Aggregate Margin Task Force
Aggregate Margin for VM-20 Proposal

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Life Actuarial Task Force

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Aggregate Margin Task Force

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Executive Summary

The current draft of VM-20 requires that a margin for uncertainty be added to each individual risk factor that is not prescribed. The individual margin approach is problematic for several reasons, including difficulty in reflecting correlations between different risks, which requires a high degree of judgment that can be quite time consuming; and concerns that it may produce an overly conservative margin in the aggregate. To at least partly address these concerns, the Life Financial Soundness / Risk Management Committee of the American Academy of Actuaries (Academy) formed the Aggregate Margin Task Force (AMTF or task force) to assist the National Association of Insurance Commissioners' Life Actuarial Task Force (LATF) in reviewing the pros and cons of replacing the individual margin approach with an aggregate margin approach. An aggregate margin approach applies a single margin to the "best estimate" reserve that is calculated without margins being added to the individual reserve assumptions.

This paper provides a summary of the work of the task force. The objectives of the task force are to**:**

1. Review and research various alternative aggregate margin approaches.
2. Provide an analysis of the pros and cons of each alternative.
3. Provide a recommendation for a specific aggregate margin approach, along with reasons to support the recommendation.

Several different methods to determine an aggregate margin were examined. Two methods rose to the top: the Cost of Capital Method and the Confidence Interval Method. The paper describes these two methods, discusses the pros and cons of each, and addresses practical approaches to implement both methods.

There is a foundational difference between the two methods, which is discussed in further detail later in the paper. Both methods meet the desired characteristic of policyholder protection; however this is achieved in two different ways. Under the cost of capital method, the margin is determined such that another market participant (e.g., another life insurance company) would be willing to take on the policyholder obligations if assets equal to the reserves plus the margins were transferred to that market participant. This is achieved by setting the margin equal to the cost of holding capital to protect against all material risks to which the holder of the obligations is exposed. In other words, if a market participant has this margin available over and above the base reserve, it will compensate the market participant for the opportunity cost of holding capital in relatively safe investments to cover the risks, rather than investing that capital in new business opportunities. This method is similar to what is used currently in some US and global accounting methods, as well as some European capital methods.

Under the confidence interval method, the margin is determined such that there is a specified level of confidence, for example 80%, that the reserve plus the margin is sufficient to cover the future obligations under a wide range of potential future outcomes, considering all material risk factors that will impact future outcomes. This method is similar to what is used currently in principle-based reserves.

Based on a conceptual analysis of the both methods, the task force tentatively recommends the Cost of Capital method, pending further analysis of the practical implementation approach for such a method. While the task force has considered some of the practical implementation issues in coming to this recommendation, a more in-depth analysis of possible implementation approaches is a critical next step. To the extent that that detailed implementation analysis results in significant issues in terms of implementing the Cost of Capital method, an alternative approach may be required. In light of the potential for issues regarding implementation, the task force also recommends that further analysis of the potential implementation approach for the Confidence Interval Method also be considered. The task force believes that both the Cost of Capital and the Confidence Interval methods are robust methods that meet our overall objectives, and therefore warrant further analysis as to practicality and auditability in order to facilitate a final decision.

This paper also discusses several practical approaches to implementing both methods, including:

1. Representative Scenarios Approach
2. Use of Company's Internal Capital Model
3. Use of External Capital Measure (RBC or Rating Agency)

Of these three potential approaches to implement an aggregate margin method (under either the Cost of Capital or the Confidence Interval Method), the task force recommends a Representative Scenarios Approach as the most beneficial. This approach retains many of the conceptual benefits associated with use of a full stochastic distribution, such as:

1. Consideration of all material risks
2. Ability to maintain internal consistency among the best estimate reserve, the margin, and capital, to the extent desired
3. Consideration of diversification among risks
4. Ability to specifically identify a level of confidence of meeting policyholder obligations, either for the reserve margin directly in a Confidence Interval approach or for the capital underlying a Cost of Capital approach.

The topics discussed in the paper include:

1. Task Force Charges and Objectives
2. Defining the Reserve to Which Margin Will Be Added
3. Intent of Aggregate Margin and Risks Covered
4. Application of the Aggregate Margin
5. Potential Methods Considered
6. Recommendation and Rationale
7. Potential Approaches for Implementation
8. Practical Considerations for Recommended Methods
9. Summary
10. Next Steps

Task Force Charge and Objectives

VM-20 requires that margins for uncertainty be added to each individual reserve assumption that is not prescribed (that is, each anticipated experience assumption) as opposed to adding a single aggregate margin to the total "best estimate reserve" that is based on individual assumptions with no margins. [Note: throughout this report, the "best estimate reserve" with no margins will be referred to as the "anticipated experience reserve" to be consistent with the terminology in VM-20]. Benefits of the individual margin approach include:

1. Provides explicit feedback loops by assumption, providing the ability to monitor the appropriateness of reserving in light of emerging experience.
2. Relatively easy to review and monitor the degree of uncertainties assumed by actuaries and the variation of actual experience from expected assumptions as the business matures.

However, the Life Practice Council of the Academy has long advocated for the use of an aggregate margin approach, rather than the individual margin approach, as the preferred methodology to incorporate a provision for uncertainty in the underlying reserve assumptions. Concerns with the individual margin approach include:

1. Per-assumption margins are time-consuming to set and in many cases involve a high degree of judgment.

2. Given that the impact of correlation between assumptions is not included, the cumulative individual margins are likely to produce a distorted picture of the cumulative uncertainty associated with the set of modeling assumptions, thereby producing overly conservative reserves (for example, if mortality margins provide for a 1/200 mortality event, and interest rate margins provide for a 1/200 event, and the margins are simply added together, the event provided for in total is much less likely than 1/200, unless the mortality and interest events are expected to happen at the same time).

3. It is very difficult to determine appropriate margins on many policyholder and management behavior assumptions, such as non-guaranteed elements (NGE), premium pattern assumptions, and allocation of policyholder funds between available investment and crediting options.

4. Establishing assumptions for NGEs is problematic under an individual margin approach since the margin in each individual assumption represents adverse experience that the NGE assumptions are designed to mitigate. This raises the question: are the NGE assumptions to be based on the underlying anticipated experience assumptions with no margins (i.e., expected experience), or prudent estimate assumptions with margins (i.e., adverse experience)? If the latter, then the impact of the margins on the reserve is reduced (and potentially eliminated).

Benefits of the aggregate margin approach include:

1. Eliminates the time consuming and difficult task of quantifying margins on each individual assumption.
2. Explicitly quantifies the margin relative to the anticipated experience reserve at an aggregate level, thereby addressing the correlation issue and producing a reserve level that considers diversification among risks.
3. Mitigates the problem of establishing NGE assumptions that offset the margins incorporated in the individual assumptions.
4. Implicitly considers interactions among various risks that may not be considered in the individual margin approach.

The Aggregate Margin Task Force was created at the request of the Life Financial Soundness and Risk Management Committee of the Academy to assist LATF in reviewing the pros and cons of various aggregate margin approaches.

The objectives of the task force are to:

1. Review and research various alternative aggregate margin approaches.

2. Provide an analysis of the pros and cons of each alternative.

3. Provide a recommendation for a specific aggregate margin approach, along with reasons to support the recommendation.

The principal criterion used to evaluate any aggregate margin approach will be a qualitative assessment of the degree of protection afforded to policyholders. This principle implies establishing stress tests of adequacy of the aggregate margin, both in total and by product groupings, while also recognizing the essential role of capital in providing additional protection for tail risks. Thus, quantifying the threshold dividing reserves and capital is an essential task of this task force, as well as defining product groupings for which the aggregate margin should be stress-tested.

Approaches considered:

1. Cost of Capital method

2. Percentage method

3. Confidence Interval method

4. Other methods considered and discarded

    a. “Pure” exit value method
    b. Adjusted discount rate method
    c. Use of sensitivity tests

Defining the Pre-Margin Reserve

The use of an aggregate margin in VM-20 presumes that such a margin is added to a reserve amount that doesn't include margins, that is an anticipated experience reserve. So key goals of this report are to define what is meant by an anticipated experience reserve and to identify how an anticipated experience reserve differs from the reserves required by VM-20.

1. Definition of anticipated experience reserve

   Generally, the anticipated experience reserve would be the amount needed today, along with expected future net premium and investment return on the assets backing the reserve, that would be exactly enough to fund all future expected benefits and expenses under the policies being measured.

   As noted in the introduction to this document, VM-20 prescribes certain assumptions and requires margins to be added to each individual assumption that is not already prescribed. Prescribed assumptions may include an implicit margin. The CTE 70 calculation by its nature also represents an implicit margin. For the purpose of determining an aggregate margin approach we have assumed that no margins are included in the anticipated experience reserve. Any implicit margins in the prescribed assumptions and stochastically generated assumptions (e.g., interest rates) or the required margins for non-prescribed assumptions would be excluded from the anticipated experience reserve. We believe that this is a theoretically clean approach to arriving at an aggregate margin method and that there is value in determining an anticipated experience reserve that excludes any margins. It allows for the determination of the overall level of margin included in the final reserve, which may not be readily determinable when using prescribed assumptions that already include margins. We believe it is better to be explicit and transparent regarding the amount of margin included in the reserve and that this information may lead to better determination of needed margins in the future and better risk monitoring and management.

   Due to the nature of the options and guarantees frequently included in insurance products, the concept of "expected" amount often requires the use of stochastic modeling. "Anticipated experience" may be based on the unbiased probability-weighted expected (mean) value of relevant cash flows evaluated across many scenarios, and discounted for the time value of money.

2. Application to VM-20

   Below is a list of the explicit and implicit margins in VM-20.

   a. Mortality assumption
      1. Prescribed margins (the percentages applied to company experience rates and the percentages applied to the industry basic table).
      2. Prescribed grading to an industry table.
      3. Lack of mortality improvement beyond the valuation date.
      4. Required adjustment to modify mortality assumptions for term polices following the end of a level term period.

   b. Policyholder behavior assumption
      1. Explicit margin requirement that is applied to the anticipated experience assumption.
      2. Prescribed use of the Canadian lapse table under certain conditions for ULSG products.
      3. Required adjustment to modify lapse assumptions for term polices following the end of a level term period.

   c. Revenue sharing assumption
      1. Explicit margin requirement that is applied to the anticipated experience assumption.
      2. Prescribed caps (i.e., haircuts) on net revenue sharing income.

d. For all other prudent estimate assumptions, explicit margin requirement that is applied to the anticipated experience assumption.

e. Asset default assumption

   1. For assets with an NAIC designation:

      A. Baseline annual default cost factors.

      B. Maximum net spread adjustment.

   2. For assets without an NAIC designation, the requirement that the net yield be capped at 104% of the applicable Treasury yield rate.

f. For reinvestment spread assumptions, the cap that is based on a 50/50 blend of A2/A and Aa2/AA net asset spreads.

g. Interest rate and equity return assumptions

   1. For the deterministic reserve, use of Scenario 12 from the set of prescribed scenarios used in the stochastic exclusion test (includes an implicit margin since Scenario 12 is based on one-standard deviation shocks for the first 20 years; using Scenario 9 from the set of prescribed scenarios would remove this implicit margin since it assumes no shocks).

   2. For the stochastic reserve, requiring the use of CTE 70 metric (includes an implicit margin since it uses the "worst 30% of outcomes; using a CTE 0 metric based on the mean reserve from the distribution of stochastic outcomes would remove this implicit margin).

We recognize that LATF may want to maintain some or all of the implicit margins listed above. To the extent that any implicit margins continue to be included in the deterministic and stochastic reserve calculations, then appropriate adjustments would need to be made to the aggregate margin to avoid double counting of these implicit margins.

Intent of Aggregate Margin and Risks Covered

A. Intended use of the margin in a statutory framework

1. It is generally agreed that the intended use of reserve margins in a statutory framework is to provide policyholder protection. However, that concept can be hard to quantify. The following issues arise when this is considered.

2. Statutory reserves for long-term life insurance and annuity contracts have historically included large margins. Yet statutory claim reserves for property-casualty business have typically not included any explicit margin, although one can see that there is a small implicit margin due to the absence of discounting.

3. Since both reserves and capital provide policyholder protection, one needs a rationale to differentiate the level of margin in reserves and in capital.

4. A key criterion used to evaluate any aggregate margin approach will be an assessment of the degree of protection afforded to policyholders. This principle implies establishing stress tests of adequacy of the aggregate margin, both in total and by product groupings, while also recognizing the essential role of capital in providing additional protection for tail risks. Thus, quantifying the threshold dividing reserves and capital is an essential goal of this task force, as well as defining product groupings for which the aggregate margin should be stress-tested.

B. Practicality and auditability for regulators

There may be theoretically sound approaches for establishing an aggregate margin that present challenges in terms of their transparency, understandability, and auditability. There are a number of considerations related to auditability of VM-20 margins that are important in selecting an aggregate margin approach. For example, understanding of how the margin covers the underlying individual risks associated with the product, how the margin can be calibrated to the desired level of policyholder protection, how correlations among risks are being developed and considered, and how the underlying assumptions are developed and validated are important components of the aggregate margin.

C. Risks covered by the aggregate margin.

Several different approaches can be used to determine which risks are to be covered by the aggregate margin. Our starting point is to consider all the risks that are typically included in a comprehensive required capital calculation and then make modifications (if needed) to determine risks that we recommend be included in the aggregate margin. Possible approaches include:

1. Identify all risks that are included in capital requirements, but exclude some from the aggregate margin calculation that are not directly associated with the policies being valued.

2. Include all risks that are used for capital requirements, but assume a lower degree of severity for each risk.

3. Include all risks that are used for capital requirements, but measure each risk using a different methodology than what is used for the required capital calculation.

4. Combination of 1 and 2: exclude certain risks from aggregate margin calculation, but for risks that are included in reserves, assume a lower level of severity (this is the current approach used in VM-20).

Let us consider each of these approaches in turn.

1. <u>Recognizing risks by category</u>

This approach would include only those risks in the aggregate margin arising from actual or potential events or activities that are both:

a. Directly related to those policies or contracts or their supporting assets; and

b. Determined to be capable of materially affecting the reserve.

This approach is consistent with the Academy's Consistency Work Group's position on risks that are to be included in principle-based reserves (PBR) versus risks included in RBC. Criteria for categorization of the risks include:

a. Whether the risks have a high likelihood of loss within the projection period;

b. The relationship of the risk to the policy/contract; and

c. How risks affect the amounts, timing and likelihood of the underlying cash flows.

Risks not reflected in the determination of reserves for life insurance and annuities or contracts are:

a. Those that would not be reflected in a fully principle-based approach to the determination of Risk-Based Capital; and

b. Those that would be reflected in a fully principle-based approach to the determination of Risk-Based Capital, but which arise from obligations of the company not directly related to the policies or contracts, or their supporting assets, as described above (for example, general business risks).

2. Assume same risks as capital, but use a different level of severity

   In this case, a targeted probability level is determined, reflecting all risks together. Two different points on this probability distribution are then used to set the level of reserves and the capital requirement. For example, one could specify that reserves cover fluctuations up to some probability level, say 80%, and that capital provides protection up to a much higher probability level, such as 99%. This is similar to the approach for variable annuity reserves and capital (Actuarial Guideline XLIII), although in that case two different distributions are used.

3. Differentiating reserves from capital by using different measures of risk

   A third approach to differentiate the risks used in the aggregate margin from the risks used in capital is to use a different kind of risk measure for each. For example, for the aggregate margin for reserves one can use the market price of risk, as measured by the present value of the cost of capital. For capital itself, one can use a measure based on the probability of sufficiency. This approach is consistent with the idea that reserves provide for expectations, while capital provides for fluctuations. In this example, the expectations that are included in reserves include the expected cost of capital. This serves as the margin for policyholder protection, because it provides for the cost of obtaining new capital if an adverse event results in the loss of the current capital. Another example would be to use anticipated experience for the reserve, without any margin, and to include additional provision for risk in capital.

4. Exclude certain risks in the reserve calculation, and assume a lower level of severity for risks that are covered by reserves.

   As mentioned above this is the current approach used in VM-20. Risks that are not directly associated with the policies being valued are excluded from reserve calculation (i.e., risk of company mismanagement, fraud and theft, company reputation, etc.), and some risks are included are at a lower severity level (interest rate and equity risk are 70 CTE, not 90CTE; mortality risk does not include pandemic risk, etc.).

In principle, the task force supports approach #4 (exclude certain risks and assume a lower level of severity for risks that are covered). This consistent with the Academy's Consistency Work Group's stated position. However, as a practical matter, since the risks that are to be excluded are relatively small, and since the presumed level of severity of these excluded risks will likely be immaterial, our aggregate margin recommendation will not exclude approaches exclusively on the basis that the approach includes all risks.

Application of the Aggregate Margin

The aggregate margin could be used in at least two possible ways. One way is to use the aggregate margin as a "standalone" margin that is added to the anticipated experience reserve without calculating or incorporating the impact of individual margins on each assumption. An alternative approach is to continue to calculate margins for individual risks, and use the aggregate margin in combination with the individual margins.

The application of the approach with a combination of individual margins and an aggregate margin could involve one of the following:

1. Continue to require individual margins on each risk factor, but utilize an aggregate margin as a cap on the total margin produced by using individual margins. Individual margins would remain as defined currently in VM-20.
2. Continue to require individual margins on each risk factor but utilize an aggregate margin as a floor on the total margin produced by using individual margins. Greater discretion would be allowed to determine individual margins, and prescribed margins currently in VM-20 would be eliminated.
3. Eliminate the requirement to determine individual margins on each risk factor, but require that individual margins be determined on specifically identified risk factors in addition to the aggregate margin in limited circumstances (e.g., the aggregate margin does not capture a particular risk that is unique to the product).

The task force recommends the "standalone" approach, based on the following:

1. Determining appropriate margins based on the risk profile of the underlying business is a time-consuming task, whether the margins are individual margins on each risk or an aggregate margin that includes provision for individual risks. Requiring determination of both individual margins and an aggregate margin could result in significant additional work and potentially not add significant value to the results.
2. Use of individual margins on each risk without consideration of the diversification benefits across risks can result in inappropriately high margins, in particular for products with a variety of risk exposures that are not correlated strongly.
3. Unlike individual margins, certain aggregate margin approaches, and in particular the one(s) recommended by the task force, are associated with a specific policyholder protection objective, for example ensuring an aggregate level of confidence that obligations can be met.

Potential Methods Considered

Below is a summary of potential methods considered for the aggregate margin, including a description, pros and cons, details of how the method might be implemented, and a discussion of ways the margin could be adjusted to achieve the desired level of policyholder protection.

The level of aggregate margin will need to be tested in order to provide assurance that the reserves provide an appropriate level of policyholder protection. An example of how such testing could be performed is as follows:

- Several defined scenarios could be constructed that combine deviations from anticipated experience in several factors. These scenarios would need to be considered moderately adverse based on historical experience.
- If based on defined criteria or judgment, the anticipated experience reserve plus the aggregate margin fails to be adequate based on testing with these scenarios, then the aggregate margin would be increased to the point that adequacy is achieved.

A. Cost of Capital Method

1. Description of conceptual method

   The Cost of Capital method is based on the concept that the margins for uncertainty should reflect the cost of holding capital to back the underlying risks being modeled (or valued). This is consistent with the view of margins being required to compensate an insurance company for bearing the risks.[1]

   Under this method the probability level for reserve adequacy depends greatly on the remaining length of the contract. Contracts with many years remaining will have reserves that provide a much higher "probability of adequacy" in the short term than short-term contracts or those that are nearing expiry. This is because the margin is proportional to the cost of holding capital to cover the risks.

2. What are the key components?

   The applicable capital metric and cost of capital are needed at the reporting date and at each projection period in the runoff of the obligations.[2]

   i. $Aggregate\ Margin = \sum_t \frac{K_t \times c_t}{\prod_{s=0}^{t-1}(1+i_s)}$

   ii. $K_t = Capital\ amount\ for\ year\ t$

   iii. $c_t = cost\ of\ capital\ rate\ for\ year\ t$

   iv. $i_t = appropriate\ risk\ free\ rate\ for\ discounting$

3. Defining the cost of capital, c_t, is based on consideration of the "opportunity cost" of holding capital in relatively lower risk (and lower return) assets as opposed to investing that capital in higher return (and higher risk) business opportunities. How this can be applied, i.e., how is K_t determined?

   i. A simplified method would need to be determined to estimate the capital requirement that captures all risks. For example, a modified RBC approach could be used by applying risk factors to key parameters and combining them with a correlation matrix.

   ii. If a stochastic economic capital approach were used to determine the capital, it would be very similar to using a Confidence Interval method as discussed below, but a more extreme point in the tail would

[1] Analysis of Methods for Determining Margins for Uncertainty under a Principle-Based Framework for Life Insurance and Annuity Products; SOA 2009, p.34

[2] Measurement of Liabilities for Insurance Contracts: Current Estimates and Risk Margins; International Actuarial Association; April 2009, p. 79

be selected as the confidence interval for capital than for reserves. Therefore, the considerations discussion below would apply.

4. Pros/Cons

   i. Pros:

      1. The definition of the aggregate margin provides a clear quantification of its level of prudence in the reserves through the defined confidence level.
      2. Methodology is based on an amount to compensate an insurance company for assuming the risk, based on consideration of the "opportunity cost" of holding capital in relatively lower risk (and lower return) assets as opposed to investing that capital in higher return (and higher risk) business opportunities.
      3. Levels of margins are more proportional to the level of aggregate risk associated with the contracts
      4. Other accounting and solvency regimes, such as IFRS and Solvency II, use this method
      5. There are existing capital frameworks that capture most material risks that may be leveraged for use in the method

   ii. Cons:

      1. Methodology is based on the cost of capital and not a direct quantification of the level of confidence provided to cover provision for the risk, therefore stress testing of the confidence level in a "runoff" situation may be needed for regulatory purposes.
      2. Methodology produces a margin that may be different than the amount needed to protect the policyholder if the obligation is not transferred and the obligations are run off.
      3. Methodology may produce margins that are lower than other methods for short-term contracts and higher than other methods for long-term contracts. This has the potential to impact the products offered.
      4. If a single, standardized capital method (for example, formulaic statutory risk-based capital) is the basis for the Cost of Capital method, the methodology may fail to reflect the individual characteristics of companies.
      5. Methodology may not reflect the fact that many policies have mechanisms to adjust for adverse experience (e.g., policyholder dividends, COIs and other non-guaranteed elements).

5. Calibration

   i. There are two main levers for adjusting the level of aggregate margin calculated using this method:

      1. Level of capital required

         - Theoretically, this would correspond to the target surplus needed to support the liabilities and would reflect the unique risk profile of each company. However, a more general measure is needed to create a level playing field for companies for the purpose of calculating aggregate margins.
         - For example, if Company Action Level RBC (CAL RBC) were to serve as the proxy for capital, then a multiple of CAL RBC could be used in the aggregate margin formula. Some companies currently use a multiple of simplified CAL RBC as target surplus in their pricing models.
         - Note that whatever measure of capital is chosen, it will be subject to definitional updates over time as new risks emerge and other changes take place.

      2. Cost of capital rate

- Theoretically, this would represent the weighted average cost of capital as determined by each company given its capital structure and risk profile. However, for the purpose of aggregate margins, a more general measure of cost of capital is needed.
- A question needing to be answered is whether this is a long-term, relatively fixed number or a dynamic value that could change more frequently.
- For example, a certain number of basis points above a point on a historical Treasury yield curve could be chosen as a proxy for the cost of capital.

B. Percentage Method

1. Description of conceptual method

   i. Define an approach to determine an anticipated experience reserve and then apply a prescribed fixed percentage to the anticipated experience reserve to determine an aggregate margin that reflects the underlying risks of the policies.

   ii. The prescribed percentage will vary depending on a high-level assessment of the risks underlying the policies. These percentages could be as simple as a 3-factor "High/Medium/'Low" approach, or a more complex table look-up based on multiple factors such riskiness and mix of asset portfolio, level of policy guarantees, mix of product types (ULSG, term, WL, etc.), rigor of underwriting practices, etc.

2. What are the key components?

   i. Anticipated experience reserve (AER)

   ii. Table of prescribed percentages to apply to the AER

3. How can this be applied?

   i. An underlying methodology or analysis would be used to determine the appropriate percentages to be applied to the AER for each risk covered by the margin.

   ii. Percentages could be aggregated based on some assumed underlying mix of risks or could be applied for each individual risk with some consideration of non-correlation benefits.

4. Pros and Cons

   i. Pros: simplicity

   ii. Cons:

      1. May not properly capture the underlying risks of the company due to the simplified method to quantify the margin.
      2. Methodology may not be sufficient to protect the policyholder with a desired degree of confidence, unless a confidence level test is also performed.
      3. The level of margin produced may be disproportionate to the amount of aggregate risk in the products, and therefore may be insufficient in certain durations and/or overly conservative in others.
      4. The methodology may fail to reflect the individual characteristics of companies. Therefore, this method may be counter to the objective of PBR to "right-size" reserves.
      5. Methodology may not reflect the fact that many policies have mechanisms to adjust for adverse experience (e.g., policyholder dividends, COIs and other non-guaranteed elements).

5. Calibration

   The prescribed percentage value(s) can be adjusted up or down to calibrate the margin.

C. Confidence Interval Method

1. Description of conceptual method

   i. This method determines the reserve under multiple scenarios that cover the universe of possible economic and policyholder behavior outcomes. Once a distribution of outcomes is determined, a point on the distribution (the confidence level) is then selected to determine the reserve amount.

   ii. The selection of the confidence level determines the extra amount required to be added to the anticipated experience reserve so that the actual losses will be less than the amount of the liability with the chosen level of confidence. This is often referred to the Value at Risk (VaR) approach.

   iii. The Conditional Tail Expectation (CTE) is a modified Confidence Interval method. It calculates the mean of the losses of a defined tail of a distribution. For example, CTE(70) is the mean of the highest 30% of the distribution. (This approach is used for variable annuity reserves under Actuarial Guideline XLIII.)

   iv. In terms of differentiating between reserves and capital, a different confidence level is used for reserves versus capital.

2. What are the key components?

   i. The number of scenarios that cover all risks that are used to produce the distribution of outcomes.

   ii. The point on the resulting distribution that is used as the reserve (i.e., the confidence level). The confidence level should consider such factors as the mean, the degree of skewness and the purpose of the valuation.

   iii. For the CTE approach, the CTE level is required and the margin is calculated as the difference between the chosen level and estimate of the mean for the distribution.

3. How can this be applied?

   The method requires estimates of the parameters of the statistical distribution being studied. These can be estimated from historical experience or using judgment. For example, one could estimate the mean and standard deviation for mortality rates given a group of policies and time frame.

   Ideally, a single multivariate distribution of outcomes, covering all risks, would be determined. However, this is extremely difficult to do. Hence, some proxy for this joint distribution of outcomes would need to be used. Examples of possible approaches include:

   i. Determine outcome distributions for each risk and then apply a set of co-variance/correlation factors to “blend” the distribution outcomes into a single reserve number.

   ii. Copula approach

   This method would involve combining individual risk distributions together using copulas, the result of which would be a distribution of losses across all risks. From this aggregate risk distribution, a point (or average of points) could be chosen as the basis for the aggregate margin. In addition, in the event that a company might be using its existing risk aggregation approach, including use of copulas, to support the derivation of an aggregate margin, there is no reason this approach could not be used. It does not appear viable as a required approach though in light of its complexity. Further details on copulas can be found in the appendix.

4. Pros and Cons

   i. Pros

   - It is relative transparent and easy to communicate.
   - Historical experience and company data can be used.

- It involves a clear articulation of the level of confidence the margin provides to cover policyholder obligations in the event the company retains the liabilities.

ii. Cons

- Risk factors do not follow clearly defined probabilistic distributions.
- Developing a single multivariate distribution is complex.
- Methodology is based on the amount needed to protect the policyholder if the obligation is not transferred and the obligations are run off.
- Methodology may produce margins that are higher than other methods for short-term contracts and lower than other methods for long-term contracts. This has the potential to impact the products offered.
- If standardized approaches are used to simplify assessment of the risk at the desired level of confidence, the methodology may fail to reflect the individual characteristics of companies. Therefore, this approach may be counter to the objective of PBR to "right-size" reserves.
- Methodology may not reflect the fact that many policies have mechanisms to adjust for adverse experience (e.g., policyholder dividends, COIs and other non-guaranteed elements).

5. Calibration

The prescribed confidence level can be adjusted up or down to calibrate the margin. In addition, conservatism can be added to the copulas or correlations used to combine risk factors to limit the level of cross-risk non-correlation recognition.

D. Other potential methods that were considered and discarded, and the rationale for discarding such methods, are summarized below:

1. A "pure" exit value method, under which the value of the liability would be based on the amount that would be paid by a willing seller to a willing buyer to transfer the liability in an arms-length transaction. This method was discarded based on the undesirable characteristics associated with period-to-period volatility of the measurement as market conditions change, and the introduction of an "own credit" component that would result in a declining liability in the event that an insurer's credit rating deteriorated.
2. An adjustment to the discount rate, under which the aggregate margin would be developed based on reducing the liability discount rate. This method was discarded based on lack of transparency (i.e., it is hard to assess whether the level of margin using this approach is appropriately capturing all material risks).
3. Use of sensitivity testing as the basis for the margin. This was a method considered in the SOA research report described in the Background section of this paper, which, according to that report, has several favorable characteristics. However, the focus of the SOA's work was on margins for individual assumptions, not an aggregate margin approach. This method was discarded as a standalone approach for an aggregate margin since the selection of specific sensitivities as the basis for determining an aggregate margin may not appropriately capture all material risks, may not reflect correlations among risks, and is not transparent in terms of the level of policyholder protection afforded by the resulting total reserve amount. However, use of sensitivity testing is recommended as a method to test the adequacy of the total reserve developed using one of the other aggregate margin approaches.

Recommendation and Rationale

Based on our conceptual analysis of the potential methods for determining an aggregate margin, the task force tentatively recommends a Cost of Capital method, pending further analysis of the practical implementation approach for such a method. While the task force has considered some of the practical implementation issues in coming to this recommendation, the detailed implementation method is a critical next step. To the extent that that detailed implementation work results in significant issues in terms of practicality of the Cost of Capital method, an alternative approach may be required. In light of the potential for issues regarding practicality, the task force also recommends that further analysis of the potential implementation approach for the Confidence Interval method also be considered. The task force believes that Cost of Capital and Confidence Interval are both robust methods that meet our overall objectives and therefore warrant further analysis as to practicality and auditability in order to facilitate a final decision.

The rationale for selecting the Cost of Capital method as the preferred method includes:

1. The definition of the aggregate margin provides a clear quantification of its level of prudence in the reserves. In particular, the Cost of Capital methodology is based on the premise that the reserves will be sufficient so that the liabilities could be transferred to another market participant such that that market participant can appropriately cover the associated risks in the business. This premise implies protection to the policyholder, since another market participant would be willing to uphold the obligations. A key component of this protection, however, is that the capital used in the Cost of Capital method adequately captures all material risks to the market participant. Therefore, in the event that such capture of all material risks proves to be a significant challenge, this method may not meet this desired characteristic.
2. A Cost of Capital-based margin is consistent with the treatment of the risk that policyholder obligations will exceed expectations in the marketplace. Most market participants evaluate purchase decisions in relation to the potential return on their investment. Often with transactions in industries such as insurance, where capital is required to be held at a certain level in order to continue operating and absorb fluctuations in underlying experience, the economic cost of holding this capital is reflected in the measurement through a reduction in the expected return on investment. As a result, the Cost of Capital method is often used as opposed to other measurement techniques. It most closely aligns the measure of risk (the amount of capital deemed necessary to hold – however it is measured) with how market participants evaluate potential purchase decisions. Absent any regulatory constraints, economic capital might be the most theoretically appealing measure of capital that could be used in a Cost of Capital method, but that is not the only approach that could be used.
3. Other accounting and solvency regimes, such as IFRS and Solvency II, use this method. In light of the increased globalization of the insurance industry, and the increased coordination of regulators across the globe, increased consistency of methodology is desirable.
4. There already exists in the marketplace several accepted capital measures, e.g., Statutory Risk-Based Capital and Rating Agency Capital, for insurers that could potentially be leveraged for purposes of determining the Cost of Capital. Since many of these measures are well known by insurers and regulators, have been used and tested over time, and are relatively robust in terms of capturing risk, one or more of these could serve as inputs to the calculation. Any use of existing capital measures would need to be modified to meet the other criteria described in this paper, for example, to appropriately include material product risks such as policyholder behavior; but the ease of determination of RBC relative to other potential approaches described in this paper may enable a more practical and consistent implementation.

The rationale for recommending continued investigation of the Confidence Interval as well, as a potential alternative method, is based on the following:

1. This method meets the policyholder protection objective through explicit identification of a specified level of confidence that policyholder obligations will be met.
2. This method allows for consideration of all material risks as well as correlations among risks.
3. This method is consistent with some existing statutory reserve and capital requirements, such as Actuarial Guideline 43 and Risk-based Capital requirements for variable annuities.
4. Many of the practical challenges associated with determining capital under a Cost of Capital methodology also arise in determining a margin under a Confidence Interval method. Therefore concurrent consideration of practical issues for the two methods, while taking more time than evaluating a single method, is not double the work.

In addition, since the pattern of the margin runoff may be quite different between the two methods, it may be worth further investigation of the impact of both Cost of Capital and Confidence Interval on representative blocks of business.

Potential Approaches for Implementation

A full implementation of either a Cost of Capital or a Confidence Interval approach may not be feasible for many companies, particularly if they qualify for the Stochastic Exclusion under VM-20. Both methods require the development of a distribution of potential future outcomes considering all material risks, which can be challenging to implement. Therefore we considered possible simplified approaches to implement a Cost of Capital or Confidence Interval method, including the following:

1. Representative Scenarios Approach
2. Use of Company's Internal Capital Model
3. Use of External Capital Measure (RBC or Rating Agency)

Further details regarding each of these follows.

A. Representative Scenarios Approach

This approach uses a small number of deterministic scenarios to arrive at an aggregate margin. The procedure can be used to calculate a margin under either the Cost of Capital method or the Confidence Interval method, with only minor differences as noted below. The procedure can be described using the following steps:

1. Identify a short list of primary risks that the company faces and that drive the variability in financial results for this product. The list will always include future investment conditions, but may include mortality, persistency, and some other aspects of policyowner behavior (e.g., election rates for optional benefits).

2. For each risk, develop a small number of scenarios involving adverse experience for the risk driver. For the Cost of Capital method, these scenarios must be at the worst likelihood of occurrence that is to be provided for by the sum of reserves and capital. For the Confidence Interval method, these scenarios should be at the level that is to be provided for by reserves alone.

3. For each scenario, calculate the scenario reserve. The scenario reserve is equivalent to the amount of starting assets required to fund the liabilities in that scenario.

4. For each risk, determine the scenario with the greatest scenario reserve. Subtract the anticipated experience reserve from the greatest scenario reserve for a risk driver to get the risk amount for the risk driver. These risk amounts are conceptually much like the C1, C2, C3, and C4 capital requirements used in RBC, except that they may be enumerated differently. For the Cost of Capital method, the amount for each risk is intended to be at the level the company normally carries rather than a regulatory minimum.

5. Determine an aggregate risk amount by aggregating the amounts for each risk, reflecting correlations among risks. The simplest approach to aggregate individual risk margins is through the use of a correlation matrix. A more complex approach involves the use of copulas. These methods, including a sample correlation calculation, are discussed in more detail in Appendix III. To meet the objectives of practicality and auditability, a correlation approach may be desirable.

6. Use the aggregate risk amount determined in this way as the basis of the aggregate reserve margin. This can be done in one of two ways, depending on the theory being used for the margin.

    a. Cost of Capital Method. The aggregate risk amount is treated as the starting capital amount because the scenarios used to determine the risk amount were at that level of severity. Set the margin equal to, for example, 6% (the cost of capital rate) of the present value of projected capital amounts. The projected capital amounts can be obtained by applying a multi-factor formula to the

runoff of the liability in the anticipated experience scenario. The multi-factor formula may be something like x% of expected claims plus y% of the best estimate reserve. Companies could be allowed to use any reasonable multi-factor formula for this purpose, subject to the need to scale the factors to reproduce the starting capital amount. Other constraints may be appropriate.

b. Confidence Interval Method. Set the reserve margin equal to the aggregate risk amount. Since the scenarios used to determine the risk amount under the confidence level approach were at the level of severity that is to be covered by reserves, the aggregate risk amount can be used directly and no further calculation is required to convert the risk amount into an aggregate reserve margin.

Step 2 is a key to this process. Scenarios must be developed for each risk driver at an experience level that is appropriate for the approach being used. For the Cost of Capital method, this experience level can be defined as the 99.9% point on the distribution of the risk driver, or about three standard deviations from the mean. For the Confidence Interval method, this experience level can be defined as the 84% point on the distribution, or about one standard deviation from the mean. If one can define anticipated experience and the distribution of each risk driver around anticipated experience, then scenarios involving experience at the desired percentile level can be computed.

The procedure for computing scenarios at a pre-determined probability level can be the procedure developed to define scenarios in the Stochastic Exclusion Test as defined in VM-20, which is based on the mathematical theory of random walks.

The margin under this approach will be driven by the width and skewness of the distributions around anticipated experience for each risk driver. Regulators may wish to specify the width (standard deviation) and skewness of the distributions for common risk drivers, perhaps allowing exceptions only with the approval of the commissioner. Assumptions regarding the anticipated experience at the center of these distributions might be allowed to be determined by the valuation actuary, subject to staying between some regulatory "guard rails" that define a wide range.

B. Use of Company's Internal Capital Model

Many companies have developed an internal capital model as part of their overall risk management process. Allowing the company to utilize the results from their internal model, perhaps with some modifications, would greatly simplify the aggregate margin calculation. These internal models can be quite robust, often times utilizing stochastic calculations and techniques to recognize risk offsets (such as correlation matrices). The company would then not need to develop a separate target capital amount or an aggregate risk amount just for the purpose of the determining the aggregate margin, but could leverage the work that has already been done from its own internal capital analysis.

Under the Cost of Capital method, the internal capital amount would be used as the starting capital amount for the Cost of Capital calculation, but projected capital amounts would still need to be estimated to determine the present value of future capital amounts that would be multiplied by the cost of capital rate (for example, 6%). These projected capital amounts could be determined similar to the process described above (i.e., applying a multi-factor formula to the runoff of the liability).

It is very common for companies, regardless of size or sophistication, to include a measure of capital in its pricing studies. For the purposes of this paper, we will call this capital amount the "target surplus." The pricing of any life insurance product includes target surplus in order to ensure that the long-term capital and surplus of the company are sufficient for the ongoing solidity of the organization, including the maintenance of favorable evaluations by the rating agencies. Therefore, one of the key metrics in pricing is called "distributable

earnings," which represents statutory book profits minus the change in target surplus during the accounting period.

In practice, a company derives its aggregate level of target surplus and then develops target surplus formulas for each line of business or product group that calibrate well to reproduce the desired aggregate level of target surplus. The development of these target surplus formulas by line of business or product group has the effect of allocating that surplus to those specific lines of business or product groups. These target surplus formulas are also used to project target surplus year by year as the block of business ages in the pricing models. The formulas can be thought of as the implementation of an overall company capital strategy, the practical faces of an internal capital model, whether based on sophisticated risk models or a simple multiple of Risk-Based Capital.

The important point to remember is that life insurance companies use these formulas in pricing. For the cost of capital approach, these formulas might serve as the basis for calculating aggregate margins by product line or product group, possibly subject to a regulatory guardrail relating to the aggregate level of target surplus and certain criteria pertaining to the allocation of target surplus to the lines of business or product groups.

Under the Confidence Interval method, the internal capital model would need to be modified to only capture the risks of the company included in reserves, and at the appropriate lower level of severity that is to be covered by reserves. This should be a relatively straightforward modification, depending on the type of internal capital model that is being used. Once this adjusted risk amount is determined, it becomes the aggregate reserve margin.

The benefits of this approach are:

- The risk amounts used to determine the aggregate margin are directly aligned with the risk management practices of the company.
- Eliminates additional risk calculations for the aggregate margin calculation that are used only for that purpose.

The disadvantages of this approach are:

- Limited transparency and auditability, in particular if the models are stochastic in nature.
- Lack of consistency in the approach used to determine internal capital across companies.
- Not all companies have developed a robust internal capital model.

C. Use of External Capital Measure

There will be insurance organizations that have not developed internal capital models and may want to leverage the calculation of required capital they perform for other purposes. These calculations might include required capital as defined by insurance regulators (e.g., NAIC RBC) or ratings agencies (e.g., AM Best or S&P). The benefit of starting the measurement of a margin with these types of required capital calculations is that they are in many cases already being performed on a regular basis and to a large extent understood. These calculations are often incorporated into key indicators that are regularly monitored by company management and considered in the active management of capital. As the objective of these calculations is not completely consistent with the establishment of an aggregate margin for statutory reserves determined under PBR, it will be necessary to make some adjustments. Those adjustments may include adjusting the risks considered and to calibrate the risk severity to the appropriate level for an aggregate margin.

Types of Risks Considered

Industry participants and observers often have different opinions as to what risks should be covered by reserves and what risks should be covered by capital. As noted earlier in this paper the Academy's Consistency Work Group produced a document that identified certain risks that should be covered by capital and not reserves. External capital measures may include elements that cover risks that should not be included in an aggregate margin to be used for reserve purposes. Thus, these external capital measures should be adjusted to remove such components before they are calibrated for use in an aggregate margin. For example, a company using NAIC RBC as a starting point would want to remove much of the general business risk (C-4) component from the required capital calculation as this may be considered unrelated to the underlying insurance contracts for which the margin would be calculated.

Calibration

External capital measures (such as Statutory Risk-based Capital) are typically calibrated based on the assumption that a certain level of risk is already covered by the underlying reserves. As such, the external capital covers a layer of risk beyond the reserve and up to the level of sufficiency that is targeted by the regulator or rating agency that set the measure. For use in establishing an aggregate margin for principle-based reserves the capital measure will need to be translated or calibrated to the capital level needed for the reserve margin. One approach would be to perform simplified modeling as noted in the section above and compare the required amount of capital from the model to the amount of required capital in the external capital measure. The resulting ratio of modeled to external capital could be used to calibrate the external capital measure during subsequent valuations for determination of an aggregate margin. Periodic retesting of the calibration ratio would be necessary. However, this retesting could take place outside of the financial close process. This would provide the benefit of not having to do the testing at each valuation date.

D. Recommendation

Of these three potential approaches to implementing the aggregate margin (under Cost of Capital or Confidence Interval), the task force recommends a Representative Scenarios Approach as the most beneficial. This approach retains many of the conceptual benefits associated with use of a full stochastic distribution, such as:

- Consideration of all material risks
- Ability to maintain internal consistency among the best estimate reserve, the margin, and capital, to the extent desired
- Consideration of correlation among risks
- Ability to specifically identify a level of confidence of meeting policyholder obligations, either for the reserve margin directly in a Confidence Interval method or for the capital underlying Cost of Capital

In addition to these conceptual benefits, the Representative Scenarios Approach is reasonably practical and transparent since it involves a number of scenarios that could feasibly be reviewed and/or audited, transparency into the underlying cash flows for those scenarios, and a consistent approach across companies.

Potential issues with using a company's internal capital model include:

- Limited transparency and auditability, in particular if the models are stochastic in nature
- Differences, potentially significant ones, in the approach used to determine internal capital across different companies
- Inconsistencies among companies in the calibration level (for example, using a 99.5% confidence interval or 90% CTE, etc.) for internal capital, which may not be desirable for a regulatory framework (this could potentially be addressed by minimum floors)

Potential issues with using an external capital measure include:

- Missing risks, for example policyholder behavior risk may not be included in Risk-based Capital
- Lack of transparency and auditability for certain components of the capital measure, such as confidence level, correlation assumptions, etc., depending upon which capital measure is used
- Potential for inconsistency between determination of margin and determination of underlying reserve, depending on which capital measure is used

Practical Considerations for Recommended Methods

There are a number of practical considerations that must be considered as part of the selection and design of an aggregate margin approach for potential inclusion in a principle-based reserve framework. As described above, the scope of the work of this task force was not to develop a full methodology and design for an aggregate margin, but rather to recommend a conceptual method along with sufficient information to allow regulators to assess the recommendation and determine next steps. Therefore this section is designed to provide some insight as to the practical considerations associated with our recommendation – in particular how the following considerations might affect the decision to use a Cost of Capital or Confidence Interval methodology for determining aggregate margins:

- Practicality, auditability and transparency (including small company considerations)
- Pattern of margin runoff and extent of surplus strain
- Alignment of approaches for reserves and capital
- Approach for allocation of margin to the product level
- Responsiveness to market conditions ("dynamic-ness")
- Stress testing resulting reserve for adequacy

These items are considered based on an assumption that the practical implementation approach used for the margin is the Representative Scenarios Approach described above.

A. Practicality, auditability, and transparency

Under the Cost of Capital method, there are two key components that would need to be determined and then reviewed – the cost of capital rate and the amount of capital. A practical approach to setting the cost of capital rate is for that rate to be set by regulators and updated periodically as market conditions warrant. This would allow for practicality and auditability. In the event that this simple approach does not adequately reflect company-to-company differences, a tiered approach or use of minimums are potential alternatives.

As described above, the Representative Scenarios approach is one practical method that could be used to determine capital under the Cost of Capital method and also to determine the confidence interval margin under the Confidence Interval method. Since such an approach would use a relatively limited set of scenarios rather than a full stochastic distribution, it would be both practical for companies to implement as well as auditable by auditors and regulators. The details of how this would be implemented are described above. The details of how the margins derived under such an approach might be audited or reviewed are summarized below.

As described above, for each risk driver, the approach would involve calculation of a "risk amount," the difference between the anticipated experience reserve and the greatest scenario reserve. The resulting risk amounts would be aggregated using a correlation matrix. Therefore, the specific items to be audited or reviewed would be:

- The anticipated experience reserve amount
- The greatest scenario reserve amount (for each risk driver)
- The scenarios used to determine the greatest scenario reserve amount (for each risk driver)
- The correlation matrix used to aggregate risk amounts into a single aggregate margin
- The calculation of the aggregate reserve amount resulting from combining individual risk amounts using the correlation matrix.

1. Anticipated Experience Reserve

This would need to be reviewed regardless of the method used to determine the aggregate margin, and therefore is not covered further in this paper, which is focused on determining the aggregate margin (not the anticipated experience reserve).

2. Greatest Scenario Reserve Amount

The greatest scenario reserve amount for each risk driver would be calculated in a manner similar to the anticipated experience reserve, except that the assumptions associated with the specific risk driver being analyzed would be more severe. Therefore, the approach to reviewing this reserve would be similar to that used in any principle-based reserve calculation and would involve items such as the following:

- Reviewing the anticipated experience assumptions for reasonableness, consistency with experience as applicable, and consistency with regulatory requirements
- Reviewing methods used to group policies into model cells and associated demonstrations of the reasonableness of the method
- Reviewing trends in the reserves over time and discussing drivers of change with the company
- Performing (or reviewing the company's) analytical tests on output from the cash flow projection model, such as static and dynamic validations, ratio analysis of specific cash flow items (i.e., premiums per unit, expense per unit or premium, investment income as a percentage of assets, etc.)
- Testing (or reviewing the company's testing) of underlying data (for example, underlying inforce data or data driving experience assumptions) to ensure accuracy and completeness

In addition to these tests, regulators could compare the cash flows for the greatest scenario reserve for a specific risk factor to the cash flows for the anticipated experience reserve to determine whether the relationship between the two is reasonable in light of the risk factor being analyzed. For example, if the risk factor is expenses, it would be expected that most of the greatest scenario reserve cash flows would mirror those of the anticipated experience reserve other than expenses, which would be higher.

The audit or review would not necessarily involve performing the above procedures for each greatest scenario reserve. Instead, the regulator could select a subset of risk drivers based on one or more of the following:

- Assessing which risk drivers are the biggest contributors to the aggregate margin
- Randomly selecting risk drivers
- Focusing on risk drivers not recently tested or that have changed materially since the last review

3. Scenarios Used for Greatest Scenario Reserve Amount

One potential approach is for regulators to prescribe the scenarios to be used to determine either capital under the Cost of Capital method or the confidence level under a Confidence Interval method. If the scenarios are prescribed, regulators could then simply review the company's analysis to check that the prescribed scenarios are being used. This approach is recommended for market and credit risk, since the degree of stress for a specified confidence level would not be company-specific. Prescribed scenarios may also be a reasonable approach for non-market or credit scenarios, since even when companies have their own experience related to these risks, that experience is not likely to be sufficient to support independent derivation of a confidence level if it is a tail event, due to the infrequency of such event occurring.

To the extent companies are allowed to use their own stress scenarios, one way such assumptions could be reviewed would be to compare the company's scenarios to some prescribed set or range, and require that companies provide the experience data used to derive the scenario to support using something less

conservative (more conservative scenarios may not need close review). Regulators could also request comparisons of results for the scenarios used as compared to the prescribed scenarios to better understand whether they result in lower reserve margins.

4. Correlation Matrix Used for Aggregation

   One potential approach is for regulators to prescribe a correlation matrix and then simply review the company's analysis to check that the prescribed matrix is being used. This approach is recommended for market and credit risk, since correlations among these risk drivers would not be company-specific. Prescribed values may also be a reasonable approach for other risk drivers, since even when companies have their own experience related to risks, that experience is not likely to be sufficient to support independent derivation of a tail, or even moderately severe, correlation assumption.

   To the extent companies are allowed to use their own correlation assumptions, one way such assumptions could be reviewed would be to look at some range of correlation benchmarks (some of which are publicly available or could be developed based on a set of company data) to see if the company assumptions are within the range. Regulators also could request sensitivity testing of correlation assumptions to determine which correlation assumptions have the biggest impact on reserve results.

5. Calculation of Aggregate Reserve Amount

   This item could easily be reviewed, since it is simple matrix multiplication and could be easily replicated. See Appendix III for a simple example of the calculation.

B. Pattern of margin runoff and surplus strain

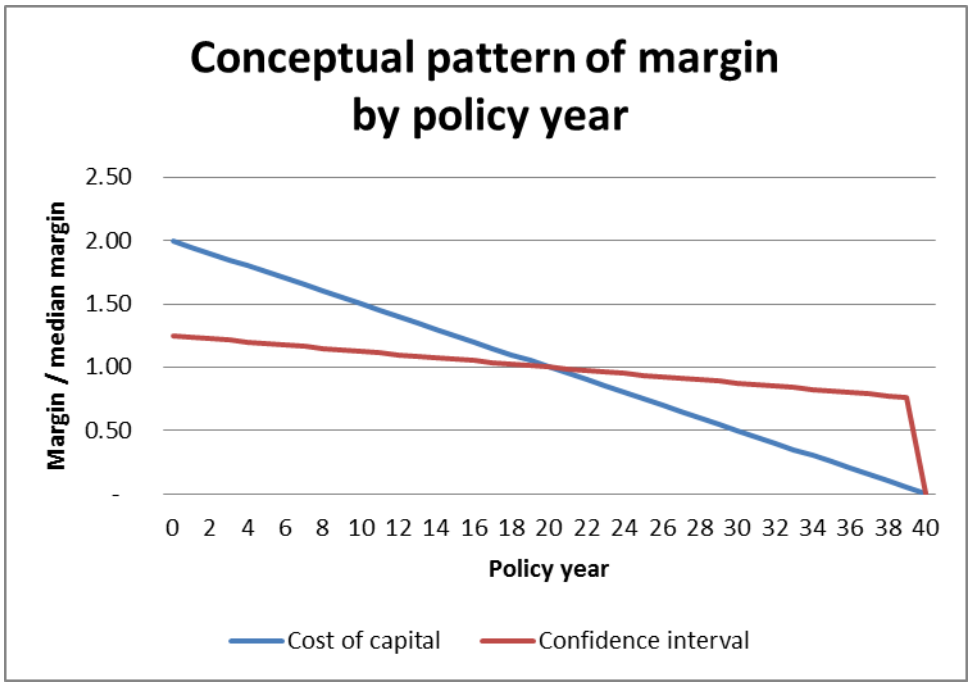
In light of the objective of policyholder protection, one desirable characteristic of an aggregate margin is that it reflects the extent of risk associated with the remaining obligations, and that the runoff of the margin would generally be proportional to the release from risk.

The Confidence Interval and the Cost of Capital are two different measures of risk, and the difference in measurement approach leads to a difference in the pattern of margin runoff as a contract ages and expires. The Cost of Capital method is designed to release margin to cover the cost of capital each year. Assuming that the capital measure is a good measure of the risk associated with the obligations, the runoff of the margin would be proportional to the release from risk. The Confidence Interval method has no clear connection to a pattern of margin release, and generally releases margins more slowly, with a much larger remaining margin just before the contract terminates.

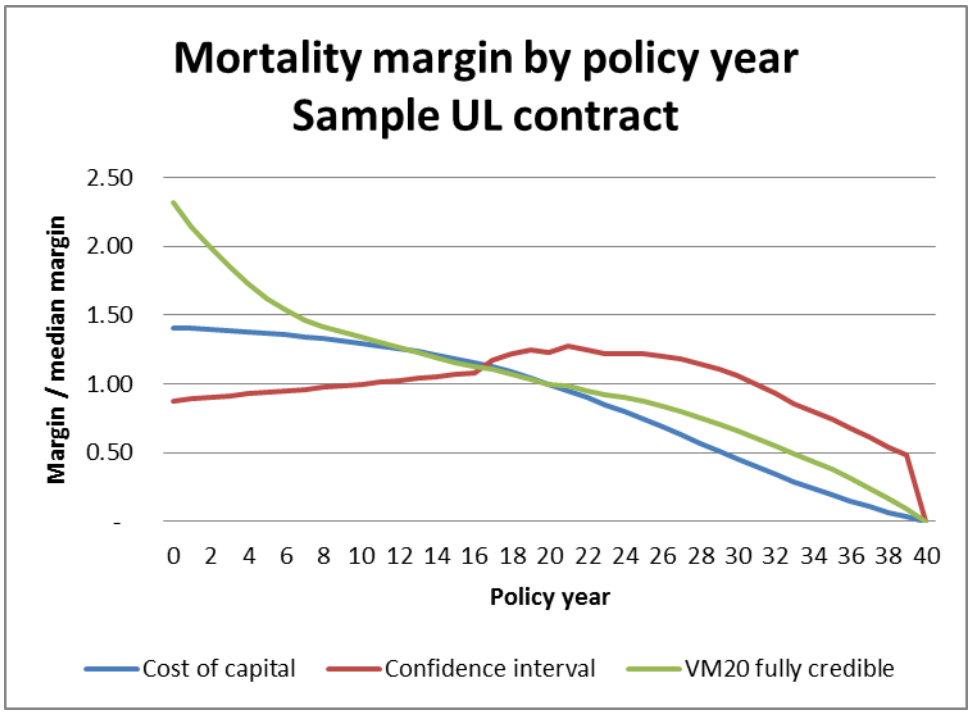
In general, when compared to the Confidence Interval method, the Cost of Capital method leads to higher margins for contracts with a very long remaining term and lower margins for contracts that are near expiry. For a mature block of contracts with a variety of remaining terms that on average are near the median term at issue, the level of margin under the two methods should be comparable if the margins are calibrated to be approximately equal for a median duration.

The chart below illustrates the pattern of margin runoff that could be expected for a long-term contract. This example is illustrative only, for a single term contract, and was designed such that the midpoint margin is equivalent between the two methods. The risk factors included were interest rates and mortality (pandemic and misestimation risks). Very simple underlying assumptions were used, and the actual margin pattern will differ, perhaps materially, if different assumptions were used. The confidence interval amount was assumed to equal half of the capital used in cost of capital for simplicity.

Under the Cost of Capital method the margin starts at a higher level but is released more quickly. Under the Confidence Interval method the margin is released more slowly over time and a significant margin remains until contract expiry.



While the pattern above may hold in general, it will differ for any specific contract. The task force carried out a sample calculation limited to the mortality margin for a Universal Life contract and obtained the results in the chart below. For comparability, we assumed that the margins under any approach would be calibrated so that the median margin over the life of the contracts would be the same.



The comparative patterns of margins under the Cost of Capital method and the Confidence Interval method are more or less as expected in this example. The margin under the Cost of Capital method starts higher and runs

off more quickly. In this case the margin under the Confidence Interval method actually increases in early years as the effect of mortality selection wears off and discounting for interest wears off.

For comparison, the mortality margin under VM-20 is shown for a company with fully credible experience and a "sufficient data period" of 10 years. The pattern of margin release is mostly between the two other methods in later policy years. In early policy years the VM-20 margin is higher mainly due to the required blending with a standard table for periods more than 20 years in the future. In this example the standard table had higher mortality than company experience.

Related to the pattern of runoff, another practical consideration is the extent of surplus strain that may be created by the margin approach, as it could affect the viability of continued issue of new business for individual companies or the industry more broadly. The relative surplus strain associated with any approach depends on the standard of comparison. In comparison with the Confidence Interval method, one can say that the Cost of Capital method will lead to more surplus strain when issuing long-term contracts, and less strain when issuing short-term contracts. But current statutory reserves do not use a Confidence Interval method; most are net premium reserves and the implied Confidence Interval is inconsistent between products and among companies. Further, the margins under VM-20 are larger in some cases than those under either the Confidence Interval or Cost of Capital method, as illustrated in the chart above. So it is difficult to make any comprehensive statement about the level of surplus strain that might be associated with the proposed methods relative to current statutory reserves.

C. Alignment of Reserves and Capital

Although the charge of this task force is to develop a recommendation for determining an aggregate margin method for reserves, the task force recognized the important role that capital plays in providing additional protection for tail risks. Throughout the paper consideration is given to capital implications. This is the case for both conceptual as well as practical implementation considerations.

Most recent efforts towards principle-based reserve methods in the U.S. have been using the Confidence Interval method. Under the Confidence Interval method both the reserve margin and capital are viewed as parts of the buffer against adverse experience, with the reserve margin viewed as sufficient for "moderately adverse" events and capital being a supplement for more severe events. The distinction between reserves and capital has been expressed in either or both of the following ways:

- The reserve margin does not cover some risks, as those risks are covered by capital
- The reserve plus margin provides a lower probability of sufficiency than the sum of reserves and capital

There is no clear distinction or "cutoff" between the reserve margin level and the capital level.

One reason for our tentative recommendation of the Cost of Capital method is that it may provide more conceptual clarity regarding the separate roles of reserve margins and capital. To understand this, it is helpful to consider what happens to a company after an adverse event occurs. Assume the adverse event is sufficiently costly that it depletes the company's entire buffer against such events.

Under the Confidence Interval method, the buffer consists of the sum of capital and the reserve margin. If the company loses both of these, the company is left with assets less than reserves. It is insolvent and guarantee funds would need to make up the deficiency in reserves before markets might be tapped to replenish capital.

This situation occurs because the reserve margin is viewed as being available to cover the cost of the adverse event. Under the Cost of Capital method, the reserve margin is not viewed as available to cover the cost of an adverse event[3] – that role falls to capital. The purpose of the reserve margin is to cover the cost of having to hold capital going forward, so that if another market participant is to take over the obligations, the assets supporting reserves plus margins covers the cost holding the associated capital.

The Cost of Capital method therefore provides a clear distinction between the roles of reserve margins and capital. Capital provides the buffer against adverse experience, while the reserve margin provides for the cost of maintaining that buffer. In each reporting period, the cost of maintaining the buffer is released from the reserve margin, thereby defining the pattern of runoff of the reserve margin as shown in the previous section. For short term contracts, since the single period cost of maintaining the buffer is a small fraction of the buffer itself, the reserve margin is small relative to capital. For longer term contracts, since the present value of the cost of maintaining the buffer for a long period can be large, the reserve margin is large.

It may at first seem that the Cost of Capital method is more conservative since the margins are higher at contract inception. If the entire buffer against adverse experience must be in capital, then capital would need to be larger than if part of the buffer is in the reserve margin and only the remainder is in capital. However, there is a question of the time period over which volatility due to adverse events is measured. Under the Cost of Capital method that time period can be shorter than the life of the contract. It can be thought of as the time horizon for management or regulatory action – that is, the time horizon required for an adverse event to be recognized and for management or regulatory action to be taken to mitigate the impact of the adverse event. This may be just a few years, if management or the regulator believes that a few years is sufficient time to put mitigation plans in place. The volatility due to adverse events over a limited time period may be less than that over the life of the contract. This does not mean that volatility over the life of the contract is not considered, simply that remedial action by the company or the regulator does not need to be delayed until all contracts expire.

In summary, it is clear that both reserve margins and capital play important roles in providing policyholder protection. We have recommended the Cost of Capital method partly because it lends conceptual clarity to the difference between the roles of reserve margins and capital, thereby helping to better align them.

D. Allocation to the Product Level

The modeled reserve amounts determined as part of the PBR method are aggregate in nature, i.e., determined for groupings of policies, not sums of individual policy amounts. There are reasons, however, to allocate or assign the total aggregate reserve amount (either deterministic reserve or stochastic reserve) to individual policies. This calls for an allocation method.

VM-20 Section 2 (C) defines a policy-level minimum reserve when minimum reserves are determined using either the deterministic reserve (Section 2.A.2) or the stochastic reserve (Section 2.A.3). Adopting an aggregate margin approach should not be reason to move away from the requirements of Section 2 (C). The allocation is described below.

Each policy's minimum reserve is equal to: $ANPR^P + \frac{ANPR^P \times E}{ANPR}$

Where

[3] Actually, that part of the reserve margin that is released in the period of the adverse event would be available, but that is normally a small part of the total reserve margin for long term contracts.

$ANPR^P$ = Allocation Net Premium Reserve, which is the Net Premium Reserve for the policy less that policy's portion of any net premium reserve credit for reinsurance ceded.

$ANPR$ = Allocation Net Premium Reserve in aggregate for all policies of the group

E = Excess of the deterministic reserve (or stochastic reserve) over the the aggregate net premium reserve, adjusted as necessary for any deferred premium asset held on account of those policies.

If an allocation to the product level is necessary, this amount would simply be the sum of the policy-level minimum reserves in the product group.

E. Responsiveness to Market Conditions

Both the anticipated experience reserve and the aggregate margin would be determined based on market conditions at the time of the valuation. Actual levels of interest rates, spreads, and equity levels would be the starting point for projecting future cash flows. Therefore, the reserve and the margin would move to some degree with changes in market conditions. This would not be a "market-consistent" or fair value measurement, since many parameters (for example equity and interest rate volatility) would be based on a long term view, and would not change materially from period-to-period.

There are different methods that can be used to reflect changes in market conditions in the aggregate margin. A simplified summary of these possible methods follows:

1. Absolute Scenarios

As described in the Representative Scenarios approach above, a small number of adverse scenarios would be used to determine a margin for each risk driver. One approach to deriving these adverse scenarios is to calibrate scenarios based on a point in the expected distribution of potential outcomes on an absolute basis. For example, for interest rate risk, if the defined calibration point were at the 99th percentile, the scenario could be set based on whatever the level of historical interest rates was at the 99th percentile from historical data. This interest rate scenario would be used as the basis for setting capital regardless of the current level of interest rates. In other words, in a low rate environment the margin for interest rate risk would be lower, since the difference between current rates and the 99th percentile level of rates would be smaller. In a high rate environment, the margin for interest rate risk would be higher.

An outcome of this approach is that the margin would act as a buffer against the volatility in the anticipated experience reserves. As reserves increase due to dropping rate levels, the margin would decrease, since the chance of rates going even lower has declined.

2. Relative Scenarios

Unlike the Absolute Scenarios approach, this method would involve identifying the adverse scenarios for each risk driver relative to the current environment. Adverse scenarios would be calibrated based on a distribution of the size of the change in the risk driver. For example, for interest rate risk, if the defined calibration point were at the 99th percentile, the scenario could be set based on whatever the level of change in interest rates (as a % or in basis points) over some period of time at the 99th percentile from historical data. This change in interest rate levels would be applied to current interest rate levels to determine the

level of interest rates for the adverse scenario. As a result, the margin would not change as much as in the Absolute Scenarios approach when current market conditions change.

An outcome of this approach is independence of the margin level relative to the reserve level. If reserves increase due to dropping rate levels, the margin would be relatively stable.

3. Hybrid Approaches

Variations on the two approaches above are also possible. Margins could be based on relative scenarios within some band of current market conditions and absolute scenarios outside those bands. Some risk drivers could use relative scenarios and others could use absolute scenarios. Hybrid approaches that are closer to an absolute approach will tend to result in margins that move in the opposite direction as reserves when market conditions change, and hybrid approaches that are closer to a relative approach will tend to result in margins that are more stable over time (but a total reserve, anticipated experience plus margin, that is more responsive to market conditions).

In light of the many other considerations to be addressed by regulators in implementing an aggregate margin framework, the task force does not currently have a specific recommendation on this topic. However as the details are identified, further support by the Academy could likely be provided on this issue.

F. Stress Testing Resulting Reserve for Adequacy

A key criterion used to evaluate any aggregate margin method will be an assessment of the degree of protection afforded to policyholders. This principle implies establishing stress tests of adequacy of the aggregate margin, both in total and by product groupings (while also recognizing the essential role of capital in providing additional protection for tail risks). To the extent a Representative Scenarios Approach is used as the implementation approach for an aggregate margin, the calculation of the margin itself will involve looking at the required amount of margin needed to cover individual risks at a tail level, and therefore this method would give some comfort with respect to the degree of protection afforded to policyholders for each individual risk. However, additional stress testing may be needed with respect to the following:

- Since the derivation of the margin would involve analysis of individual risks at a tail level and combination of those risks using some assumptions as to correlation among risks, stress testing may be helpful to determine the level of protection afforded when risks occur simultaneously. So, for example, if a margin of 100 is set for interest rates and a margin of 50 is set for policyholder lapse, and when combined using a correlation matrix the total margin for both risks is 125, there may be value in subjecting the resulting reserve to a defined scenario in which interest rates move adversely and policyholders behave adversely to get a better sense of the impact of combined risks on the reserve amount
- If a Cost of Capital method is used, there is not a direct relationship between the aggregate margin and the degree of confidence it provides. The capital underlying the Cost of Capital method would correspond to a specified confidence level based on the representative scenarios used; however, there may be benefit to subjecting the reserve itself to specific stress tests to better understand the degree of policyholder protection afforded.

An important consideration will be the relationship between the scenarios used to derive the margin and those used for stress testing. In particular, it would make sense to use stress tests of combined risks in instances in which there is relatively less certainty around the expected correlation between risks or when there is an expectation that two risks are highly related in a negative way. Therefore it would be beneficial to first develop

the set of representative scenarios, and then use information about these scenarios, their impact, and expected correlations among risks as a basis to determine appropriate stress tests.

Another consideration in developing the reserve margin itself, as well as the stress tests, is how the analysis might relate to, or be duplicative with, cash flow testing. To the extent reserve adequacy is already being assessed through cash flow testing, it may make sense to either supplement cash flow testing scenarios as a means of stress testing or reduce cash flow testing requirements where new stress testing covers a risk, in order to avoid unnecessary duplication.

Summary

The purpose of this paper is to provide a conceptual recommendation to LATF regarding the determination of an aggregate margin under a principle-based reserve approach for individual life insurance products. The intended users of this work product are members of LATF, for the purpose of evaluating and recommending an appropriate method for determining principle-based reserve margins for individual life insurance products. ,

The scope of the work did not involve analysis of the specific implementation methodology for such a method and, therefore, further work on the specific implementation method is required before an aggregate margin approach could be implemented. To the extent the recommendations in this paper are accepted and such work is undertaken, the Academy is interested in providing continued support to LATF on such an undertaking.

To the extent an aggregate margin approach is ultimately implemented as recommended, there are many assumptions that would be needed, many of which are challenging to set. Examples of such challenging assumptions include scenarios that are representative of specific points in a distribution of risk events or losses arising from risk events, correlation assumptions among risks, and certain baseline assumptions that do not have credible historical data, such as policyholder behavior. Care would need to be taken in setting such assumptions.

The examples included in this paper are meant to be illustrative. They are hypothetical examples and actual results from implementing an aggregate margin approach will differ, perhaps materially.

The work was performed by a group of volunteers with expertise in various areas. Based on that expertise, a wide range of practices and issues were considered as part of the analysis. However, the specific facts and circumstances associated with principle-based reserve analysis vary widely across the industry, and there may be situations and issues that exist that were not considered by the task force based on the limitations of the experience of individual members.

Next Steps

This document represents the final deliverable of the Aggregate Margin Task Force based on our assigned scope and objectives. However, we recognize that if an aggregate margin method is adopted by LATF, significant additional work will be needed to implement such a method, including items such as:

- Defining implementation details for purposes of the valuation manual
- Performing "field testing" of the method using actual company data to assess the impact of the approach
- Coordinating with other work on principle-based reserves, such as the work currently underway related to annuity products

While the Academy is limited in terms of support it can provide that involves collection of company data, further support by the Academy may be needed on the implementation details and coordination of other work groups, such as the Annuity Reserves Work Group. There are members of the Aggregate Margin Task Force that may be interested in supporting this additional work; however it appears that the ideal approach to do so would be in conjunction with those working on this topic as it relates to other products such as annuities.

APPENDIX I – ADDITIONAL BACKGROUND INFORMATION AND HISTORY OF THE USE OF AN AGGREGATE MARGIN APPROACH IN VM-20

1. In 2005, the Life Reserves Work Group (LRWG) explored an approach to quantify the level of margin in the principle-based reserve by the use of a metric called the "Z-factor." This metric, which was based on the Cost of Capital method, was presented to LATF as a way to quantify the size of the aggregate margin that was produced by adding individual margins to each risk factor in the VM-20 reserve calculation. The LRWG recommended to LATF that the Z-factor metric could be used as an overall cap on the margin produced by the individual margin approach, or could be used as a replacement for the individual margin approach. Due to concerns over the difficulties of implementing the approach, LATF decided not to pursue the use of the Z-factor at that time.

2. Steve Strommen, a member of the LRWG who was instrumental in developing the Z-factor metric, submitted a paper on the Cost of Capital method to the SOA's *The Financial Reporter* that was published in June 2006. This paper describes in detail the Cost of Capital method and discusses the use of the Z-factor approach as a way to quantify and/or determine an aggregate margin in a principle-based reserve framework.

3. Also in 2006, LRWG submitted a report to LHATF (Life and Health Actuarial Task Force) outlining the impact of principle-based valuation concepts on the Universal Life with Secondary Guarantee (ULSG) product. This report can be found on the Academy website at http://www.actuary.org/naic/life.asp (scroll down to the April 2006 report). Research performed for the ULSG product included calculation of deterministic reserves at various margin levels. In this LRWG report, a "margin ratio" was calculated (which is the same as the "Z-factor" discussed in the Strommen paper) to quantify the amount of aggregate margin for the product tested, which again, was based on the Cost of Capital Method.

4. In 2010, LHATF issued a request to the LRWG for additional guidance surrounding the topic of margins and specifically ranges of margins to be placed on risk factors within a principle-based valuation framework. The paper utilized the Z-factor metric to quantify the impact of various assumption margins. Shortly thereafter, the idea of incorporating some variation of the Z-factor (or Margin Ratio) was presented once again to LATF, but LATF decided to not pursue it at that time.

5. As a result of concerns over the individual margin approach arising from companies participating in the NAIC VM-20 impact study, the idea of replacing the individual margin approach was once again submitted to LATF. Mark Birdsall (LATF member from Kansas) submitted an aggregate margin proposal to LATF in January 2012 based on the Cost of Capital method. It also included the concept of a "factor margin," which is "a per unit margin that will equal zero except when there is extraordinary estimation error or unusual sensitivity to adverse deviation for a particular assumption." After reviewing Mark Birdsall's proposal, LATF agreed to study the idea of incorporating an aggregate margin in VM-20 to replace the individual margin approach, but due to timing concerns over securing NAIC approval of the Valuation Manual by the end of 2012, the decision was made to defer any further discussion of the proposal until after the NAIC had adopted the Valuation Manual.

6. The Academy formed the Aggregate Margin Task Force in the summer of 2012 to assist LATF in reviewing the pros and cons of various aggregate margin approaches. LATF also formed an Aggregate Margin Subgroup, comprised of LATF members and other interested regulators, to work with the Aggregate Margin Task Force to assist LATF in reviewing possible aggregate margin approaches.

APPENDIX II – DEFINITION OF AGGREGATE MARGIN

Approaches to establishing margins for uncertainty can be classified into two basic categories:

- Bottom-up approaches
- Top-down approaches

A method whereby individual margins are assigned to each individual assumption or risk factor is an example of a bottom-up approach. The method whereby the margin is determined on an aggregate basis across all individual assumptions or risk factors is an example of a top-down approach. Both types have distinct characteristics. See Table 1 for a listing of these.

Table 1

Individual Margins (Bottom-up)	Aggregate Margin (Top-down)
• Provides explicit feedback loops by assumption, providing the ability to monitor the appropriateness of reserving in light of emerging experience. • Relatively easy to review and monitor the degree of uncertainties assumed by actuaries and the variation of actual experience from expected assumptions as the business matures. • Poses the challenge of how to account for the effects of diversification between risks. In practice, quantifying such diversification is time consuming, onerous and rarely done. • Has tendency to result in redundancy in the total margin result and therefore produce overly conservative final reserves.	• Explicitly quantifies the margin relative to the anticipated experience reserve or required capital at an aggregate level, implicitly addressing the diversification issue and providing a practical way to compare and contrast the degree of margin being assumed. • Certain top-down approaches implicitly consider various risks that are not considered in many bottom-up approaches. • If it becomes necessary to identify or measure the margin assigned to any one risk factor, this is difficult to do when the margin is determined using a top-down approach. Likewise, if one or more risk factors require an individual margin while the remainder utilizes an aggregate margin, there will likely be redundancies in the overall results as a result of this combined approach.

The Aggregate Margin Task Force is working exclusively with top-down approaches.

APPENDIX III – FURTHER DETAILS ON COPULAS AND CORRELATION MATRICES

1. Description of copulas

   A copula is a kind of distribution function. Copulas are used to describe the dependence between random variables. The multivariate joint distribution function of a set of risks can be written in terms of univariate marginal distribution functions for each risk and a copula. The marginal distribution functions describe the marginal distribution of each risk and the copula describes the dependence structure between the risks.

   Copulas are popular in statistical applications as they allow one to model and estimate the distribution of random vectors by estimating marginal distributions and the copula separately. There are many parametric copula families available, which usually have parameters that control the strength of dependence.

   A simplified approach to the use of copulas is the use of a variance/covariance, or "correlation" matrix to combine tail risks, using assumed correlations that are more severe than in "normal" times. This approach has theoretical drawbacks; however, a significant advantage of the approach is the ease of calculation and transparency. Further details on the correlation matrix approach as compared to use of copulas can be found in *Correlations and Dependencies in Economic Capital Models***,** by Shaw and Spivak (2009). An example of this simplified approach is shown in Item 6 of this Appendix.

2. Key components of a copula approach

   In order to effectively apply a copula approach, the following items/assumptions are needed:

   - Risk or loss distributions for each risk. For example, for risk associated with the level of the equity markets, the risk distribution would be the distribution of possible equity levels, either derived from historical data, a forward-looking opinion on the distribution function and parameters, or a combination of both. The loss distribution would be the losses that the insurer would incur for each point in the risk distribution – i.e., creating financial projections of the business over a specified time horizon to estimate losses from a range of equity market results, and fitting those losses to a distribution.
   - A copula for aggregation of the loss distributions. A variety of copula functions are available for risk aggregation, each with varying degrees of appropriateness for the specific risks being evaluated. Two common copulas are Gaussian and Student's t.
   - It is common in insurance for there to be risks that cannot be fit to a distribution due to either limited data or environmental changes that make historical data inappropriate for projecting future outcomes. In this instance, an alternative approach might be used for these risks, such as using a simple, single point stress scenario. So for example, market and mortality risks might be combined using distribution and copula assumptions, and then other risks such as lapses and expenses might be modeled using a single severe event assumption.
   - In addition to the above, an assumption must be made as to the point on the distribution that will be used for setting the margin (e.g., 70CTE, 99.5% VaR, etc.).

3. Application within PBR

   a. The modeled reserves in VM-20 (deterministic, stochastic), when being used with an aggregate margin, are determined using no explicit margins on the assumptions; i.e., with anticipated experience. Exceptions to this are made for mortality, for example, where the requirements define the method of grading into the industry mortality table, etc.

   b. The aggregate margin is determined by running a second calculation of the reserve at the chosen point on the joint risk distribution curve. For example, a set of 1,000 stochastic scenarios are developed reflecting all risk distributions combined together via a copula. The present value of losses for each scenario is determined and rank ordered. For a 99.5% VaR approach to margins, the margin would be equal to the difference between the 5^{th} worst loss and the average loss.

   c. The deterministic and stochastic reserves are set equal to the amount in a. plus the amount in b.

   d. Regulatory levers in this method include:

i. Defining the mean and standard deviation (or level of stress if there is no distribution) for each risk distribution

ii. Defining the point on the distribution for determining the margin

iii. Defining the choice of copula and its parameterization

4. Pros

   a. Used correctly, a copula approach can capture the potential for more extreme correlations in the tail than using a multivariate risk distribution

   b. May be viewed as more consistent with European solvency approaches (e.g., Solvency II, Swiss Solvency Test)

   c. Can be used to combine either risk factor distributions or loss distributions

5. Cons

   a. Complex to use and to explain

   b. Useful only if univariate risk distributions exist for individual risks – if individual margins cannot be expressed as a point in the distribution, copulas cannot be used effectively

6. Simple example

   Assume we have margins for two risks, credit risk ($400) and interest rate risk ($200). Also assume that these two risks, at the confidence level defined for the margin, are expected to be 50% correlated, in other words the correlation matrix is as follows:

$$\begin{bmatrix} 50 & 0 \\ 0 & 50 \end{bmatrix}$$

   Determining the aggregate margin would involve combining the individual risk margins using the correlation matrix, with the following calculation:

   SQRT (400 x (400 x 100% + 200 x 50%) + 200 x (400 x 50% + 200 x 100%)), or $529.15. This is lower than the sum of the individual risk margins of $600 since it reflects that credit risk and interest rate risk are less than 100% correlated.