More Depth, More Breadth in Reinsurance Solutions

With the acquisition of Generali USA a few months behind us, your SCOR team is following through on our promise to bring you the best attributes of both organizations. During 2014, we can offer you a broader and deeper set of products, services, skills and expertise. Here’s an overview of our reinsurance offerings.

- **Traditional life reinsurance.** As a full service life reinsurer, your coinsurance and YRT arrangements are reinforced by expert teams of actuarial, underwriting, finance, marketing and administration professionals.
- **Mortality and lapse knowledge.** An industry leader with unparalleled mortality and lapse experience, we are committed to developing and sharing new insights on the risks that drive the performance of your business.
- **Facultative underwriting.** Our newly combined underwriting and medical teams are committed to delivering fast and superior service to our facultative clients.
- **Velogica®.** Our automated underwriting delivery system has underwritten well over one million applications. The Velogica team is continually refining the highly sophisticated algorithm that drives this best-in-class underwriting solution.
- **Financial reinsurance.** As level premium term life blocks approach their peak reserve requirements, we are helping clients manage XXX reserves and capital strain with smart, compliant approaches and structures.
- **Longevity solutions.** We are providing cost-effective longevity solutions to assist clients in managing annuity tail risk, particularly through longevity swaps. We capitalize on SCOR’s global expertise in structuring the most efficient and useful approaches to particular longevity needs.
- **Group life reinsurance.** SCOR provides competitive risk management solutions for group life and accident lines. We also offer financial solutions that support our group clients’ capital optimization goals.

Our portfolio of products and services is supported by SCOR’s global infrastructure and backed by solid financial strength. This past November Standard & Poor’s raised the outlook on SCOR’s “A+” rating to “positive,” a testament to the company’s steadfast attention to risk management and solvency targets.

As we enter a New Year, let me take this opportunity to tell you how important your business is to us and to thank you for choosing SCOR as your reinsurer. We look forward to the year ahead and hope it brings many opportunities for us to work together. ∞

## Contents

**Building Permanent Structures to Address XXX Reserves**

By Scott Boug, FSA, MAAA, CFA

Senior Vice President, Global Deputy Head, Financial Solutions

Pg. 2

**Pricing a Single Premium Immediate Annuity**

By Matthew Daitch, FSA, MAAA, CFA

Vice President, Longevity Solutions

Pg. 4

**Mortality Experience – The Funnel Effect**

By David N. Wylde, FSA, MAAA, CLU, ChFC

Pricing Research Actuary, Life Solutions

Pg. 6

**New Ways to Estimate Insured Population Mortality**

By Zhiwei Zhu, PhD

Vice President, Risk Modeling & Analytics

Pg. 8
It has been a decade since the height of the term wars, when many life companies were selling policies at lower and lower rates and reinsuring the risk with reinsurers. Carriers then came to believe that they were leaving short-term profits on the table. They began to retain higher levels of risk in anticipation of financing future peak reserve strain through securitization.

The market collapse in 2008 derailed these plans. Today a number of companies are seeing their books of term business reach peak reserve strain. To compound the challenge, the timing of the peak coincides with the maturity of many “longer-term” (i.e., 5-7 year) letters of credit and other financing solutions that life insurers considered stopgaps on the way to securitization.

Today several companies are reassessing their options for financing redundant XXX reserves. The least attractive option is retaining the business unfinanced on the balance sheet. This causes a triple blow against a company’s statutory capital:

- Peak redundant reserves consume capital at an increasing pace
- Allocating that capital to address reserve strain is not an efficient way to deploy capital
- Unless a carrier stopped writing new level-premium term life 7-8 years ago, they are reaching a near constant level of capital allocation

Figure 2 outlines the steps in the process for structuring capital financing relief. A number of carriers were in the midst of structuring their own deals when the market crisis hit. Most financing activity came to a sudden halt at this point, demonstrating the extent to which these deals were exposed to execution risk – the risk that unforeseen events, internal or external, can jeopardize the entire venture.

The Term Concern
Companies that sell both permanent and term life products get considerably higher returns from their permanent business. Yet, even with tighter margins, most carriers are committed to offering term life because the product provides important consumer protection and is a necessary product to round out a producer’s portfolio.

Given the cost of financing peak redundant reserves, companies that are not “term shops” may view their mature term portfolios as more of a burden than an asset. The good news today is that as reserve requirements peak, financing options also appear to be opening again.

Reserve Financing Options
Straight insurance-linked securities designed for reserve financing are still limited; the investment community remains a little gun-shy following the housing bubble, and monolines, key players in past reserve securitization deals, are sidelined entirely. Reinsurers, by contrast, are
increasingly willing and able to help fill the demand for financing services.

By the mid-2000s, many life reinsurers had in place capital efficient structures to help companies manage redundant XXX reserves. These structures continue to enable reinsurers to offer competitive rates to life insurers who, in turn, can pass the savings onto consumers. At the core of many of these structures is coinsurance – a reinsurance tool that has proven its worth in building highly effective capital management solutions.

SCOR Global Life has developed a global Financial Solutions discipline to assist clients with reserve and capital financing. The key to our approach is flexibility – in identifying products that can benefit from financing, structures to use, structure ownership and client company strategy.

Our team leverages SCOR’s global expertise to help companies assess the best approach to their short- and long-term needs.

- We can enter into a coinsurance agreement (with recapture) to provide immediate reserve and surplus relief
- During the coinsured period clients can assess and elect the best structure for longer-term needs and count on us for support in executing these plans
- We work in tandem with clients to determine our role in managing strain and underlying risk through capital efficient structures
- We look beyond peak reserve financing to help clients optimize their portfolio’s entire performance
- In most cases our execution and financing costs are more competitive than other market options

Our approach addresses immediate needs for reserve and surplus financing, which gives clients more time to investigate other long-term or permanent options. As a reinsurer, we can assist in the development of these permanent solutions in ways that help clients deploy capital more effectively.

Figure 3 provides a snapshot of the relative strengths and weaknesses of different financing alternatives. SCOR can assist in structuring any of the alternatives listed in the illustration. An ideal approach to surplus management combines a short-term coinsurance solution with a future transfer of business to a permanent structure.

**Conclusion**

While most life insurers can manage peak XXX reserve redundancy with existing internal capital, such an approach is far from efficient. SCOR is helping clients find an effective solution and is serving as a key partner through the entire process.

If you would like to explore your company’s options, please contact your account executive. If you would like to speak more about specific deals you and your company may be considering, please feel free to contact me directly at sboug@scor.com or 704.344.2755. ∞

---

**Figure 3 – Comparison of Financing Structures/Strategies**

<table>
<thead>
<tr>
<th></th>
<th>Cost</th>
<th>Execution Time</th>
<th>Regulatory Approval</th>
<th>Complexity</th>
<th>Leverage Impact</th>
<th>Flexibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCOR Solution</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Coinsurance</td>
<td>–</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>LOC</td>
<td>0</td>
<td>–</td>
<td>+</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Conditional LOC</td>
<td>0</td>
<td>–</td>
<td>+</td>
<td>0</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>Funded Solution</td>
<td>–</td>
<td>–</td>
<td>+</td>
<td>0</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

Alternative structures above are rated, “+” as better, “–” worse and “0” as neutral. All financing options carry some challenge relative to others, and none is perfect. However, our flexible approach and willingness to enter short-term structures until permanent solutions can be implemented makes our services stand out.
Many editorials have been devoted to the need for a protected income stream in retirement and the public’s reluctance to annuitize savings. There are many reasons for this aversion: loss of liquidity, preference for mutual funds, a lack of focus on outliving assets, etc. As a result, annuities generally are sold as asset accumulation vehicles that rarely enter the distribution phase.

In recent years insurers have begun addressing product design to increase the attractiveness of annuitizing at least a portion of a retirement lump sum. Consequently, consumers may begin to appreciate lifetime income as a way to address their individual longevity risk. If an insurer has not already developed an annuity product to meet this growing need, now may be the time.

The question then becomes how to price a SPIA or income from a deferred annuity properly. There are three main components to pricing:

1. Net interest rate for a fixed annuity or the mortality and expense/rider charges for a variable annuity
2. Base mortality table
3. Mortality improvement assumption

Net Interest Rate
The interest rate used for discounting future annuity income benefits is made up of two components: the gross yield assumption and the expected spread. The gross yield assumption can be developed using a portfolio rate, new money rate or investment generation method. Regardless of the approach used, one should work very closely with the investment department to determine an accurate projection of the yield associated with the current asset allocation.

Once a company determines its gross yield, it subtracts its expected spread to calculate the net interest rate.

Base Mortality Table
A base mortality table is a company’s view of current mortality. Because unhealthy people are unlikely to buy an annuity, expected mortality should be significantly better than the general population. The best approach to developing a table is by using actual company experience. While we prefer to build an attained-age table from raw mortality rates, it is perfectly acceptable to perform an A/E study against an industry table and then apply adjustment factors to the table to reflect a company’s own experience (via scalars or setbacks). With enough credible data a pricing actuary can also layer on adjustment factors based on the relative size of annual annuity income and/or other information such as the existence of any guarantees.

Unfortunately, most insurers do not have credible internal experience to build their own robust payout annuity table. Annuity actuaries can use one of the annuity tables published by the Society of Actuaries as an alternative. Annuities are not underwritten so an industry table is likely to be a better fit for an annuity product than for life insurance, where a company’s underwriting guidelines can greatly affect experience. However, companies must still factor how their preferred distribution channel and target clientele choices may affect their table construction.

Historically, most companies have used the Annuity 2000 Table as the standard (with many applying a company-specific overlay). It is important to note that this table is based on dated information, a product of the 1983 A Table improved to 2000 using Projection Scale G (50% for females). Even if annuity experience is relatively similar, the table would be considered current only as of 2000, and needs to be generationally improved to an annuity’s issue date.

Recently the SOA published a new table for payout annuities called the 2012 Individual Annuity Mortality (IAM) Table. This table was developed from a prior SOA study on payout annuities covering 2000-2004, and then improved to 2012 (see Figure 1 for a comparison). Based

![Figure 1 - 2012 IAM vs. Annuity 2000](image-url)

As a percentage of the Annuity 2000 Table, the IAM Table projects lower mortality for older-age males and females until both sexes reach very old age, at which time the tables’ relationship inverts.
on the company’s annuity design (e.g., refund feature, liquidity provision), one can use adjustment factors from the SOA 2000-2004 Individual Payout Annuity Experience Report to make modifications to the 2012 IAM Basic Table.

**Mortality Improvement**

Mortality tables must reflect mortality improvement or they will be out-of-date before they are even used. First we must generationally improve the mortality table to the annuity issue date. We also need to layer in periodic mortality improvement for each future calendar year to project future mortality rates. For example, to project the attained-age mortality rate at age 70 for an annuitant who purchased an annuity at age 65 in 2013, we would modify the 2012 IAM Table as follows:

\[ q_{70} \times (1 - MI_{\text{generational}})^{2013-2012} \times (1 - MI_{\text{periodic}})^{70-65} \]

There are many schools of thought regarding mortality improvement. Historically, many insurers used the SOA’s Projection Scale G. The SOA has since published two new scales for US business. Projection Scale G2 was published in tandem with the 2012 IAM Table. This version was developed by modifying rates developed by Social Security Administration (SSA) actuaries, who derived the rates based on SSA experience.

In addition, the Pension Section of the SOA recently published Projection Scale BB. This scale uses past US population experience, projected forward using the Continuous Mortality Investigation tool developed in the UK for projecting improvement on a calendar year basis. The scale was developed by present-valuing the calendar year projection into a single vector of improvement rates.

However, traditional methods have consistently underestimated improvements in longevity. Both scales show significantly lower improvement than what was experienced during 2000-2010 (Figure 2).

Approaches popular outside the US include:

1. **Extrapolative Methods**
   a. Targeting methods, which interpolate between current mortality rates and a set of target rates assumed to hold at a certain future date (based on expert opinion)
   b. Trend methods, which involve projection of historical trends in age-specific mortality. This includes parametric models which involve fitting a parameterized curve (or surface) to past mortality data (aggregate or cause specific) and then projecting these parameters forward

2. **Explanatory methods**, cause-of-death and disease-based models relying on medical expert opinion, government health policy, socio-economic development, etc.

Annuity pricing does not require many assumptions, but developing a credible set is still complicated with multiple options and likely little credible experience. Given the long-tail nature of annuities, a carrier will only know whether pricing assumptions were valid after years of accumulating data (and business). Many stakeholders view this uncertainty negatively.

Life companies may wish to share some of the risk, which would allow them to grow assets in a risk-controlled environment. A reinsurer can partner with insurers in pricing annuities and participating on the risk. For example, longevity swaps are an easy tool to reduce exposure to mortality table basis error and the risk of underestimating future mortality improvement, with no up-front premium. Our sales and pricing staff look forward to discussing how we may help you manage the risk of your payout annuity block.
In analyzing client mortality studies over the years, I noticed that companies with very similar underwriting practices, guidelines, preferred criteria, and marketing strategies often have very different experience. Even after normalizing for age, gender, mortality class, exposure period and other identifiable characteristics, credible actual-to-expected (A/E) ratios for these supposedly similar companies can differ significantly. I call this phenomenon “the funnel effect,” i.e., a company’s mortality experience is partially determined by the population funneled to it (via distribution channels and market forces). Even though a company’s underwriting process selects and segments this applicant pool, if a company’s funnel draws from a population having worse/better than average mortality, such mortality deviations will permeate the company’s segmented experience due to unspecified, but relevant, population characteristics. Recently, I considered applying some science around my observed funnel effect hypothesis in order to “substitute facts for appearances.” This article discusses the results of such an experiment.

Defining the Experiment
The funnel effect implies that a company’s early duration mortality experience does not converge at some point to an industry average as measured by, for example, a Society of Actuaries Inter-company study or a reinsurer’s combined experience table. Thus, the concept behind my experiment was to see if a company’s mortality remained stable over durational time. In other words, did a company with high early duration mortality also have high mortality in later durations? Likewise, did a company with low early duration mortality have low mortality in later durations?

An ideal experiment would look at current early duration A/E ratios for a wide variety of companies and then follow these closed blocks of business for the next 30+ years to see if the initial A/E ratios hold steady into the future (all else being equal). This would provide solid evidence that individual company experience does not converge to a common level. Unfortunately, I did not have the luxury of waiting this long for results. Instead, using information from a large industry mortality study, I compared today’s recent experience among companies for policies issued during 1980-84, 1985-89, 1990-94, 1995-99, and 2000-04. This allowed me to view A/E ratio trends by company for durations 1-5, 6-10, 11-15, 16-20, and 21-25, using the SOA 2008 VBT as the expected basis. This form of the experiment is far from perfect due to marketplace evolution over the issue periods surveyed. Elements such as target market, product characteristics, distribution channels, underwriting philosophy, company reputation, and mergers/acquisitions could have affected historical mortality experience. However, I filtered the data as much as possible to compensate for these items.

Preliminary Results
I obtained data from 20 companies’ experience (labeled A through T). The first analysis entailed ranking the company A/E ratios from lowest (1) to highest (20) for each of the five issue era periods. Figure 1 shows the results for the seven companies that appeared to have very stable rankings from period to period. An additional nine companies had rankings that were reasonably stable (one anomalous period). The final four companies had rankings that varied from period to period.

These preliminary results were promising since they showed that many companies have maintained their relative mortality position in the marketplace over the past 25 to 30 years. However, the question still persisted as to whether the A/E ratios used to rank the companies remained reasonably stable over that time period.

Further Analysis
From a research perspective, the heart of the problem I
was trying to solve was: “Is a company's early duration mortality experience predictive of later duration mortality?” That is, can our pricing actuaries be confident that overall A/E ratios derived from a client’s experience study covering, say, the first 8-10 durations predict later duration A/E ratios? To provide an answer to this question, I used the A/E ratio data from the 20 companies and averaged the ratios for durations 1-10 (issue years 1995-2004) and for durations 11-25 (issue years 1980-1994). Figure 2 shows these average ratios by company.

<table>
<thead>
<tr>
<th>Company</th>
<th>Durations 01-10</th>
<th>Durations 11-25</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>108.1</td>
<td>136.0</td>
</tr>
<tr>
<td>B</td>
<td>100.0</td>
<td>140.6</td>
</tr>
<tr>
<td>C</td>
<td>82.4</td>
<td>82.2</td>
</tr>
<tr>
<td>D</td>
<td>100.9</td>
<td>133.8</td>
</tr>
<tr>
<td>E</td>
<td>127.8</td>
<td>149.3</td>
</tr>
<tr>
<td>F</td>
<td>116.6</td>
<td>117.3</td>
</tr>
<tr>
<td>G</td>
<td>78.0</td>
<td>125.6</td>
</tr>
<tr>
<td>H</td>
<td>88.5</td>
<td>105.0</td>
</tr>
<tr>
<td>I</td>
<td>104.3</td>
<td>111.1</td>
</tr>
<tr>
<td>J</td>
<td>94.5</td>
<td>97.4</td>
</tr>
<tr>
<td>K</td>
<td>80.7</td>
<td>84.1</td>
</tr>
<tr>
<td>L</td>
<td>94.8</td>
<td>89.1</td>
</tr>
<tr>
<td>M</td>
<td>86.8</td>
<td>82.8</td>
</tr>
<tr>
<td>N</td>
<td>90.0</td>
<td>108.4</td>
</tr>
<tr>
<td>O</td>
<td>109.4</td>
<td>124.1</td>
</tr>
<tr>
<td>P</td>
<td>113.8</td>
<td>91.6</td>
</tr>
<tr>
<td>Q</td>
<td>114.4</td>
<td>91.1</td>
</tr>
<tr>
<td>R</td>
<td>87.6</td>
<td>75.4</td>
</tr>
<tr>
<td>S</td>
<td>76.3</td>
<td>74.5</td>
</tr>
<tr>
<td>T</td>
<td>90.1</td>
<td>109.7</td>
</tr>
</tbody>
</table>

While one can identify some deviation among certain companies, late duration A/E ratios in general tend to follow early duration A/E ratios. This would seem to suggest that companies’ early duration A/E ratios are somewhat predictive of later duration A/E ratios.

Next, I plotted each company's set of ratios as shown in Figure 3. In statistics, the Pearson product-moment correlation coefficient is a measure of the linear dependence between two variables. Its value can range between +100 percent and −100 percent, where 100 percent is total positive correlation, 0 percent is no correlation, and −100 percent is total negative correlation. If our predictions of duration 11-25 A/E ratios based upon duration 1-10 A/E ratios were absolutely perfect, all of the data points would fall along the diagonal red line and would produce a correlation coefficient of 100 percent. In reality, the data show a correlation of around 54 percent, which indicates a fairly strong positive linear relationship.

### Summary

Results of my funnel effect experiment were encouraging. In general, companies with lower than average A/E ratios for business issued today tended to have lower than average A/E ratios for business issued 10 years ago, 15 years ago, 20 years ago, and so forth. The same held for companies with higher than average A/E ratios. While not conclusive, I believe the results provide some evidence that the level of a company’s early duration experience is predictive of the level of their later duration experience and will not necessarily grade back to an industry average as a block ages. A company can make some improvement in its mortality experience by refining underwriting and marketing practices, but as long as it is “fishing in the same pond,” better bait will not necessarily attract better fish.

---

New Ways to Estimate Insured Population Mortality
By Zhiwei Zhu, PhD
Vice President, Risk Modeling & Analytics – zzhu@scor.com

The use of big data and advanced analytics is beginning to transform our industry. Life insurers who effectively use data from both internal and external sources are gaining a competitive advantage. They are developing valuable insights about how their business performs, enabling them to target the right markets, develop better products, price more precisely, select profitable business, and optimize capital.

At SCOR, executing on big data opportunities for innovation and discovery is an important strategic goal. As a leading life reinsurer, we have the largest block of US life reinsurance mortality and lapse experience. To leverage the true value of this data, we are employing analytical tools and modeling approaches that deliver more accurate, credible, and insightful experience research.

Mortality experience studies are a cornerstone of our business. The paper, *Logistic Regression for Insured Mortality Experience Studies* (presented at the January 2014 Living to 100 Symposium in Orlando, Florida) demonstrates our commitment to finding ways to enhance industry experience studies. In this paper, we introduce a predictive modeling approach based on logistic regression to analyze US insured mortality experience, including at advanced ages where less credible experience data is available.

Logistic Regression: Highlights of the Paper
Logistic regression is a practical alternative to conventional methodologies used in insured experience studies. A unique and important benefit of a logistic regression model is its flexible model application and straightforward parameter interpretation. It tests the statistical significance of risk drivers in explaining mortality differentiation. It simultaneously analyzes many risk drivers, such as issue age, policy duration, underwriting class, etc., by performing multiple variable analyses. It allows us to make better use of limited amounts of data to derive more credible and normalized mortality differentials. When model-estimated mortality is used as future mortality projection for pricing or underwriting, it becomes a predictive model.

For our study, we developed a logistic regression model with nine of the most frequently used insured mortality drivers: gender, duration, issue age, smoker status, study year, face band, product, issue year and underwriting class. In addition to mortality differentials by these variables, we also constructed industry experience tables with model-estimated mortality.

The benefits of employing logistic regression do not come without challenges. Critical to superior model development is the requirement for copious amounts of data, specialized statistical modeling expertise, and in-depth business knowledge.