R&D: Shaping Our Future

The life insurance industry is entering an age of innovation driven by technology and new data sources. Being part of this movement is an important part of SCOR’s mission. We have made a significant investment in research and development so that we can help our clients incorporate these advances into their day to day processes.

SCOR’s R&D efforts focus heavily on two themes: innovations in underwriting and mortality risk analytics, areas of prime importance to our clients as they seek to achieve growth and return objectives. In addition to this, we collaborate with our affiliate ReMark to support R&D efforts in alternative distribution and consumer engagement.

In this issue of SCORviews we highlight a number of projects underway at SCOR.

- A key initiative is the study of post level term and the relationship between premium increase, persistency and mortality. Actuaries Timothy Roy and Aisling Bradfield discuss their work on model development to further our understanding of policyholder behavior at the end of the level period.

- Another R&D achievement this year is the completion of our first SCOR Mortality Insight (SMI) study. Under the direction of Mary Bahna-Nolan, EVP and Head of Life R&D, a team of research actuaries studied the mortality experience of 18 companies. Project leads Katherine Warner and Colleen Murray cover highlights of the study.

- Sharing the R&D spotlight at SCOR is our continuing work to help transform the underwriting process and improve the consumer buying experience. Three SCOR innovators – Al Mele, Richard De Sousa and Rick Pretty – share views on accelerated underwriting, changing consumer attitudes and behaviors, and the potential of electronic data to replace traditional underwriting requirements.

To augment our R&D initiatives, SCOR and ReMark have become an anchor partner in Plug and Play Tech Center, a technology accelerator for startups and investors. Plug and Play’s focus on InsurTech is strong affirmation of where things are headed.

As ReMark’s Richard De Sousa states in his interview in this issue, Plug and Play’s attention to life insurance “means the industry is attractive for startups and real innovation across all sectors of our business is to be expected... It also shows that the industry participants recognize the changing landscape and are aiming to proactively embrace novel solutions either for internal improvements or better customer engagement.”
Every day hundreds of term life policyholders receive 60-day notices of rate changes because their level premium guarantee is coming to an end. The question for life insurers is: How many will exit and who will linger?

Enough experience has now emerged which provides a spectrum of outcomes that help us model the relationship between premium increase, persistency and mortality.

Life insurers have accumulated abundant lapse data, and mortality experience is emerging for policies in the early end of level premium durations. Where companies have less experience, however, is in clearly understanding the correlation between mortality, lapse and consumer behavior. The industry is working hard to increase its understanding of these interactions as more experience data emerges. This is a focus area for SCOR’s R&D team.

When the end of the product horizon is reached, a policyholder generally has 4 options:

- Lapse the product (stop payment and coverage).
- Replace with a new product, typically requiring at least some new underwriting.
- Convert to a permanent product, generally with higher premiums.
- Keep coverage while paying a new schedule of premiums.

Some variations of the last option exist, but this article is focused on the historically most popular version, which is known informally as Jump to ART. Typically this implies a large spike in the first premium followed by annual premium increases of about 10%. Future publications will discuss alternative versions which are becoming more prevalent.
This post level term (PLT) structure was added to US term products in the 1990’s and early 2000’s. Over the past number of years, experience has emerged and as a result analysis has been kicked off to observe the policyholder behavior in reaction to reaching the end of level period (EOLP).

Determining the appropriate post-level (referring to after the fixed period) premium to charge is not an easy task. Not only is the policyholder much older, but so much time has elapsed since the policy was last underwritten, especially for longer level premium periods, the risk classification is no longer very reliable. Often, companies increase the premiums by 10-20 times (or more) to deter most policyholders from continuing to stay on the books. The remaining policyholders are the least healthy and experience much higher mortality rates, behavior known as anti-selection.

Conversely, some products were priced with lower premium increases that would not only retain the anti-selectors but some healthier lives that would help offset the adverse mortality experience. Enough experience has now emerged which provides a spectrum of outcomes that help us model the relationship between premium increase, persistency, and mortality.

**SCOR’s Research & Development**

Given that SCOR reinsurers a large block of US term business and since term is a key product line for our clients, policyholder behavior at the end of level term is a prime topic for our Mortality R&D team. In late 2016, the team launched a major project to assess our PLT lapse and mortality experience on 10- and 15-year term products. Experience for longer duration level premium periods was not studied as data was limited.

The study includes premium information with more than 200,000 lapses and 1,000 post-level claims, sufficient for a credible study. We performed thorough statistical analysis on this data and have built models for post-level behavior.
Shock Lapse

The initial lapse that occurs immediately before the first premium increase is referred to as the shock lapse and typically is the largest lapse rate. For higher premium increases, these rates can approach 100% and often are modeled at 100% beyond a certain threshold. Our research has shown that a Generalized Linear Model (GLM) produces a strong fit. Usually a logistic or negative binomial (i.e., over-dispersed Poisson) regression is deployed. Both models have attractive features: logistic regression ensures the outcome is constrained between 0 and 1 while negative binomial regression models counts and can account for high variance.

Premium increase is highly correlated with shock lapse and research shows no other variable provides as much explanatory power as premium jump. However, including additional extraneous and confounding variables are vital to producing a reliable model. Difficulties can arise from the association among the explanatory variables which should be accounted for. For example, age and premium jump have a compound effect which can be modeled by including an interaction term. Some factors are assumed to have a direct effect (such as age) while others are confounding variables and may be used as a proxy – for example, face amount can be used as a socio-economic proxy and as a proxy for the nominal premium increase.

Even when accounting for common variables – such as age, sex, class, etc. – SCOR finds material differences in lapse behavior among companies. Some of these factors may be difficult to quantify and can be attributed to unseen drivers such as marketing strategy, geographic location and reputation.

Post-shock Lapse

Post-shock lapses can be modeled using a combination of the same factors used in the shock lapse model and an auto-regressive component. Again, careful treatment of the interaction among the explanatory variables needs to be considered. Using prior lapses as the input to the autoregressive component have produced successful models. In fact using the shock lapse and post-level duration as the only autoregressive inputs generate accurate predictions.

We strive to find a parsimonious model and perform several tests including cross-validation, factor analysis, ROC curve analysis etc. Still, professional judgment is used. For example if a slightly more accurate model is a lot more cumbersome to implement and maintain, the business needs are considered as well.

Post-level Mortality

Since we are only considering the “Jump to ART” product structure, most of the premiums follow a similar pattern: a large one-time premium spike followed by annual increases around 10%. While more data is still needed to provide a complete picture of post-level mortality behavior, called mortality deterioration, a definite pattern has emerged in the data.

Post-level mortality is typically modeled as the ratio of the expected mortality to the base mortality (expected mortality if no premium increases occurred). The Dukes-MacDonald algorithm and its variations have been successful in producing a table of estimates for these ratios.
Producing a discrete table to model PLT mortality behavior has been successful except for what may be the most crucial area: the high premium jump / high shock lapse cohort. A catch-22 often leaves us guessing what the mortality pattern extrapolates to for the high shock lapsers: we need a lot of exposure to produce credible experience but it takes a long time for sufficient exposure to emerge due to especially low persistency. Hence a flexible continuous function can help us understand how mortality might extrapolate and can be extremely useful when experience at the fringe is sparse.

A summary of the basic Dukes-MacDonald algorithm is as follows:

1. Assume a base lapse rate.
2. Calculate the shock lapse rate.
3. Assume the excess lapsers are a mixture of healthy lives and anti-selectors.
4. Assume the persisters are a mixture of healthy lives and anti-selectors.
5. Assume the sum of the excess lapsers and persisters equals the expected base mortality.
6. Back into the persister mortality based on the above information.

A non-linear pattern in the PLT mortality behavior became apparent after using experience to produce a table varying by post-level duration and shock lapse bin. Using a variant of gradient descent (with momentum), we calibrated a function that fit the table and the data using only shock lapse rate and post-level duration as the input variables. This allows us to produce a continuous spectrum of outcomes and model the high shock lapsers more accurately.

**Going Forward**

As more experience emerges and data become richer, we have more models at our disposal, including machine algorithms which usually require a large depth of data to be successful.

PLT experience from products with longer level periods, such as 20- and 30-year periods, are beginning to emerge. SCOR is committed to extending the R&D work to deepen our understanding of policyholder behavior around this important product feature. Associations we have yet to include in our modeling but have reason to believe exist will become practical as we collect more data.

In addition, other post-level premium structures have become prevalent in the market and our research is expanding to study differences in lapse and mortality as premium structures vary. Different structures will likely have different models to begin with, but with enough data we may have the ability to create a model that generalizes many of the premium structures into one model.

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**SCOR Is Here to Help**

The R&D teams have advanced the understanding of post-level behavior significantly through this exercise and continue to learn more. SCOR would be happy to share these findings with your company. Please contact the R&D teams to discuss our study results in more detail.

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Innovations in Life Insurance

Technology and data are disrupting practically every aspect of life insurance. In the following interview, we talk to three SCOR innovators who are advocates of doing things differently. Al Mele heads our Velogica® automated underwriting solution, Richard De Sousa directs non-traditional distribution programs for SCOR’s Global Distribution Solutions, and Rick Pretty leads our underwriting R&D team.

SCORviews: Velogica was one of, if not the first point of sale, instant life underwriting system, and you’ve been the technical expert behind the system from the beginning. What’s the biggest surprise to you in the way this has played out?

Al: I thought the adoption rate of automated underwriting would rise more quickly than it did, and that the availability of instant sources of data to bring into that process would increase at a faster pace. I think the industry has hit the tipping point on both... the information available now, along with the innovative ways of analyzing it and applying it to the underwriting process will make instantly available underwriting decisions the new normal.

What are some of the unexpected benefits of automated underwriting? Unexpected challenges?

The first Velogica cases were processed in 2005. Everyone has learned so much about these programs since then that what was unexpected then seems obvious now. Two things stand out as having been unexpected at the beginning but obvious in retrospect.

On the challenge side, the degree to which distribution may attempt to manipulate an underwriting process was unexpected. As the volume of business picked up we were able to identify that sort of manipulation by analyzing the patterns of business and implement sentinel controls to protect against it.

On the challenge side, the degree to which distribution may attempt to manipulate an underwriting process was unexpected. As the volume of business picked up we were able to identify that sort of manipulation by analyzing the patterns of business and implement sentinel controls to protect against it.

From the benefit side, we underestimated the value of consistency in the underwriting decisions. If you give a lengthy, complex data profile to 10 underwriters you might get five different opinions.

With an automated system you’ll get back the same answer for the same demographics and data profile every time.

From a systems perspective, what’s the biggest challenge in developing and maintaining a fully automated underwriting system?

There are a lot of challenges but the biggest is probably ensuring that the system is robust enough to handle unusual cases. For example, if one in a thousand cases has an unexpected value in the drivers’ license status field, we might see six of these in a single day. The logic, monitoring, and error resolution facilities must be extremely resilient. The number one concern is to ensure that there are no incorrect underwriting decisions. Close behind that is to prevent any adverse impact on downstream customer systems. So keeping the system robust while making improvements is the biggest challenge.

What are some recent upgrades? Planned upgrades?

Upgrades range from the relatively minor (enhancing scoring templates to incorporate additional applicant information as rule criteria) to the purely technical (migrating our back-end database platform) to major enhancements of underwriting requirements for use in fully underwritten programs. From our customers’ perspective, the most notable are:

- Rewritten logic supporting our reflexive questionnaire.
- Added ability for traditional evidence (e.g., blood and urine lab results, APS summaries and electronic inspection reports) to be submitted to Velogica for correlation with the instantly
available evidence. This facilitates “triage” decisions, avoiding expensive and lengthy evidence for cases that cannot be offered at the desired premium class. It also provides underwriter efficiency, allowing them one “touch” – and not until all evidence has been acquired.

- Criminal history has been added as a new data source.

Changes in progress now include support for clinical lab histories (going live in fourth quarter with our initial rule set) and credit-based mortality scores (first half of 2018).

*How do you test the effectiveness of the Velogica underwriting engine? How good an indicator are these results?*

For existing programs, the underwriting can be evaluated with an experience study (just like a traditionally underwritten program). An advantage of an automated underwriting program that is data-driven, though, is that you can identify and implement rule changes early in the process (without waiting for mortality to emerge).

For changes to underwriting rules we have an extensive quality process (over 30 quality checks ranging from requirements review at the start of a new change to a post-release audit at the end), but the most protective of these is what we call our “retrospective rescore”. For each release which touches the underwriting logic a retrospective rescore will be performed (typically on a six-month block of business).

The results of this rescore will be compared to production, and variances from the production outcome will be examined. The Product Owner and Underwriting team will examine the rescore to determine if the outcome in the rescore matches the baseline pre-release outcome. For variances, explanation is provided as to whether the change was intentional based on the work done in the release. Unexplainable variances are investigated and resolved prior to release. It may sound like a slow process, but we’ve gotten the rescore process down to just a few days.

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**Richard De Sousa**

Managing Director, Europe and Americas, ReMark (owned by SCOR, Remark forms part of SCOR’s Global Distribution Solutions)

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**SCORviews: How are the global resources of SCOR being used to support innovation in life insurance distribution?**

**Richard:** Within SCOR Global Distribution Solutions, which includes ReMark, our focus is to support our insurance partners globally in understanding and engaging with their end consumers. We see how quickly technology is enabling consumers to inform themselves and purchase very differently than how they used to – just a few years back – and we aim to remain ahead of that curve.

**What are the most significant changes in “direct to consumer” marketing?**

The most meaningful change in direct to consumer marketing is that companies are coming to realize that to drive growth they need to focus on the consumer journey rather than just the offer. A price and brand strategy alone are not sufficient differentiators to attract consumers who are more likely to purchase from an insurer if it’s easy and relevant for them.

We see insurers decreasing media spend (TV ads, for example) to re-invest in social media forums. From these forums, consumers signal interest and are guided through mobile application (with an increasing amount of chatbot usage powered by artificial intelligence) to review tailored product offerings. If the consumer wishes to speak to a “live agent” – without leaving the environment – they should be able to do so. This makes channel management more difficult for insurers but consumers want to transact where and how they feel most comfortable, including using multiple channels during the same purchase.

**ReMark conducts an annual Global Consumer Study (GCS). What are some takeaways from the last study that every life insurer should keep top of mind?**

The 2016 edition, “You Can’t Always Get What You Want,” focused on the perception of life insurance needs from the viewpoint of the consumer and the inherit trust (or not) that they have in the industry. Some of the key takeaways were:

- Consumers globally have a certain level of cynicism about the purchase of life insurance, and some doubt the relevance of purchasing it. To curb this trend, insurers need to invest more in value propositions and consumer incentives.

**Continued**
Innovations in Life Insurance

ReMark’s 2017 study finds that a focus on health is a way in to the consumer for life insurers.
The full study, “Life is a Rollercoaster” is available at http://remarkgroup.com/life-is-a-rollercoaster/. For a print copy email your request to scorgloballifeamericas.com

- Consumers often don’t understand what they want or need. Product innovation needs to extend beyond features to components that are relevant, such as the need for Health and Wellness. Products need to be simple to understand and transact.
- Consumers in most markets are generally willing to share personal data from their wearables if they can gain a tangible benefit from doing so. Hence the growing trend in rewarding healthy lifestyle behaviors.

What can you tell us about the recently published 2017 study?
“Life is a Rollercoaster” is our 2017 edition and focuses on a few key themes:

- The behavior and attitudes of millennials towards life insurance and protection in general. This market segment is much sought after but difficult to engage.
- The need to respond to changing attitudes and behaviors by focusing on health as a way in to the consumer for life insurers.
- A focus on automation to make purchasing seamless (integration of data sources, reducing repetition, improving the user experience and making the purchase easy).
- The need to reduce the burden of choice to empower rather than overwhelm, and to reframe propositions in a more positive way to chime with, encourage and reward contemporary desire for a healthier lifestyle.

In the past, innovation came from within insurance companies and with traditional external vendor/partners. Now we see InsurTech startups moving into the insurance space. What’s driving this?
The most interesting aspect of most of these InsurTech companies that are moving into the insurance space is that they often aren’t from the insurance industry. Once launching their products, they realized the very strong applicability their products or services have in the insurance space which is very broad (covering life, health, property & casualty). The additional attraction for these startups is that Insurance is a very established industry and is traditional in its approach to change. So the breadth of applications that be can be deployed combined with the perception that the industry is ripe for change, if not outright disruption, is motivating many newcomers.

Plug and Play is a technology accelerator for startups and investors. They now have an InsurTech program. What’s the significance of this to the industry?
Plug and Play has been operating for more than ten years and has invested in some of the biggest brands we know today, such as PayPal and DropBox. Their InsurTech vertical is relatively new but has grown to be one of their biggest verticals in the past 18 months with many insurers, brokers and reinsurers joining the program in search of innovation.

The significance is twofold. Firstly, it means the industry is attractive for startups, and real innovation across all sectors of our business is to be expected. Secondly, it shows that the industry participants recognize the changing landscape and are aiming to proactively embrace novel solutions either for internal improvements or better consumer engagement.

You attended the recent Plug and Play Expo. What areas of life/health insurance are generating the greatest interest among startups and entrepreneurs
We attended a selection summit and saw more than 50 start-ups present their products and services during “pitch” sessions. It was exciting to see so much energy and innovation being worked on across a wide range of our industry. For Life/Health specifically, the key areas were:

- Application of artificial intelligence for chatbots, distribution and consumer targeting.
- New sources of data and how to access them for better risk profiling.
- Health and wellness platforms – including gamification to incentivize the consumer to join and remain interested.
- New non-invasive technologies for diagnosis and prevention – watches, soles, socks, bands and more!
SCORviews: How are you using predictive models to assess the mortality impact of underwriting without fluids?

Rick: Since mortality is a lagging indicator and is often not credible, due to the large number of deaths required, we often need to use mortality proxies to supplement actual measured mortality. Predictive models tend to be far superior to any other methodology to connect inputs available at time of underwriting with outcomes (deaths).

Having said that, there are many different types of predictive models and the most suitable approach depends on the circumstances. We have a team of highly qualified statisticians who work with underwriters and actuaries to determine the best approach.

How close are we to getting to preferred risk pricing using an accelerated underwriting approach?

We are already there – it is entirely possible to define preferred and super preferred risk classes using new sources, such as credit based mortality risk scores. The issue the market still has to overcome is that the risks traditionally assigned to preferred classes by biometric centric selection approaches will be different risks than those identified by other methods. Innovative carriers will come to accept non-traditional underwriting practices and new products are sure to follow.

Why is it important to start the accelerated underwriting development process with a clear understanding of business objectives?

While the seeming similarity of selection approaches for many US companies makes it tempting to think that all are mostly the same, the reality is that different markets, differences in distribution, product and specific underwriting selection make every scenario different from the next. One size approach certainly does not fit all, so defining the most important business objectives is key. Accelerated underwriting is simply one additional way to accomplish some of these objectives.

What new data sources are too good to be true – or still a long way away?

Due to the non-structured format and lack of standardization among vendors, EHR (Electronic Health Records) may still be years away from being consumed by an automated engine. Although a PDF version of an applicant’s medical record may currently be available through EHR vendors, it does not help with ‘speed to issue’.

The holy grail of complete automation, including attending physician statements via electronic health records, is still out of practical reach.

There is a false presumption that today’s underwriting approach appropriately classifies all the risks.
MORTALITY ANALYTICS

SCOR Mortality Insight

In response to growing demand for research on mortality experience, SCOR has significantly expanded our R&D capabilities. Our goal is to give clients relevant, high value research that they can use to make business decisions and improve performance. SCOR Mortality Insight (SMI) is an example of the in-depth research we are committed to delivering as a service to clients.

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Broad based industry studies demonstrate general mortality trends, but shed little light on how an individual company’s experience compares to its peer group. To deepen clients’ understanding of their mortality experience, SCOR conducted a comprehensive study that offers participants a view of their experience against all study participants (aggregate study) as well as a select group of peers (peer group study). In the future, we look forward to possibility expanding the number of participating companies beyond those included in this initial study.

A total of 18 companies participated in our first SMI study. Analysis focused on traditional, fully underwritten business. The study covered years 2010-2014 and issue years 1995 and later in order to capture modern preferred underwriting classes popular in the market. Face amounts $50K and greater for Permanent (Perm) products and $100K and greater for Term products were also included. In general, these face amounts have similar underwriting and distribution methods. The study excluded conversions, COLI/BOLI business and SI/GI underwritten products.

Overall results of the study are below, using the 2015 VBT RR100 (2015 VBT) industry mortality table as the expected basis.

Key insights from the aggregate study

Product Type – Perm products appear to experience higher A/Es than Term products. This is primarily driven by older policies issued when underwriting was not split out into today’s preferred class structure.

Figure 2 - A/E by Product Type

Compared to Term, the issue year eras where Perm products are more heavily weighted to standard risk classes have A/Es that are higher than Term. For the issue year eras where Perm and Term products have similar exposure to preferred risk classes, they also have similar A/Es by amount. This is consistent with anti-selection that was observed in the market as Perm products lagged behind Term in the introduction of preferred class structures.

Figure 1 - Experience with Filters (each is weighted)

<table>
<thead>
<tr>
<th>Exposure Amount</th>
<th>Claim Count</th>
<th>Claim Amount</th>
<th>A/E Count</th>
<th>A/E Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grand Total</td>
<td>$15,903B</td>
<td>67,800</td>
<td>$26,873M</td>
<td>93.8%</td>
</tr>
</tbody>
</table>
**Underwriting Class** – The mapped underwriting class structure produces results where mortality improves with better risk classes. While preferred classes are broken out into ‘Prf+ NT’ and ‘Prf NT’, the standard class broke into standard plus and residual standard more recently. Due to lower credibility in standard classes, both are grouped into ‘Std NT’.

**Figure 3 - A/E by Underwriting Class**

Due to company-specific differences in underwriting requirements and thresholds, a considerable spread exists around this overall average. The above results provide ‘rules of thumb’ to inform a high level benchmark for reasonable levels of mortality by class but vary by company.

**Duration** – While the 2015 VBT does not remove contestable claims from the first two durations, a bump in duration 3 A/Es by amount continues to exist in the experience.

**Figure 4 - A/E by Duration**

Due to the construction of the 2015 VBT, lower A/Es in durations 1-2 are not expected. The study confirms this with durations 1-2 and 4-5 having similar A/E ratios, both of which are close to the overall A/Es of more recent issue year business overall. The higher A/E in duration 3 indicates an increase from what is expected in the VBT table. Experience after the contestable period ends varies among companies based on each company’s claims contesting policies and success rate.

The generally increasing trend by duration is partially due to the older issue years contributing to later durations. Where earlier issue years with less preferred business have higher A/Es, they also drive later duration experience higher.

**Face Amount** – A commonly observed pattern in mortality studies is improving experience as the face amount of policies increase. This downward trend substantiates the value of additional underwriting evidence required at larger face amounts and of socioeconomic factors that contribute to better mortality. More affluent policyholders tend to have better access to health care, healthier lifestyle choices and less exposure to certain hazards. This pattern is observed in the overall study up to and including policies at $1M. Thereafter, in face amounts greater than $1M, experience stabilizes and continued improvement is less apparent.

**Figure 5 - A/E by Face Amount**

The study results did not evidence deterioration in mortality at the highest face amounts above $10M. While high-risk behavior in the most affluent has been thought to create a ‘mortality smirk’, or uptick, results at these high face amounts did not support this hypothesis, though the analysis is based on a limited number of claims.

Continued
**Mortality Analytics**

**SCOR Mortality Insight**

Cont.

**Attained Ages 80+ –** Mortality begins to grade to population mortality at attained ages in the mid- to high-90s as underwriting selection and market forces have worn off.

As shown in Figures 6 and 7, older attained age mortality rates from the aggregate study range from about 90% to 95% of population rates for both male and female and begin to grade to 100% at the older ages. At these super high ages, mortality should begin to approach population. Underwriting has generally worn off and these super-seniors would be the very healthiest in the population (or else they would not have survived to these ages).

Any selection effects from initial underwriting or market forces should have almost completely worn off.

**Figure 7 - Mortality Rates for Females (Count)**

Through SMI, we value the opportunity to partner with our clients to analyze mortality in an innovative way. We hope that by doing so we collectively deepen our understanding of developing mortality trends and their contribution to strategic decision making.