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Company Profitability and Risk Dashboards—A Tool in the Understanding and Management of Risk, Part 2

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This is the second article in a two-part series examining the potential value to both small and large companies of implementing a company profitability and risk dashboard. The dashboard concept involves regular collection and updates of key metrics defined by the company for its particular markets, products and distribution channels. The key metrics are disseminated through a data visualization tool that can be accessed across the organization.

In recent years, state regulators and rating agencies have increasingly looked for companies to demonstrate that they understand, quantify and effectively manage the risks that they accept.

For many companies, two of the key process risks they must manage are:

1. Company distribution and the resulting quality of new business written through these channels and

2. Assumption-setting for pricing, repricing, reserve and capital calculations, including asset adequacy analysis and the new principle-based reserving (PBR) requirements.

The Part 1 article in the September 2016 issue of *Small Talk* discussed identifying and managing risks connected with distribution and the quality of new business being written. This included examples of key metrics including actual-to-expected results for key risk factors by agent, agency, region or independent marking organization (IMO). Variations from the business plan production targets including the impact of product mix were also illustrated in the Part 1 article sample dashboard.

This article will focus on risk management in the realm of assumption-setting for actuarial projection purposes by examining suggested best practices and key metrics to include in a risk and profitability dashboard in the following areas:

SETTING CENTRAL ESTIMATE ASSUMPTIONS

- Identifying key risks
- Measuring historical results for key risks
- Developing dynamic functions for key risks
- Quantifying and ranking risk margins
- Measuring assumption objectivity

MONITORING ADEQUACY OF RESERVES AND CAPITAL

- Testing reserve adequacy
- Measuring company value changes
- Measuring target capital changes

SETTING CENTRAL ESTIMATE ASSUMPTIONS

For the purposes of this article, "central estimate assumptions" refers to assumptions that combine company and industry experience to develop baseline assumptions for modeling key risks in cash-flow projection models.

Identifying Key Risks

As noted in the Part 1 article, targeted sensitivity testing utilizing existing pricing models and asset adequacy analysis models helps identify the key risks in a block of business. The company may want to select and document a set of objective criteria for identifying key risks through sensitivity-testing results.

To the extent that the sensitivity tests represent the actuary's best estimates of moderately adverse deviations from the key risk assumptions, these results also provide a basis for testing the adequacy of the reported reserves. (This reserve adequacy testing will be discussed in more detail later in this article.)

Measuring Historical Results for Key Risks

It is important that the company align its experience studies with the identified key risks for a product or product group. This process of aligning experience studies with specific material assumptions and calculating actual-to-expected ratios for those key assumptions helps set the stage for understanding company experience, including the identification of trends in experience.

Relevant industry experience should also be considered, either formally or informally, in setting central estimate assumptions for key risks. In this context, "relevant" means that the industry experience is directly applicable to the company experience with respect to factors related to the underlying business, including underwriting methods, product designs, distribution channels and target markets. Aggregate industry experience representing industry averages should be used with care, recognizing that

there is a distribution of experience around the average that is likely correlated with factors including those just listed.

If industry experience is not relevant or directly applicable to company experience, it is important that professional actuarial judgment be applied in making adjustments to the industry experience. In a PBR and Actuarial Standard of Practice (ASOP) 41 world, the rationale for those adjustments should be documented in the actuarial report related to the specific project.

LIMRA, MIB and other data aggregators have been working on the development of enhanced experience studies that identify additional predictors of experience, including product design elements, specific agent or distribution channels, demographic variables, and projected in-the-moneyness of a benefit. These enhanced experience studies can serve as the basis for identifying relevant industry experience.

With respect to formally including relevant industry experience in the assumption-setting process, VM-20 provides a road map for a credibility-blending process specific to the mortality assumption. Please note that this credibility-blending process can be applied to other key assumptions as well. While VM-20 applies to setting modeling assumptions for the PBR Deterministic and Stochastic Reserve calculations, this credibility-blending process is a sound methodology for developing central estimate assumptions for other risk analysis purposes, including pricing.

Per VM-20, there are two basic methods for calculating credibility: the Limited Fluctuation method and the Bühlmann method. Using the Bühlmann method requires the company to have access to industry-level information, which the data aggregators and/or reinsurers could help provide. The Society of Actuaries (SOA) provided a research paper showing sample results of lapse and mortality results using the Limited Fluctuation and Bühlmann methods.[1] In our observation, the Bühlmann method often provides a higher credibility measure than the Limited Fluctuation method.

Developing Dynamic Functions for Key Risks

Having set the central estimate assumptions for the key risks, we can now turn to developing dynamic functions that will provide more consistent measures of the interactions of the key risks as the cash-flow projections unfold year by year. As noted before, industry data aggregators are increasingly using predictive modeling methods to identify the significant predictors of experience for key risks beyond the traditional predictors used in the past.

In industry-level predictive modeling analysis, one of the key predictors often turns out to be the "company code," the code used by a data aggregator to identify different companies contributing data. The company code is often the data aggregator's only indicator of additional predictive factors specific to a particular company profile, including differences in the products, producers and policyholders.

With this specific, additional data each company possesses, the companies themselves could employ results of the enhanced industry studies both as a road map and as a starting point for developing enhanced company experience studies. For example, development of dynamic policyholder functions at the industry level is currently in progress for term life insurance mortality and lapse rates.[2] These industry results could be applied at the company level by adding the specific company information regarding product design, underwriting practices, producers, policyholders and other company-specific factors to identify additional predictors that were embedded in the company code.

Based on these enhanced company studies, dynamic functions using the key predictors could be developed and incorporated into cash-flow projection models.

Quantifying and Ranking Risk Margins

With key risks identified and base central estimate assumptions selected, including application to appropriate dynamic functions, we now consider the development of margins on these assumptions, whether in aggregate or individually. The difference between margins on individual assumptions versus aggregate margins involves considering the covariance of the individual risk factors. In VM-20, there is a provision for adjusting the margins to reflect the covariance among the risk factors with individual margins. For simplicity of discussion, we will address only aggregate margins in this article, recognizing the link between margins on individual assumptions and aggregate margins.

One approach to developing aggregate margins is through the use of a multi-risk scenario generator. The SOA has funded a

It may be desirable to separately identify the impact of the dynamic policyholder behavior functions from the other impacts of the economic scenarios.

PBR Simplified Methods project that includes the development of such a multi-risk generator that would be freely available for use, similar to the SOA/AAA economic scenario generator that is incorporated as part of the new multi-risk scenario generator. This multi-risk scenario generator is available for testing through the SOA.

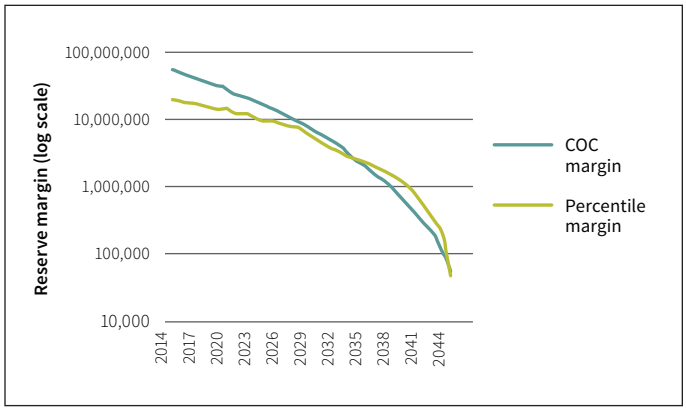
The multi-risk scenario generator will be based on a process of identifying the base central estimate assumptions for all key risks, the actual-to-expected ratios for these assumptions, the credibility of the experience with respect to the assumptions, and the distribution type for each key risk. With these inputs, the generator can create probability distributions for all key risks. With these distributions, the scenario generator can then provide scenarios for each key risk at a specified probability level, such as at the 85th percentile of the distribution (moderately adverse for margin analysis) or the 99th percentile (for target capital analysis). In addition, the generator can provide any number of stochastic scenarios for testing all key risks simultaneously in the calculation of company estimates of PBR and target capital.

With the multi-risk scenario generator as a new tool for measuring risk, aggregate margins for both reserves and capital can be calculated using either of two methodologies: the cost of capital (COC) method, which is common in international circles; or the percentile method, which may be more familiar to U.S. actuaries.

These two methods for calculating aggregate margins were described in a September 2015 *Small Talk* article introducing the Representative Scenarios method (RSM, with examples of margin calculations provided in the Part 2 article[3]). Reprinted from the Part 2 article, Figure 1 provides a graphical comparison of aggregate margins calculated using the two methods for individual level term insurance.

As stated in the Part 2 RSM article, "The main difference between these two margin methodologies is apparent from this graph. The COC margin tends to be larger when the business still has a long period to run. However, the COC margin is released faster, crosses over and becomes lower than the percentile margin."[4]

Figure 1
Margins Over Time



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Note that as you aggregate several similar-risk product groups (e.g., level term insurance, accumulation universal life, traditional whole life), the aggregate margin for the aggregated block will likely be lower than the sum of the aggregate margins of the separate product groups. This reduction in aggregate margin is due to the impact of offsetting cash flows, called by some "product hedging" or "natural hedging." It may be desirable to separately identify the impact of the dynamic policyholder behavior functions from the other impacts of the economic scenarios. Doing so does not change the numerical results, but it may increase understanding of the relative impact of the risks for ranking purposes.

Measuring Assumption Objectivity

In a principle-based environment, regulators, auditors and rating agencies, as well as non-actuarial company management and shareholders, need assurance that the assumptions used in calculating and testing reserves and capital are appropriate. Measures of assumption objectivity could be developed and used in communications with these important stakeholders.

Possible measures of assumption objectivity are being developed as part of the SOA's PBR Simplified Methods project. For the purposes of this article, calculating actual-to-expected ratios for each material assumption provides a basis for developing one such measure of assumption objectivity. These actual-to-expected ratios can be used to sensitivity-test the key assumptions and provide a view of the cost of setting assumptions that vary from company experience, regardless of the statistical credibility of that experience. Weighting the actual-to-expected ratios of the key assumptions by the respective sensitivity test deviations and dividing by the sum of those deviations can serve

as an overall measure of the objectivity of the company portion of the central estimate assumptions for a block of business with similar risks. Similar analysis can be performed for different levels of aggregation of a company's business.

Assumption Objectivity Score =

$$\frac{[(\text{Actual/Expected})_{\text{risk(i)}} \times (\text{sensitivity test impact of deviation from central estimate})_{\text{risk(i)}}]}{[\text{Sum over risks i of the sensitivity test impact of deviation from the central assumption}]}$$

MONITORING ADEQUACY OF RESERVES AND CAPITAL

Figure 2 depicts an additional set of visualizations for the sample Company Profitability and Risk Dashboard introduced in the Part 1 dashboard article. Additional metrics include an Assumption Objectivity Score as well as measures of the impact of variations in actual-to-expected results and a ranking of key risks associated with the business as developed earlier.

The additional dashboard visualizations and metrics also include measures of reserve adequacy and company value as detailed later.

Sections of Figure 2 will be shown and discussed separately.

Figure 2
Visualizations for Sample Company Profitability and Risk Dashboard

Figure 3
Company Value in Terms of Embedded and Appraisal Value

Company Value

Prior Period Company Value	In Force Value End of Period	Value of Future Production	Current Period Company Value	Company Value per Share (500K shares)	Stock Price
$177,283,765.86	$107,966,186.74	$15,750,000.00	$192,716,186.74	$385.43	$355.00

Figure 4
Components of the In-Force Value End of Period

Description	Current	CY-1	CY-2
In-Force Value Beginning of Period	$107,033,766	$105,844,207	$110,000,000
PV Distributable Profits In-Force Business End of Period	$104,000,000	$103,000,000	$108,000,000
PV Impact of A/E Variations	–$1,465,000	$305,000	–$1,550,000
PV Impact of Assumption Changes	$0	$0	$0
Adjusted PV Distributable Profits In-Force Business End of Period	$102,535,000	$103,305,000	$106,450,000
Adjusted Value of New Business Written	$5,431,187	$3,728,766	–$605,793
In-Force Value End of Period = 6 + 7	$107,966,187	$107,033,766	$105,844,207

Figure 5
Comparing AMR Produced Using Multi-risk Scenario Generator to Approximate CTE 70 Reserve and SR

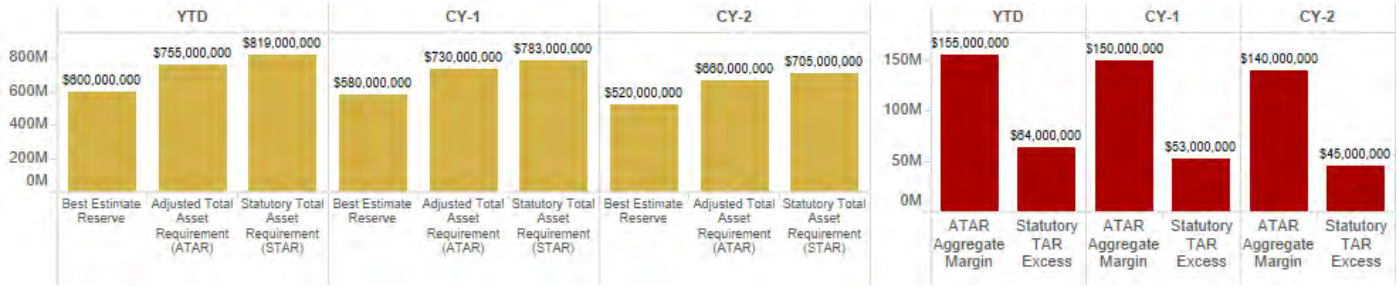
Figure 3 develops a measure of "Company Value" that roughly corresponds with concepts underlying embedded value and appraisal value, and this Company Value measure rolls forward from one period to the next. The components of this roll forward include the In-Force Value End of Period, the Value of Future Production, Target Capital and Free Surplus. Target Capital and Free Surplus are shown and discussed in Figure 7.

With the Current Period Company Value, an additional comparison can be made between Company Value per Share and the company's current stock price, if applicable.

The components of the In-Force Value End of Period are displayed in Figure 4 and could be accessed as a "drill down" element of the dashboard. The In-Force Value End of Period includes the Present Value of Distributable Profits for In-Force Business End of Period, the Present Value of the Impact of Actual to Expected Variations (see Figure 2 for a breakdown of these variations), the Present Value of Assumption Changes (zero in this sample dashboard; otherwise an additional line would be presented or the impact could be combined with the impact of Actual-to-Expected Variations), and the Adjusted Value of New Business Written (where adjustments have been made for the expected quality of the business written as well as the difference in actual-to-expected acquisition costs).

In Figure 5, the focus is on comparing the Adjusted Modeled Reserve (AMR) produced using the multi-risk scenario generator to approximate a CTE 70 reserve and the reported Statutory

Figure 6
Comparison Between CTE 90 ATAR Produced Using Multi-risk Scenario Generator and STAR



Reserve (SR). The AMR can be deconstructed into three components: (1) the "Best Estimate Reserve," calculated using a single, deterministic level economic scenario and all the central estimate assumptions; plus (2) the "Reserve Aggregate Margin;" minus (3) the "AMR Product Hedging Benefit" resulting from the cash-flow offsets obtained by modeling multiple product types together. The AMR Aggregate Margin shown in Figure 5 represents (2) minus (3). The AMR is compared to the Best Estimate Reserve and the reported SR, while the AMR Aggregate Margin is compared to the Statutory Reserve Excess, which equals SR minus AMR. The Statutory Reserve Excess provides perspective on the degree of conservatism in the statutory reserves versus the more principle-based AMR. The AMR Aggregate Margin and the Statutory Reserve Excess are the two components of the margin between SR and the Best Estimate Reserve. If desired, the AMR Product Hedging Benefit could be shown as a negative number together with the Reserve Aggregate Margin calculated before adjustment for the AMR Product Hedging Benefit.

In Figure 6, a similar comparison is made between a CTE 90 Adjusted Total Asset Requirement (ATAR) produced using the multi-risk scenario generator and the reported Statutory Total Asset Requirement (STAR). STAR consists of SR plus the Interest Maintenance Reserve plus the Asset Valuation Reserve plus the Company Action Level Risk-Based Capital (RBC). Note that STAR represents a statutory minimum and the company's actual assets available to meet its obligations will usually be far greater than this minimum.

As before, ATAR can be deconstructed into three components: (1) the Best Estimate Reserve; (2) the Capital Aggregate Margin; and (3) the ATAR Product Hedging Benefit. In Figure 6, the ATAR Aggregate Margin represents the Capital Aggregate Margin minus the ATAR Product Hedging Benefit. Note that the ATAR Aggregate Margin represents a margin beyond the Best Estimate Reserve and therefore is significantly larger than the AMR Aggregate Margin, which is also based on the Best Estimate Reserve.

The Statutory Reserves Excess is the difference between STAR and ATAR and is a measure of the conservatism of the STAR as compared to the more principle-based ATAR. Based on this sample data, the level of conservatism in STAR is significantly smaller than the level of conservatism in SR. For this sample data, this result indicates that the additional asset requirement based on CTE 90 versus CTE 70 is larger than the additional capital required by the IMR, AVR and RBC. This is due in large part to CTE 90 being a target capital measure rather than a minimum capital measure (as represented by RBC). For this comparison, the company may want to use a rating agency capital measure or a multiple of RBC needed to support its desired ratings, instead of RBC.

In Figure 7, "Target Capital" is calculated as the difference between ATAR and SR. Based on the sample data, Target Capital is relatively small, indicating that SR covers a significant portion of the tail risk at a CTE 90 level. This principle-based analysis of Target Capital could serve as the basis for allocating capital for pricing and repricing products.

In Figure 7, Target Capital is compared with the statutory Total Adjusted Capital (TAC), and "Free Surplus" equals the excess of TAC above Target Capital. In addition to other capital ratios, Free Surplus provides a principle-based limit in the analysis supporting the payment of shareholder dividends. Alternatively, Free Surplus could be treated as a separate line of business for investment and management reporting purposes.

In the last visualization of Figure 7, the results of 99th percentile scenarios generated by the multi-risk scenario generator, adjusted for covariance, are used to rank the risks embedded in ATAR. A similar ranking of risks could be produced for AMR and the two sets of rankings compared.

Figure 7
Calculating Target Capital

Total Asset Requirement Relative Risks (99%)

Description	
Lapses & Surrenders (%)	40%
Asset Default Rates (%)	15%
Policyholder Election of Living Benefits (%)	10%
Asset Prepayment Functions (%)	5%
Aggregate Margin-Mortality (%)	5%
LTC Morbidity (%)	25%

CONCLUSION

This article addresses several issues related to developing an additional section of a sample Company Profitability and Risk Dashboard.

- Sensitivity testing can be used to identify key risks according to objective criteria and in-force business can be grouped into blocks with similar risk profiles.
- Setting central estimate assumptions that reflect both company experience and relevant industry experience is essential to producing meaningful risk analysis. To accomplish this task, enhanced experience studies at both the industry and company levels are needed to align those studies in support of the key risks that companies need to model.
- Dynamic policyholder behavior functions developed using predictive modeling tools can improve the consistency of the cash-flow models by adjusting assumptions based on not only the economic scenarios but interactions with other projection variables, such as in-the-moneyness of benefits.
- A multi-risk scenario generator can provide scenarios at desired probability levels as well as generate simultaneous stochastic scenarios for all key risks to help companies quantify and rank risks, evaluate the effectiveness of risk mitigation programs, measure statutory risk margins in reserves and capital, and calculate target capital for pricing purposes.
- Company value can be consistently measured over time, driving objective decision-making by management.

Not only do these analytical tools have the intrinsic value noted, but the actuary's ability to explain risks to management, shareholders and regulators, to optimize investment strategies, and to work with rating agencies on possible rating upgrades would be enhanced. With these enhanced analytical tools, any future company transition to the principle-based approach (PBA—both reserves and capital) would become less bumpy as PBA requirements evolve over time to become more principle-based. A company might use these methods as PBR Simplified Methods instead of the full-blown PBR approach per provisions authorizing approximation methods, such as contained in VM-20 Section 2G. Lastly, principle-based measures calculated by companies could demonstrate the level of statutory conservatism in the current statutory requirements, providing a catalyst for improvements in regulatory requirements. ■

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ENDNOTES

1 "Credibility Theory Practices Report," Society of Actuaries, December 2009. *https://www.soa.org/research/research-projects/life-insurance/research-credibility-theory-pract.aspx.*

2 Possible SOA project with MIB, RGA and Lewis & Ellis as researchers. With respect to guaranteed lifetime withdrawal benefits on variable annuities, see "Dynamic Assumption-Setting for Variable and Non-Variable Annuities," by the authors, *Financial Reporter*, September 2015 .

3 "Representative Scenarios Method (RSM) Part 2: Field Testing the RSM," by Mark Birdsall and Steve Strommen, *Small Talk*, March 2016.

4 *Ibid*., page 16.