The Value of PSA Screening in Underwriting

Prostate cancer is the most common malignancy among men aged 45 and over. An estimated one in six men will be diagnosed with prostate cancer in their lifetimes, though the risk of death is only one in 35. While many clinicians believe that men generally will die with prostate cancer rather than because of it, that is not always the case. The introduction of the prostate-specific antigen, also known as PSA, led to the thought that early detection could improve both mortality and morbidity from the disease.

Clinicians began using PSA for prostate cancer screening in the mid-1980s. Its use was quickly accepted, despite the lack of studies demonstrating the hoped-for benefits. Life insurers rapidly added the PSA screen to their underwriting requirements for fully underwritten male applicants, and it is commonly required for all male applicants age 45 and older. They hoped that this test could prevent earlier death claims and reduce adverse selection by men who knew their PSA was elevated or those already diagnosed with prostate cancer.

The Pros and Cons of the PSA

Over the past 30 years, the medical field has accumulated more data about males screened with PSA testing and treated for prostate cancer. Interestingly, the data appears to support doctors who argue that screening for prostate cancer, while detecting some cancers earlier, will not have any measurable improvement in overall survival, especially in males diagnosed after age 75. The PSA screen, however, has its advocates and its opponents.

Dr. Oliver Sartor, medical director of the Tulane Cancer Center, estimates that prostate-cancer mortality rates have decreased by 40 percent since screening became routine in middle-aged males’ physical exams.¹ He says prostate cancer monitoring (with the PSA as a component) has helped identify an estimated 17,000 cases of metastatic cancer annually.

However, according to Richard Albin, MD, a pathology professor at the University of Arizona’s Medical College and discoverer of the PSA, the screen is imperfect and may actually be harmful.² Key to his view is the high level of false positives the test generates.

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SCOR regularly reviews its mortality pricing tables to ensure that they are the most up-to-date, accurate and client-specific based on available proprietary data. Our pricing team, comprised of actuaries, product developers, statisticians and underwriters, reviewed SCOR’s tables last year and introduced several changes that reflect both emerging experience and our best estimates for future projection.

We found that logistic regression tools can be useful in creating or updating mortality experience tables. The models’ results have been instructive in helping us not only understand our inforce business but also project how business may perform under different scenarios. This allows us to price reinsurance rates more accurately on a client-by-client basis.

However, constructing a useful model is not a simple task. Perhaps most importantly, the modeling requires a large amount of data on existing business to produce credible results. I outline some of the features, benefits and challenges below.

Logistic Regression Model
Logistic regression can be used as a predictive model to estimate mortality for an insured population. This model has the general form of

\[ q_x = \frac{e^{(\alpha + \beta_1 x_1 + \beta_2 x_2 + \ldots)}}{1 + e^{(\alpha + \beta_1 x_1 + \beta_2 x_2 + \ldots)}} \]

Where

- \( q_x \) is the predicted mortality rate (dependent variable)
- \( x_1, x_2, \ldots \) represent the risk drivers used in the study (independent variables)
- \( \alpha, \beta_1, \beta_2, \ldots \) represent model coefficients derived from the experience data

In other words, the linear regression common to most business school graduates only allows for a dependent variable value of 0 or 1 – in the case of mortality, for example, determining whether a subject is dead or alive. In contrast, logistic regression allows for non-binary values. In the case of mortality experience, we expect the value of the dependent variable \( q_x \) to range from zero to one, allowing an analyst to determine the probability of death given particular risk drivers.

Companies can determine their own set of risk drivers (\( x \)) based on the data they have available. The more credible and specific the data, the more credible results the model will produce. Figure 1 provides examples of such drivers, grouped into distinct categories.

### Figure 1 – Key Risk Driver Categories

<table>
<thead>
<tr>
<th>Risk Driver</th>
<th>Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Issue age</td>
<td>1 to 99 as a continuous variable</td>
</tr>
<tr>
<td>Duration</td>
<td>Continuous variable</td>
</tr>
<tr>
<td>Study year</td>
<td>Continuous variable</td>
</tr>
<tr>
<td>Face amount</td>
<td>Banded</td>
</tr>
<tr>
<td>Risk class</td>
<td>Preferred, Residual, etc.</td>
</tr>
<tr>
<td>Gender</td>
<td>Male or female</td>
</tr>
<tr>
<td>Smoking status</td>
<td>Smoker or nonsmoker</td>
</tr>
<tr>
<td>Product</td>
<td>Term, whole life, UL, etc.</td>
</tr>
<tr>
<td>Underwriting</td>
<td>Medical/Paramedical, Nonmedical</td>
</tr>
</tbody>
</table>

Values for a set of independent risk drivers are used to create models that predict mortality rates for the experience tables.

Issue age, duration and study year may be treated as continuous for three reasons:

- To estimate smoothed relationships between \( q \) and these variables
- To allow the coefficients of these variables to be transformed as mortality slopes
- To enable model-based mortality projections for older ages and longer durations where data may be sparse or unavailable

Adjusting the Experience
After constructing base experience tables, the pricing team will typically need to make adjustments to create tables suitable for pricing new business. A couple of examples of adjustments that may be needed include negating the effect of selective lapsation and accounting for mortality improvement.

#### Negating the effect of selective lapsation
Much of the experience for later duration mortality comes from issue year eras that experienced very high lapse. For example, during the 1980s average lapse rates for term insurance ranged from 15-20 percent in durations 1-10 to 9 percent for durations 11 and after. In comparison, today’s lapse rates range from around 6-7 percent for those earlier durations, grading down...
to 3 percent. If the cohorts issued insurance in the 1980s experienced some level of selective lapsation (i.e., better risks lapsed leaving poorer risks inforce), then the experience we measure today for those groups is higher than what we should expect from a newly issued cohort going forward. To negate some of this anti-selective mortality, a company can perform successive Dukes-MacDonald calculations to back out the effects. (For a description of the Dukes-MacDonald theory, see my November 2011 *Messenger* article “2001 VBT – Caution: Steep Hill Ahead.”) Removing the effects of selective lapsation will result in lower mortality in later durations.

**Accounting for mortality improvement**
A company may develop their own annual mortality improvement rates based on historical US population data (for example, from the Human Mortality Database, available at www.mortality.org). Annual improvement rates by gender and attained age can help in developing factors applied to both select and ultimate experience mortality to reflect the impact of secular trends. Experience tables should be generationally improved from the mid-point of the exposure period to the current pricing era (e.g., 2013). Then, separate durational factors can be added to reflect future improvement.

Although we have seen continual improvement in mortality throughout the 20th and early 21st centuries, this does not imply that it will continue forever into the future. A direct writer’s actuaries will need to determine the most appropriate length of time to incorporate durational improvement, depending on their view of future trends.

**Logistic Regression’s Benefits, Challenges**
Logistic regression can be a useful tool in reviewing and updating pricing mortality tables. Its particular strengths include:

- The ability to control and analyze multiple explanatory variables directly related to an insured population or block of business
- Insights into relative mortality relationships among the risk drivers
- Less stringent theoretical assumptions
- Relative ease in implementing with commonly available software systems

However, the benefits do not come without challenges. Critical to the model is the requirement for copious amounts of policy-level data on a large heterogeneous block of business, in a useable format. While industry data may suffice as a proxy (alone or in tandem with some degree of internal company data), a carrier’s pricing team must remain aware of the unique features of its own business. Heavy reliance on industry data may require at least some adjustment to credibility expectations.

Additionally, even with available data and systems, the modeling process is a laborious task that should be reviewed by multiple layers and departments within the insurer. SCOR’s pricing team includes pricing and marketing actuaries, statisticians, sales staff, underwriters and risk managers. Recruiting this team and gaining their commitment can be an overlooked but critical challenge.

**Your Reinsurer Can Help**
SCOR’s current pricing mortality tables, along with deal-specific adjustments based upon client experience, represent our best estimate view of future expected mortality for a block of fully underwritten life reinsurance issued today. Using a combination of our own and industry experience, our pricing team has developed robust statistical models to create best-fit mortality rates for male and female / smoker and nonsmoker. Using actuarial expertise, we have adjusted the experience to produce tables appropriate for pricing new business. These tables are the current expected basis in our experience study system with which we can monitor emerging results against this new set of mortality expectations.

As an aggregator of record-level data, SCOR has invested considerable resources in examining company data and the resulting “fit” to the client’s business strategies (see next article for a discussion on real-world benefits we have offered to clients). Our sales and pricing staff look forward to assisting our clients in developing their own effective reviews of existing and proposed pricing strategies.

Seriatim Reporting Adds Value to Insurer Pricing

By George Hrischenko, FSA, MAAA
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A few years ago a client requested a quote for YRT reinsurance coverage. They presented their mortality tables along with the seriatim data used to develop those tables. They informed us that an outside actuarial firm had just reviewed and approved the proposed tables. Upon review we discovered some material anomalies. When we presented our findings – and the potential loss in revenue that they could experience – the client was shocked. Their actuaries revised the tables based on our findings; as a result, the insurer is writing competitive and profitable term life.

The most helpful tool in identifying these situations is our massive database of client seriatim data. The availability of per-record data allows our actuaries and underwriters to examine current mortality experience and provides the starting point for a genuine conversation with clients about their marketing strategies and product goals. For many insurers, collecting such information in a usable format for their reinsurers is a laborious task and, therefore, not a high priority. Carriers incur costs in time, labor and systems. However, the resulting benefits of providing seriatim data often outweigh these costs.

More Accurate (Re)Insurance Rates
For term life reinsurance quotes many carriers submit premium rates based on their internal tables and request the rates we would charge based on their tables. This provides an opportunity for our marketing actuaries and underwriters to have a productive discussion about the direction and velocity of their rates. Most of these discussions result in the insurers adjusting their rates not only for the cost of reinsurance but more importantly for the value added by gaining the reinsurer’s view on the projected performance of the book. In some cases the final premium rates that insurers charge end up greatly different from their initial rates. If an insurer cannot provide such data, we must adjust our reinsurance rates to reflect the greater uncertainty from not being able to see the business at a granular level.

A Partner on the Risk
Actuarial consulting firms do a good job at reviewing a proposed product and recommending a rate structure to a direct writer. However, when the case is closed, their role is concluded. In contrast, reinsurers remain engaged to ensure that the rate structures support the carrier’s underwriting, marketing and profit strategies. In addition to being a risk and capital partner, your reinsurer can also play important consulting and advisory roles. Data submitted to SCOR not only helps direct writers avoid potentially significant pricing errors but also identify areas for growth.

Arms-Length, with Vested Interest
From time to time many carriers consider changing their class structure, modifying their reinsurance guidelines or taking a different approach to band pricing strategies. Using seriatim data, reinsurers can apply the proposed changes to their data set and simulate future performance of the affected block of business – before the client makes the product modifications. We can help determine what mix of mortality, lapse, band and class structure should create the best performing product given the carrier’s unique underwriting and marketing strategies.

Reinsurers assist direct writers in supplying consumers with sufficient insurance coverage at an appropriate rate. Therefore, reinsurers are in effect an extension of the direct writer, participating not only in various aspects of the risk under its reinsurance treaties but also in assisting the direct writer in developing its business strategy and objectives.

To provide the greatest value to the client, reinsurers need access to the same data that direct writers have. Using our experience database, we can “torture” the client’s data, slicing and dicing the information in a variety of ways to observe underlying trends. We can segment the data by band, gender, issue age, risk class, etc., apply the data to our table (or an industry table) and review the results for anomalies. Once we identify the outliers, we can examine the underlying data more closely and against the carrier’s underwriting and marketing strategies to determine what might be happening with the block. In some cases the adverse results may simply be due to normal fluctuations or specific company goals. However, such a thorough review can also help expose fundamental weaknesses in an insurer’s pricing assumptions or risk controls.

Real-Life Examples
Here are a few real-world examples of where access to such data resulted in tangible benefits for SGLA clients:

• *Experience Studies.* In trying to validate seriatim data provided by a client, our pricing team could not duplicate durational exposure amounts tied to the
client’s issue and termination dates. After reviewing our findings with the client, we discovered that the client had recently converted their experience studies from a grouped basis to a seriatim basis but had continued a “grouped” approximation approach for exposure calculation. While the client knew this approximation introduced some conservatism into their experience studies, they were surprised at just how conservative they were: the seriatim adjustment resulted in 10 percent overall better mortality experience and as much as 50 percent better experience in the first two policy durations. As a result, we were able to offer a much more competitive quote that the client could convert into a much more competitive product.

• **Proper Data Set.** A client submitted a request for quote, providing seriatim data on request. Our pricing actuaries applied the data against our tables and identified a block of policies with mortality experience that was consistently more than 500 percent of expected. We brought the issue to the client’s attention. Upon further investigation, the insurer determined that this particular segment of the business involved group conversions and should not have been included in the quote. After identifying and correcting the issue, the insurer resubmitted requests for reinsurance quotes, and we were able to provide a much more competitive rate.

• **Gender Mortality.** A fraternal requested a quote on a new term life policy they planned to introduce and provided their pricing tables. After applying our tables to the business, our pricing actuaries had difficulty in matching their gender-based pricing. Mortality experience for males was much higher than for females, though this discrepancy was not reflected in the client’s pricing. We discussed this issue with the client and worked with their underwriting team to identify probable causes for the material pricing differentials. The client used this information to adjust its male pricing tables.

Acting as a genuine business partner, a reinsurer can advise a life insurer on how to optimize its business strategy and capital deployment. To get the greatest advantage of this relationship, a carrier needs to provide seriatim data as part of the reinsurance treaty process. Your reinsurer can return the favor by providing a much more in-depth summary of your business.
Public perception on marijuana use has been evolving for the past couple of decades. A drug once considered taboo increasingly is becoming more generally accepted, at least in certain states. As of this writing, four states have legalized some use of marijuana: California and New Jersey for medicinal use and Colorado and Washington State for recreational use. Massachusetts passed a referendum in November calling for its legalization for medicinal purposes.

Other state legislatures have bills on their dockets to legalize marijuana for either medical (11) or recreational (five) purposes (Figure 1), though passage is not guaranteed. Still other jurisdictions have taken a light-handed approach to enforcing laws on marijuana use and possession.

Marijuana, Mortality and Morbidity
Although marijuana is a common recreational drug, very little medical research has been conducted on its effect on mortality and even less so on an insured population. Studies performed to date indicate that, all other factors held constant, marijuana has either negligible\(^1\) or inconclusive\(^2\) effects on mortality. Marijuana use after certain cardiovascular surgeries appears to be the exception and may adversely affect mortality.\(^3\)

However, underwriters may wish to consider other circumstantial information when underwriting an applicant who uses marijuana. Frequency of use or criminal history may shed light on marijuana being part of more questionable behavioral or psychosocial issues. Underwriters may also wish to consider evidence of the drug’s use as a gateway to using other, more potent, addictive or lethal drugs or use in conjunction with common recreational drugs (e.g., alcohol). Factors such as applicant age can be more difficult to interpret (Figure 2). These and other qualitative factors will require an underwriter’s judgment – and therefore company weighting of such factors likely will vary.

The chief underwriters responding to our survey cited the APS as their most common resource for determining a marijuana user’s risk classification. Underwriters also consider age, frequency of use, criminal background checks, motor vehicle records and chemical profiles.

In contrast to the relative lack of mortality information, morbidity effects are better understood and negatively correlated to marijuana use. Connections between drug use/abuse/addiction and mental illness, while not present in all patients, are fairly well documented.\(^4\) Mental problems that commonly accompany drug use include bipolar disorder, depression and anxiety, as well as mental trauma brought on by prior physical, mental or sexual abuse. Addiction counselors refer to patients’ drug use in these circumstances as “self-medication.”

In addition, drug use, including alcohol and marijuana, disrupts the natural release of chemicals in the brain including dopamine. Excessive drug use, including marijuana, may sufficiently alter normal brain chemistry introducing its own set mental and behavioral challenges, including tolerance, depression, anxiety, paranoia and apathy. Underwriters should become familiar with addictive medicine to understand the mortality and morbidity implications of common drugs.
State-by-state decriminalization efforts create difficulty in staying up-to-date on where marijuana use may be legal and under what circumstances. Companies should develop a consistent, defensible approach to how they treat marijuana use when underwriting life insurance.

### The Future of Regulation

It is fairly safe to say that the trend toward legalization will continue. While most pending legislation appears to focus on the medical benefits of marijuana, trends in California point to a fairly liberal definition of “medically necessary,” from the treatment of chemotherapy side effects to impairments of a more questionable nature. Unless other state bills are worded to control the circumstances under which the drug may be dispensed, it seems reasonable for other states to follow California’s lead.

However, the federal government still classifies marijuana as a Schedule I controlled substance, defined as a drug with “no currently accepted medical use in the United States, a lack of accepted safety for use under medical supervision, and a high potential for abuse.” The FDA has not assigned a National Drug Code for medical marijuana, and it is uncertain whether they will. (In contrast, medical cocaine is identified as a “hospital-dispensed drug.”) Carriers that increasingly rely on prescription drug databases to augment or replace information normally collected in the application may miss signs of underlying health problems for applicants in states that allow medical marijuana, especially when use of the drug replaces more traditional treatments.

Ultimately, it is possible that the Drug Enforcement Agency may derail state legalization efforts. The DEA likely will have the last word on determining marijuana’s legality. Companies commonly consider criminal background during underwriting, and obviously such laws could have an impact on the risk classification for an applicant with such a history.

While indications point to further state movement on legalization, a unified national approach is unlikely and may actually be preempted by federal law. Life insurers need to be flexible in responding to the potential changes that may arise with legalization efforts over the near term. The matter of legalization is far from settled and likely will be a patchwork for the near future.

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**Endnotes**

The Value of PSA Screening in Underwriting (cont’d)

While PSA can indicate cancerous cells, it is more likely that prostate infections or a benign prostatic enlargement (BPH) caused the elevation. This can create highly erratic test results. For example, a cancer-free man may produce a “normal” PSA count during a routine visit and a highly elevated count during a follow-up visit due to minor infection or high cholesterol.

Once an elevated PSA is detected, many doctors immediately refer patients for urologic evaluation and ultimately a prostate biopsy. Fortunately for the individual, many of these biopsies are negative for tumor. A treatment dilemma arises if a test indicates the possible presence of cancer: should the patient undergo surgical removal or extensive irradiation of the prostate and surrounding tissue, or should he simply be observed? Evidence exists that waiting for treatment with careful and regular observation can result in the same outcome for low to intermediate grade tumors, especially at older ages. However, many men faced with this decision will choose the more aggressive therapy, despite potentially significant complications including incontinence, rectal dysfunction and impotence.

The US Preventive Services Task Force’s current guidelines recommend against PSA-based screening for prostate cancer. “There is adequate evidence that the benefit of PSA screening and early treatment ranges from 0 to 1 prostate cancer deaths avoided per 1000 men screened.” The American Cancer Society recommends that “asymptomatic men who have at least a 10-year life expectancy have an opportunity to make an informed decision with their health care provider about screening for prostate cancer.”

A Question of Ethics?
If the test is not required by an applicant’s physician, can an insurer compel the applicant to submit for the test? Many insurers have defended the practice on free-market principles: applicants are always free to apply for coverage from carriers that do not require a PSA. Dr. Peter Albertson (University of Connecticut) maintains that the test’s goal is to identify applicants who are at higher risk of having cancer and therefore constitute a greater risk of loss.3

Christopher Coley, MD (Harvard University Health Service) disagrees. “Ethically, it’s really a problem to do a test and say, ‘We’ll deal with the consequences later’... PSA is particularly problematic because the clear proof of benefit, at least for the average man, just doesn’t exist the way it does for mammography, for instance.”4 Dr. David Atkins, the Agency for Healthcare Research and Quality, adds, “It is coercing men into getting tested with an unproven technology, which may actually do more harm than good to the individual. Second, it removes testing from the clinical setting where actions can be taken to reduce harms and maximize benefits.”5

A Matter of Effectiveness, Not Ethics
If a test is relatively ineffective in generating accurate and desired results, insurers should seriously question the value of requiring the test. However, the industry finds it highly difficult to discontinue a test once implemented. As it stands, both the clinical and insurance value of the PSA appear to lack significant merit for a majority of middle-aged males.∞

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Endnotes

2 Ibid.
4 Ibid.
5 Ibid.