Understanding VM-20 Results

Understanding VM-20 Results

SPONSOR		AUTHORS	
	Financial Reporting Section		Seng-Siang Goh, FSA, MAAA
	Product Development Section		William Hines, FSA, MAAA
	Smaller Insurance Company Section		Mike Nam, FSA, MAAA
	Committee on Life Insurance		Karen Rudolph, FSA, MAAA
	Research		William Sayre, FSA, MAAA
			Tung Tran, ASA, MAAA
			David Wang, FSA, MAAA

Milliman

CONTENTS

Understanding VM-20 Results

Background

The new principle-based framework for U.S. statutory reserves as defined in Chapter 20 of the National Association of Insurance Commissioners' Valuation Manual (VM-20) may be used for life products issued starting in 2017. While research and educational materials have been produced to help actuaries and others better understand the implications and implementation of the new requirements from a valuation perspective, little has been developed emphasizing the options for evaluating period-to-period changes in VM-20 reserves and communicating those changes to interested stakeholders.

The Society of Actuaries' Financial Reporting Section, Product Development Section, Smaller Insurance Company Section and the Committee on Life Insurance Research engaged Milliman to examine options for analyzing these periodic changes in VM-20 reserve amounts. The research surveys the sources of reserve movement and volatility, surveys other reporting regimes for potential attribution approaches, conducts interviews with financial reporting actuaries regarding their use of attribution methods and provides a demonstration of a proposed attribution approach for a case study for VM-20 valuations.

Disclaimer of Liability

This report is to be reviewed and understood as a complete document. Any distribution of this report must be in its entirety. Nothing contained in this report is to be used in any filings with any public body, including, but not limited to, state regulators, the Internal Revenue Service and the U.S. Securities and Exchange Commission.

This report has been published by the Society of Actuaries (SOA) and contains information based on input from companies engaged in the U.S. life insurance industry. It may or may not reflect the experience of any individual company. The SOA, the authors and Milliman do not recommend, encourage or endorse any particular use of the information provided in this report. Any results or observations made may not be indicative of the impact on any particular product or company and may not be representative of the life insurance industry as a whole. It is for informational purposes only. It is not intended to guide or determine any specific individual situation, and persons should consult qualified professionals before taking specific actions. The opinions expressed and conclusions reached by the authors are their own and do not represent an official position or opinion of the SOA or its members or Milliman. Neither the SOA, the authors nor Milliman makes any warranties, guarantees or representations whatsoever regarding the accuracy or completeness of the content of this report. The study should not be construed as professional or financial advice. Neither the SOA, the authors nor Milliman shall have any responsibility or liability to any person or entity with respect to damages alleged to have been caused directly or indirectly by the content of this report.

With the January 1, 2017, effective date of VM-20, we expect that actuarial practice in calculating VM-20 reserves and reflecting reserve changes through attribution analysis will evolve over time as companies, actuaries and regulators gain experience in calculating such reserves. The evolving actuarial practice may differ from what is assumed in the case studies. The methodology and assumptions used in

developing VM-20 reserves for the case studies are illustrative and should not be viewed as recommendations of the SOA, the authors or Milliman with respect to the application of VM-20. Further, future changes are expected in VM-20, including changes to certain prescribed assumptions such as defaults and spread assumptions as well as potential re-parameterization of the Net Premium Reserves. In addition, there is a lack of guidance from the U.S. Treasury concerning the appropriate tax reserves after VM-20 becomes effective. The reserves and attribution analysis examples included in this report are intended for illustration purposes only.

Report Content

The report is organized into three broad areas.

Components of Period-to-Period Change: Section 1 provides an inventory of the components of period-to-period change in reserve and how these elements introduce volatility in the movement of reserve from one period to the next. Section 2 discusses these components in the context of VM-20 principle-based reserve calculations.

Comparative Approaches to Attribution Analysis: Section 3 surveys the landscape of financial reporting regimes at a high level and discusses how each of five reporting regimes approaches the reserve attribution analysis. Section 4 provides a practical look into the use of attribution analyses in insurance companies through interviews with financial reporting actuaries.

Practical Guidance and Illustration: Section 5 presents a "how-to guide" for processing the stepwise attribution in an actuarial model. Section 6 provides two valuation case studies for which a reserve attribution has been developed and is mapped out in grid format.

This report is not intended as a primer on VM-20, and the reader is expected to be familiar with the basic requirements of VM-20.

Executive Summary

The need for an attribution analysis, also called reserve movement analysis, arises in any financial reporting regime that derives its prevailing (or final) reserve amount using components that include modeled cash flows, which, in turn, are dependent upon a company's experience assumptions and economic parameters. A reserve change is any quantifiable difference between a reserve at the beginning of a reporting period or prior valuation date and that same reserve amount at the end of the current reporting period or valuation date. Our research uncovered a variety of methods to present this attribution analysis to better understand results. Each presentation method is regime specific. Interviews with financial reporting actuaries find that in practice, where the form of the attribution analysis is not specified by the regime or regulated in some way, the reporting function tends to adopt the attribution analysis (specifically the order of the steps and the steps themselves) that adequately quantifies the reserve movement without over-burdening the effort needed to develop the analysis. In other words, there is a trade-off whereby the actuarial function responsible for the analysis must balance the value of a robust attribution analysis against available resources. Of course, resources are often limited during a financial reporting period, and as a result, the analysis is typically scaled to a more practical level of granularity (at least for now).

It is clear from the interviews that the roll-forward (also called movement analysis) is the tool of choice in understanding and communicating the change in reserve. A roll-forward starts with the prior period's reserve value and walks it forward to the end of the current period using a few or many interim steps. It is not unusual to find a variety of attribution displays—one for each regime reported by the company. Within a regime, however, the properties of the attribution analysis usually remain consistent from period to period. A company's board and senior management are typically the audience for the attribution analysis report, and the report merits more attention by this audience when results are viewed as volatile. Senior management is interested in knowing the source or reason for reserve volatility. Actuaries in the interviews were concerned about the potential sources of volatility introduced into the statutory reporting framework by the myriad assumptions and periodic unlocking that go into VM-20 calculations. Their concern is, for now, countered by the realization that the subject insurance block will be quite small for several years. All financial reporting actuaries interviewed view resources as their primary near-term need with VM-20 implementation looming. Ideally, the interview subjects would like to have more resources available to review and analyze the results while the modeling function becomes more centralized and subject to tighter controls.

Change in reserve is brought about by a variety of causes, some that are expected, and others that are not expected. A modeled reserve has many drivers for unexpected changes, whether from demographic changes, experience assumption changes or economic elements. Through interviews conducted as a part of this research, we find that it is the more significant *unexpected* changes (i.e., volatility) in reserves that get the attention of senior management. At present, companies are indeed using attribution analysis techniques for communicating results to senior management for reporting regimes other than VM-20. Actuaries also are using the attribution analysis exercise as a due diligence tool for the modeling function.

While our interviews established that some companies are already accustomed to including the attribution analysis into production schedules, during our conversations with actuaries they acknowledge an additional layer of complexity specific to VM-20. The prevailing reserve concept applies

to any regime where the final financial measure, such as the reserve, is determined by taking the larger of more than one calculated component. Prevailing reserve type is relevant in the context of VM-20 since there are three reserve components being calculated, and, depending on the characteristics of the valuation and the underlying business, predicting whether there will be a switch in prevailing reserve will be challenging.

The order of execution of the steps in processing the attribution is important and can influence the complexion of the resulting analysis. Three of five surveyed regimes largely adhered to a similar order of attribution steps. Like VM-20, all three of these regimes require cash flow models to produce the reported reserve. The recommended order of attribution steps for VM-20 is:

1. *Demographic Changes*—changes in the in-force over the current period
2. *Non-economic Changes*—assumption changes for all future periods; method changes; prevailing reserve; nonguaranteed elements
3. *Economic Changes*—changes known to impact the valuation such as the Treasury curve from Time 0 to Time 1
4. *Risk Mitigation*

Within each of these four categories is a recommended order for substeps. To facilitate a demonstration of attribution analysis in production, the research includes two case studies—a Term insurance block and a Universal Life with Secondary Guarantees (ULSG) insurance block. Below is a sample narrative extracted from the Term case study. Each step of the attribution is detailed in a manner similar to that shown and sets up the hypothetical situation—in this case the company's emerging mortality experience suggests an update to the company experience mortality assumption is needed. As well, an additional year of experience has resulted in an improved credibility measurement.

> *Experience Assumptions—The reserve calculations in this part of the demonstration are hypothetical scenarios under which prudent estimate assumptions are adjusted. Narratives are included to provide motivation for the adjustments in each step.*
>
> > **Mortality Experience.** *With an additional year of experience, a company may decide it is time to update its prudent estimate mortality assumptions based on a periodically performed experience study. The Term business in this case study exhibits favorable mortality experience, with generally lower mortality rate assumptions. Reserves reflecting the revised mortality assumption are $1,097 million for a reserve change of ($229 million). This reserve change is considered volatility because it reflects the company's revision to its prudent estimate mortality assumption.*
> >
> > **Mortality Credibility.** *In this example the credibility of company experience is assumed to increase from 70% to 75%. The prescribed mortality margins decrease with a higher level of credibility, and for Term insurance reserves are expected to decrease as well, all else equal. The resulting reserve volatility is ($28 million) for the period, resulting in reserves of $1,069 million. Although a company may expect that its mortality experience should become more credible with time, the exact quantification is unknown at Time 0 and would be considered volatility rather than anticipated change. Note the margins applied correspond to the Limited Fluctuation Method; to change the credibility method would require approval of the commissioner, and this alternative was not explored here.*

> The case studies help to illustrate just how complex an attribution analysis can be. Since there are no regulatory requirements for a VM-20 attribution analysis, the level of complexity implemented

by each company for its VM-20 results will vary. Enough granularity is needed for the actuarial team to enable an understandable explanation of reserve changes to key stakeholders. At the same time, the degree of granularity for the steps involved cannot be so great that the actuarial team is burdened by the number of iterations required to produce the analysis. What is provided in this report is a framework of potential attribution steps, a suggested sequence for processing these steps and an explanation around the model mechanics for executing these steps. Although the suggested stepwise attribution presented here is very granular, our interviews suggest that as with other reporting regimes, companies will begin to tailor the steps in the analysis to meet management and reporting needs.

Introduction

With the implementation of principle-based reserves for a wider variety of life insurance products comes a need for systematic methods to assess and communicate changes in statutory reserves from one statutory reporting period to the next. An attribution analysis uses successive valuation steps to walk the results from the prior valuation date to the current valuation date. Along the way, the steps are categorized into change amounts that are anticipated and those that are not anticipated and introduce volatility to the results. Attribution analyses are used in reporting regimes and other exercises that rely on periodic processing of an actuarial projection model. Changes can be categorized as those that fall into:

1. Economic assumptions
2. Non-economic assumptions
3. Demographics of the in-force block
4. Reinsurance or risk management

VM-20 valuations require the use of an asset-liability cash flow model; therefore each of these four broad categories has several contributing subcomponents in the VM-20 reserve determination. Within economic assumptions, for example, anything contributing to the generation of the interest and equity scenarios used in the VM-20 valuation can be said to play a part in the change in reserve and would include the U.S. Treasury yield curve, the prescribed asset spreads and default charges, and the company's investment strategy, to name a few. Each subcomponent within the four broad components merits careful consideration by a company in determining whether to use that level of detail as part of the reserve attribution analysis. This analysis may be new to companies that report only on a statutory basis. Sections 1 and 2 lay the groundwork on the scope of this attribution analysis by outlining the various subcomponents within these four categories and highlighting the VM-20 considerations within each category.

Most regimes have no regulatory specifications for the reserve attribution analysis. Rather, the analysis can be shaped by the company to fit its needs. This research surveys several established reporting regimes to better understand the components that frequently appear in the attribution analysis steps used within those regimes. Four reporting regimes and one actuarial valuation standard are surveyed in Section 3: Market Consistent Embedded Value; Actuarial Guideline XLIII; Generally Accepted Accounting Principles in the United States; International Financial Reporting Standards; and Canadian Asset Liability Method. We find that the analysis used by each has a focus that serves its intended purpose. For example, an attribution analysis under Market Consistent Embedded Value showcases components that drive a company's underlying value such as value changes due to new business and contributions from existing business. These same attribution steps are utilized by some companies within the Actuarial Guideline XLIII standard but with slightly different labels, notably new business impact and in-force business impact. In general, the exercise of creating an attribution analysis is similar between regimes. What differs is the order of execution of the attribution analysis, the labels used to describe the steps and the granularity of the steps. Characteristics important to VM-20 valuations include a net premium approach reserve (i.e., a method that recalculates the premium used in the reserve calculation) and an ending value (i.e., minimum reserve) calculated as the greater of two or more components. It is this latter feature that introduces the "prevailing reserve" complexity to the attribution analysis display.

Section 4 of this research report brings color to the survey of regimes by summarizing live interviews with actuaries responsible for a company's financial reporting function. Through these interviews, we endeavored to discover the practical use of attribution analyses, how a company may begin to assemble a VM-20 attribution analysis and the challenges seen as being introduced by VM-20 in this regard.

How does one process an attribution analysis for VM-20 in a logical and meaningful way? The How-To Guide in Section 5 synthesizes common elements from the Section 4 survey and provides a suggested attribution analysis for VM-20 valuations. Each subcategory of change is described in terms that an actuary familiar with actuarial projection modeling systems would understand. These descriptions give a practitioner the key to executing the stepwise changes within the model that result in the amounts reported in the attribution analysis. The How-To Guide specifically identifies the difference in model execution between a run intended to assess an anticipated change amount and one intended to assess the volatility amount. Identification of such difference will be critical to understand the source of volatility in the reported reserve from period to period.

Last, the research culminates in two case studies found in Section 6. The narrative around each VM-20 model run is supported by the attribution grid display—one for Term and one for a ULSG product block. Each case study sets forth a viable real-life situation and discusses the impact it has on the attribution analysis.

Section 1: Sources of Change in Reserve

Section 1 is a practitioner's overview of the sources and components of change in reserve from one reporting period to the next. This overview discusses components of change in actuarial projections at a high level without reference to any specific reporting regime. It is followed by a discussion of these components of change in the context of VM-20 calculations in Section 2.

To better understand the discussions in this and later sections, we first define for the purposes of this report the terms "reserve change," "volatility" and "attribution analysis."

A reserve change is any quantifiable difference between a reserve at the beginning of a reporting period or prior valuation date and that same reserve amount at the end of the current reporting period or valuation date. Change in reserve is brought about by a variety of causes, some which are expected, such as accumulation with interest, release for anticipated claims and anticipated survivorship, and other causes that are not expected. An example of unexpected change in reserve would be lapse experience over the period between the prior and current valuation dates that materially exceeds (or is materially less than) that which was assumed in the calculation of the beginning of period reserve or a change in valuation assumption.

The unexpected portion of the change in reserve is referred to as volatility. It is the variance from expected outcomes that introduces volatility to the financial measures.

An attribution analysis is simply a way, using successive valuation steps, to quantify the components of change in reserve and identify those components as either the expected or unexpected types of experience. Section 3 of this report describes an attribution analysis more fully. This type of analysis can provide the company with a deeper understanding of the sensitivity of the balance sheet to changes in experience, show the company where the greatest risks lie in terms of each product group, aid the actuary in communicating statutory reporting results to senior management, and help the actuary in estimating reserve between the reporting cycles.

Each assumption upon which a reserve amount depends has the potential to produce volatility. A stochastically calculated financial measure, such as the stochastic reserve under the principle-based reserve (PBR) framework, Market Consistent Embedded Value (MCEV), Solvency II (SII) capital, fair value reserve and others, typically requires a larger number of critical assumptions or inputs to its calculation than a deterministic reserve calculation. Each of these elements introduces the potential for unexpected change in the calculated value from one reporting period to the next. In this section, we divide these elements into the following categories and separately discuss the potential for each to produce unexpected change:

1. Economic assumptions
2. Non-economic assumptions
3. Demographics of the in-force block
4. Reinsurance or risk management, applicable if the financial measure is net of reinsurance or other risk management

To understand the change of the financial measure, we will need to understand how each element in these categories affects the measure, and to build a systematic way to analyze the individual impact of each as a component of the total changes.

The version of VM-20 on which this research was based was the Valuation Manual dated 2016 and effective for valuations during 2017. The Valuation Manual is a living document. Any regulatory change to the VM-20 requirements for valuations in years after 2017 could potentially be cause for volatility in the period-to-period reported reserve and should be considered in the company's attribution analysis. We have presented broad categories of components of change in an attempt to provide a working structure for such an analysis. Actuarial judgment should be used to determine whether a change in the VM-20 requirements fits into one of the categories presented in this report or a separate category. Either way, the fundamental principles of attribution analysis apply.

Economic Assumptions

A deterministic reserve calculation will utilize a single economic scenario. The reserve is expected to move forward reflecting this scenario. When actual experience does not follow this scenario, unexpected changes in the reserve may occur. A stochastic calculation often requires multiple economic scenarios with reserve amounts being determined using a weighted average across the scenarios. These economic scenarios are typically generated using a complex economic scenario model generator together with a number of assumptions. The expected movement in the reserve will reflect how the weighted average of the scenarios would move. This may not represent any of the specific scenarios. Thus one source of unexpected change in a stochastic environment is due to the weighting of scenarios. Changes in any of the following components will result in a change in the financial measure:

A Change in the Underlying Economic Scenario Model Generator Being Used

For example, when a company decides to switch from a normal interest rate model to a lognormal interest rate model, the interest rates in the scenarios will be different even though both models may be calibrated to the same market data. Correspondingly, the stochastically calculated financial measure may also be very different due to the switch. It is thus important to understand the potential impact of a change in the underlying economic scenario generator model before doing so.

There are financial reporting regimes that permit companies to select their own economic scenario generator, such as SII, and companies may select the generator based on a number of factors including their own familiarity with the model or the ease of implementing the model.

Change in the Reference Yield Curve

The U.S. Treasury Yield Curve (yield curve), or sometimes swap curve, on valuation date is an important input in the economic scenario generator model. A lower starting yield curve typically results in lower projected interest rates, all else equal. These low interest rates may potentially affect the interest rates insurance companies can earn and thus pass on to policyholders as well as discount rates. In isolation, a lower yield curve implies a higher reserve or capital amount. But it rarely happens that the curve changes in isolation, without changes in other economic conditions like asset spreads or defaults, for example. Therefore, the impact of a change in yield curve will vary depending on the nature of the product and corresponding changes in other

economic parameters. Yield curves are constantly changing, and so a financial measure from any reporting regime will demonstrate period-to-period volatility as a result of changes in the yield curve.

Any yield curve has built into it an expectation as to the path of future interest rates. Reserves discounted using yield curves will be expected to follow this expected path. Thus, even when a yield curve itself does not change from the beginning to the end of the valuation period, the reserve may change to reflect the expected path of future interest rates that is implied by the yield curve. For example, consider a cash flow expected to occur three years into the future. At the valuation date, the cash flow could be discounted using a series of one-year forward rates or a spot rate that is appropriate to cash flows occurring three years into the future. Both the forward rates and the spot rate can be derived from the yield curve. Assume that one year later the yield curve and the expected cash flows have not changed. The cash flow is now two years into the future, so the reserve would reflect one fewer year of discounting. This is the effect of the normal passage of time. However, when discounting with yield curves there is an expected change due to the path of interest rates implied by the curve. At the end of the first year the Time 3 cash flow could be valued using either a series of two one-year forward rates or a spot rate that is appropriate for cash flows occurring two years into the future. These rates are potentially different from those used to value the contract at the initial valuation irrespective of the periods. This additional change of "rolling down the yield curve" is an important component of analysis of any yield curve impact. Before examining changes to the yield curve and the impact this has on the change in financial measure, the company could work to parse this contributor in two parts: first, the change due to the accumulation with interest, assuming no change to the yield curve, and second, the change due to updating the yield curve for the current valuation date. The first part is simply the fact that the financial measure calculated as of previous reporting cycle would grow at the interest rate following the assumed yield environment of the previous reporting cycle. This is the expected portion of the change in financial measure. The second layer would be the change introduced by reflecting the new yield curve as of the current valuation date. This is the unexpected portion of the change.

Change in Mean Reversion Target or Mean Reversion Strength

The mean reversion target rate, or mean reversion point (MRP), reflects the theory that ultimately a particular tenor of the U.S. Treasury interest rate will eventually move toward this target level in the future. Mean reversion strength reflects how quickly today's interest rate will grade to the target. A change in either the MRP or the reversion strength will result in changes in projected interest rates in scenarios, and correspondingly the financial measure. Typically, both assumptions are set with a long-term perspective and are not likely to change every valuation cycle. However, if the MRP is a formula that automatically updates itself based on the recent historical interest rates, then it is important to understand the impact from the change in the MRP. Change in MRP and/or mean reversion strength would belong to the category of unexpected change in the financial measure and would be captured in the step of updating the generator with parameters appropriate for the current valuation date (MRP, mean reversion strength etc.) and generating the scenario(s) for the current reporting cycle.

Change in Interest Rate Volatility

Interest rate volatility determines how widely dispersed interest rates can be in the scenarios. Typically, the volatility assumption does not change frequently in real-world scenarios and thus does not have a material impact on a financial measure that is based on the real world. Volatility assumptions on the other hand can change every day in a risk-neutral framework and can be critical for a financial measure that is risk-neutral based. Another consideration is that a change in volatility may or may not have a material impact on the insurance products. If a liability has some form of guarantee, the cost of that guarantee can be higher with a higher volatility assumption and thus is affected by a volatility assumption change. But a liability that has no such guarantee may not be affected significantly by the volatility assumption change. In practice, isolating the financial impact of this component separately from the other influences on the generated scenario(s) means generating the scenario(s) with the new volatility assumption parameter and keeping all other parameters the same as the prior step. This component is considered unexpected change.

Change in Starting Asset Portfolio

Typically, changes to assets of a life insurance company are driven by changes from the liabilities. Therefore, performing a stepwise approach on assets to provide details on what assets are bought, sold or matured would not typically add much value to the analysis. Instead, changes to asset values that flow through together with the steps of liability movement provide actuaries with a view of the net position (asset less liability). As demonstrated later in Section 3, the AG 43 attribution template shows that hedge assets can be shown together with AG 43 movements to illustrate the effectiveness of hedge program against the change in AG 43 liabilities.

However, a company could also perform a stepwise asset attribution analysis where there is an expected versus actual rate of return analysis that separately identifies the impact of assets that are sold and purchased versus those that are assumed at the beginning of the period. The idea is generally to isolate the impact of items that are outside of management's control, such as the level of interest rates, from those that are in management's control, such as how closely to match cash flow or duration.

Change in Asset Spreads and Asset Default Charges

Asset spreads and asset defaults are seldom modeled stochastically in practice. However, this is an important assumption in the context of projecting general account asset returns, and a change in the asset spreads and default charges from projection period to period will affect the financial measure. The impact of such change may depend on whether the company expects the change to persist in the projection. For example, the company's assumption with respect to spreads may be to reflect current spreads for *N* years into the future and grade to a stable, long-term asset spread assumption over time. Asset default charges are commonly expressed in terms of a reduction in basis points of the asset yield spread over U.S. Treasuries. A reasonable approach for quantifying this component in the attribution analysis is to call changes to either the short–term spreads or the long-term average spreads unexpected change. Changes to default costs would fall in the unexpected category as well.

Change in Equity Assumptions

In a risk-neutral framework, expected equity return is determined by risk-free rates that change almost constantly as market conditions change. In a real-world framework, expected equity return is determined by risk-free rates plus the equity risk premium expected from investing in particular types of equity (indices). Equity volatility (implied in the risk-neutral framework and long term in the real-world framework) determines how the equity returns in the economic scenarios are disbursed around the expected return. However, since equity assumptions and equity return scenarios are irrelevant to most of the life products, they will not be discussed in detail.

Change in Investment Strategy

The company's investment strategy is a fundamental part of the modeling process. Any change to this assumption in the modeling will impact the asset returns of the projection. It can also affect the liability value either directly through the cash flow discounting process or indirectly through changes to the interest amounts credited to policyholder fund values. A related consideration is whether the change in the strategy is to occur right away, over time or only when the projected economic condition along the stochastic scenario calls for it. In the attribution analysis, modifications to the company's investment strategy from the prior reporting period is considered entirely unexpected change unless it was included in the prior valuation date analysis by reflecting its implementation one period out.

Non-economic Assumptions

The non-economic assumption category includes the following broad subcomponents:

Experience Assumptions

Experience assumptions include the company's baseline expectation for policyholder surrender, partial withdrawal, policy loan activity, mortality, premium persistency, expense, conversions and other aspects affecting the liability cash flows. Any fundamental change in the baseline expectation for each of these assumptions will affect the Time 0 liability values, which are based on discounted future cash flows. A company's experience analysis process informs whether the non-economic assumption merits changing. If, through the experience analysis process, the company observes that experience has been trending upward or downward for consecutive study periods, the company may propose changing the underlying baseline assumption to better reflect where they anticipate the experience will be in future years.

Quantifying each of these assumptions individually is an aspect of the attribution analysis. The order in which these are quantified in the analysis matters since there are correlations, particularly between the assumptions affecting the decrements of the population. The change that would have naturally occurred in the liability measure had the baseline assumption not been updated is the expected portion of the change, and the amount of change directly related to the update of the baseline assumption is the unexpected portion of the change.

Methodology Changes

This subcategory would include any variance in approach the company is taking with respect to determining the financial measure. For example, if the company upgraded its actuarial projection software or implemented system changes, this in itself could be a source of change that would be accounted for under the heading of "methodology change." Another example is when a company reevaluates its approach regarding the number of scenarios to use in determining a stochastic financial amount. The change in approach from 1,000 scenarios to 200, for example, would be quantified in the attribution analysis as a methodology change. A correction to a known modeling error and changing the structural form of a dynamic lapse formula are further examples of methodology changes. For the period of the change, the attribution will quantify the changes by calculating the financial measure under the former approach as well as the revised (or corrected) approach. This step of the attribution would be considered an unexpected change.

Prevailing Reserve Type

This subcategory of non-economic assumption changes applies to any regime where the financial measure is determined by taking the larger of more than one calculated component. Prevailing reserve type is relevant in the context of VM-20 since three reserve types are being calculated and, depending on the assumptions and characteristics of the business, there may or may not be a principle-based excess reserve over the NPR. If the prevailing reserve for the group of policies remains the same between two valuation dates, this component contributes $0 to the attribution analysis. However, if the prevailing reserve changes from the NPR to the Deterministic or Stochastic Reserve, or vice versa, such a change needs to factor into the overall components of the attribution to provide a comprehensive view. The example in Section 2 demonstrates a way to separate this kind of change into expected and unexpected categories.

Nonguaranteed Elements

For a product group which includes nonguaranteed elements (NGEs) as part of the product design, NGEs themselves are not a contributor to the change in financial measure. However, if management makes material adjustments to NGE factors in reaction to policyholder behavior or emerging experience, then NGEs would become a contributing element to the attribution analysis. Material adjustments to NGE factors are considered unexpected changes.

Tangential to NGE modeling is the formula used to represent dynamic policyholder behavior. In the model, there is often a specified formula for policyholder surrender, for example. It is a dynamic formula in that it will react to the assumed competitor rate and its relationship to the company's declared credited interest rate. If the competitor rate is based on a spot rate of the Treasury curve, then the starting point may be different from one valuation period to the next, depending on where these spot rates are on each valuation date. This second-order effect of interest rates would be captured in the attribution step related to change in the reference yield curve.

Demographics of the In-Force Policy Portfolio

This category includes anything that changes the characteristics of the group of in-force policies. This includes the following.

Time Passage

> All else equal, the passage of time from last valuation cycle to the current means these policies are one period (year, quarter, month etc.) closer to their maturity date. The insured life is one period older, and each policy now exhibits behavior indicative of policies more mature by one period. Time passage is evaluated in terms of the policies that were in-force during the prior valuation exercise. The policy block is treated as a closed population, and the valuation is simply performed one period later to quantify the contribution of time passage to the change in reserve. Newly issued policies and terminations of existing policies are not recognized as part of this component. Time passage is typically a stable and predictable contributor to change in reserve over time, and its impact is considered part of expected changes.

Terminations

> This includes release of reserve and capital or other financial measures due to terminations of contracts. Terminations may include deaths or surrenders, and each can be studied separately if desired. It can also be defined to include partial surrenders or withdrawals. This component can be thought of in two layers, the first layer being change in reserve due to anticipated terminations and the second layer as the change in reserve due to terminations beyond those that were anticipated. The first layer is expected change, the second layer is unexpected change. The difference between the subcategory "Terminations" and the subcategory "Experience Assumptions" is that unexpected change due to terminations are only seen in the inventory of policies at the valuation date, whereas unexpected change due to experience assumptions is a modification of assumed terminations in all future periods.

New Business

> Policies issued during the dates between the prior valuation and the current one represent the new business cohort. These policies generate additional reserve and capital requirements and can therefore be a material contributor to the change in reserve. Examining this component separately aids in understanding the difference in reserve and capital requirements between new business and in-force business. A company will have an expectation of the change that new business brings to the reserve amount based on sales projections. The total amount of reserve change attributed to new business can be parsed into an expected component, based on sales projections, and an unexpected component, measured by the amount of actual new business that either exceeded or fell short of sales projections.

Account Value Changes

> Flexible premium products that have an account value introduce yet another dimension to the demographics of the in-force population. These account values will grow or decline between valuation cycles, depending on policyholder behavior with respect to premium payments and withdrawals, the interest crediting policies of the company, and the charges and loads of the

underlying product. All these characteristics will have an impact on reserving that is considered expected change.

When the account value characteristics of the policy block change materially from one valuation date to the next, this contributes to the reserve change in an unexpected way. An example of an unexpected change is when a block of policies that were mostly minimally funded have now become funded to a degree that would put the policies into the "medium-funded" or "heavily funded" buckets, thus opening these policies up to a different set of policyholder behavior assumptions in the model. In this example, the company does not consider the recent funding behavior as a basis for modifying its underlying premium payment assumption, but rather as a short-term anomaly. This is an extreme example but helps to explain what an unexpected change due to account value changes would look like.

Miscellaneous

The characteristics of the in-force policies can be impacted by benefit elections and other changes such as rider addition or deletion, change in a specific product feature like a reduction to face amount, or the election of any number of product options. Typically these are not the source of a material change in reserve from period to period; however, if a company starts to observe such changes persisting over time, it is likely an indication or flag that merits deeper investigation. This subcategory of change is considered unexpected.

Risk Mitigation Programs; Management Actions; Other

A valuation process involving the prediction of future insurer cash flows will be subject to a variety of factors and elements, and the categories and subcategories above attempt to capture the more "regular" of these elements. This last category attempts to capture examples of the kind of elements that can have a material impact on the financial measure being calculated but are not expected to occur in the normal course of business, period after period.

Risk Mitigation Programs

Coinsurance, mortality risk reinsurance and hedging are examples of programs that work to mitigate the volatility in financial measurements coming from economic and non-economic sources. Say that an insurer implements a new risk mitigation program for a block of policies in one financial reporting period or makes a change to an existing program. For example, in Q4 of a calendar year, the company enters into a reinsurance agreement ceding a material amount at risk for the subject block of policies. This represents an element in the attribution analysis that is expected to persist (i.e., once in place, the agreement is assumed to continue), but the effect of implementing the agreement is a one-time event. For the valuation period during implementation of the program, the change in calculated financial measure introduced by the risk mitigation program is considered unexpected.

Management Actions

Management actions that have a material impact to the balance sheet will often have downstream impacts on the valuation process. Take, for example, the situation where management decides to divest the company of an underperforming block or to liquidate a large

real asset. All at once, the asset portfolio becomes laden with cash, and the company must work to rebalance the portfolio to align with its investment policy. The actuarial projections underlying the valuation exercise must also reflect this situation. If this type of activity is not expected to occur on a regular basis, then the impact to the financial measure is best presented in isolation within the attribution analysis and is considered an unexpected change for the period during which it occurs. A more challenging task is to predict and model future management actions. For example, management action is required to be considered and modeled in SII. Its complexity warrants an independent research just on itself, and we do not plan to discuss this in detail in our research.

Other

Countless other situations exist in which actuaries performing the financial measure calculation will find themselves. Discerning one-time events from repeating events is important in how these situations are portrayed in the analysis of change in reserve from period to period. Changes in financial measure due to situations that fall into this subcategory are considered unexpected.

Section 2: Components of Change in Reserve in the Context of VM-20

Section 2 builds on the material in Section 1 by discussing the nature of the components of change in a VM-20 valuation regime. Specifically, Section 2 looks at the components of VM-20 requirements that may be a source of reserve volatility from one period to the next.

Economic Assumptions

A Change in the Underlying Economic Scenario Model Generator Being Used

In VM-20, only use of the prescribed economic scenario generator is permitted. The prescribed scenario generator is jointly maintained by the SOA and American Academy of Actuaries and can be found on the SOA research page (www.SOA.org/tables-calcs-tools/research-scenario). This tool generates both interest rates and equity returns. Within the prescribed scenario generator are many assumption settings; however, the requirements in VM-20 are set such that all companies will generate the same set of economic scenarios for a given valuation date if the tool is populated with the same historical yield curves, while leaving all other parameters at prescribed settings. Unless changes to VM-20 requirements exist that permit use of a generator other than the prescribed scenario generator, or regulatory changes to the generator, this component will not be a source of volatility.

Change in U.S. Treasury Yield Curve

This element will always be a potential component of change for VM-20 reporting where a PBR excess reserve amount lasts from period to period. In the actuarial model, changes in the Treasury yield curve will impact the following characteristics, among other things:

- The company's potential investment yields on new assets purchased by the model, which in turn influences the resulting discount rate used in developing the Deterministic Reserve as well as the company's credited interest rate if applicable
- The competitor rate used to set assumed dynamics with respect to policyholder behavior
- The rate of inflation, if inflation is assumed to pivot from the Treasury curve and
- The starting level of the seed curve used to generate the Deterministic Scenario and all Stochastic Scenarios

Change in Mean Reversion Target or Mean Reversion Strength

The prescribed scenario generator for use with VM-20 calculations allows for a MRP for the long bond yield that is formulaic and based on a specific combination and weighting of historical 20-year U.S. Treasury rates. The MRP is allowed to change only once per year, in January. The formula for the MRP is A + B + C, where

A =   20% of the median 20-year Treasury bond rate over the last 600 months
B =   30% of the average 20-year Treasury bond rate over the last 120 months
C =   50% of the average 20-year Treasury bond rate over the last 36 months

The formula emphasizes the last 36 months over longer historical periods. Meanwhile the reversion strength of the prescribed scenario generator works to bring the 20-year Treasury rate toward the formulaic MRP over a number of years. Below are listed the MRP values for the last 10 years, had VM-20 been operative during those years:

2007: 5.50%
2008: 5.25%
2009: 5.00%
2010: 4.75%
2011: 4.75%
2012: 4.75%
2013: 4.25%
2014: 4.00%
2015: 4.00%
2016: 3.75%

In the economic scenario generator, once calculated, the MRP is rounded to the nearest 0.25%; therefore changes in MRP occur in 25 basis point minimums. The strength of the MRP is a set parameter in the prescribed scenario generator. Figure 1 shows the monthly median of 1,000 scenarios over 600 months for the 20-year Treasury rate. The median of the generated rates takes approximately 360 months or 30 years before achieving the level of the 3.75% MPR. Were the strength parameter allowed to be increased, the generated rates would close in on the MRP over fewer months, and likewise if the strength were decreased, the generated rates would take longer to close in on the MRP. Since the strength parameter cannot be changed under VM-20 requirements, this will not be a source of volatility in calculated results.

Figure 1

20-year U.S. Treasury Rates
Median of 1,000 Scenarios using 12/31/2016 Seed Curve

MRP ——— Median (at each month) of 1,000 generated scenarios
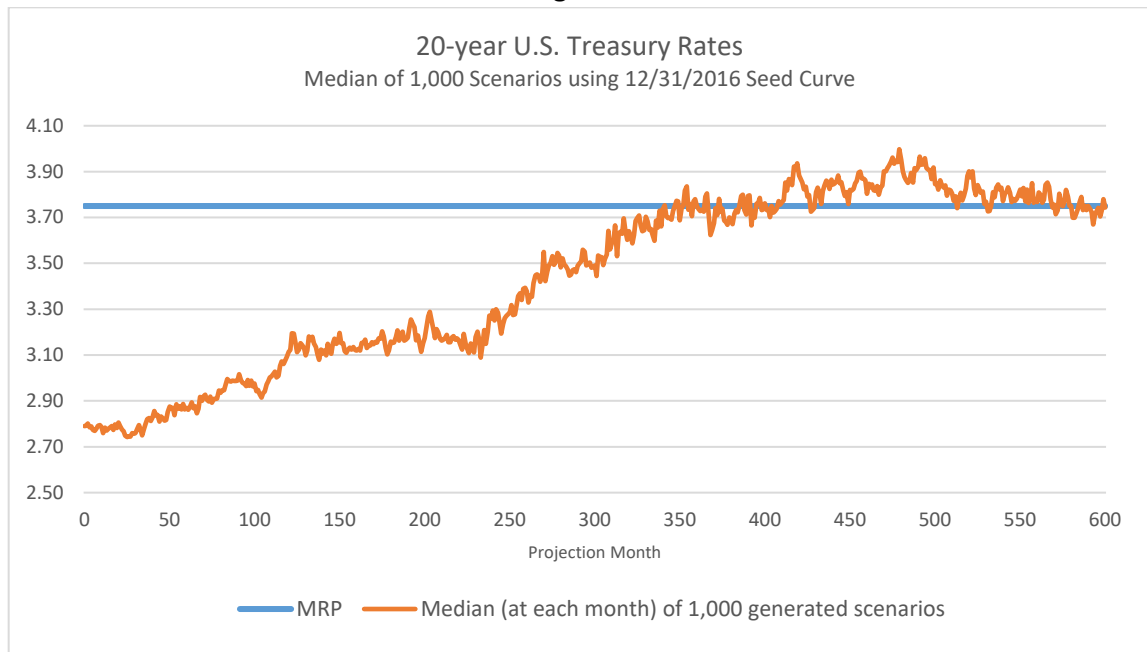
Change in Interest Volatility

Volatility of interest rates is another parameter in the prescribed scenario generator that cannot be changed, per the VM-20 requirements. The interest volatility setting in the scenario generator will not enter into the attribution analysis as a component of change in the VM-20 reserve calculations. The floor on short-term rates in the prescribed scenario generator is 0.01%, an important thing to know if this parameter ever changes in future versions of the prescribed scenario generator.

Change in Asset Spreads and Asset Default Charges

In VM-20 calculations, the asset spreads are prescribed[1] and provided in the VM-20 Appendix 2 as tables of basis points of yield spread for current conditions (Illustrative Current Market Benchmark Spread Tables F and G) and a set of tables for long-term yield spread averages (Long-Term Benchmark Spread Tables H and I). These data are provided in terms of basis points of spread and vary by characteristics of weighted average life and credit rating. These tables are updated quarterly by the National Association of Insurance Commissioners (NAIC). Recently, the long-term benchmark average spreads have not changed materially from quarter-to-quarter. For example, from September 30, 2016, to December 31, 2016, the change in long-term investment grade asset spread data averaged 0.80 basis points. The current spread tables, however, averaged an 11.30 basis point change over the same period.

The spread tables impact two characteristics of the principle-based reserve calculation. First, the relationship between the illustrative current and long-term spreads factors into a component of the default cost charged to starting assets during the first three years of the projection. The total default cost charged to any starting asset has a "spread-related factor" adjustment and a "maximum net spread adjustment factor" that will either increase or decrease the "baseline annual default cost factor." The total default cost assumption is the sum of these three factors.

The spread-related factor is based on the corporate bond spread environment as of the valuation date. This adjustment can be positive or negative, and grades to zero over a three-year period. It is intended to recognize the current market perception of expected defaults, which could be higher or lower than historical averages.

The maximum net spread adjustment factor can only result in an increase, not a decrease, to the baseline default charges. This adjustment grades to zero over a three-year period. This adjustment provides a cushion of conservatism for regulatory purposes in that it will adjust the net yield of the starting assets of the model segment to a level that aligns with a "Baa"-rated regulatory threshold asset. If the starting asset segment on the valuation date has a weighted average spread greater than a hypothetical "Baa"-rated regulatory threshold portfolio, the

---

[1] The NAIC maintains the quarterly publication of the prescribed asset spread data, which can be found on the Life Actuarial Task Force web page: http://www.naic.org/cmte_a_latf.htm.

maximum net spread adjustment works to bring the overall net yield of the asset segment in line with a "Baa"-rated average.

Second, the illustrative current spreads are used as the gross asset spread over Treasuries for purchases in the model during projection year one of public non-callable corporate bonds. The long-term benchmark spreads are used as the gross asset spread over Treasuries for purchases in the model during projection years four and later of public non-callable corporate bonds. For years in between, purchases will use a linear grade between these spreads.

Whether change in asset spreads is an element to include in the attribution analysis depends on any period-to-period changes in the distribution of assets by type, maturity and quality as well as the degree of movement or change in the prescribed asset spread tables of VM-20.

Change in Equity Assumptions

Together with generating scenarios of interest rates, the prescribed scenario generator produces equity returns for a variety of fund types. One of these is a fixed income fund. Returns for the fixed income fund are based on the path of interest rates in the same numbered scenario. This implies that the fixed income fund scenarios depend on the starting yield curve. Other than this characteristic, the equity fund returns are not correlated to the interest rate scenarios. Equity fund returns depend on a random number generator and a set of fixed parameters. Changes in equity assumptions will impact only valuations of equity-linked or variable fund return–type products. Such products are not included in this analysis.

Change in Investment Strategy

Appropriately reflecting the investment strategy in the model used for principle-based valuations is a fundamental requirement of the cash flow modeling necessary in complying with valuations pursuant to VM-20. Certifying to the accurate representation of the investment strategy is a requirement of VM-31, Paragraph 12, "Certifications." Should the company's investment strategy for the model segment change from one reporting period to the next, whether in terms of allocation among assets, asset characteristics or any timing considerations, these would have an impact on the projected net cash flows and accumulated surplus totals. An attribution step whereby the model assumes the prior strategy and differencing this with a step assuming the revised strategy provide a quantification of the impact of such a change.

Non-economic Assumptions

Experience Assumptions

Projected cash flows depend on experience assumptions, and these must be measured, monitored and documented in compliance with VM-20 and VM-31. As noted above, quantifying each of the non-economic assumptions underlying the projected cash flows is an aspect of the attribution analysis. Quantifying a change in one assumption in isolation also enables a better understanding of the material risk drivers for the model segment.

Mortality and policyholder lapse are primary to the principle-based valuation, and we will focus attention on these. For both assumptions, the model from the prior reporting period reveals what the company reasonably expects the current period's reserve amount to be, ignoring new

business, mortality improvement over the period and any economic changes. It is from this basis the change to the baseline assumption may be measured.

Because VM-20 prescribes all the steps in construction of the prudent estimate mortality, the discussion can be itemized.

- **Mortality segment.** A mortality segment, as defined by VM-20, is a subset of policies for which a separate mortality table representing the prudent estimate assumption will be determined. Defining the mortality segment(s) is the first step in the process of deriving the company's prudent estimate mortality assumption for use in principle-based valuations. It is difficult to imagine a scenario where the mortality segment would change from one valuation date to the next. In the early years of VM-20 implementation, a company may begin valuing products under PBR at different times. This should not have a bearing on the defined mortality segments, however, since a mortality segment would include experience from all experience eligible to be in that segment, whether valued pre-PBR or post-PBR.
- **Company experience.** If *emerging* company experience has decidedly become *anticipated* company experience, then it is time to update the baseline mortality assumption. Determining when and by how much will be judgment-based and must be documented in the company's actuarial report.
- **Mortality credibility.** The credibility of the experience mortality can potentially change between reporting dates, and this measurement, in part, drives the margin to be used on the company experience assumption, as well as the grading rules for grading in to the industry rates.
- **Sufficient data period.** The sufficient data period also drives the grading rules and is based on the number of durations within the mortality study for which there are at least 50 claims. This period is more likely to increase from one reporting date to the next, rather than decrease.
- **Industry experience.** Industry experience rates work to fill in the areas where company's experience is insufficient, according to the VM-20 mortality requirements. Once the industry table is identified, this aspect of the mortality assumption is not likely to change between valuation dates. The potential exists, however, for the prescribed set of industry mortality tables to be updated between reporting dates.

Less prescription is found in VM-20 around establishing the policyholder lapse assumption. The company experience must be based on experience studies. Here too, if *emerging* company experience has decidedly become *anticipated* company experience, then it is time to update the baseline lapse assumption. The margin used must work to increase the reserve. Once the margin is initially established, under what circumstances would it be changed? An example of a situation may be where the company establishes a level +10% margin for all durations of a level premium Term product. For valuations performed during the early years of the Term period, this +10% margin was shown to increase the modeled reserve amount. However, as the product aged (and absent new business), the +10% needed to be a −10% to increase the modeled reserve amount. A wholesale change to the margin structure should be a part of the attribution analysis.

Methodology Changes

Section 1 outlined examples of changes to a company's methodology: upgrades to actuarial projection software, correction to a known modeling error or change in the number of scenarios used in the valuation. An example specific to VM-20 would be when the company chooses to use a simplification, approximation or model efficiency technique as part of the valuation exercise. The company must demonstrate that the use of these techniques does not understate the reserve by a material amount and the expected value of the reserve calculated using such techniques is not less than the expected value of the reserve calculated without such techniques. For a company in this situation, the required demonstration can become part of the attribution analysis since it provides quantification of the values "before" and "after" the methodology change.

Prevailing Reserve Type

As noted in Section 1, if the prevailing reserve from one reporting period to the next remains the same (NPR, DR or SR), then this component contributes $0 to the attribution analysis. The more challenging situation is when the prevailing reserve switches between periods. Figure 2 outlines an example for a Term insurance block. In this example, the company has successfully demonstrated the group of policies passes the stochastic exclusion test, so that reserve type is excluded from the example.

Figure 2

Attribution Category Step	NPR	DR	PBR	Volatility from Prevailing Reserve Type	Reserve Change from All Other Attribution Categories
Opening	**10**	8	**10**		
Step 1	**12**	10	**12**	0	2
Step 2	13	**15**	**15**	2	1
Step 3	14	**16**	**16**	0	1
End			**16**		

Assume that at the prior reporting period NPR dominates and the resulting reserve is 10. Then we perform attribution analysis through the various steps, and for illustration purposes let us assume that there are only three steps of changes. In step 1, NPR still dominates, and the resulting reserve is 12. In step 2, the prevailing reserve changes from NPR to DR, and the resulting reserve is 15. Between step 1 and step 2, the total change in reserve is 3, which can be further divided into change of 1 from the impact of step 2 on NPR alone and a change of 2 resulting from the unexpected change in the prevailing reserve.

As the illustration shows, it will be helpful to track the attribution analysis of both NPR and DR through each step, which will then help identify at which step the change in prevailing reserve happens and correspondingly help quantify the volatility from the change in prevailing reserve.

Nonguaranteed Elements

> By themselves, NGEs do not contribute to the change in financial measurement unless management has made material adjustments to NGE factors in reaction to policyholder behavior or emerging experience. If so, the projected cash flows must reflect this change as closely as possible. VM-20 does not introduce anything new or different than other reporting regimes in this regard, unless the company has applied a margin to the NGE factors, which might complicate the analysis.

Demographics of the In-Force Portfolio

Section 1 introduced five elements of model demographics that impact the financial measure: time passage, terminations, new business, account value changes and miscellaneous changes. Modeling cash flows for principle-based valuations does not introduce any unique considerations to quantifying these elements. In early years, principle-based valuations will involve only new business, and during these years, a company will need to consider how to present the reserve attribution analysis in light of the company's planned implementation of PBR methods. For example, if the Term insurance product group is valued according to VM-20 for issues of 2017, while the Universal Life with Secondary Guarantees (ULSG) product is implemented beginning with issues of 2019, and all other products are implemented beginning with issues of 2020, then it may make sense to keep separate attribution analyses for each of these three groups. At such time as the entire PBR block has critical mass, a combined attribution analysis may be considered beneficial to the process.

Risk Mitigation Programs; Management Actions; Other

Section 1 introduced the elements of this category and provided some examples of events or conditions that would belong in this category. With respect to PBR-specific situations for this category, the reinsurance modeling merits consideration. VM-20 requires reinsurance cash flows be included in the determination of the minimum reserve, as it is a post-reinsurance ceded reserve amount. Implementing the requirements around reinsurance cash flows will involve actuarial judgment with respect to how reinsurance cash flows should reflect assumptions specific to VM-20. An example is the prudent estimate mortality assumption and its impact on the timing and amount of mortality risk reinsurance premium rates. As PBR valuations evolve, emerging practices may arise that regulators come to expect in PBR valuations, or regulators may simply determine that the language of VM-20 requirements needs to be more specific around reinsurance cash flow modeling. In any case, the early years of PBR valuations may require the company to be nimble in how it fits these kinds of interpretive changes into the attribution analysis.

Section 3: Overview of Reporting Regimes

This section is a high-level overview and discussion of five reporting regimes currently used by insurance companies to provide financial information on in-force insurance business. In order, the five regimes covered are:

Market Consistent Embedded Value	Market Consistent Embedded Value (MCEV) is a system used primarily as a measure of the value of shareholders in an insurance enterprise. From its first emergence in the 1980s in the United Kingdom to the publication of *Market Consistent Embedded Value Principles* in June 2008 by the CFO Forum, this regime has evolved to provide comparability across companies and greater consistency in insurance company reporting with the reporting of other financial institutions.[2]
Actuarial Guideline XLIII	Although not a regime by itself, an actuarial guideline is a regulatory interpretation of a broader statute, where the statute may not speak specifically to a particular product design or feature. In the case of Actuarial Guideline XLIII (AG 43), the interpretation is of the Commissioner's Annuity Reserve Valuation Method in use in the United States. Companies with variable annuity contracts with minimum guaranteed death benefits or guaranteed living benefits are subject to AG 43. This guideline applies the concepts of asset adequacy analysis to the risks inherent in such contracts.
Generally Accepted Accounting Principles in the Unites States	Generally Accepted Accounting Principles in the United States (GAAP or U.S. GAAP) is established by the Financial Accounting Standards Board (FASB) whose mission is to improve financial accounting and reporting to provide useful information to investors and other users of financial reports.[3] U.S. GAAP is a financial reporting regime required to be used by U.S. companies that are publicly traded. The FASB issues financial accounting standards (FAS) to be used in valuing certain insurance liabilities and contracts. In this report, we focus on the FAS aligned with life insurance.
International Financial Reporting Standards	International Financial Reporting Standards (IFRS) are considered a global standard and framework for how companies prepare financial statements. These standards are established by the International Accounting Standards Board (IASB), whose mission is to bring transparency, accountability and efficiency to financial markets around the world. As a global organization, the IFRS standards are particularly useful for companies that have operations in different countries.
Canadian Asset Liability Method	Canadian Asset Liability Method (CALM) is a method required for use by Canadian companies reporting under Canadian Generally Accepted

---

[2] "Market Consistent Embedded Values, A Public Policy Practice Note," American Academy of Actuaries, March 2011.

[3] "About the FASB," www.FASB.org.

Accounting Principles. The method is applied for purposes of measuring the insurance policy liabilities. Its purpose is to quantify an amount of policy liability under CALM equal to the amount of supporting assets at the valuation date that are forecasted to reduce to zero coincident with the last liability cash flow in that scenario.[4]

Each subsection to follow includes a brief introduction to the reporting regime, a high-level comparison of insurance liability measurement under the regime versus under VM-20, a discussion of reserve movement elements—for example, reserve attribution elements—and an example of an attribution grid where appropriate.

MCEV

Embedded Value (EV) reporting started in the United Kingdom in the 1980s as a way for life insurance companies to provide informed guidance to analysts and shareholders on their underlying economic values. At that time, accounting standards were not fully equipped to handle the unique nature of life insurance, and it was very difficult to use standard financial statements to assess a life insurer's economic value.

The latest evolution in EV reporting came in 2008, with the introduction of the MCEV principles by the CFO Forum.[5] These principles introduced mandatory market-consistent valuation of assets, liabilities and financial risks, while also introducing more specific disclosure requirements. The CFO Forum had originally intended to introduce MCEV as the mandatory standard for its members from 2012 onwards, but this requirement was withdrawn in 2011 pending the development of SII and IFRS.

The latest set of MCEV principles was issued in April 2016. In an appendix to the principles, the CFO Forum suggests certain disclosures that might be issued in conjunction with the MCEV amounts, including:

> Opening and Closing MCEV, together with a breakdown of the change in MCEV over the period.

In other words, an attribution analysis is part of the MCEV disclosure requirements. A sample template is provided in another appendix. The template is reproduced at the end of this section.

MCEV versus VM-20 Reserves

Although there are similarities in the calculations, it should be noted that MCEV amounts and VM-20 reserves are fundamentally different measures. MCEV is a measure of shareholder value of an enterprise or block of business. A VM-20 reserve is a measure of the value of obligations to policyholders arising from insurance contracts following statutory accounting rules. The MCEV amount has a broader scope, so therefore more drivers could affect an MCEV measure as compared to the VM-20 reserve. The MCEV principles amendments issued April 2016 allow the alignment of SII and MCEV valuations. SII provides an attribution analysis framework. The alignment provision suggests that an

---

[4] "Final Standards—Practice-Specific Standards for Insurers, Section 2300—Valuation of Policy Liabilities: Life and Health (Accident and Sickness) Insurance," Actuarial Standards Board, September 2010.

[5] Formally known as the European Insurance CFO Forum Market Consistent Embedded Value Principles. The MCEV principles are a copyright of the Stichting CFO Forum Foundation 2008.

MCEV attribution analysis could parallel the SII attribution analysis framework. In SII the attribution analysis is presented by a decomposition of the best estimate liability. Those who report on a SII basis in the United States have the option to translate the attribution analysis prescribed by SII and apply this to their MCEV process.

Attribution Elements of MCEV That May Be Relevant to VM-20

To begin, certain elements of the typical MCEV attribution analysis would not be relevant for VM-20. These include, but are not limited to:

- Risk allowances for certain types of non-hedgeable risk
- The impact of income taxes
- Capital contributions or dividends to shareholders
- Business acquired or divested

The remaining sections focus on the attribution elements that would have relevance for reserves under VM-20.

New Business Value

MCEV attributions typically separate the impact of adding new business since the last reporting date from the impacts affecting the business that was in-force at the beginning of the period. This allows for a clear distinction between the expected movement in reserve on the existing business and deviations in experience from those expectations.

Expected Existing Business Contribution

Generally all expected movement in the MCEV is aggregated for presentation purposes. There is no split by individual driver, rather it is looked at on a net basis. This expectation reflects all of management's estimates as to future economic markets, cost of options and guarantees and management actions in response to such conditions. Mechanically it is presented as unwinding of the discount rate and release of risk allowances and time value of options and guarantees from the period just completed. The unwinding of the discount rate should represent the net cash flows and investment spread expected in the period.

Operating Variances

It is common to distinguish between operating experience variances and other operating variances. Operating experience variances are typically quantifications of actuarial experience driver variances such as mortality, lapse and policyholder behavior. Miscellaneous model changes are also classified as "operating" as they occur with some regularity. Other operating variances are typically nonrecurring operating items such as actuarial platform enhancements, extraordinary expenses and residual variances. It is common to separately disclose any significant changes to methods or approaches, such as material model changes.

Change in Assumptions

Changes in future experience assumptions are separately identified. This aspect of MCEV reporting would apply if a company updated its future expectation of lapse activity from what it had been assuming in prior valuations, for example.

Economic Variances

Under MCEV there is no separation of the impact of current period economic experience variances versus changes in economic assumptions as to future periods. These are treated as one category in the attribution analysis. This is often the largest component of the attribution analysis as it reflects the impact of the economic mismatch between the asset and the liability discount rates.

Non-operating Variances

Non-operating variances under MCEV include mandatory local regulatory changes such as taxation and fundamental business reorganizations such as court-appointed schemes. Exchange rate movement and acquisitions/divestitures are also included in the non-operating category. The impact of management actions in response to these would be reflected in "other operating variance." Although perhaps not directly applicable to VM-20 attribution analysis, this category may appear from time to time in a company's VM-20 valuation. For example, a company that acquires a block of business that includes policies valued using VM-20 principle-based reserves, it would need to fold those policies into its own policy blocks subject to VM-20, creating a variance of an unusual nature.

CFO Forum MCEV Movement Analysis Template

Figure 3 shows the template included in the CFO forum MCEV principles document from April 2016. Although some variation exists in practice with regard to the presentation, most companies include the categories shown in the template.

Figure 3

	Earnings on MCEV Analysis			
	Free Surplus	**Required Capital**	**VIF**	**MCEV**
Opening MCEV				
Opening adjustments				
Adjusted opening MCEV				
New business value				
Expected existing business contribution (at reference rate)				
Expected existing business contribution (in excess of reference rate)				
Transfers from VIF and required capital to free surplus				
Experience variances				
Assumption changes				
Other operating variance				
Operating MCEV earnings				
Economic variances				
Other non-operating variances				
Total MCEV earnings				
Closing adjustments				
Closing MCEV				

AG 43

AG 43 is a regulatory interpretation of the application of the Commissioner's Annuity Reserve Method (CARVM) to VA with guarantees. AG 43 became effective December 31, 2009. Prior to this time, AG 33 (Determining CARVM Reserves for Annuity Contracts with Elective Benefits), AG 34 (Variable Annuity Minimum Guaranteed Death Benefit Reserves) and AG 39 (Reserves for Variable Annuities with Guaranteed Living Benefits) were the standard guidelines for calculating statutory reserves for VA with guarantees. These earlier actuarial guidelines used traditional formulaic approaches at a time when the designs of the VA guarantees were becoming more complicated and sensitive to economic conditions. A limitation of these earlier approaches was that extreme events were not taken into account in the valuation exercise. AG 43 was developed to address these concerns.

Although AG 43 is an improved methodology to calculate reserves, it presents a challenge for companies in analyzing movements from period to period primarily because of the stochastic reserve component and the corresponding increased run time. Although attribution analysis is not a regulatory requirement, some companies with VA blocks have developed attribution analysis methods to better understand changes in reserve from period to period.

AG 43 versus VM-20 Reserves

A number of similarities are seen between AG 43 and VM-20. Put simply, under AG 43, the minimum statutory reserve is equal to the standard scenario amount plus the excess, if any, of the conditional tail expectation (CTE) amount over the standard scenario amount.

We can think of the VM-20 deterministic reserve as the parallel to AG 43's standard scenario amount. Both regimes include consideration for a stochastic reserve. However, while AG 43 *requires* calculation of a stochastic reserve, under VM-20 a stochastic reserve *may* be a part of the valuation unless an exclusion test is passed. In determining the stochastic reserve, both regimes call for a large number of scenarios included in the calculation. These scenarios are limited to interest rate and equity market risks. Both regimes use a CTE as the risk measure required for the stochastic reserve, and in both regimes the calculations are performed on a pretax basis.

The one component of VM-20 that does not have a parallel in AG 43 is the NPR. The NPR is the formulaic floor component of VM-20 and has a corresponding due and deferred net premium asset. There is no formulaic reserve within AG 43 requirements. Definitions of AG 43 and VM-20 are summarized below to illustrate the similarities and differences:

- AG 43: Aggregate Reserve = Standard scenario reserve + Excess, if any, of Stochastic reserve over Standard scenario reserve
- VM-20: Minimum Reserve = NPR + Excess, if any, of max(Stochastic reserve, Deterministic reserve) over NPR, adjusted for due and deferred premium asset

These similarities between AG 43 and VM-20 suggest that the attribution analysis for AG 43 may be used as a guide for a VM-20 attribution analysis.

Attribution Elements of AG 43 Relevant to VM-20

Impact from Equity Market

Changes in the value of separate accounts due to equity market changes from period to period are typically the largest contributor to AG 43 reserve movement. The most common equity indices that

companies track are the S&P 500, EAFE, Russell 2000 and Bond Index. One of the most common methods used to quantify the impact of changes in the equity indices from period to period is unwinding the account values on a seriatim basis for each fund and recalculating the AG 43 reserves. This method can be arduous since it would require four additional stochastic runs. Some companies will perform one run by combining all four indices to measure the total equity market impact. This attribution step is applicable in a VM-20 context for life insurance products having a tie to the equity markets such as Variable Universal Life (VUL) and Equity Indexed Universal Life (EIUL).

Impact from Interest Rates
For VA, changes in the yield curve will impact the portion of the account value in bond funds as well as the discount rate used in the stochastic reserve calculation. An upward shift to the yield curve means the account value assigned to bond funds declines in value, whereas the reduction in discount rate increases the reserve. Although the impact on the reserve is mixed, in general the net impact is a reduction in reserve. The opposite effect is true for a decrease in interest rates.

For life insurance products, an upward shift to the yield curve is favorable from the perspective of increasing the interest spread (interest earned over contractual guarantees). A reserve determined by a present value of cash flows calculation will be lower when using a higher discount rate. However, one cannot ignore the impacts from adverse policyholder behavior brought on by a higher interest environment, such as policyholder lapse activity due to more attractive competitor credited rates.

In the AG 43 attribution analysis, companies will typically unwind the yield curve to analyze the impact. Typically, unwinding the entire yield curve is a useful attribution step, particularly when the shift of the yield curve is parallel. However, many times changes of the yield curve are not parallel, hence it would be more effective to unwind each key bond duration at a time. Key rates are typically limited to the 1-year, 5-year, 10-year, 20-year and 30-year bond rates. As with the equity attribution step, this granular unwinding takes many runs to dissect the entire yield curve. Therefore, each company will need to assess the trade-off between a more refined attribution and extended run time.

Impact from Volatility
Generally, the higher the market volatility, the more likely the account value will deviate significantly from the expected value. Unwinding the volatility assumption typically will not be a material component of the attribution unless there are major economic shocks in the market. Similar to impact from equities, in the context of VM-20, the life insurance products impacted by volatility will be those tied to the equity markets such as VUL and EIUL.

In-Force Business Impact
Changes in the in-force file that impact the AG 43 minimum reserve primarily include change in fund allocation, decrements from lapses and mortality, and partial withdrawal utilization. For assessing changes to fund allocation in the attribution analysis, companies look at the prior period in-force file to determine the fund allocation present at the beginning of the reporting period and apply the same allocation to the current period in-force file. For assessing the impact due to lapses and mortality, a company may include the terminated policies together with the current period in-force file, then run the model with the prior valuation date. This quantifies the impact these terminated policies have on the attribution analysis. Last, variances due to partial withdrawal activity being more or less than anticipated during the period can be quantified by setting the partial withdrawal assumption associated with the

current period's in-force file equal to the assumption used with the prior period in-force file. This quantifies the impact of the variance in expected versus actual partial withdrawal activity.

New Business Impact
The impact from new business issued during the period can be quantified by simply isolating newly issued policies remaining in-force to the valuation date and calculating the AG 43 reserve for these policies separate from the broader in-force block.

Change in Assumptions
The key risk drivers for VA business are periodically analyzed by experience studies. These experience studies are the basis for resetting assumptions in the AG 43 models. Key risk drivers for VA business include partial withdrawal utilization, lapses, mortality and expenses. Any assumption that changes will have an impact on the AG 43 reserve will need to be tested in the current period model on a "before" and "after" basis to analyze its contribution to the attribution analysis.

Unexplained
This item will be the difference between the ending balance less the beginning balance less all the items otherwise quantified in the attribution steps described above.

Derivatives and Hedging Assets
For companies that attempt to hedge against change in AG 43 reserve amounts, attribution of the hedge portfolio can be presented side by side to the reserve attribution to quantify the net gain or loss of the hedge program. Normally companies will use derivatives to hedge interest and equity risks. The attribution analysis of the hedge portfolio will not usually have the granularity of the liability attribution, but it does impart information regarding comparable movements between the reserves and hedge portfolio and whether these are proportional. In a VM-20 context, hedging programs can be utilized for variable life insurance products.

Reinsurance
The aggregate reserve in AG 43 is calculated net of reinsurance. Both the standard scenario amount and the CTE amount are usually determined net of reinsurance. Companies can perform the attribution analysis in this manner. However, sometimes it is necessary or beneficial to reflect reinsurance after the aggregate reserve is determined as a separate line item in the attribution breakdown. This approach can be insightful for financial reporting where the actuary can see the true attribution movement of the direct business alone and observe gains and losses from the reinsurance arrangement separately.

Sample AG 43 Movement Analysis Template

Figure 4 is a sample template for an AG 43 attribution analysis. It illustrates a potential way for companies to compare change in AG 43 reserves with the change in hedge assets. However, not all companies hedge against the change in AG 43, and thus some companies may simply track the change in AG 43 itself without attempting to reconcile with hedge assets movement.

Figure 4

	Earnings on AG 43 Analysis		
	AG 43 Reserve	**Derivatives and Hedging Assets**	**Net Gain (Loss)**
Beginning balance			
Equity			
S&P 500			
EAFE			
Russell 2000			
Bond fund			
Subtotal equity market impact			
Interest rates			
1-year rate			
5-year rate			
10-year rate			
20-year rate			
30-year rate			
Subtotal interest rate impact			
Volatility impact			
In-force business			
Unwind fund allocation			
Unwind decrements			
Unwind partial withdrawal utilization			
Subtotal in-force business impact			
New business impact			
Assumption change impact			
Reinsurance (if applicable)			
Unexplained			
Closing balance			

U.S. GAAP

Although statutory reporting is important from a pure solvency standpoint, it does not necessarily serve the financial reporting needs of other stakeholders such as investors and creditors. These needs were primary drivers of the evolution of GAAP, and in this section, we discuss GAAP in terms of U.S. companies, therefore U.S. GAAP. As a reporting regime, GAAP is used worldwide. The designated accounting standard setter for public companies is the Financial Accounting Standards Board (FASB). The FASB issues financial accounting standards intended to promote reporting that provides useful information to investors and others who use financial reports.

No promulgated standard exists for how the movement in policyholder liabilities should be analyzed under U.S. GAAP. Certain disclosures of information are required under the applicable FASB standards, but those disclosures are often principles based and allow for the preparer to adjust as to the level of detail and the exact format of the disclosures. For the purposes of this report we have reviewed the public U.S. GAAP financial statements of several insurers as well as the supplementary financial information they release in conjunction with those statements, and we summarized the various analyses that might be relevant to VM-20–type reserves.

U.S. GAAP versus VM-20 Reserves

Current U.S. GAAP requirements for long-duration contracts vary depending on the underlying type of contract. For fixed premium, fixed death benefit–type contracts, a net premium type of valuation is used (i.e., FAS60). This has a direct analogy to the VM-20 NPR method. For flexible premium interest-sensitive contracts, the policy's account value serves as the U.S. GAAP liability (i.e., FAS97). Liabilities in addition to the account value are held for guarantees that are not funded by the account value. These additional liabilities are often calculated using multiple economic scenarios. The multiscenario liability calculation is analogous to the stochastic reserve under VM-20.

Attribution Elements of U.S. GAAP Relevant to VM-20

Net Premium Approach Liabilities
Utilization of an attribution analysis for insurance blocks under the net premium approach within U.S. GAAP varies. Some companies report the outstanding balances of these types of liabilities only at the current and prior valuation dates. Some companies provide a roll-forward of these liabilities, separating out policyholder cash flows including premiums, surrender payments or withdrawals, and benefit payments, from non-policyholder elements such as interest credited on reserves and mortality charges assumed to be collected. In addition to roll-forwards of the liabilities, trends in the reserve balances as well as insurance amounts in-force are frequently provided. A disclosure that is often made is the accrual interest rate on the reserve liabilities. This is often disclosed on a line of business or product-type basis.

Multiscenario Approach Liabilities
Liabilities calculated using a multiscenario approach are often related to minimum guaranteed benefits associated with universal life insurance or variable annuity products. Such guarantees persist even after the underlying policy account value is exhausted. Roll-forwards of liabilities valued using the multiscenario approach are typically provided. The attribution analysis will show liabilities established in the current period for newly guaranteed benefits, benefits paid and other increases in the reserve. It is also common to show information comparing the level of account values and the value of the minimum

guaranteed benefit. This can be shown separately for general and separate account products and by line of business.

Normalized Earnings

In any reporting period, one may find significant income statement components that distort or mask the underlying performance of the insurance business. Companies will often separate these items out from the "normal" components of income in an effort to bring the current period's statement of income to a presentation comparable to prior statements. The normalized income is referred to by such names as "adjusted operating earnings" or "adjusted income." The specific items that are adjusted out vary by company and line of business. For example, many companies remove the impact of certain economic market changes whose relative size can dwarf the underlying mortality, lapse or other policyholder behavior activity. It is the insurance aspects of the income statement that are important to stakeholders in estimating future sources and uses of capital. Companies will provide a reconciliation of the adjusted operating earnings to the actual reported income, often on a line-by-line basis. This often includes an attribution analysis for the change in policyholder liability.

Reinsurance

Many companies provide a separate analysis of the impact of reinsurance on the line items of both the income statement and the balance sheet. Some companies with significant affiliated reinsurance will provide separate analyses for affiliated and nonaffiliated reinsurers.

Sensitivity Analysis

Companies reporting using U.S. GAAP will use sensitivity analysis to demonstrate the impact of potential movements in market values and interest rates on elements of the income statement and balance sheet of the entity and include this sensitivity in the liability attribution analysis. The impact of each potential market movement is typically shown separately. Market movements may include changes in equity prices, changes in yield curves, changes in interest rates and changes in foreign exchange rates.

Fair Value Disclosures

Companies are required to show the fair value of any items not carried at fair value in the financial statements. Because insurance contract liabilities are not measured at fair value under U.S. GAAP, this kind of information is typically found in the disclosures. Some companies are also disclosing the valuation techniques used to determine such values, the inputs to such techniques including quantitative ranges and the directional impact on fair value if such inputs increase relative to their current values.

Sample U.S. GAAP Movement Analysis Template

Movement analysis is used infrequently within the U.S. GAAP regime. In practice, the type of analysis most relevant to an attribution analysis is an account value roll-forward for interest-sensitive products. An example of an account value roll-forward is shown in Figure 5. The most significant aspect of this example is the general order of the roll-forward.

Figure 5

	Total
Beginning account value	
Impact of new business	
Impact of surrender and partial withdrawal	
Impact of benefit payments	
Impact of market value changes, interest credits, other	
Impact of policy charges, fees	
Ending account value	

IFRS

Since the adoption of IFRS in the early 2000s, specific standards have been issued for application to many types of financial contracts. In March 2014, the IASB issued IFRS 4, which permitted companies continued use of previous valuation methods for life insurance contract liabilities. IFRS 4 also introduced enhanced disclosure requirements. Companies currently use a range of different reserving methods for different business segments. A segment may be defined as a particular geographical region or type of product (Whole Life, Universal Life etc.).

IFRS 4 is being replaced by IFRS 17, a standard issued in May of 2017. IFRS 17 is anticipated to have an effective date of January 1, 2021, a year after the end of the three-year transition period for VM-20. Since IFRS 4 was meant as an interim standard, the wide variety of valuation methods continued under IFRS 4 will move to a more uniform reserve method under IFRS 17. This section discusses the practices currently used by companies reporting under IFRS. For IFRS specific to Canadian insurance companies see the CALM section.

IFRS versus VM-20 Reserves

Similarities between a company's IFRS methods and VM-20 methods will depend upon the method in use at the company under the IFRS 4 standard for the company. Under the current IFRS regime, a company may be using a net premium reserve method in determining life insurance liabilities. If so, this is comparable to the VM-20 NPR method. For a company employing a present value of cash flows approach or a multiscenario tail risk approach in valuing certain liabilities under its IFRS 4 reporting, these methods are comparable to the deterministic and stochastic reserve components, respectively.

Differences between these two regimes can be found in the assumptions permitted for use in each regime. Specifically, IFRS calls for the company's best estimate assumptions with provision for risk. This practice is seemingly analogous to the use of prudent estimate assumptions in valuing deterministic and stochastic reserves under VM-20, although VM-20 likely has more prescription in the development of a company's anticipated experience factors as well as conservatism built into the margins, both explicit and implicit. Notable differences also are seen in the development of discount rates to use in determining liability amounts between these two regimes.

Attribution Elements of IFRS Relevant to VM-20

Liability Adequacy Test

Liability adequacy tests are usually performed for each insurance portfolio using current estimates of future claims, expenses, premium earned and proportionate investment income. For long-duration contracts a premium deficiency is recognized, if actual experience regarding investment yields, mortality, morbidity, terminations or expense indicates that the existing contract liabilities, along with the present value of future gross premiums, will not be sufficient to cover the present value of future benefits and to recover deferred acquisition costs.

Sensitivity Test

Under IFRS, the sensitivity of net income attributed to changes in both economic and non-economic assumptions are required to be disclosed and are usually presented in the companies' notes of the consolidated financial statements. Descriptions of the sensitivities are also disclosed in the report. Typical non-economic sensitivity scenarios include 10% increase or decrease in mortality rates, 10%

increase or decrease in morbidity rates and 20% increase or decrease in lapse rates. Typical economic sensitivity scenarios include 100 basis point increase in discount rate.

Reinsurance

IFRS 4 introduced a new and extensive requirement for disclosing reinsurance information. For example, reinsurance assets must be explicitly listed as an asset item in the balance sheet, and changes in reinsurance assets must be listed separately from changes in insurance contract liabilities in the income statement.

Sample IFRS Movement Analysis Template

Figure 6 is a sample template for Movement in Insurance Contract Liabilities (long-duration business). For companies reporting on an IFRS basis, there may be differences in presentation or order of the attribution analysis template.

Figure 6

Movements for Long-Term Business	Total
Carrying amount at January 1	
Provisions in respect of new business	
Expected change in existing business provisions	
Variance between actual and expected experience	
Impact of changes in assumptions	
Other movements	
Change in liability recognized as an expense	
Effect of portfolio transfer, acquisitions and disposals	
Foreign exchange rate movements	
Other movements	
Carrying amount at December 31	

CALM

CALM reflects the Canadian life insurers' needs to meet regulatory reporting requirement and professional standards. The CALM reserving approach became effective in the early 2000s. Prior to the adoption of CALM, most life insurance companies in Canada used the Policy Premium Method to valuate insurance liabilities.

Since the adoption of IFRS in Canada on January 1, 2011, and, as explained in the section above, IFRS 4 allowing the continuous use of previous valuation methods, CALM continued as an acceptable method for life insurance policy valuation. Under IFRS 4 directives, more information disclosure is required. In particular, certain situations are found where the discussion and disclosure of reinsurance are of particular importance, and amounts gross, ceded and the net basis must be disclosed.

IFRS 17 (IFRS Phase II) is anticipated to be in effect on January 1, 2021, stepping in to replace the interim IFRS 4 standard. Under the new IFRS general model, CALM can no longer serve as an acceptable method. It is expected that Canadian life insurance companies will phase out CALM and adopt a new methodology for liability valuation. This report, however, focuses on CALM and its application to VM-20 concepts.

CALM versus VM-20 Reserves

A number of similarities are found between CALM and VM-20. The CALM regime includes a component very similar to a deterministic reserve whereby the amount of policy liabilities using CALM for a particular scenario is equal to the amount of supporting assets at the valuation date that are forecast to reduce to zero coincident with the last liability cash flow in that scenario. This amount of assets quantifies the liability or reserve amount. This is similar to the direct iteration approach to calculating the VM-20 deterministic reserve. Both regimes require the use of a company's experience assumptions with appropriate provision for adverse deviation.

The application of a multiscenario approach to determining reserves within CALM is limited to valuing general account policy liabilities associated with segregated fund guarantees. Like VM-20, when performing the stochastic calculation, a large number of scenarios are required for this calculation.

CALM is a cash flow roll-forward method, without a formulaic reserve floor. In contrast, VM-20 includes a formulaic NPR component. The NPR uses prescribed assumption and is the component that is first calculated before the consideration of deterministic or stochastic reserves. The NPR is a reserve determined on an individual policy level, while the deterministic and stochastic reserves are both considered aggregate amounts for a group of policies. In contrast, CALM is for groups of policies and has no seriatim component. Both regimes, however, reflect the risks inherent in the policies of the insurance company. Also, depending on the underlying product design, there is the option to choose to perform either a deterministic or stochastic calculation under CALM, whereas VM-20 requires both deterministic and stochastic calculation unless an exclusion test is passed. Although VM-20 stochastic scenarios consider both interest risk and equity market risk, CALM scenarios consider only interest rate risk. In addition, VM-20 uses CTE70 as the risk measure required for the stochastic reserve, whereas stochastic CALM uses the midpoint of the range of CTE60 to CTE80.

Attribution Elements of CALM That Are Relevant to VM-20

Supporting Assets

Total assets are segmented and matched to liabilities with similar underlying characteristics by product lines. This allows for a clearer distinction on the underlying market risk that is driving the deviation from expected experiences.

New Business Value

Like other regimes, the impact of newly issued policies during the reporting period is separately listed as a step in the attribution analysis as well as in the detail surrounding sources of earnings. This quantitative impact of new business is accompanied with a brief qualitative explanation of differences in actual market conditions versus those assumed in the pricing of the new business.

Existing Business Contributions

All expected movement is aggregated, but often key drivers are shown separately. Primary sources of earnings are separately listed for *Expected Profit from in-force business*, *Experience gains or losses*, *Management actions and change in assumptions*, *Earning on surplus funds*, *Other* and *Income Taxes*. Again, each of the categories is accompanied with a qualitative explanation of the driving forces behind the changes.

Change in Assumptions

Extensive disclosure requirements surround the company's development of the valuation assumptions. Numerically, the attribution analysis will separately list the impact on a pre–income tax basis from mortality and morbidity assumption updates, lapse and policyholder behavior assumption updates and any other assumption updates. These key drivers are also explained in the narrative supporting the attribution analysis.

Reinsurance

Since the adoption of IFRS 4, extensive requirements are in place on disclosing reinsurance information separately. Since the CALM method is on a net of reinsurance basis, insurance companies now explicitly list reinsurance assets as one of the asset items in balance sheet. Changes in reinsurance assets are also generally listed separately from changes in insurance contract liabilities in the income statement.

Sensitivity Analysis

Sensitivities of net income attributed to changes in both economic and non-economic assumptions are required to be disclosed and are usually presented in the companies' annual reports Risk Management section. The sensitivity scenarios are usually disclosed in the report and updated on an as-needed basis. Typical non-economic sensitivity scenarios include 2% adverse change in future mortality rates, 5% adverse change in future morbidity rates, 10% adverse change in future termination rates and 5% increase in future expense levels. Typical economic assumptions include parallel shift in yield curve, change in range of interest rates, change in equity markets and change in best estimate returns for equities.

Sample CALM Movement Analysis Template

Figure 7 is a sample template for Changes in Insurance Contract Liabilities and Shareholder Net Earnings. Most companies present the attribution analysis using the categories shown in the template.

Figure 7

	Changes in Insurance Contract Liabilities		
	Insurance Contract Liabilities	**Reinsurance Assets**	**Net**
Balance, beginning of year			
New polices			
Normal in-force movement			
Changes in methods and assumptions			
Impact of foreign exchange rate changes			
Balance, end of year			

	Shareholder Net Earnings		
	Segment A	**Segment B**	**Total**
Expected profit on in-force business			
Impact of new business			
Experience gains (losses)			
Management actions and changes in assumptions			
Other			
Earnings (loss) on surplus			
Income (loss) before income taxes			
Income tax (expense) recovery			
Net income (loss) attributed to shareholders			

Section 4: Company Interviews

This phase of our research involved interviews with company actuaries who are actively involved in or lead the financial reporting function within their company. The objective of these interviews was to discover types of attribution analysis currently in use, the insight this may lend to the company's management as they begin to consider VM-20 attribution analysis, and the challenges these actuaries see as being introduced by a VM-20 attribution analysis.

The interviews were conducted as free-flowing conversations, rather than using a survey approach. However, we covered the same topics in each interview. Although the script was similar from company to company, the conversational nature allowed companies to provide anecdotal information regarding their experiences in this area. A summary of the profiles of companies involved is below, followed by a narrative of the interview outcomes (note that this narrative does not provide direct quotations; rather, we paraphrase the key responses we received during the interview).

We spoke to actuaries at six companies, of varying size that use various accounting bases in addition to statutory. For most of the conversations, more than one company actuary participated. Although the focus of the discussions was on reporting regimes and attribution analysis, other issues often came up, for example, modeling challenges, governance and controls and VM-20 implementation.

All six companies are rated A+ or better by A. M. Best. The smallest company has approximately $20 billion in net admitted assets.

Financial Reporting Regimes Used

Figure 8 shows the responses of companies when asked which of the five regimes (USGAAP, AG 43, Canadian CALM, IFRS and MCEV) have a part in their company's financial reporting processes.

Figure 8

USGAAP	AG 43	CALM	IFRS	MCEV
5	6	1	2	2

What Analysis Tool Is Most Frequently Used to Understand Period-to-Period Changes?

When investigating period-to-period changes or reserve movement analysis, the roll-forward analysis is the tool of choice. Other tools include reserve trending, reserve-per-thousand analysis and statutory-to-GAAP ratios. Additional color on the company's processes are summarized below. In our interview conversations, we encouraged companies to also consider asset adequacy testing in their responses because attribution is often used in reviewing period-to-period results, even though it is not a financial reporting regime by itself (similar to AG 43).

- In the source of earnings analysis, adverse deviation is considered on a quarter-by-quarter basis. The data warehousing system affords the facility to view any attribution on a seriatim basis.
- In the attribution exercise, expected movement versus actual movement is part of the analysis. Layering on newly issued business is a step identified separate to all others.
- A source of earnings presentation is developed from the statutory income statement presentation. This exercise enables a breakdown of the movement in the reserve.

- For embedded value reporting, the movement analysis is enterprise-wide, not line of business level.
- Recently, the roll-forward has not moved outside of expected ranges. However, when the prevailing reserve method flips back and forth, like it could for VM-20, this is problematic. Tracking two roll-forwards may be necessary: one for the standard scenario and one for the modeled reserve. For example, in the AG 43 analysis, if the standard scenario prevails, the roll-forward is more straightforward than if the stochastic reserve prevails.
- Equity impacts are considered separate from all other impacts.
- For embedded value reporting, a roll-forward analysis is required to explain period-to-period changes.
- Economic changes, liability changes and modeling update changes are separately split out in a robust way.
- Assumption unlocking is performed annually, and this affects all types of reporting. The impact of assumption unlocking on the reserve is quantified, if such unlocking were to occur. The same basic assumptions are used throughout the company, although margins may differ.
- No rigid format is reflected as to order of attribution. Each material change is run on its own to capture the impact. The order of attribution is not strictly defined as long as the attribution hangs together, while understanding that order does affect the presentation.
- Since GAAP is developed quarterly, the focus for attribution is from the same quarter one year ago. Quarter-to-quarter attribution leads to interesting trends due to seasonality.
- The main focus is mortality by comparing actual-to-expected mortality quarterly and annually. Quite a lot of analysis goes into this experience factor.

Is There Consistency in Attribution Analysis Methods between Regimes, if More than One Regime Is Used?

When more than one reporting regime is used, it is clear from our conversations that the attribution analysis is not necessarily consistent between regimes. It was also evident that companies had no compelling reason to make the attribution analysis presentations consistent. Because each regime provides for a unique reporting focus, consistency in attribution analysis is not a priority. Comments on this topic varied from company to company, with highlights noted below:

- A reporting regime performed annually will have different needs with respect to the attribution analysis than will a reporting regime performed quarterly.
- The evolution of the reporting regime within the company and the needs of the company with respect to the attribution will affect the presentation. For example, attribution for a Variable Annuity block under AG 43 will be different than for a participating Whole Life block under FAS 120.
- The complexity and components of the attribution will depend on which reserve prevails. For example, AG 43 reporting tracks a standard scenario reserve and a stochastic reserve.
- The structure and purpose of the regime impacts the presentation of the attribution analysis. For example, U.S. GAAP has a structure of analysis by FAS 97, FAS 120 and so on. This does not translate well to other regimes, nor does it make sense to try.

- As long as consistency is seen in the attribution presentation within a regime from quarter to quarter, it matters not whether there is consistency in presentation between regimes.
- Management puts a higher priority on some reporting regimes more than others.

Describe Management's Use of and Attention to the Attribution Analysis Provided

All companies we interviewed reported that the attribution analysis is used as a tool in communicating financial results to senior management. A prevailing sentiment is that the attribution analysis results get more attention from the board and senior management when there are unusual swings in the reserve movement. In contrast, stakeholders that are most often interested in the details of the attribution analysis are in the actuarial and finance areas of the company.

Excerpts from commentary provided around this topic follow:

- When things are moving around, senior management tends to take notice. They are more reactive than proactive.
- AG 43 attribution analysis gets quite a bit of attention. By extrapolation, there may also be more attention paid to the VM-20 reserve movement attribution.
- Different internal audiences have their own preferences when it comes to what they pay attention to. For example, controllers and actuarial management look carefully at SOP 03-1 analysis, while senior management likes to focus on a version of U.S. GAAP that is done internally using real-world assumptions.
- Actuarial leadership takes the deeper dive into the analysis, whereas senior management is more receptive to high-level overview.
- Attribution analysis is typically presented at an overview level. If stochastic reserves are prevailing, this component is shown separate to the other components. Stochastic components generate more questions from senior management.
- Any regime involving hedge effectiveness, like AG 43, gets scrutiny from the senior managers of the investment function area.
- U.S. GAAP results get a lot of scrutiny before being reported out. A parent company will ask many questions, and senior managers want to be prepared to answer these questions.
- Senior management will provide feedback and, in particular, suggestions regarding consistency across the company for a given reporting regime.
- Together with senior management, actuaries are striving for consistency in how assumption updates are processed and presented.

How Would You Like to Improve Your Work in the Area of Attribution Analysis?

The common thread in this area is a desire for more insightful analyses in less time, with more controls and governance around the process. Interviewees recognized that, although reporting deadlines do not change, the technology necessary to enable these improvements is available, or will be soon—it is only a matter of advancing along the learning curve. To add color to this idea, interviewees provided the following comments.

- The attribution analysis is being enhanced to make it more robust around the stochastic reserves, whether for statutory or for U.S. GAAP. Attribution analysis should inform the meaning of each change and be a source of due diligence for the model and implementing current period changes into the model.

- If the model were processed more efficiently, more resources would become available to do "what-if" sensitivities. Becoming adept with model compression or simplification techniques could be helpful in this regard.
- It is desirable to produce forecasts more accurately. This requires adopting consistent modeling platforms throughout the enterprise, as well as increasing granularity in each model. More granularity in the model would expand the ability to explain the results and communicate results to management.
- Better controls and definitions of roles for the modeling teams would improve the model governance significantly and provide for better due diligence on the modeling process.
- Ideally, a centralized modeling unit would be developed at the company, with actuaries outside of this centralized unit doing the analysis of results coming out of that modeling unit.

Are Graphical Presentations Used to Present the Attribution Analysis?

On this topic, we found a mixed bag of responses: some yes, some no. Generally, any presentation approach that has been used in the past successfully continues to be used currently. Changing presentation templates is difficult because senior management becomes accustomed to one style or method. Graphical presentation formats do not seem to be a request of senior management. It is also true among the interviewees that by the time the results are processed, the reporting deadline has arrived. There is no time left to develop new styles of presentation. Below are viewpoints obtained in the interviews:

- A chart of the trend in market performance against GMDB reserve for VUL product line has been used and considered helpful.
- Graphical displays have been developed, in particular with embedded value attribution analysis. The financial planning area translates the information to a management presentation deck. Senior management appreciates the graphical style of presentation. On the other hand, the actuarial audience prefers to see a more granular level of detail, one that does not lend itself well to graphs.
- If the audience is accustomed to seeing a particular template, it is difficult to change and move to a graphical presentation.
- The actuarial department does not use graphs for period-over-period analysis; however, the finance area does use graphs in conveying the financial forecasts.

Have You Thought about the Analysis Method Best Suited to Explaining Period-to-Period Reserve Results for VM-20?

Because the amount of business subject to VM-20 will be initially quite small even for large companies, the interviewees had not committed much thought to selecting a particular method but know this is a hurdle they need to cross. Prevailing sentiments are that there will be time to build out the process; companies already having implemented an attribution analysis for one in-force reporting regime will likely implement similar processes with potentially different steps for VM-20 reporting; and the three reserve components of VM-20 will be challenging to manage through the attribution analysis. Comments included:

- The NPR, DR and SR may be tracked separately, if necessary. The data warehouse facility will be the tool used for VM-20 as it is already used for other regimes. The VM-20 attribution method has not been identified, however.
- The process of determining an attribution analysis method is in its infancy. VM-20 will not be implemented until the end of the three-year transition period. Building something totally new is unlikely, and a format similar to a regime already in use will likely be the default methodology.
- A roll-forward analysis whereby components like interest and mortality and the impact of each are separately identified in the analysis makes sense as a starting point.
- For the NPR, this analysis would probably not be much different from other approaches already in use for formulaic reserves. Folding the DR and SR into the analysis is expected to present challenges, because any of the three components—NPR, DR or SR—could prevail at different valuation dates. This concept was expressed by more than one company interviewed.
- Relying on the framework of reporting under AG 43, it makes sense to port this process for use with VM-20. The actuaries see efficiencies in this from the perspective of staffing resources and management communications. A separate roll-forward for NPR, DR and SR is not considered a critical need.
- There will not be much variability or volatility initially, until the VM-20 blocks gain in size. The period in advance of such critical mass can be used to plan for the attribution analysis.
- It seems reasonable to include in-force changes, assumption changes and any change in prevailing reserve component in the attribution analysis. What it would mean in terms of work effort if the SR was part of the VM-20 valuation has not yet been contemplated.

What Aspects of VM-20 Valuations Will Be Most Challenging with Respect to Volatility of Reported Results?

As noted above, companies we interviewed recognize that, initially, the size of the block requiring VM-20 reserves will be small as a part of the total enterprise. But ignoring this for the moment, the volatility in results presented by frequent assumption updating and unlocking was named as an obvious challenge. Tax reserve status and regulatory changes are two "unknowns" that also show up on the challenges list:

- Not knowing with certainty what the tax-qualified reserve will be is a problem.
- The more frequently assumptions are updated, the more complicated the reserve movement analysis becomes. For example, it may be necessary to understand whether the combined change (in reserve) is the result of several changes that tend to offset each other, or a single assumption change prevailing over the others.
- The multiple reserve components introduce a potential for "switching" from one to another, but does this represent volatility, or is it simply a construct of the VM-20 method? These are concepts to consider.
- Having the interest scenario change with every reporting period will be a challenge, if either the DR or SR prevails.
- Although VM-20 is new to statutory reporting, many already have processes in place to deal with reserve volatility. There will be time to develop a company's attribution templates during the period when VM-20 reserves are a small segment on the total balance sheet.

- VM-20 volatility is not anticipated to be excessive initially, because the NPR is expected to prevail for several years. Even if the DR were to prevail, it may be many years before credible experience emerges that would be cause for a change to assumptions.

What Tools Do You Wish You Had Available for Analyzing Period-to-Period Changes for VM-20 Reserves?

Not surprisingly, the concepts that float to the top in responding to this question are more resources, shorter run times and standardized reporting templates. Actuaries participating in the interviews understand that a higher level of knowledge about the VM-20 reserve movement can be obtained through sensitivity or "what-if" analysis. This, however, burdens staff and requires more run time as well. This research may provide a starting point or tool for companies as they develop VM-20 reporting plans. Comments of the actuaries interviewed with respect to this topic are paraphrased below:

- Run times for IFRS reporting were significantly reduced by working with the software provider. Once this was accomplished, more sensitivities could be included in our attribution analysis work.
- Because companies still have to meet the same reporting deadlines as before VM-20, they are looking to software providers to offer the audit reports and decomposition tools as part of the systems.
- There are always more runs that could be done to better inform the baseline outcomes. But when pushed against deadlines, the actuarial function is left with having to select the most essential ones.
- At least one company builds tools external to its actuarial software and is likely to build another external tool for VM-20 reserves. External tools are developed to analyze the output from the actuarial software, and this external review process will likely be developed for VM-20 also.

Discuss What You See as Educational Needs to Better Understand VM-20 Attribution. What Form Should This Take?

Generally, the sentiment around further educational opportunities was positive. Traditional methods of webcasts, research reports and professional seminar presentations remain the preferred approach for this education. This research report can begin to fill the need for educational material in the context of understanding and communicating VM-20 results:

- A robust industry survey around attribution analysis would be helpful. In particular, this kind of market survey would allow readers to gauge if they are over-analyzing their own reported reserve movement in their attempts to better understand volatility.
- Reporting templates and case studies were suggested as tools for this education. (Note: Section 6 of this report includes a demonstration Term and ULSG case study.)

What about VM-20 Education for Senior Management? Is There a Need for a VM-20 Primer for This Level?

International companies did not think that their global managers would have much need to focus on VM-20 education. The U.S. domestic senior managers would likely already know about VM-20 at a high level. That said, further education on governance and controls would be beneficial in driving home the requirements of VM-G.

In response to this question, many felt senior management would not benefit from a VM-20 primer, either because they were already made aware of the basics from company staff, or because their focus was elsewhere.

Describe How You See the Valuation Actuarial Staff Communicating Statutory Results to Board and Senior Management Five Years from Now.

Most interviewees did not see a material difference in the method of communicating statutory results to the upper tier management and board members, other than having VM-20 results in the mix. As with most topics at that level, it will take on an executive summary look and feel. Specific viewpoints around this topic are paraphrased below:

- VM-20 concepts have already been communicated to management because of life insurance captives reporting, so upper management level staff had been exposed to the concepts of principle-based reserving.
- The VM-31 report will be condensed down to a slide deck with an executive summary and made available to the board and senior management. Because of the certifications required in the report, the actuaries will provide as much comfort as possible around the work that is done. The nature of communications to management will not be materially different than today.
- As robust actual-to-expected analyses are developed, internal communications will leverage this work and better inform senior management. This will be a beneficial development.

Section 5: Suggested Reserve Attribution for VM-20 and How-To Guide

As review, in Section 1, the sources and components of change in reserve from one reporting period to the next were introduced and summarized. Section 2 presented a discussion of these components of change in the context of VM-20 calculations.

Section 3 provided a survey of attribution methods from financial reporting regimes commonly used by insurance enterprises as well as an overview of how companies use attribution analysis. Section 4 provided a view into the use of these regimes through interviews with valuation actuaries.

Section 5 synthesizes common elements from the survey of other reporting regimes and outlines a suggested attribution analysis for VM-20. The suggested attribution analysis is demonstrated in Section 6 through sample attribution grids for two case studies.

Suggested Attribution Analysis

The ordering of the components of change is critical in evaluating the meaning of each. Three of the five reporting regimes surveyed (MCEV, IFRS, CALM) largely adhered to this order: demographic changes first, followed by non-economic changes including assumption changes, followed by changes to the economic environment. All three of these regimes require cash flow models to produce the reported reserve, similar to VM-20. The U.S. GAAP approach did not contribute to the proposed attribution order since the U.S. GAAP regime has a varying presentation depending on the type of business (FAS60, FAS97, FAS120 etc.). AG 43 is already an attribution method under principle-based reserves (VM-21) for variable annuities. For these reasons, for life insurance products without material equity exposure it is reasonable to adopt the order commonly used in attribution analysis processes of the MCEV, IFRS and CALM regimes.

1. **Demographic changes**. Changes in the in-force over the current period
2. **Non-economic changes**. Assumption changes for all future periods, method changes, prevailing reserve, non-guaranteed elements
3. **Economic changes.** Changes known to impact the valuation such as the Treasury curve from Time 0 to Time 1
4. **Risk mitigation.** Examples of risk mitigation include changes to or introduction of hedging programs or reinsurance arrangements

In the following How-To Guide section, the detail steps under each of the broad categories can be found. As a company's development of the attribution analysis for VM-20 reserves matures, it is possible that certain detail steps under any one broad category can be collapsed together without losing value from the analysis. In this report, we present a robust breakdown of each broad category. This allows the reader to see the granular detail and possibilities for combining steps. Detail below the broad categories above will vary by company and product group, just as it does for other reporting regimes.

How-To Guide

For this narrative, we define the following terms used:

Valuation	The process of running an evaluation of VM-20 reserves for the current date. The current valuation date is referred to as Time 1, and the valuation date immediately prior is referred to as Time 0.
Forecast	A projection where, in addition to the current valuation date, reserves are produced for future periods.
Anticipated reserve change	Change in reserve brought about by expected causes, such as accumulation with interest, release for anticipated claims, and anticipated survivorship.
Prevailing reserve type	The component of the three VM-20 reserve types (NPR, DR, SR) that is the source of the minimum reserve.
Reserve volatility	Change in reserve brought about by causes that are not expected, such as lapse experience that materially exceeds (or is materially less than) that which was assumed in the calculation of the beginning of period reserve. A change to a company's anticipated experience assumption would also be a source of reserve volatility at the time of the assumption change.
Rolling down the yield curve	(From Section 1) The financial measure calculated as of the previous reporting cycle as it would grow under the interest environment of the previous reporting cycle, that is, without updating the yield curve for the current reporting cycle.
Time passage	(From Section 1) The policy block is treated as a closed population, and the valuation is simply performed one period later to quantify the contribution of time passage to the change in reserve.

Demographic Changes

Under the category of demographic changes, the following potential breakout items were outlined in Section 1:

– Time passage
– Account value changes
– Terminations
– New business
– Miscellaneous

Of these five, time passage, terminations and new business occur most frequently in other regimes— and are fundamental to the underlying concept of advancing a valuation date to the next reporting period. The account value change component is relevant for blocks including policies with account values. The following discussion addresses how the attribution amount is determined in the actuarial modeling process. Each step builds on the steps before it. Please refer to Section 1 for the comprehensive explanation of each of these components.

Time passage. Time passage is evaluated in terms of the policies that were in-force during the prior valuation exercise. To be clear, one does not update the policy inventory to the current valuation date or unlock any of the economic settings. This step quantifies the condition of the policies in-force from the prior valuation date being one period closer to their maturity date. This attribution step is performed by advancing the valuation date in the model used for the prior valuation period. This is the only change made to the model, unless there are conflict errors associated with updating the valuation date—for example, assets whose maturity date falls in between the two dates. Resolving those errors should be considered part of this attribution step. This step will fall under "anticipated reserve change" since the advancing of the valuation date uses assumptions resident in the model from the last reporting period.

Account value changes. Insofar as time passage from the prior step does not update the policy inventory inputs or unlock any of the economic settings, any changes to account value generated by the time passage step are based on the anticipated economic environment from the perspective of Time 0. From the perspective of Time 1, the actual outcome of economic metrics underlying account value crediting strategies over the prior period are available. This step quantifies reserve volatility from replacing anticipated credited rates with (estimated) actual credited rates between the two periods.

Terminations. As noted in Section 1, there are two layers to this attribution step. The first layer (expected layer) is defined by quantifying what the model expected the terminations to be based on assumptions for mortality and lapse (and partial withdrawal and the like) resident in the model. The second layer (actual layer) is defined by quantifying the terminations the company actually experienced during the period.

The first, or expected, layer requires a look back to the Time 0 valuation and extracting the forecast of the reserve one period hence. Essentially, this is what the model thought the "one period later" or Time 1 reserve would be for the block in force as of Time 0. Practically speaking, this step requires the Time 0 model to have functionality to forecast the VM-20 components forward one period. In some systems this is referred to as "outer loop/inner loop" functionality.

The second, or actual, layer is measured by updating the policy inventory file to remove those policy records that are in the inventory for Time 0 but are no longer in the inventory for Time 1. Update the policy liability file, run the model and extract the reserve.

New business. As noted in Section 1, there are two layers to this attribution step. The first layer (expected, or plan, layer) is defined by quantifying the reserve associated with the volume of new business the company was expecting to write for the period just ended. The second layer (actual layer) is defined by quantifying the new business the company actually issued during the period. Both layers presume that the underlying model has new business modeling capabilities in addition to existing business.

The first, or expected, layer does not require the model to be run. Rather, look back to the Time 0 valuation and pull the forecast of the reserve one period hence that is generated solely by anticipated new business. Essentially, this is what the model thought the "one period later" or Time 1 reserve would be for the new business block expected to be issued between Time 0 and Time 1.

The second, or actual, layer is measured by updating the Time 1 policy inventory file for the actual policies issued during the period just ended. Update the policy liability file, run the model and extract the reserve.

A summary of steps so far in this process is shown in Figure 9.

Figure 9

Step	Definition	Reserve Change Characterized as	Model Process Type
1	Time passage	Anticipated	Valuation
2	Account value changes	Volatility	Forecast
3a	Terminations—Expected	Anticipated	Forecast
3b	Terminations—Actual	Volatility	Valuation
4a	New business—Plan	Anticipated	Forecast
4b	New business—Actual	Volatility	Valuation

Non-economic Changes

Under the category of non-economic changes, the following potential breakout items were outlined in Section 1:

- Experience assumptions
- Methodology changes
- Prevailing reserve
- Nonguaranteed element changes

Of these four, the Experience Assumptions item occurs in all regimes for which a cash flow model is used to produce reserves. Because VM-20 has three reserve components, with any of these prevailing on any given valuation date, the Prevailing Reserve item is also included. The following discussion looks at how the attribution amount is determined in the actuarial modeling process for these two attribution items. Each step builds on the steps before it. Please refer to Section 1 for the comprehensive explanation of the non-economic components of reserve change.

Experience assumptions. When the company's experience indicates a baseline assumption needs to be modified (i.e., "revised" baseline), the assumption update will introduce volatility to the current period modeled reserve. The attribution step is performed by updating the assumption in question, processing a valuation and comparing the Time 1 reserve to the reserve amount that was apparent just prior to the assumption change. The attribution analysis will include the difference between the reserve before and after the assumption revision and include this amount as a reserve volatility component. In the case studies of Section 6, the experience component of the attribution analysis breaks the experience assumption element out separately by mortality, mortality credibility, lapse, premium payment and expense. Of course, not all these individual breakouts will be necessary in a reporting period.

Prevailing reserve. As noted in Section 1, any regime where the financial measurement is determined by comparing more than one calculated component may have "prevailing reserve" as an attribution step. Caused by the prevailing component switching from one to another, it may be a challenge to know in

advance where this attribution step fits in the overall stepwise attribution analysis. The case studies in Section 6 track all three components in the attribution analysis, and the step related to prevailing reserve is treated in a manner similar to that shown in Figure 2.

A summary of steps so far in this process is illustrated in Figure 10.

Figure 10

Step	Definition	Reserve Change Characterized as	Model Process Type
1	Time passage	Anticipated	Valuation
2	Account value changes	Volatility	Forecast
3a	Terminations—Expected	Anticipated	Forecast
3b	Terminations—Actual	Volatility	Valuation
4a	New business—Plan	Anticipated	Forecast
4b	New business—Actual	Volatility	Valuation
5	Experience assumptions	Volatility	Valuation
6	Prevailing reserve	Anticipated/Volatility	Valuation

Economic Changes

Under the category of economic changes, the following potential breakout items were outlined in Section 1:

- Change in the economic scenario model generator used
- Change in the reference yield curve
- Change in mean reversion target or mean reversion strength
- Change in interest rate volatility
- Change in asset spreads and asset default charges
- Change in equity assumptions
- Change in investment strategy

The economic scenario generator and its parameters (mean reversion target, mean reversion strength and interest rate volatility) are established by the NAIC and likely will not be subject to change, at least in the early years of principle-based reserves reporting. Of the remaining items, those most frequently impacting a VM-20 attribution analysis will be changes in the starting yield curve, the asset spreads and defaults, and changes in investment strategy. Please refer to Section 1 for the comprehensive explanation of each of the economic components of reserve change.

Starting yield curve. There is an "anticipated" and a "volatility" component to this element. Therefore, there are two modeling steps to quantifying this attribution element. The first step is the asset side of "time passage" and, on the grid, is aptly labeled "rolling down the Time 0 Treasury curve." Similar to the liability side, this first step recognizes that the assets are one period closer to their maturity dates, or first call dates, or other feature impacting asset cash flows. To implement this concept in the model, the yield curve from Time 0 is shifted one year. For example, the Time 0 five-year Treasury rate would be used as the Time 1 four-year Treasury rate. Running a valuation under this premise and differencing the

reserve with the reserve from the step immediately prior quantifies the anticipated reserve change due to change in reference yield curve.

The second step to this attribution element is the reserve volatility component. Update the starting yield curve in the model to be consistent with the curve on the valuation date. Difference the reserve that emerges with the step just above, and this is the reserve volatility component for the change in starting yield curve.

Changes in asset spread and default charge assumptions. In the Valuation Manual, asset spreads are updated quarterly, and default charge assumptions are updated annually. As these assumptions are updated in the actuarial model, a valuation run will provide the reserve amount, which, when differenced with the reserve amount from the immediately preceding step, will quantify the reserve volatility introduced by these changes.

Change in investment strategy. A company's investment strategy is constantly evolving and reacting to current conditions. This introduces volatility to reserves when the prevailing reserve is one determined using a cash flow model. As the revised investment strategy assumption is implemented in the actuarial model, a valuation run will provide the reserve amount, which, when differenced with the reserve amount from the immediately preceding step, will quantify the reserve volatility introduced by a company's changes to its investment strategy.

A summary of steps so far in this process is shown in Figure 11.

Figure 11

Step	Definition	Reserve Change Characterized as	Model Process Type
1	Time passage	Anticipated	Valuation
2	Account value changes	Volatility	Forecast
3a	Terminations—Expected	Anticipated	Forecast
3b	Terminations—Actual	Volatility	Valuation
4a	New business—Plan	Anticipated	Forecast
4b	New business—Actual	Volatility	Valuation
5	Experience assumptions	Volatility	Valuation
6	Prevailing reserve	Anticipated/Volatility	Valuation
7a	Starting yield curve—Time passage	Anticipated	Valuation
7b	Starting yield curve—Valuation date	Volatility	Valuation
8	Asset spreads and default charges	Volatility	Valuation
9	Investment strategy	Volatility	Valuation

Risk Mitigation

Under the category of risk mitigation, the following potential breakout items were outlined in Section 1:

- Risk mitigation programs
- Management actions
- Other

A company will have its own unique items falling into the risk mitigation category, but for the case studies presented in this section reinsurance retention limit changes and hedge programs were used as examples of changes of risk mitigation programs that potentially introduce volatility to the reserve change.

Risk mitigation programs. For both the reinsurance and the hedge program changes, the revised program is implemented in the actuarial model for the current valuation date. A valuation run will provide the reserve amount, which, when differenced with the reserve amount from the immediately preceding step, will quantify the reserve volatility introduced by a company's changes to any risk mitigation programs.

A summary of all the steps in this process is shown in Figure 12.

Figure 12

Step	Definition	Reserve Change Characterized as	Model Process Type
1	Time passage	Anticipated	Valuation
2	Account value changes	Volatility	Forecast
3a	Terminations—Expected	Anticipated	Forecast
3b	Terminations—Actual	Volatility	Valuation
4a	New business—Plan	Anticipated	Forecast
4b	New business—Actual	Volatility	Valuation
5	Experience assumptions	Volatility	Valuation
6	Prevailing reserve	Anticipated/Volatility	Valuation
7a	Starting yield curve—Time passage	Anticipated	Valuation
7b	Starting yield curve—Valuation date	Volatility	Valuation
8	Asset spreads and default charges	Volatility	Valuation
9	Investment strategy	Volatility	Valuation
10	Risk mitigation—Reinsurance	Volatility	Valuation
11	Risk mitigation—Hedge program	Volatility	Valuation

Section 6: Case Studies

VM-20 Product Group Definitions

The Term insurance product group includes 10- and 20-year level premium Term to age 95 policies with four nontobacco classes and two tobacco classes. At Time 0 there are four issue years of in-force business. At Time 1, an additional year of issue is added (i.e., the company continues to sell policies from this product group between Time 0 and Time 1). The Term product is similar to that offered by a top-quartile direct writer. Two size bands are represented by face amounts at two average policies sizes: $350,000 and $1,200,000. The company retains $1 million of face amount and cedes the excess under a yearly renewable Term (YRT) reinsurance arrangement. Policies are distributed across genders, risk classes, issue ages and policy sizes consistent with industry data for this type of product. Expense factors and commissioning schedules are consistent with top-quartile Term insurance writers. Mortality and lapse assumptions are set at levels consistent with top-quartile writers (mortality) and LIMRA industry studies (lapse). The NPR assumes 2017 CSO as valuation mortality rates and 4.5% valuation interest. The DR assumes prudent estimate mortality based on company experience with 70% credibility and a 15-year sufficient data period. Prudent estimate lapse margins are +5% during the first three years for the 10-year plan and the first five years for the 20-year plan, and −5% margin after this. There is a 5% margin on expenses, with 1.5% inflation assumed. The product group is assumed to pass the stochastic exclusion test, and therefore no SR is calculated.

The ULSG product group includes policies with a lifetime secondary guarantee. There are three nontobacco risk classes. At Time 0 there are two issue years of in-force business. At Time 1, an additional period of issue is added (i.e., the company continues to sell policies from this product group between Time 0 and Time 1). The ULSG product is similar to that offered by a top-quartile direct writer. The premiums are assumed at a level that will maintain the secondary guarantee at least through attained age 110. Based on this assumed payment behavior, there is minimal cash value buildup at current crediting rates. Two size bands are represented by face amounts at two average policies sizes: $350,000 and $1,200,000. The company retains $1 million of face amount and cedes the excess under a YRT reinsurance arrangement. Policies are distributed across genders, risk classes, issue ages and policy sizes consistent with industry data for this type of product. Expense factors and commissioning schedules are consistent with top-quartile ULSG insurance writers. Mortality and lapse assumptions are set at levels consistent with top-quartile writers (mortality) and LIMRA industry studies (lapse). There is a dynamic lapse adjustment that modifies the base lapse assumption. If the account value is $0 and the secondary guarantee is paid up, the lapse assumption is 0%. If the account value is $0 and the secondary guarantee is not yet paid up, the assumed lapse rate is 50% of the base case lapse rates. The NPR assumes 2017 CSO as valuation mortality rates and 4.5% valuation interest. The modeled reserves assume prudent estimate mortality based on company experience with 70% credibility and a 15-year sufficient data period. Prudent estimate lapse margins are -10% during all years. For years 11–15, for policies with minimal cash value, the lapse assumption grades to the Lapse Experience table for Term-to-100 policies from the October 2007 report published by the Canadian Institute of Actuaries. There is a 5% margin on expenses and 1.5% inflation assumed.

Time 0 to Time 1 Changes Impacting the Attribution—Term Case Study

Numerical examples for a suggested VM-20 reserve attribution as described in Section 5 are provided in this section. This demonstration of the attribution analysis utilizes actuarial software to model the product in each of the two case studies. Although the numerical results in the sample attribution are based on actual model projections, they are not meant to be taken as commentary on the size or directionality of reserve change unless otherwise noted. Reserve impact may well depend on product characteristics and features as well as specific company circumstances.

Below, the VM-20 minimum reserve for Time 1 (PBR Time 1) is developed in incremental steps from the VM-20 minimum reserve at Time 0 (PBR Time 0), each step building on the steps prior. The reference numbers in the narrative match those in the attribution grid provided further below. Our illustration intends to capture some of the major sources of reserve changes, but in reality there may be others that are not captured below. For example, a change in the model coding to correct an error may introduce a one-time step in the attribution analysis to account for the volatility due to model correction.

0. <u>PBR Time 0</u>—At Time 0, the prior valuation date, the DR of $936 million prevails over NPR of $279 million, and the VM-20 minimum reserve is $936 million. For this Term insurance product as defined in this demonstration, we did not observe any instances of NPR prevailing over DR.

1. <u>Time Passage</u>—With the policy inventory and economic parameters held constant, the valuation date is moved forward by one period from Time 0 to Time 1, the current valuation date (Time 1 valuation). In particular from a modeling standpoint, holding the economic parameters constant for DR may require the modeler to treat the discount rates as a model input in this step, likely captured from the prior step as an output. By not allowing the model to calculate the discount rates from asset performance, this effectively holds economic parameters constant. Reserve changes from updates to the economic environment follow in later steps. Reserves increase to $1,297 million primarily due to the aging of the population by one year. In general it is not unreasonable to expect a relatively modest and stable reserve increase in this step. Note that reserves are calculated as of Time 1 starting in this step and for all subsequent steps of this attribution analysis, whether they are Time 0 forecasts of Time 1 or Time 1 valuations.

2. <u>Terminations</u>
   a. <u>Expected</u> –Time 1 reserves are calculated from the perspective of Time 0 (Time 0 forecast of Time 1 reserves) using a company's best estimate mortality and lapse assumptions for terminations between the two periods. For most actuarial projection systems, this implies terminating a portion of each in-force model cell. In general reserves should drop from the prior step since, all else equal, there should be fewer model cells remaining. Reserves drop to $1,230 million, representing an expected reserve change of ($67 million).
   b. <u>Actual</u>—A Time 1 valuation is performed with the policy inventory updated for actual deaths and lapses over the prior period. Differences between the reserves in this step and Step 2.a are due to differences in actual and expected terminations. As unexpected differences, these are by definition considered reserve volatility. In this example, the reserves of $1,239 million are $9 million higher than expected, indicating lower actual terminations and resulting in reserve volatility of $9 million for the period. Note that in this step, while the policy inventory is adjusted based on actual terminations, the experience assumptions in the projection remain unchanged from assumptions used at Time 0.

3. New Business
   a. Plan—A Time 0 forecast of Time 1 reserves is performed assuming a company's sales target for new business issued between the two periods. All else equal, reserves should increase due to the inclusion of new issues, and in this example, one year of new business does increase reserves by $84 million to $1,324 million. The $84 million is considered anticipated reserve change.
   b. Actual—A Time 1 valuation is performed with actual new business sales reflected in the policy inventory, replacing the expected company sales target from Step 3.a. Reserves are $1,326 million, which is $2 million higher than the $1,324 million expected value. The $2 million represents reserve volatility. In general, larger actual new business volume over expected may lead to positive reserve volatility. However, it is worth noting that the distribution of sales across different products within the VM-20 product group may have offsetting effects. For example, higher sales of a 10-year Term plan and lower sales of a 20-year Term plan may have offsetting effects. Because of product-level offsets in the attribution, a company may choose to analyze this step at a level of granularity that permits the stakeholders using the analysis to make product-level business decisions. Note that the policy inventory used in this step is in fact the actual policy inventory for valuation purpose at Time 1, reflecting actual terminations and actual new business. This policy inventory will also be used in all future steps.
4. Experience Assumptions—The reserve calculations in this part of the demonstration are hypothetical scenarios under which prudent estimate assumptions are adjusted. Narratives are included to provide motivation for the adjustments in each step.
   a. Mortality Experience—With an additional period of experience, a company may decide it is time to update its prudent estimate mortality assumptions based on a periodically performed experience study. The Term business in this case study exhibits favorable mortality experience, with generally lower mortality rate assumptions. Reserves reflecting the revised mortality assumption are $1,097 million for a reserve change of ($229 million). This reserve change is considered volatility because it reflects the company's revision to its prudent estimate mortality assumption.
   b. Mortality Credibility—In this example the credibility of company experience is assumed to increase from 70% to 75%. The prescribed mortality margins decrease with a higher level of credibility, and for Term insurance reserves are expected to decrease as well, all else equal. The resulting reserve volatility is ($28 million) for the period, resulting in reserves of $1,069 million. Although a company may expect that its mortality experience should become more credible with time, the exact quantification is unknown at Time 0 and would be considered volatility rather than anticipated change. Note the margins applied correspond to the Limited Fluctuation Method; to change the credibility method would require approval of the commissioner, and this alternative was not explored here.
   c. Policyholder Lapse Experience—Based on an updated persistency study, prudent estimate lapse rates are adjusted to reflect generally higher than anticipated persistency. Lapse rate assumptions at Time 1 are up to 1% lower on average in earlier policy years than assumed at Time 0. Reserves are $1,124 million with a reserve volatility of $55 million for the period.
   d. Premium Payment—not applicable to this Term case study.

e. Expenses—Prudent estimate expenses were assumed to decrease from $45 to $40 due to efficiencies from a recent business acquisition which are supported by a company expense study. The reserves decrease to $1,102 million, producing a reserve volatility of ($22 million) for the period.

5. Prevailing Reserve—This step is designed to quantify the impact due to the prevailing reserve moving from one method to another, for example, moving from the NPR to the DR. We did not observe any change to prevailing reserve component in this case study.

6. Economic Environment

   a. Starting Yield Curve—Time Passage—The Time 1 valuation is updated for discount rates that reflect the passage of one period as was assumed in the economic environment at Time 0. For DR, this means the discount rates are still those calculated as of Time 0 from the projected performance of the assets in-force at that time; however, in this step the projected cash flows and discount rates are finally synced up in time from the perspective of Time 1. In the projection model used for this illustration this was achieved by moving down one period in the vector of outputs calculated in Step 0 (and modeled as inputs in Step 1). For example, if the modeled discount rates through the prior step were based on 10-year Treasury yields of 5%, 4% and 3% in successive periods starting *at Time 0*, as of this step they are based on the Treasury yields of 4% and 3% in successive periods starting *at Time 1*. Therefore, we are able to "roll down the Time 0 Treasury curve" while still keeping the economic environment frozen in its prior state. Also, in this illustration, we did not observe asset/liability interactions that led to meaningful deviations from the rates calculated as of Time 0 based on projected asset performance at that time. To the extent a company expects significant deviations to occur, it may consider introducing an interim step to recalculate these rate vectors. The reserves decrease to $1,059 million, producing an anticipated reserve change of ($44 million). Due to the timing of cash flows, it is difficult to generalize the directionality of reserve change in this step, even under strictly increasing or decreasing yield scenarios.

   b. Starting Yield Curve—Valuation Date—The asset inventory and starting yield curve are updated to be consistent with the company's in-force asset portfolio and the economic environment at Time 1. If the modeling approach in prior steps was to treat discount rates as model inputs, in this step the input approach is discarded and the model is allowed to once again calculate the rates from projected asset performance. In our example, reserve volatility of ($27 million) for the period leads to reserves of $1,032 million. In our illustration we chose to include the asset inventory update in this step. An alternative approach could be to include the asset inventory update in the next step together with the asset spreads and default charges change.

   c. Asset Spreads and Default Charges—These two components generally have offsetting effects on asset performance; that is, an increase in spreads over Treasury rates would be offset by higher default charges. In this case study, the net effect of updated asset spreads and updated default costs yields a net asset spread of 80 bps. This change results in reserves of $1,072 million which produces a reserve volatility of $41 million for the period.

   d. Investment Strategy—The reinvestment strategy in this case study is assumed to shift toward higher quality, lower yielding bonds. When this step is processed in the model, reserves are $1,068 million, producing a reserve volatility of ($4 million) for the period.

7. Risk Mitigation
   a. Reinsurance Retention Limit—In this final step of the attribution analysis, the retention limit of the YRT reinsurance arrangement is increased from $1 million to $1.2 million. The case study assumes that the YRT mortality risk reinsurance comes at a net cost to the ceding company. When the retention is increased, the net cost is now lower to the direct writer. The reserves decrease to $1,010 million, producing reserve volatility of ($58 million) for the period.
   b. Hedge Programs—Part of the risk mitigation category, but not applicable to this Term case study.
8. PBR Time 1—The VM-20 minimum reserves at Time 1 reflect all sources of reserve change as illustrated in this attribution analysis, including those from demographics, non-economic assumptions, economic assumptions and risk mitigation activity. VM-20 minimum reserves at Time 1 are $1,010 million, a result of the DR of $1,010 million prevailing over the NPR of $423 million. It reflects a total anticipated reserve change of $334 million and total reserve volatility of ($260 million) over the Time 0 VM-20 minimum reserves of $936 million.

Attribution Grid—Term Case Study

The attribution steps for the Term case study are presented in Figures 13 and 14. Within the attribution grid are shown the VM-20 reserve components by attribution step, a column for Anticipated Reserve Change, Reserve Volatility and Reserve Calculation Type (of process or run), and a detailed Description column. This last item is presented on a separate page, following Figure 13. Figure 14 is a graphical representation (stacked bar chart and pie chart) of the attribution analysis.

Figure 13

VM-20 Reserve Movement Analysis
Term Life - 10yr/20yr, $1.2MM/$0.35MM Face
($ thousands)

Step	Movement Analysis from T0 to T1 (see descriptions on following page)	Policy Reserves NPR	Policy Reserves Deterministic Reserves	Policy Reserves Final VM-20 Reserves	Type of Reserve Change Anticipated Reserve Change[1]	Type of Reserve Change Reserve Volatility[2]	Reserve Calculation Type
0	*PBR TIME 0 - Valuation*	$ 279,182	$ 936,133	$ 936,133			Valuation
	DEMOGRAPHIC CHANGES						
1	*Time Passage of Reserves*	$ 439,888	$ 1,296,508	$ 1,296,508	$ 360,375		Valuation
2.a	*Inforce Terminations - Expected*	$ 416,460	$ 1,229,633	$ 1,229,633	$ (66,874)		Forecast
2.b	*Inforce Terminations - Actual*	$ 422,567	$ 1,238,993	$ 1,238,993		$ 9,360	Valuation
3.a	*New Business - Plan*	$ 416,460	$ 1,323,502	$ 1,323,502	$ 84,509		Forecast
3.b	*New Business - Actual*	$ 422,567	$ 1,325,680	$ 1,325,680		$ 2,178	Valuation
	COMPANY EXPERIENCE						
4.a	*Mortality Experience*	$ 422,567	$ 1,096,801	$ 1,096,801		$ (228,879)	Valuation
4.b	*Mortality Credibility*	$ 422,567	$ 1,069,104	$ 1,069,104		$ (27,697)	Valuation
4.c	*Policyholder Lapse*	$ 422,567	$ 1,124,120	$ 1,124,120		$ 55,017	Valuation
4.d	*Premium Payment*	$ 422,567	$ 1,124,120	$ 1,124,120		N/A	N/A
4.e	*Expenses*	$ 422,567	$ 1,102,377	$ 1,102,377		$ (21,743)	Valuation
	PREVAILING RESESRVES						
5	*Prevailing Reserve Change*	$ 422,567	$ 1,102,377	$ 1,102,377	$ -	$ -	Valuation
	ECONOMIC ENVIRONMENT						
6.a	*Starting Yield Curve - Time Passage*	$ 422,567	$ 1,058,606	$ 1,058,606	$ (43,772)		Valuation
6.b	*Starting Yield Curve - Valuation Date*	$ 422,567	$ 1,031,564	$ 1,031,564		$ (27,042)	Valuation
6.c	*Asset Spreads and Default Charges*	$ 422,567	$ 1,072,431	$ 1,072,431		$ 40,868	Valuation
6.d	*Investment Strategy*	$ 422,567	$ 1,068,082	$ 1,068,082		$ (4,350)	Valuation
	RISK MITIGATION						
7.a	*Reinsurance Retention Limit*	$ 422,567	$ 1,010,171	$ 1,010,171		$ (57,911)	Valuation
7.b	*Hedge Programs*	$ 422,567	$ 1,010,171	$ 1,010,171		N/A	N/A
8	*PBR TIME 1*	$ 422,567	$ 1,010,171	$ 1,010,171	$ 334,238	$ (260,200)	Valuation

(1) Anticipated Reserve Change: change in reserves due to anticipated experience in inforce demographics and anticipated economic/non-economic assumptions
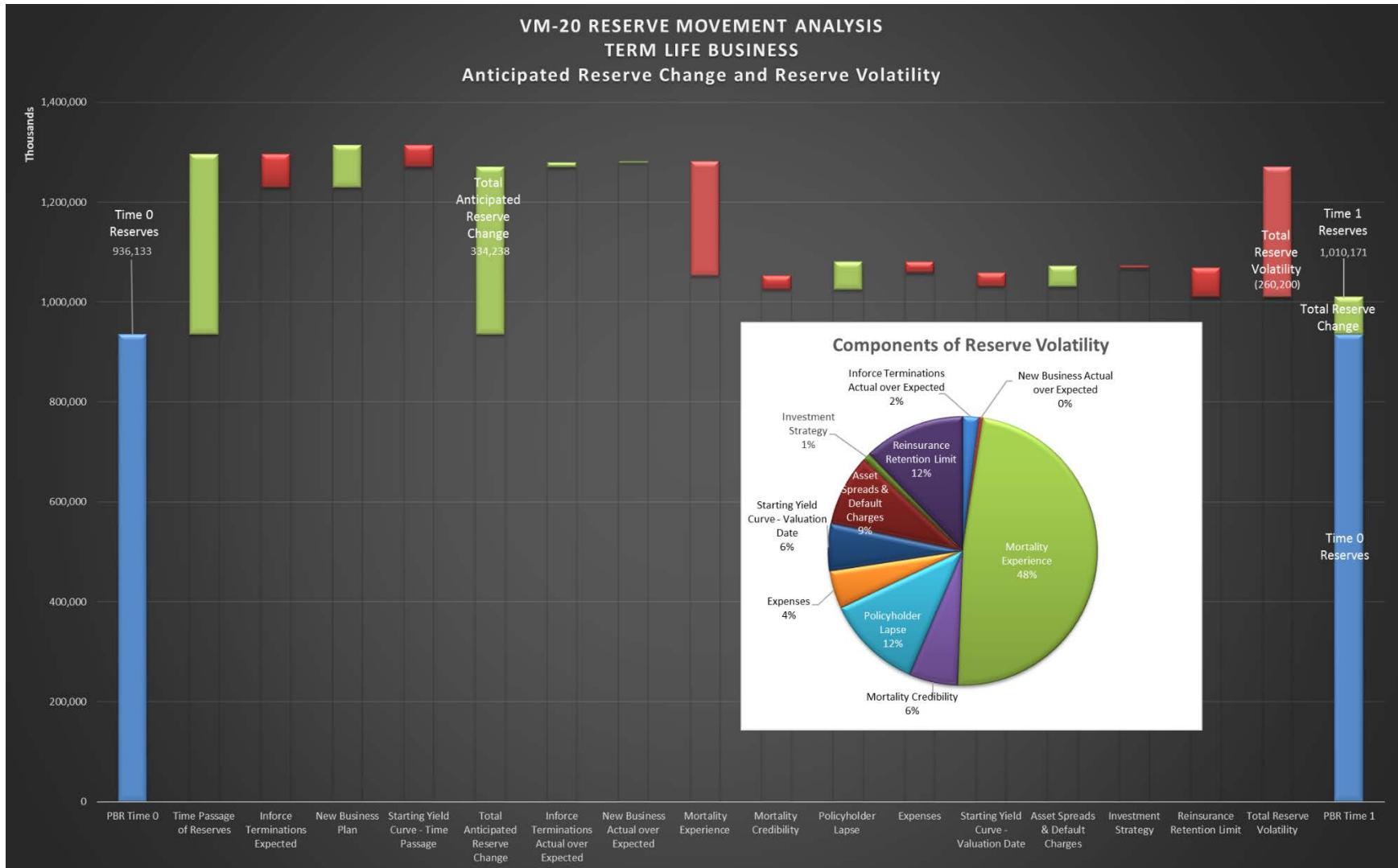
(2) Reserve Volatility: deviations from anticipated reserve changes due to emerging experience, or due to unexpected changes in economic/non-economic assumptions

Figure 13 continued

VM-20 Reserve Movement Analysis
Term Life - 10yr/20yr, $1.2MM/$0.35MM Face
($ thousands)

Step	Movement Analysis from T0 to T1	Description of Attribution Step
0	*PBR TIME 0 - Valuation*	VM-20 reserves at Time 0, i.e., at the end of the prior valuation period.
	DEMOGRAPHIC CHANGES	
1	*Time Passage of Reserves*	The inforce population ages by 1 period between Time 0 and Time 1. Terminations and new business are ignored to isolate the expected period-to-period reserve change. Economic environment fixed at Time 0.
2.a	*Inforce Terminations - Expected*	Expected reserve change from company's best estimate mortality and lapse assumptions. Company's best estimate includes mortality improvement over the period.
2.b	*Inforce Terminations - Actual*	Actual reserve change from policy decrements due to deaths and lapses. Actual reserves are higher than expected, indicating total terminations were lower than expected.
3.a	*New Business - Plan*	Expected reserve change due to company's new business sales target between Time 0 and Time 1.
3.b	*New Business - Actual*	Actual reserve change from new issues over the period.
	COMPANY EXPERIENCE	
4.a	*Mortality Experience*	Prudent estimate mortality assumptions are updated from a periodically performed mortality study. Results indicate overall mortality assumptions should be lowered, with adjustments varying by gender, smoker status, u/w class, and band.
4.b	*Mortality Credibility*	The credibility of the company's mortality experience increases from 70% to 75% with the one additional period of claims experience. Limited fluctuation margins decrease.
4.c	*Policyholder Lapse*	This step represents a change in anticipated lapse rates. Generally the persistency is assumed to be higher, with up to a 1% decrease in lapse rates for younger ages and lower durations.
4.d	*Premium Payment*	Not applicable for term life.
4.e	*Expenses*	Per policy expenses decrease from $45 to $40 due to cost savings from a recent acquisition.
	PREVAILING RESESRVES	
5	*Prevailing Reserve Change*	Reserve change due to a change in the prevailing reserve from NPR to DR or from DR to NPR.
	ECONOMIC ENVIRONMENT	
6.a	*Starting Yield Curve - Time Passage*	The expected reserve change from the natural progression of moving down the Treasury curve.
6.b	*Starting Yield Curve - Valuation Date*	The Treasury curve reflects the current economic environment.
6.c	*Asset Spreads and Default Charges*	Asset spreads and default charges corresponding to current yields and economic environment. Overall net asset spread is updated to 80bps.
6.d	*Investment Strategy*	The company's most up-to-date reinvestment strategy is consistent with the company's investment policy of a shift towards higher quality bonds.
	RISK MITIGATION	
7.a	*Reinsurance Retention Limit*	With the growth in company size as well as credibility of its own claims experience, retention limit is increased from $1M to $1.2M.
7.b	*Hedge Programs*	Not applicable for term life.
8	*PBR TIME 1*	VM-20 reserves at Time 1.

Figure 14

VM-20 RESERVE MOVEMENT ANALYSIS
TERM LIFE BUSINESS
Anticipated Reserve Change and Reserve Volatility

Time 0 Reserves 936,133

Total Anticipated Reserve Change 334,238

Total Reserve Volatility (260,200)

Time 1 Reserves 1,010,171

Total Reserve Change

Time 0 Reserves

Components of Reserve Volatility

- Inforce Terminations Actual over Expected 2%
- New Business Actual over Expected 0%
- Investment Strategy 1%
- Reinsurance Retention Limit 12%
- Asset Spreads & Default Charges 9%
- Starting Yield Curve - Valuation Date 6%
- Expenses 4%
- Policyholder Lapse 12%
- Mortality Credibility 6%
- Mortality Experience 48%

Time 0 to Time 1 Changes Impacting the Attribution—ULSG Case Study

Below, the ULSG VM-20 minimum reserve for Time 1 (PBR Time 1) is developed in incremental steps from the VM-20 minimum reserve at Time 0 (PBR Time 0), each step building on the steps prior. The attribution steps are largely similar to the Term insurance case study of the preceding section, with additional considerations for reserve changes due to nonguaranteed elements and changes in account value. In this case study demonstration, the additional components of reserve change are either explicitly broken out in separate attribution steps or modeled as part of a larger overarching change. The reference numbers in the narrative match those in the attribution grid, provided further below. Our illustration intends to capture some of the major sources of reserve changes, but in reality there may be others that are not captured below. For example, a change in the model coding to correct an error may introduce a one-time step in the attribution analysis to account for the volatility due to model correction.

0. PBR Time 0—At Time 0, the prior valuation date, the DR of $60.6 million prevails over both the NPR of $0.5 million and SR of $49.3 million, resulting in a VM-20 minimum reserve of $60.6 million. These relationships between the DR and NPR and between the DR and SR are worth elaborating.
    With regard to the NPR, the minimum reserve standards of VM-20 Section 3.B.6 set forth requirements for shadow account design structures in calculating the NPR. The relatively low NPR in this case study owes to the product design as well as the relatively recent issues of the model office in-force. Although outside the scope of this exercise, we would expect to see a progressive buildup of NPR as policies age and the funding ratio increases.

    With regard to the SR, we see that it is exceeded by the DR in this step and in all subsequent steps of this analysis. The ULSG product design of the case study is protection oriented with relatively low policy values in most years. Therefore projected liability net cash flows are very similar across stochastic scenarios albeit with some small variation in surrender benefits. Without much volatility among the stochastic scenarios, the CTE70 is muted. Valuations performed at later durations—a time when significant assets have built up to support the liability—may begin to show volatility across stochastic scenarios due to asset cash flow variation.

1. Time Passage—With the policy inventory and economic parameters held constant, Time 1 reserves are calculated from the perspective of Time 0 (Time 0 forecast of Time 1 reserves). Note that this approach differs from that of the Term insurance example where a Time 1 valuation is performed. Reasons for this difference are explained further below. Reserves increase to $82.0 million from an increase in the prevailing DR. Holding the economic parameters constant in this step involves "locking in" the discount rates from the prior step, similar to the Term insurance example. Unlike Term, for ULSG, consideration must be given also to account value (AV) because it is a critical component of calculating reserves. We followed the modeling approach detailed below; however, the specifics may vary depending on a company's objectives.

    Policy AVs are credited interest over the period between Time 0 and Time 1 in this step, based on the policy specifications and management's crediting strategy, and per the expected economic environment *at Time 0*. Since terminations and new business are yet to occur in the attribution steps thus far, interest is credited to the AV of the entire population in force at Time 0. Other nonguaranteed elements such as loads and charges must apply to the AVs as well, such that the AVs and cash values (CVs) at Time 1 are also consistent with the aged population. Time 1 reserves calculated based on the "old reality of Time 0" will allow for quantification of reserve change due solely to the passage of time without recognition of the one year later policy inventory or economic parameters.

From a modeling implementation perspective, the approach taken was to project the AV in-force forward from Time 0 to Time 1 in the projection model, utilizing model mechanics for AV calculations. Both the AV credited rate vector and the discount rate vector are captured in the prior Time 0 step as outputs and treated as model inputs within Step 1. For SR, the vectors will likely vary for each of the stochastic scenarios. An alternative implementation method to using the projection model may be to reflect the changes in a separate in-force file build. The modeler will want to consider an approach that is sustainable and repeatable.

Note that reserves are calculated as of Time 1 starting in this step and for all subsequent steps of this attribution analysis, whether they are Time 0 forecasts of Time 1 or Time 1 valuations.

2. Account Value Roll Forward—Similar to the prior step, the in-force population of policy values as of Time 0 is credited interest and deducted loads and charges; the difference in this step is that the expected credited interest rates are replaced with actual credited interest rates. In this illustration, actual credited rates were lower than anticipated, resulting in generally lower AVs and higher reserves of $82.4 million for a reserve volatility of $0.4 million. In terms of modeling, a company may find it a reasonable simplification to use an average credited rate for similar products to reduce model complexity or retain a higher level of granularity for precision. Also the economic assumptions underlying projected AV growth have not changed with this step, which is designed to quantify reserve change strictly due to in-force AVs. Therefore the vector of AV credited rates into future years is still the one locked in with the initial Time 0 step.

It is important to make the distinction between actual credited interest rates and actual interest credited. The actual credited interest rates are the rates in effect between Time 0 and Time 1 per the outcome of the economic environment parameters in the model, usually Treasury rates. Generally, companies should have an established practice of maintaining a history of credited rates by plan. The actual interest credited is the dollar amount that can be found in the company's financial statements—a figure that is likely lower than modeled in this step, all else equal, due to in-force terminations. Since this attribution step is quantified before recognizing terminations, the actual interest credited (dollar amount from financials), if used, would likely understate the Step 2 AV.

Although a case could be made that this step constitutes a change in the economic environment, it is considered a demographic change in this illustration for two reasons. First, other nonguaranteed elements are also applied to AVs and CVs that are unrelated to the economic environment. Second, in this analysis we consider changes to in-force to be demographic, whereas changes in the economic environment also impact future projected assumptions.

3. Terminations
   a. Expected –To get the expected portion of reserve change due to terminations, Time 1 reserves are calculated from the perspective of Time 0 using a company's best estimate mortality and lapse assumptions for terminations between the two periods as well as best estimate premium persistency. In general, reserves should drop from the prior step since, all else equal, there should be fewer model cells remaining. Reserves drop to $80.5 million, representing an expected reserve change of ($1.9 million).

   The lapse assumption in this case study consists of base lapse rates as well as dynamic adjustments to the base assumptions. For this illustration, the "expected" dynamic policyholder behavior is based on "actual" AVs to the extent the AVs are in turn based on actual credited rates. Using such an approach

allows for the reserve attribution to capture reserve volatility strictly due to the policyholder behavior assumption, excluding any potential noise from using "expected" parameters that may be outdated from the perspective of Time 1.

With respect to projecting Time 1 reserves from Time 0, the AVs between the two periods are released upon death or lapse in addition to being rolled forward with the aforementioned assumptions for crediting, premium payment, loads and charges.

b. Actual—A Time 1 valuation is performed with the policy inventory updated for actual deaths and lapses over the prior period as well as actual AV in-force. Differences between the reserves in this step and Step 3.a are due to differences in actual and expected terminations and premium payments. As unexpected differences, these are by definition considered reserve volatility. In this example, the reserves of $80.8 million are $0.4 million higher than expected, indicating lower actual terminations and resulting in reserve volatility of $0.4 million for the period. Note that in this step, while the policy inventory is adjusted based on actual terminations, the experience assumptions in the projection remain unchanged from assumptions used at Time 0.

4. New Business
   a. Plan—A Time 0 forecast of Time 1 reserves is performed assuming a company's sales target for new business issued between the two periods. All else equal, reserves should increase due to the inclusion of new issues, and in this example, one year of new business does increase reserves by $17.3 million to $98.1 million. The $17.3 million is considered anticipated reserve change.
   b. Actual—A Time 1 valuation is performed with actual new business sales reflected in the policy inventory, replacing the expected company sales target from Step 4.a. Reserves are $102.6 million, which is $4.5 million higher than the $98.1 million expected value. The $4.5 million represents reserve volatility. In general, higher than expected volumes of new business leads to positive reserve volatility.

5. Experience Assumptions—The reserve calculations in this part of the demonstration are hypothetical scenarios under which prudent estimate assumptions are adjusted due to recent company experience. Narratives are included to provide motivation for the adjustments in each step.
   a. Mortality Experience—The ULSG business in this case study exhibits unfavorable mortality experience for the standard underwriting classes and mortality rate assumptions are adjusted upwards. Reserves reflecting the revised mortality assumption are $111.5 million for a reserve volatility of $8.8 million.

   In this analysis, it was assumed the illustrated ULSG product was part of a larger mortality segment for setting prudent estimate assumptions. If emerging experience were to indicate a dissimilarity in experience for the ULSG business as compared to other products in the segment, the current approach may need to be reviewed and revised.
   b. Mortality Credibility—The credibility of company experience is assumed to increase from 70% to 75%. The prescribed Limited Fluctuation Method mortality margins decrease with a higher level of credibility. The resulting reserve volatility is ($0.8 million) for the period, resulting in reserves of $110.7 million. Although a company may expect that its mortality experience should become more credible with time, the exact quantification is unknown at Time 0 and would be considered volatility rather than anticipated change. Note the margins applied correspond to the Limited Fluctuation Method; to change the credibility method would require approval of the commissioner, and this alternative was not explored here.

c. <u>Policyholder Lapse Experience</u>—Based on an updated persistency study, company experience lapse rates are adjusted to reflect generally higher than anticipated ultimate lapse rates. The model assumptions remain in compliance with VM-20 Section 9.A.6, which relates to the credibility weighting of company experience with industry experience. Reserves are $97.0 million with a reserve volatility of ($13.7) million for the period. The dynamic modeling methodology underlying any adjustments to base lapse rate was assumed to remain unchanged in this analysis. For an assumption change in the form of an update to dynamic modeling methodology, the modeler may consider introducing an attribution step to separately quantify any impact on reserves.

Also note that this analysis was not intended to cover all types of policyholder behavior assumptions. For assumptions other than base lapse rates such as partial withdrawals or other benefit utilization assumptions, a company may introduce appropriate attribution steps to the extent it is necessary or useful to quantify corresponding reserve volatility.

d. <u>Premium Payment</u>—With a secondary guarantee design oriented toward minimal CV buildup, premium persistency is assumed to decrease similarly to policyholder persistency of the previous step. Company experience suggests premium persistency assumptions should be 2% lower on average at higher policy durations. Though premium revenue is slightly lower, the no-lapse guarantee provision works to maintain nearly the same number of in-force policies. Reserves increase to $100.6 million with a reserve volatility of $3.6 million for the period. For product designs that allow flexible premium payments, this attribution step may also provide a useful reference point for calibrating the premium sensitivities required as outlined in VM-20 Section 9.D.4.

e. <u>Expenses</u>—Prudent estimate expenses were assumed to decrease from $45 to $40 due to efficiencies supported by a company expense study. The reserves decrease to $100.2 million producing a reserve volatility of ($0.4 million) for the period.

6. <u>Prevailing Reserve</u>—This step is designed to quantify the impact due to the prevailing reserve moving from one method to another, for example, moving from the NPR to the DR. We did not observe any change to prevailing reserve component in this case study.

7. <u>Economic Environment</u>

a. <u>Starting Yield Curve—Time Passage</u>—The Time 1 valuation is updated for discount rates and AV credited rates that reflect the passage of one period as was assumed in the economic environment at Time 0. For DR and SR, this means the investment earnings rate vectors are still those calculated as of Time 0 from the projected performance of the assets in-force at that time; however, in this step the projected cash flows and rates are finally synced up in time from the perspective of Time 1. In the projection model used for this illustration this was achieved by moving down one period in the vector of outputs calculated in Step 0 (and modeled as inputs in Step 1). For example, if the modeled discount rates through the prior step were based on 10-year Treasury yields of 5%, 4% and 3% in successive periods starting *at Time 0*, as of this step they are based on the Treasury yields of 4% and 3% in successive periods starting *at Time 1*. Therefore, we are able to "roll down the Time 0 Treasury curve" while still keeping the economic environment frozen in its prior state. Also, in this illustration, we did not observe asset/liability interactions that led to meaningful deviations from the rates calculated as of Time 0 based on projected asset performance at that time. To the extent a company expects significant deviations to occur, it may consider introducing an interim step to recalculate these rate vectors. The reserves decrease to $96.4 million producing an anticipated reserve change of ($3.8 million).

b. <u>Starting Yield Curve—Valuation Date</u>—The asset inventory and starting yield curve are updated to be consistent with the company's in-force asset portfolio and the economic environment at Time 1. If the modeling approach in prior steps was to treat discount and credited rates as model inputs, in this step the input approach is discarded, and the model is allowed to once again calculate the rates from projected asset performance. In our example, reserve volatility of ($7.4 million) for the period leads to reserves of $89.0 million. We chose to include the asset inventory update in this step. An alternative approach could be to include the asset inventory update in the next step together with the asset spreads and default charges change.

c. <u>Asset Spreads and Default Charges</u>—These two components generally have offsetting effects on asset performance; that is, an increase in spreads over Treasury rates would be offset by higher default charges. In this case study, the net effect of updated asset spreads and updated default costs is a decrease of 15 bp. This change results in reserves of $101.0 million, which produces a reserve volatility of $12.0 million increase for the period.

d. <u>Investment Strategy</u>—The reinvestment strategy in this case study is assumed to shift toward higher-quality, lower-yielding bonds. When this step is processed in the model, reserves are $102.1 million, producing a reserve volatility of $1.1 million for the period.

8. <u>Risk Mitigation</u>

a. <u>Reinsurance Retention Limit</u>—In this final step of the attribution analysis, the retention limit of the YRT reinsurance arrangement is increased from $1 million to $1.2 million. The case study assumes that the YRT mortality risk reinsurance comes at a net cost to the ceding company. When the retention is increased, the net cost is now lower to the direct writer. The reserves decrease to $96.4 million, producing reserve volatility of ($5.7 million) for the period.

b. <u>Hedge Programs</u>—Part of the risk mitigation category, but not applicable to this ULSG case study.

9. <u>PBR Time 1</u>—The VM-20 minimum reserves at Time 1 reflect all sources of reserve change as illustrated in this attribution analysis, including those from demographics, non-economic assumptions, economic assumptions and risk mitigation activity. VM-20 minimum reserves at Time 1 are $96.4 million, a result of the DR of $96.4 million prevailing over the NPR of $5.5 million and SR of $88.0 million. It reflects a total anticipated reserve change of $33.0 million and total reserve volatility of $2.8 million over the Time 0 VM-20 minimum reserves of $60.6 million. Note the $2.8 million in total reserve volatility is the net result of both positive and negative unexpected reserve changes. In the context of volatility as a quantity without directionality (i.e., always positive), the subtotal of the absolute value of unexpected reserve changes yields $58.6 million, a figure much higher than $2.8 million. A company may consider analyzing the magnitude of reserve differences, without directionality, to better understand areas of large reserve volatility and potential impact on total reserves. The pie chart inset of Figure 5 illustrates the breakdown of the total absolute value of reserve volatility by attribution step.

Attribution Grid– ULSG Case Study

The attribution steps for the ULSG case study are presented in Figures 15 and 16. Within the attribution grid are shown the VM-20 reserve components by attribution step, a column for Anticipated Reserve Change, Reserve Volatility and Reserve Calculation Type (of process or run), and a detailed Description column. This last item is presented on a separate page, following Figure 15. Figure 16 is a graphical representation (stacked bar chart and pie chart) of the attribution analysis.

Figure 15

VM-20 Reserve Movement Analysis
Universal Life with Secondary Guarantee
($ thousands)

Step	Movement Analysis from T0 to T1 (see descriptions on following page)	NPR	Deterministic Reserves	Stochastic Reserves	Final VM-20 Reserves	Anticipated Reserve Change[1]	Reserve Volatility[2]	Reserve Calculation Type
0	*PBR TIME 0 - Valuation*	$ 464	$ 60,565	$ 49,339	$ 60,565			Valuation
	DEMOGRAPHIC CHANGES							
1	Time Passage of Reserves	$ 5,682	$ 82,038	$ 73,251	$ 82,038	$ 21,473		Forecast
2	Account Value Roll Forward	$ 5,625	$ 82,386	$ 73,571	$ 82,386		$ 347	Forecast
3.a	Inforce Terminations - Expected	$ 5,455	$ 80,474	$ 71,858	$ 80,474	$ (1,911)		Forecast
3.b	Inforce Terminations - Actual	$ 5,481	$ 80,848	$ 72,187	$ 80,848		$ 374	Valuation
4.a	New Business - Plan	$ 5,483	$ 98,134	$ 87,136	$ 98,134	$ 17,286		Forecast
4.b	New Business - Actual	$ 5,483	$ 102,639	$ 90,629	$ 102,639		$ 4,504	Valuation
	COMPANY EXPERIENCE							
5.a	Mortality Experience	$ 5,483	$ 111,467	$ 100,580	$ 111,467		$ 8,828	Valuation
5.b	Mortality Credibility	$ 5,483	$ 110,713	$ 99,835	$ 110,713		$ (754)	Valuation
5.c	Policyholder Lapse	$ 5,483	$ 97,046	$ 87,014	$ 97,046		$ (13,667)	Valuation
5.d	Premium Payment	$ 5,483	$ 100,651	$ 89,525	$ 100,651		$ 3,604	Valuation
5.e	Expenses	$ 5,483	$ 100,245	$ 89,143	$ 100,245		$ (405)	Valuation
	PREVAILING RESESRVES							
6	Prevailing Reserve Change	$ 5,483	$ 100,245	$ 89,143	$ 100,245	$ -	$ -	Valuation
	ECONOMIC ENVIRONMENT							
7.a	Starting Yield Curve - Time Passage	$ 5,483	$ 96,410	$ 86,522	$ 96,410	$ (3,835)		Valuation
7.b	Starting Yield Curve - Valuation Date	$ 5,483	$ 89,043	$ 79,798	$ 89,043		$ (7,367)	Valuation
7.c	Asset Spreads and Default Charges	$ 5,483	$ 101,073	$ 90,033	$ 101,073		$ 12,030	Valuation
7.d	Investment Strategy	$ 5,483	$ 102,134	$ 93,298	$ 102,134		$ 1,061	Valuation
	RISK MITIGATION							
8.a	Reinsurance Retention Limit	$ 5,483	$ 96,429	$ 88,024	$ 96,429		$ (5,705)	Valuation
8.b	Hedge Programs	$ 5,483	$ 96,429	$ 88,024	$ 96,429		N/A	N/A
9	*PBR TIME 1*	$ 5,483	$ 96,429	$ 88,024	$ 96,429	$ 33,013	$ 2,851	Valuation

(1) Anticipated Reserve Change: change in reserves due to anticipated experience in inforce demographics and anticipated economic/non-economic assumptions
(2) Reserve Volatility: deviations from anticipated reserve changes due to emerging experience, or due to unexpected changes in economic/non-economic assumptions

71

Figure 15 continued

VM-20 Reserve Movement Analysis

Universal Life with Secondary Guarantee

($ thousands)

Step	Movement Analysis from T0 to T1	Description
0	*PBR TIME 0 - Valuation*	VM-20 reserves at Time 0, i.e. at the end of the prior valuation period.
	DEMOGRAPHIC CHANGES	
1	*Time Passage of Reserves*	The inforce population ages by 1 period between Time 0 and Time 1. Actual experience is ignored to isolate the expected reserve change from period-to-period. Economic environment is assumed to be that as of Time 0. Account values grow per the expected economic environment *at Time 0*.
2	*Account Value Roll Forward*	Account values grow with the actual credited rates realized over the period. Actual credited rates were lower than anticipated.
3.a	*Inforce Terminations - Expected*	Expected reserve change from company's best estimate mortality, lapse, and policyholder behavior assumptions.
3.b	*Inforce Terminations - Actual*	Actual reserve change from policy decrements due to deaths and lapses as well as differences in account value inforce. Total termination was lower than expected.
4.a	*New Business - Plan*	Expected reserve change due to company's new business sales target between Time 0 and Time 1.
4.b	*New Business - Actual*	Actual reserve change from issues over the period. Production was higher than the company's forecast.
	COMPANY EXPERIENCE	
5.a	*Mortality Experience*	Prudent estimate mortality assumptions are updated from a periodically performed mortality study. Results indicate higher mortality among the standard underwriting classes.
5.b	*Mortality Credibility*	The credibility of the company's mortality experience increases from 70% to 75% with the one additional period of claims experience. Limited fluctuation margins decrease.
5.c	*Policyholder Lapse*	Base lapse rate assumptions are adjusted upwards due to higher than anticipated ultimate lapse experience.
5.d	*Premium Payment*	Premium payment assumptions are adjusted downwards due to lower than anticipated premium persistency.
5.e	*Expenses*	Per policy expenses decrease from $45 to $40 due to cost savings from a recent acquisition.
	PREVAILING RESESRVES	
6	*Prevailing Reserve Change*	Reserve change due to a change in the prevailing reserve among NPR, DR, and SR.
	ECONOMIC ENVIRONMENT	
7.a	*Starting Yield Curve - Time Passage*	The expected reserve change from the natural progression of moving down the Treasury curve.
7.b	*Starting Yield Curve - Valuation Date*	The Treasury curve reflects the current economic environment.
7.c	*Asset Spreads and Default Charges*	Asset spreads and default charges corresponding to current yields and economic environment. Overall net spread decreases by 15bps.
7.d	*Investment Strategy*	The company's most up-to-date reinvestment strategy is consistent with the company's investment policy of a shift towards higher quality bonds.
	RISK MITIGATION	
8.a	*Reinsurance Retention Limit*	With the growth in company size as well as credibility of its own claims experience, retention limit is increased to $1.2M from $1.0M.
8.b	*Hedge Programs*	Not applicable this ULSG case study.
9	*PBR TIME 1*	VM-20 reserves at Time 1.

Figure 16

VM-20 RESERVE MOVEMENT ANALYSIS
UNIVERSAL LIFE WITH SECONDARY GUARANTEE
Anticipated Reserve Change and Reserve Volatility

73