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SECTION

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Health Watch

Letter from the Editor

By Valerie Nelson

Hello again!

We've had a successful year of *Health Watch* publications, and I want to say THANK YOU to all the contributors and behind-the-scene staff at the Society of Actuaries (SOA) for helping make this publication happen.

This issue will feature some exciting topics. First up is an article on critical illness products and pricing from Rex Durington.

Dale Cap, Chris Coulter and Kevin McCoy offer some suggestions on how to minimize bias when setting reserves.

In April 2015, the research arm of the SOA published a set of papers on predictive analytics; these techniques can be used in practice. Reprinted in this publication is a paper written by Sheamus Kee Parkes titled "Producing Actionable Insights from Predictive Models Built Upon Condensed Electronic Medical Records."

For the recurring series "Examining the Evidence," Tia Goss Sawhney and Bruce Pyenson offer another great read titled "Blood, Guts, ASOPs and Delivery System Reform." Hopefully the title alone has piqued your interest!

One last item of note—we will be having a new recurring section titled "5 Numbers." These are five numbers, published in other material, that health actuaries may find fascinating, knowing the information is available, and worth talking about. Citations are included.

As always, there are many articles of interest to check out in the *North American Actuarial Journal*. Volume 19, Issues 2 and 3 are now available. ∎

5 NUMBERS

1. Risk corridor program payout for 2014 benefit year: 12.6%

2. Utah hospital estimate of emergency room costs per minute: $0.82

3. Annual incremental costs of morbid obesity in a group health plan: $5,467 to $5,530

4. Expected annual cost of new specialty cholesterol drugs (PCSK9 inhibitors): $7,000 to $12,000

5. Expected number of individuals with dementia worldwide in 2030: 65.7 million

[1] *https://www.cms.gov/Newsroom/MediaReleaseDatabase/Fact-sheets/2015-Fact-sheets-items/2015-10-1.html.*

[2] *http://www.nytimes.com/2015/09/08/health/what-are-a-hospitals-costs-utah-system-is-trying-to-learn.html?_r=0.*

[3] *http://www.ncbi.nlm.nih.gov/pubmed/22361992.*

[4] *http://healthaffairs.org/blog/2015/02/17/in-the-debate-about-cost-and-efficacy-pcsk9-inhibitors-may-be-the-biggest-challenge-yet/.*

[5] *http://www.ncbi.nlm.nih.gov/pubmed/23305823.*

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Critical Illness Pricing Overview— 2015 Update

By Rex Durington

> CI may be seen as a simple and affordable solution to the primary health risk most consumers recognize and fear—the financial hardship of a catastrophic or critical illness/accident.

"The prime goal is to alleviate suffering, and not to prolong life. And if your treatment does not alleviate suffering, but only prolongs life, that treatment should be stopped."—Dr. Christiaan Barnard

"It's paradoxical that the idea of living a long life appeals to everyone, but the idea of getting old doesn't appeal to anyone."—Andy Rooney

As a product of our research and client work on critical illness (CI) coverage, Hause Actuarial Solutions (Hause) found that there is a dearth of published material on product design and pricing for this market. There was a flurry of activity in the late '90s and early 2000s but not much of late. The state of the market is that there are as many product designs as there are carriers and a wide disparity in premium rates for roughly the same benefits. This article attempts to condense our thoughts and observations on the state of the market and the art of CI product design and pricing.

CI insurance was created by Dr. Marius Barnard, brother of Dr. Christiaan Barnard, in 1983. I won't go into the historical detail since there is sufficient literature on this topic other than to point out that the product has had a longer run and achieved a greater popularity in other countries.

That being said, Hause has noticed a significant increase in interest from providers and consumers for CI coverage in the United States over the last few years. For the interested reader, sources such as Gen Re, LIMRA and CSG Actuarial have kept score on this rapid rise in coverage and carriers.

THE MARKET

The marketplace for CI is principally made up of group, individual and worksite/voluntary products. CI is also offered as an accelerated benefit rider on a life policy or as an additional benefit rider usually attached to a term insurance policy or combined with other health coverage.

Group and worksite offerings require the additional complexity of setting guaranteed issue limits, rate guarantees, participation levels and portability provisions. Given the limited historical data available for CI in these markets, Hause recommends sig-

nificant coordination between the distributors, actuaries, underwriters and reinsurers in setting these parameters.

According to the survey respondents to the 2011 Gen Re Critical Illness Insurance Market Survey, approximately 90 percent of in-force policies were either voluntary worksite or individual policies. Accordingly, the primary focus of this review is the stand-alone CI product rather than CI riders. Although the thought occurs that if you renamed a rider "Critical Care" (CC Rider) you would have a ready-made theme song. How many insurance products come with their own classic rock song?

Consumer interest continues to rise as consumer-driven health plans (i.e., higher consumer out-of-pocket plans) lead to costly coverage gaps and less flexibility of treatment options due to network restrictions. Now that the Affordable Care Act (ACA) is in full effect, consumers have to make many decisions concerning their major medical coverage—where to buy; how much does it cost; which plan is right for me; should I opt out entirely?

A number of insurers are getting into the market at least in part as a reaction to the confusion running rampant in the current health insurance environment. Companies that chose not to develop multiple major medical plans for the ACA may see CI as a product many people will gravitate toward. While not a substitute for major medical insurance, a well-designed CI product may be seen as a simple and affordable solution to the primary health risk most consumers recognize and fear—the financial hardship of a catastrophic or critical illness/accident.

BENEFIT DESIGN

One of the key distinguishing features of CI insurance is the smorgasbord of benefit designs available. Benefits are principally lump sum payments on diagnosis or treatment for the major benefit triggers. Benefits for coverages shown in the "Other Benefit Triggers" category generally have a fixed dollar limit.

A minimalist plan by today's standards would be one that covers Heart Attack, Stroke and Invasive Cancer. These plans were often filed as specified disease or dread disease policies. Subsequent enhancements added major organ transplants and end-stage renal disease.

Today's offerings include the following menu of benefit triggers:

CI Benefit Design Triggers				
Invasive Cancer	Heart Attack	Stroke	ESRD	Major Organ Transplant
Coma	Paralysis	Severe Burns	Loss of Sight, Speech, Hearing	Alzheimer's Disease
ALS (Lou Gehrig's Disease)	Benign Brain Tumor	Occupational HIV/Hepatitis	Quadriplegia	Multiple Sclerosis
Loss of Limbs	CABG (Bypass Surgery)	Angioplasty	Stent	Carcinoma in Situ
Prostate Cancer	Skin Cancer	Laser Relief	Consultation Benefit	Hospital Confinement
Radiation/Chemotherapy	Loss of Independent Living	Bone Marrow Transplant		
Additional Child Triggers				
Cerebral Palsy	Cleft Lip/Palate	Cystic Fibrosis	Down Syndrome	Spina Bifida
Acute Respiratory Distress Syndrome	Type I Diabetes	Muscular Dystrophy	Congenital Heart Disease	Child Care Expense
Other Benefit Triggers				
Wellness Benefits	Cancer Vaccine	Ambulance Transportation	Hospital Admission Benefit	Hospital Confinement Benefit
Air Transportation	ICU Confinement	Follow-up Care	Health Screenings	Lodging

If the above list is not daunting enough, there are also variations by benefit trigger on the percentage of the policy paid or dollar limits by benefit. Some product designs group the benefits by category and apply limits within each benefit category. Invasive cancer is most often priced separately to allow marketing flexibility and avoid duplication of coverage. State requirements may also dictate particular benefit trigger inclusion or exclusion.

Popular optional benefits include return of premium and recurrence benefits on a full or partial basis. Recurrence benefits are usually structured to allow for 50 to 100 percent of the original coverage to be paid for a recurrence of a covered benefit trigger. A distinction is usually made between the same diagnosis or a different diagnosis and the length of time between occurrences. Also, some benefits such as cancer in situ may be excluded or limited to one occurrence under the policy.

In designing the benefits, it should be kept in mind that the various triggers will appeal to different demographics. The younger crowd won't be as concerned with heart attacks and stroke as with triggers that may occur due to an accident—paralysis, coma, etc.

There also is the philosophical (and sometime regulatory issue) of what constitutes a "critical illness." Many of the benefits above may not be considered "critical" to either the consumer or regulators. Regulators are also concerned that certain benefit triggers may falsely lead consumers into believing they are buying comprehensive medical coverage rather than CI.

Benefit design should also consider the abilities/constraints of the underwriting, compliance, claims and actuarial departments. More complex designs require a longer application and a length-

ier filing process. Claims departments have to adjudicate each claim against a menu of triggers and benefit limits. At some level of product complexity, the pricing actuary will run out of credible data. "Actuarial judgment" usually translates into long talks with regulators—without a walk on the beach.

Under HIPAA there are "excepted benefits" exemptions that avoid minimum loss ratio (80–85 percent) and unlimited annual and lifetime benefits requirements of the ACA. The essential exemption provisions are:

- Benefits for medical care are secondary or incidental to other insurance benefits.
- Offered as independent, non-coordinated benefits.
- Coverage only for a specified disease or illness, hospital indemnity or other fixed indemnity insurance.
- Coverage is provided under a separate policy, certificate, or other fixed indemnity insurance.
- Benefits are paid for an event regardless of whether benefits are provided for the same event under any group health plan maintained by the same plan sponsor.

In order to be hospital indemnity or other fixed indemnity insurance, the insurance must pay a fixed dollar amount per day (or per other period) of hospitalization or illness, regardless of the amount of expenses incurred and not a per service benefit.

One of the key distinguishing features between CI plan designs is the benefit reduction or termination age. The most common reduction noted in Hause's research was 50 percent at age 70 or 75. Variations range from termination at age 65 to no reduction of benefits with advancing age. This design feature will significantly impact claims costs and reserves; and therefore premium

levels. Here again, differing state regulations may require multiple plan designs as some states restrict reduction by age.

Spouse and child coverage, if offered, may be individually priced or family mix priced. Child rates may be for each child or an all-children rate. Spouse and child benefit limits are often limited to a percentage (50 percent spouse, 25 percent children, for example) of the primary insured's coverage or a dollar maximum.

Waiting periods are normally zero or 30 days, and pre-existing exclusions are not covered for six to 24 months (optionally selectable in some cases). Look-back periods vary by state, with six months being the most frequent limit.

Hause sees this morass of benefit triggers and features as overloading a simple and practical product. The menu of options will also probably overwhelm most pricing actuaries. The extra marketing pizzazz of additional benefit triggers is probably lost on consumers and may be detrimental to sales if the consumers feel they are paying for more than they want or will likely use. Extra complication in the plan design will also lead to more difficult, costly and time-consuming state filings.

UNDERWRITING CRITERIA

Group coverage generally excludes health questions (other than tobacco use) except for late entrants or those applying for higher amounts than the guaranteed issue limits. Employee-pay plans are more similar to the individual and worksite products.

Worksite and individual products often use simplified underwriting of seven or fewer health questions beyond age, gender, height and weight:

1. AIDS question
2. Cancer question
3. Heart question
4. Transplant-related question
   - Organ transplant generally refers to kidney, lung, liver and pancreas.
5. Family history
   - Have two or more parents or siblings ever been diagnosed or died from a benefit trigger before the age of 45/55/60?
6. Tobacco/nicotine question
   - Typically within 12 months on an "any usage" basis.
7. Employment status (worksite/group products)
   - Actively at work
   - Hours worked per week
   - Missed more than five consecutive days due to illness or injury.

Additional questions generally relate to expanded benefit triggers such as asking whether help is needed with activities of daily living (ADLs) as a condition for a loss of independent living benefit.

Wording variations in applications have also been noted. The questions may relate to whether the person has ever (or within two to 10 years, depending on insurer):

- Been diagnosed
- Been medically advised
- Sought treatment
- Had surgery
- Had an indication, sign or symptom of a listed condition

"Ever had" language may be restricted in many states.

REGULATORY ISSUES

Regulatory issues associated with CI filings may be separated into forms issues and rate issues.

Forms Issues

The most common state variations key on definitions and benefit limitations. "First occurrence" and "first diagnosis" language may be considered in conflict with waiting period and pre-ex limits in a number of states.

States also vary on their allowance and treatment of waiting periods and how to handle diagnoses during the waiting period. Some require a reduced benefit or a return of premium while other states may not allow a waiting period.

Pre-existing condition restrictions vary as to whether they are allowed, the length of time allowed for look-back, and the length of time they may be excluded.

Other state variations include:

- Issue age restrictions to age 65
- Whether benefit reductions are allowed
- Mandated benefits or provisions—mammography, breast cancer, preventive care

Rate Issues

While a "generic" pricing model may be used in most states, a number of state variations will require special treatment. A recent Hause CI filing resulted in about 60 percent of the states fitting the generic model with the balance requiring some state-specific pricing.

Variations:

- Loss ratios (50–60 percent)
- Benefit reduction variations
- Benefit trigger inclusion/exclusion
- Issue age ranges
- Mandated benefits

PREMIUM RATE COMPARISON

As the accompanying charts show, premium rates vary substantially between companies. Some of this variation may be explained by marketing method and benefit design differences between plans. Hause believes a substantial portion of this variation is due to the relative immaturity of the market. One might expect less premium variation as most of the companies have priced off of the same underlying data sources.

> In designing the benefits, it should be kept in mind that the various triggers will appeal to different demographics.

Issue Age 20 Non-Tobacco

Issue Age 60 Non-Tobacco

Issue Age 20 Tobacco

Issue Age 60 Tobacco
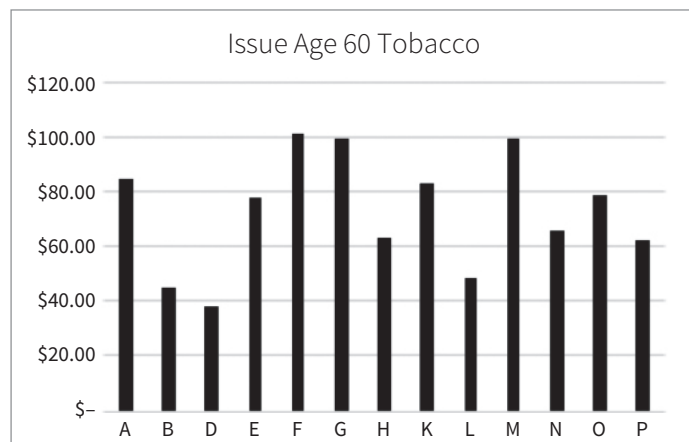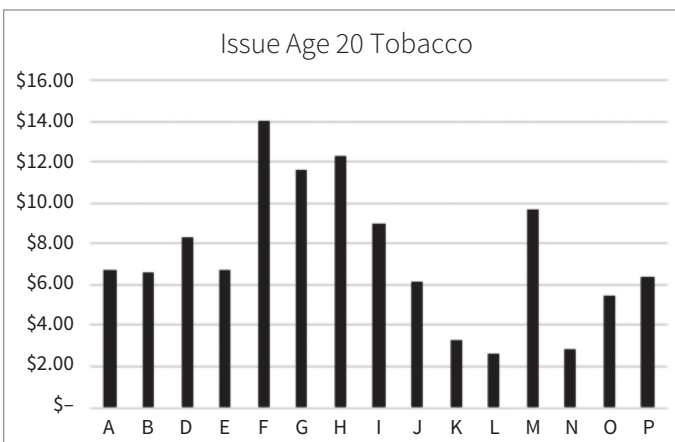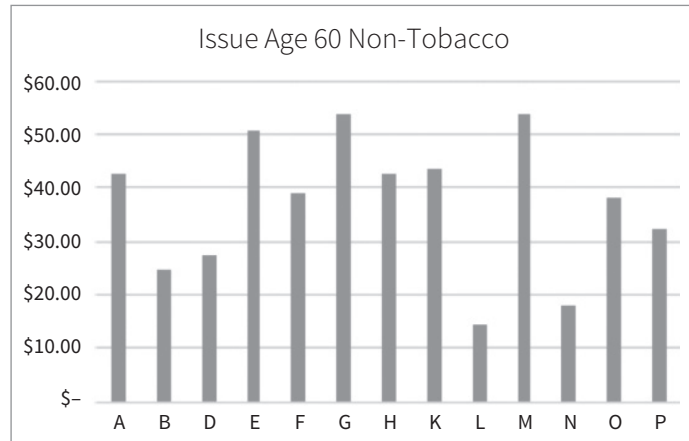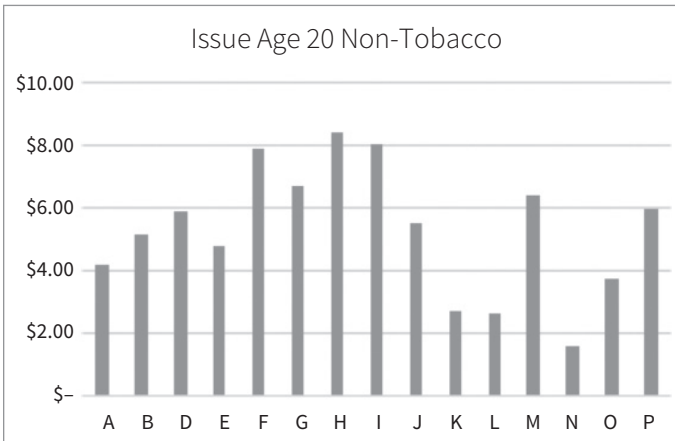
Currently, competition is not as much on price, but on which trigger appeals to each particular insured or group. Despite the ubiquitous duck commercials, prospective insureds are not aware of the variety of CI product features or relative prices. They generally will not look at more than one CI product (especially in worksite or group environments). This helps explain why there are so many varieties of CI insurance on the market at markedly different premium rates.

In looking at the premium split for cancer coverage versus all other benefits, it was found that cancer coverage represents roughly 50–75 percent of the total premium rate for most carriers with the higher percentages occurring at the younger ages. Heart-related triggers account for about 35 percent of premium,

organ-related (ESRD and transplants) about 10 percent, with the balance to other benefits. The percentages by carrier are also relatively consistent by issue age.

The following charts show the average high and low premiums for cancer only and other than cancer benefits by issue age. The dispersion increases with advancing age due primarily to variations in claim costs and benefit differences at the older ages. Also, it should be mentioned that care needs to be taken when comparing different carrier rates as benefits may be paid only for the first occurrence of any trigger, limited by maximums within a trigger category or otherwise restricted such that benefit pieces (cancer versus non-cancer) are not additive.

Cancer Only Benefits – Non-Tobacco
Annual Premium per $1,000

Cancer Only Benefits – Tobacco
Annual Premium per $1,000

Non-Cancer Benefits – Non-Tobacco
Annual Premium per $1,000
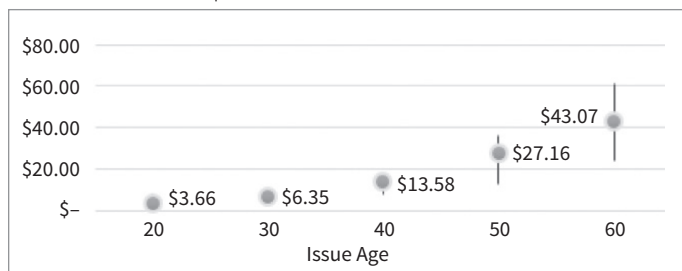
Non-Cancer Benefits – Tobacco
Annual Premium per $1,000
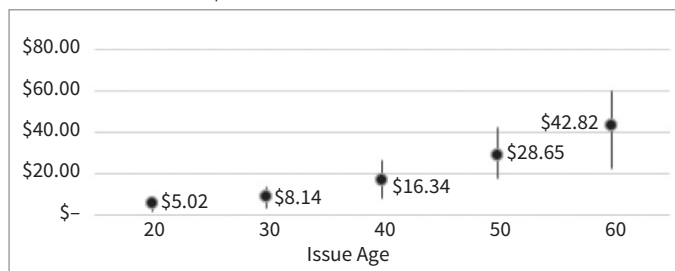
Wellness benefits or health screening benefits generally provide a $50 annual payment if the insured(s) have a preventive care test or procedure. The premium for this benefit was found to range from $15 to $40, with the most typical rate being about $20 without regard to issue age or tobacco usage.

Subsequent diagnosis/recurrent benefit premium rates vary by the included coverages, percentage allowed on recurrence, and provisions for the same trigger (reoccurrence) or a different trigger (recurrence). As mentioned earlier, design variations also exist on the required time to elapse between occurrences.

The table below shows the approximate percentage adjustments for a 100 percent recurrent benefit provision. In general, the probability of recurrence is highest for heart-related triggers. At the 2015 Critical Illness Insurance Forum, Jean-Marc Fix of Optimum Re presented his research that estimates the premium adjustment for a recurrence benefit could be in the range of 25 to 30 percent.

Caution is in order here. There is significant interplay between the recurrent benefit provision and the reduction in benefits at advancing age provision (if any). Product pricing will most likely entail extensive testing of the mix between these benefit provisions, the expected distribution of business by age and competitive considerations.

Reduction-in-benefit provisions naturally impact the higher issue ages more than the earlier issue ages. If the target market is in the younger ages, a steeper benefit reduction provision may be added to the design to lower premium rates slightly without sacrificing key benefits. However, if the target market is older, the attractiveness of the coverage may decrease with a steep benefit reduction.

The following table shows the approximate percentage change in premium rates of a reduction of benefits by 50 percent at age 70 versus a plan with no reduction in benefits.

Approximate Recurrence Adjustments		
Issue Age	Without Cancer Coverage	With Cancer Coverage
20	8%	11%
30	11%	13%
40	17%	24%
50	20%	24%
60	20%	24%

Approximate Percentage Change Due to a 50% Benefit Reduction Factor at Age 70	
Issue Age	Percentage Adjustment
20	2%
30	4%
40	6%
50	10%
60	20%
65	33%

> CI insurance, while still not fully developed in the U.S. market, shows promise as a product that can fill costly out-of-pocket gaps in health coverage.

Given the significant percentage impact at the older issue ages, a viable approach to benefit design would be to begin with an age 65 pricing target and work backward from there.

CLOSING

CI insurance, while still not fully developed in the U.S. market, shows promise as a product that can fill costly out-of-pocket gaps in health coverage. It is attractive to the "young invincibles" as catastrophic coverage and to the rest of us as income pro-tection from high deductibles, lost income and other costs that arise with an unexpected catastrophic illness or accident.

While potentially intricate in design and pricing, the product concept is simple: one-stop shopping for protection against the illnesses we all fear the most. The key point in CI product design and pricing is to follow Occam's razor—keep it simple. Your policyholders will thank you, and your actuarial, underwriting, compliance and claims departments will thank you.

Finally, if you have made it this far, a final quote:

"I'm the only M.A.S.H. character covered by a Critical Illness policy."—Major Burns

Couldn't resist the last one. Actuarial humor—never gets old, never gets funny. ∎

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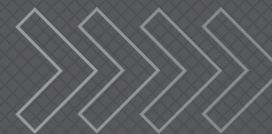
Chairperson's Corner

By Elaine Corrough

"So … what do *you* do for a living?"

I used to have a hard time answering this question. My informal chit-chat skills have always been deplorable anyway, even after 20+ years in consulting. Few people knew what a health actuary was back in the day, and for many years, it seemed easier just to say "I work with spreadsheets, a lot" or "I work in insurance," however inadequate those descriptions seemed. As time went by and I took new roles with different employers, the answer seemed increasingly complex.

This holds true for many of us. In the past 20 years, we have expanded our roles as deep subject matter experts and technical masters, adding both breadth and depth to the collective expertise of our profession. Some of our health actuaries have committed themselves to the important goal of preserving excellence in traditional actuarial roles, while others are creating innovation at the boundaries of the current health care system. Some of us, myself included, are just trying to keep up on both fronts. We have attracted new customers and employers who see the value that health actuaries bring with our problem-solving skills and ability not just to report the numbers, but also to explain what the numbers mean.

So, how would I answer that same question today? I'm reminded of my favorite book as a child: the wonderfully illustrated *What Do People Do All Day?* by Richard Scarry. From that book, Grocer Cat and the many other fine citizens of Busytown were introduced to me, and I loved learning about what each of them did in the community. I dreamed about becoming Stitches the Tailor.

What would Mr. Scarry write if Harvey the Health Actuary came to Busytown? If the occupations of our friends and colleagues are any indicator, Harvey might be a medical economics guru, or an expert on long-term care. He might spend most of his time analyzing cost and utilization trends, or be an all-things-actuarial resource for his professional counterparts. He might focus solely on rate filings, or programming and statistics, or financial reporting. Harvey could be a predictive modeling expert, researcher, Medicare specialist, risk consultant for hospital systems and provider groups, strategic adviser to health plans, or that guy who loves calculating reserves. He might advise employers on benefit design, work with state government, or interpret new regulations for other actuaries. This is by no means a complete list, and Harvey will have likely done more than one of these things in his career.

With all these activities to choose from, it's an exciting time to be a health actuary, and I encourage members to explore the different roles that health actuaries might play. We must also recognize that some of those roles do not exist today. To support our members through this evolution, we embarked last year on a major strategic initiative, titled, fittingly enough, "Evolution of the Health Actuary." Over the next several months, you will continue to hear more about this initiative and what it means for the support you and your colleagues get from the Society of Actuaries (SOA) and the Health Section.

Back to the original question: Nowadays, I simply reply, "I'm a health actuary." 'Nuff said!

* * *

If you have not had the opportunity, please be sure to check out the Health Section publication *The ACA@5: An Actuarial Retrospective*. This report covers a variety of issues we have faced under the Affordable Care Act (ACA), written by actuaries and professionals who have been steeped in ACA activities since its enactment. Many thanks to Valerie Nelson, our *Health Watch* editor, who edited *ACA@5*, as well as all of the contributing authors.

* * *

Health Section Council members are among our most active and committed volunteers, and we would like to thank Kara Clark and Eric Goetsch, whose terms are expiring. A very special thank you goes to Andie Christopherson, whose term is expiring and who has been a truly admirable chairperson this year.

At the same time, I'm delighted to welcome our newly elected council members. JoAnn Bogolin, Greg Fann, Sarah Osborne and Jenny Gerstorff are joining our council. I'm also delighted to announce the appointment of Marilyn McGaffin to our 2016 council. Our continuing council members form the backbone of our council, and of course, I will rely heavily on Brian Pauley, our incoming council vice chair.

Finally, I would like to thank all of you who contribute your time and expertise as volunteers. We all enjoy a richer and more exciting profession as a result of your efforts. ■

Elaine Corrough, FSA, FCA, MAAA, is senior consulting actuary with Axene Health Partners LLC in Murrieta, Calif. She can be reached at *elaine.corrough@axenehp.com.*

Up Front with the SOA Staff Fellow

By Joe Wurzburger

The release of this issue of *Health Watch* roughly coincides with the end of my first year as the Society of Actuaries' (SOA's) Health staff fellow, and what a year it has been. On both a personal and professional level, it has been a year marked by seemingly nonstop change. While it would seem difficult to top my personal change trifecta of a new job, new house and new baby girl, the health care industry may have in fact pulled it off over these past 12 months.

Between the *King v. Burwell Supreme Court* case, potential industry consolidation, announcements related to 3Rs programs, etc., one would be hard-pressed to find a more dynamic industry. And I'm proud to say that the Health Section, tasked with providing continuing education in this ever-changing landscape (among its many responsibilities), was up to the challenge. From its robust offering of sessions at the Health Meeting to its comprehensive syllabus at Health Boot Camps; from its myriad webcast and podcast offerings to the remarkable issue of *The ACA@5: An Actuarial Retrospective*, the Health Section has lived up to—and even exceeded—its usual lofty standards.

The increasing significance of the health care industry—and the Health Section's role in it—was on full display at the 2015 Valuation Actuary (Val Act) Symposium in Boston. Historically the content at this meeting has been dominated by life insurance topics, but this is no longer the case. Not only were there plenty of health topics in general, but there was actually an Affordable Care Act (ACA) "track" of sessions; a few that I attended include:

- Reserving for and Opining on Risk Adjustment Transfer Payments
- A Look Back at 2014 Health Opinions and Lessons Learned
- Premium Deficiency Reserves for Health Products

Perhaps most telling in terms of the rising status of health topics at Val Act was the keynote speaker: Nathan Wolfe, known widely as the "Virus Hunter." The fact that he was an engaging speaker was no surprise—anyone who has seen one of his TED Talks or has seen him on *The Colbert Report* anticipated that. What impressed me was that the keynote speaker for this event is world-renowned for his work with epidemic diseases, i.e., a *health* topic. Yes, friends, health care is in fact fascinating to talk about, and not just for those of us who consider ourselves health actuaries.

In the year ahead, I would anticipate this fast pace to continue. With a presidential election, rate volatility, the continuing drama of potential mergers and acquisitions, new specialty drugs, etc., there's no letup in sight. It promises to continue to be a wild adventure. Let's enjoy the ride. ■

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Producing Actionable Insights from Predictive Models Built Upon Condensed Electronic Medical Records

By Sheamus Kee Parkes

In April 2015, the research arm of the SOA published a set of papers on predictive analytics and how these techniques can be used in practice. One paper has been selected for publication in this issue of Health Watch; *however, readers are encouraged to check out the following link and read the rest of the publication. Please refer to this link for the entire publication: http://www.soa.org/News-and-Publications/Publications/Essays/2015-predictive-analytics.aspx.*

* * *

Predictive modeling often has two competing goals: accuracy and inference. In health care, risk scoring is used to make different groups more comparable and to explore drivers of costs. With care coordination specifically, patients need to be prioritized for intervention while also understanding why a given patient was prioritized. Care coordination can benefit from custom trained models that adapt to service patterns and include any novel sources of available information. These custom models can include industry-leading risk scores as inputs to retain their strengths and insights. One important novel input could be electronic medical records (EMR) data.

Predictive modeling with EMR is commonly associated with mining physicians' notes for nuanced opinions not found in the coarse diagnosis coding of medical claims. Although valuable, physician notes are not the only information in EMRs; other novel pieces of information include vitals measurements and lab results. Vitals information includes items such as height, weight, and blood pressure. Labs information includes results of panels such as lipid, metabolic, and blood counts. These too can provide a more nuanced view of a patient's health than demographics and claims alone. This article will recount the process of including labs and vitals information into a set of custom models built for care coordination efforts and then understanding the added value in accuracy and insights.

OBTAINING AND STANDARDIZING

The first hurdle in utilizing EMR information is obtaining it; it is often stored separately from claims data and under control of different staff or even a different organization. EMR table structure is commonly even less standardized than claims tables. Limiting to just vitals and labs makes the acquisition process easier. Once acquired, the labs and vitals information need similar, but not identical, processes to make them useful in predictive modeling.

Labs and vitals both are needed on a timeline basis. Just having the most recent results for each patient would not be helpful unless pre-trained models were available that expected them as inputs. When training custom prospective models, a strong history of measurements is needed.

Labs and vitals are both subject to measurement and transcription errors. Although there is some clinical guidance available, concepts from robust statistics are invaluable in estimating useful bounds for outliers. Most items have generally symmetrical distributions of results.

While vitals data is collected more frequently than lab data, there are fewer types of information captured. Figure 1 shows the distribution of some key vitals information.

> Possibly more important, the EMR features provided new and potentially more actionable reasons for a given patient's predictions.

Figure 1

Distribution of EMR Vitals Information
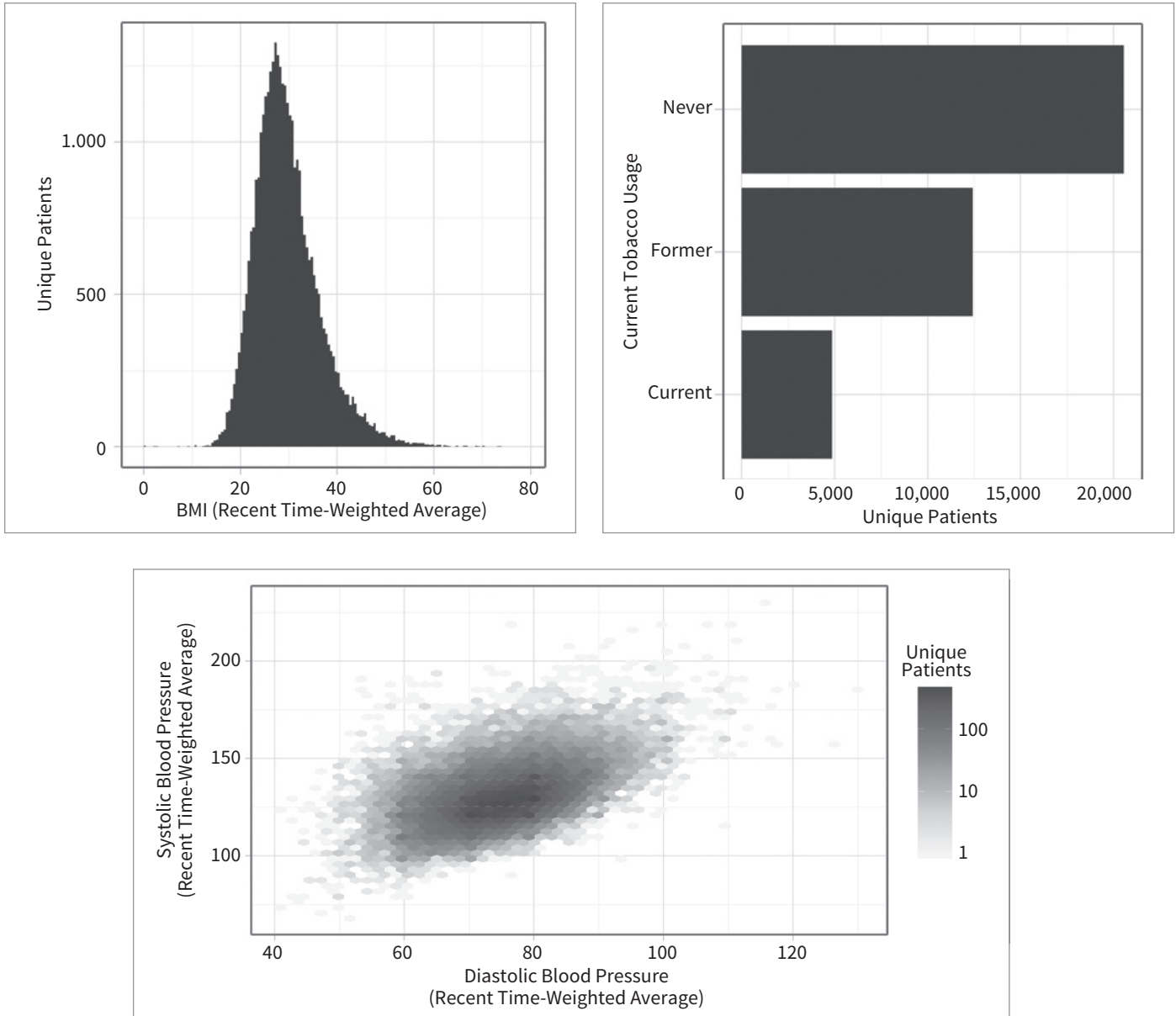
> Choosing among all these encoding possibilities can be somewhat of an art. However, it should be influenced by what learning algorithms will be applied.

Lab tests present additional hurdles. Results are collected from a variety of brick and mortar labs, and typically these entities do not report on a consistent basis. Most grievous is the lack of consistent naming of the item tested. For example, the following terms—BA%, BASOPHILS, Basophils %, and BASO%—all mean the same thing, which is separate from BA#, ABSOLUTE BASOFILS, and BASO (ABSOLUTE). A parsing library must be developed to standardize and categorize the labs data into consistent panel groups and individual items.

BUILDING FEATURE VECTORS
In health care, many analyses use patients as the units of observation. To perform analysis at a patient level, a useful feature vector needs to be built for each patient for each pertinent time period. When training custom models at least two time periods are needed: a historical training feature period for which future outcomes are known, as well as a current prediction feature period for which future outcomes are not yet known (but are of interest).

Within each feature period a given patient may have many measures of a given vital or lab, or none at all. There are many useful ways to collapse these sporadic time series. Simple possibilities would include taking the most recent value or a straight average of all recorded values. A slightly more refined approach would be a weighted average that gave more credit to recent values; this can strike a nice balance between freshness of information and measurement error reduction. There are seldom enough measurements per member to estimate a trend, but differences between first/last and minimum/maximum can be interesting, as can the simple count of the number of measurements of each item. Missing values are coded for those items a patient did not have measured at all.

Choosing among all these encoding possibilities can be somewhat of an art. However, it should be influenced by what learning algorithms will be applied. A reasonable choice of algorithm could be ensembled decision trees, primarily because they gracefully handle missing values, nonlinearities, and interactions

while maintaining excellent performance. They can also utilize random feature sampling similar to that championed by Random Forests, so having modestly redundant features can be tolerated, as long as the included EMR features are not so plentiful that the more standard claims and eligibility features become diluted.

TRAINING MODELS AND ESTIMATING EFFECTS
Once the feature vectors are created, reasonable outcomes need to be chosen. Care coordination is often focused on avoiding the worst near-term outcomes, so useful outcomes can include the median and tail risk of total costs for the next six months.

Ensembled decision trees provide useful insights into what features are important. In this example, the claims-based features were still the most important, but the EMR features provided a small lift in model performance when judged on a handful of different metrics. The EMR features did cause large shuffling in the ranking of predictions, so similar performance was reached with a noticeably different cohort. Possibly more important, the EMR features provided new and potentially more actionable reasons for a given patient's predictions.

Marginal effect estimates should likely be avoided when calculating and communicating the effects of individual features in this scenario; marginal effect estimates depend upon holding all other features constant. Given the highly overlapping and collinear nature of many of the features explored here, it is improper to even hypothetically hold all other features constant. Instead, reestimated univariate/single feature effects can communicate more useful information.

The reestimated relation between the median cost predictions and a few EMR features are shown in Figure 2. The rug plots and width of the lines emphasize the area of support that contains most of the example patients' results. The recurring horseshoe shape is very common in EMR effects and reflects a natural optimal equilibrium. These shapes also tend to align with general clinical guidance.

PRESENTING RESULTS
Care coordination can use these results for both their accuracy and their insights. The predictions themselves can help prioritize what patients are selected for care coordination. The insights can be presented to care coordinators in the form of individual patient profiles. Each patient profile presents many of the features for that patient and ranks them by their importance to the patient's overall prediction. Individual feature importance is derived from the reestimated effects presented in Figure 2 using a given patient's actual feature values. Labs and vitals that appear higher in the feature importance list can be especially valuable for care coordinators because they can represent more actionable information than just warnings of high historical utilization. Care coordinators could still go directly to an EMR for this informa-

Figure 2

Example Effects of EMR Information
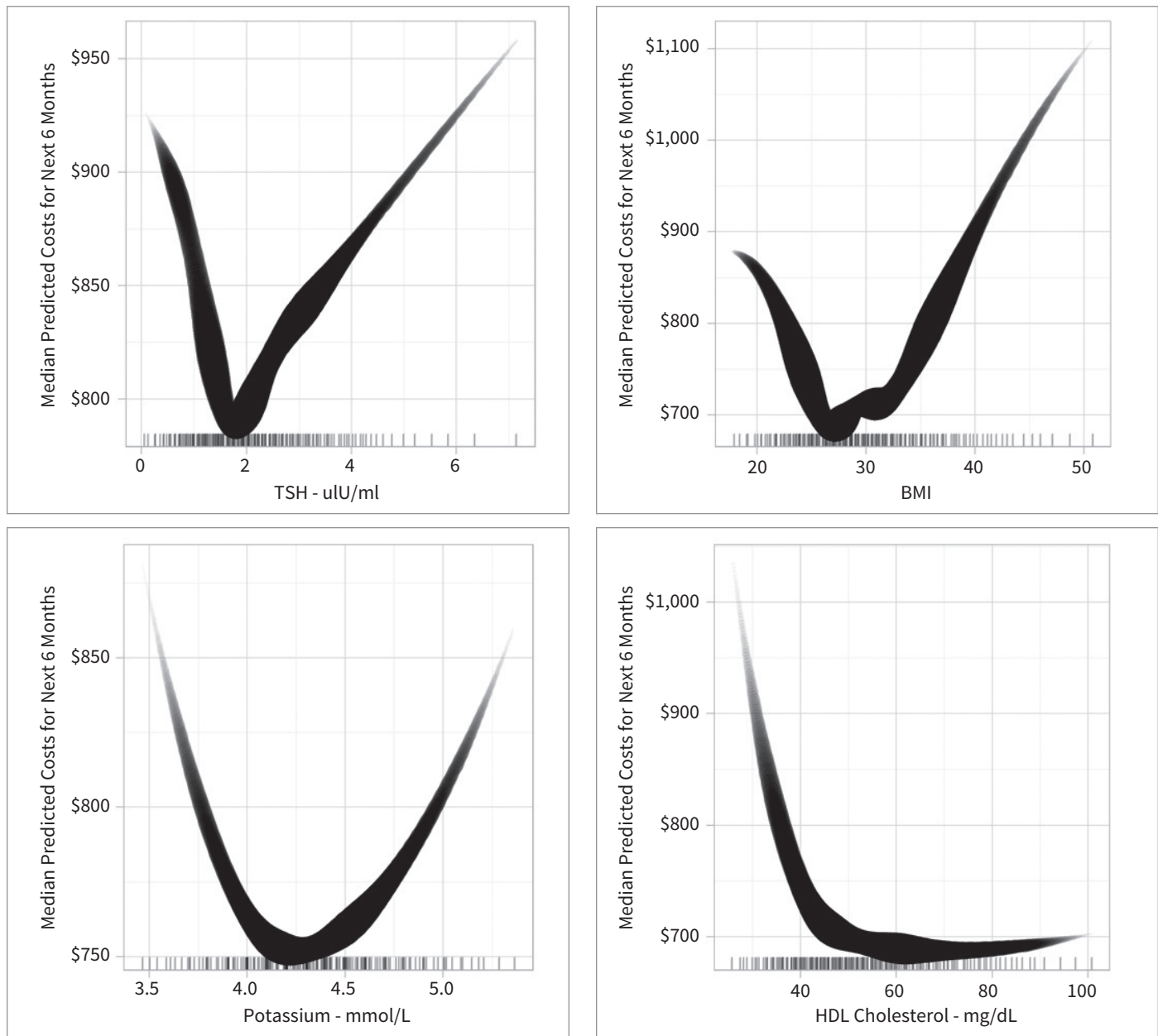
tion, but this feature importance reporting puts the information in a useful context. Adding EMR information provided value, but more to inferential insights than predictive accuracy. However, the value of EMR information depends upon the process used to extract it and this only recounts one useful approach. ■

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Simple and Effective Reserve Practices: Approaches to Combine Your Reserve Estimates for Better Prediction

By Dale Cap, Chris Coulter and Kevin McCoy

> The idea is simple—take the various predictions you are already making and weight them in a way that minimizes variance and increases accuracy.

Actuarial judgment is pervasive in our work. In many cases, judgment is a necessary element to our modeling and analysis. Over the past four decades behavioral research has shown that simple linear models can do much better than a human practitioner in many cases (Kahneman & Tversky, 2011; Wacek, 2007).

We present a couple of simple but effective reserving techniques that an actuary can add to his or her current reserving practices to produce significant reductions in reserve bias as well as reductions to reserve variance. Aggregating reserve estimates using only actuarial judgment can result in high variance and biased results, which can have consequences in many other areas of your company.

According to the Washington State Office of the Insurance Commissioner's data, the range of reserve error reported on financial statements for the largest insurance entities for the years 2008 through 2014, was –10 percent to 40 percent (Company Annual Statements, n.d.). More importantly, the standard deviation of these errors is 11 percent. This data supports the possibility of biases that actuaries generally believe to exist. Biases in reserve estimates include overcompensation (when you've reserved low one year, you overcompensate the next year by reserving way too high); or keeping too much weight on the prior estimates when new information is available; and more. It also indicates that the reserving techniques that are being employed are not very precise. With an 11 percent margin and an 11 percent swing, companies can easily see reserve estimates exceeding the final paid claims by up to 40 percent. This leaves capital in the prior year that could be used to benefit this year. This could impact the bottom line, distort the company's profitability over time, adversely affect ratings in the following year, trigger regulatory action, or impact pricing and forecasting models. Under-reserving can have similar effects. In addition to pricing and forecasting impacts, accruals may be set aside assuming a medical loss ratio (MLR) or other rebates are due, causing inappropriate payments on performance bonuses and bringing additional scrutiny to your department and deteriorating your credibility as the reserving actuary.
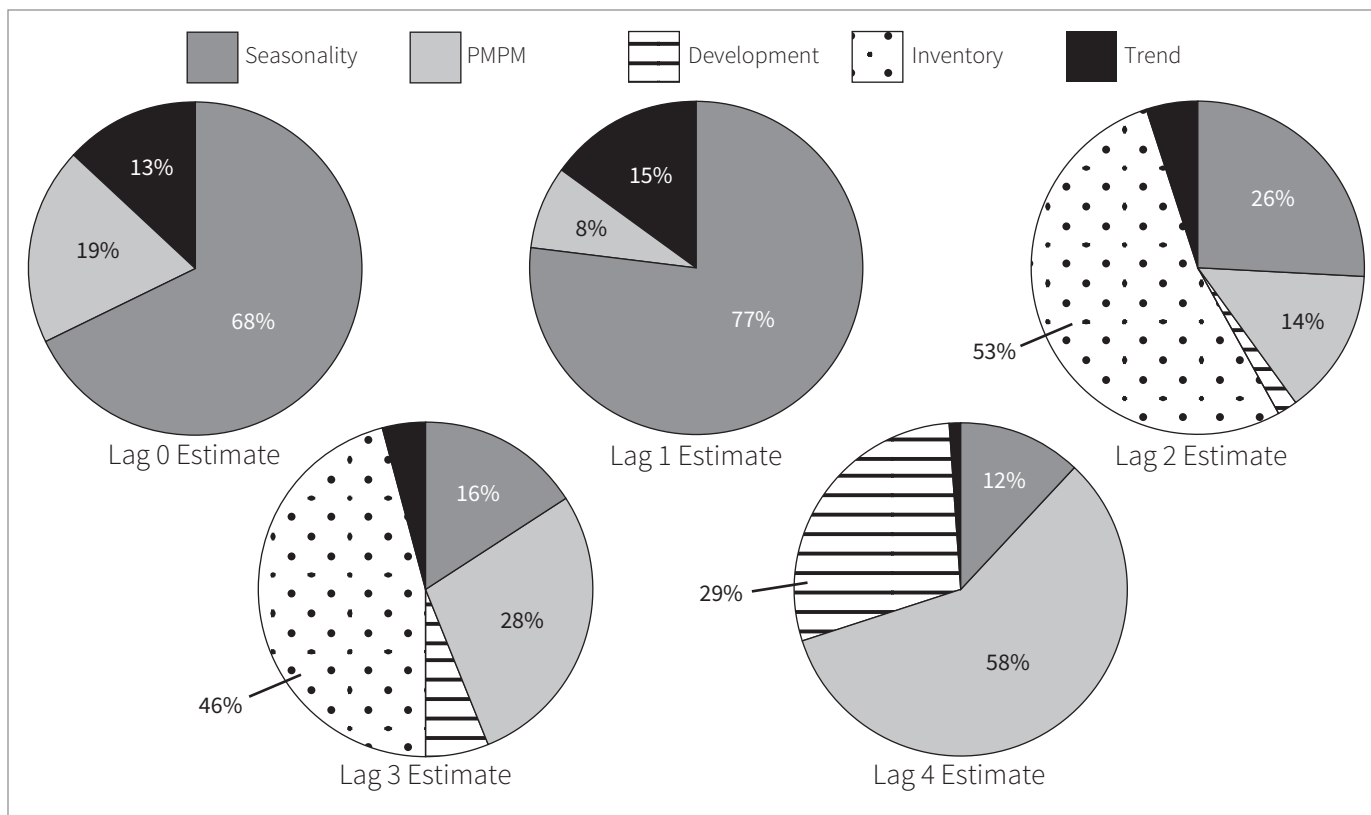
The following results are based on a simulation study with 8,000 simulations of claims run-out. The simulations took into account a seasonality component, a benefit change component, and a large claim component. Each of these components was developed with some randomness in each simulation. These simulations show a reduction of 5 percent variance to the reserve estimates. Unless estimators are completely correlated, these techniques should produce a reduction in variance and a more consistent estimate of the mean. With reduced variance and more accurate predictions, the margins needed could be reduced, resulting in a better estimate of each year's results.

The remainder of this article will outline the proposed techniques, followed by a high-level summary of the simulated data used to illustrate the results. Note: Although we illustrated the results by way of simulation, these techniques have been used in real practice and have shown a significant impact.

WEIGHTING TECHNIQUES

The idea is simple—take the various predictions you are already making and weight them in a way that minimizes variance and increases accuracy. This paper will discuss two weighting techniques you can use. However, there are many different ways to calculate the weights. Every reserving actuary is inherently doing this weighting in some fashion, whether it is via a mental algorithm or a more formalized approach. We advocate using a formalized approach that is testable and avoids potential human biases. In addition, the proposed formalized approach will tend to discredit reserving methods that perform poorly, focusing on those methods that are more reliable and consistent. If nothing else, this will give you a better baseline in which to apply judgment.

The following is an example illustrating the outcome from a weighting technique over multiple reserve methods by lag month.

| Seasonality | PMPM | Development | Inventory | Trend |

Lag 0 Estimate
- 68%
- 19%
- 13%

Lag 1 Estimate
- 77%
- 8%
- 15%

Lag 2 Estimate
- 26%
- 14%
- 53%

Lag 3 Estimate
- 16%
- 28%
- 46%

Lag 4 Estimate
- 12%
- 58%
- 29%

In this example, we used the weighting technique to combine the seasonality, paid per member per Month (PMPM), development, inventory, and trend methods. As you can see each lag differs in the weights applied to each method. In Lag 0, the seasonality method had the highest weight, indicating that it was the "best" model for that lag. However, the seasonality method alone is not the best method. Rather, the weighting given in the above panel minimizes the variance of the estimate, so we would use that weighting for our predictions of Lag 0 claims.

We recommend ongoing monitoring and measurement of any approach used to ensure the intended outcomes and expectations are being met. One of the pitfalls of this more data-driven weighting approach is over-fitting. This is a common pitfall in any estimation or prediction procedure.

TECHNIQUE 1: INVERSE VARIANCE

Inverse variance weights each of the reserve methods based on the inverse proportion of error variance when comparing to actuals. Therefore, lower weights are applied to those methods that have historically produced a larger variation of errors.
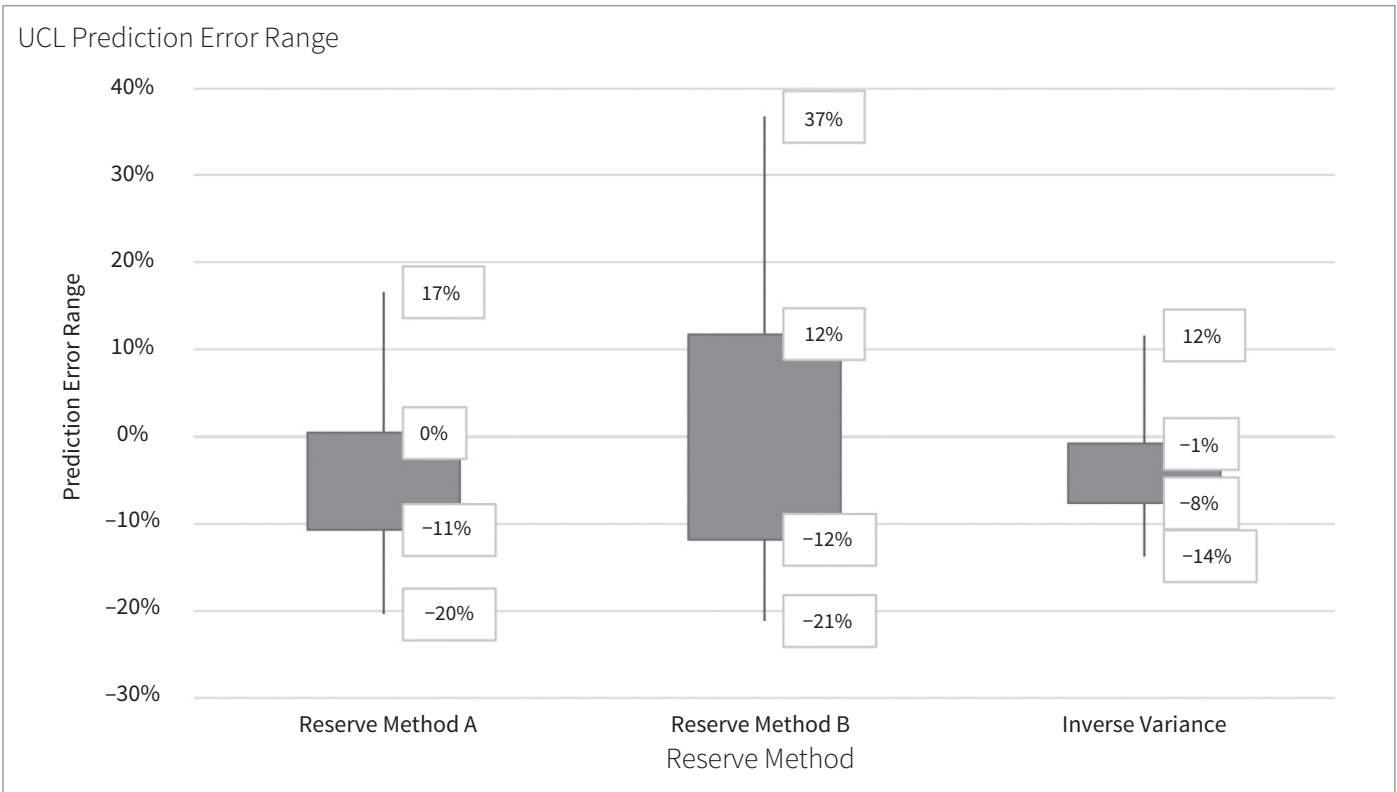
This approach is straightforward and simple to implement without having to add any additional features to one's existing reserve model. It also avoids any complex calculations, making it easy to explain to others. On the other hand, this type of approach ignores the correlations between the reserve methods being used and their distance from the target, which could be used to help lower the variance even further. This is why we offer two approaches.

Example

Suppose you have two methods for reserving: A and B. Each of these methods has a historical monthly reserve error associated with it (variance of 10 and 20, respectively). Based on the inverse variance technique, the proposed future weights when developing a projection could be 86 percent A and 14 percent B. This type of back-test has established that A is a better predictor; however, the mix of the two methods is still preferred. This technique provides a systematic approach to choosing a good mix and possibly better starting point prior to applying judgment in your reserve picks going forward.

Historical Experience	Method A	Method B	Actuals
Month 1	150.00	155.00	151.10
Month 2	160.00	145.00	155.20
Month 3	170.00	180.00	172.30
Variance of Monthly Errors	14.44	88.94	
Inverse Variance	0.07	0.01	
Proposed Future Weights	**0.86**	**0.14**	

After applying the inverse variance against our simulated claims database, using two of the more common reserving methods, we captured the unpaid claim liability (UCL) estimates for each incurred month. These estimates were then compared to the actual known liability, and their range of error is illustrated below. As seen below, the range of error using the inverse variance approach reduces the overall range of error when compared to each reserve method independently. However, you can also see that the technique doesn't improve accuracy significantly.

UCL Prediction Error Range

Chart showing Prediction Error Range (y-axis, from −30% to 40%) by Reserve Method (x-axis).

- **Reserve Method A:** 17%, 0%, −11%, −20%
- **Reserve Method B:** 37%, 12%, −12%, −21%
- **Inverse Variance:** 12%, −1%, −8%, −14%

TECHNIQUE 2: LINEAR REGRESSION

The linear regression approach should produce more accurate weightings than the inverse variance approach, but it is far more computationally intensive. To ensure accuracy, the linear regression technique minimizes the sum of squared prediction errors for all points, penalizing larger errors disproportionately. On the other hand, the inverse variance focuses on reducing the dispersion of the estimates instead of the size of the error. In other words, the inverse variance method tends to enhance the precision of the estimate, but not necessarily the accuracy.

Example

Suppose you have two methods used for reserving: A and B. Each of these methods produced a historical estimate for the month. If we define A and B as X (a 2 x 3 matrix with A being column 1 and B column 2) and Y being the actuals, we could use the normal equation to solve for the proposed weights (assuming the matrix is invertible). Below is an example of the equation, where T is the transpose of the matrix and –1 is the inverse.

$$\text{Weights} = (X^T X)^{-1} X^T y$$

Applying this to the table below, the proposed future weights for these methods would be 71 percent A and 29 percent B (for this particular lag).

Historical Experience	Method A	Method B	Actuals
Month 1	150.00	155.00	151.10
Month 2	160.00	145.00	155.20
Month 3	170.00	180.00	172.30
Proposed Future Weights	**0.71**	**0.29**	

This type of back-test has established that A is a better predictor; however, the mix of the two methods is still preferable. This technique provides a systematic approach to choosing a good mix and possibly better starting point prior to applying judgment in your reserve picks going forward.

A similar illustration using linear regression against our simulated claims database can be found below. As discussed above, accuracy is what sets linear regression apart from the inverse variance approach. Unlike the previous results, the results here tend to center themselves on zero.
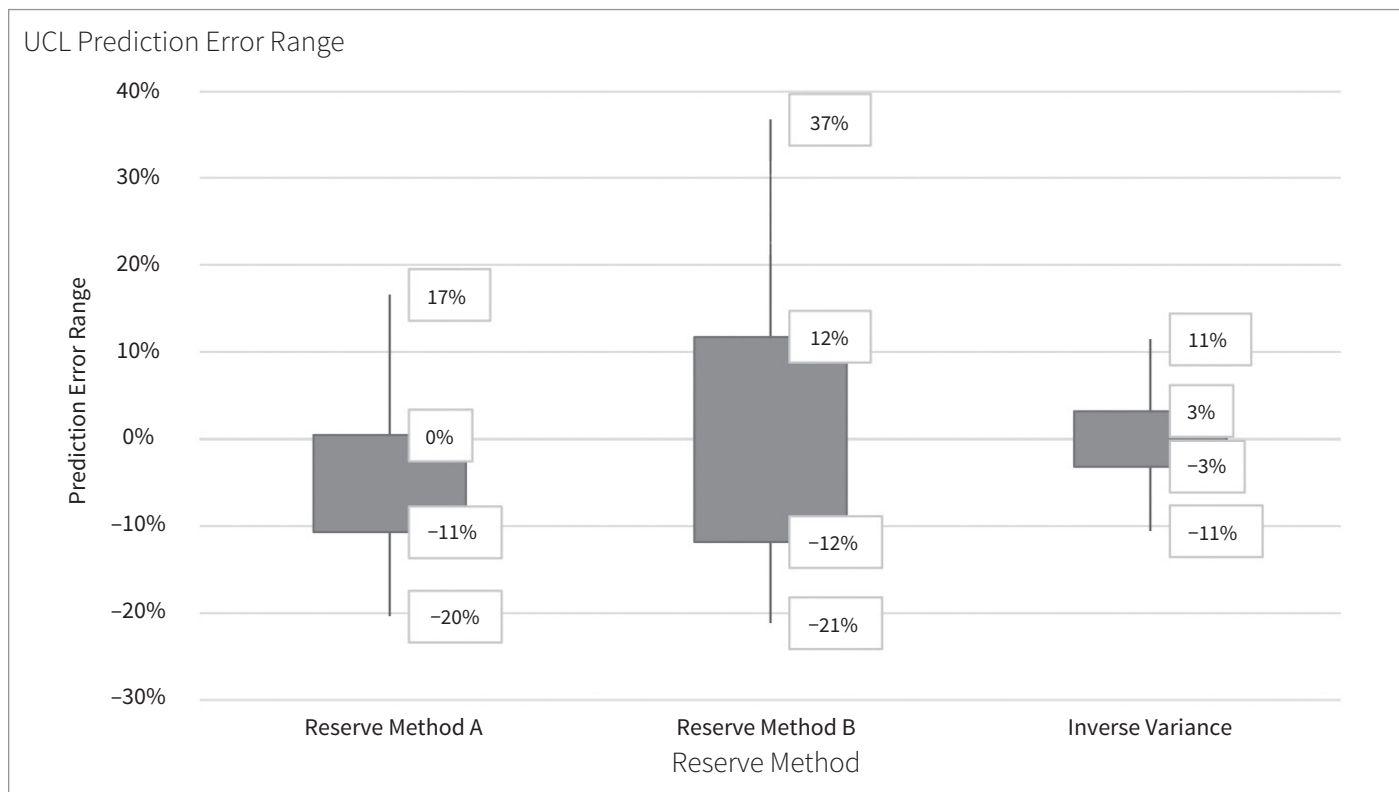
Although we provided an actual example where only two predictors are used, you can include more. Typically, actuaries may have many methods at their disposal like the development method, the paid PMPM method, loss ratio methods, trend-based methods, seasonality-based methods, etc. You can also integrate other variables into the analysis, such as the size of the current claims inventory. For whatever methods are ultimately chosen, we encourage you to pick methods that are diverse and not well-correlated with one another. We also encourage the methods to be consistent and stable over time. At the same time, you should be careful not to over-fit your data.

SUMMARY

In the examples outlined above, we presented two high-level techniques to weight existing reserve estimates. We showed how these techniques can improve your already defined reserving process with little extra work. In addition to the improvement to your estimates, there are two other benefits: the techniques will help the reserving actuary more precisely quantify where and when each reserving method works; and linear regression allows the actuary to integrate stochastic techniques in the calculation of reserve margins. However, there are limitations, and you should be aware of these and use judgment where necessary.

Predictive analytics is the practice of extracting information from existing data to determine patterns and predict future outcomes and trends (Predictive analytics, n.d.). If you don't use a weighting algorithm to combine your reserve estimates, you probably have a pretty good sense of which of your models performs the best for each lag month. But, the question is by how much. A weighting algorithm trained on real data can give you more precision around which models work better and when.

"Predictive analytics" is the new catch phrase, but not long ago stochastic analysis was a hot topic. Reserving is certainly a place where more stochastic models can prove beneficial. A Society of Actuaries sponsored report gives a definition of what margin is for incurred but not reported (IBNR). In math, it is written as:

$$\text{Probability}(\text{Estimate} + \text{Margin} > 95\%) > 85\%$$

The report also gives the reader a couple of ideas on how to obtain this estimate (Chadick, Campbell & Knox-Seith, 2009). In this report, the authors also point you to another Society of Actuaries published report, *Statistical Methods for Health Actuaries IBNR Estimates: An Introduction*, which outlines some more sophisticated ways to statistically approximate your IBNR (Gamage, Linfield, Ostaszewski & Siegel, 2007). Using Technique 2 is a great first step in integrating the stochastics into your already defined reserving system.

The idea of combining two or more estimates for better prediction or lower variance is used in many other contexts; it's called meta-analysis in statistics and ensemble methods in data science, while in finance the capital asset pricing model (CAPM) uses an optimal weighting structure. In any case, they work and can help to reduce the biases that exist in your reserving process.

DATA AND SIMULATIONS

Although these techniques have been shown to be successful in practice, the results included in this paper were developed using data from our simulated claim database to avoid the use of actual data in this paper. The ultimate incurred claims were developed by lag month and include adjustments for changes in claim processing patterns, number of weekly paid claims in a month, benefit design, workday factors, random large claim shocks, seasonality, leveraging, and other factors (which include random noise within each component and overall).

Consistent with actual experience, our simulated examples have shown improved performance when compared to using a single method for reserving. Although we are not able to simulate judgment, we have seen actual improvement when comparing to our final picks (adjusting for margin and implicit conservatism), but we will leave it to the readers to test their own historical performance and whether these techniques add value (or just a better baseline from which to build their estimates).

In the end, we believe if employed correctly—using various reliable and stable methods—these techniques (particularly regression) can help reduce both the bias and variance in the estimates.

Below are the results obtained from applying these techniques to our claims database. Roughly 8,000 simulations were generated estimating the ultimate claim liability for a given month.

Summary Statistics				
Statistics	Reserve Method A	Reserve Method B	Inverse Variance	Linear Regression
Mean Error	−5.2%	0.0%	−4.2%	0.0%
Std Error	5.6%	11.8%	3.4%	3.2%
Kurtosis	−1.9%	−14.8%	24.1%	−0.8%
VAR95%	13.5%	23.4%	9.36%	6.3%
Skew	43.2%	68.3%	30.8%	2.4%
Worst Error	**20.4**%	**36.7**%	13.7%	11.5%

VAR95% represents the point at which 95 percent of the errors (in absolute terms) fall below.

Simulated Distribution of Prediction Errors
IBNR Estimates
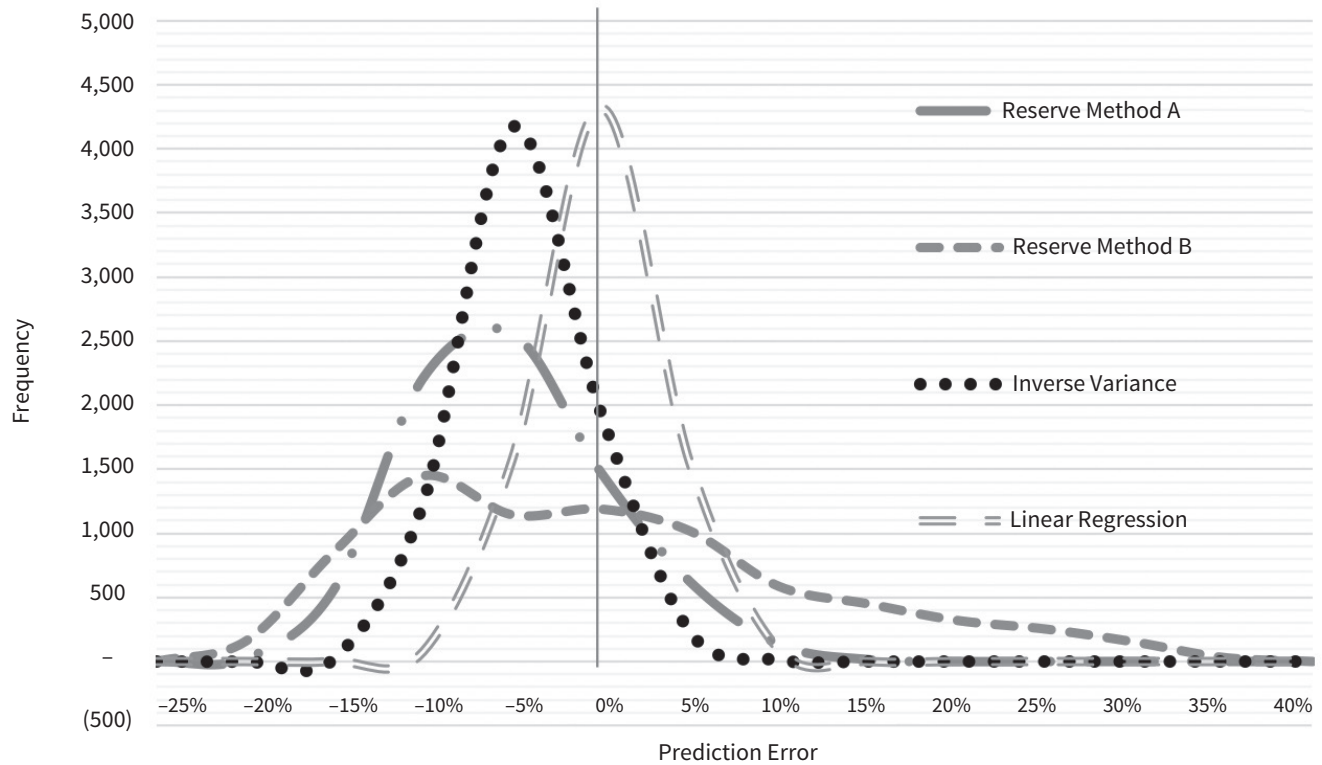
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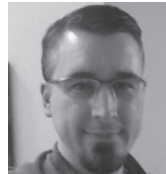
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Articles in the *North American Actuarial Journal* of Interest to Health Actuaries

By Ian Duncan

After a good run of health-related articles, Volume 19, No. 2 did not have any articles of direct interest to health actuaries, although those actuaries interested in the relationship between disease and longevity may be interested in "Causes-of-Death Mortality: What Do We Know on Their Dependence?" by Séverine Arnold (-Gaille) and Michael Sherris. (We reproduce the abstract of this article below.) Health actuarial topics are back in force in Vol. 19, No. 3 with several interesting articles. Colin M. Ramsay and Victor I. Oguledo address an increasingly important topic for health actuaries—absenteeism and presenteeism—in "Optimal Disability Insurance with Moral Hazards: Absenteeism, Presenteeism, and Shirking." Sam Gutterman has an article on "Mortality of Smoking by Gender," which I am sure all health actuaries will want to read. The relationship between health and longevity continues to be an important source of articles with "Mortality, Health and Marriage: A Study Based on Taiwan's Population Data" by Hsin Chung Wang and Jack C. Yue.

ABSTRACT: CAUSES-OF-DEATH MORTALITY: WHAT DO WE KNOW ON THEIR DEPENDENCE?

Over the last century, the assumption usually made was that causes of death are independent, although it is well-known that dependencies exist. Recent developments in econometrics allow, through Vector Error Correction Models (VECMs), to model multivariate dynamic systems including time dependency between economic variables. Common trends that exist between the variables may then be highlighted, the relation between these variables being represented by a long-run equilibrium relationship. In this work, VECMs are developed for causes-of-death mortality. We analyze the five main causes of death across 10 major countries representing a diversity of developed economies. The World Health Organization website provides cause-of-death information for about the last 60 years. Our analysis reveals that long-run equilibrium relationships exist between the five main causes of death, improving our understanding of the nature of dependence between these competing risks over recent years. It also highlights that countries usually had different past experience in regard to cause-of-death mortality trends, and, thus, applying results from one country to another may be misleading.

OPTIMAL DISABILITY INSURANCE WITH MORAL HAZARDS: ABSENTEEISM, PRESENTEEISM, AND SHIRKING

Presenteeism occurs when employees are present at the workplace but cannot perform at their best due to ill health or other reasons, while absenteeism occurs when employees are absent from the workplace. While absenteeism is important, researchers now say presenteeism can be more costly to businesses and may be responsible for as much as three times the health-related lost productivity as compared to absenteeism, and may cost the U.S. economy as much as US$150 billion per year. Given the cost of absenteeism and presenteeism, one of the objectives of this paper is to provide actuaries with the techniques and insights needed to design disability insurance policies that take into account the dynamics of absenteeism and presenteeism. To this end we develop a simple multi-state sickness-disability model of the evolution of an employee's health over time. We assume employees receive sick-pay, the size of which depends on their health state and there is a government-sponsored unemployment insurance program. In our model it is possible for employees in good health to avoid work by staying home, which is called *shirking*. To reduce shirking, the employer decides to check the health status of a certain percentage of employees who call in sick. Given the sick-pay structure, the probability of a health check, and the existence of unemployment insurance, employees develop rational strategies about whether to engage

in shirking, absenteeism or presenteeism. These strategies are captured in a set of Volterra integral equations. We use these Volterra integral equations to show how the employer can design a disability insurance plan that can incentivize employees to eliminate shirking and to act in a manner that will maximize the employer's expected profits.

MORTALITY OF SMOKING BY GENDER

Exposure to cigarette smoke has had and will continue to have a huge effect on mortality. Significant differences in smoking prevalence rates by gender have contributed to varying levels and rates of improvement in mortality over the last several decades and are expected to continue to influence mortality improvement differently over the next several decades.

The combined effect of greater historical smoking prevalence rates by males and their corresponding earlier and larger reduction has in part been responsible for the recent improvement in mortality rates for males compared to that for females in the United States. Similar patterns are evident in almost all economically developed countries, although their timing and levels differ. The patterns in less-developed countries will likely follow similar patterns as concerns emerge about the effect of smoking on the mortality of their citizens.

The objective of this paper is to compare smoking prevalence and cessation by gender and the effect on smoking-attributable and, in turn, all-cause mortality. A summary of mortality attribution approaches used to enhance the evaluation of the effect of smoking and projections of mortality rates by gender is also provided. ■

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Examining the Evidence:
Blood, Guts, ASOPs and Delivery System Reform

By Tia Goss Sawhney and Bruce Pyenson

Health care reform's first stage, insurance reform, has now become business as usual and health actuaries have thrived. The Affordable Care Act (ACA), Medicare risk, and Medicaid managed care are well matched to actuaries' skills in quantifying and assimilating complex financial and benefit rules. Many of us can relax and work in actuarial silos—at least for now.

The second stage, care delivery system reform, promises to make Americans healthier and happier and at a lower cost, at least according to the Triple Aim.[1] Care delivery reform is about value, data and transparency—for example, determining which hospitals and doctors are really good, and what makes them good, so others can learn from them. Care delivery reform is another natural match for actuaries. While the profession is quite comfortable working with the payer industry's mega-data and financial managers, this second stage tests actuaries' adaptability outside traditional silos, answering new questions and serving new clients.

Silo-breaking is not for soloists. For these new challenges, actuaries will need help from other professionals. Other professionals will also seek help from actuaries. A medical director might ask an actuary for help demonstrating the value (or not) of an intervention administered by a vendor. Actuaries will ask non-actuarial professionals for key insights; for example, an actuary charged with evaluating virtual colonoscopy as an alternative to colorectal cancer screening by optical colonoscopy might ask a clinical researcher about the importance, or not, of very small polyps. Given this two-way street, we need to quickly learn what we don't know as a profession and as individuals—and size up what others don't know.

The care delivery system seeks actuaries because of our knowledge and skills. We've seen a growth in work with provider systems, pharmaceutical companies and policy consultants. However, this sometimes does not end well for actuaries or their employers. The mechanics of working with delivery system issues may appear familiar to actuaries, but the different contexts can be a trap for the unwary. For example, the authors recently reviewed a report where an actuary using a familiar claims database greatly understated the prevalence of an ambiguously described clinical syndrome. Clinical or epidemiological insight would have helped to avoid the problem. Our skills from the silo can turn to embarrassment when the context changes.

PROFESSIONALISM: DO YOU STAY IN THE SILO—OR NOT?

Of course, actuaries rely upon the work of other professionals, inside and outside of their organizations. Actuarial precepts and standards require actuaries to assume individual responsibility for actuarial work products. How do actuaries responsibly incorporate the work of non-actuaries, especially medical or delivery system experts?

Many health actuaries will, sooner or later, run into a project where blood and guts just can't be ignored. Actuaries, with little to no clinical training, would then (hopefully) engage with clinical professionals who often have little to no mathematical training. For the actuary, neither working without clinical input nor blindly trusting clinical professionals is a good option.

The authors routinely work on clinically focused and multidisciplinary projects with people who challenge but respect one another across disciplines. We have learned that "many years of actuarial experience" or "the ASOPs say …" will not discourage clinicians from questioning us. Everybody takes responsibility for the integrity of each other's work and that includes us, as actuaries, taking responsibility for clinical assumptions.

The Actuarial Standards Board (ASB) standards expect this type of inter-professional relationship—sort of. According to the standards, actuaries must generally take responsibility for the

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ASOP 41, ACTUARIAL COMMUNICATIONS

3.4.3 RELIANCE ON OTHER SOURCES FOR DATA AND OTHER INFORMATION

An actuary who makes an actuarial communication assumes responsibility for it, except to the extent the actuary disclaims responsibility by stating reliance on other sources. Reliance on other sources for data and other information means making use of those sources without assuming responsibility for them. An actuarial communication making use of any such reliance should define the extent of reliance, for example by stating whether or not checks as to reasonableness have been applied. An actuary may rely upon other sources for information, except where limited or prohibited by applicable standards of practice or law or regulation. Further guidance on when such reliance is appropriate, and what the actuary's responsibilities are when such reliance is stated, is found in ASOP No. 23, Data Quality.

reasonableness of data, assumptions and methods provided or selected by others, including non-actuaries. An actuary, however, may elect to disavow responsibility for assessing reasonableness and simply "rely" upon others (see sidebar).

Compared to the ASB approach, we prefer the guidance of the International Committee of Medical Journal Editors (ICMJE) for defining the role of authors.[2] The ICMJE says that all authors must give final approval of the paper, agree to be accountable for all aspects of the work by (at a minimum) ensuring that questions related to the accuracy or integrity of the work are investigated and resolved, and have confidence in the integrity of the contributions of the co-authors. While the ICMJE acknowledges that co-authors will very often be responsible for specific portions of the work, all authors share global responsibility. A co-author or solo author cannot disclaim responsibility by stating reliance on others.

GETTING COMFORTABLE, BUT NOT TOO COMFORTABLE

So, how can a health actuary become comfortable with clinical care issues? The actuary will need to have an understanding of the topic's vocabulary and science. Just-in-time Internet searches and conversations with co-authors are likely, even for clinical professionals. However, actuaries who use such rapid learning will already need to have knowledge of common scientific methods, literature searches, biological sciences and/or clinical practices. An actuary lacking the basic knowledge to readily grasp the clinical aspects of the project should reconsider whether he is qualified to play a leading role. Obtaining the necessary knowledge is never "beyond the scope of the assignment."

Assumptions and methods that work quite well within routine, narrowly defined actuarial projects may not work well for more novel or broadly defined projects. Even datasets familiar to the actuary can present huge challenges when redeployed for use with therapeutics or the bio-sciences. We recently advised an actuary who was trying to estimate cost loads for obesity in connection with a mortality study. Recognizing that obesity is rarely coded in claims datasets, she tested using surrogates such as diabetes and developed an unusually high "burden of disease" estimate. A quick literature search informed the actuary that about half of diabetics are not obese—and led her to other methods.

Numbers about clinical care or health events should get the same scrutiny from actuaries as if they were reviewing "pure" actuarial work. In the authors' experience, the techniques actuaries use to critically examine actuaries' methods and assumptions also work well for reviewing input from clinicians and other non-actuaries.

Even basic numbers from the health literature need verification for both accuracy and context as a published number is not guaranteed to be the correct number, let alone generalizable to a new context. Numbers and risks are ours to examine, no matter the source.

Likewise, the vocabulary and communication styles that work well within the actuarial community don't work as well outside the community. For example, non-actuaries understand "health service use" but not "utilization," graphics may be more effective than tables in communicating with non-actuarial audiences, and a comprehensive report may need to be presented in layers with an abstract or an executive summary and then the report.

LEADERSHIP—CHALLENGING AND PRECARIOUS

Actuaries on multidisciplinary teams can lead through questioning. When someone's contribution appears unsound, we should recognize it as a learning or teaching opportunity rather than asserting that they have made a mistake. The real issue may be as minor as differences in professional vocabularies. Or it may be that our fresh eyes and perspective have discovered an anomaly or a critical problem—or (our favorite!) that our actuarial gut sense was misinformed.

Working within a collegial, multidisciplinary team is both fun and hard, especially if the project involves new topics and professionals who have not previously worked together. Doing it well results in a superior work product and learning for everyone involved. ■

ENDNOTES

1   Institute for Healthcare Improvement, "IHI Triple Aim Initiative: Better Care for Individuals, Better Health for Populations, and Lower Per Capita Costs," [Online]. Available: *http://www.ihi.org/Engage/Initiatives/TripleAim/pages/default.aspx.* [Accessed June 15, 2015].

2   *http://www.icmje.org/recommendations/browse/roles-and-responsibilities/defining-the-role-of-authors-and-contributors.html.*

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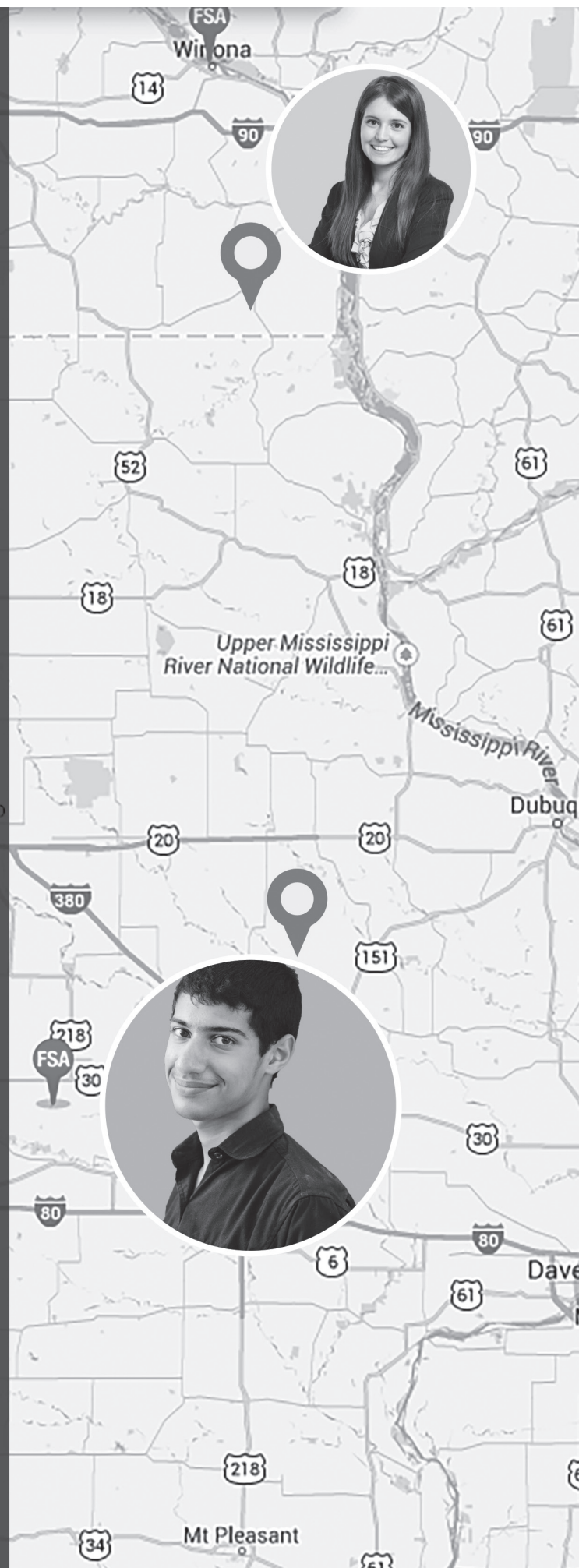
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