LIFE PRINCIPLE-BASED RESERVES (PBR) ASSUMPTIONS RESOURCE MANUAL

Life Practice Council

American Academy of Actuaries

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An actuary's step-by-step sample framework for setting, updating, and governing life insurance assumptions for PBR and other valuation frameworks

Created by the American Academy of Actuaries
PBR Assumptions Resource Manual Work Group

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This resource manual is not a promulgation of the Actuarial Standards Board, is not an actuarial standard of practice, is not binding upon any actuary, and is not a definitive statement as to what constitutes generally accepted practice in the area under discussion. Events occurring subsequent to this publication of the resource manual may make some of the practices described in this practice note irrelevant or obsolete.

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Overview and Intended Use

What is this? This resource manual is intended to provide a step-by-step sample roadmap of a life insurance assumption development cycle. It provides considerations for actuaries tasked with setting and updating experience assumptions, determining margins, generating documentation, and reviewing modifications made to valuation model inputs. The focus is not necessarily on specific methodologies for setting and updating assumptions themselves, but rather on governance, process, margin development, and considerations for updating valuation assumptions, especially for principle-based reserving (PBR) purposes.

What is it for? This resource manual is intended to assist actuaries in implementing or maintaining a process for updating, reviewing, and uploading assumptions for **valuation modeling purposes**. The resource manual also specifically focuses on establishing the valuation assumption governance process, including communication, documentation, and the creation of controls. Finally, there are sample case studies for establishing materiality and developing margins appropriate for principle-based valuations. While PBR and life insurance contracts are the focus, users may also find applications to non-PBR and non-life contracts (such as governance and assumption development).

What is it not for? This resource manual is not a promulgation of the Actuarial Standards Board, is not an actuarial standard of practice, is not binding upon any actuary, is not a definitive statement as to what constitutes generally accepted practice in the area under discussion and does not provide authoritative guidance for actuaries involved in setting, reviewing, or updating assumptions. Neither is it intended to document or interpret PBR requirements in the National Association of Insurance Commissioners (NAIC) Valuation Manual (VM). This resource manual is intended to apply to processes involving valuation assumptions, rather than pricing assumptions. The governance practices discussed in this manual are intended for assumption development in general and are not necessarily applicable to model governance. In addition, while there may be applications to VM-21, fixed annuities, and other non-life insurance contracts, these are not intended to be the focus of this manual.

What information is provided? The following information is provided in the resource manual:

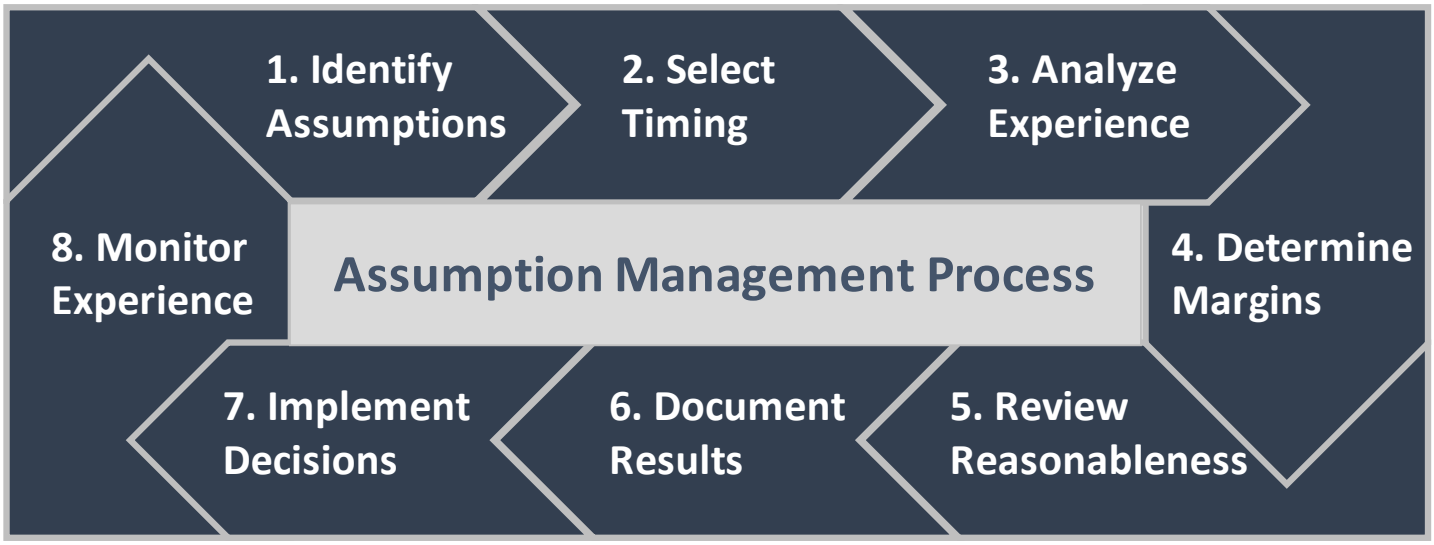
- An outline of a sample, step-by-step process for developing, reviewing, and updating valuation assumptions, as well as a framework for governing such processes.
- Three example case studies for determining and analyzing margins appropriate for principle-based valuations.
- One example case study for governing and documenting margins for principle-based valuations.
- Considerations for review, documentation, and governance.

- Common steps and sample practices for analyzing experience and identifying trends.

Who developed this? The assumptions resource manual was created by the PBR Assumptions Resource Manual Work Group, reporting to the PBR Model Governance Working Group within the Life Practice Council of the American Academy of Actuaries.

Visual of Valuation Assumption Sample Framework

The PBR Assumptions Resource Manual is intended to provide a step-by-step sample roadmap for updating actuarial assumptions for life insurance valuation purposes. Throughout the document, we refer to an example assumption management framework that could be considered by practicing actuaries. This framework is an eight-step process as shown below:



Each section of the PBR Assumptions Resource Manual focuses on one of the steps contained in this example framework. The framework is intended to be a cycle, with a feedback loop from monitoring results leading into identifying assumptions to update for the next reporting period.

In addition, four case studies are located toward the end of the resource manual that discuss different aspects of the assumption update process. The resource manual also contains an appendix with a list of references and additional resources. There are many approaches to updating valuation assumptions, which vary across companies, regulatory requirements, and product lines. The process discussed in this document is intended only to serve as an example of a framework.

Section I: Identify Assumptions

Overview

This section provides an overview of common risks and associated actuarial assumptions that are typically used for life insurance valuation purposes, and that will be referred to throughout the remainder of the resource manual. This consists of a description for each primary life actuarial assumption category, in addition to the underlying drivers for actual experience deviating from anticipated experience.

Emerging experience for liability and asset cash flows will vary from anticipated experience for a variety of reasons. For instance, actual experience on liability risk factors such as mortality and policyholder behavior can vary from anticipated experience due to changes in the population mix of policyholder characteristics, such as issue age, attained age, gender, and risk class. In addition, product mix and external forces can also influence experience. Throughout this section, we explore common sources of variation in experience and the data elements actuaries consider when analyzing and modeling experience assumptions for valuation purposes.

Variations by Assumption

Each type of assumption has its own drivers of experience variation, emerging trends, and general volatility. This subsection describes the key drivers for the following actuarial assumptions for life insurance policies:

- Policyholder Behavior—Lapses and Surrenders
- Policyholder Behavior—Other
- Expenses
- Mortality
- Reinsurance
- Asset Assumptions
- Other Considerations

Policyholder Behavior

Policyholder behavior risk commonly refers to uncertainty with regards to policyholder premium payment patterns, premium persistency, surrenders, lapses, partial withdrawals, loans, allocations between available investment and crediting options, benefit utilization, and similar elections. These policyholder behavior assumptions can vary due to policyholder characteristics and may also dynamically reflect the economic environment, including considerations for interest rates, market value, competitive environment, and consumer confidence.

Lapses and Surrenders

Lapse and surrender risk refers to the uncertainty that policyholders stop paying premiums, lapse upon depleting cash value, or voluntarily surrender their policies. These events then result in the termination of the policy and potential payout of non-forfeiture benefits. Lapse and surrender experience can vary due to several factors. One primary driver is the presence of contract features that incentivize or disincentivize contract termination. For flexible premium contracts, surrender charges in early durations can discourage policyholders from surrendering their policies. In contrast, as surrender charges decrease in later policy durations, surrender rates could also increase in the absence of contract guarantees. In many cases, when the surrender charge period ends, a block of business may experience a spike in lapses, or a "shock lapse." A similar phenomenon occurs on term policies that contain premium rate increases following a level premium period. In general, the greater the post-level premium jump, the higher the expected lapse rate, especially for policyholders who are still in relatively good health and are able to purchase a new life insurance policy.

The distribution channel and target market also influence lapse and surrender experience. For instance, if policies are being purchased through a bank or other financial institution, it may be more likely that the client is financially savvy and better understands the insurance product, leading to lower likelihood of lapse. Alternatively, selling through direct-to-consumer distribution channels, in which the client has no interaction with an agent or broker, may be associated with less policyholder knowledge of the product upon purchase. This could result in buyer's remorse and greater lapse rates, especially in early durations. With regard to target markets, affluent populations with greater propensity to buy life insurance can mean greater product and financial knowledge. Policy size may serve as a potential indicator of such policyholder affluence. This may potentially correspond to fewer lapses shortly after issue, but also either fewer or more lapses depending on when it would be advantageous to the policyholder. Such advantageous situations can occur when crediting rates are more competitive than investment rates available elsewhere in the market. Similarly, policyholders are less likely to surrender when product guarantees are in-the-money, and the opposite is true when product guarantees are out-of-the-money. For these situations, actuaries find it might be appropriate to model surrenders/lapses dynamically, to vary the assumption with movements in market rates or product guarantee in-the-moneyness.

Valuation frameworks may also include additional assumption requirements. U.S. statutory reserves calculated under VM-20, for instance, require that lapses in Universal Life with Secondary Guarantee (ULSG) modeled reserves grade to the Canadian Institute of Actuaries (CIA) *Lapse-Experience Under Term-to-100* table for durations without substantial credibility when the cash value is zero or minimal (see Section 9.D of VM-20 for more details). Therefore, actuaries must determine how to define "sufficient credibility" based on their respective lapse studies, as well as what constitutes "minimal cash value." In addition, actuaries may consider modifying lapses for term modeled reserves as one method to comply with the requirement to eliminate post-level profits (note that anticipated post-level losses are to still be reflected—see Q17.10 in the Academy's VM-20 practice note). With regard to developing margins for PBR, asset adequacy testing, or Generally Accepted Accounting Principles (GAAP) Provisions for Adverse Deviations (PADs), there may be considerations made for relevance, credibility, and data quality/completeness (see Section 14 in the Academy's VM-20 practice note).

Other Policyholder Behavior Assumptions

Risk due to other policyholder behavior elements may have drivers similar to those affecting surrenders and lapses. For instance, the likelihood of a term policyholder exercising a conversion privilege is typically linked to policyholder characteristics (age, duration, risk class) and financial savviness (which may be associated with policy size). In addition, there are drivers specific to term conversions. For instance, if policyholders have worsening health and are not able to obtain new coverage, they are more likely to convert. This anti-selection will impact future mortality, and the assumptions may be adjusted. Analysis of these underlying effects can be helpful to more accurately update a conversion assumption. Additional factors may also come into play:

- A policyholder may be better able to afford permanent insurance and thus more likely to convert if household income increases.
- A policyholder may be more likely to convert if the need for insurance has increased (e.g., marriage, family, etc.).
- Sales inducements on conversions, such as offering additional premium credits for a new permanent policy, can also increase conversions.
- The availability to the policyholder of a secondary market option ("life settlement") may increase conversions.

Another common policyholder behavior assumption is guarantee utilization, which is often driven by the in-the-moneyness of the guarantee. For example, policyholders tend to exercise guarantees on cash value floors when the cash value is at or below the guaranteed amount. For secondary guarantees, policyholders are more likely to stay in-force when their current account value is below zero, since they receive no surrender benefit for lapsing and, if they retain their policies, they still receive coverage. The degree to which this actually occurs will also depend on whether additional premiums are required and, if so, how they compare to other available coverage in the market.

Partial withdrawal and policy loan assumptions are especially relevant assumptions for permanent policies with cash value. Partial withdrawal assumptions could have similar characteristics to surrenders except that only a portion of the cash value is depleted. The precision required for setting partial withdrawal assumptions could also depend on the extent to which partial withdrawals have a material impact on financial profitability.

Policy loans can be modeled as liability assumptions or, alternatively, as assets. Policy loan assumptions can also dynamically change based on economic assumptions or participating programs with dividend payments. In addition, a key consideration for policy loan assumptions is the interest rate charged, which can interact with other interest rates on the policy (such as a credited rate on a Universal Life contract). Some policies might be sold with the intention of heavy use of loans, which could make loan utilization a material assumption in such cases.

Lastly, actuaries would typically take caution with partial withdrawals and loan assumptions that might interact in situations where the policyholder is withdrawing funds from the contract in later durations of the policy life. Whether the interaction between these two is a material assumption can depend on how the product is designed, marketed, and affected by tax considerations.

Expenses

Expense risk commonly refers to the risk of uncertainty in future expenses. This can relate to fluctuation in overhead, supplier/maintenance factors, employment, inflation, and unexpected one-time expense incurrences.

Company expenses fluctuate due to a variety of causes. Drivers of expenses depend on the underlying nature of the expense being incurred. If an expense is higher when the contract is larger, it can be modeled as a per $1,000 face amount or premium. Expenses dependent on number of policies but that do not vary with contract size might be expressed as a per policy unit cost.

“Direct expenses” are clearly linked to a policy or block of business. Expenses that cannot be clearly tied to a given contract or block of business, such as company overhead, can be modeled and allocated at a higher level. These expenses are commonly referred to as “indirect expenses.” If indirect expenses are allocated proportionately to direct expenses (or are covered by grossing up unit expenses such as per policy, per thousand, or per premium expense assumptions), the degree of coverage of total expenses will be sensitive to deviations between assumed and actual allocation bases. Such allocation of indirect expenses to business segments might be performed separately for lines of business, product groups, distribution channels, and / or market segments. Analysis of trends in overages or deficiencies can be helpful in modifying the allocation procedure.

Expense risk might also vary by the company's ability to manage expenses. If expenses are higher than expected, is the company able to reduce its spending to get back to budget? How volatile are a company's expenses and how much is the company in control? External forces such as consumer demand, mergers and acquisitions, industry employment, and wage levels can affect expense levels. Companies that grow faster may face greater expense risk than companies with stable growth. Expense inflation, commonly linked with economic risk and the company's use of technology, can result in differences between actual vs. expected expenses, especially over extended periods of time. VM-20 also contains requirements on expense inflation, amortization of one-time expenses, allocation of costs across lines of business, going concern treatment, and future known non-recurring expenses. Some valuation frameworks, such as VM-20, do not permit taking account of expected future improvements in expenses. Further discussion on these topics can be found in ASOP No. 52, *Principle-Based Reserves for Life Products under the NAIC Valuation Manual*.

Mortality

Mortality risk commonly refers to the risk of volatility in life insurance claims, reflecting uncertainty of future mortality payouts. This can mean general fluctuation of mortality claims experience, trends in mortality, varying mortality risk across population segments, and severe mortality events.

Mortality expectations can differ based on policyholder characteristics. Age, gender, insurability, risk class, smoker status, policy size, product type, distribution, and target market are common factors that influence mortality. Mortality improvement and severe mortality events, while often difficult to predict, can have large impacts on mortality over an extended period. Historical experience is frequently used as a basis for both future anticipated experience and associated trends, though this may be influenced by changes made to the underwriting (risk selection) process. Mortality projections may also be influenced by policy provisions and associated policyholder behavior (for instance, mortality deterioration in which less-healthy policyholders stay inforce following a premium jump). Methods are available to reflect the impact of policyholder behavior (particularly lapses) on expected mortality, such as the Dukes-MacDonald and Becker-Kitsos algorithms ("Term Mortality and Lapses" from *Product Development News*, August 2005).

There are several considerations around the source and quality of data. Credibility metrics and associated blending frameworks provide techniques for developing mortality assumptions using limited data. Industry tables, similar products, and external studies provide additional sources that may be explored in the absence of data. VM-20 provides restrictions and parameters for setting mortality assumptions, including prescribed minimum margins and industry blending rules, and does not allow mortality improvement beyond the valuation date.

A complete discussion of credibility and mortality drivers is extensive and goes beyond the scope of this resource manual. Readers who wish to understand the process better may find additional details in the Academy's *Credibility Practice Note*; the Academy's VM-20 practice note; ASOP No. 25, *Credibility Procedures*; ASOP No. 52 (PBR for life products); the ASOP exposure draft on assumption setting; and *Topics in Credibility Theory* (SOA Construction and Evaluation of Actuarial Models Study Note, Dean).

Reinsurance

Reinsurance risk refers to the uncertainty of future cash flows for reinsurance arrangements. Reinsurance cash flows are driven by the underlying reinsurance agreement. For yearly renewable term (YRT) reinsurance arrangements, cash flows primarily consist of death benefit payments and premiums and may be subject to a retention limit. Coinsurance and modified coinsurance (ModCo) arrangements present unique model considerations, as cash flows can span VM-20 product groups and may include considerations for interest adjustments and risk charges.

Reinsurance assumptions must reflect non-guaranteed elements in the reinsurance contract, such as the ability for either party to modify contract features. An example of this for YRT arrangements is the ability of reinsurers to increase premium rates paid by the ceding company. The likelihood of such rate increases varies with changes in mortality over time (e.g., mortality improvement/deterioration), treaty provisions, history of past rate increases, competition in the reinsurance market, and whether the ceding company has the right to recapture the mortality risk upon rate increases. Reinsurance assumptions can also reflect counterparty risk. Section 8 in VM-20 contains specific requirements regarding the reflection of counterparty risk by ceding and assuming parties.

Some rule-based valuation frameworks, such as the pre-2017 Commissioners' Reserve Valuation Method (CRVM) and the Net Premium Reserve (NPR) under the current CRVM described in VM-20, require direct and ceding companies to calculate reinsurance reserves and reserve credits using prescribed formulas that can result in nearly identical amounts being calculated by both parties. In contrast, other valuation frameworks, such as modeled reserves under VM-20, require each party within the arrangement to calculate reserves using company-specific assumptions. Because company-specific assumptions can differ for each party in the arrangement, the direct and ceding companies could generate different reserve amounts.

When the reserve credit is calculated using cash flows based on company-specific assumptions and anticipated experience, there could be margins, premium increases, or recaptures projected for reserve purposes to account for the uncertainty of future reinsurance cash flows. Methods to reflect such uncertainty can vary from company to company. In addition, under such circumstances, there is the possibility for a ceding company to reflect a negative reserve credit (reserves net of reinsurance are greater than reserves gross of reinsurance), regardless of whether the reinsurer is holding positive reserves (i.e., holding a liability) itself.

Asset Assumptions

Asset risk refers to uncertainty related to asset spreads, default rates, recoveries, reinvestment/disinvestment strategy, Treasury rate/equity scenarios, hedging programs, and transfers between the separate and general accounts, among others. Assumption development for valuation purposes can depend on whether asset assumptions are prescribed, such as spreads, defaults, scenarios, and other guardrails, which is the case under VM-20.

Asset Liability Management (ALM) frameworks also consist of assumptions for the interactions between liabilities and assets. As asset scenarios change (e.g., interest rates or equity assumptions), policyholder behavior could change with respect to lapses, surrenders, and guarantee utilization. There might also be assumptions on how to treat mismatches between assets and liabilities in association with liquidity risk. This can include thresholds on duration or cash flow matching that result in management decisions to purchase/sell assets upon changes to liability cash flows over the model projection.

Section 8.D of VM-20 requires special asset considerations for the calculation of the pre-reinsurance-ceded minimum reserve. Because the actual cash flows are post-reinsurance, the pre-reinsurance cash flows must consider hypothetical asset cash flows that could arise in a scenario with no reinsurance. Section 3.5.2 (Pre-Reinsurance-Ceded Minimum Reserve) in ASOP No. 52, *Principle-Based Reserves for Life Products under the NAIC Valuation Manual*, provides guidance for selecting a hypothetical portfolio of assets for this purpose.

This resource manual does not intend to focus on asset assumptions. More information can be found in the Academy's VM-20 practice note and *Asset Adequacy Analysis* practice note.

Other Considerations

There are several liability risks to be considered when developing valuation assumptions. These include non-guaranteed elements, fee sharing, and other cash flows. In many cases, these assumptions are influenced by anticipated management decisions and economic, political, or other external factors.

Non-guaranteed elements can include dividends, crediting rates, and modifications to other premiums/charges. It may be reasonable to model non-guaranteed elements dynamically in accordance with changes to the economic environment or policyholder behavior, especially when performing stochastic modeling. For contracts with separate account funds, revenue sharing could also be a material assumption that can change based on modifications to fund availability and policyholder behavior over time. VM-20 also has specific requirements on the extent to which non-guaranteed contractual fees can be recognized as income (see Academy VM-20 practice note for more information).

Another assumption includes the utilization of riders, such as exercising guaranteed insurability options, policy split options, and others. Exercising such riders might depend on preset windows within the contract, changes to policyholder needs, and policyholder efficiency. In addition, riders that include provisions to accelerate a portion benefit upon critical or terminal illness require morbidity assumptions, and could include additional considerations for anti-selection and interaction with base policy features.

This document does not intend to focus on these liability assumptions in depth. More information can be found in the Academy's VM-20 practice note and the Academy's *Asset Adequacy Analysis* practice note.

Statistical Analysis & General Variations

General variations in experience can be analyzed using statistical methods. Statistical distribution functions can be developed to represent frequency or severity of events. Examples include frequency of deaths, lapses, and surrenders, and how large the death benefits or cash surrender values are when they occur. In addition, statistical distributions can determine the variability of these events. Development of these distributions can rely both on the goodness-of-fit and modeling restrictions.

Historical experience can be fitted to statistical distributions to develop predictive models, depending on whether the underlying applicability and assumptions of the statistical model are appropriate for the actuarial assumption being developed. Approaches such as maximum likelihood estimation can be used to set the statistical parameters within a particular function (for more details on parameter estimation, one reference to consult is *Loss Models: From Data to Decisions* by Klugman, Panjer, and Willmot). Such techniques become relevant for actuarial assumptions developed using predictive models, for example, premium persistency, dynamic lapses, and even mortality variability. Additional predictive approaches include generalized linear modeling, deep learning, Markov modeling, random forests, and clustering. "Using Predictive Modeling for UL Premium Assumptions" by Cassidy and Logan, *Financial Reporter 114*, September 2018, gives a high-level description of a case study where a rain forest approach is used to model funding patterns for flexible-premium products.

Variations by Product

The following describes common factors of experience variation for specific product types:

- Term—Term policies with guaranteed level premium periods may exhibit lapse experience that varies during the level period, at the end of the level period, and following the level period due to the length of the level premium period and size of the post-level premium jump. In general, the greater the premium jump, the greater the expected shock lapse and the higher the expected mortality for policies that remain in-force. This relationship can be modeled with Dukes-MacDonald, Becker-Kitsos, or other methods. See "Term Mortality and Lapses" from *Product Development News*, August 2005 for more discussion on this topic. In addition, to supplement these theoretical frameworks, readers can refer to the Society of Actuaries (SOA)-sponsored RGA (Reinsurance Company) report titled *Report on the Lapse and Mortality Experience of Post-Level Premium Period Term Plans* (2014), and modify parameters based on observations of company-specific data. Term products can have conversion privileges that result in higher mortality rates for the permanent contracts into which the term policy converts, due to lack of re-underwriting upon conversion and any associated anti-selection.

- Whole Life—For participating contracts, there can be additional considerations related to the dividend payment. The level of the Dividend Interest Rate (DIR) used to determine dividend payments relative to competing market rates can influence the prevalence of policyholder surrenders. In addition, assumptions of the future dividend payments can vary across economic, mortality, and expense scenarios.

- Universal Life—Secondary guarantees are sometimes included in universal life (UL), variable universal life (VUL), and indexed universal life (IUL) contracts. When secondary guarantees are present and the account value drops below zero, the likelihood of policyholder surrender is generally expected to decrease. Other guarantees such as guaranteed minimum interest rates on UL, guaranteed minimum accumulation benefits on VUL, and indexed growth floors on IUL can be expected to result in higher policyholder persistency when the guarantee is in-the-money. High surrender charges and higher investment returns outside the contract can also increase anticipated persistency. Product complexity could influence policyholder behavior based on the level of policyholder and distribution agent understanding of the product.

Changes Over Time

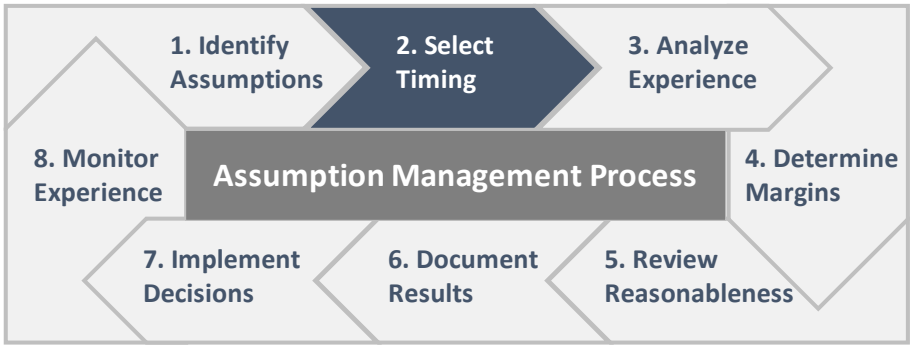
Drivers in experience variation can also change over time. For example, shifts in policyholder demographic mix within a block of business can affect average levels of mortality, lapse, and other policyholder behavior assumptions.

If a particular experience data cohort adds new business each year, then business mix could also change. This might be due to shifts in factors such as target market, distribution system, or product design. For instance, if a company decreases post-level premiums on a new term product, then post-level period persistency could increase as these policies become a larger portion of the term inforce block over time. To the extent that product design changes affect anticipated mortality and policyholder behavior, the actuary might set separate assumptions for different blocks of business by issue year or product code.

New risk selection/underwriting frameworks can also affect mortality and policyholder behavior risk. For example, including additional medical tests or purchasing access to an external database that checks accuracy of policyholder reported data can decrease anticipated life insurance mortality due to improved risk selection. However, major changes, such as introducing a completely new underwriting method, could generate additional risk in modeling this assumption due to a lack of historical data.

Now that the different types of life insurance risks and actuarial assumptions to consider have been identified, in the next section is an exploration of the process of selecting which of the assumptions to update for valuation purposes, and the order of updating these assumptions.

Section II: Select Timing



Overview

After identifying assumptions required in a valuation framework, the next step in the process would be to determine the order and frequency of assumption updates. For PBR valuations, VM-20 requires assumptions to be periodically reviewed and updated as appropriate, with specific guidance requiring mortality assumptions to be reviewed at least once every three years. Furthermore, VM-20 states that the qualified actuary shall annually review relevant emerging experience for the purpose of assessing the appropriateness of the anticipated experience assumption. Actuaries might consider updating valuation assumptions more frequently than required in VM-20, depending on emerging trends and changes in expectations of future experience.

Actuaries can determine the order and frequency of assumption reviews based on the materiality of each assumption. The materiality discussed in this section is at a high level and for the purpose of determining the order and frequency of assumption updates—whereas determining materiality for specific valuation and margin purposes is further discussed in Section IV of this document.

Materiality can refer to an item or combination of related items that could influence the decision of an intended user upon its omission or misstatement. Materiality depends on the purposes of the actuary's work and the intended use. In company practice, a particular assumption's materiality might be determined based on the extent to which it impacts a particular value or process. For determining materiality, considerations may be given to key business drivers, including mortality, morbidity, policyholder behavior, utilization of benefits, investment returns, expenses, and distribution mix. Materiality might also be based on an enterprise perspective and not just relative to a specific business. Actuaries might consider developing materiality thresholds that align with the risk framework and size of the business.

Materiality for Determining Which Assumptions to Update

Materiality generally has two key considerations: quantitative materiality and qualitative materiality. An assumption can have a high materiality rating if it crosses the threshold for either quantitative or qualitative factors.

Quantitative Factors

The quantitative threshold may be based on either, or both, of the following:

a) The expected actual impact on financial metrics (pricing returns, increases to surplus, increases to reserve, etc.) based on historical fluctuations

b) The potential financial impact of an assumption on a specified financial quantity

Quantitative thresholds can be based on a number of metrics that include but are not limited to expected sales, present value of cash flows, net income, and financial impacts to reserves. These metrics can either be expressed in total amount of dollars or percentages of an underlying measure (e.g., reserves, surplus, earnings, etc.).

Confidence intervals might be established around certain assumptions and actual-to-expected (A/E) testing can be used as a metric to set a threshold for initiating assumption updates. In addition, sensitivity testing can help determine the materiality of an assumption (see Section IV on how materiality can inform the determination of margins for valuation purposes).

Qualitative Factors

Qualitative factors might influence materiality as they may impact company strategy or business operational costs. Qualitative factors could include (but are not limited to) the following:

a) The amount of judgment used in the assumption-setting process

b) Associated risk impacts on field force morale, corporate reputation, and company management actions

c) Any new, unique, or volatile aspects of the assumption

d) Ability for a company to modify experience (e.g., managing expenses within a targeted budget)

Frequency

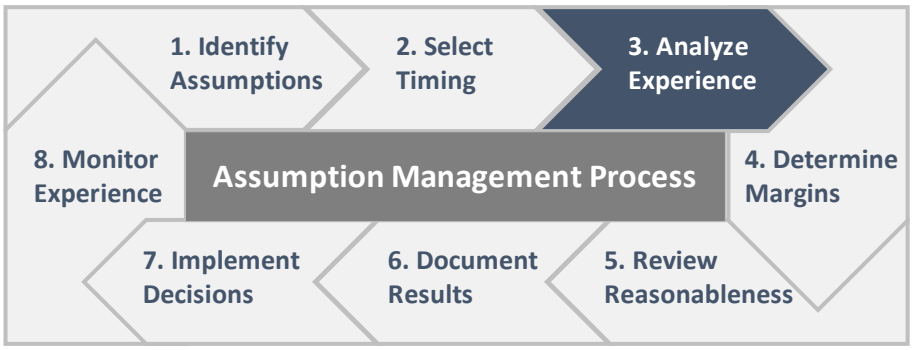
As discussed earlier in this section, some valuation frameworks, such as VM-20, require that assumptions be periodically reviewed and updated. The assessed materiality of an assumption can be used to determine the frequency and order in which assumptions are reviewed and the review process used. For example, even if not required, companies could consider reviewing and potentially updating significant assumptions on an annual basis (e.g., mortality) or on a more frequent basis for assumptions that change more frequently throughout the year (e.g., some policyholder behavior or dynamic assumptions).

In addition, the actuary might consider performing an updated experience study if there is an event or trend that indicates a material change in experience and/or material financial impact on business results. Actuaries might develop tools to monitor key metrics that drive company business results. These tools can provide an early warning of changes in experience. An example of such a tool would be a Source of Earnings (SOE) analysis. Information on SOE analysis can be found in the SOA online library including papers such as *Source of Earnings Analysis for Flexible Premium and Interest-Sensitive Life and Annuity Products*.

Under certain conditions, the review of an assumption might be performed less frequently or using a high-level analysis (as long as the actuary documents the rationale for this frequency). These situations may include the review of low materiality assumptions for which there has been little historical experience variation and low cumulative financial impact. In such cases, a company could conduct a review of an assumption without committing as many resources as a full experience study. The ability to perform a high-level review of an assumption might be limited to a set numbers of years, at which point a full review would occur.

Having established a foundation for determining the order and frequency of assumption reviews, the following section will provide an overview of analyzing experience.

Section III: Analyze Experience



Overview

This section provides a brief overview of analyzing experience, including considerations for data quality, credibility, data analysis, identifying and reflecting trends in experience, assumption structure, and incorporating company/external factors. This section does not cover in-depth techniques for using raw data to develop mortality tables and other assumptions; readers can consult additional resources such as *Actuarial Mathematics for Life Contingent Risks* (Dickson, Hardy, Waters, 2013), *A Practitioner's Guide to Statistical Mortality Graduation* (Ramonat, Aktuar, 2018), and other actuarial resources on the SOA website.

Data Quality

Analyzing actuarial experience and trends begins with gathering data. Data may be gathered from a variety of sources depending on the assumption being analyzed and the data available. Common sources of internal company data are administration systems, valuation systems, and accounting ledgers. Examples of external data include industry data from actuarial organizations, consulting companies, and reinsurers, as well as any applicable population data from a government entity. Asset data may also be taken from databases with past interest rates, equity rates, index fund returns, and external sources.

When using internal or external data, actuaries commonly compare against alternative sources, such as an industry study or another source of internal data. For example, if an analysis is utilizing data from the company administration system, this data could be compared to information within the valuation system and accounting ledger to conduct a review and ensure internal consistency. If external data has been audited and validated, the actuary may note that as part of the data review.

Data Credibility

Following an analysis of data quality, an evaluation of the credibility of the data is usually performed. VM-20 specifies calculating credibility for mortality by using either the Limited Fluctuation Method or the Bühlmann Empirical Bayesian Method. The credibility level affects the prescribed minimum mortality margin and timing of the required grading to an appropriate industry assumption. In the case of the Bühlmann method, because

experience beyond the individual company is necessary for the calculation, the parameters are provided in VM-20. For more discussion on the VM-20 mortality credibility methods, refer to the Academy's VM-20 practice note.

Determining credibility for non-mortality assumptions in VM-20 or for other actuarial purposes involves more judgment by the actuary. ASOP No. 25, *Credibility Procedures*, provides actuarial professional standards for determining credibility. When using internal company data only, actuaries commonly use Limited Fluctuation theory with varying levels of minimum probability levels and a specified percentage of error margin. For reference, the Limited Fluctuation minimum probability for mortality in VM-20 is 95% with an error margin of not more than 5% (and requires the measure be amount-based). If the actuary engages a statistical agent that has access to other companies' data, it may be possible to determine credibility relative to that group of companies using the Bühlmann method.

Determining credibility will also inform the application of margins to the developed assumptions. Several resources exist with respect to credibility including *Credibility Theory Practices* (sponsored by the SOA, 2009), and the Academy's *Credibility Practice Note*.

Using External Data to Analyze Experience

When deciding whether to use a particular data source for developing assumptions, the actuary would typically consider whether the data source is relevant, sufficient, and whether any significant limitations exist. ASOP No. 23, *Data Quality*, particularly sections 3.2 (Selection of Data) and 3.4 (Use of Data), provide standards with respect to this determination. For example, data used in a mortality study for life products would ideally include data elements that can be used to develop the mortality assumptions for classes that differ by gender, date of birth, policy year, and risk classification.

If available data is relevant, credible, and has been validated, the actuary might decide to use the data in determining the experience assumption. If the data lacks credibility, has known limitations, or is otherwise not appropriate for specific applications of the assumption, the actuary might decide to blend the data with external or industry data for those specific applications of the assumption. Prior to blending, according to ASOP No. 23, *Data Quality*, the actuary should determine whether the external data is appropriate for use. If the external data is free of significant defects and includes similar data elements to company internal, then it could be appropriate to blend with internal data. A common approach to blending company experience with industry experience is to use a credibility factor 'Z' to weight the experience:

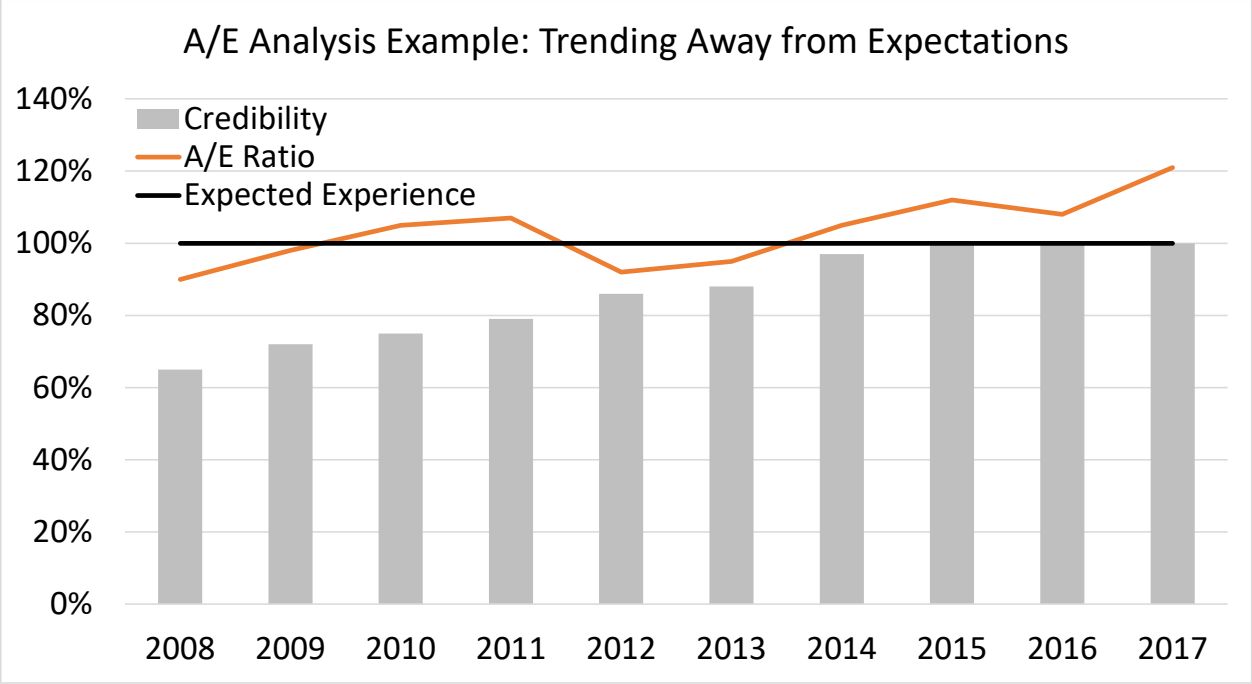
Z x (Company Mortality) + (1 – Z) x (Industry Mortality)

The calculation of Z is based on the credibility methodology chosen.

Identifying and Reflecting Trends in Experience

An actual-to-expected (A/E) analysis is often used to compare historical experience to expectations. Utilizing data that was previously validated and measured for credibility, actual experience can be compared to expectations to identify where experience is deviating. If a deviation is identified, viewing the experience by calendar year can reveal whether the deviation is consistently trending away from expectations or whether the deviation might be an anomaly. Examples of adjustments to account for trends could include mortality improvement, mortality underwriting adjustments, or policyholder efficiency assumptions. Based on the structure of these adjustments, it may be appropriate to apply a trend factor from a central date based on an associated experience study. The SOA has published an extensive resource titled *Experience Study Calculations* (Atkinson, McGarry, 2016) that details a number of methods and approaches to conducting experience study calculations.

If experience is emerging in an area where credibility is lacking, the actuary might blend company experience with industry or other external experience when setting assumptions. However, if there are specific reasons to believe company experience will continue to deviate from the external experience, the actuary might adjust expectations accordingly. This could happen due to shifts in the demographic mix of the business, including socioeconomic considerations, or differences in product distribution. A graphical representation of an A/E analysis is shown below:



Analyses performed in addition to calculating A/E ratios can include predictive models that determine which data elements are good predictors of the behavior being studied.

Assumption Structure

In many cases, the assumption being studied will have an established structure for analyzing experience. If the assumption is new, based on the initial emergence of experience being studied, the actuary would typically determine the structure of the assumption, which can be based on data elements collected in the experience study or external references. This can be an iterative process while analyzing the experience, especially if particular data elements appear to drive experience significantly enough to warrant modification to the assumption structure.

In addition to reflecting differing expectations due to trends over time, the actuary might consider reflecting any anticipated changes that could cause future company experience to deviate from the experience used in the study. Examples can include changes in company policy, distribution channels, target markets, underwriting risk selection process, or planned acquisitions/divestures.

When developing a best estimate assumption, the actuary also considers external factors that could cause future experience to deviate from the historical experience used in the study. For example, if a medical advancement develops, the actuary might want to reflect this into future expectations. Similarly, if a web-based application becomes widely used that helps a policyholder determine the optimal point to lapse a policy, the actuary might want to incorporate an adjustment to increase policyholder efficiency into the best estimate assumption.

After analyzing experience and trends to form the basis for anticipated experience assumptions, margins can be developed to determine an initial set of prudent estimates for PBR valuation.

Section IV: Determine Margins

Overview

This section discusses practical considerations in the determination and application of margins to actuarial assumptions for valuation purposes. The primary focus will be on margins developed for the VM-20 deterministic and stochastic reserves. Many of these considerations also apply to margins and PADs in other valuation frameworks.

A general overview will be provided for margins, including highlights for each key risk factor along with considerations for developing a company margin-setting policy. This section will conclude with observing some practical methods for developing margins.

General Overview

Types of Margin

In VM-20, a prudent estimate assumption is defined as anticipated experience plus a margin, where the margin covers both adverse deviation and estimation error. Furthermore, VM-31 describes two types of margin for the actuary to consider: aggregate and individual.

The aggregate margin provides a holistic view of the total margin for the reserve and is determined by subtracting the deterministic reserve using anticipated experience only (no margins) from the reported deterministic reserves (includes margins, applied to all risks).

DR^{aeALL} = Deterministic Reserve (anticipated experience excludes all margin)
DR^{pe} = Reported Deterministic Reserve (prudent estimate)

AM = Aggregate Margin = DR^{pe} - DR^{aeALL}

In contrast, an individual margin is applied to an individual assumption, which reflects the uncertainty of the associated key risk. For VM-20 deterministic reserve, the margin for a specified risk factor is defined as the deterministic reserve as reported less the deterministic reserve calculated using anticipated experience on the specified risk and prudent estimate assumptions for all other risks. The process of removing the margin from the total deterministic reserve for each key risk factor can be used to quantify the reserve impact for each individual margin separately.

DR^{aeM} = Deterministic Reserve excluding Mortality Margin
DR^{aeL} = Deterministic Reserve excluding Lapse Margin
DR^{aeP} = Deterministic Reserve excluding Premium Persistency Margin
DR^{aeE} = Deterministic Reserve excluding Expense Margin

IM^{m} = Individual Margin on Mortality Only = $DR^{pe} - DR^{aeM}$
IM^{l} = Individual Margin on Lapse Only = $DR^{pe} - DR^{aeL}$
IM^{p} = Individual Margin on Premium Only = $DR^{pe} - DR^{aeP}$
IM^{e} = Individual Margin on Expense Only = = $DR^{pe} - DR^{aeE}$

Comparing the aggregate margin to the sum of individual margins can help the actuary understand and adjust for correlation of the individual margins, as the difference between the two measures the impact of interactions or dependencies between risks (for further discussion, see the Academy's VM-20 practice note).

What Is a Margin?

The definition of margin may vary depending upon the application. For VM-20, margins are intended to increase the reserve to account for uncertainty on key risks, except when margins are prescribed or a risk factor is stochastically modeled (e.g., asset credit spreads, default assumptions, and economic scenarios).

The actuary might consult ASOP No. 10, *Methods and Assumptions for Use in Life Insurance Company Financial Statements Prepare in Accordance with U.S. GAAP,* when developing a prudent estimate. For U.S. GAAP, this estimate should be the most likely, average outcome, or 50th percentile. Prudent estimate requirements in U.S. statutory reserves, including VM-20 reserves, are more conservative than for U.S. GAAP. In VM-20, prudent estimate assumptions are determined by applying margins to experience assumptions to increase the reserve to a moderately adverse level. An actuary might expect that the VM-20 statutory reserve will exceed the corresponding GAAP reserve, as such statutory requirements are intended to promote solvency while GAAP is meant to provide investors with a realistic view of liabilities.

Margins for VM-20 are described in Section 9.B of VM-20 as outlined below:

- Determined independently for each material assumption and consistent with key risks (key risks may already be identified in the Own Risk Solvency Assessment [ORSA])
- Can be adjusted for correlation across risk factors (for example, through correlation matrices and dependency structures defined in the ORSA report, where applicable)
- Expected larger margin under the following circumstances: low credibility or relevance, incomplete experience data, unreliable assumption, model constraints, greater sensitivity, and large historic fluctuations
- Not required for immaterial assumptions
- May change method for determining margins annually
- There might be a need to increase margins over the prescribed level (e.g., for mortality) under the following circumstances: low reliability of company experience, length of time since last experience study, underwriting criteria changed or not effective, data lack homogeneity, unfavorable environment, and change to marketing/administration increased anti-selection

For more discussion on the interpretation of VM-20 margin requirements, refer to the Academy's VM-20 practice note.

Company Margin-Setting Policy

Companies might establish margin-setting policies. Such company policies can be expressed as an internal company guideline, company practice, or exposure paper that describes principles, considerations, and/or a methodology for the company to consistently follow throughout the organization. Company margin-setting policies could be consistent with the company Enterprise Risk Management (ERM) frameworks, and be documented in the ORSA report.

Ultimately, the company margin-setting policy might need to consider practical goals from the company perspective, including:

- Management discretion
- Limitation of result manipulation
- Minimization of reserve fluctuations impacting financial results
- Account for company size and available capital to absorb fluctuations
- Transparency
- Reproducibility
- Ease of calculation
- Ease of understanding and communicating with management, auditors, and regulators

Margin Considerations for Key Risk Factors

Margin considerations can vary depending on the risk factor being addressed.

For policyholder behavior, a key characteristic that is considered is whether policyholder efficiency increases over time. As an example, an actuary could assume that a policyholder would no longer pay premium once the secondary guarantee on a universal life policy is fully funded. Other situations unique to companies include the presence of administration practices that encourage potential anti-selection, which could lead an actuary to choose a higher margin.

Canadian practice and the VM-20 Impact Study suggest a potential range of +/- 5% to +/- 20% of the expected lapse rate, with the goal of applying the margin directionally at each duration to increase the reserve (see Canadian Institute of Actuaries SOP section 2350.25 and VM-20 Impact Study, Table 4.2—Sensitivity Description). In general, the direction of the margin would be chosen to increase the reserve. Complications can arise when determining the direction of the margin when reinsurance is present, which might affect the slope of profitability and can change the lapse-supported status of the product. In addition, various durations can be sensitivity-tested to determine whether, over the course of the projection, the lapse margin should change directions at future points during the coverage period. The lapse assumption can be dynamic and depend on the economic environment, attained age, and net surrender value of the policy, so margins can also be dynamic.

Some policyholder options considered for applying margins include:

- Electing non-forfeiture options (such as extended term insurance or reduced paid-up options)
- Taking policy loans
- Adjusting the level of premium for flexible premium universal life insurance (ratchets or bonuses)
- Eligibility to convert the policy at specified periods

For expense assumptions, there can be less variability across different deterministic and stochastic scenarios, except for expense inflation, which can vary by scenario. Per VM-20, a company can't assume future expense improvements (e.g., expense reductions) for the PBR reserve and must apply consistent allocations across lines of business. The VM-20 Impact Study in Table 4-2 applied a sensitivity test by increasing expenses by 10%. The general range of margins on expenses for Canadian practice is between 2.5% and 10% of the best estimate (see CIA SOP section 2350.38). Margins are also not required on assumptions associated with risks that the company deems immaterial. The end of this section further discusses considerations in the determination of materiality of risks.

For mortality, the VM-20 minimum margins to be added to anticipated experience are prescribed based on company credibility percentage, credibility method, and attained age. The minimum mortality margin is also

prescribed for industry experience, varying by attained age and the applicable industry mortality table. For more information on prescribed elements of the mortality assumption for PBR modeled reserves, refer to the Academy's VM-20 practice note. Although the minimum mortality margin is prescribed, the company may apply an additional margin.

In the case of revenue-sharing assumptions, the margin decreases the Gross Revenue Sharing Income (GRSI) and might depend on industry trends and uncertainty in expectations. The model cannot reflect a margin in the contractually guaranteed GRSI, but company expenses related to contractually guaranteed GRSI can reflect a margin.

The margin or prudent management action applied to non-guaranteed elements (NGE) depends on company prior practices and established NGE procedures. Margins can be applied to NGEs by applying a "hair-cut" to reduce the NGE assumed or, alternatively, a prudent management action can be modeled by delaying the recognition of the NGE. Examples of NGEs include interest credited on flexible-premium contracts (direction to apply margin may not be clear-cut), dividends on participating contracts (apply margin to increase dividends), and additional cases where the current contract features are not set to the guaranteed contract features.

For reinsurance, the direct writer and assuming company are not required to use the same margins (or the same anticipated experience assumptions) for VM-20 modeled reserves. If a company has knowledge of counterparty impairment, then a margin for counterparty risk might be necessary. The margin could depend on counterparty ratings, risk-based capital (RBC) ratio, and ability of the company to replace the services previously provided or recapture the business being reinsured. Margins can also be held by the ceding company if the reinsurer reserves the right to increase premiums/charges at future durations (see Section I of this document for more discussion).

Methods for Determining Margin

Sensitivity Testing

Sensitivity testing is a common method for ensuring that margins are set at a moderately adverse level and serves as supporting documentation that margins are set reasonably. However, sensitivity testing alone might not be sufficient to determine the size of the margin; additional methods suggested in the *Analysis of Methods for Determining Margins* paper published by the SOA in 2009, prior to the adoption of VM-20, might be useful.

Throughout VM-20, sensitivity testing is identified as one of the methods for measuring the materiality and impact of deviations in assumptions on results. Generally, this approach involves shocking, increasing, or decreasing best estimate assumptions across a plausible range of scenarios. This method can provide considerations for determining and selecting margins that increase the reserve to a moderately adverse level.

The definition of moderately adverse and appropriate level of margin depends on actuarial judgment. Some common sensitivity tests include:

- Increasing/decreasing surrenders in x% (e.g., 5%) multiplicative increments
- Modifying formula parameters (i.e., scalars, exponents) for policyholder behavior dynamic assumptions (for example, changing sensitivity to in-the-moneyness)
- Increasing/decreasing conversion rates in x% (e.g., 5%) multiplicative increments
- Decreasing premium in y% (e.g., 10%) multiplicative increments or assume minimum premium to keep policy inforce
- Increasing mortality in x% (e.g., 5%) multiplicative increments
- Increasing renewal expenses in multiplicative x% (e.g. 5%) increments
- Increasing future expense inflation in z% (e.g., 0.25%) additive increments
- Decreasing net asset earned rate in z% (e.g., 0.25%) additive increments
- Increasing/decreasing starting assets in x% (e.g., 5%) multiplicative increments
- Comparing reinvestment strategy to VM-20 50% AA / 50% A non-callable public bond fixed income guardrail
- Comparing 100% term post-level shock lapse to best estimate shock lapse plus mortality
- Testing no reinsurance, with reinsurance, with reinsurance & x% (e.g., 5%) incremental higher charges, and future recapture

While sensitivity testing is up to company discretion, VM-31 does require the following sensitivity tests for premium payment pattern scenarios for flexible premium products (see additional discussion in the Academy's VM-20 practice note):

i. Minimum premium
ii. No further premium
iii. Pre-pay remaining premium with single payment
iv. Pre-pay remaining premium with level premiums to maturity

Please refer to the Academy's VM-20 practice note or the NAIC Valuation Manual for a more detailed description of these sensitivity tests.

Statistical-Based Methods

One potential statistical-based approach is to set the prudent estimate equal to a sample mean plus a multiplicative factor applied to a sample standard deviation. The standard deviation can be added or subtracted depending on the direction that is necessary for the margin to increase the reserve. One application of this approach is to determine the prudent estimate and margins for a lapse or surrender assumption.

Prudent Estimate = Sample Mean + (or –) Multiplicative Factor * Sample Standard Deviation

Under this approach, a sample could consist of historical lapse rates (e.g., monthly or annual). One method to measure the sample mean is the average of the rates over the historical period. A disadvantage of this approach is that it does not capture changes in distribution of the population over time. Therefore, another method can be to measure the actual-to-expected ratio for each period rather than using a simple average.

The sample standard deviation measures the deviation of rates around the mean within the sample. In practice for lapse or surrender assumptions, some actuaries might floor the lapse rate at zero to avoid negative lapses.

Sample Mean = $\bar{x} = \sum \bar{x} / s$

Sample Standard Deviation = $SD_x = [\sum (x_i - \bar{x})^2] / (s-1)$

x_i = lapse or surrender rate for a given historical period

s = number of historical periods observed

The multiplicative factor is determined based on the targeted confidence interval level. If assuming a normal distribution, the confidence level will correspond to the normal distribution z-score for a given confidence level. This might be based on confidence levels of 80% (one-tailed multiplicative factor of 0.84) or higher for long-duration contracts. Some actuaries set a higher confidence level as the anticipated contract duration increases. More discussion on this approach can be found in the SOA-sponsored PricewaterhouseCoopers paper *Analysis of Methods for Determining Margins for Uncertainty under a Principle-Based Framework for Life Insurance and Annuity Products*.

Another potential statistical-based method to estimate margins is to use confidence intervals. Confidence intervals can be employed through a variety of approaches, such as normal approximation intervals of a binomial variable. This approach estimates a confidence interval by assuming normal distribution of error around a binomially distributed variable. This confidence interval can be determined by calculating the sampling error (SE). While standard deviation measures the spread and variability of the data around the mean, sampling error measures the precision of mean within a given sample based on the variability and number of observations within the sample. The sampling error gets smaller as the number of observations in each sample increases. In contrast, the standard deviation itself measures dispersion around the true mean and is not impacted by the number of observations. The normal approximation confidence interval method assumes the sampling distribution of the variable being measured (e.g., lapses or surrenders) is approximately

normally distributed. This tends to be more of the case for the sampling of some variables than others. In many cases, the assumption of normality might not hold due to the distribution being skewed in one direction or the other (depending on the direction of the margin). Some actuaries find that it is more appropriate to use actual-to-expected ratios over large samples for this approach.

For example, a normally distributed sampling error can be estimated by the standard deviation (SD) of the underlying variable with number of observations (n). The standard error of the mean of a sample of size n is:

Sampling Error = SE = SD / $\sqrt{n}$

For example, assuming a sample statistic $\hat{p}$ (such as lapse or surrenders) follows a binomial distribution, then SD = $\sqrt{\hat{p} * (1 - \hat{p})}$. Note that using binomial distribution assumes that the risk of incidence is the same for each policy and that each policy risk is independent of each other.

A normal distribution CI with sample mean $\hat{p}$ is:

CI = $\hat{p}$ +/- Z $*$ SD / $\sqrt{n}$

Assuming Z has a standard normal distribution with mean = 0 and standard deviation = 1, then for a given probability p, the z-score is p(-z ≤ Z ≤ z) = p.

Probability (p)	Standard normal (Z) one-tailed	Standard normal (Z) two-tailed
80.0%	0.84	1.28
84.1%	1.00	1.41
90.0%	1.28	1.645
95.0%	1.645	1.96
98.0%	2.055	2.33
99.0%	2.33	2.58

Therefore, depending on the intended direction of the margin, a 95% one-sided confidence interval estimate is $\hat{p}$ + 1.645 * $\sqrt{\hat{p} * (1 - \hat{p})}$ / $\sqrt{n}$ or $\hat{p}$ – 1.645 * $\sqrt{\hat{p} * (1 - \hat{p})}$ / $\sqrt{n}$. Note that using a one-tailed z-score might be more appropriate when focusing on a one-sided prudent estimate. If the intention is to track two bounds for a confidence interval to estimate the mean, without intending to develop a one-sided prudent estimate, then a two-tailed z-score might be more appropriate.

For example, if assuming 100 lapses out of a sample of 1,000 policies, then $\hat{p}$ = 100 / 1000 = 0.1. In addition, assume that the lapse margin is positive.

The 95% one-sided confidence interval is .1 + 1.645 * $\sqrt{0.1 * 0.9}$ / $\sqrt{1000}$ = 0.1 + 1.645 * 0.009487 = 0.1 + 0.015606. If using a two-sided confidence interval to estimate the mean, the z-score would be 1.96 instead of 1.645.

This suggests a lapse sampling error of 0.0156 is within a 95% one-sided confidence interval assuming a standard normal distribution, which can be used as another possible basis for setting the margin. Again, whether the margin is added or subtracted depends on which direction increases the reserve. In addition, note this example assumes that the sampling distribution of lapses is approximately normally distributed.

The risk of mis-estimation of the mean is only one of the factors that can determine the margin, with other factors including risks associated with the underlying variability of an assumption as well as potential changes in trend. In cases where there is a large sample size, sampling errors might be very small, but a larger margin might still be warranted in the presence of significant potential variability, changes in trend, and materiality to the reserve. Therefore, some actuaries could use sensitivity testing or other approaches to supplement this method.

It might be prudent for actuaries to observe any presence in trends before developing a standard deviation or confidence interval as the basis for the margin, as the trend risk can warrant a different margin than only looking at the historical variability. For example, a large standard deviation over a 10-year period with a steady downward trend in experience could merit a different prudent estimate than the same standard deviation over a 10-year period but no clear trend. Reflecting adjustments to margins to account for risk in trends could lead to an either larger or smaller margin than what would otherwise be developed under other approaches.

Another potential statistical-based approach is to set the margin based on a specific value-at-risk (VaR), or percentile level. This method can be used if there is a statistical distribution and/or stochastic model available for the underlying risk. In addition, rather than rely on one percentile point within a distribution, some actuaries use tail value-at-risk (TVaR) or conditional tail expectation (CTE), which measures the average of values within the tail of a distribution starting at specified percentile. Monte Carlo techniques could also be used to estimate an aggregate distribution to calculate risk metrics; one option is to generate pseudo-random numbers to simulate lapses or claims over thousands of trials. The units of exposures and number of trials vary depending on intended purpose and resource constraints when employing this technique. More information on these approaches can be found in the Academy XXX practice note and SOA-sponsored PricewaterhouseCoopers paper, *Analysis of Methods for Determining Margins for Uncertainty under a Principle-Based Framework for Life Insurance and Annuity Products*.

Additional Statistical Tools

As PBR valuations continue and predictive analytics becomes more prevalent for assumption development, many additional tools might emerge from industry and professional organizations to aid the practice of setting margins for life PBR and other valuation frameworks. Future versions of the NAIC Valuation Manual could permit other supplemental tools for developing margins, such as the SOA multi-risk scenario generator, which could include applications for margin development, risk correlations, and experience data analytics.

Net Asset Earned Rate

A practical application of a discount method can help assess the reasonability of the range of variability by adjusting the net asset earned rate (NAER) used to discount the VM-20 deterministic reserve. The goal of the adjustment is to increase the reserve by using a lower rate for discounting the cash flows. The lower rate used could be a less volatile assumption than the actual NAER. Companies might consider decreasing the discount rate in 25-basis-point increments as a starting point. Note for VM-20 that this method is not to be used in lieu of margins applied to individual assumptions but can be used to assess the reasonableness of variability.

Considerations for Determining Materiality

For VM-20, margins are only required for risks that are deemed material. In the NAIC Valuation Manual, VM-31 refers to "percentage of surplus, a percentage of reserve, or a specific monetary value" as examples of considerations for determining whether risks reserved for under VM-20 valuations are material (see Section VI for more details).

There are four elements that are considered when determining whether a risk is material, as described below:

A) **Materiality criteria used in other actuarial frameworks.** Companies that are determining materiality for PBR and other valuation, financial reporting, or risk management purposes might consider how materiality has been established in other actuarial frameworks used by the company. For instance, does the company have an ORSA report or risk enterprise framework that establishes materiality? Another consideration is whether there is a materiality threshold that a company adheres to for the Model Audit Rule (MAR) and external audits—if so, how has this threshold been established? Sometimes materiality criteria used in such company-wide risk assessments might not be appropriate in a risk-focused context, such as when the materiality of an a variable relative to a specific calculated quantity, such as the modeled reserves for a group of policies, is under consideration (further discussion below).

B) **Materiality to the reserve or calculation being measured.** This materiality can be determined by sensitivity testing an assumption across mild to severe scenarios and calculating the percentage change in the underlying reserve or calculation. For instance, materiality to a VM-20 reserve could be

measured based on the percentage change in the specific VM-20 product reserve, present value of benefits, or present value of premiums. When determining possible bases to use for materiality metrics, the following elements might be considered:

i. Metric Stability—Some measures may not be stable measures of risk. For example, if considering percentage of modeled reserve as an indicator of materiality, it is possible that the present value of benefits and expenses might be close to the amount of the present value of premiums in early durations, but not at later durations. If this occurs, then the modeled reserve could be close to zero (either positive or negative), which can lead to percentage changes in the reserve appearing more amplified than in later durations when the block matures and the modeled reserve stabilizes.

ii. Relevance to Underlying Variable—It is reasonable for the chosen indicator of materiality to relate to the underlying variable for which materiality is being measured. For instance, one method to measure materiality on VM-20 modeled reserves is by measuring the percentage changes in the underlying modeled reserve. VM-20 modeled reserve materiality can also be measured using percentage changes in the present value of benefits or premiums. In addition, though less relevant, simplified materiality metrics can also include percentage changes in face amount or net premium reserve.

Some companies might focus on the materiality to the PBR reserve for defining key risks when developing the VM-31 Report (see more details about VM-31 in Section VI). Since VM-20 makes up a greater portion of inforce business over time, actuaries are prudent to think ahead about whether to modify the materiality metric to address such changes.

C) **Statistical variability of risk itself.** Another perspective can be to measure the statistical variability of the risk itself, using a confidence interval or measuring variability (e.g., standard deviation) of the risk metric across past periods. This consideration alone is not sufficient in measuring materiality, because even if a risk contains low statistical variability, it can still have a significant impact on a reserve calculation. One example of this might be a mortality assumption supported by a significant amount of historical experience—there could be low variability of average mortality levels over time, but a small change in the mortality assumption can lead to a large impact on the modeled reserve.

D) **Materiality to total company or legal entity surplus.** This might be determined by sensitivity testing an assumption across mild to severe scenarios and calculating the percentage change in the total company surplus. Another technique is to measure the percentage of the relevant block (e.g., face amount or reserves) to the total company or legal entity inforce surplus. For VM-20 valuations, initially this ratio can start out smaller, but then grow over time as new business is issued under VM-20.

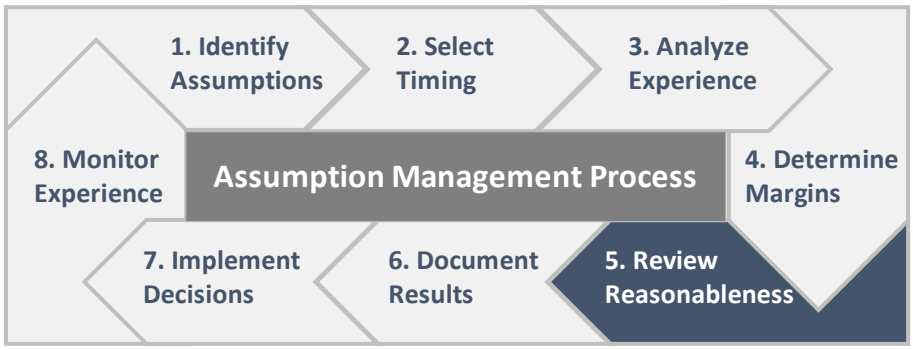
VM-20 Margin-Setting Case Studies

To see illustrative case studies on determining margins under a VM-20 framework, refer to the following three case studies later in this document:

- Case Study 1: ULSG Margin Impact Analysis
- Case Study 2: ULSG Premium Persistency
- Case Study 3: Term Lapse Margins—Development for VM-20

Now that examples of methods and considerations have been covered for developing margins for valuation purposes, the following section looks at methods for reviewing and adjusting assumptions for reasonableness and consistency.

Section V: Review Reasonableness



Overview

As highlighted throughout this resource manual, assumption-setting is a complex process involving a significant amount of data, review, and judgment. Regulatory considerations, prescribed requirements, and margins/PADs can further complicate a final assumption set. Although assumption-setting can be a detailed process, if broader considerations are overlooked, the final assumptions may be inappropriate or inconsistent with either internal or external information. To avoid this situation, a prudent actuary might consider conducting additional reviews and making additional adjustments as necessary.

This section of the resource manual provides further information on the reviews and adjustment approaches actuaries consider when establishing reasonable and consistent assumptions for PBR and other valuation purposes.

Reasonableness Checks

Actuaries are not prescient and therefore acknowledge that actual experience will differ from expectations. Because there is no way to achieve complete accuracy, the goal of assumption-setting is to provide reasonable results. ASOP No. 1 states:

> **ASOP No. 1, Section 2.10:** *In many instances, the ASOPs call the actuary to take "reasonable" steps, make "reasonable" inquiries,* ***select "reasonable" assumptions*** *or methods, or otherwise exercise professional judgment to produce a "reasonable" result when rendering actuarial services. The intent is to call upon the actuary to exercise the level of care and diligence that, in the actuary's professional judgment, is necessary to complete the assignment in an appropriate manner.*
>
> *Because actuarial practice commonly involves the estimation of uncertain events, there will often be a range of reasonable methods and assumptions, and two actuaries could follow a particular ASOP, both using reasonable methods and assumptions, and reach different but reasonable results.*

This ASOP allows for a range of reasonable methods and assumptions. Sample checks for reasonableness are discussed in the sections below.

Assumption Rate Checks

A comparison of rates can be performed to ensure original principles and relationships between assumptions hold for the final rate set. Where these relationships do not hold, an actuary might consider making adjustments to achieve a more reasonable relationship. A simple example for this type of reasonableness check is provided within the illustration below, which describes an approach in reviewing mortality assumptions for simplified-issue business.

Simple Example: Simplified Issue Preferred Mortality

1. All else being equal, an actuary expects a preferred-rated policy issued with simplified underwriting (SI) to have a mortality level somewhere in between a preferred risk and a standard risk on the company's traditional fully underwritten business.

Step 1: *Prior to and independent of rate-setting, document expectation for relationships / establish assumption principles.*

Step 2: *Identify test cases that can be used to confirm assumptions align with the expectations.*

2. The actuary decides to compare mortality rates on the three classes (SI preferred, traditional preferred, traditional standard) for both male and female, at issue ages 25, 45, and 65.

3. Based on the test cases defined, the actuary observes that the SI preferred age 65 rates beyond duration 10 for both male and female are lower than the same attributes on the traditional preferred risk.

Step 3: *Perform the test cases and document results. Review as issues are identified, as needed.*

Step 4: *Make adjustments to resolve issues, as appropriate.*

4. After discussions with key stakeholders and considering multiple approaches, the actuary decides to recommend flooring the SI preferred rates at the traditional preferred rates.

5. With the additional mortality floor, the actuary again tests the cases and confirms the resulting rates are in line with expectations.

Step 5: *Re-perform testing to ensure adjusted assumptions are in line with defined expectations.*

Model Cash Flow Analysis

An actuary might consider validating model assumptions by analyzing model results. Validation techniques, which can be considered for both liability and asset modeling, include:

- **Dynamic Validation / Back-testing**: Using modeled results from a prior valuation and comparing the expected amounts to what actually occurred. Varying definitions of back-testing exist throughout the industry, though all are intended to use actual experience in some capacity to validate modeled cash flows. Typically, this includes some form of an actual-to-expected analysis for key cash flows. A large gap between historical experience and future expectations can indicate a need to re-examine certain assumptions.
- **Stress and Sensitivity Testing**: Considering alternative assumptions sets and analyzing the modeled results under mild to severe stress scenarios. An actuary might model various points within a plausible anticipated range to help better understand the impacts they present. Understanding assumption sensitivities can illustrate the materiality of the associated risk and help support the appropriateness of any margins.
- **Statistical Analysis**: Using statistical methods on experience data to validate assumptions. In these instances, the volatility and credibility of the data can be considered when assessing the reasonableness of the assumption. An actuary might review after an extended period for a less frequent event. Statistical approaches, such as confidence intervals, can be used to further support the reasonableness of assumptions. The *Credibility Practice Note*, issued by the American Academy of Actuaries' Life Valuation Subcommittee in July 2008, can be referenced for additional information on these topics.
- **Cross-Referencing Databases:** Comparison of data from multiple sources. If data originates from a valuation or transactional database and flows into an actuarial model, the data inputs in the model can be compared to the original source database. This ensures the correct inputs are being used in the model and that data was not lost upon transfer between systems.

Many of these tests require actual experience data and managing model inputs. When using additional data to conduct reasonableness checks, refer to ASOP No. 23, *Data Quality* or other applicable ASOPs.

Margin Analysis

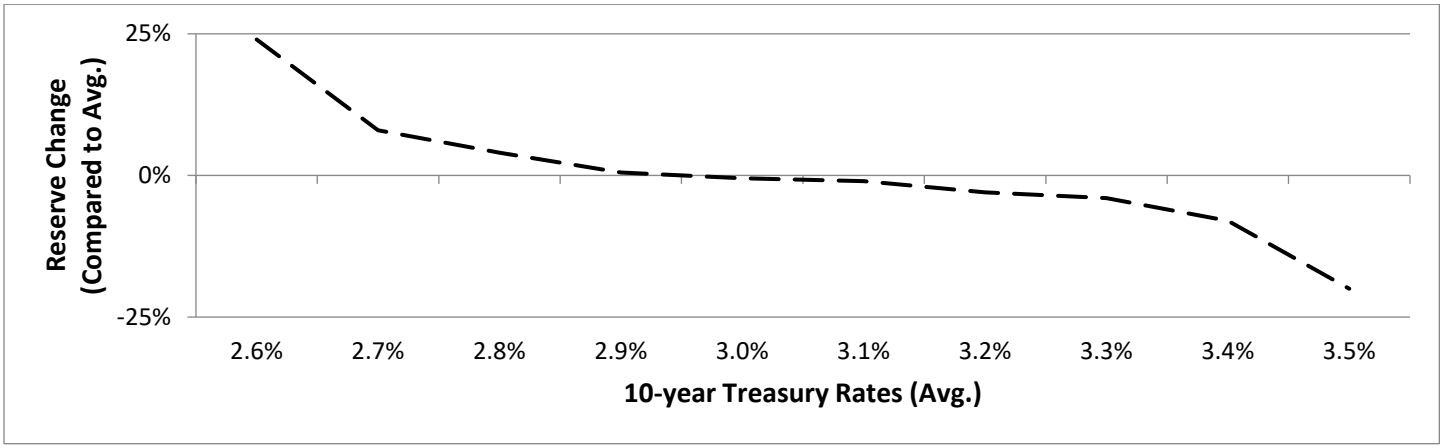
As discussed in Section IV (Determine Margins), margins are a key component of reserving under VM-20. An actuary might consider performing specific checks, similar to those described above, on the prudent estimate assumptions to support the reasonableness of such margins. For example, an actuary could consider analyzing the actual-to-expected results across individual and aggregate cash flows to ensure that margins are reasonable. To demonstrate this type of analysis, the results of a simplified, illustrative example are provided in the table below. Actual results ("A") are compared to modeled results using prudent estimate assumptions (including margins—"E"). The A/E ratio percentages are expected to be over 100% for cash inflows and below 100% for cash outflows if the margins being applied are sufficient:

Calendar Year:	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average A/E
Premium	103%	106%	103%	102%	100%	100%	111%	105%	103%	102%	**104%**
Invest. Income	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Total Revenue	**103%**	**106%**	**103%**	**102%**	**100%**	**100%**	**111%**	**105%**	**103%**	**102%**	
Death Benefits	63%	97%	58%	93%	56%	59%	51%	115%	64%	109%	**76%**
Surr. Benefits	88%	85%	84%	99%	97%	81%	110%	84%	78%	88%	**89%**
Total Benefits	**69%**	**92%**	**70%**	**96%**	**78%**	**71%**	**85%**	**97%**	**72%**	**97%**	
Commissions	103%	106%	103%	102%	100%	100%	111%	105%	103%	102%	
Maint. Expense	93%	102%	87%	102%	92%	90%	100%	88%	92%	87%	**93%**
Total Expenses	**103%**	**106%**	**102%**	**102%**	**100%**	**99%**	**110%**	**104%**	**102%**	**100%**	
Increase in Res	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Total Profit	**119%**	**112%**	**125%**	**106%**	**123%**	**133%**	**134%**	**112%**	**161%**	**113%**	**124%**

Using this type of analysis, an actuary can uncover additional information supporting the reasonableness of the assumption set or may identify areas to review further. In the illustrative example provided, an actuary might consider the individual prudent estimate assumptions to be reasonable, though the actuary could also consider further reviewing the correlation of the individual assumptions and the impact the individual margins have on aggregate results.

Scenario Analysis

For purposes of requiring multiple modeled scenario runs, such as the Stochastic Reserve in VM-20, an actuary might perform additional validation checks to ensure the reasonableness of the assumptions under the defined economic conditions. An actuary could have an expectation of how the underlying business should perform under changing economic conditions and can confirm that modeled results are in line with this expectation. For example, if a block of business is expected to be sensitive to interest rate changes and dynamic policyholder behavior assumptions are used, an exercise could be performed to analyze reserve levels of the scenario results against an average return of the scenario. The illustration below demonstrates this type of exercise where reserve changes (% difference from average result) are compared against the interest rate returns of the modeled scenarios (average of 10-year Treasury rates) for each scenario.



Depending on the product type, an actuary could expect reserve levels to decline as interest rates increase. A correlation in line with this expectation, as shown in the above illustration, can support the dynamic nature and reasonableness of the assumptions being used by the actuary. Alternatively, an approach similar to what is described in the Assumption Rate Checks section above might be considered.

Consistency Checks

Reviewing assumptions for consistency can take various forms depending on the facts and circumstances of an individual situation. The actuary might consider consistency across the business, process, or industry. An actuary could also contemplate under which situations it would be reasonable for such inconsistencies to exist, if applicable. Sample checks for consistency are discussed below.

External Assumptions / Studies

Where appropriate, an actuary might consider comparing assumptions to externally available assumptions or experience studies. This external information can be narrow and specific to a unique characteristic (e.g., the relationship between mortality improvement and market downturns on simplified underwriting business) or can apply broadly to the industry as a whole (e.g., GDP returns or census data). Regardless of the type of information being used, demonstrating how it applies to the modeled business is an important consideration for supporting a company's assumptions.

Internal Practices

Business practices can be reflected in company assumptions and used for modeling the applicable cash flows. These practices could include investment and hedging strategies, management action for setting non-guaranteed policy elements, reinsurance management, or company expense allocation. Where applicable, an actuary might compare the assumptions to relevant company practices. For example, an asset / investment strategy could be compared to reinvestment assumptions to ensure projected investment cash flows are consistent with company strategy. Underlying observations could include understanding defined limits on the levels of asset risk or the amount of duration mismatch allowed in a portfolio.

Alternative Modeling Purposes / Bases

Actuarial assumptions are often used for varying purposes throughout a company. Each of these purposes may have unique requirements for setting assumptions. An actuary might review assumptions across such frameworks for consistency and document the supporting rationale for any instances where inconsistencies are intended. A sample illustration is provided below:

Surrender Assumption Review—Product X

	Forecasting / Plan	Initial Pricing	Cash Flow Testing	GAAP Valuation	Statutory Valuation	Enterprise Risk Mgmt.
Base Rate Table	Exp.	Pricing	P-Exp.	Exp.	P-Exp.	Exp.
Base Rate Adj.	Cal. Yr. Adj.	None	None	Cal. Yr. Adj.	PBR Margin	None
Dynamic Behavior	None	Yes	Yes	None	Yes	Yes

Notes:

1. **Pricing**: Original pricing assumptions developed at launch using similar product assumptions and adjustments for specific product features based on actuarial judgment. Actual product experience has emerged since pricing.
2. **Exp.**: Assumption based on recent experience specific to the product.
3. **P-Exp**: Blend of "Pricing" and "Exp." to reflect a level of prudence on recent better-than-expected experience.
4. **Cal. Yr. Adj.**: Where dynamic behavior is not used, a top-side calendar year adjustment is reflected to account for an expectation of shifts in behavior due to economic environment (deterministic modeling).
5. **PBR Margin**: An additional margin is applied for the statutory valuation to account for limited credibility on experience-based assumptions and the heightened uncertainty due to this limitation.
6. **Dynamic Behavior**: A dynamic formula is used to reflect an expectation of changes in policyholder behavior due to current economic conditions (stochastic modeling).

Results:

Based on the review, the assumptions used across bases are appropriate given the intended uses. It is noted that the inconsistencies across frameworks are intended and appropriate.

Model and Process Design

The setup of a model or experience study process can influence how an assumption should be analyzed and set. Within the technical specifications of a model, these setup parameters are defined and could include model timing, order of operations between related events, and frequency of cash flows. To ensure internal consistency, an actuary might review each model parameter against the manner in which inputs are developed and make an adjustment to the inputs to account for any inconsistencies. Examples of situations an actuary might consider when reviewing assumptions for model design include:

- Frequency of premium assumptions and how this may impact policyholder behavior (e.g., surrenders).
- Reflecting no-lapse guarantee (NLG) provisions consistently between modeled lapses and experience studies (appropriately including / excluding exposure for NLGs).
- Interaction of policyholder surrenders, contractual lapses, premium patterns, and economic conditions.
- Aligning expense inflation with other modeled economic parameters (e.g., fund or asset returns).

- Considering order of decrements and ensuring consistency between modeling and assumption-setting (e.g., surrenders occurs after deaths in the model and deaths are excluded from exposures in experience studies).

Assumption Justification

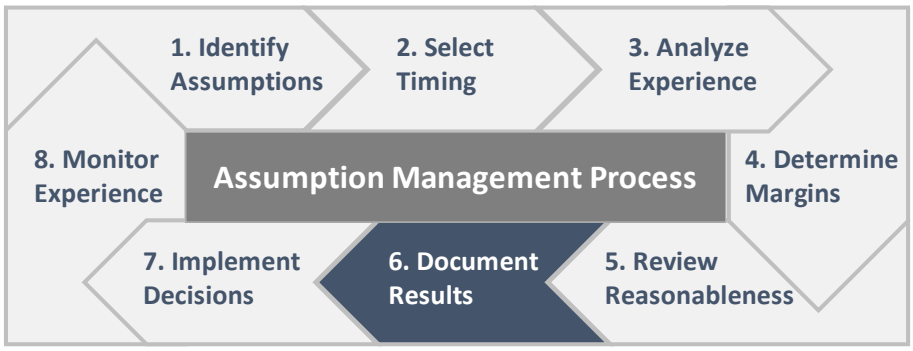
Justifications of the assumptions can be performed after early iterations during the assumption development process. This can be completed by plugging in initial assumption proposals into the actuarial models being used. For VM-20 assumptions, this can include pricing models, valuation models, and business planning/forecasting models. If the results do not seem reasonable, the actuary can revisit the model calculations or initial assumption set to understand the source of the inconsistency with expected results.

From a timing perspective, actuaries might find it is prudent to perform assumption justifications concurrently with development for the following reasons:

1) The assumptions can be changed if they can't be justified.
2) The method of deriving the assumptions can be examined from a justification point of view while the data and models are still available.

With an understanding of reviews and validation techniques to determine the reasonability and consistency of assumptions for PBR and other valuation purposes, the actuary can proceed to document findings. The next section discusses documentation considerations further.

Section VI: Document Results



Overview

This section focuses on considerations for documenting the assumption development process for valuation purposes. This includes disclosures necessary for the VM-31, and covers considerations for other valuation purposes, such as for Model Audit Rule (MAR) and VM-G.

Documentation for Valuation Assumption Development

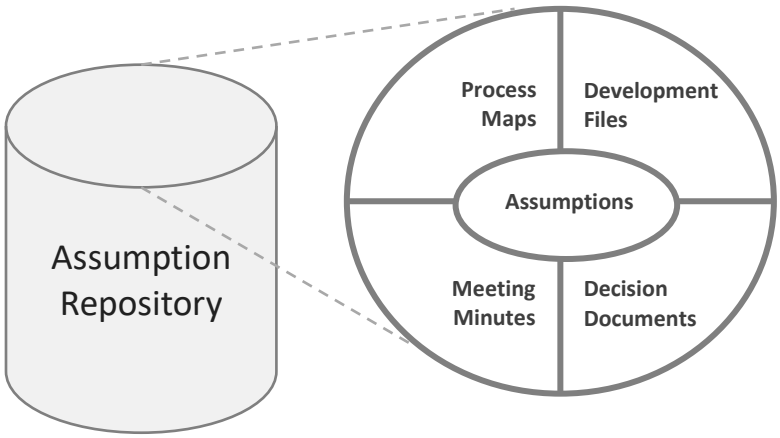
It might be prudent to document the full assumption cycle, from beginning to end. Preparing reference documents at each stage can assist in keeping people informed and on track throughout an actuarial process. Maintaining clear and transparent development files can expedite assumption updates and reviews. Cataloging final results can allow people to easily locate applicable assumption materials. Continuation of this process over time can facilitate a collective understanding of assumption evolution and precedence.

There are numerous ways information is documented. A key in this process is to create a meaningful result for all parties involved. A few steps in a thoughtful implementation can propel a cumbersome exercise into a meaningful and effective routine. First, creating a pattern for documenting information in a way that is relatively simple to prepare and easy to read can prove to be worthwhile. Second, finding a functional way to organize and file the documents can help users store and retrieve information efficiently. Finally, preparing resulting actuarial communications in accordance with the requirements of ASOP No. 41, *Actuarial Communications,* can provide clarity for the intended user.

Documentation might include a repository of the following elements:

- A process map that identifies the stages, parties, activities, and flow for initiating and implementing an assumption.
- A development file that provides source material, calculations, and final results for an assumption cycle.

- Meeting minutes from a committee or other decision-making process to serve as a reference for when assumption decisions were made and approved.
- Decision documents that provide reference information, such as a clear and succinct description of the decision, context and justification, and a history of adjustments that may have occurred over time.
- Assumption summaries that provide the numerical values for use or reference.



Of even greater significance might be the documentation that discloses, explains, and justifies the assumptions used for principle-based reserves. These descriptions can be referenced and further developed to meet the specifications provided in VM-31 for the PBR Actuarial Report.

VM-31

A VM-31 PBR Actuarial Report is required for companies that issue products subject to VM-20 modeled reserves or exclusion tests. In addition, a VM-31 PBR Actuarial Report is required for any variable annuity contract issued on or after Jan. 1, 2017, and for which VM-21 is applicable. The NAIC Valuation Manual contains required disclosures for VM-31.

Key Components

The VM-31 PBR Actuarial Report consists of an Executive Summary, a Life Insurance PBR Actuarial Report, and a Variable Annuity PBR Actuarial Report, as applicable.

The Life Insurance PBR Actuarial Report and the Variable Annuity PBR Actuarial Report contain one or more sub-reports, with each sub-report covering a group of policies or contracts. The sub-reports include descriptions of all material decisions and information used by the company. Tracking decisions as they are made throughout the PBR valuation process can help companies prepare documentation upon developing the VM-31 PBR Actuarial Report.

VM-31 requires disclosures that describe assumption development and rationale. Some unresolved VM-20 assumptions could warrant more attention earlier on in the documentation process to provide appropriate disclosures; one example of this might be modifications to policyholder behavior assumptions due to an emerging external factor, such as a new regulation or tax law. In addition, a company must also provide a sub-report for policies that pass the exclusion tests, as long as such policies are still applicable to VM-20. In this case, the sub-report will only consist of a summary of material risks, the VM-20 supplement, and results of the exclusion tests.

Document Format

The VM-31 PBR Actuarial Report requires a table of contents and must retain and follow the order of the requirements provided in VM-31. In addition, VM-31 requires headers for each requirement and an explanatory statement for any requirement that is not applicable.

Executive Summary

The Executive Summary of the VM-31 PBR Actuarial Report shall: (i) identify the qualified actuary of each sub-report; (ii) describe the policies/contracts; (iii) describe the sub-reports; and (iv) include VM-20 Supplements 1 and 2. Different qualified actuaries may be responsible for different sub-reports. The sub-report description will summarize the following critical elements:

- Materiality—An assessment of materiality is summarized for each risk and associated assumption, in addition to any quantitative support used to justify the assessment. Establishing a company materiality standard, similar to establishing a company margin policy as discussed in Section IV, could be helpful.
- Material Risks—Material risks must be described. It is good practice to maintain consistency with the summary report for the board of directors, per VM-G requirements.
- Changes in Reserve Amounts / Changes in Methods—Describe the rationale for changes from prior year, including changes to (i) reserve amounts, (ii) the methods used to model cash flows or other risks, or used to determine assumptions and margins, and (iii) anticipated experience assumptions and/or margins. These changes can stem from company-specific updates or amendments to the Valuation Manual during the year. Companies might consider disclosing the impact of such changes.
- Assets and Risk Management—Asset and hedging strategy descriptions can mirror other company reports, such as memorandums required for asset adequacy testing.
- Consistency Between Sub-Reports—Expand on differences between sub-reports for different groups of policies. One example is explaining different hedging strategies being used for life and for annuity products.

Life PBR Actuarial Report

The Life PBR Actuarial Report consists of a set of sub-reports. Each sub-report contains PBR disclosures for a group of individual life insurance policies subject to VM-20. The contents consist of valuation

assumptions, margins, credibility, assets, exclusion test results, reliances, certifications, approximations, and sensitivity tests.

Liability-Related Disclosures

VM-31 contains specific sections for documenting the details of mortality, policyholder behavior, expense, and non-guaranteed element assumptions. For mortality, VM-31 requires mapping relationships between underwriting classes and the industry mortality table. This section also pertains to accelerated underwriting classes, including justification for such risk classes related to the existing underwriting classes. If there are any additional mortality margins beyond those prescribed in VM-20, the additional adjustments must be disclosed within the VM-31 PBR Actuarial Report. For non-mortality assumptions, VM-31 requires descriptions of both the rationale and development of margins (e.g., sensitivity testing, statistical methods, actuarial judgment).

Asset-Related Disclosures

VM-31 requires a description of the method used and rationale for selecting the starting assets. In addition, required disclosures include selection of assets for the policies subject to PBR and those policies not subject to PBR and product groups, as well as several other requirements related to market values, derivatives, reinvestment strategy, investment fees, policy loans, equity mapping, separate account mapping, scenarios, and compliance with other VM-20 specific requirements.

VM-31 Certifications

VM-31 requires certification from senior management on reviewing internal controls and their effectiveness. In addition, VM-31 requires certification from an investment officer on the modeled investment strategy to ensure consistency with the company's investment strategy, as well as the qualified actuary on assumption/margin and compliance with the standard valuation law and VM-20.

Variable Annuity PBR Actuarial Report

The Variable Annuity PBR Actuarial Report contains disclosures for VM-21 reserve calculations. At the time of drafting this document, VM-31 points to VM-21. Note that VM-21 reporting requirements are currently analogous to those required for Actuarial Guideline 43. The NAIC is reviewing the Variable Annuity valuation and reporting framework for both VM-21 and Actuarial Guideline 43, but work has not been completed as of the development of this manual. Both VM-20 and VM-21 applicable business must be addressed in the executive summary of VM-31.

Other Related Controls

An actuary might find it useful to refer to documentation required for other actuarial frameworks when gathering documentation for the VM-31 Report.

Model Audit Rule (MAR)

The Model Audit Rule is a U.S. statutory financial reporting requirement that covers the core aspects of reserving, including the development and review of assumptions. Further areas of MAR include establishing appropriate controls, building a formal risk assessment, reviewing and documenting data process flows (experience studies, assumption load processes, etc.), and having a robust approval process around actuarial judgment used in the assumption-setting process. For further information, refer to the November 2010 Academy *Model Audit Rule* practice note.

VM-G Governance

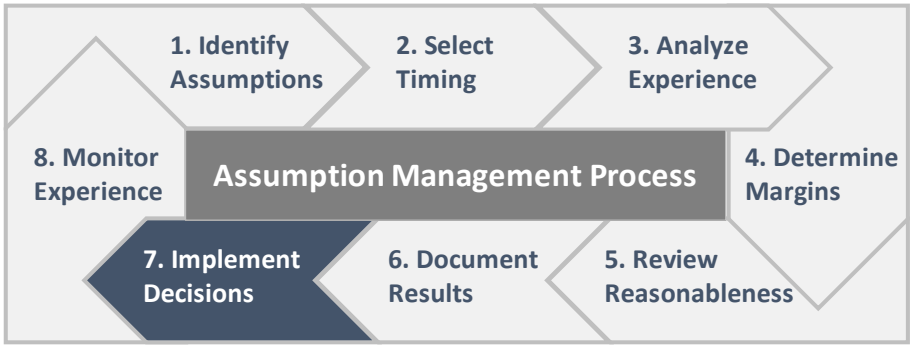
VM-G, *Governance*, outlines corporate governance guidance for PBR calculations, which includes VM-20 and VM-21 valuations. This topic is covered in more detail in the following section.

Sarbanes-Oxley Act (SOX)

The Sarbanes-Oxley Act requires financial reports of public companies to include an Internal Controls Report (ICR) for GAAP accounting. The ICR demonstrates that the financial information is accurate and that adequate controls are in place.

After developing disclosures required for valuation assumptions, the final step is to approve the final assumptions and apply them as intended within the associated actuarial model.

Section VII: Implement Decisions



Overview

Assumption governance procedures help establish a systematic pattern of approving assumptions for implementation, as well as applying them as intended in actuarial models. The pattern can vary from company to company, depending on the structure of departments, roles, and company culture. This section explores common elements and considerations involved in governance, communication, approval, and implementation of assumptions for valuation purposes.

VM-G, *Governance*

For a principle-based reserve valuation, VM-G specifies related corporate governance responsibilities. VM-G outlines an overarching structure for managing the PBR valuation process, including procedures for assumption governance. For consistency and efficiency purposes, it can be beneficial to connect the assumption management procedures used for principle-based reserves with the procedures used for other company risk assessment projects.

The steps to satisfy VM-G requirements include assigning roles and responsibilities, establishing and following internal procedures and controls, producing documentation, writing summary reports, and overseeing associated activities.

VM-G identifies three roles, for which there are specific responsibilities related to governing the principle-based reserve valuation: board of directors, senior management, and qualified actuary. A high-level summary is provided in the following figure:

Board of Directors	Senior Management	Qualified Actuary
• Oversee processes • Review reports • Document PBR-related activities in the board meeting minutes	• Ensure adequate infrastructure • Evaluate findings • Facilitate reports and certifications	• Oversee PBR calculations • Verify VM requirements are reflected • Prepare summary and PBR Actuarial Reports • Certify PBR assumptions are prudent estimates (other than stochastic & prescribed assumptions)

Board of Directors and Senior Management

For the board and senior management to carry out their PBR-related duties effectively, the company might consider developing an infrastructure that includes policies, procedures, controls, and resources to conduct oversight activities. Companies might also construct or enhance communication channels to facilitate the reporting of PBR results and findings. For example, this could include formulating a process to document the review of PBR calculation, including associated actions undertaken by senior management or the board of directors. Examination actuaries can request meeting minutes and/or materials as evidence of such a meeting with the board of directors.

Some companies might consider the use of "pre-meetings" with senior management or the board of directors, which could be prior to implementation of VM-G compliance and on a periodic basis. This can help educate parties of their associated roles and responsibilities under VM-G. It is also important to carefully identify the applicable senior management responsibilities for VM-G purposes (the Valuation Manual refers to the chief executive officer (CEO), chief financial officer (CFO), and chief risk officer (CRO) as examples of senior management with PBR responsibilities).

Qualified Actuary

The qualified actuary assigned to oversee the principle-based valuation of a group of policies or contracts has a number of responsibilities outlined in VM-G. It might be helpful to develop recurring analyses, examinations, and checks in order to complete the assigned tasks. Monitoring the PBR valuation process in relation to the company's internal standards, controls, and documentation can also help ensure that the company is meeting the Valuation Manual requirements. As required by VM-G, the qualified actuary is responsible for sharing these results, actions, and findings with senior management.

The company might decide to choose more than one qualified actuary for a single group of policies and could also assign different qualified actuaries to different groups of policies.

Other Parties

Governance principles and procedures can act as a resource for all parties to carry out their responsibilities. The qualified actuary can be in a unique position to influence the establishment and ongoing evolution of this assumption governance process. There are a number of ways to accomplish this, which can include a combination of activities to communicate, approve, implement, and document assumptions. The remainder of this resource manual provides example approaches and considerations.

Communicate Assumptions

Communication is important to both the governance and the valuation process. Assumptions are often part of conversations that cover planning, analyzing, and reporting. As such, an important aspect of the process is a culture that provides useful information in a timely and efficient manner. Investment in the following practices can be a valuable way to enhance communication:

- Building a common vocabulary
- Clarifying the parties involved in the process
- Registering the model assumptions in an inventory
- Managing resources for assumption development
- Developing effective systems for communication

Descriptions, examples, and possible considerations for each of these topics are provided below:

COMMON VOCABULARY: One of the most important steps in cultivating an effective communication process is the development of a common vocabulary relating to assumptions. The terms can be itemized and defined according to company practice and use. An example glossary might include:

COMMON VOCABULARY WITH EXAMPLE DEFINITIONS

Assumptions Inventory ~ A collection of assumptions currently managed in actuarial models.

Assumptions Repository ~ A storage structure filled with assumptions and related information that can be used as a reference system.

Assumptions Calendar ~ A schedule for assumption updates.

Assumptions Committee ~ A decision-making body that approves assumptions.

Decision Document ~ A reference that documents a decision along with context.

Process Map ~ A visual display or flowchart that shows the steps to complete a process.

Assumption Structure Template ~ An empty table structure that defines how the assumption values should be formatted and filled.

Aggregation Instructions ~ An explanation to combine multiple tables of values to produce a final assumption result intended to be used in actuarial models.

INVOLVED PARTIES: It is also important to identify those who need to be involved in the assumption process, their roles, and their level of involvement. Considerations include:

- Who plays key roles in developing and applying assumptions? Who plays supplemental or peripheral roles in developing and applying assumptions? What expertise can each person contribute to the assumption development and application?
- How does each party become engaged in the assumption cycle process? How are the various parties interrelated, and how do they communicate with one another?
- How are responsibilities and assignments divided among the parties?

ASSUMPTIONS INVENTORY: Identifying the assumptions needed and understanding their intended purpose are fundamental steps. Considerations include:

- Which assumptions are in the universe of the assumption cycle process?
- How can the assumptions be organized into an inventory list that can be accessed and reviewed? How can the transparency of the assumption structures and values be enhanced so that they are known to all associated parties?
- How do assumptions compare across models? What is the reasoning for any differences? Is it possible to create more consistency of assumptions used across various actuarial applications? Please refer to the subsection "Alternative Modeling Purposes / Bases" in Section V of this document for further discussion on this topic.

RESOURCE MANAGEMENT: Planning resources to make assumption updates or changes is typically an ongoing effort. Considerations include:

- What are the priority and timing needs for different assumptions? How will resources be planned and deployed? How will unscheduled requests be handled?
- What is the process to assess the need for an assumption change? How will modeling or other modifications impact the extent of assumption development efforts?
- How will development options be presented in order to determine project direction? How will agreement among parties be acquired? How will results be reviewed and finalized?

COMMUNICATION TECHNIQUES: Managing the logistics of communication is a common challenge for valuation practitioners. Encouraging clear and transparent messages can help reduce misunderstandings and unproductive actions. Creating a history of assumption implementations can provide a reference for understanding the evolution of an assumption framework. Considerations include:

- What is the balance between making communication efforts useful but not time-consuming?
- How can the proposed or completed actions be made clear? How will all involved parties be informed of the changes, updates, revisions, or corrections?
- Is the explanation of a given request or result sufficient? Does the documentation allow a new party to follow the process and find the final assumptions?
- Can the historical record of assumptions be tracked and easily shared if needed?

Approve Assumptions

After an assumption has been developed and communicated, it might need to be approved prior to being used in practice. Practice and procedures for this will vary widely by company. Several questions could be considered when completing the approval process:

> *Key Questions:*
>
> 1. *Who are the decision-makers?*
> 2. *What is the schedule for updating and approving assumptions?*
> 3. *How do approval procedures differ between experience assumptions and margins?*
> 4. *How will the decisions be documented?*

Who has the authority to make the approval decision?

- What is the process for assessing whether an assumption is reasonable for the intended purpose?
- How is the approval of an assumption acquired and documented?
- Is there a hierarchy for what assumptions need to be approved and who has been designated to approve the assumptions?

Is there an assumptions calendar (see example in figure below) for the qualified actuary, assumptions committee, or other designated decision-maker to approve?

- What is the procedure to engage in this process?
- If there is a committee, how is it set up for making a decision—consensus, majority vote, 100% agreement?
- In what manner will the decision be solicited and documented?

Example of a simple ASSUMPTIONS CALENDAR		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Experience or Prescribed	Asset				■						■		
	Revenue Sharing					■							
	Policyholder Behavior							■					
	Expense								■				
	Mortality									■			
	Other										■		
	Margins											■	

Will there be separate procedures for experience assumptions vs. margins?

- What are the triggers?
- What are the considerations?
- Do different groups of people need to be involved?

Once a decision is made, how will the conclusions be documented?

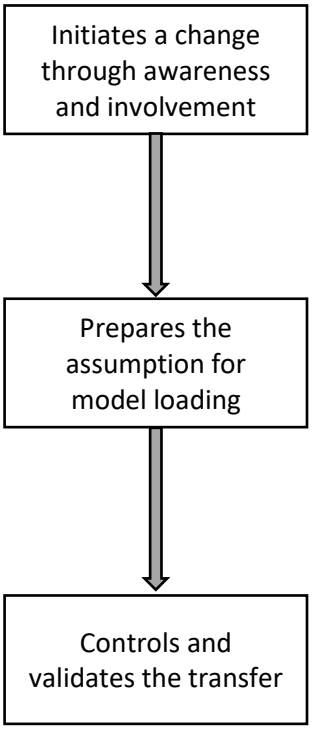
- What information will sufficiently document the decision?
- Should context be included to exhibit the assumption's evolution over time?
- How are the approved assumptions labeled as final and ready for use?

These and many more questions might be considered when setting up an assumption approval process, especially when balancing the needs for multiple purposes and stakeholders.

Implement Assumptions in the Model

After the assumptions have been developed and approved, they are loaded into the actuarial model. It is important to keep an open line of communication between parties who develop the assumptions and parties who implement the assumptions into the model. To minimize errors of transferring assumptions into the model, it is critical for both groups to have the same understanding of how the assumptions operate and are applied in the model.

The following steps provide an example framework for facilitating this communication.



The first step is to generate awareness that an assumption needs to be updated, changed, or added. It is beneficial for both the assumption developers and model developers to be in communication and part of the decision-making process described above. This allows both parties to provide input on the direction and outcome for the final assumption.

After the assumption has been developed, the next step is to prepare for loading the assumption into the model. What is necessary to convert an assumption table from a communication format to a modeling format? Are there component tables that need to be combined or aggregated to assemble a final assumption? If so, would aggregation instructions be helpful?

The last step is establishing controls and validation. Specific input procedures and checks help to ensure that the assumption gets transferred into the model appropriately and accurately so that the assumption can be used in the model as intended. Is the correct value being transferred? Is the model appropriately referencing the assumption being applied? Is the model producing the expected pattern of results given the new assumption? To ensure these are done properly, it may be helpful to follow established procedures to implement and document the model updates. Also, referencing validation procedures may confirm that the assumptions were implemented as intended.

Document

It can be helpful to document the full assumption cycle from beginning to end, including the approval and application of assumptions. Reference documents and summary reports are critical elements of the assumption development and governance process. Therefore, it could be beneficial to cultivate a culture that encourages useful and meaningful documentation. For more information, please refer to Section VI of this resource manual on considerations for documenting valuation assumption development.

Analyze Assumption Impacts

After developing and transferring assumptions into the valuation model, it is important to analyze their impact. This can include highlighting the movements in assumptions from one period to the next as well as understanding the key drivers and reasoning. The purpose of this is to associate assumption measurements with model result explanations. A helpful resource on this topic is the "Understanding VM-20 Results" report published by the Society of Actuaries. Governance around unlocking assumptions for valuation of inforce policies can require a specified process that not only includes developing the assumptions, but also documenting approval and application of the assumptions.

Documentation and Governance Case Study

To see a case study on VM-31 documentation and VM-G governance considerations under PBR valuation, refer to Case Study 4: Term Lapse Margins—VM-31 and Governance Considerations later in this document.

The next step in the process is to monitor experience going forward. Detailed information about this topic is provided in the following section.

Section VIII: Monitor Experience

Monitoring Anticipated Experience Assumptions

After assumptions have been reviewed, approved, and loaded into the valuation model for the upcoming financial reporting period, the next step is to monitor the experience. One approach is to assign responsibility for monitoring experience to a specific person or group within the organization, reporting to the assumption governance group, if one has been set up. Below are some procedures that might be considered:

1) **Determine which assumptions need closest monitoring**

   a) Review VM-31 (see Section VI), especially the certification of prudent estimate assumptions, and any qualified actuary disclosures (e.g., ASOP No. 41). These can help provide direction in deciding where to focus for monitoring experience.

   b) Review sensitivity tests. Products for which assumption changes have the biggest impact on reserves might require close monitoring.

   c) Review recent or upcoming company changes that could affect assumptions:
      - Changes in marketing or distribution.
      - Changes in underwriting, claims, or other procedures.
      - Introduction of new products, especially if experience will be combined with experience of one or more existing products.

   d) Review changes in the economic, physical, legal, or social environments that could impact risk factors:
      - Interest rates and market prices can affect policyholder behavior
      - Introduction of secondary markets can affect lapse-supported products

   e) Use the information from the above reviews to set priorities for closer monitoring of experience.

2) **Review trends of A/E ratios for assumptions associated with material risks**

   a) Determine frequency of reviews based on priorities considered from 1.e above.

   b) A high A/E for a block of policies is not necessarily significant if data for the base period is scarce. Where sufficient data is available, confidence intervals are applied to determine the significance of fluctuations. In any case, close monitoring is usually appropriate.

c) Look for patterns in fluctuations—for example, if mortality is worse than expected for all cells (across gender, issue age, risk class), a systematic problem could be present.

d) If the A/E for a block of policies is unfavorable for several periods in a row, a higher level of concern may be appropriate.

e) Analyze trends and fluctuations in light of changes in internal and external factors.

3) **Where significant fluctuations occur, consider recommending experience studies earlier in the reporting year**

a) This could include more ad hoc reviews of the anticipated experience assumption.

Monitoring Margins

Because margins reflect the uncertainty in anticipated experience assumptions, if reviews indicate a higher-than-expected level of fluctuations, the margin could be insufficient. The following steps might be considered in such a situation:

1) If a company margin policy exists, its current application can be compared to the margins used in the most recent valuation.

a) Changes that affect anticipated experience can also affect margin determination.

b) Even if the A/E is within expected bounds, higher-than-expected fluctuations could imply that the margin is inadequate.

2) If the existing margin method produces margins that consistently appear too high or too low relative to the monitored fluctuations in experience, the margin method might need to be revisited.

a) VM-20 permits such change if the rationale for the change and the impact on the minimum reserve are disclosed.

Continuing the Cycle

As the monitoring phase occurs throughout the year, the actuary might notice that assumptions need to be modified, enhanced, or added. At this point, the actuary will start the assumption cycle again by identifying the assumptions that could need to be updated (Section I), determining such (Section II), and analyzing experience (Section III). This creates a natural loop in the assumption development framework cycle. As experience is monitored throughout the year, assumptions are updated and refined for the subsequent reporting period.

Case Studies

This section of the PBR Assumptions Resource Manual explores four case studies that relate to the development of PBR margins, materiality, documentation, and governance. These case studies are illustrative, are not intended to be exhaustive or all-encompassing of the assumption update process for valuation, but rather aim to provide examples of common situations and considerations that can be encountered by practicing actuaries.

The case studies contained in the next set of pages are listed as follows:

- Case Study 1: ULSG Margin Impact Analysis
- Case Study 2: ULSG Premium Persistency
- Case Study 3: Term Lapse Margins—Development for Valuation
- Case Study 4: Term Lapse Margins—VM-31 and Governance Considerations

Case Study 1: ULSG Margin Impact Analysis

The following example shows illustrative results of margins (prescribed mortality, lapse, and expense) on the deterministic reserve from both a total and individual margin perspective. The graphs provide a picture of the impacts of different hypothetical margins on a generic Universal Life product with a secondary guarantee and show the total level of individual margins. Additional sensitivity tests with respect to premium and interest discount rate are shown in relation to the reported deterministic reserve.

The example highlights the deterministic reserve mechanics for one Universal Life policy issued at age 45 on Jan. 1, 2018, for a $100,000 face amount with a 20-year specified premium secondary guarantee. This is an illustrative example of a small company offering a new product with no credible mortality experience. Industry experience is used immediately and there is no grading from company experience to the industry. This product might not be representative of current or future products sold in the industry, but it helps establish a basis for the analysis and discussion that follows.

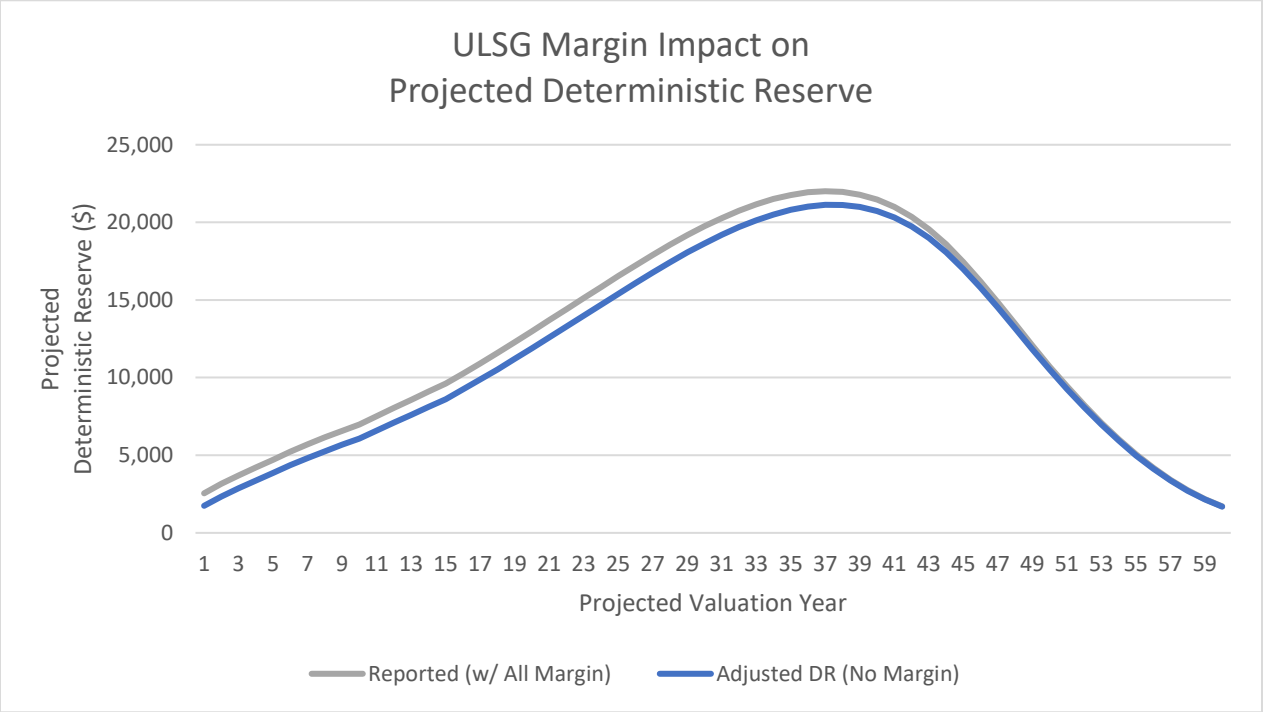
Margin and Sensitivity Analysis

PBR reporting disclosures require the individual margins and total margin to be shown in relation to the reported deterministic reserve using prudent estimates. Examples of this demonstration along with potential sensitivity tests on the modeled reserve are shown in the following exhibits:

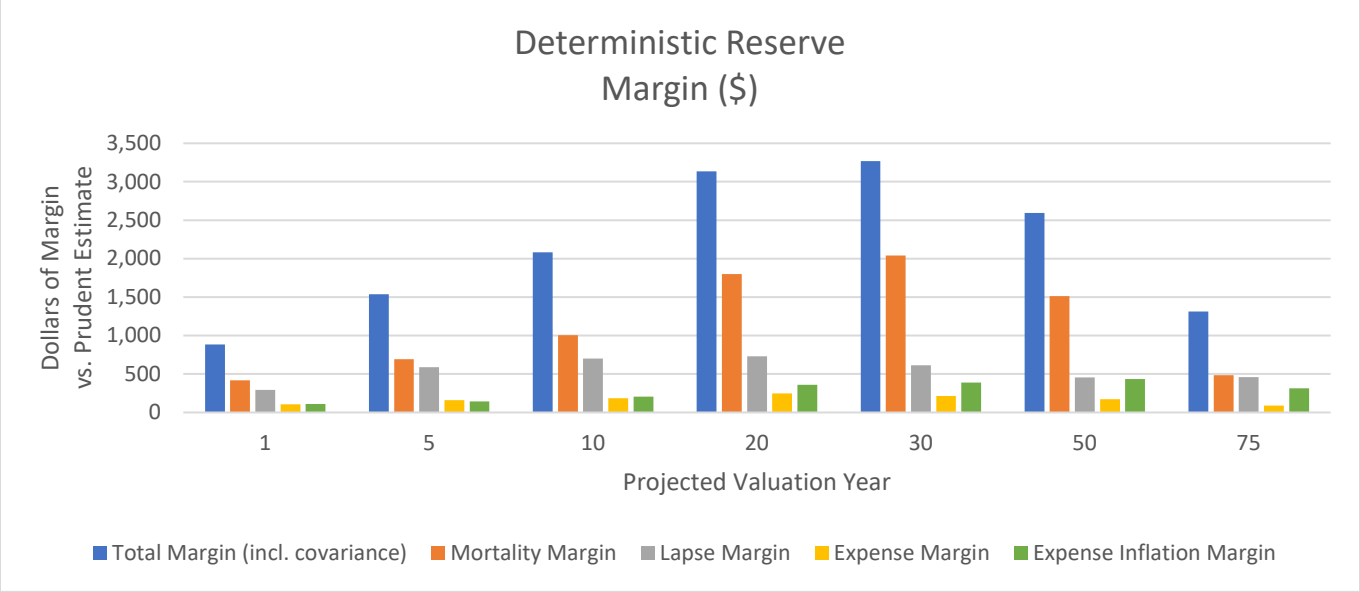
- *Exhibit 1* shows the impact of margins on the deterministic reserve, both in total and by individual margin components. The individual margin components include the mortality margin, lapse margin, expense margin, and expense inflation margin. In practice, there could also be additional VM-20 margins, such as a premium persistency margin or conversion margin (on term products). This exhibit also only focuses on explicit margins—not on implicit margins, such as removing future mortality improvement, using prescribed asset assumptions, and grading to a prescribed lapse table for ULSG products.
- *Exhibit 2* shows sensitivities for the following scenarios:
  - A reduction of 25 basis points in the NAER to discount the deterministic reserve cash flows.
  - No premiums paid after the first five years.
  - Minimum level premiums required to fund the secondary guarantee.

These sensitivities are not intended to be comprehensive but are only meant to show some examples of how to measure the impact of changing margins and various PBR assumptions on the VM-20 deterministic reserve.

Case Study 1: Exhibit 1—Margin Impact on Projected Deterministic Reserves



Projected Valuation Year	Total Margin (incl. covariance)	Mortality Margin	Lapse Margin	Expense Margin	Expense Inflation Margin	Sum of Individual Margins
1	31.11%	14.68%	10.28%	3.76%	3.95%	32.68%
5	21.41%	9.64%	8.20%	2.22%	1.98%	22.03%
10	15.05%	7.26%	5.08%	1.35%	1.49%	15.17%
20	10.70%	6.14%	2.49%	0.84%	1.22%	10.68%
30	6.71%	4.18%	1.26%	0.44%	0.80%	6.68%
50	3.09%	1.80%	0.54%	0.21%	0.52%	3.07%
75	1.36%	0.50%	0.48%	0.09%	0.33%	1.40%



The first graph shows an example of the total margin (for all material risks combined), which is represented by the difference between the reported deterministic reserve and adjusted deterministic reserve with no margin. This graph shows the projected deterministic reserve at each future date, assuming decrements based on company experience up to the projected valuation dates.

The margin starts off as a higher percentage of the reported deterministic reserve in early valuation years compared to later valuation years. This is primarily because the reported deterministic reserve is lower in early valuation years, which inflates the percentage of the total margin reserve impact over the reported deterministic reserve, as the denominator is smaller early on. As the present value of benefits grows in relation to the present value of premiums, the percentage impact of the margin decreases. Eventually, as the business begins to terminate in later years, the notable difference between the two lines begins to recede.

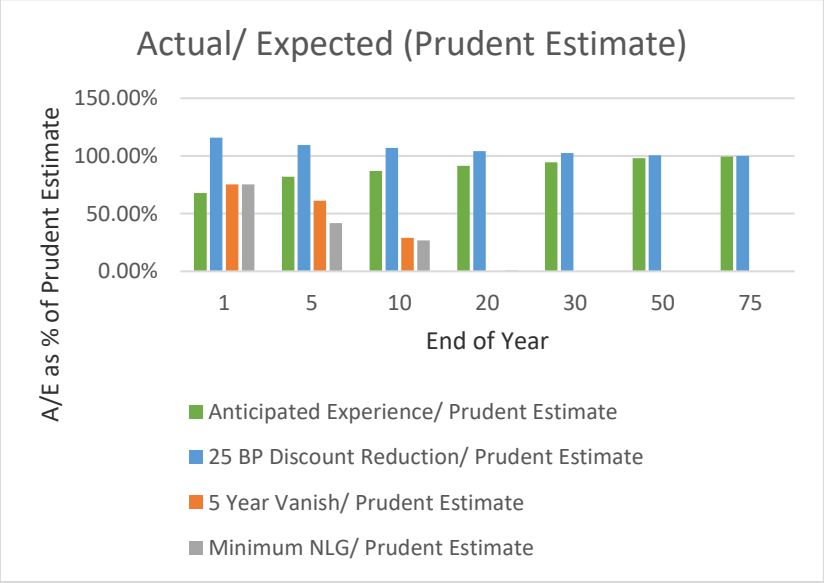
The table and bar chart show the numerical percentage impact of each individual margin component, in addition to the total margin percentage impact. In this analysis, only explicit VM-20 margins are shown. Therefore, implicit margins that might be due to anticipated experience differing from PBR prescribed

assumptions due to investment scenarios, asset assumption, mortality improvement, and grading to mortality and lapse industry tables are not included.

In this example, the prescribed mortality margin has the largest individual impact on results followed by lapse and expense. For more lapse-supported products (e.g., a lifetime secondary guarantee), the lapse margin may have a larger impact, which may vary between products and companies. For this analysis, the expense inflation margin was considered separately from general expense margin, but it would also be reasonable to combine these expense margin impacts, if desired. The total margin impact is not the equal to the sum of the individual margin impacts; the difference represents covariance between risks.

Exhibit 2—Deterministic Reserve Sensitivity Over Prudent Estimate

Current Year End	Anticipated Experience/ Prudent Estimate	25 BP Discount Reduction/ Prudent Estimate	Premiums Stop after 5 Years/ Prudent Estimate	Minimum NLG/ Prudent Estimate
1	67.84%	115.79%	75.34%	75.36%
5	81.92%	109.48%	61.35%	41.93%
10	86.95%	107.09%	29.17%	26.91%
20	91.58%	104.32%	0.00%	0.75%
30	94.43%	102.52%	0.00%	0.00%
50	98.11%	100.66%	0.00%	0.00%
75	99.61%	100.16%	0.00%	0.00%



The table and graph show multiple sensitivity tests. The first sensitivity shows the reserve using only anticipated experience (no explicit or implicit margins), which is less than the reported deterministic reserve. The comparison at different projection periods illustrates that percentage impact of using only anticipated experience decreases as the reported reserve increases.

The second sensitivity shows that decreasing the NAER used to discount deterministic reserve cash flows by 25 bps increases the reserve. Over time, the impact of this decreases, as the remaining cash flow projection period shortens and, hence, the impact of discounting diminishes.

The third sensitivity shows the deterministic reserve assuming that no premiums are paid after five years. In this example, the policy terminates around the 10^{th} duration. This shortens the reserve projection period, and therefore the deterministic reserve falls to zero.

Case Study 2: ULSG Premium Pattern Considerations Under VM-20

Below is a list of conceptual topics and considerations for setting the premium funding assumption on a universal life contract under VM-20. This case study does not intend to show numerical results, but rather focuses on considerations that may be appropriate in establishing premium pattern assumptions.

The product. An insurance company is valuing an inforce UL policy with a material secondary guarantee under VM-20. This product has a lifetime guarantee and uses a shadow fund mechanism. It is sold by agents and policyholders may employ a variety of funding patterns and to keep the policy inforce, as long as the shadow fund value is above zero (regardless of whether the account value is above or below zero). If the shadow fund is below zero, the policy will lapse.

Identify assumptions. This universal life product assumptions include mortality, expenses, lapses, premium patterns, and premium persistency. As a product with a secondary guarantee available through attained age 120, VM-20 requires that the lapse assumption grade from credible company experience to lapse experience from the Canadian Institute of Actuaries' *Lapse Experience Under Term-to-100 Insurance Policies* table if the cash surrender value is zero (or minimal) starting in the last duration when there is no substantially credible lapse experience available.

Select assumptions. The actuary focused on developing the VM-20 prudent estimate assumption for premium persistency. However, the actuary is aware that lapse rates and premium persistency are interrelated and will therefore consider the relationship between the two.

Analyze experience. The company has monitored experience on similar products and has found four key types of premium payment patterns, each with their own lapse experience (which is limited to five years). Patterns are based on illustrated premiums. The company's lapse rate experience for this product is assumed to be fully credible for five years.

Theoretical Premium Patterns	% of Contracts	Lapse Rate Pattern				
Single Pay (First year fully funds guarantee for life)	15%	0.5%	3.0%	2.6%	2.3%	2.0%
Level Ongoing premiums						
Large first year dump in, following by level pay	15%	0.5%	3.0%	2.8%	2.7%	2.5%
Level Pay for Guaranteed coverage to age 95+ *	45%	1.0%	4.0%	3.6%	3.3%	3.0%
Level Pay for Guaranteed coverage to age <95 *	25%	1.0%	4.0%	3.6%	3.3%	3.0%
Non-Level Ongoing premiums (associated with paying minimum required to fund the annual guarantee)						
Minimum Funding	0%	NA				

*The two starred categories can be thought of as level pay premiums for lifetime coverage and level pay premiums for some term shorter than lifetime (Not every company has data at a level that will permit the company to distinguish these separately). Because this company only has five years of experience, they look identical in the lapse study.

The company defines a premium persistency assumption and lapse assumptions for each of the cohorts. In general, it is noted that the definition of the lapse assumption depends on the purpose of the model and software used to model the policies.

For pricing purposes, the company defines an assumption of how many policies will fall into each of the categories modeled. This is done by looking at the past experience to observe such patterns, but the actuary also decides to consider how competitive the product is in each pattern. For example, if the new product is the most competitive single premium in the market, but a similar inforce product was not competitive, he/she might decide the best estimate assumption needs to put more weight on the single pay pattern than was done for the inforce product.

In the case of an inforce model, the company's plan is to assign each policy to a cohort and model the projected premiums accordingly. There are several considerations that arise when dealing with the actual inforce block.

- Projecting future premium cessation for a secondary guarantee UL contract is difficult due to deciding how to define the cohorts and setting the assumptions for each cohort.
- Some policyholders might have already ceased payment of premiums, which the actuary considers for determining how to model those policies. Though there are limitations in the actuarial model for being able to illustrate these scenarios, it is possible the policyholder might choose to:
    - Never pay another premium (with a positive cash value). The policy could either surrender for cash value or could leave the policy inforce until the guarantee expires.
    - Never pay another premium (without a positive cash value, but with an inforce guarantee). The policy will stay inforce until the guarantee expires. Because there is no cash value and no premium being paid, no lapses should be assumed.
    - Pay a catch-up premium and then resume paying premium to restore funding levels necessary for the original intended coverage period.
    - Resume premiums on a non-level basis, such as a minimal funding that would be expected from someone with a terminal illness. This gives rise to a fifth cohort that might not be identifiable based on early-duration experience.
- In general, the company finds that most policyholders pay the billed premiums either until the lifetime secondary guarantee is paid up or until the policy's secondary guarantee terminates on term funded contracts.

In the case of the company, the actuary is dealing with valuation of an inforce block. The actuary meets with the modeling team and learn that the modeling system will terminate contracts if he/she assumes premium cessation. Therefore, the modeling system is not capable of supporting his/her proposed policyholder

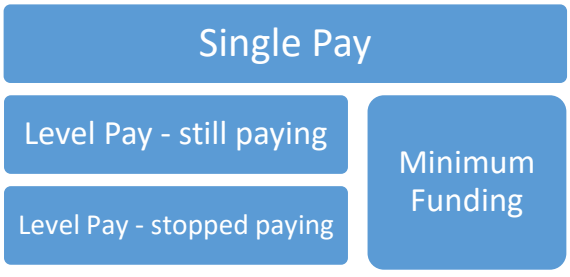
behavior assumption, so the actuary modifies the assumption to project no future premium cessation. The company has found the following in studies of similar products:

1. 100% of policyholders cease funding when the guarantee is fully funded for lifetime—that is, when no future premium is required.
2. 99% of policyholders who paid a premium for the prior two years will pay 100% of the billed premium in the subsequent year.
3. If a policyholder paid a premium in year x-2 and no premium in year x-1, then 50% will pay double the billed premium in in year x and 50% will pay the billed premium in year x.
4. If a policyholder has paid no premium in two years, then 90% will pay no premium in year x. This data is not complete, so they may resume premiums later in the projection.
5. 99% of the policyholders who have minimally funded their policies will continue to minimally fund their policies.

Given these findings, the actuary establishes a company experience assumption of the following:

- If no premium has been paid in two years, no future premium is expected.
    - *If no future premium is modeled and there is no cash value, then no surrenders will be projected.*
    - *If no future premium is modeled and there is positive cash value, some surrenders will be expected, but they would be minimal. The company assesses the value of the guarantee in relationship to the cash value to determine the surrender rate.* This essentially is a dynamic adjustment based on in-the-moneyness.
- If premium has been paid within the past two years, premiums will be paid at the billed level.
    - *The company assumes policies will terminate prior to maturity if the secondary guarantee expires.*
    - *Even though premiums are being paid, the company assumes that some policies will lapse.*
- Exception: No premiums are paid after the guarantee is fully funded.
    - *Surrenders could take place if there is positive cash value, but not if cash value reaches zero. Lapses are no longer possible.*
- Exception: Policies that have historically paid the minimal level will continue to fund at the minimal level.

That is, the five theoretical premium patterns have been replaced with four practical premium cohorts.



Determine Margins. The starting point for determining margins will be sensitivity tests. VM-20 requires prescribed sensitivity tests on premium persistency. The company performs these sensitivity tests on each assumed type of premium payment pattern, as they are likely to react differently. The VM-20 prescribed tests are:

i. Minimum premium scenario
ii. No further premium payment scenario
iii. Pre-payment of premiums—single premium scenario
iv. Pre-payment of premiums—level premium scenario

1. Single Pay Cohort. If the policies were all single premium for lifetime guarantee, there would be no difference between the four required runs as no additional premium is due. Some policyholders might have intended to pay a single premium to fund a guarantee for a specified term rather than for the length of the maximum secondary guarantee. This means that some policies could pay more premium and extend their coverage under these scenarios.
    - The company performs additional sensitivity testing to help inform a prudent estimate.
    - *The prudent estimate could involve some portion of the policies commencing additional funding for a longer coverage period. This additional coverage period could be through single premium, level premium, or some minimal funding at the end of the currently funded guarantee period.*
2. Level pay—still paying premium cohort. As noted before, these may be policies paying level premium to fund a lifetime secondary guarantee or a shorter-term secondary guarantee. The following additional sensitivities may be considered:
    - All policies moving to a level period for shorter term (such as to age 85 or to age 90), followed by minimum funding).
    - Keeping the current guarantee period at a level premium and assuming that minimum funding commences once the guarantee expires.
    - *The prudent estimate could involve some portion the cohort moving to one of the other patterns.*
3. Level pay—stopped paying premium cohort. If the contracts have no cash value, this scenario will assume no voluntary lapses. This means that the base assumption has zero present value of premium and a positive present value of death benefits. It is possible that the prescribed sensitivities will all produce a lower reserve for these policies because they will all produce a positive present value of premiums that is greater than zero. The actuary considers a range of sensitivities such as:
    - Single premium to keep the policy inforce for 5 years, 10 years, etc.
    - Level premium to keep the policy inforce for 5 years, 10 years, etc.
    - *As with other cohorts, a change in premium which increases currently funded guarantee period could be a more prudent estimate.*

4. Minimum funding cohort. These policies have already shown a history of paying minimal premiums. The actuary might consider whether it is prudent to increase the mortality assumption.

Concluding thoughts

Premium funding assumptions may be challenging to implement and there are multiple approaches possible. Because there is flexibility in how to set this assumption, implementing such can be data-intensive and could require a variety of cohorts to model. Each company might consider the data sources available. Factors such as billed premium or illustrated pattern can be useful. An overly simplistic model can easily become either too aggressive or excessively conservative without intention. An overly complicated model could give a false sense of accuracy.

For premium funding assumptions in particular, a teamwork-oriented approach involving experts on data and analysis, experts on the product being modeled, and experts on the specific modeling system and its limitations is necessary. It is prudent to perform sensitivity testing with care.

Case Study 3: Term Lapse Margin—Development for VM-20

The company has been selling a 10-year level term product for many years and is beginning to value it under PBR. The product offers a five-year YRT term after the 10-year level period.

Identify Assumptions to Update

Based on pricing, the actuary knows that lapses have a significant impact on term premiums and revenues, so the actuary identifies it as an assumption that might need to be updated annually.

Analyze Experience

Because the company has been selling the product for so long, the actuary has enough experience for credible lapse data. Thus, for setting PBR assumptions, the actuary uses the company experience and does not utilize experience from other sources, such as industry studies or reinsurers. After analyzing recent experience, as shown below, the actuary decides to set his/her anticipated experience for lapse rates based on an average of the past five calendar years:

Duration	2014	2015	2016	2017	2018	Average
1	7.1%	7.7%	6.6%	6.9%	6.1%	6.9%
2	5.4%	5.1%	4.6%	4.9%	5.0%	5.0%
3	3.0%	5.0%	2.1%	2.0%	3.6%	3.1%
4	2.8%	2.5%	2.0%	1.6%	1.7%	2.1%
5	1.4%	1.1%	0.9%	1.1%	0.8%	1.1%
6	1.0%	0.7%	1.1%	0.5%	1.6%	1.0%
7	0.9%	1.0%	1.0%	1.1%	1.0%	1.0%
8	0.8%	1.1%	0.6%	1.0%	1.2%	0.9%
9	1.3%	0.8%	1.5%	0.6%	1.4%	1.1%
10	88.9%	82.7%	87.9%	79.5%	86.1%	85.0%
11-15	6.1%	7.0%	7.2%	7.1%	8.0%	7.1%

Because lapse rates are similar in durations 5-9, the actuary sets one lapse rate for those durations. This simplifies his/her lapse assumption structure and model inputs. The actuary sees a large shock lapse in duration 10 when premiums increase sharply after the level period. In the last five durations, he/she sees similar experience and, again, combines it for simplification purposes.

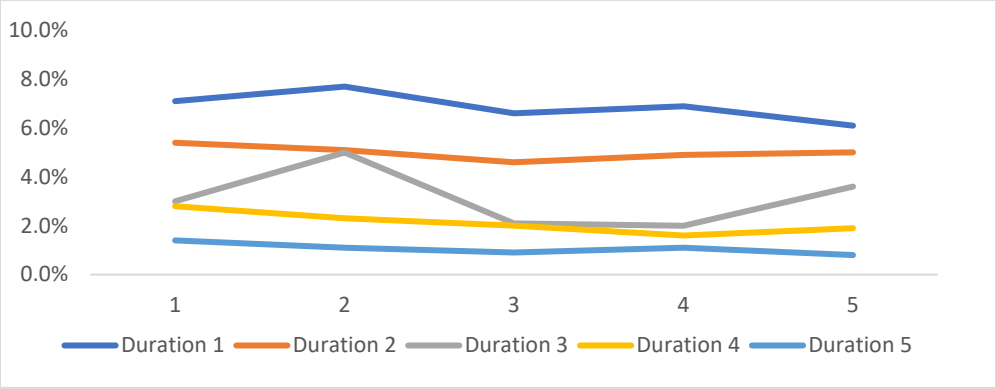
The actuary sets his/her lapse rate anticipated experience assumption at:

Duration	Lapse Anticipated Experience
1	6.9%
2	5.0%
3	3.1%
4	2.1%
5-9	1.0%
10	85.0%
11-15	7.1%

Other considerations:

- Do different segments have materially different experience (e.g., male and female)?
- Are there any emerging trends in experience?
- Are there any anticipated changes to the product design or external environment?

Trend by duration:



In reviewing the chart, the actuary notices that some of the durations have slightly decreasing trends. He/she decides to keep the anticipated experience at the average but will monitor the trend and may decide to use an additional margin.

Segment analysis:

The actuary reviews the experience by gender, age band, and risk class, and sees no material differences. He/she decides to keep the assumptions the same across all segments. In many cases the experience will differ across segments, so it is important for actuaries to review all segments and use different assumptions for different segments as appropriate.

Anticipated changes in environment:

There are no anticipated changes in lapse experience due to external environment or product changes.

Determine Margins

One key driver in setting the margins for an assumption is the materiality of the assumptions. In the company's MAR process, it uses a dollar amount, $2 million, as the *di minimis* change value for financial reporting. To be consistent with that, the actuary has decided to use $2 million as the materiality threshold for assumption changes. As this is the first year these policies are valued under PBR, he/she knows the dollar impact will grow over time, so he/she also looks at the change as a percent of the modeled reserve.

The actuary considers setting the basis of the prudent estimate equal to the standard mean plus or minus a normal distribution one-tailed z-score times the standard deviation, with the z-score representing the desired confidence level. The sample in this case consists of annual observations of the lapse rate over a 10-year period of data. The 10-year time period includes experience from 2008 and 2009, which provide policyholder behavior experience during an economic downturn.

In addition, the actuary is also considering constructing a two-sided normally approximated confidence interval for the lapse assumption. To do this, he/she assumes lapses are binomially distributed with sample mean $\hat{p}$, and use the following formula: $\hat{p}$ +/- $Z_{(two\text{-}sided)} * \sqrt{\hat{p} * (1 - \hat{p})} / \sqrt{n}$. The actuary decides to measure the sampling error with a sample size of 3000 (n) individual observations for each policy year over the past 10-year period. The sample size of 3000 was selected because this was the lowest sample size across policy year cohorts over the 10-year period.

The following table shows the sample mean ($\overline{x}$), sample standard deviation (SD_x), and sampling error (SE) over the 10-year period:

Pol Yr	2009	2010	2011	2012	2013	2012	2015	2016	2017	2018	$\overline{x}$	SD_x	SE
1	8.0%	7.8%	6.5%	7.2%	8.2%	7.1%	7.7%	6.6%	6.9%	6.1%	7.2%	0.7%	0.5%
2	4.0%	6.0%	4.5%	6.2%	5.3%	5.4%	5.1%	4.6%	4.9%	5.0%	5.1%	0.7%	0.4%
3	3.4%	3.0%	2.5%	3.5%	2.9%	3.0%	5.0%	2.1%	2.0%	3.6%	3.1%	0.9%	0.3%
4	2.5%	2.0%	2.1%	2.0%	2.0%	2.8%	2.3%	2.0%	1.6%	1.9%	2.1%	0.3%	0.3%
5	1.5%	1.0%	1.3%	1.0%	0.9%	1.4%	1.1%	0.9%	1.1%	0.8%	1.1%	0.2%	0.2%
6	1.4%	0.9%	0.8%	1.1%	1.1%	1.0%	0.7%	1.1%	0.5%	1.6%	1.0%	0.3%	0.2%
7	1.8%	1.2%	0.7%	0.9%	1.0%	0.9%	1.0%	1.0%	1.1%	1.0%	1.1%	0.3%	0.2%
8	1.0%	1.3%	0.9%	1.5%	0.9%	0.8%	1.1%	0.6%	1.0%	1.2%	1.0%	0.3%	0.2%
9	1.2%	1.1%	1.1%	1.0%	1.0%	1.3%	0.8%	1.5%	0.6%	1.4%	1.1%	0.3%	0.2%
10	84.0%	87.0%	79.1%	92.0%	86.3%	88.9%	82.7%	87.9%	79.5%	86.1%	85.4%	4.1%	0.6%
11-15	8.2%	7.1%	7.7%	6.6%	6.9%	6.1%	7.0%	7.2%	7.1%	8.0%	7.2%	1.0%	0.5%

The actuary decreases the lapse assumption one duration at a time to determine whether the margin should be negative or positive to increase reserves. In this example, increasing the lapse assumption in durations 1-3 and durations 10 and greater increases the reserves. However, it is observed that decreasing lapse rates in durations 4-9 results in an increase to reserves. Therefore, the actuary decides to set a positive lapse margin in durations 1-3 and 10 and greater, but to set a negative lapse margin in durations 4-9 due to the lapse-supported nature of the level term product.

Duration	Lapse Anticipated Experience[1]	Adjusted for 1 x SD_x	Increase in Modeled Reserve
1	6.9%	7.6%	$2.0 Million
2	5.0%	5.7%	$1.5 Million
3	3.1%	4.0%	$0.9 Million
4	2.1%	1.8%	$1.0 Million
5-9	1.0%	0.7%	$1.5 Million
10	85.0%	89.1%	$2.0 Million
11-15	7.2%	8.1%	$2.0 Million
Combined			$10.9 Million

(1) The anticipated lapse experience is based on the average of the 5 most recent calendar years

The combined change in reserves is above the $2 million threshold, so the assumption is considered material, and margins should be set appropriately.

Initial Lapse Assumption Proposal: To reflect a moderately adverse scenario, the actuary decides to set the margin at 1 sample standard deviation (a z-score of 1 is associated with a confidence level of 84.1% assuming normal distribution). Although the margin is based on a sample standard deviation over a 10-year period, anticipated experience is set based on the sample mean over only the five most recent years to reflect recent trends in experience. Therefore, the prudent estimate equals the anticipated experience (sample mean over 5-year period) plus the margin (sample standard deviation over 10-year period), with the margin being positive in durations 1-3, negative in durations 4-9, and positive in durations 10-15.

Duration	Initial Lapse Assumption Proposal (Anticipated Experience + or − Z x Sample Standard Deviation)
1	7.6%
2	5.7%
3	4.0%
4	1.8%
5-9	0.7%
10	89.1%
11-15	8.1%

The actuary looks at a 90% confidence interval for the lapse assumption, as defined by the formula: $\hat{p}$ +/- 1.645 * $\sqrt{\hat{p} * (1 - \hat{p})} / \sqrt{n}$. $\hat{p}$ is the sample mean, and there are 3,000 observations. To perform a sensitivity test, the actuary changes the lapse assumption by one standard error in each duration (including the associated z-score for normal distribution). He/she uses a 10-year period of data to calculate the standard error. Also, the longer time period includes experience from 2008 to 2009, which will help inform how policyholder behavior changes due to market experience during an economic downturn.

Pol Yr	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	μ	**St. Error**
1	8.0%	7.8%	6.5%	7.2%	8.2%	7.1%	7.7%	6.6%	6.9%	6.1%	7.2%	0.8%
2	4.0%	6.0%	4.5%	6.2%	5.3%	5.4%	5.1%	4.6%	4.9%	5.0%	5.1%	0.7%
3	3.4%	3.0%	2.5%	3.5%	2.9%	3.0%	5.0%	2.1%	2.0%	3.6%	3.1%	0.5%
4	2.5%	2.0%	2.1%	2.0%	2.0%	2.8%	2.3%	2.0%	1.6%	1.9%	2.1%	0.4%
5	1.5%	1.0%	1.3%	1.0%	0.9%	1.4%	1.1%	0.9%	1.1%	0.8%	1.1%	0.3%
6	1.4%	0.9%	0.8%	1.1%	1.1%	1.0%	0.7%	1.1%	0.5%	1.6%	1.0%	0.3%
7	1.8%	1.2%	0.7%	0.9%	1.0%	0.9%	1.0%	1.0%	1.1%	1.0%	1.1%	0.3%
8	1.0%	1.3%	0.9%	1.5%	0.9%	0.8%	1.1%	0.6%	1.0%	1.2%	1.0%	0.3%
9	1.2%	1.1%	1.1%	1.0%	1.0%	1.3%	0.8%	1.5%	0.6%	1.4%	1.1%	0.3%
10	84.0%	87.0%	79.1%	92.0%	86.3%	88.9%	82.7%	87.9%	79.5%	86.1%	85.0%	1.0%
11-15	8.2%	7.1%	7.7%	6.6%	6.9%	6.1%	7.0%	7.2%	7.1%	8.0%	7.2%	0.8%

The actuary decreases the lapse assumption one duration at a time, which results in material changes in some durations, as described below. For many assumptions, the margin will increase the assumptions, as is the case in durations 1-3 of this example for the lapses. However, in this particular example for lapses, decreasing the lapse assumption for each duration starting in duration 4 increases the reserves due to the lapse-supported nature of the product.

Considerations made in choosing the assumption:

a) **Combining Multiple Products:** In some cases, multiple products' experience is combined. However, this example only contains term products with 10-year level premium periods. In general, policyholder behavior for different level premium periods for term products can vary due to shock lapses, etc. Additional analysis might be considered if the experience for multiple products is combined.

b) **Margin as a Percent of Reserves:** The total deterministic reserve on this block of business before adding the lapse margin was $37.5 million. The combined lapse margin represents an 8% margin. The actuary suspects whether this percentage is partially inflated by reflecting lower deterministic reserves in early policy durations. He/she estimates the combined lapse margin impact at the projected peak of the deterministic reserve as 5%.

c) **Total Margin:** The explicit mortality margin that was added was 10% based on credibility. The implicit margin by not using a best estimate future improvement is 16%. This leads to an overall mortality margin for the term block of about 26%. When the lapse margin is aggregated with this and the other assumption margins, there is a margin on the block of 34%. Again, the actuary projects the margin impact at the future peak of the deterministic reserves and calculates the mortality margin for the term block as 20%, leading to an overall margin of 25% after including the estimated 5% impact from the lapse margin at the projected peak of deterministic reserves. Margins may also need to reflect correlations between deteriorating experience.

d) **Sensitivity Testing:** In addition to relying on a statistical-based approach, the actuary decides to look at various levels of increasing/decreasing lapses through a sensitivity testing approach. He/she decides to test lapses by applying multiplicative factors that result in -20%, -10%, -5%, +5%, +10%, and +20% changes to the lapse rates. He/she observes that a 10% multiplicative margin to lapse rates increases the reported deterministic reserve by 8%, which is roughly in line with using the statistical-based approach.

% Change to Lapse Rates[1]	% Change to Reported Reserve
-20%	-17%
-10%	-8%
-5%	-4%
0%[2]	0%
+5%	+4%
+10%	+8%
+20%	+17%

(1) Changes made in all years prior to shock lapse (direction adjusted for lapse-supportedness)
(2) Baseline set to anticipated experience

e) **Review for Consistency:** When reviewing the lapse assumption for consistency across other processes, the actuary finds that business plan forecast assumes an increasing trend in lapses due to external forces. Thus, his/her baseline lapse assumption is out of pattern with the business plan assumptions. Although he/she would not update the anticipated experience assumption, he/she considers whether the margin is appropriate. When projecting cash flows to calculate the deterministic reserve, he/she sees a pattern of post-level profits, which are not allowed per VM-20.

Final Lapse Assumption: Taking the considerations above into account, the actuary decides to decrease the margin on the lapse assumption. He/she changes the margin to a multiplicative 10% in all durations to give about an 8% overall margin. The actuary also increases the shock lapse to 100% to remove the post-level profits:

Duration	Lapse Assumption (Anticipated Experience + 10% Multiplicative Margin)
1	7.6%
2	5.5%
3	3.5%
4	1.9%
5-9	1.0%
10	100%
11-15	N/A

The associated governance and documentation of this margin for PBR disclosures and financial reporting are discussed in Case Study 4: Term Lapse Margins—VM-31 and Governance Considerations.

Case Study 4: Term Lapse Margins—VM-31 and Governance Considerations

This case study builds off of Case Study 3: Term Lapse Margin by discussing applications and reporting responsibilities for VM-31 and VM-G. The scope is limited to the lapse rate assumption for the 10-year term product discussed in the prior example.

This case study does not provide an exhaustive list of all considerations for VM-31 and VM-G applications for a PBR lapse rate assumption; only a subset is provided to give the reader a general sense of possible outcomes. Additional considerations and conclusions are needed when evaluating other types of assumptions in the PBR calculation.

Disclaimer*: This example is not a VM-31 PBR Actuarial Report itself, just a description of considerations, actions, and conclusions made before preparing a VM-31 report. An actual VM-31 PBR Actuarial Report will contain significantly more detail than what is included in the boxes shown below, as well as being considerably greater in length.*

A. ASSUMPTION DOCUMENTATION

An actuary has been assigned the role of the life qualified actuary. During the process of developing the PBR lapse rate assumptions for the 10-year term product, he/she reviewed guidance as well as company policies, controls, and documentation.

Concurrently, the actuary finalized a collection of internal documents to support the conclusions made at various points in the assumption cycle. This internal documentation was kept on file to explain the procedures followed, the analyses performed, and the bases of the final assumptions used for the PBR valuation. In some instances, the documentation went beyond the requirements of VM-31 or VM-G and included items such as:

- Flow charts, process maps, data maps
- Working papers, analysis findings, summary reports
- Meeting minutes, evidence of review, approval forms

Beyond that, the actuary prepared the PBR Actuarial Report as formal documentation following VM-31 requirements. Considerations and conclusions made in preparation for writing some of the report sections are provided below.

- Material Risk Disclosure: (VM-31 Section 3, Executive Summary, PBR Summary). Within the VM-31 Executive Summary, the company must provide a description of the rationale and associated decision to determine the lapse assumption sensitivity and a summary of whether the lapse and policyholder risks are material. The following items were considered to determine the sensitivity and materiality for the term product lapse risk, both with respect to total surplus and to the term PBR reserve calculation specifically.

Considerations	Actions and Conclusions made before preparing the VM-31 report
Size of PBR Block	• Examined the size of the PBR block relative to the size of total reserves inforce and to total company surplus. Estimated how the PBR block could grow over time to gauge the rate at which this initially small block of business would gain significance.
Impact to PBR Modeled Reserve	• Examined the PBR block relative to specific risks of the block. • For materiality on the PBR reserves, lapse rate sensitivity tests across a plausible range of scenarios were conducted to examine the percentage impact on the PBR modeled reserve. • Sensitivity tests were evaluated for different points in time. First, measurements were taken for the point-in-time reserve at the valuation date. Then impacts were reviewed for projections of the reserve over time, including specified policy years and the point at which the reserve peaks. • Impacts relative to other assumptions (investment, mortality, expense) were also recognized to determine that the impact on reserves was material. • Documentation of these sensitivity tests were provided in Section 11.d of the VM-31 Life PBR Actuarial Report.
Sensitivity to Company Surplus	• The company already established a pre-tax company surplus materiality threshold of $10 million for ORSA, capital, and audit materiality purposes. This threshold was determined based on past discussions with senior management in addition to reviewing historical changes in company surplus.
Confidence Interval of Assumption	• Using the calculated sampling error, the company decides to construct a confidence interval under the 84.1% confidence level used in setting the margin, as well as 90% and 95% confidence levels to determine potential ranges and mis-estimation of the lapse assumption.

- Experience Assumptions: (VM-31 Section 4, Life PBR Actuarial Report, Policyholder Behavior). In section 4 in the Life PBR Actuarial Report, the company must provide the method used to develop the anticipated experience lapse rate assumption. This includes describing data sources and an actual-to-expected analysis, in addition to compliance with the post-level term profitability restriction.

Considerations	Actions and Conclusions made before preparing the VM-31 report
Sources of Experience Data	• In Section 4.a of the Life PBR Actuarial Report, the company must provide a list of data sources, along with an explanation on why the data source is reasonable and appropriate. Therefore, the company documented the years of persistency experience data and measured deviations from an industry persistency report. The differences found when company data was compared to industry data were deemed appropriate, considering the Company's market and expectations determined through discussions with the reinsurer for this business.

Post-Level Term Profits	• VM-20, Section 9.D contains a restriction that post-level term profits may not be used in the deterministic reserve calculation for term policies with level premium periods greater than five years. Therefore, the company ran the model with and without post-level term cash flows to demonstrate that profits were expected under the anticipated experience assumption. This led to the decision to use a 100% shock lapse rate to restrict these profits. The company documented this method and assumption in the "Anti-Selected Lapses" section, or 4.j of the Life PBR Actuarial Report.

- Reliability: (VM-31 Section 4, Life PBR Actuarial Report, Policyholder Behavior). Section 4 of the PBR Actuarial Report requires a description of how to supplement components of the assumption for which there is "Sparse Data" or low credibility. Therefore, the company disclosed the method used to assess the reliability of the data and the level of granularity used for the analysis. Credibility could be used as a method under the umbrella of reliability, though the measure of reliability can be different under frameworks that do not use credibility (e.g., predictive models).

Considerations	Actions and Conclusions made before preparing the VM-31 report
Credibility Method	• The company standard for full credibility utilizes the Limited Fluctuation Credibility Method (LFCM); frequency only; 95% confidence of being within 5% of the true mean (i.e., P=95% and k=5%). Note the company uses this credibility threshold for credibility blending purposes, which varies from the confidence level used in the method to determine the margin level. • Experience was reviewed by gender and smoker status, with the credibility calculation tested separately for these segments.
Reviewing and Documenting Credibility	• The data source and credibility measurements were summarized to demonstrate that the company experience at the given granularity was reasonable and appropriate. • Assumptions based on less than fully credible data were identified, along with an explanation for how those assumptions were determined.

- Margin: (VM-31 Section 4, Life PBR Actuarial Report, Policyholder Behavior). Section 4 of the Life PBR Actuarial Report requires the company to describe the methodology used to determine the margins and the rationale for the choice, including the results of sensitivity tests.

Considerations	Actions and Conclusions made before preparing the VM-31 report
Method for Testing Margin	• Tested the margin sensitivity across each duration and determined that the margin should be positive the first five years and negative the next five years, which was documented in Section 4.e of the Life PBR Actuarial Report.
Method for Selecting Margin	• Set the margin to a level consistent with the sample mean plus or minus the normal distribution z-score times the sample standard deviation over a 10-year period. The z-score selected was 1.0, which is consistent with an 84.1% confidence level. The 10-year period was chosen to capture lapse experience during an economic downturn in years 2008 and 2009.

B. APPROVAL

- Approval of the Assumption and Margin: (VM-G Sections 1, 3, and 4). The company described the process used to obtain internal company approval of the assumption and margin, including identification of the decision-maker and how the decision was documented.

Considerations	Actions and Conclusions made before preparing the VM-31 report
Responsibilities of the Company	• The company assigned the actuary as a qualified actuary to carry out its responsibility for the actuarial assumptions used in the PBR valuation of the 10-year term policies. The actuary was specifically assigned to the VM-20 calculation on the company's life insurance business.
Responsibilities of Senior Management	• Senior management created an Assumptions Committee to review PBR valuation assumptions and enforce consistency with other company risk assessment processes, in addition to documenting any justifiable differences. • Senior management participated in an ongoing review of the resources, processes, infrastructure and knowledge/experience of personnel responsible for PBR.

Responsibilities of the Qualified Actuary	• As the qualified actuary, he/she verified that the prudent estimate lapse rate assumptions are compliant with the requirements in the Valuation Manual.
	
	• The lapse rates and margins developed for the 10-year term product line were presented to the Assumptions Committee established by senior management, and the committee approved a complete set of assumptions. The actuary referenced the committee's meeting minutes when communicating the assumptions for implementation.
	
	• As part of the implementation process of the 10-year term anticipated experience assumptions and margins, the actuary verified that the company's documented internal standards and internal controls were used, and that those procedures appropriately reflect the requirements of the Valuation Manual.
	
	• For internal purposes, the actuary assembled a collection of working papers and documentation to demonstrate the development, selection, and appropriateness of the 10-year term lapse rate anticipated experience assumptions and margins. Examples included:
	  ◦ Data sources, validations, and reconciliations
	  ◦ Descriptions of calculation methods
	  ◦ Summaries of analysis
	  ◦ References to internal standards, policies, and thresholds
	  ◦ Evidence of reviews and controls
	
	Following VM-31 requirements, the actuary prepared the disclosures placed in the Executive Summary and Sections 1 and 4 of the Life PBR Actuarial Report for the lapse

	rates 10-year term policies. For more details, see the Assumptions Documentation located in Section A of the case study above.

- Certification of Assumption and Margin: (VM-G Section 4) As the qualified actuary, he/she certified that the VM-20 lapse rate assumption is a prudent estimate assumption and the margin is appropriate.

Considerations	Actions and Conclusions made before preparing the VM-31 report
Responsibilities of the Qualified Actuary	• As the qualified actuary, he/she certified (VM-31 Section 3.C.13.f of the PBR Life Actuarial Report) that the lapse rate assumptions and margins used in the PBR valuation for the 10-year term policies, other than assumptions that are prescribed in the Valuation Manual or by law, or that pertain to risk factors that are modeled stochastically, are prudent estimates with appropriate margins.

C. EXECUTIVE BRIEFING

- Summary Report to Senior Management and Board of Directors: (VM-G Section 4). The company described the process where the qualified actuary provided a summary report to senior management and to the board of directors that includes an overview of the valuation process and results relating to PBR.

Considerations	Actions and Conclusions made before preparing the VM-31 report

Responsibilities of the Qualified Actuary	• As the qualified actuary, he/she provides a summary report to the board of directors and to senior management. The summary report includes a number of required descriptions, conclusions, and results concerning the PBR valuation. Examples include:
	  • Valuation processes
	  • Valuation results
	  • Levels of conservatism
	  • Materiality
	  • Significant and unusual issues/findings
	
	• Senior management then presented to the board of directors as part of the required communication (per VM-G Section 3.A.6.b).

Responsibilities of the Board	• The board of directors' meeting minutes were documented and include discussion concerning the review and actions undertaken by the board relating to the PBR valuation in its oversight role.

Appendix I: Resource List & Links

Overview
This section summarizes external references from the main body of this document and additional applicable resources.

First, there is a list of general references to the NAIC Valuation Manual, laws, and regulations. This is then followed by considerations for applicable ASOPs, including sections of the process where they may be most relevant. The appendix then identifies specific resources relevant to each section of the document, including Academy practice notes, SOA research reports, CIA guidance notes, and published industry experience.

The listed links are only current as of the initial development of this document.

A. General References

NAIC: This Assumptions Resource Manual focuses on VM-20, which is under the purview of the NAIC Life Actuarial (A) Task Force (LATF): http://www.naic.org/cmte_a_latf.htm.

The **"Related Documents"** tab at the upper right-hand of the page contains links to:

- Current and prior versions of the VM that apply to different valuation dates
- Investment spreads and default cost tables
- SOA 2017 CSO Tables and 2015 VBT Basic and Relative Risk Tables used in VM-20 mortality

The **"Exposure Drafts"** tab, also at the upper right-hand of this same NAIC webpage, contains links to:

- Currently exposed APFs that are open for comment at public LATF teleconference meetings
- A VM Question and Answer Document from August 2017 that provides official NAIC responses to frequently asked questions about the wording and guidance in the Valuation Manual

Valuation Manual (effective for 1/1/2018):
https://www.naic.org/documents/cmte_a_latf_related_val_2019_edition.pdf

Academy's PBR Practice Note on PBR Reserves under VM-20:
https://www.actuary.org/files/publications/VM_20_PN_Revised_January_2019_Final.pdf

American Academy of Actuaries' "PBR in Practice" Hub: http://actuary.org/content/pbr-practice
This includes links to:

- The Valuation Manual (VM) versions applicable at various valuation dates as it is amended
- The Standard Valuation Law (SVL)
- Model Governance Checklist and Practice Note
- Economic Scenario Generators

SOA Financial Reporting Section: The SOA Financial Reporting Section Council's goal is to encourage and facilitate professional development, research studies, and disseminate literature in the field of life insurance company financial reporting. This group developed a curated regulatory change web resource organized for life insurance and annuities: https://www.soa.org/sections/financial-reporting/financial-reporting-landing/

Contingencies Article on Role of the Actuary and ASOPs while performing PBR Work:

An article titled "PBR—Who, What, and How" was published in the American Academy of Actuaries' March/April 2017 edition of *Contingencies* magazine. The article discusses the role and responsibilities of the qualified actuary, applicable ASOPs, and considerations for Sarbanes-Oxley (SOX), NAIC Model Audit Rule (MAR) or ORSA and ERM framework for PBR processes. The article can be found at the following link: http://contingencies.org/pbr-who-what-and-how/

B. Actuarial Standards of Practice (ASOPs) to Consider

- **ASOP No. 1,** *Introductory Actuarial Standard of Practice*: http://www.actuarialstandardsboard.org/wp-content/uploads/2013/10/asop001_170.pdf
  This ASOP applies to all steps discussed in the PBR Assumptions Resource manual. It defines the terms "must/should" and "may." Definitions and discussions included in ASOP No. 1 are intended to apply to all other ASOPs if the term is used in such ASOPs, unless the ASOP includes a specific definition of the term.

- **ASOP No. 2,** *Nonguaranteed Charges or Benefits for Life Insurance Policies and Annuity Contracts*: http://www.actuarialstandardsboard.org/wp-content/uploads/2013/12/asop002_171.pdf This ASOP governs actuarial practice for non-guaranteed charges or benefits, which must be accounted for within PBR modeled reserves. This applies to Section I for identifying assumptions and could also be relevant to Section V for assessing reasonableness of NGEs and policyholder behavior assumptions associated to NGEs.

- **ASOP No. 07,** *Analysis of Life, Health, or Property/Casualty Insurer Cash Flows*: http://www.actuarialstandardsboard.org/wp-content/uploads/2014/01/asop007_128.pdf This ASOP covers analysis of life cash flows, which are used in determining PBR modeled reserves. In particular, Section 3.2 (Determining the level of analysis of cash flows) of the ASOP discusses the level of analysis required based on level of risk. This is applicable to Section I and IV within PBR Assumptions Resource Manual.

- **ASOP No. 10,** *Methods and Assumptions for Use in Life Insurance Company Financial Statements Prepared in Accordance with U.S. GAAP*: http://www.actuarialstandardsboard.org/wp-content/uploads/2014/02/asop010_130.pdf This ASOP covers methods and assumptions used to determine life insurance financial statements prepared in accordance with U.S. GAAP, including provisions for adverse deviations. This ASOP may be useful when reviewing Sections I, II, IV, and V of this resource manual.

- **ASOP No. 11,** *Financial Statement Treatment of Reinsurance Transactions Involving Life or Health Insurance*: http://www.actuarialstandardsboard.org/wp-content/uploads/2014/02/asop011_131.pdf
  This ASOP covers life insurance financial statement treatment of reinsurance transactions. This ASOP is most relevant in Sections I, II, IV, and V for reinsurance applicable to valuation frameworks, including materiality, NGEs, reasonability, and consistency. The ASOP may also apply to Step VIII, since non-guaranteed reinsurance rates may be monitored for premium increases based on emerging experience.

- **ASOP No. 21,** *Responding to or Assisting Auditors or Examiners in Connection with Financial Audits, Financial Reviews, and Financial Examinations***:** http://www.actuarialstandardsboard.org/wp-content/uploads/2014/02/asop-021_183.pdf This ASOP applies to practices of auditors/examiners and is relevant to all steps within the PBR Assumptions Resource Manual, as reviewers may intend to understand the entire valuation end-to-end process to gain comfort with the assumptions, margins and the processes used to set/monitor them.

- **ASOP No. 23,** *Data Quality*: http://www.actuarialstandardsboard.org/wp-content/uploads/2017/01/asop023_185.pdf Analyzing data is necessary for identifying key assumptions and risks for valuation, including considerations for qualified actuary, appointed actuary, auditors, examiners, and rating agencies. This ASOP is relevant to all sections in the PBR Assumptions Resource Manual, as data quality could impact the selection of material assumptions, ability to measure experience, size of margins, reasonability, relevance and staleness of that data, documentation of data quality, and ability to monitor the quality of data over time.

- **ASOP No. 25,** *Credibility Procedures*: http://www.actuarialstandardsboard.org/wp-content/uploads/2014/02/asop025_174.pdf This ASOP is particularly relevant to modeled reserves in PBR valuation and is relevant to all sections in the PBR Assumptions Resource Manual for the same reasons as ASOP No. 23 (since both data quality and data credibility are involved with the decisions for updating experience assumptions).

- **ASOP No. 41,** *Actuarial Communications*: www.actuarialstandardsboard.org/wp-content/uploads/2014/02/asop041_120.pdf
  This ASOP covers appropriate practice for actuarial communications. It requires that actuaries clearly communicate the scope of their analyses, qualifications, document their work, highlight limitations to the data, and develop documentation. This ASOP is relevant to all sections in the PBR Assumptions Resource Manual, especially Step VI on Documentation.

- **ASOP No. 46**, *Risk Evaluation in Enterprise Risk Management***:** http://www.actuarialstandardsboard.org/wp-content/uploads/2013/12/asop046_165.pdf This ASOP covers risk evaluation in enterprise risk management, including identification and evaluation of key risks. An actuary may find this ASOP to be relevant to all steps in this PBR Assumptions Resource Manual, as the evaluation of risk materiality is related to assumption and margin development, in addition to the analysis for reasonability and ongoing monitoring.

- **ASOP No. 52,** *Principle-Based Reserves for Life Products under the NAIC Valuation Manual*: http://www.actuarialstandardsboard.org/wp-content/uploads/2017/10/asop052_189.pdf This ASOP covers principles-based reserves for life insurance. Section 2 of the ASOP defines the terms "credibility," "granularity," "margin," "prudent estimate assumption," "scenario," and "sensitivity testing." Section 3.4.6 (Determining Assumption Margins) specifically addresses standards of practice for determining assumption and margins, and section 4 pertains to communication and disclosures. This ASOP is relevant to all sections in the PBR Assumptions Resource Manual, and actuaries are bound by this ASOP when preparing VM-20 reserves.

- **Exposed Draft ASOP on Setting Assumptions**: http://www.actuarialstandardsboard.org/asops/setting-assumptions-exposure-draft/ This ASOP is not yet finalized at the time of the writing of this document. If approved by the ASB, it may become relevant for Sections I, II, III, and V of the PBR Assumptions Resource Manual.

C. Other Resources Referred to in this Manual—Organized by Process Step:

Section I—Identify Assumptions:

Valuation Manual: Introduction, which defines risks that should be included in determining reserves as opposed to those that are accounted for within surplus; **VM-01**, which defines terms within the VM; **VM-20 Section 1.B,** which defines terms used within VM-20 itself; and VM-20 Section 9 are specifically geared toward Assumptions (link above in appendix).

Potential Guidance:

- **Canadian Institute of Actuaries (CIA) 2007 Lapse Experience Under Term-to-100: http://www.cia-ica.ca/docs/default-source/2007/207085e.pdf** VM-20 Section 9.D requires that lapses for ULSG modeled reserves grade ultimately into this prescribed table.

Academy Practice Notes:

- **Credibility Practice Note (2008):** https://www.actuary.org/files/publications/Practice_note_on_applying_credibility_theory_july2008.pdf

SOA Research and articles in SOA Section Council Newsletters:

- This link contains an article titled *End-to-End Assumption Documentation* Process that is relevant to documentation and disclosure practices: https://www.soa.org/Library/Newsletters/Financial-Reporter/2016/march/fr-2016-iss-104-li-zaidlin.aspx

Sections II-III—Select Timing and Analyze Experience

The Valuation Manual: VM-20 Section 9 Assumptions (https://www.naic.org/documents/cmte_a_latf_related_val_2019_edition.pdf)

Academy Practice Notes:

- **VM-20 Practice Note (2019):** https://www.actuary.org/files/publications/VM_20_PN_Revised_January_2019_Final.pdf
- **Practice Note on Applying Credibility Theory (2008)**, which can be found at https://www.actuary.org/files/publications/Practice_note_on_applying_credibility_theory_july2008.pdf

SOA Research Papers:

- **Credibility Theory Practices Research Report (2009**), which in addition to a report provides worked-out examples of Bühlmann, Limited Fluctuation, and Bayesian approaches for mortality and lapses. Source: https://www.soa.org/research-reports/2009/research-credibility-theory-pract/
- **Experience Studies Calculations Educational Tool (revised 1/2018)**, which presents and explains methods for determining rates from experience studies and includes an Excel workbook with examples.

- **Source of Earnings Analysis for Flexible Premium and Interest-Sensitive Life and Annuity Products** (1998) by Robert Stein, published in the *Transactions*, and now in the SOA online library.
  Source: https://www.soa.org/library/research/transactions-of-society-of-actuaries/1988/january/tsa88v40pt23.pdf
- **Understanding VM-20 Results (August 2017)** which specifically addresses Source of Earnings (SOE) analysis in a PBR context as a "feedback" mechanism to observe actual versus expected experience as it emerges to see which assumptions may be drifting from current levels.
  Source: https://www.soa.org/research-reports/2017/2017-understand-vm-20-results/

Canadian Standards of Practice:
Section 1720 discusses electing assumptions and Section 1750 discusses comparing current and prior assumptions under Canada's Principles-based reserving regime. While not binding on U.S. actuaries, this resource may provide useful guidance for principle-based approaches.
Source: https://www.cia-ica.ca/docs/default-source/standards/sc033115e.pdf

Section IV—Determine Margins

The Valuation Manual: VM-20 Section 9.B and VM-31 on documenting aggregate and individual margins (link above in appendix).

Academy Practice Notes:
- **VM-20 Practice Note,** Section 14 on margins (https://www.actuary.org/files/publications/VM_20_PN_Revised_January_2019_Final.pdf)
- **Model Audit Rule Practice Note (2010):** Discusses a formal review process for margin setting, controls over these processes, and documentation and approvals because setting margins may involve considerable judgment which in turn requires robust controls under Sarbanes-Oxley (SOX) and the Model Audit Rule (MAR)
  Source: https://www.actuary.org/files/MARPN_Final_111010.4.pdf/MARPN_Final_111010.4.pdf
- **XXX Practice Note (2001):** Discusses common practice for Model Regulation XXX, including the techniques used to determine the aggregate distribution of claims for developing X factors. Some of these methods may relate to possible VM-20 margin development techniques, such as the use of Monte Carlo studies: http://dev.actuary.org/files/publications/Practice_Note_on_NAIC_Model_Regulation_XXX_updates_the_2000_version_feb2001.pdf

Society of Actuaries Research:
- ***Analysis of Methods for Determining Margins for Uncertainty under a Principles Based Framework for Life insurance and Annuity Products* (2009):** This document provides context in term of required capital and profit margins. The report provides a comprehensive discussion of bottom-up and top-down approaches to setting margins, which are based on factors, discounted values, judgement, stress-testing, percentiles of distributions, cost of capital, and calibration to market values as specific techniques. It ends by applying these techniques to mortality, expense, policyholder behavior and reinsurance assumptions and evaluates their relative strengths and weaknesses in each case.
  Source: https://www.soa.org/files/research/projects/research-analysis-life-annuity.pdf

Canadian Standards of Practice:
Sections 1740, 2250, 2260, and 2270 discuss margins for adverse deviation under Canada's Principles-based reserving regime, which while not binding on U.S. actuaries, may provide useful guidance.
Source: https://www.cia-ica.ca/docs/default-source/standards/sc033115e.pdf

Section V—Review Reasonableness

The Valuation Manual: VM-30 Section 3.A.6 discusses reliance by the appointed actuary on work performed by others and prescribes that the appointed actuary to evaluate "the data, assumptions, projections, or analyses for reasonableness and consistency" (link above in appendix).

Academy Practice Notes:

- **Practice Note on Applying Credibility Theory (2008):** https://www.actuary.org/files/publications/Practice_note_on_applying_credibility_theory_july2008.pdf This resource discusses how statistical credibility of underlying data influences the development of assumptions or margins, and that the consistency of an assumption between periods may depend on how much that assumption changes over time.

Section VI—Document Results:

The Valuation Manual: VM-31 requires specific documentation, disclosures, and justification for PBR assumptions, methods, models and margins. VM-G also requires reports to the board of directors and senior management on the processes and controls, and the adequacy of the human and systems resources performing PBR valuation (link above in appendix).

Other Laws and Regulations:

- **Sarbanes-Oxley (SOX):** While not directly applicable to PBR, the document may be useful when determining governance procedures and controls. Specifies Internal Controls Reports (ICRs), which demonstrate that financial information is accurate and controlled. A relevant article on this topic is "A Layperson's Guide to Internal Control Over Financial Reporting (ICFR) published by the Public Company Oversight Board (PCAOB) in 2006:
  Source: https://pcaobus.org/News/Speech/Pages/03312006_GillanCouncilInstitutionalInvestors.aspx

Academy Practice Notes:

- **Model Audit Rule (2010):** This includes documenting processes and controls over processes in statutory accounting. A useful resource is Section 4, Documentation of Processes.
  Source: http://www.actuary.org/files/MARPN_Final_111010.4.pdf/MARPN_Final_111010.4.pdf

Sections VII-VIII—Implement Decisions and Monitor Experience:

The Valuation Manual: VM-G describes the role of the company, board, management, one or more qualified actuaries and the appointed actuary in approving, applying and certifying assumptions (link above in appendix).

Academy Resources:

- **The Academy's Model Governance Checklist**, in PDF form, which can be found at the following link: http://actuary.org/files/publications/PBRChecklist_Final.pdf