analytics is being deployed as a tool to enhance core business operations, often by saving time and money, and/or improving efficiency or accuracy.

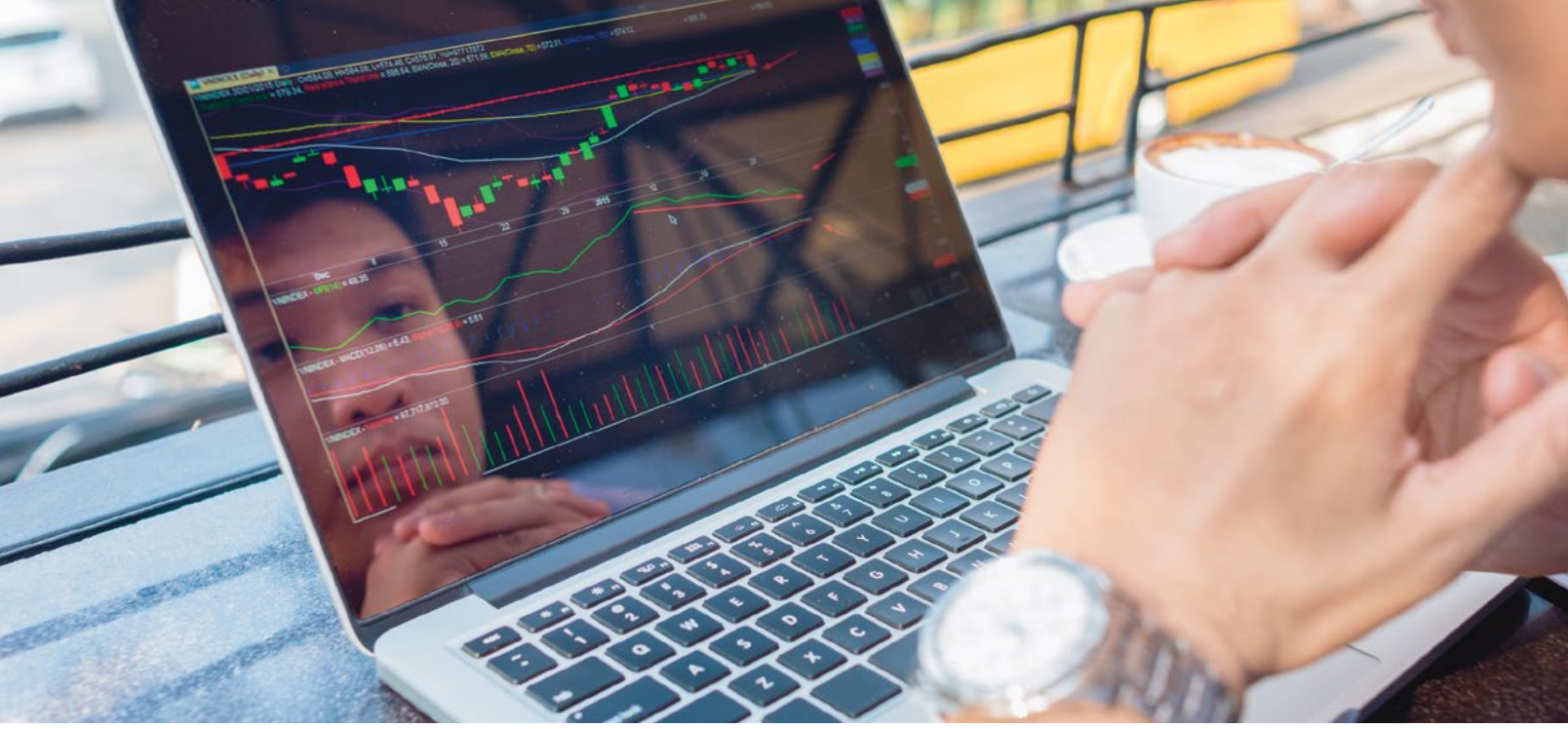
These examples and others leave me convinced that organizations should treat data as a strategic asset and use it to improve traditional business processes. We are approaching a day when that approach to business will be common for insurance companies, as has already happened in other industries. Insurance companies and other actuarial employers will use predictive analytics and digitization to uniquely identify customers for targeted marketing campaigns, with a customized product offer at the right time and the right price. Internal company operations, such as new business, inforce management and claims, will be monitored, improved and eventually optimized using predictive analytics. While this evolution will not happen overnight, the pace of innovation in this area is only increasing, and the associated set of opportunities facing many business organizations is enormous and growing.

In fact, in my experience, this opportunity set can be so broad that it can be daunting to decipher, and to determine how and where to begin. There are many considerations that go into determining the use cases or business applications of predictive analytics an organization may wish to pursue. And the answer is different for each organization. Not only does it depend on the company's business—in terms of its target markets, distribution channels, core operations and so on—but it also depends on the willingness and the appetite of that organization to challenge traditional business processes, and to redesign and improve those by deploying applications of predictive analytics. Due to sheer volume and associated strategic impact, the exercise of determining and deciphering this broad opportunity set, aligning with strategic business priorities and developing an execution plan is one of the most critical and strategic challenges companies face with predictive analytics.

ACTUARIES ARE EQUIPPED TO LEAD

As actuaries, due to our skills, training and natural interests, we are well positioned to lead our respective organizations and industries through these exciting opportunity sets. As actuaries, we are recognized for skills and abilities in blending statistics and risk management to create business value. Our recently revised strategy map refers to us as highly sought-after professionals and leaders who measure and manage risk, and who develop and communicate solutions for complex financial challenges. It calls for us to be at the forefront of evolving methods for solving complex business problems, and to provide trusted research, analysis and insights.

In my practice area of life insurance, I often refer to senior actuaries as "the engineers of a life insurance company," since they deeply understand the financial, business, risk, profitability and long-term viability aspects of a company's core business operations. In this role, actuaries can challenge and improve traditional business operations by deploying applications of big data and predictive analytics in core business operations. Yes, *we*, *as actuaries*, will lead our organizations and industries through the pending disruption and the strategic opportunity that is emerging



as a result of big data and predictive analytics, because *we* are uniquely positioned to do so.

THE PATH WILL NOT BE EASY

The path of true leadership through this pending wave of disruption and opportunity will not be easy, and it will include challenges. Selected natural hurdles for us to overcome may include the following:

- **Culture and mindset.** In order for us to lead in this opportunity to transform our organizations into leading data-driven organizations, we must have the courage to change. A natural initial reaction may include resistance to such change, referencing years of historical business stability without such data sources or methods, or a lack of "need" to change today. Furthermore, certain business functions can feel threatened, particularly if the data sources and models are not well understood. This transformational path will require us to be open-minded and transparent, to try new approaches and to display overall willingness to embrace the power of predictive analytics in improving our core business operations.
- **Focus on creating business value.** As we expand beyond traditional actuarial data sets and supplement those with various big data sources, the quantity of data becomes magnitudes larger. By our nature as actuaries, we enjoy exploring these large data sets to discover new insights, but we need to be careful, as that magnitude can become a trap for us. Before we get lost in the exercise of data exploration and model building, we need to remind ourselves that we create business value only when we develop a model that becomes implemented in a business operation. In the midst of many "interesting" or "theoretical" observations as we explore the data sets and build predictive models, we must remain focused on creating solutions to practical business needs.
- **No "easy button."** In the vast opportunity set we face, predictive analytics does not magically produce solutions. Instead, predictive analytics is a tool that helps deliver insights from data. It is up to us to interpret those insights and to design operational tactics to act upon those insights as they arise in a future business production process. The design and implementation of those operational tactics are the means by which we use predictive analytics to improve core business. That exercise requires careful thought and effort, and is far from hitting an "*easy button*."

CONCLUSION

This is a uniquely exciting time to be an actuary. Predictive analytics brings a large, complex business opportunity, which increases in size and complexity on a daily basis. As actuaries, our skill sets, training, and individual motivations and abilities leave us well positioned to lead. I find this to be a fascinating opportunity for our profession. ■

Andy Ferris, FSA, MAAA, FCA, is managing director at Deloitte Consulting LLP in Chicago.

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Meet the actuarial talent behind *The Actuary*

Authors, editors, designers, SOA staff and a host of volunteers are highly instrumental in producing *The Actuary* six times a year. But the group whose names appear on the magazine's masthead—the board of contributing editors—is the one that devotes countless volunteer hours finding writers, offering advice to authors and reviewing the articles that stream into us for submission. Their talent, energy and expertise are the backbone of this publication.

Serving a two-year term as content experts in their area of practice, contributing editors also provide direction on industry trends and important emerging topics, ensuring each area of practice receives the appropriate coverage and that there is something of interest for every member in each issue.

These SOA members currently serve as contributing editors of *The Actuary*:

Richard Berger
FSA, EA, MAAA

Mark Birdsall
FSA, MAAA, FCA, MBA

Achille Sime
FSA, CERA, MAAA, FIAF

Ksenia Whittal
FSA, MAAA

Larry Zhao
FSA, CERA, CFA, Ph.D.

Meet the newest members of the team, from left to right:

Sarah Hinchey
FSA, CERA, MAAA

Andy Ferris
FSA, FCA, MAAA

Robert L. Brown
FSA, ACAS, FCIA, HONFIA

Xu (Vincent) Xuan
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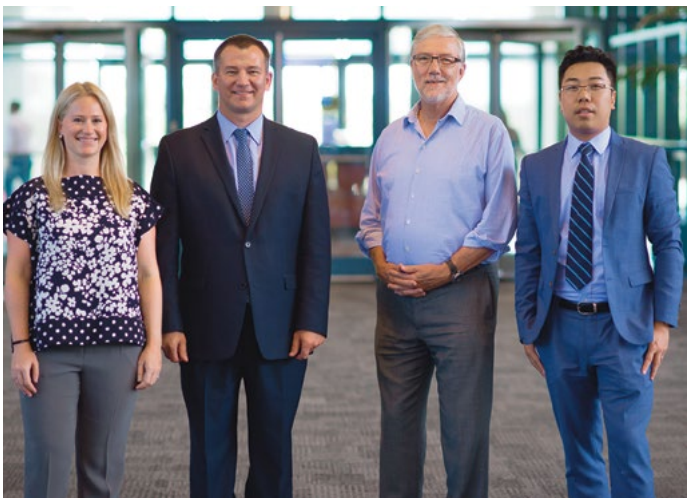

The education consultant is:

Lorne W. Schinbein
FSA, MAAA

We extend our gratitute to the contributing editors who recently rolled off the volunteer board, including:

Alan Cooke
FSA, FCIA, MAAA

Carl Hansen
FSA, MAAA, FCA, EA

Christine Hofbeck
FSA, MAAA

Albert Moore
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BY JEREMY J. BROWN

Jeremy J. Brown, FSA, MAAA, is president of the Society of Actuaries.

from the **PRESIDENT**

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Growing your network (and your knowledge base)

With the start of the year, we all have an opportunity to build upon our skills and grow our professional connections. Be a lifelong learner. Keep a look out for new ideas and approaches. There is a lot to gain, and there are many ways to achieve it.

The Society of Actuaries (SOA) continues to identify and develop different ways to support us, its membership. In fact, the SOA's 2017–2021 strategic plan focuses on knowledge and expertise as well as insight and influence. It is ingrained into our organization.

Here are some ways to build upon your knowledge base and expand your network. Join a professional interest section. Become an SOA volunteer. Participate in professional development to tap into education and networking. Connect with our membership around the world. All of these also are a conduit to share your thoughts and expertise with others.

SECTIONS

The SOA has 20 professional interest sections that cover a lot of practice areas, including pensions, health, reinsurance and much more. There also are sections focusing on international, the future of the profession, technology and predictive analytics. Take a look at what they have to offer, as there are plenty of opportunities for networking, education and research. For the full list, visit the sections' webpages (see "Related Links").

VOLUNTEERING

Becoming a volunteer is another way to grow your network and knowledge base. As a longtime SOA volunteer, I've gained a lot from my involvement with education, exams and several other groups. Even through my retirement, I have kept my connection with the profession, and especially this organization.

Consider gaining new experiences, ideas and connections, while at the same time helping to advance the actuarial profession. The SOA developed a new database of volunteer opportunities, so members can easily search and apply for volunteer positions. Search the database by expertise area and the level of time commitment. For example, it lists Canada-specific volunteer projects, section-specific volunteer needs, specific professional development events for moderators and project oversight group volunteers for supporting SOA research. There is a range of

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RELATED LINKS

Sections Webpage
bit.ly/SOASections

Volunteer Opportunities Database
bit.ly/VolunteerSOA

Professional Development Opportunities
bit.ly/SOA-PD

PBR Professional Development Series
bit.ly/SOA-PBRSeries

SOA Explorer
explorer.SOA.org

SOA Engage
engage.SOA.org

Jeremy J. Brown on LinkedIn
bit.ly/JJBrownSOA

> “To me, it all comes down to the following advice: participate, participate, participate.”

opportunities, from those lasting less than four hours to time commitments of more than 40 hours. I urge you to visit the volunteer opportunities database and begin applying for one or more opportunities.

PROFESSIONAL DEVELOPMENT

The SOA has many different live events (conferences, symposia, seminars) and regularly hosts webinars. I also would like to mention the growing volume of podcasts and e-Learning, all accessible from the SOA website. There is a new and timely item to call out: the free educational lessons on principle-based reserves (PBR). The SOA developed this on-demand material, with input from the National Association of Insurance Commissioners (NAIC), to provide education on PBR and VM-20 requirements.

GLOBAL CONNECTION

In addition to the SOA’s regular communications, there are also several social media channels (SOA LinkedIn company page, SOA Facebook account, plus *@SOActuaries* on Twitter and Instagram). However, that is only a portion of the connections available. Use SOA Explorer to search for jobs, connect with other local actuaries and find actuarial clubs. SOA Engage is the online community where members can discuss myriad topics, as well as provide advice and insights to actuarial candidates. I also have a showcase page on LinkedIn where I post and comment on the latest developments involving the industry, so feel free to reach out to me there, too.

To me, it all comes down to the following advice: participate, participate, participate. Help others, and in turn it will help you along your career. ■

Challenges and opportunities in Asia

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.

20TH ASIAN ACTUARIAL CONFERENCE

The 20th Asian Actuarial Conference (AAC), organized by 12 actuarial associations in Asia, took place Nov. 9–12, 2016, in Gurgaon, India. This year's theme was "Changing Asian Societies: Challenges and Opportunities," and focused on the challenges and opportunities actuaries and other professionals in the financial sector face in the region due to the evolving political, economic and demographic forces.

The Society of Actuaries (SOA), one of the event's sponsors, was represented at the conference by 2017 SOA President Jeremy Brown, FSA, MAAA; Dale Hall, FSA, CERA, CRA, MAAA, SOA managing director of research; Ann Henstrand, SOA senior director, international; and Jessie Li, FSA, the SOA's lead China representative.

Brown was the keynote speaker during the opening ceremony on the second day of the conference and delivered a speech during the plenary session under the title "Expanding the Profession and Blurring of Boundaries."

VISIT TO INDONESIA

The Society of Actuaries (SOA), represented by 2016 SOA President Craig Reynolds, FSA, MAAA; Ann Henstrand, senior director, international; and Wai Ling Yung, programs manager in Hong Kong, attended the symposium "Global Trends in Actuarial Education and Professional Development," which was organized by the Risk Management, Economic Sustainability and Actuarial Science Development in Indonesia (READI) Project on Sept. 26, 2016, in Jakarta, Indonesia.

The READI Project's goal is to increase the number and quality of Indonesian actuarial science graduates to address the country's growing demand for actuaries.

During the symposium, Reynolds presented the SOA's mission, vision and the newest developments in the association's educational track, including the Associate of the Society of Actuaries (ASA) curriculum changes. Reynolds discussed the SOA's presence and activities in the Greater Asia region, including local professional development programs.

The SOA's team was able to meet with Rianto Ahmadi Djojosugito, president of the Persatuan Aktuaris Indonesia (Society of Actuaries of Indonesia) in Jakarta, along with other senior staff, to discuss ways in which the two societies might work together. They also exchanged information about challenges for attracting and retaining actuarial staff with PT AXA Life Indonesia's Vincentius Wilianto, chief financial officer and country chief risk officer, other senior AXA Life staff, and Indonesia SOA Ambassador Kim Yeoh, chief actuary for PT Prudential Life Assurance Indonesia.

The visit concluded on Sept. 27, 2016, with an evening networking reception organized by the SOA at PT Prudential Life Assurance. More than 50 members, candidates, university lecturers and even one high school student interested in an actuarial career attended the event that included a meet and greet session, dinner and a presentation by Henstrand that covered news and education updates.

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ACTUARIES CLIMATE INDEX EXAMINES CLIMATE TRENDS AND POTENTIAL IMPACT

The Actuaries Climate Index is a new educational tool that provides a quarterly measure of changes in extreme weather events and sea levels. Data analysis indicates a sustained increase in the frequency of extreme weather occurrences in the continental United States and Canada. The Actuaries Climate Index was developed by the Climate Change Committee, a joint effort of the American Academy of Actuaries (the Academy), the Canadian Institute of Actuaries (CIA), the Casualty Actuarial Society (CAS) and the Society of Actuaries (SOA).

RELATED LINK

Explore the Actuaries Climate Index

ActuariesClimateIndex.org

ACTUARIES AND BIG DATA

Big data (also known as predictive analytics) is an often talked about topic. Learn how actuaries are working with predictive models and analytics.

RELATED LINK

Big Data Insights

SOA.org/predictive

LEADERSHIP OPPORTUNITIES

BY SCOTT RANDLES

The Leadership and Development (L&D) Section is transforming to provide you with the tools you need to grow and succeed as a leader.

Last year, we changed our name to emphasize the importance of leadership in the actuarial profession. This year, we're providing more opportunities for you to interact with senior leaders, and more frequent, short, electronic communications on L&D topics.

These are the benefits you will receive as a member of the L&D Section:

- Tools to facilitate your personal career development, such as our popular publication, *The Stepping Stone*, and our new *LeAD* monthly e-bulletin.
- Practical leadership topics and results-oriented skills on our LinkedIn page, no matter at what point you are in your career.
- Summaries of leadership books to help you build the bridge from technical knowledge to decision-making, via the getAbstract Library.
- Educational opportunities and resources to become a more effective leader within your organization. Attend one of the section-sponsored sessions at an upcoming meeting.
- Network, enhance management practices and experience professional feedback. Attend an interactive section-sponsored session or webcast, such as the "Women's Leadership Forum" or "Breakfast with Senior Leaders."

Interested in joining or participating? Log on to My SOA, and then go to "My Community" to join the L&D Section today. You can also send ideas for speakers or topics, or submit a leadership article to be published in an upcoming edition of *The Stepping Stone*.

Scott Randles, FSA, MAAA, is the senior vice president and appointed actuary at Allstate Benefits in Jacksonville, Florida. He is the chairperson of the SOA's Leadership & Development Section.

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RECIPES FOR NEXT GENERATION ANALYTICS

BY JEFF HUDDLESTON AND NATE POHLE

Data about each of us is being collected on a minute-by-minute basis through our regular actions, such as using a credit card, sending a personal email, posting to social media, enabling location-based services on a smartphone or logging our daily exercise. While some of this data requires our permission to be collected by third parties, other elements can be collected without our permission or knowledge.[1] As a result of these new data sets and other changes, many industries, such as retail, banking and sports, are using data and advanced analytics to improve their core business operations and to better inform their strategy. Many of these efforts are focused on the consumer and how to enhance his or her experience.

Over the last few years, insurance companies have been using big data and analytics to streamline operating procedures and processes, with the goal of managing and delivering their products more efficiently. For example, application triage underwriting algorithms, which seek to

PREDICTIVE ANALYTICS APPLICATIONS FOR LIFE AND ANNUITY PRODUCTS

identify applicants for individual life insurance for whom certain medical exams can be waived, are becoming table stakes in some life insurance distribution channels due to demands by consumers, agents and executives alike. Saving time and money, increasing placement rates and application volume, and other compelling reasons make this a logical place for many life insurance carriers to begin integrating applications of predictive analytics into their core operations.

While application triage is one example of disrupting a core business process by introducing an application of predictive analytics, it is merely the tip of the iceberg. Many new applications of predictive analytics that affect other core operations of insurance companies are being developed. This article provides a refresher on the different data sources available to insurance companies and provides a deeper dive into several innovative applications of predictive analytics for life insurance and annuity manufacturers.

DATA SOURCES

The combination of traditional data sources and new data sources forms the foundation for advanced analytics to improve core business operations. In our current data age, it is a worthwhile exercise to take a step back and reassess what data points are being used for strategy, operations and other functions. There is a chance that some data points are not being used simply because the processes were established before the new data sets were created.

Some of the specific sources of traditional and new data to consider are:

❶ | Traditional data sources
- Policy applications
- Paramedical exams
- Medical Information Bureau Group Inc. (MIB)
- Motor vehicle records (MVRs)
- Prescription drug databases

❷ | Traditional data sources that are now easier to obtain quickly, inexpensively and in a digital format
- Property records—ownership, tax appraisal and so on
- Genealogy records—births and death
- Marriage licenses and divorce decrees
- Criminal records, court dockets, jail inmate records
- Voter registration
- Bankruptcy records

❸ | New data sources
- Third-party marketing databases
- Electronic health records (EHRs)
- Biometric data from wearable devices
- Social networking sites
- Behavioral and lifestyle data

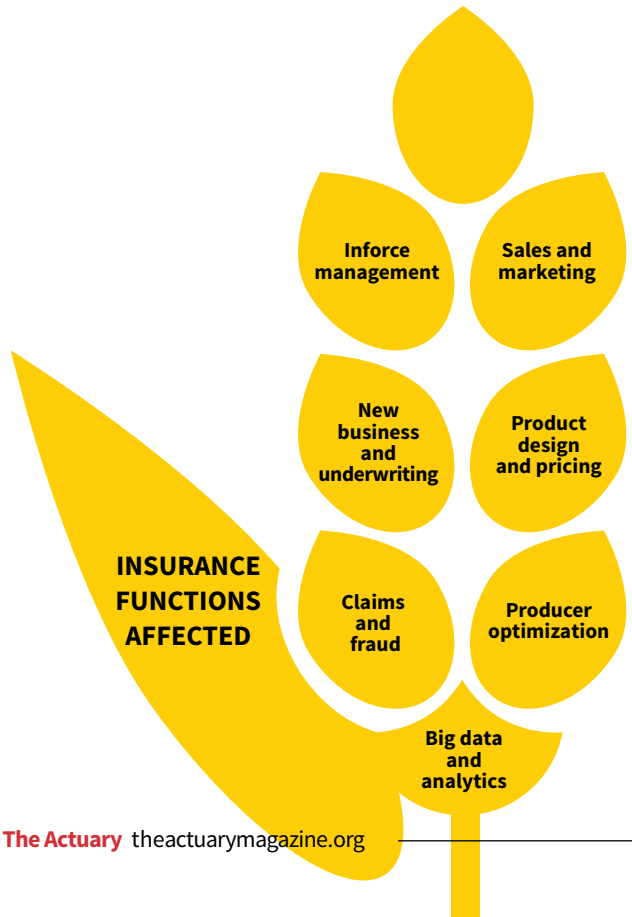
Given that the sheer number of data points and their potential correlations can be overwhelming, there are standardized and proven procedures that can help. For example, a univariate review can test which variables are

statistically significant with the proposed dependent variable. This helps to narrow down the number of variables to those that reflect the most predictive power, among other factors like reputational risk, legal impact, data availability in the future and changes to vendor relationships.

Often, the data utilized by predictive analytics includes health, behavioral and lifestyle information that can be highly sensitive and closely regulated. In the United States, the Fair Credit Reporting Act and the Health Insurance Portability and Accountability Act (HIPAA) primarily apply, along with state privacy laws and other rules.[2] These should be considered, along with the intended business purpose, when deciding what data should be used.

INSURANCE FUNCTIONS AFFECTED

While big data and analytics may have only permeated one or more functions of many insurance companies, it is likely that they will have an impact on the remaining functions in the near term. A helpful mindset to take is that additional data and analytics can help *enhance* current processes and do not necessarily need to *replace* the current processes entirely. This incremental mindset is more practical and can help functional leaders maintain current service level agreements while improving efficiency, effectiveness, cost and/or timeliness of that business function. This incremental approach helps the company/function progress toward transformational change in the long term. There are tools and accelerators that insurance companies can use from third-party vendors to promptly tap into data sets and leverage off-the-shelf models.



Example 1: Agent and Policyholder Matching

In addition to enhancing underwriting and retention operations, big data and analytics can be used to improve the relationship between insurance company agents and policyholders. Predictive algorithms can be developed to identify characteristics of agents and policyholders that have contributed to effective relationships in the past. These characteristics then can be applied to optimize the future matching of agents and new policyholders. By identifying the characteristics that have best aligned agents and policyholders, insurance companies can improve agent retention and productivity while improving the policyholder experience and retention. (See **FIGURE 1**).

Example 2: Enhanced Assumption-Setting

Big data and analytics can enhance the traditional actuarial assumption-setting process to provide deeper insights. Third-party marketing data sets exist with several thousand data fields on most individuals in the United States. Those data fields can be sent through an algorithm to score each individual and create an estimate of future mortality for each individual. That scoring distribution can be appended to traditional assumptions to make the final result more accurate and granular. This is helpful when internal experience upon which to base assumptions is not credible enough.

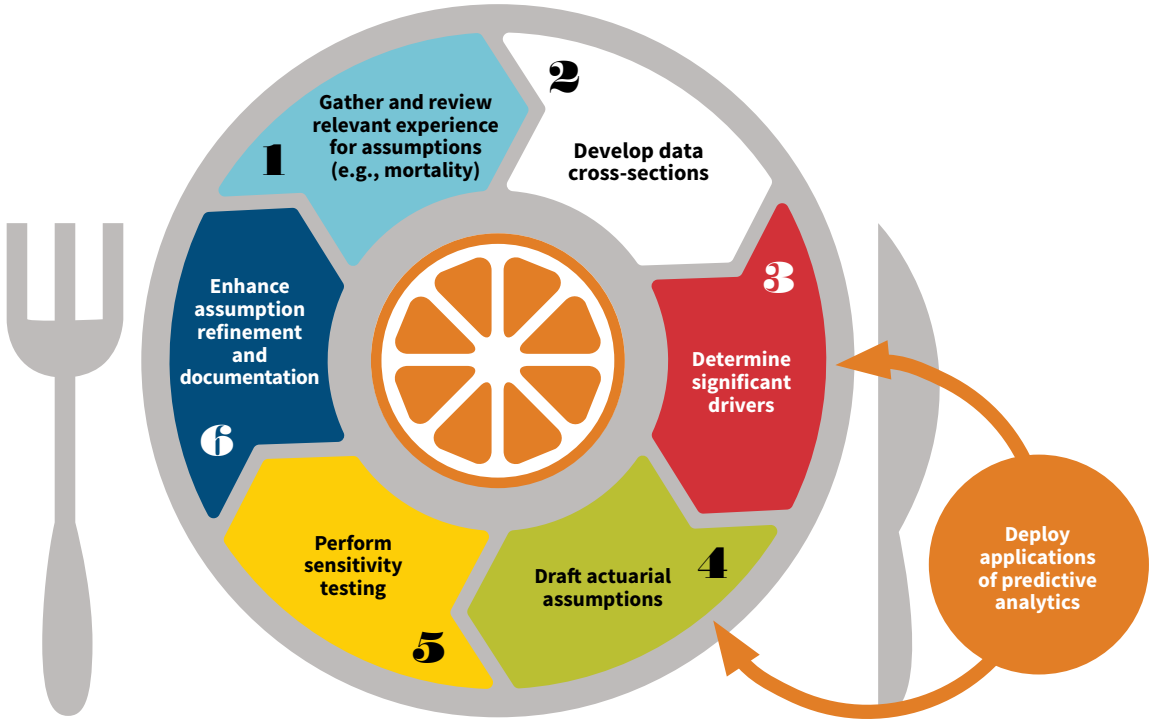
Example 3: Policyholder Wellness Programs

Big data and analytics are not limited to process improvements. They also can be extended to the products that insurance companies sell. Big data and analytics don't simply change how insurance companies operate internally or go to market—they also can improve what they offer to the market.

For example, wellness programs are becoming more commonplace in today's workplace. These programs have a component of social good, as they often are win-win programs for policyholders and insurance companies. They instill a sense of competition and offer opportunities to interact with other participants. These types of wellness programs are being embedded within health or life insurance products. A policyholder wellness program by an insurance company could include offering personalized health challenges to participants who earn rewards for

FIGURE 1

ENHANCED ASSUMPTION-SETTING



completing those challenges. The rewards could include premium discounts, free health checkups, gift cards to retail stores and other rewards. These programs have the potential to generate benefits for both the policyholders and the insurance companies. Benefits include:

- Increased quantity and quality of policyholder interactions, improving the communication process.
- Improved policyholder customer experience from the health benefits stimulated by the programs, helping policyholders achieve improved length and quality of life.
- Generating financial benefits for the insurer in the form of reduced and/or deferred claims and increased premium revenue, because of the increased length and quality of life.
- The life insurer may appeal to a more health-conscious segment of the population by offering the program, effectively generating "favorable selection" benefits to the company's mortality and morbidity risks.
- The products can create a richer data set for insurance companies, which can be used for future predictive modeling initiatives.

CONCLUSION

Agent and policyholder matching, enhanced assumption-setting and policyholder wellness programs: These are three specific examples of ways that insurance companies are utilizing new sources of data and advanced analytics in their core business operations. The opportunity set spans the entire insurance lifecycle, from marketing to new business, to reinsurance, to inforce management, to claims. Although this may seem daunting, the changes are doable if they are broken into bite-sized chunks. Internal and external data sets should be reviewed with fresh eyes to see if they can augment traditional processes. A variety of advanced and predictive statistical techniques can then be applied to the data—from generalized linear models, to classification/tree-based modeling, to artificial intelligence modeling. This way, companies can begin to translate everyday information into actionable insights by embedding analytics across the organization's strategy, operations and systems, and by building analytics into core organizational areas, including customer, supply chain, finance, risk and workforce. ■

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BEYOND RISK

SCORES

BY SARAH PRUSINSKI

PRIORITIZING HEALTH CARE INTERVENTIONS WITH PREDICTIVE ANALYTICS

Current health care system structures are increasingly focused on a balance of improving quality and decreasing costs. In the United States, aspects of the Patient Protection and Affordable Care Act (ACA), the Medicare Access and CHIP Reauthorization Act (MACRA), the development of accountable care organizations and electronic health record (EHR) meaningful use initiatives are all examples of programs set up to improve health care quality and cut costs. In other countries with universal health care, these same two priorities are present in the allocation of funding and resources.

Simultaneously, new provider-related teams are being formed to support these initiatives. These groups have teams of care managers who oversee patient care and determine who should receive interventions and how each intervention should be personalized for a given patient. The teams are set up in in a variety of ways, ranging from doctor-led organizations, entities in which nurses oversee the care of patients and other office-run arrangements. Interventions refer to a number of different contact points with patients, including phone calls to discuss health and lifestyle, as well as more intensive in-person care and observation.

These care management teams need answers to the following questions:

- Which interventions are worth it?
- Who should receive interventions?
- Do the benefits outweigh the costs?
- How are outcomes measured?

With the increased emphasis on outcomes in health care, how these questions are addressed is more important than ever.

THE OLD WAY OF THINKING

One of the common methods of determining where to intervene to reduce costs is by examining patients' risk scores. In the health care industry, a risk score is a number that is assigned to patients based on their demographics and diagnoses—a numerical representation of how costly

they are expected to be compared to the average patient. One of the common applications of using risk scores is to adjust premium payments. A baseline (or average) risk score is assigned a value of 1.0. A patient expected to cost half as much as the average patient would have a risk score of 0.5, and a patient expected to cost twice as much would have a risk score of 2.0.

Although risk scores are a good way to gain an understanding of a patient's anticipated health care costs relative to the rest of a population, they still have flaws that keep them from giving an accurate picture of who is "impactable." In health care, impactable refers to the extent an intervention can affect the health and costs of a patient.

One of the flaws of risk scores is that there are many factors other than diagnosed conditions that contribute to a patient's costliness, which are not reflected in the risk score. One example is a patient's level of compliance with a doctor's orders or with taking medication. A patient who is not compliant will likely cost more than a patient with the same conditions who does comply because of unmanaged complications. Another example is a patient's level of moral hazard. Behaviors such as frequent, unnecessary trips to the emergency room, frequently receiving care from specialists and the network status of providers seen cannot be captured in a risk score. Behavioral factors play a large role in a patient's costs.

Another shortcoming of risk scores for determining with whom to intervene is that little to nothing can be done to lower the costs of some conditions. End-stage renal disease (ESRD) is an example of a costly condition for which little can be done to alter the costs of care. Although a patient with this condition may have a high risk score, targeting the patient for intervention will not aid in lowering the patient's dialysis costs.

Risk scores also fail to take into account programs already implemented for specific populations. In health insurance, the term "population" refers to a group of patients who share the same health insurance coverage or are managed by the same organization.

The types of management from population to population vary. For instance, a population that has seen effective management of diabetes will have different characteristics from one that focuses on managing patients with chronic obstructive pulmonary disease (COPD). The risk scores for a population will be the same whether diabetes or COPD is targeted, because risk scores simply flag conditions. However, how impactable a patient is will vary based on the already existing programs. COPD patients in a population that already manages patients with COPD will be less impactable than COPD patients in a population that does not.

NEW TECHNOLOGY, NEW TECHNIQUES

Traditional methods for determining who would be most in need of intervention, such as risk scores, give some insight but fall short in many ways. However, technology allows for the ability to model other aspects of a patient's health and costs with relative ease. Data about the patients in a population is more readily available and includes information that previously was not known. An example of this is the information contained in EHRs. Vitals, lab results and other details that are more specific than what is coded in medical claims data are now available.

> “One of the most important aspects of a patient that can be modeled through predictive analytics is the level at which an intervention can cut costs.”

Sophisticated modeling software allows for new and complex statistical methods to be applied when analyzing a patient’s information. These models allow for a patient’s behaviors and conditions to be projected into the future through predictive analytics in a way that was not previously possible. For example, a patient’s care patterns can be modeled. The ability to identify that a patient unnecessarily overutilizes certain services, and apply that knowledge to determine the level of effectiveness of outreach to the patient, is key for cutting costs. Similarly, medication use can be tracked and factored into a patient’s overall expected costliness.

One of the most important aspects of a patient that can be modeled through predictive analytics is the level at which an intervention can cut costs. Not all high-cost conditions have the same level of costs that can be cut through intervention. Predictive modeling allows for the examination of costs that can be cut based on a patient’s behaviors, pattern of care and conditions. Other patients with similar health care characteristics can be observed in order to help make informed predictions on how impactable a given patient might be in the future. The analysis of costs over time for an entire population increases the amount of information available about the likely future cost profile of a patient. In turn, patients who have a cost profile that is predicted to have potential savings as a result of an intervention can be targeted. The ability to know with greater certainty whether intervening with a given patient will affect end costs—and having an estimate of what the maximum impact could be—is a tremendous step forward when managing patients. The cost-savings value of an intervention can be known and considered before it takes place, leading to improved decision-making abilities and better allocation of time and resources for patient interventions.

A CASE STUDY

This case study looks at a health care management organization focused on managing emergency room visits and inpatient admissions. The organization enters into arrangements with an insurer to manage an entire population, but it is only liable for certain categories of service. The arrangements it enters into stipulate that it receives a fixed per-member payment for all emergency room and some inpatient services used by the population. This organization uses sophisticated predictive models to optimize its interventions by targeting the most impactable patients.

Almost all insurers with which this organization contracts want to know about return on investment (ROI), but not all of them are willing to do a properly designed study to measure ROI. One insurer was willing to create a study, however, and came up with an experiment to measure the impact the organization has on a population. For this contract, the insurer ranked what it considers to be the 50,000 most impactable patients from a large population, with the intention of giving half of the top-ranked patients to the organization to manage and keeping the other half to manage and intervene. Sometime into the contract, there will be a comparison of which group is less costly to determine if the organization’s strategies and ability to manage patients is actually superior to the insurer’s management.

The insurance company used two main patient characteristics when determining who it considers to be most

impactable: the risk score and the presence of a chronic condition. As previously discussed, the application of a risk score, although helpful, does not give the full picture of a patient's health. There are other condition-specific and behavioral aspects that need to be taken into account when determining how impactable a patient is. The presence of a chronic condition also does not provide enough information about a patient to determine the level of possible cost impact. The 50,000 patients were split evenly between the insurer and the organization for risk score, presence of a chronic condition, age, gender, race and geographic location. Many cost impact questions were left unanswered, such as the ability to affect the patients' behavior and health care costs.

Because of its prior work with predictive models for targeting intervention in its other populations, the organization knows there are more items that need to be taken into account when determining how impactable a patient is. The data for the new population was run through custom predictive modeling algorithms to determine the predicted possible level of impactability for each patient. Then the model results were employed to determine whether the population the insurance company assigned the organization is at least as impactable overall as the population the insurance company is managing and using as a control group.

Through the use of predictive modeling, a comparative value between the two populations was estimated. Because the contract between the organization and the insurer is set up in such a way that the organization needs to cut more costs than the insurance company while still managing patients, it is crucial to have a population that is impactable. Although the management of the populations is still ongoing and the outcomes will not be compared for quite some time, the use of custom predictive analytics in addition to the original risk score and condition comparison methodology has helped ensure that the final outcome comparison is fairer.

CONCLUSION

Care management and the reduction of health care costs are extremely important. Companies and providers are scored on health outcomes and decreases in cost trends. The levels of reimbursement and profitability are affected by these outcomes. Because of the cost of intervention and limited resources, focusing management efforts on patients who will benefit most from the intervention is critical.

The use of predictive analytics allows for an informed decision when determining with which patients to intervene. Unlike more traditional methods, custom predictive modeling allows for information about a patient's behavior and care patterns to be taken into account when determining the future impactable level. Where patients go to receive care, their levels of drug compliance, the frequency with which they receive care from specialists and the network status of their providers all affect the costs that can be reduced for a patient—and all can be modeled through predictive analytics.

Additionally, predictive analytics helps with assessing more specific cost categories, such as the costs that can be reduced through intervention. Because not all patient costs associated with a condition are impactable, it is important to examine the impactable costs when deciding whether to conduct an intervention. Predictive modeling can base results on these potentially impactable costs, leading to a much more accurate sense of who can benefit from intervention and by how much.

Another way the use of custom predictive analytics may lead to better outcomes than the use of more traditional methods is by incorporating the information of the whole population when determining future costs. When modeling a population, patients naturally will have things in common (existing care management programs, where they receive coverage, geographic location, and age or financial status). Capitalizing on these similarities can better predict the future costs of a patient. Deeper similarities, such as the combination of conditions or care patterns, can be found in other patients within the population. In turn, their historical impactable spends can be used to help inform the model of what an original patient's cost will be. The ability to apply detailed information from similar patients leads to significantly more accurate predictions.

Despite tools like risk scores being able to provide high-level insight into a patient's expected future costs, modern technologies and methodologies lend themselves to even greater insight. With a growing number of provider-related teams trying to cut the costs of populations below certain thresholds, the ability to identify the most impactable patients is more crucial than ever before. Through custom predictive analytics, the level of impact on a patient can be more accurately and robustly estimated, and more educated intervention decisions can be made, allowing for groups to meet their financial goals. ■

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FIGHTING INERTIA

BY BRIAN O'NEILL

IS THE PENSION RISK TRANSFER MARKET THE NEXT GREAT FORAY FOR PREDICTIVE ANALYTICS?

The field of predictive modeling has been around for quite some time. It has been a mainstay in the property and casualty (P&C) insurance world for decades, particularly in what might be called the out-of-the-money risk space. For certain lines like automobile insurance, voluminous reams of credible data on accident claims have typically existed, and this data was generally sufficient for pricing and reserving actuaries to gain comfort with the claims frequency and severity assumptions they used.

Such credible data did not exist, however, for coastal homeowners insurance where the frequency and severity of claims could vary wildly as a result of unpredictable natural disaster activity, for example. Unlike auto insurance actuaries (and, similarly, life actuaries who typically have also had reams of credible data on mortality), "tail risk" actuaries have not relied as much on past data ("the then") in pricing policies and setting reserves. They instead generally had to rely more on the predictive power of observable variables ("the now") related to the exposure insured, which has required the use of predictive modeling.

In its simplest form, predictive modeling is an exercise of collecting lots of data about the characteristics of an insured exposure and running multivariable regressions to determine which variables, in which combinations, have predictive power. It's a pretty straightforward exercise—for the average actuary, at least.

As time progressed and modeling capabilities improved across the insurance industry, predictive modeling started to be used in the health insurance space by the turn of the century. Health actuaries began to realize that, for example, collecting data on someone's medical records, health history, exercise habits, shopping habits and risk appetite (e.g., tendency to gamble, frequency of speeding tickets) could inform models that have significant predictive power. The next logical step for health actuaries was to incorporate this modeling into health insurance pricing and reserving.

Over the last decade and a half, the availability of information, both public and confidential, has increased exponentially, which has caused the predictive power of these models to increase in turn. It was only a matter of time, and indeed a foregone conclusion, that these models would begin to be utilized in the life insurance space to help inform mortality and longevity assumptions. True to form, we are seeing many applications of predictive modeling inform underwriting, pricing and marketing decisions in the life insurance space more and more. What does the future hold? What is the next great foray for predictive analytics? Perhaps it is the "land of vanishing inertia"—the U.S. pension risk transfer (PRT) market.

THE PRT MARKET—PAST, PRESENT AND FUTURE

In my view, pension risk across the globe has been largely mismanaged macroeconomically for many decades, due in large part, as noted previously, to some forces of inertia fighting against the transfer of risk into the hands of the most appropriate managers of that risk. That risk is largely financial and actuarial in nature. Modern insurers have

PENSION RISK TRANSFER MARKETS AROUND THE GLOBE VARY NATURALLY IN SIZE, SCOPE AND NATURE DUE PRIMARILY TO DIFFERENT REGULATORY PARADIGMS, DIFFERENT CULTURES AND RISK TAKERS WITH DIFFERENT STYLES AND APPETITES.

been researching, modeling and managing actuarial and financial risks for decades, whereas, to plan sponsors—particularly those that are nonfinancial companies—pension risk is typically an unwanted distraction to an organization's business plan and often a source of seemingly uncontrollable uncertainty. The mission, vision and values of these organizations simply don't tend to incorporate pension risk management. Nor should they. These companies do things like make the tiles that end up on your kitchen counter; they make sure you have clean running water 24/7; they make sure we fly the friendly skies in a safe and efficient fashion. Pension risk doesn't belong in their wheelhouse.

Now, let's add a few additional points to the narrative. The cost to administer pension plans is becoming increasingly burdensome at many plan sponsor organizations. Investment management fees for plan sponsors are often significant and vaguely disclosed. Many life insurers are finding it increasingly challenging to drive top line revenues and achieve target returns on capital with traditional products. When compared to the menu of modern life insurance product liabilities that insurers hold, PRT liabilities are squeaky clean (for example, the exposure to policyholder behavior is either minimal in comparison or nonexistent). Taking all of that into consideration, it is no surprise that the PRT market continues to exhibit significant growth and is poised to do so for many years to come.

PRT markets around the globe vary naturally in size, scope and nature due primarily to different regulatory paradigms, different cultures and risk takers with different styles and appetites.

In the United Kingdom, for example, the PRT market is relatively mature and uses several instruments (annuity buy-ins, group annuity buy-outs and longevity swaps) to help plan sponsors cover the various pension risks. Contributing to that might be the fact that the regulatory construct requires actuaries to be on both sides of the pension balance sheet (plan scheme actuaries on the liability side and trustee actuaries on the asset side).

In Canada, the PRT market is nascent, but clearly growing, with the first longevity swap transaction closing in 2015.[1]

In Japan, there has been a small wave of transactions for Japanese companies that have U.S. subsidiaries with U.S. plans. These organizations might be likely candidates for PRT if and when the funded status of Japanese plans eventually improves, which would be helped by an increase in interest rates. They also have the hurdle, in certain circumstances, of needing to get buy-in from two-thirds of the covered workforce.

Irrespective of the specific country of domicile, the general themes that surround the transactions are common:

- Care needs to be taken (by regulatory bodies as well as paternalistic plan sponsors) to ensure that the insurer that assumes the pension benefit obligations is financially strong and well positioned to make good on the pension promises in perpetuity.
- From the perspective of both the plan sponsor and the insurer, the economics of the transaction must fit within their general business models.

We now turn to the U.S. market specifically to illustrate how the dynamics of the transactions work and where predictive analytics might fit.

THE PRT MARKET IN THE UNITED STATES

By the numbers,[2] as shown in **FIGURE 1**, the growth and growth potential is quite eye opening. We count just fewer than 20 major players that are either actively transacting in the U.S. group annuity pension buy-out market and/or demonstrating genuine appetite to transact in 2017. Those companies were responsible for the transfer of about $15 billion in pension assets and liabilities in 2016, which is no small number. Nonetheless, it is well below 1 percent of the total potential market of transferrable U.S. corporate defined benefit (DB) plan assets. In short, to the extent pricing remains attractive and capacity on the insurance side remains adequate, this market likely will be a source of safe haven growth for years to come.

Another wrinkle to add, which is likely to continue to contribute to PRT market growth, is that the premiums that plan sponsors must pay to the Pension Benefit Guaranty Corp. (PBGC) per participant have increased exponentially and are scheduled to increase by an additional 25 percent by 2019.[3] All in all, the trends seem to point toward a bright future for this burgeoning market.

That market, at the moment, appears to be somewhat segmented, with some price competition on the lower end, some capacity constraints and a smaller field of potential writers on the larger end, and a mixed bag of structures in the middle market. The larger end, or jumbo market, transactions typically include separate account structures that transact using assets in kind (as opposed to cash). In these situations, insurers take a look at the assets held by plan sponsors and elect the basket of securities they find to be more favorable. Consequently, the plan sponsor avoids the trading costs associated with cashing out, and the insurer avoids the costs associated with reinvesting.

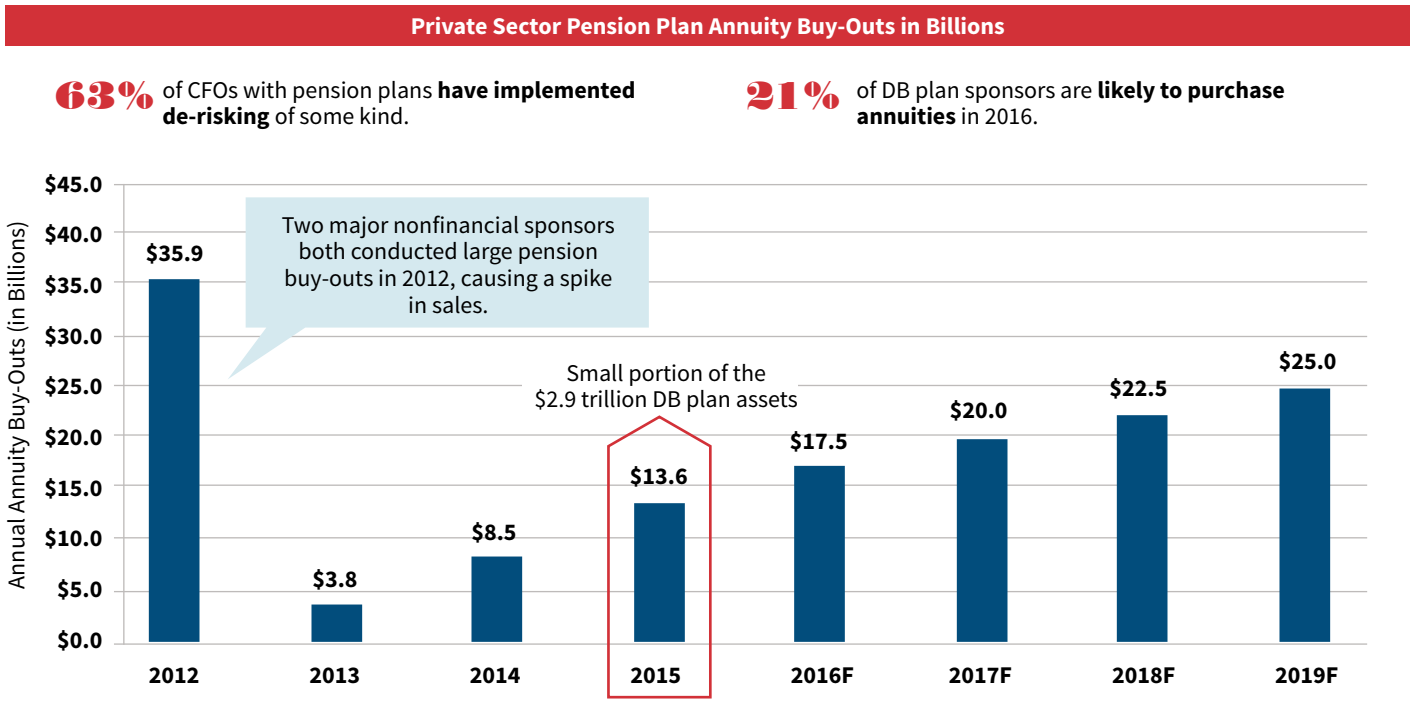
The middle and jumbo markets tend to transact through an independent fiduciary, who signs off on the transaction being in compliance with the applicable regulatory guidance.

That applicable regulatory guidance, which dictates how PRT transactions must occur and ensures that the plan participants become policyholders in a safe and orderly fashion as the pension plan assets and liabilities are transferred from the plan sponsor to an insurance company, can be found in Department of Labor (DOL) Interpretive Bulletin 95-1. DOL 95-1 prescribes several requirements that must be met and upon which plan fiduciaries must opine to ensure that the group annuity provided by the PRT insurer can be deemed the "safest available annuity."[4] In short, the safest available annuity factors that should be considered require a deep-dive look into the bidding insurer's ability to effectively run the business it is assuming as part of the PRT transaction. The factors include:

- Quality and diversification of investment portfolio.
- Size of the provider compared to the proposed PRT contract.
- Level of the insurer's capital and surplus.
- Lines of business and other liability exposures.
- Structure of the annuity contract (e.g., use of a separate account or other guarantees).
- The availability of additional protections through state guaranty associations and the extent of those guarantees.
- Other relevant considerations, such as the insurer's ability to administer the annuity benefits efficiently and effectively.

What this construct effectively does to the PRT market is help ensure that the pool of PRT providers remains financially strong, profitable, highly rated, reputable and very risk aware. This acts as a natural inhibitor to overly aggressive pricing in the PRT space. We should not be tempted (and, as actuaries, it is indeed our professional duty to not be tempted) to think that DOL 95-1 compliance is simply a "cover your tracks" or "check the box" exercise. Approximately one year after a high-profile sponsor's large 2012 PRT transaction closed, there was a class-action lawsuit brought by a group of retirees who questioned the legality of the fact that the checks they used to get from the plan sponsor were now coming from a PRT insurer. The case was thrown out of court, with the primary reason being the lengths to which parties to the transaction went to ensure DOL 95-1 compliance (and the documentation of such compliance).[5]

FIGURE 1 **CORPORATE PENSION PLANS ARE BEING TRANSFERRED TO INSURERS AT AN INCREASING RATE**



Source: Deloitte CFO Survey, February 2016.

STATE GUARANTY ASSOCIATION (SGA) COVERAGE

Focusing for a second on the sixth factor in the DOL 95-1 list of considerations provided on page 29, in the United States, should a licensed insurer become insolvent and be liquidated by the National Organization of Life and Health Guaranty Associations (NOLHGA), after liquidation, policyholders holding policies insured by the liquidated insurer are made whole up to certain limits. These limits vary state by state (the large majority are in the $100,000–$500,000 range, with the most common being $250,000),[6] and should be applied on a policy-by-policy basis to the present value (PV) of the policy's expected future cash flows using market consistent assumptions. Smaller benefit annuities for older lives will have, of course, lower PVs relative to larger benefit annuities for younger lives. The lower the PVs are, the more likely it becomes that they would be under the state guaranty association (SGA) limits, which would help ensure that policyholders are made whole in the highly unlikely event of an insurer liquidation.

What this likely means for the PRT market is that, since there tends to be more SGA protection available for older lives with smaller annuity benefits, it is easier to gain comfort with the DOL 95-1 "safest available annuity" definition for these lives. Consequently, transactions with large groups of these lives tend to be a bit less complicated from a DOL 95-1 perspective.

We've seen a trend in the U.S. PRT market toward transactions in which blocks of retirees with small benefits are carved out and transferred to insurers, while the plan sponsor continues to retain the remaining plan participants. Actuarially speaking, the valuation of these carved out blocks of retirees is not complicated, which can be a good thing from one perspective; however, it doesn't help the insurers to differentiate themselves from a pricing standpoint. It often becomes a contest of who can model mortality (as the next section of this article lays out, often in 15 days or fewer) better than everyone else. When you ask that question to a number of teams of seasoned actuaries, there's not a lot of room for standing out in such a short time frame without uncomfortable levels of uncertainty. Predictive modeling could be a cure for that.

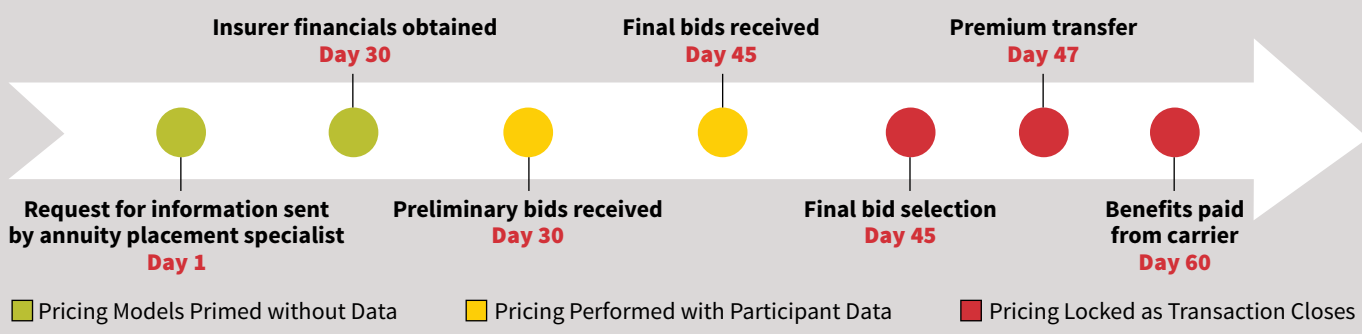
PREDICTIVE MODELING IN THE CONTEXT OF PRT TRANSACTIONS AND HOW THAT MIGHT WORK

The illustration in **FIGURE 2** shows a typical transaction timeline for a PRT deal in the United States in the current market. Typically, there is approximately a two-week time frame between the time the census data is delivered to the bidding insurers (around day 30) and the time that final bids are due (around day 45). Insurers generally have their mortality assumptions prepared and ready to go before receiving the census and apply those assumptions to the census when they receive it to determine pricing. There is simply not a lot of time for studies or application of different scalars based on population characteristics to meaningfully affect pricing. We usually see different tables being applied based on a handful of industry standard factors, such as age, sex, blue collar/white collar, region of residence and so on.

What if there was a way to gather more data on the census? Lots more. And what if an evaluation of the predictive power of that data could be accomplished overnight? In today's world of big data and formidable predictive modeling, this can unquestionably be accomplished. The question is how it might be included as a key ingredient in PRT pricing.

Let's say, for example, that two men lived next to each other and worked next to each other, and the first guy ("Oz") was in PRT census No. 1 and the second guy ("Ozzie") was in PRT census No. 2. Let's assume, with

FIGURE 2 **PRT TRANSACTION TIMELINE**



respect to the factors PRT pricing actuaries look at to determine which mortality assumptions to apply in their PRT pricing (age, sex, etc.), Oz and Ozzie are identical.

However, when we look at the big data set, we see that Oz shops at a health food store, owns a racing bike store, is on the board of a local hiking club, has never gotten a speeding ticket, gets annual physicals and takes no medications (other than the multivitamins he buys at Whole Foods), while Ozzie runs a store that sells kegerators, eats fast food 10 times a week, has extraordinarily high cable bills, and has been on and off cholesterol medication.

That type of information has been used by predictive models in the health insurance world to inform premium pricing for many years, where the probability of contracting cancer, heart disease, diabetes and many other illnesses is taken into account by the pricing actuaries. As time goes on, that kind of information is also informing underwriting, pricing and marketing decisions in the life insurance space more and more.

Going back to our example, if census No. 1 had 10,000 people like Oz and census No. 2 had 10,000 people like Ozzie, from the perspective of a PRT insurer, census No. 2 would be much more attractive to bid on and census No. 1 might be a deal that should be avoided. We can clearly understand that logically and intuitively, but predictive modeling helps us quantify it by producing health scoring, which leads to mortality/longevity scoring. Based on that scoring, which, again, can be produced very quickly (which is needed in the context of a live PRT transaction given the tight time frame), a PRT insurer can decide whether to be a bit more aggressive with pricing or walk away from a deal. In either case, the insurer can better gauge its comfort level with the mortality assumptions it is using.

IF I WERE A BETTING MAN ...

The PRT market in the United States is growing at a modest rate. Predictive modeling is permeating the life insurance space at a similarly modest rate. The eventual marriage of the two seems to be a foregone conclusion. The challenge actuaries are faced with is getting the math right. How, specifically, can we use the predictive modeling score results on a PRT census to adjust our mortality assumptions? That predicament is real, but inertia (i.e., we'll never be able to get our arms around the math) should not be an answer for us.

As life actuaries, we should begin to understand that "the now" can be equally as powerful as "the then." We should embrace the art of the possible and get to work on proving

HOW CAN WE USE THE PREDICTIVE MODELING SCORE RESULTS ON A PRT CENSUS TO ADJUST OUR MORTALITY ASSUMPTIONS?

to ourselves that predictive modeling can help reshape the way we think about mortality and longevity risk. We should welcome the fact that the confluence of skill sets required—pension liability valuation expertise, life insurance annuity valuation expertise and statistical modeling proficiency—is uniquely in our wheelhouse. Let's help our industry evolve. ■

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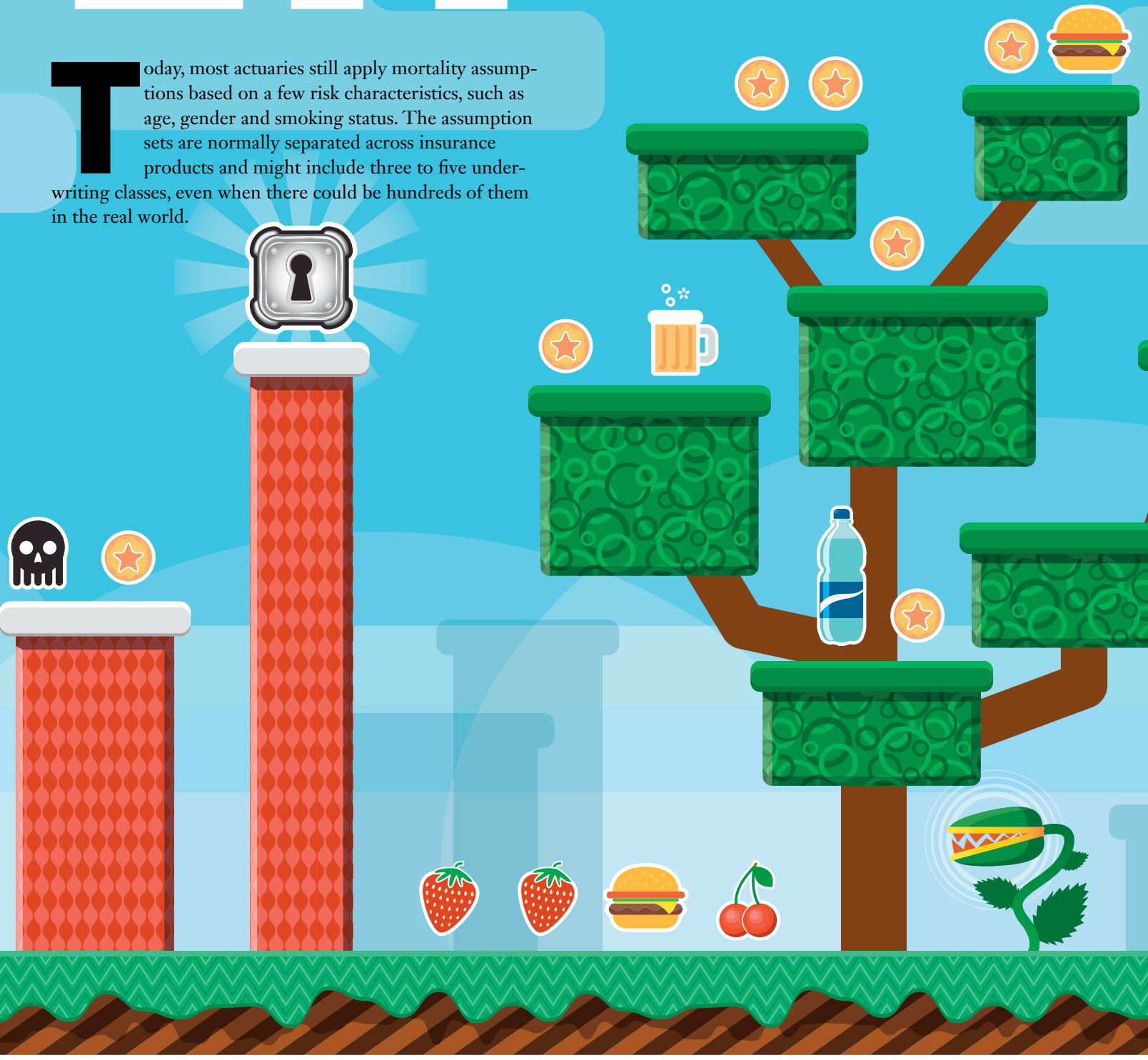
GAME

UTILIZING GAMES TO BETTER UNDERSTAND POLICYHOLDERS IN THE LIFE INSURANCE REALM

BY MICHAEL CHAN, FRED NGAN AND JACK NG

Today, most actuaries still apply mortality assumptions based on a few risk characteristics, such as age, gender and smoking status. The assumption sets are normally separated across insurance products and might include three to five underwriting classes, even when there could be hundreds of them in the real world.



In the future, we can easily picture how the digital footprints we leave online, and those tracked by "smart" devices, can be used to provide more pleasant customer experiences through simpler processes and/or more refined risk-based pricing analyses. We already see signs of these changes: Sun Life Canada loosened its medical underwriting requirements based on results from claims behavior analysis,[1] and Aviva America is experimenting with identifying potential health risks through online purchasing behavior.[2]

The mechanism that will bring about these changes seems clear enough: As finer splits of the data and underlying causes become available and practical,[3] competition will drive market players (whether existing or new) to target more attractive risk groups that previously were overpaying. An example is the pay-per-mile auto insurance model from Metromile. Technological advances and increased acceptance of tracking devices allows for more cost-effective means of tracking car usage, which opened the opportunity to sell to a "new" segment of drivers who were driving far less frequently than others (e.g., weekend drivers) and whose insurance premiums were not reflecting this difference.

While property and casualty insurers are rightly focused on opportunities brought about by smart devices, the question for life insurers then is how such a mechanism would work on the life and health side—will there be any progress made, and who will be pushing things forward along this path? In this article, we introduce some of the initiatives we're trying, and why we think these (seemingly frivolous) attempts might become something meaningful. See **FIGURE 1**.

BACK TO BASICS—FOCUSING ON MORTALITY

Mortality is the most fundamental risk life insurers bear. Life contingencies is often one of the first classes on the actuarial syllabus. The basic life tables we were taught to look up include age, gender and smoking status, in the same way industry tables are split. Yet, we all intuitively know that there are many additional individual factors affecting mortality, and the highly aggregated basis on which we develop and study assumptions is increasingly being challenged.

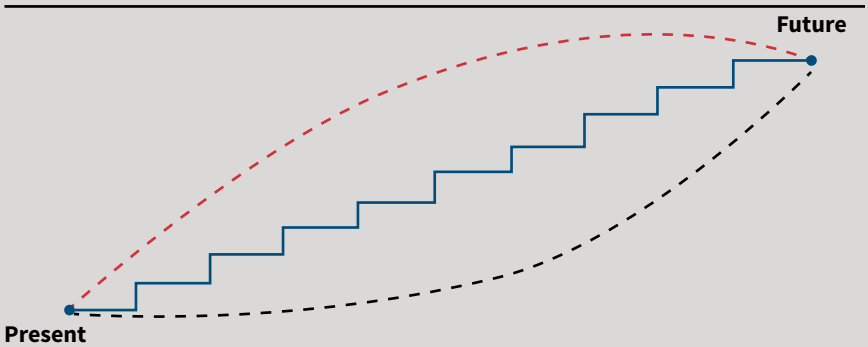
The Lack of Data

It's fair to say that the biggest impediment to more advanced practices being applied is the actuary's lack of access to richer data sets that an insurance company theoretically should have about its policyholders. Mortality research is limited to smaller groups of people within the organization, and they often do not have access to data in underwriting, marketing and customer relationship management (CRM) systems, for example. Furthermore, a lot of data is "stored" with the insurance salesperson, and such information rarely makes its way to the actuary's desk.

Consequently, the actuarial function has a very incomplete view of the individual policyholders. This leads to cross-subsidizations that might not be fair to policyholders—especially the healthy ones—and leaves the insurance pool vulnerable to competitors through price segmentation.

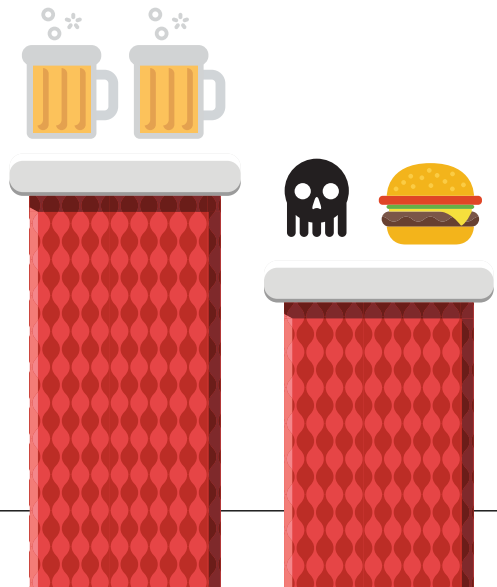
Getting a more complete view of policyholders could lead to significantly different estimates of an individual policyholder's mortality and behaviors. For example, we developed a simple experimental life expectancy calculator

FIGURE 1 **DIFFERENT PATHS TO THE FUTURE**



We have a good guess as to what the future will look like (an increasing number of things tracked and accounted for). The challenge is moving from the current state to such a future state, and finding the path that will get us there.

Individual variations in lifestyle habits and genetics can have a profound impact on individual life expectancies.



based on Hong Kong mortality data (supplemented with medical research from around the world) to estimate the effect different lifestyle and behavioral changes can have on mortality. We estimated that an average 30-year-old nonsmoking man in Hong Kong can expect to live to 88 years (using standard mortality and mortality improvement assumptions), but this expected value could easily vary by +/– 5 to 15 years with relatively small changes in lifestyle habits (e.g., drinking more than two glasses of alcohol a day, increased consumption of red meat without vegetables, getting divorced and so on). See **FIGURE 2**.

This is just another way of stating an all-too-obvious fact that individual variations in lifestyle habits and genetics can have a profound impact on individual life expectancies, and the divergence increases with time after the insurance company first underwrites the policy.

WAYS TO OBTAIN THIS DATA?

An obvious first step is to look for data from within the organization, targeting the data sitting in marketing, underwriting and other databases. Such efforts are well underway across many companies, but the challenges can be formidable given the different systems and data quality issues.

DID YOU KNOW?

Studies of mortality among monks and nuns suggest that gender itself isn't the sole causal driver of morality differences.[4] The gender mortality gap we observe might be influenced more by lifestyle and cultural differences.

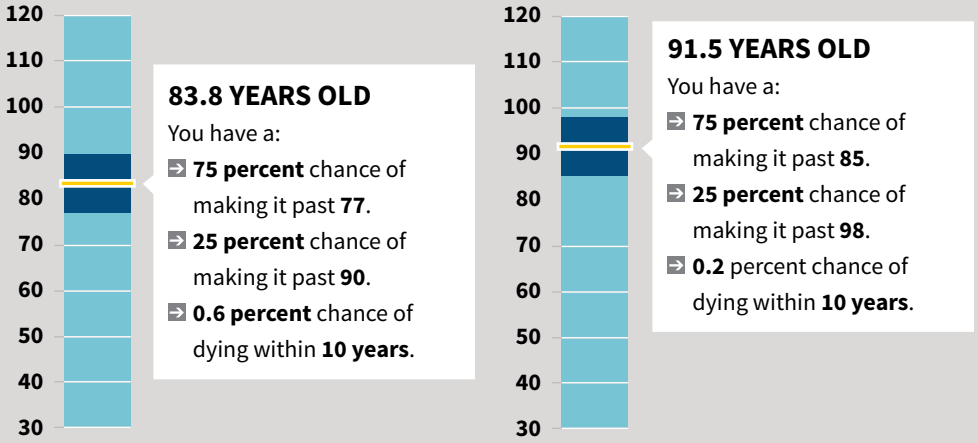
Male and female mortality are affected quite differently by different relationship statuses. One interesting difference is that males generally suffer higher mortality risk than females after getting divorced.[5]

Sexual activity is another factor related to one's mortality risk. While academic research into this area is a bit sparse (we can only guess why), available literature suggests that men with a higher frequency of sexual activity tend to have lower mortality risk,[6] although this reverses for advanced ages, while past enjoyment (rather than frequency) is more predictive for women.[7] These factors could be confounded with health levels, as the two are hard to separate.

FIGURE 2 **VARIATION IN EXPECTED LIFESPAN BASED ON DIFFERENT LIFESTYLE AND SOCIOECONOMIC FACTORS**

Your traditional life expectancy: **87.6 YEARS**

This is the traditional calculation based on your age, gender and smoking status. Our **seasonlab** actuarial team has gone through the latest scientific research and made this more fun for everyone. This is our **Experimental Life Expectancy Calculator**.



Lifestyle and socioeconomic indicators can have a noticeable impact on one's life expectancy. We calculated the "traditional" life expectancy (87.6 years) using standard mortality and mortality improvement assumptions. The "experimental" life expectancies (91.5 years and 83.8 years) tested the effects of different lifestyle and socioeconomic indicators (e.g., drinking habits, marriage status, education level and so on).

Our life expectancy calculator considers factors beyond age, gender and smoking status to give the public a general sense of how different lifestyles might affect their health. The calculations are clearly labeled as experimental and should not be interpreted as definitive estimates of individual life expectancies, but they can be a fun and simple reference.

Source: Hong Kong A01 Mortality Table and Seasonalife Analyse

It's important not to dismiss data outright even if it has some data quality issues. After all, expectations for the necessary data quality vary depending on your intended application. Data that might not be "good enough" for actuarial pricing or valuation might be "good enough" for prototyping pilot projects around inforce management or marketing.

One quick option is to purchase data from vendors that may have collected comprehensive background information on individuals from various sources. Obviously, the data quality, cost and suitability are important considerations when obtaining data in this manner.

Another option is to get data directly from the policyholders. Often, this requires providing some other value to the policyholders in exchange. For example, some insurers have partnered with genetic testing companies and smart device companies to provide additional benefits to their policyholders. Some campaigns under this theme are designed to provide more opportunities for customer engagement, and some might even be considered "marketing gimmicks."

Customer research reveals that many are coming to accept, if not expect, insurance companies to provide more support and interactions beyond the insurance product, extending toward more personalized services. Providing services and advice, such as managing health and personal finances, can help improve customer satisfaction and, just as important, customer retention.[8,9]

SIMPLE GAMES

Simple "games" might be another way for insurance companies to survey their policyholders at little cost. Customers may get defensive when asked about their personal information, such as income level and family medical history. Millennials have much shorter attention spans and have little interest in a lengthy, boring questionnaire, even when it's the necessary path to comprehensive financial planning.

Obviously, any such surveys would need to be carefully positioned to avoid personal data privacy issues. The goal of games like a "life expectancy calculator" or "retirement readiness calculator" is to get a temperature check on the inforce group. When accompanied by other inforce management programs, they could be used as an inexpensive method of tracking changes and the effectiveness of such programs.

Using such data for more "traditional" actuarial activities will be trickier. We expect that calculators with differing levels of granularity will be offered to meet different needs (e.g., advice based on high-level heuristics versus comprehensive recommendations), and these will generate data at corresponding levels of granularity. The target of such games might also vary among population-level groups and policyholders (depending on where such games are offered and to whom they are made available).

While our expectation is that the initial data will be far from being rigorous enough for actuarial pricing or valuation, we do think that both the data quality and quantity will improve over time, and it will be interesting to explore how this new data can be merged with existing data (e.g., with the company's own experience data, as well as those from industry studies). The credibility methods actuaries currently use likely will need to be modified. In particular, we note that these "external sources" of data might be

FIGURE 3 PERSONALIZED RECOMMENDATION OFFERED BASED ON USER'S LIFESTYLE

It is possible to gain 5.2 years of life expectancy if you become a nonsmoker.

It is possible to gain 3.3 years of life expectancy if you become married.

It is possible to gain 2.1 years of life expectancy if you consume 0.5 servings or less of meat and 3 or more bowls of vegetables per day.

These are suggested action items for a 35-year-old smoking male with their potential impacts on the user's expected lifespan. Such impacts vary with the user's other lifestyle and socioeconomic indicators.

more voluminous in quantity, but they are not as directly relevant and are less deserving of high credibility factors.

Regardless of these considerations, the main purpose of these activities is to provide a fun, interactive and gamified experience, where the insurer provides useful information or services to the customer in exchange for data that can be used to help the insurer improve its product and services. This issue is particularly acute as insurance companies have some of the lowest customer engagement scores compared to other industries, including other financial services. Each interaction with a customer is an opportunity to delight or annoy, and currently there are very few opportunities to delight. This is an important issue, as customer engagement and customer satisfaction/loyalty are highly valued.

A possible way to delight customers is to provide more actionable advice about their well-being. Simple calculator recommendations, as shown in **FIGURE 3**, generated positive user feedback and very high engagement rates in the calculator's limited preliminary beta access.

In **FIGURE 4**, consuming one more cup of vegetables (equivalent to about 2 servings) each day could extend life expectancy by nearly two years. (These are indicative estimates—not intended for actuarial pricing!)

To take a step forward, insurers may even provide incentives to encourage users to act. This sets up a continuous interaction model between customers and the insurance company.

To illustrate the potential benefits, **FIGURE 5** shows an illustrative (simulated) change in the mortality distribution if we're able to subtly influence policyholders' lifestyle choices.

FIGURE 4 **POSSIBLE LIFE EXPECTANCY IMPACTS**

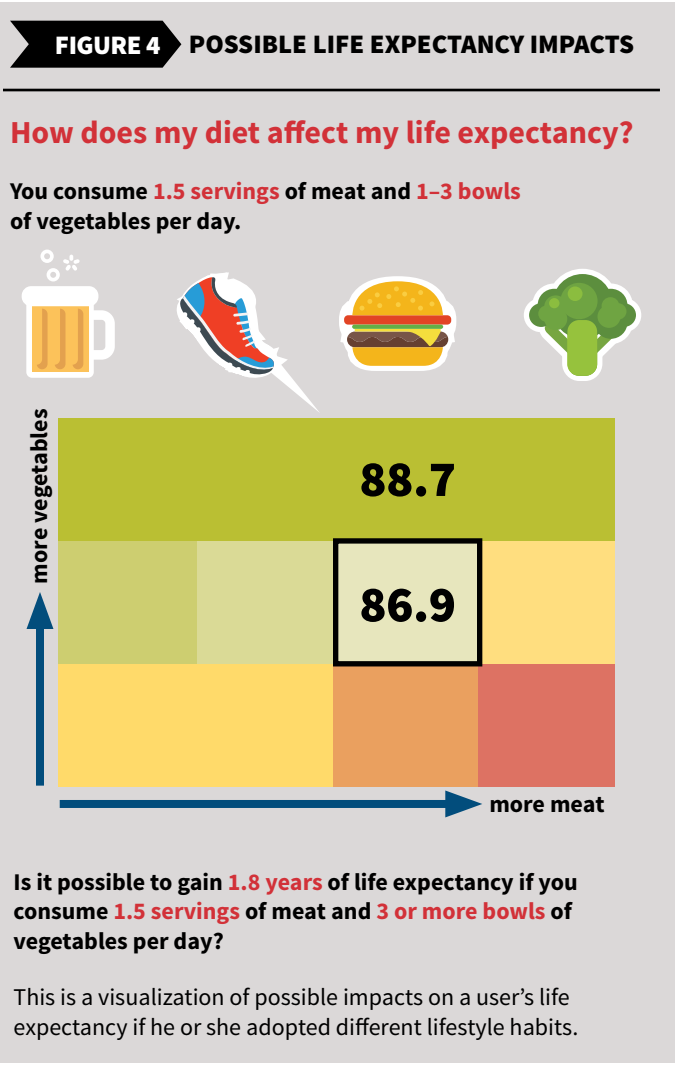
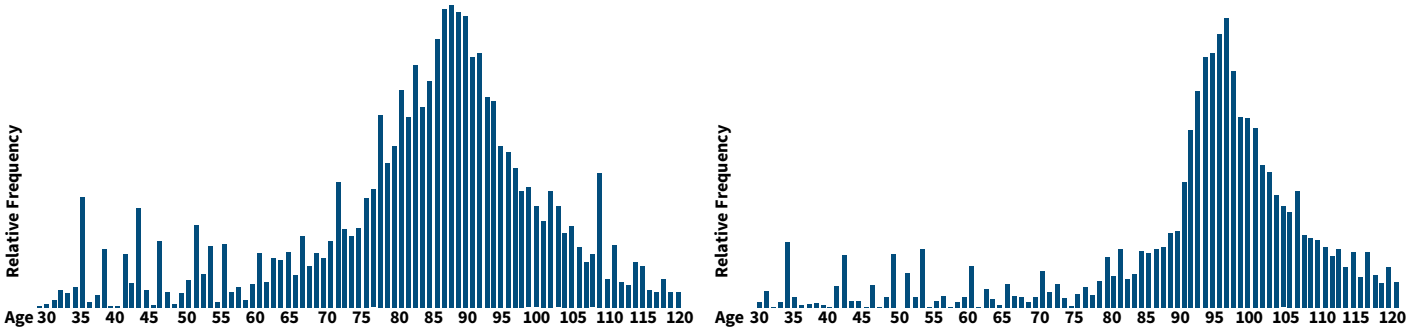


FIGURE 5 **SIMULATED MORTALITY DISTRIBUTIONS BASED ON DIFFERENT LIFESTYLE INDICATORS**



Change in lifestyle creates a noticeable difference in claims experience. The first chart shows a simulated mortality distribution of an average 30-year-old nonsmoking male in Hong Kong following standard mortality and mortality improvement assumptions. The second chart shows a simulated distribution assuming certain changes in lifestyle were made (e.g., better eating and exercising habits).

Source: Hong Kong A01 Mortality Table and Seasonalife Analyse

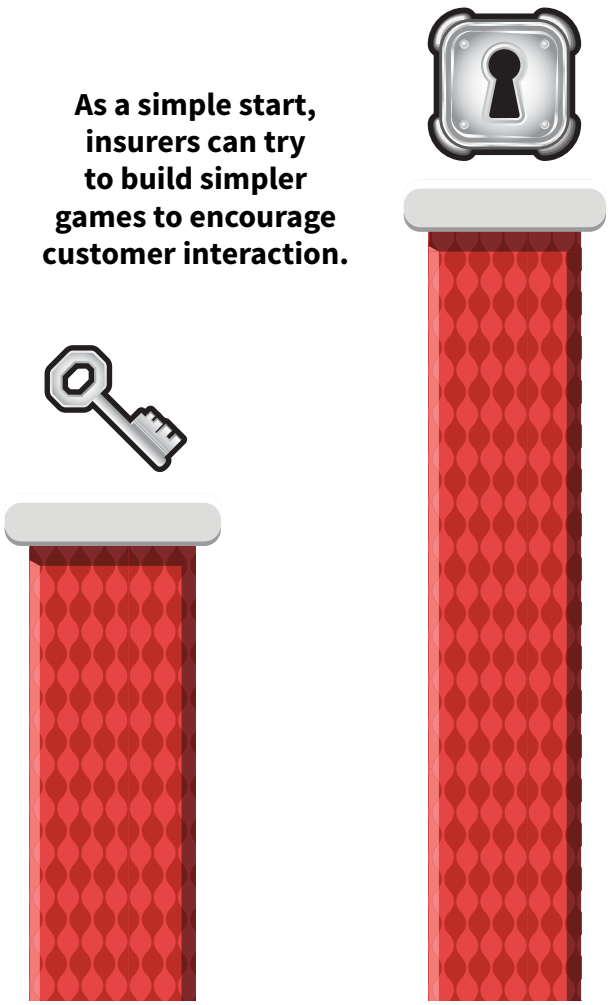
CONCLUSION

Such value-add interactive services should not be merely treated as marketing campaigns. They offer more than branding and loyalty improvements. The value of firsthand data in the digital age cannot be over-emphasized, especially to insurance companies that take long-term liabilities requiring close experience monitoring.

Changing customer engagement and policyholder behaviors can be a very high-leverage activity for insurers. With large inforce blocks, minor improvements to the block can result in material improvements that can support any cost-benefit analysis at the beginning of such projects, but the challenge is often in taking the first steps when any such estimates are simply "expert judgments."

Finally, we emphasize that it is important to avoid creating negative discrimination. The aim of reducing cross-subsidization is to reward those bringing improved experience to the company, but not to penalize other policyholders who may leave feeling discriminated against.

As a simple start, insurers can try to build simpler games to encourage customer interaction.



As a simple start, insurers can try to build simpler games to encourage customer interaction. The data collected may not be rigorous enough for a serious experience study or assumption-setting, but with more of these simple games we are able to obtain more information about other aspects of people's lives, such as lifestyle and preferences that are key parameters in the dynamic modeling of policyholder behaviors for more complex insurance products. Indeed, it's often when actuaries embark on policyholder behavior studies and step back to get a holistic view of the data that they realize how little they know about their policyholders. As data accumulates, we can use it for real analyses like inforce management—and this is when the investment starts to pay off. ■

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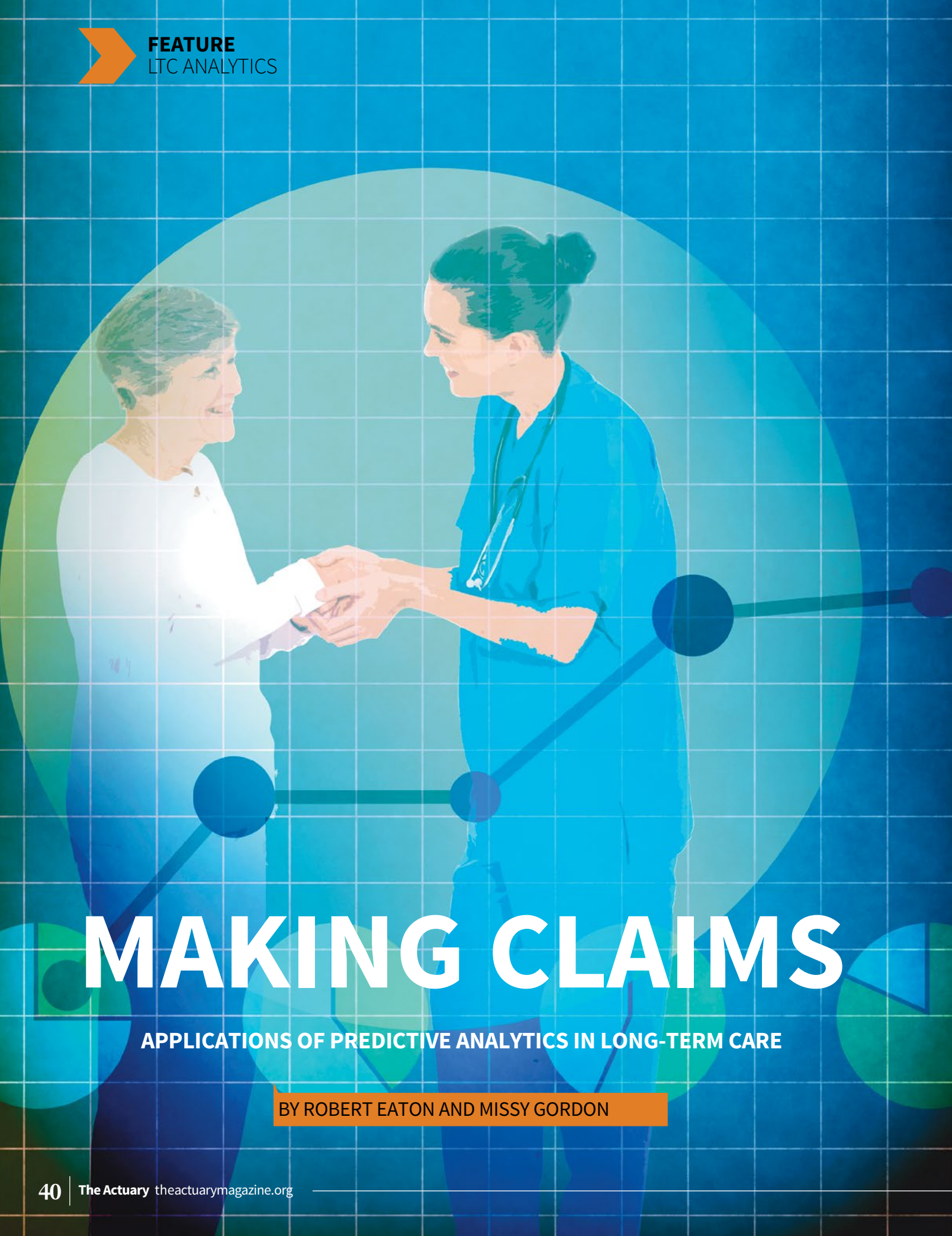

MAKING CLAIMS

APPLICATIONS OF PREDICTIVE ANALYTICS IN LONG-TERM CARE

BY ROBERT EATON AND MISSY GORDON

Predictive analytics has taken far too long in getting its foothold in the long-term care (LTC) insurance space, but it promises to have a lasting impact now that it has arrived. This article explores the current LTC predictive analytics landscape. We examine two case studies demonstrating the use of predictive analytics tools in assumption-setting for LTC claims. Finally, we take to the whiteboard and plot out ways in which predictive analytics may be used in the future.

BACKGROUND

2015 SOA Tables

In July 2015, the Society of Actuaries (SOA) completed its report "Long-Term Care Experience Basic Table Development"[1] (the SOA Tables). The SOA research team used predictive analytics to develop models for claim incidence, claim termination and benefit utilization. The model for LTC incidence and claim termination is a generalized linear model (GLM) using a log-link function and Poisson error structure (for benefit utilization, a Tweedie error structure is used). These types of models generally produce a friendly, multiplicative format that is easy to understand.

2016 Predictive Modeling Workshop

The Intercompany Long-Term Care Insurance (ILTCI) conference is widely attended among LTC actuarial professionals. This makes the conference a natural setting for hosting a workshop on predictive analytics. In March 2016, the researchers who developed the SOA Tables brought their software, models and expertise to San Antonio, Texas, to educate LTC professionals on predictive analytics. The workshop included a course laying out a theoretical framework for predictive analytics followed by a four-hour hands-on predictive modeling workshop. The workshop had attendees partitioning data between the model and validation, selecting and fitting models, interpreting results, validating assumptions and comparing the predictiveness of models.

CASE STUDY NO. 1

Following the workshop, we went in search of our own predictive analytics problems. LTC claim termination assumptions typically are expressed by monthly claim duration. Carriers may assume that monthly claim terminations vary by sex, site of care (i.e., a nursing home, assisted living facility or home care), benefit period (i.e., the number of years the policyholder may claim) and potentially other attributes. The claim termination assumption in an LTC model can be used to calculate an expected length of stay (LOS) on claim.

We wondered if other policyholder attributes may also help to describe the claimant LOS. In particular, would the quality of an LTC facility, or the quality of care provided in the claimant's area, help us in understanding how long an insured would remain on claim?

We began with a data set for one carrier that included the claim LOS, along with relevant policyholder attributes and benefits. In addition to this claim data, we used the ZIP code associated with the insureds' current residences at the time of claim to find both the average income in that ZIP code as well as an area factor from the Milliman Health Cost Guidelines (HCGs). We didn't have provider quality ratings for all of the sites of care used by claimants, but we ventured (and for this analysis, assumed) that the average income by ZIP code and the HCGs area factor might serve as proxies. We also included an area factor-adjusted average income, which may remove some of the distortions from high cost of living areas. This creation of a new variable is a good example of feature engineering—an important step in predictive modeling. Our ultimate goal was to understand which of these variables or features of the policy mattered most in determining the LOS. See **FIGURE 1** for more details on these policy attributes.

FIGURE 1 ATTRIBUTES USED TO ESTIMATE LTC CLAIM TERMINATION AND LENGTH OF STAY

Traditional	All Available
Age at claim	Average income
Benefit period	Average income (area factor adjusted)
Sex	Age at claim
Site of care	Area factor
Tax-qualified status	Benefit period
	Daily benefit amount
	Incurral year
	Inflation type
	Issue age
	Marital status
	Policy duration at claim
	Product generation
	Risk class
	Sex
	Site of care
	Tax-qualified status

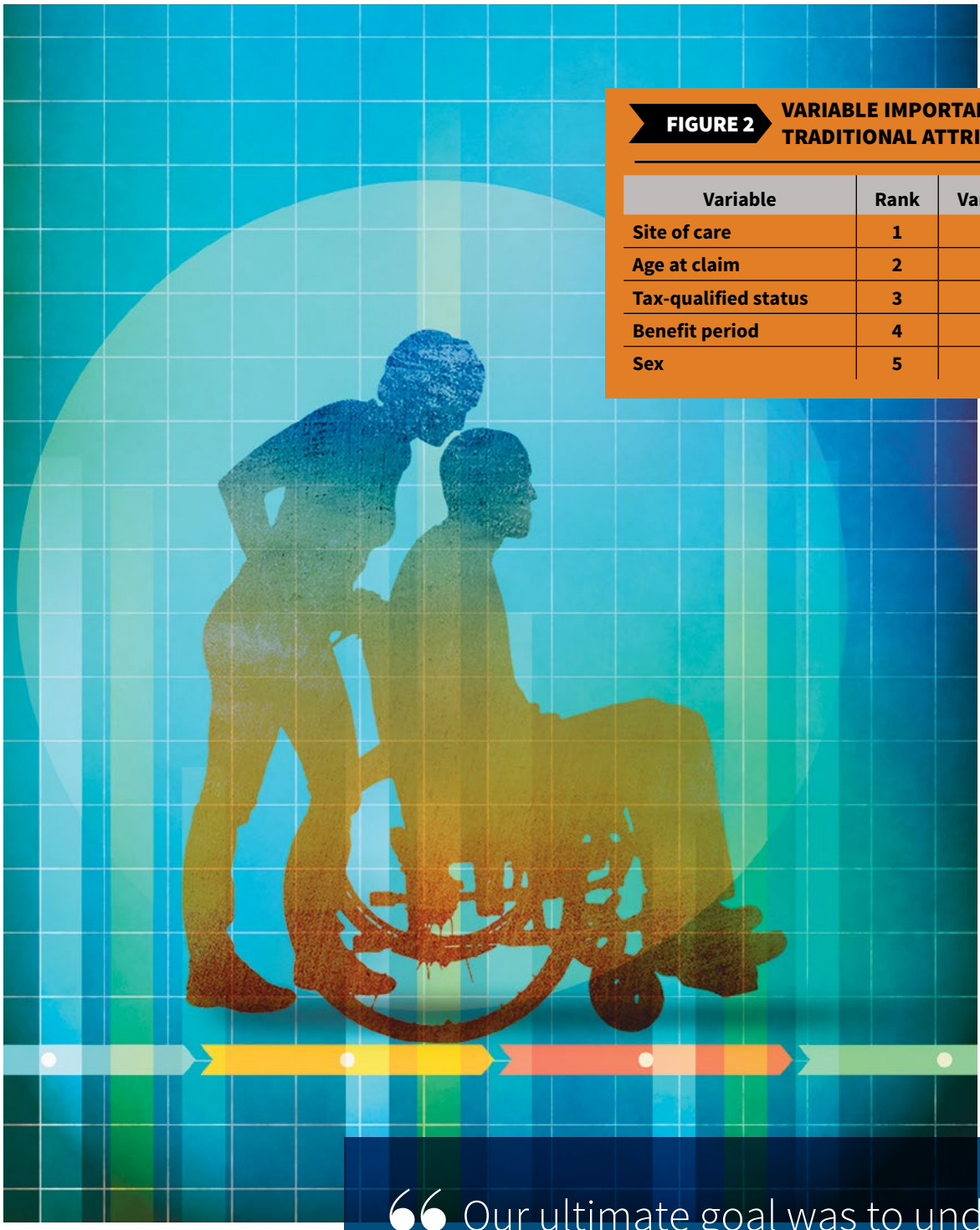

FIGURE 2 VARIABLE IMPORTANCE FOR TRADITIONAL ATTRIBUTES

Variable	Rank	Variable Importance
Site of care	1	52%
Age at claim	2	38%
Tax-qualified status	3	6%
Benefit period	4	2%
Sex	5	2%

> “Our ultimate goal was to understand which of these variables or features of the policy mattered most in determining the length of stay.”

To help estimate LOS, we applied the random forest and variable importance modeling techniques to two sets of variables: traditional descriptors of LTC length of stay, and a collection of all policy attributes we had on hand, whether or not they traditionally are used to model claim terminations and LOS. We chose these predictive analytics techniques because they are robust, handling both quantitative and qualitative variables, and the results are straightforward to apply to future modeling efforts.

The table in **FIGURE 2** shows the rank of variable importance of the five attributes from our initial random forest, where the variable importance measures have been scaled to sum to 100 percent.

It's clear that site of care and age at claim are our most important predictors of LOS for the data in this case study. Our next step was to feed our random forest model each of our 16 prediction variables, to see which variables ranked the most important. The table in **FIGURE 3** shows the results of the variable importance algorithm for all attributes.

The blue-shaded rows show where our initial five predictive variables ranked within the group. Right away, we see that certain variables, such as area factor and the average income in a claimant's area, may have similar predictive power as the age at claim in determining the LOS. Other variables that may be useful in this analysis, which weren't conducive to our data set, include diagnosis and coverage type (e.g., facility-only or comprehensive coverage).

There are many things to note about these results. To the extent that certain variables are correlated (e.g., issue age and age at claim), we should expect similar variable importance. However, this may not imply that we should develop models based on all variables with a high importance measure. The actuary should consider carefully the variable selection task so as to produce a model with meaningful predictors that also can be explained to management. We also should consider whether or not our proxy variables are doing a good job of representing the underlying fundamentals (in this case, estimating provider quality). Furthermore, the actuary also may consider which of the variables ultimately will be useful and available if the intent is to incorporate the assumption into other projection systems and models. Finally, the initial findings from this case study are relative to the data set we used. It's likely that other sets of claim data may produce different drivers of predictiveness for LOS.

A model of LOS that includes new predictors may be used, for example, to analyze claimants currently in the disabled life reserve. The actuary may be interested in understanding the impact of considering provider quality, or (proxy) affluence of a pool of disabled lives. This new view of the predictors of LOS may cause the actuary to consider, for example, high-level adjustments to disabled life reserves, particularly for companies with limited historical claims experience, and/or to revisit the claim termination assumption. The next case study outlines how a company may use predictive analytics to do just that.

CASE STUDY NO. 2

Traditionally, experience studies adjust a starting benchmark, whether it be an industry benchmark or prior assumption, for company-specific or updated data. We wondered if there was a way to use predictive analytics techniques to assist in making these adjustments, and so we researched applying such techniques to industry data.

One key question we had was: How can we incorporate the idea of credibility when using predictive analytics to update this assumption? We tip our cap to Brad Armstrong and Shea Parkes for shining light on a method for doing so in their article "Calibrating Risk Score Model with Partial Credibility," which was published in the SOA's *Forecasting and Futurism* section newsletter.[2] This article presents the

FIGURE 3 VARIABLE IMPORTANCE FOR ALL ATTRIBUTES

Variable	Rank	Variable Importance
Average income	1	15%
Age at claim	2	14%
Issue age	3	13%
Area factor	4	12%
Site of care	5	12%
Average income (area factor adjusted)	6	11%
Incurral year	7	8%
Daily benefit amount	8	4%
Policy duration at claim	9	4%
Inflation type	10	2%
Risk class	11	2%
Tax-qualified status	12	2%
Benefit period	13	<1%
Product generation	14	<1%
Sex	15	<1%
Marital status	16	<1%

idea of recalibrating a risk adjustment model for a company that had a limited amount of data to warrant full recalibration solely based on the company's experience. Their approach to solve the limited data issues was to start with a benchmark model that was developed on a much larger data set. They then made adjustments to that model to better fit the company-specific experience, where adjustments were credible. This was done by using a penalized regression with the benchmark model as an offset in the regression.

A penalized regression is a GLM with an extra constraint that penalizes the coefficients in the model. This penalty can be thought of as a "credibility lever." In this case, a large penalty would give essentially no weight to the company-specific data, leaving the benchmark unchanged. On the opposite side of the scale, a small penalty would give considerably more weight to the company data and potentially produce large adjustments to the benchmark. Hugh Miller discusses more details on this process in an article that shows the equivalence of penalized regression methods and credibility theory.[3]

After finding a way to incorporate credibility, our next step was to determine an approach to do so when developing a claim termination assumption. One common approach is to turn the claim termination assumption-setting process into a survival analysis problem. A nice trick we can perform under this setting is to use a GLM with a log-link and Poisson error structure to approximate the Cox proportional hazard rate model.[4] Doing so allows for two important things. First, it allows us to incorporate an offset into the model, which serves as our benchmark starting assumption. Second, the nature of the Poisson assumption allows us to aggregate our data to the level of unique covariates in the model, which decreases the runtime to fit a model. The resulting coefficients from the model are then multiplicative adjustments that are applied to the benchmark rates.

We have been using this modeling framework (with the addition of penalization) in our research, and it has proven to be fruitful by producing reasonable and intuitive results. Our major takeaway is that the penalized regression technique is a useful tool that we encourage actuaries to add to their toolboxes. Incorporating the use of a benchmark as an offset in the penalized regression is a great approach to use in experience studies. It provides a robust way to give weight to experience compared to some other methods of applying credibility theory when updating an existing assumption. Giving the "right" amount of weight to the experience is important in producing an assumption that is reflective of the most recent experience, while not overreacting to new data. This helps to avoid significant variation and generally applies well to other uses.

Additionally, we have found that by using predictive modeling techniques, we are able to update existing assumptions based on statistical concepts using an automated process. This leads to a robust and more transparent, reproducible process. Predictive modeling techniques also allow us to add new variables that we have not been able to use in the past, while simultaneously creating the adjustments. This in turn normalizes the effects of the other covariates, giving us a better understanding of the true relationships that drive the underlying experience. Predictive analytics is a powerful tool that requires

> "Predictive analytics is a powerful tool that requires great responsibility. We encourage actuaries to explore the application of predictive analytics, but to do so with the guidance of an experienced practitioner."

great responsibility. We encourage actuaries to explore the application of predictive analytics, but to do so with the guidance of an experienced practitioner.

While our research involved industry data, we expect this modeling framework to be useful to a smaller data set as well, such as a company updating its assumptions. As a next step, we are performing a case study that compares and contrasts the development of a claim termination assumption for one company using traditional methods versus predictive analytics. We will explore the business case for this change in methodology and examine the impact of using predictive analytics. Full results from our case study will be published in early 2017.

PREDICTIVE ANALYTICS SUPPORTING LONG-TERM SERVICES IN THE FUTURE

Predictive analytics has the potential to reach beyond supporting today's actuarial conundrums. The future of the provision and financing of long-term services and support (LTSS) is evolving. Many states are looking to the decades ahead, and they perceive the heavy burden of Medicaid LTSS funding. They are looking for solutions from today's LTC professionals.

In response to that, and as part of a broader national dialogue on LTC, the SOA has sponsored the LTC Think Tank. The LTC Think Tank aims to provide new ideas[5] to help people pay for long-term care, make care more accessible, reduce the cost of care and mitigate the need for care to start with. Two of the key ideas stemming from the LTC Think Tank are a Healthy Longevity App and an online Care Portal. Another idea in the area of care delivery is the "Uberification" of LTC services—in particular, home care services.

Each of these concepts lends itself to the adoption of predictive analytic techniques: to optimize recommendations from the Healthy Longevity App, to push salient recommendations to the front of the Care Portal, to anticipate when people may need certain home care services and more. Predictive analytics has a long and healthy future in the LTC space, and actuaries will be on the forefront of these advancements. ■

2017 PREDICTIVE MODELING WORKSHOP

The Intercompany Long-Term Care Insurance (ILTCI) conference in 2017 will host the next LTC Predictive Modeling Workshop in March in Jacksonville, Florida. This year, the workshop will last an entire day following the ILTCI conference. The workshop will be taught in R, which has the advantage of allowing attendees to return home and use the software on their own machines.

The Predictive Modeling Workshop will walk attendees through data cleaning and exploration. The workshop leaders will cover generalized linear modeling (GLM) functionality in R. The group will examine the bias versus variance trade-off, and move on to penalized regressions. The group will conclude with examples of penalized GLM and briefly discuss some advanced techniques, such as gradient boosting machine (GBM), generalized additive modeling (GAM) and clustering. Visit the workshop webpage to see if there are spots remaining and to find a list of predictive analytics resources: **iltciconf.org/predictivemodeling.htm**.

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Q&A

THE VISIONARY

Q&A WITH WORKFORCE ANALYTICS MANAGER STEVE FREDLUND

Q: How are you using predictive analytics in your position as workforce analytics manager?

A: In January 2016, Allianz Life brought me into the human resources (HR) group to start building our analytics capability. Prior to then, we were focused on reporting and data gathering with limited use of analytics to drive business decisions from a people perspective. In our first year, we have not only begun building the infrastructure necessary for an analytics capability, but we have been involved in a few analytics projects already. There is a significant leap from descriptive to predictive analytics, but we have started to make that leap. One specific example is identifying indicators of individual success (both performance and retention) in one key area of the company, and then translating those indicators to enhance the candidate profile used during the recruiting and hiring process.

Steve Fredlund, FSA, FLMI, MAAA, MBA, SWP, is workforce analytics manager at Allianz Life.

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Q: What kinds of problems are you solving using data analytics? How is this different from the issues you would address in the role of a more traditional actuary?

A: In addition to enhancing candidate profiles, we are using analytics for projects related to diversity (gender and ethnicity), performance ratings, turnover and organizational expertise. You will get different answers when you refer to "traditional actuarial" roles, since solving problems can be very different in product development, product management, valuation, reporting, profitability management and other areas considered to be traditional.

While blanket statements are difficult, in general, when we consider actuarial problems, there tends to be more of an emphasis on the "right" answer—or at least a "right" answer given an agreed-upon set of assumptions. When dealing with workforce analytics, it can often get a bit messier, as there can be far more factors, several of which are based on nonrational behavioral (unconscious bias, for example).

With that said, however, there are techniques that are consistent. Consider projecting future lapse rates on an annuity for the purposes of an economic valuation: You would make some assumption as to the relationship between lapse rates and the broader economic trends (such as interest rates). In the same way, when predicting future turnover, you would build in a relationship between turnover and the broader economic trends (such as unemployment).

Q: What professions did you consider before you decided to become an actuary?

A: Upon entering college, I only knew I wanted to do something in math or statistics, with the default to potentially teach high school. Frankly, I had never heard of actuarial science until my adviser made me aware my freshman year.

Q: What about your job brings you the most satisfaction?

A: I have much more exposure to the broader organization, which helps me understand how the overall vision and strategies are pursued at an organizational level. Further, being new to HR, I am gaining a much better understanding of people strategy and what happens behind the curtain. After nearly 25 years on the business side, I did not have an appreciation for what it takes to run an effective HR function. I have also enjoyed more team camaraderie and chemistry being a part of the HR function. While I am still an analytic and enjoy my individual spreadsheet time, I also enjoy being part of a group that values the interpersonal relationship side of our lives.

Q: What skills positioned you for work in predictive analytics?

A: I have a degree in math and have spent the majority of my professional career as an actuary. I also have been heavily involved in capital market hedging on two occasions: once building a program from scratch and more recently leading the variable annuity daily production efforts for a hedge program here at Allianz Life. Not only have these experiences built the technical skills used in predictive analytics, but I have been surrounded by brilliant people and have absorbed so much in how they approach thinking about problems and digging for answers.

The analytical skills are often where people focus when considering who would make effective analysts in this area. However, while you need a full dose of analytics, it is very easy to overlook the importance of the softer skills—the ability to cast a clear and compelling vision, develop and communicate effective strategies, collaborate and build trust, manage the processes, understand the big picture of both the problem and results, and clearly communicate the findings at the right level to the right audience. My background with several entrepreneurial endeavors (both inside and outside of the corporate world) has been huge in positioning me for success in this field.

Q: What is the most successful and efficient way to see a project to completion?

A: Vision, vision, vision. If you know me at all, my answer to just about every question involves some mention of vision. I have become less engaged with plans that fully detail every step that will lead to the end of a project; that can be time consuming, frustrating and often leads to missing some key insights. I would much rather take the time to understand the clear vision and keep asking the question, "What are the next steps to stay aligned to that vision?" This is a good way to mess with the minds of analytics, but my experience has found this to be a much more effective approach to managing a project.

JOEL MAISONET

Q: How did you learn the tools and techniques of modeling? What sparked your interest in this area?

A: Throughout my years in actuarial and hedging, I was exposed to several different models. I have always appreciated the power of technology to process vast amounts of data, analyze impacts over time and return results that can powerfully drive business decisions.

Q: What skills do you think actuaries bring to analytics that other professionals may not bring to the role?

A: Beyond the pure analytical, statistical and technical experience, most actuaries generally have a future perspective, thinking in terms of “what could happen” rather than “what happened.” While both perspectives are important, the world of predictive analytics requires a perspective that is always looking to the future.

Q: What has been the most exciting project you have worked on during your career and why?

A: Wow, that’s a loaded question! I have been extremely lucky to be on a number of great projects. One of my favorites was developing a retirement income optimizer that resulted in me being a co-holder of a patent. This project leveraged all of my experiences and skills, including analytics, psychology, collaboration, leadership, product, legal, systems, communication and so on. There was a wonderful group of people involved who worked extremely well together to develop this industry-leading approach that is still in action today.

Q: How do you see the role of predictive analytics in the next five to 10 years? Where will actuaries fit into the equation?

A: Predictive analytics is here to stay, although it will undoubtedly morph over the years. Specifically within HR, where I am working, I expect this to become a core competency as C-level executives continue to see the return on investment (ROI) impact from predictive analytics. This is a phenomenal opportunity for actuaries who tend to be interested in the nontraditional route with skills in communication, vision and collaboration. I would expect actuaries who move into leadership roles within HR analytics to become strong influencers not only in HR, but also throughout the organization.

The one difficulty will be in helping HR leadership, and potentially other leaders, get comfortable with the skill sets these actuaries have and the market pay that typically

accompanies them. The actuaries making this transition will somehow need to figure out how to communicate their value.

Q: What advice do you have for people who may be interested in positions in predictive analytics?

A: I can only speak from the HR/workforce analytics perspective. This is a pretty huge career change to move directly from one to the other. I would strongly recommend getting involved in a project that is happening now. In most cases, there may not be an active analytics group or an obvious project to get involved with. I would recommend that the interested actuary set up time to chat with the existing analytics team or HR leadership to talk about his or her interest and the potential value he or she could add. I would go so far as to think about an area where deeper analysis could have a huge value and volunteer to provide some analysis. Through that process, the actuary would get a feel for the work and also start understanding how the culture and collaboration may differ from what he or she has experienced. It would be a good initial test of fit.

Q: What is the most challenging aspect of your work?

A: I would be surprised if any analytics person wouldn't say, "data." We are doing a ton of work to consolidate and improve the quality of our data so we can increase the impact of our reporting and analytics output. In many companies, HR data has been viewed as a necessary part of the process without the rigor of understanding the potential impact of incorrect or inconsistent data—and without the perspective that good, complete data has the potential to be an extremely valuable asset. So we are working through these issues now as we work to build out a warehouse that will give us immediate, consolidated data from sources that include HR systems, other internal systems and external feeds.

Q: Can you tell our readership something they may not know about predictive analytics, such as possible opportunities for actuaries in this arena?

A: I expect predictive analytics to embed itself in all major technical, social and societal issues—everything from car insurance to security to nonprofit work. So the question may not be how to get into analytics, but how to incorporate analytics into whatever you decide to do. Being aware of what is happening will position you well to increase the value you add to your organization.

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

A: I generally have taken a more nontraditional route, which has resulted in a number of cool opportunities. I tend to be a career risk-taker, moving into roles that I find interesting and think will be a great fit. I have had a chance to be involved in capital market hedging, asset liability management, building a retirement strategy, profitability management and product development. The credibility you get from being an actuary (deserved or not) has definitely opened up many other doors for me. I have been pursued to be on project teams, nonprofit boards of directors, speaking opportunities and several other cool opportunities, both personally and professionally. Becoming an actuary can be difficult—especially when you go through exams with newborn twins and three kids under age 5 like I did—but being an actuary has been a wonderful experience that has opened numerous doors for me.

Q: How do you measure success?

A: As I mentioned earlier, I am a "vision guy"—success is lined up with how well you are achieving your vision. In my career, I would measure my success as my contribution to helping my organization, department or team accomplish its vision. If I am measuring my success more broadly, I need to consider my personal vision, which is "to have transformational impact." As I consider my career and life outside of my career, I measure my success by how much of an impact I am having in transforming things in a positive way. While money, recognition and power are nice, they have nothing to do with my measure of success. What I measure is how many of the world's poor have access to clean water because of my involvement. Are people's lives better for having a relationship with me? Have I been able to bring unity into an otherwise divisive situation? Has my employment done more than just fill a seat? Has the company realized the full value of its investment because processes or perspectives have improved? ■

toolbox

EXPLORE EVERY AVENUE

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

ONLINE

SOA EXPLORER
Jobs, Internships and More

New features to SOA Explorer include a more mobile-friendly platform, an easier way to find jobs and internships around the world, and much more. Start exploring now.
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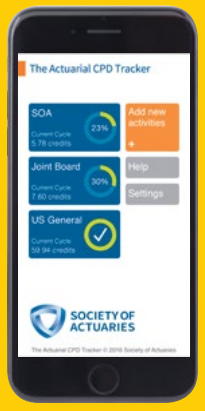
APP



CPD TRACKER
Now on Android

The SOA CPD Tracker is now available on Android to manage your Continuing Professional Development (CPD). You can easily download the app for your Android device.

The tool is also available for iOS devices and by web browser. Here are other new features to make tracking your CPD credits easier than ever:

- Entered activities may be applied to past or future cycles (activities are subject to individual CPD requirement limitations).
- There is a new visual completion gauge so you can see your tracked progress toward fulfilling CPD requirements.
- There is a new button to get more information on requirements of the five reporting standards.
- The tool's home screen is now driven by CPD reporting cycles, so it is easy to find information.

bit.ly/CPDTracker

PODCAST

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Section-sponsored podcasts go where you go. Learn about topics outside of your specialty area. Check out these recent additions, which are accessible for free.

Ensemble Predictive Modeling
This discussion explores what types of ensembles are common and some of the theory that explains their surprising power. Understanding some of this theory can help you identify problems or individual models that might benefit most from ensembling.

Decision Trees
Decision trees are an important class of predictive models that are not often covered in traditional statistics classes. Although it is becoming rarer to use a single decision tree, they are an important building block in at least two of the most prevalent ensemble learning methods in use today.

Penalized Regression
Penalized regression can be thought of as the result of applying actuarial credibility to linear modeling. The statistical theory behind it and the practical reasons an actuary might apply it are discussed.

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PUT TO THE TEST

ASSESSING PREDICTIVE ANALYTICS SKILLS IN THE NEW ASA CURRICULUM

BY STUART KLUGMAN

By now you know that starting July 1, 2018, the Society of Actuaries (SOA) will be adding a significant amount of predictive analytics material to the requirements for Associateship. Committees are at work defining the learning objectives and readings, which should be set by July 1, 2017. Key to this introduction is the development of an assessment that will test a candidate's ability to construct a model, evaluate it and then communicate how that work provides an answer to a business problem.

While many details of the logistics of the assessment remain to be determined, past SOA assessments provide guidance as to how this may be done. In this article, I review those past assessments and provide an indication of how they likely will be adapted to the new predictive analytics exam.

INTENSIVE SEMINAR ASSESSMENTS

As part of the Flexible Education System and Future Education Methods introduced in the 1980s, the SOA introduced two intensive seminars. One was Course 121, Intensive Seminar on Applied Statistical Methods. This seminar was built on the theory of regression and time series, as presented in the Course 120 exam on these subjects. Part of each candidate's assessment was a project report.

The instructions for this project say: "The analysis will consist of creating one or several explanatory statistical models and using this framework to interpret the data. … The final report is to be geared to a sophisticated client with a limited to moderate amount of statistical expertise."

For example, one project asked candidates to use a model to report on the determinants of total cost per hospital admission for a group of insured patients.

COURSE 7 IN APPLIED MODELING ASSESSMENT

From 2000–2007, a fellowship requirement was the Course 7 Seminar in Applied Modeling. As with Course 121, several days of instruction were followed by a project and a report. The focus was more on the modeling process than on a particular technique. One specific project asked candidates to build a regression model to understand the drivers of lapsation. Once again, communication is important.

The instructions of this assessment say: "An important thing to keep in mind as you produce the final report is to write for your audience (the CFO). … His background is in accounting, so he is technical but doesn't have an actuarial background. Also, he has been in management for a while so he is looking to hear from you just what he needs to know."

APPLICATIONS OF STATISTICAL TECHNIQUES MODULE

Introduced in 2013, this e-Learning module is a requirement for candidates on the General Insurance track. The focus is on the generalized linear model (though other techniques are also covered), with particular emphasis on its use in classification ratemaking and measuring reserve variability. As with all SOA e-Learning modules, candidates work remotely. Instruction is provided in the R programming environment, and the project requires a data set to be analyzed using R commands. The project is completed offline with the report uploaded for grading. As with the previous assessments, communication is important. For one of the tasks, the instructions inform candidates that their "memo is to be written to Kevin, an experienced statistician. … Given Kevin's background, this memo can use statistical terms without explanation, but still must provide convincing evidence that you have the best model from the available data."

ASSESSING PREDICTIVE ANALYTICS IN 2018

Starting in the fall of 2018, candidates will be required to pass a predictive analytics exam. As was the case with the previously described courses, the most effective way to assess a candidate's ability is with a project. Each of the three previous project-based assessments had a weakness that will need to be overcome.

Intensive Seminar 121 was available for elective credit. As such, a limited number of seats were made available each year. This limitation made it possible to offer the seminar at a few universities. Computer labs were available with the necessary software loaded (Minitab, in this case). The proctors were the instructors for the course, so expert assistance was available.

Course 7 was a requirement. At maturity, 160 candidates attended a given session, usually at a hotel ballroom. Candidates brought their own computers, with Microsoft Excel being the only analytics software required. Candidates were allowed to leave the ballroom and work elsewhere (on an honor system without help). Again, the proctors were also the instructors, and thus appropriate help was available.

The Applications of Statistical Techniques project is done as a take-home test. This absence of proctoring is deemed appropriate for fellowship modules but may not be for other assessments.

For the new predictive analytics assessment, some of these problems persist. The large number of candidates means it is likely that a large space, such as a hotel ballroom, will be required. However, the SOA Board has asked that this assessment be fully proctored, so candidates will need to stay in the room. They likely will be required to bring their own computers. This leads to three challenges.

1. Ensuring the proper software is loaded and ready to run. The current thinking is that R, Microsoft Word and maybe Microsoft Excel will need to be available. Possibly, a PDF version of the required text and/or help files also will be available.
2. Ensuring other uses of the computer are blocked. This would include access to the internet or any files or programs beyond those in the first challenge.
3. Proctors may not be knowledgeable in the subject matter.

The first two challenges will require special blocking software to be installed on each computer. The SOA is working to find a vendor with a system that meets our needs. Candidates will need to have prepared their computers in advance, and some basic troubleshooting tools and knowledge should be available on-site. For the third challenge, it will be necessary to ensure that proctors are appropriately trained and candidates be made aware that limited assistance will be available.

As with Course 7, many candidates will need to travel a greater distance to an exam center than for a typical SOA exam. While this assessment is at the Associate of the Society of Actuaries (ASA) level, it is expected that most candidates will take it late in their pathway and thus be more likely to have the resources to cover any additional costs this extra travel may incur.

We are excited about this new development in actuarial education. Look for announcements regarding more details of this assessment in mid-2017. ■

VISIT SOA.org

Questions about the new predictive analytics assessment or other aspects of the SOA's education system can be sent to **education@soa.org**.

Stuart Klugman, FSA, CERA, is senior staff fellow, Education, at the Society of Actuaries.

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findings

ASSESSMENT FEEDBACK

The Society of Actuaries (SOA) has received the following feedback from candidates regarding its assessments.

"The module's hands-on practice using R gave me a superior understanding of the internal processes that insurers undergo as they develop a model to submit for regulatory review."

"The Applications of Statistical Techniques (AST) Module provided good knowledge of advanced business analytics techniques with particular emphasis on practical application and the use of R software."

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UNDERSTANDING

How many years are humans expected to live in the future, and what is the anticipated limit? What is driving the overall changes in mortality improvement? How are older generations potentially changing the concept of retirement? These questions were part of the larger discussion around aging and human mortality at the recent 2017 Living to 100 Symposium in Orlando, Florida.

This global symposium is quite unique since it brings together gerontologists, actuaries, academics, and other researchers and business professionals in the same room to discuss longevity. The symposium had several recurring themes, including the differences in mortality across the world, challenges with illness and finance for the aging workforce/population, and how community and social connections have a positive impact for the elderly.

Additionally, keynote speaker Nir Barzilai, professor of Medicine and Genetics at the Albert Einstein College of Medicine and director of the Institute for Aging Research, spoke about what drives centenarians and how the drug Metformin may be able to address the aging process. This insightful talk focused on feeling young despite older age, with an emphasis on prevention of diseases for those at an older age.

Biochemist Judith Campisi, another keynote speaker, presented on age

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LONGEVITY

BY R. DALE HALL

suppression and extending longevity. Her discussion focused on why age is the largest single risk factor for developing a variety of diseases. For more details on her presentation, read the *Sarasota Herald Tribune* article, "While Awaiting Miracle Drugs, Eat Your Veggies." *Marketwatch's* article, "How to Fund a Long Retirement," provides a recap of presenter Vickie Bajtelsmit's session on the impact of the connection between lifespan and wealth.

We also discussed the impact of technology, both from a medical and financial perspective, including the gig economy and its potential for the semi-retired. A monograph of the symposium will be published later this year. For more updates, visit ***Livingto100.SOA.org***.

Looking to the future, the Society of Actuaries (SOA) continues to develop research on longevity and mortality topics as part of the SOA's 2017–2021 strategic plan. We are focusing on several key research topics, and, obviously, longevity factors into this strategic program.

Also, don't forget, the SOA published the MP-2016 mortality improvement scale this past October. Access the scale and other recent experience studies on our mortality research area of the website: ***bit.ly/SOA-MP-2016-update***.

We encourage you to visit ***SOA.org*** for more research on longevity and mortality. ■

RELATED LINKS

Human Mortality Database
mortality.org

Living to 100
Livingto100.SOA.org

Actuaries Longevity Illustrator
longevityillustrator.org

While Awaiting Miracle Drugs, Eat Your Veggies
bit.ly/NewWrinkles

Marketwatch Article
bit.ly/RetireLong

VISIT SOA.org

Visit **SOA.org/Research** for the latest updates on new research opportunities, data requests, experience studies and completed research projects.

action

GOOD RESEARCH READS

DATA VISUALIZATION

The Society of Actuaries (SOA) has released a collection of papers designed to encourage new ways to communicate actuarial work through data visualization techniques. The papers examine data visualization concepts to be used in a number of business sectors, from health care and pensions to predictive analytics and financial services.
bit.ly/SOA_DataVisualization

CHALLENGES AND OPPORTUNITIES OF LONGEVITY

The SOA worked with Ernst and Young to conduct a literature review on longevity topics, from analytics to the social and economic implications of an aging population.
bit.ly/EY-SOA

PBA IMPLEMENTATION GUIDE

The SOA released a research report to provide a better understanding of the key considerations an insurer would encounter in working with a principle-based framework for determining reserves and risk-based capital (PBA).
bit.ly/SOA-PBA

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3. Expand your network base.
4. Make meaningful contributions to your company, your team and the profession.

MEETINGS

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April 20–21
New Orleans
This premier global conference supports the Society of Actuaries (SOA) and Casualty Actuarial Society's (CAS) development of professionalism in this emerging discipline. The conference will include:

- Sessions featuring top risk management experts.
- Networking opportunities to renew and expand your ERM contacts.
- Sessions covering ERM research from leading universities.

ERMSymposium.org

Visit **SOA.org/calendar** for the full complement of professional development opportunities.

Life Insurance Conference
April 24–26
Orlando, Florida
Jointly hosted by the American Council of Life Insurers (ACLI), LIMRA, LOMA and the SOA, this is your opportunity to join the crucial dialogue about future regulatory challenges and the opportunities that will help you stay ahead of evolving requirements and trends.
bit.ly/SOA2017LIC

Retirement Industry Conference
April 26–28
Orlando, Florida
The LIMRA LOMA Secure Retirement Institute and the SOA deliver highly relevant content at this premier industry event, which covers the latest strategic, sales, product, operations and administration, marketing and distribution trends as well as regulatory issues.
bit.ly/SOA2017RIC

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CAS

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SOCIETY OF ACTUARIES

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