AMERICAN ACADEMY of ACTUARIES

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November 9, 2021

Mr. Philip Barlow
Chair, Life Risk-Based Capital (E) Working Group
National Association of Insurance Commissioners (NAIC)

Dear Philip,

On behalf of the C-2 Mortality Work Group of the American Academy of Actuaries[1], we are providing a recommendation on updates to the Life Risk-Based Capital (RBC) C-2 Mortality Factors. The objective of the work group was to review and update the model developed in the early 1990's, which was used in setting the currently applicable Life RBC C-2 factors.

The recommendation may be found in the attached report and accompanying slide presentation. The recommended factors are based on the following key changes.

1. Expanding factors into additional categories to reflect the assumed current mortality rate risk exposure period over the remaining lifetime of an inforce block of business.
2. Adding two catastrophe components for a) terrorism (expressed as a 5% annual probability of an extra 0.05 deaths per 1,000), and b) the risk of a sustained mortality increase from an unknown event (expressed as a 2.5% annual probability of a 5% sustained mortality increase). These two new components are in addition to the pandemic component previously included.
3. Combining the current middle two size categories into one category.

The remainder of the structure is recommended to stay the same. We look forward to presenting the work group's recommendation at the November 9, 2021 Life Risk-Based Capital (E) Working Group meeting.

Sincerely,

Chris Trost, MAAA, FSA
Chairperson, C-2 Mortality Work Group
American Academy of Actuaries

Ryan Fleming, MAAA, FSA
Vice Chair, C-2 Mortality Work Group
American Academy of Actuaries

[1] The American Academy of Actuaries is a 19,500-member professional association whose mission is to serve the public and the U.S. actuarial profession. For more than 50 years, the Academy has assisted public policymakers on all levels by providing leadership, objective expertise, and actuarial advice on risk and financial security issues. The Academy also sets qualification, practice, and professionalism standards for actuaries in the United States.

Life RBC – C-2 Mortality Risk

Model Documentation Report of the American Academy of Actuaries C-2 Mortality Work Group

to the National Association of Insurance Commissioners (NAIC) Life Risk-Based Capital (E) Working Group

November 9, 2021

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Executive Summary

Introduction

The purpose of this report is to document the model developed and used by the Academy C-2 Life Mortality Work Group in support of its work to consider and propose updates to the C-2 capital factors for life insurance mortality within the NAIC Risk-Based Capital formula. The objective of the work group was to review and update the model developed in the early 1990's, which was used in setting the Life RBC C-2 factors which have been in place since 1993.

Mortality risk is defined as adverse variance in life insurance deaths (i.e., insureds dying sooner than expected) over the remaining lifetime of a block of business while appropriately reflecting the pricing flexibility to adjust current mortality rates for emerging experience. Life insurance mortality risk was evaluated by stochastic simulation through the model documented in this memo. The mortality risks evaluated were volatility, level, trend, and catastrophe. The model is intended to simulate the run-off of inforce life insurance blocks typical of U.S. life insurers.

The capital need, expressed as a dollar amount, is determined as the greatest present value of accumulated deficiencies at the 95th percentile of the stochastic distribution of scenarios over the remaining lifetime of a block of business while appropriately reflecting the pricing flexibility to adjust current mortality rates. Statutory losses are defined as the after-tax quantification of gross death benefits minus reserves released minus mortality margin present in reserves. The after-tax statutory losses are discounted to the present by using 20-year averages for U.S. swap rates. By selecting the largest present value accumulated loss across all projection years, the solved for capital ensures survival at all projection periods. Earlier period losses are not allowed to be offset by later period gains to reduce capital. The 95th percentile is the commonly accepted statistical safety level used for Life RBC C-2 mortality risk to identify weakly capitalized companies. The after-tax capital needs are translated to a factor expressed as a percentage of the initial net amount at risk (NAR), and are shown as an amount per $1,000 of NAR. The pre-tax factor is determined by taking the after-tax factor divided by (1 minus the tax rate).

The documentation includes descriptions of model inputs and assumptions, capital quantification method, results and sensitivities, validation and peer review and limitations.

Key Assumption Changes from Original Work

The following assumptions changes from the original work are highlighted as having the most significant impact on the modeled results.

1. Experience mortality rates are significantly lower than when the original work was completed, reflecting decades of U.S. insured population mortality improvement. This leads to lower capital need through the level risk component for large inforce blocks with credible mortality experience.

2. In place of the severe human immunodeficiency virus **(**HIV) scenarios assumed in the original work, a new catastrophe risk component was developed for an unknown sustained increase in mortality. The net impact of these two changes was a reduction in the capital need as the higher probability, higher severity HIV assumptions were replaced with the unknown risk component that has lower probability and severity.

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3. The pandemic distribution was updated, and a terrorism component was added, leading to a modest increase in the capital need.

4. Trend risk was expanded to reflect a greater range of mortality trends and differences by age/gender cohorts. This update resulted in higher capital factors.

5. The capital quantification method was updated to a greatest present value of accumulated deficiencies (GPVAD) method with statutory losses defined as death benefits minus reserves released. This resulted in a modest increase compared to the prior method.

6. The risk exposure period to current mortality rates was expanded to reflect product and premium terms available in the marketplace. For individual life, the risk exposure periods were expanded from 5 years to 5 years, 10 years, and 20 years. For group life, the risk exposure periods were expanded from 3 years to 3 years and 5 years. The longer a company is exposed to current mortality rates without being able to adjust pricing, the greater the capital need.

The directional impact relative to the current RBC factors for large and small inforce block sizes is highlighted in Exhibit 1 below. For a 5-year risk exposure period, the overall impact of the model updates results in a significant decrease in most factors. However, the risk exposure period is a critical variable, and this component factors into the structural changes being recommended by this work group.

Exhibit 1

Risk Component	Large Inforce Size >$25B NAR	Small Inforce Size ≤$500M NAR
HIV Scenarios	↓ 45%	↓ 25%
Level	↓ 25%	↑ 5%
Trend	↑ 20%	↑ 10%
Catastrophe	↑ 10%	↑ 5%
Capital Quantification Method	↑ 10%	↑ 5%
Volatility	↑ 0%	↓ 5%
Length of Risk Exposure Period	↑ varies	↑ varies

Overall Results and Recommended C-2 Factors

The recommended pre-tax factors per $1,000 of retained NAR are shown in Table 1 below. Business assumed by reinsurers is treated as direct for reinsurer financial statements. The factors are differentiated by individual & industrial life and group & credit life, consistent with the current framework. The modeling focused on individual and group life, and the work group evaluated the continued appropriateness of applying the factors to industrial life and credit life business. It is recommended that industrial life and credit life continue to be mapped to individual and group life, respectively, as the product attributes are similar. The factors are rounded to the nearest 0.05 to recognize the randomness inherent in the model (see Impact of Random Number Seed for additional information). Three size bands are recommended to represent inforce blocks of small, medium, and large sizes. This reflects combining the two middle

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categories of the current framework as the risk characteristics are similar. The size bands were reviewed and continue to be relevant and appropriate, and a material portion of life insurers are represented within each category.

Within individual & industrial life, the factors are differentiated into three product categories: Universal life with secondary guarantees (ULSG), term life, and all other life. The product definitions are consistent with the annual statement – analysis of operations by line of business – individual life insurance and Valuation Manual (VM)-20. The differences by product category are the sole result of applying different risk exposure periods to an aggregate life inforce block. As described in Sensitivity 4 Individual Life Products under Model Sensitivities, the model produces consistent results by product for a given risk exposure period, as expressing the factor as a percentage of net amount at risk neutralizes product differences.

ULSG factors are the highest due to the longest current mortality rate exposure and are based on a 20-year risk exposure period for a mature inforce block. Term life factors are based on a typical 10-year risk exposure period for a mature inforce block. The industry is concentrated in 10-, 20- and 30-year level term. All other life factors are based on a 5-year risk exposure period and assume inforce pricing may be adjusted following adverse mortality experience due to the presence of non-guaranteed elements. Examples are universal life (UL) products without secondary guarantees and participating whole life products.

Within group & credit life, the factors are differentiated into two categories based on the remaining length of the premium term based on company records by group contract. The two categories are remaining rate terms over 3 years and remaining rate terms 3 years and under. The remaining rate terms over 3 years category is represented by a 5-year risk exposure period, and the remaining rate terms 3 years and under is represented by a 3-year risk exposure period. The risk exposure periods recognize a time lag between when experience emerges and when pricing is adjusted.

Table 1 - Recommended C-2 Life Mortality Factors

Pre-Tax RBC C-2 Factors	Individual & Industrial Life				Group & Credit Life		
Per $1,000 of Inforce NAR	Universal Life with Secondary Guarantee (ULSG)	Term Life	All Other Life	% of Individual Life Insurers*	Remaining Rate Terms Over 3 Years	Remaining Rate Terms 3 Years and Under	% of Group Life Insurers*
First $500M	3.90	2.70	1.90	43%	1.80	1.30	54%
Next $24.5B	1.65	1.10	0.75	36%	0.70	0.45	33%
> $25B	1.10	0.75	0.50	21%	0.45	0.30	12%

* as of 2019 annual statement reporting

Table 2 and Table 3 compare the recommended factors versus the current RBC factors in place as of 12/31/2020.

Table 2 - Individual & Industrial Life Comparison Versus Current RBC

Pre-Tax RBC C-2 Factors	Individual & Industrial Life				Change vs Current RBC		
Per $1,000 of Inforce NAR	Current RBC	ULSG	Term	All Other	ULSG	Term	All Other
First $500M	2.23	3.90	2.70	1.90	75%	21%	-15%
Next $4.5B	1.46	1.65	1.10	0.75	13%	-25%	-49%
Next $20B	1.17	1.65	1.10	0.75	41%	-6%	-36%
> $25B	0.87	1.10	0.75	0.50	26%	-14%	-43%

The overall individual life industry impact would be a modest decrease with industry exposure by NAR concentrated in term life business amongst large insurers. Factors increase for ULSG due to the long-term

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exposure period to current mortality rates. As indicated in Exhibit 1, factors decrease for products with near-term inforce pricing flexibility (i.e., all other category). Small ULSG and term carriers would experience an increase on retained business. However, reinsurance is often used to transfer/mitigate the mortality risk for small carriers.

Table 3 - Group & Credit Life Comparison Versus Current RBC					
Pre-Tax RBC C-2 Factors	Group & Credit Life			Change vs Current RBC	
Per $1,000 of Inforce NAR	Current RBC	Remaining Rate Terms Over 3 Years	Remaining Rate Terms 3 Years and Under	Remaining Rate Terms Over 3 Years	Remaining Rate Terms 3 Years and Under
First $500M	1.75	1.80	1.30	3%	-26%
Next $4.5B	1.16	0.70	0.45	-40%	-61%
Next $20B	0.87	0.70	0.45	-20%	-48%
> $25B	0.76	0.45	0.30	-41%	-61%

The overall group industry impact would be a significant decrease in C-2 capital. The factors decrease for all but one category: small size for longer rate terms which stays about the same. Group life factors decreased due to the decades-long decline in experience mortality rates, and the risk exposure periods remain shorter term as compared to individual life.

Credit for Group Life Premium Stabilization Reserves

The current RBC formula includes a 50% credit for group life premium stabilization reserves to offset the group life C-2 requirement. This component was reviewed by the work group. Based on a theoretical framework and professional experience, the 50% factor was deemed to be an appropriate offset to the capital requirement.

Correlation with Longevity C-2

The updated Life C-2 mortality modeling was completed consistent with the development of the adopted Longevity C-2 factors and correlation factor. Therefore, the work group opines that additional review of the adopted correlation factor is not necessary because of the updates to the Life C-2 mortality factors being recommended by this work group.

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Inputs and Assumptions

This section describes the inputs and assumptions used by the model. Detail on specific assumptions is available upon request.

Model Assumptions

The model assumptions section are high-level parameters for running the model and include the following inputs.

- ***Random Number Seed:*** This is the random number seed for starting the sequence of numbers for the random number generator. This was randomly set to 25 for the modeling. This assumption is necessary in order to be able to exactly re-produce model results. Changing the random number seed will result in a different sequence of random numbers and changes to model results (See sensitivities).

- ***Scenarios:*** This is a number of scenarios the model runs. 10,000 scenarios were assumed to obtain a smooth and full distribution of results.

- ***Projection Years:*** This is a number of years the model will run for each scenario. The model is set up to run from 1-30 years. The projection period represents the risk exposure period for an inforce block where current mortality rates are at risk for adverse experience. 3-year and 5-year projection periods were selected for group life insurance to cover the typical remaining periods for rate terms for group products and the ability to re-price for mortality changes after this period. This was a change from the 3-year period assumed in the prior work. Individual life insurance was selected to run for projection periods of 5 years, 10 years, and 20 years. The 5-year period is intended to represent inforce blocks where pricing may be adjusted following adverse mortality experience due to the presence of non-guaranteed elements, which are not yet being charged at maximum levels. Longer projection periods are intended to represent inforce blocks that have little to no flexibility to respond to mortality changes over the remaining lifetime. ULSG factors are based on a 20-year risk exposure period for a mature inforce block. Term life factors are based on a typical 10-year risk exposure period for a mature inforce block. The industry is concentrated in 10-, 20- and 30-year level term.

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- ***Policies:*** This is the assumed number of policies in a life insurer's inforce block. Three size bands were modeled: 1,000,000 policies for large inforce blocks, 100,000 policies for medium inforce blocks, and 10,000 policies for small inforce blocks. Policy size weightings are applied by face amount subject to the retention limits.

- ***Discount Rate (Pre-Tax):*** Projected amounts are discounted to the present using this assumption converted to an after-tax rate. A 3.5% discount rate was selected based on the 2001-2020 average of 10-year U.S. swap rates. The selection of the discount rates is aligned with the same methodology used to determine the discount rate for the RBC C-1 bond factors. The methodology uses a 20-year average and is intended to represent a risk-free rate.

- ***Retention Limit:*** This represents the maximum retained face amount per policy for a company's inforce block. Amounts above this limit are assumed to be reinsured (or not issued above the limit). Three retention limits were modeled based on company size: $1,000,000 for large inforce blocks, $250,000 for medium inforce blocks, and $50,000 for small inforce blocks. These assumptions are used to calibrate the total inforce block size for the three size categories. Results are insensitive to variations in retained face amount for a given number of policies (see Sensitivity 8 Face Amount under Model Sensitivities).

- ***Tax Rate:*** This represents the tax rate applied to pre-tax statutory losses to determine after-tax losses. The rate of 21% is based on the current U.S. corporate tax rate. It is also used to convert the discount rate to an after-tax rate.

Initial Inforce Assumptions

These set of assumptions are used to specify parameters for inforce weightings that is used to develop a block of inforce policies. Given the weights input in this section, the "Initial Inforce Loaded in Model" section is weighted to specify the inforce cohorts and policy counts run through the model processing. Based on the characteristics outlined, the inforce population may have up to 8,748 unique cohorts. The weightings assumed for the modeling analysis were developed using data from the two experience reports in the table below. The model has the ability to run individual and group life together, but the analysis was done modeling these separately to determine unique factors for each category.

Individual Life	Society of Actuaries (SOA) 2009-2013 Individual Life Insurance Mortality Experience Report
Group Life	Society of Actuaries 2016 Group Life Experience Committee Report

- ***Gender:*** The overall percentages of males and females for individual and group life.

- ***Underwriting Code:*** The underwriting codes and rating class weightings for the inforce population. The underwriting code for a given cohort is used to map to a mortality based on that underwriting class. There are 5 underwriting codes/classes for individual life aligned with the categories for the 2017 Commissioners Standard Ordinary (CSO) mortality table: non-smoker best class (super preferred), non-smoker mid class (preferred), non-smoker residual (standard), smoker best class (preferred), and smoker residual (standard). Group life policies are not assumed to be underwritten and are mapped to mortality developed from the SOA 2016 group life experience study.

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- ***Product Code:*** The product weightings for the inforce population. There are four individual life products simulated: 10-year level term, 20-year level term, permanent whole life, and accumulation universal life. Group life is simulated as a term product. The following assumptions vary by product type.
    - Attained Age and Policy Duration
    - Face Amount
    - Lapse Rates
    - Post-level Term Mortality
    - Reserve Factors
- ***Attained Age and Duration:*** These are weightings by product that vary by attained age and duration.
- ***Face Amount:*** These are weightings by product for various face amount sizes.

Mortality Risk Drivers

The model projects four categories of mortality risk through stochastic simulation: volatility, level, trend, and catastrophe. See the Experience Mortality Rates section for a description of the base mortality rates (referenced by *q* in the following formulas).

1. ***Volatility Risk:*** The risk of natural statistical deviations in mortality experience. These natural statistical deviations from expected deaths are represented in the model through a binomial distribution. Volatility risk decreases with increased exposure, and thus is lower for larger blocks than smaller blocks.
    - $Prob[Deaths = n] = \binom{Policies}{n} * q^n * (1-q)^{Policies-n}$
2. ***Level Risk:*** The risk of incorrect experience mortality assumptions. This risk is also known as pricing risk. The level risk parameters were developed from two components. This component is consistent with the level risk component used by the Academy C2 Longevity Risk Task Force to develop RBC C-2 factors for longevity products.
    a. Statistical Sampling Volatility (Credibility): Assumes mortality rates are set with experience studies. Credibility of estimates is dependent on study size (number of policies and years in the study)
        - Cred(σ) = $\sqrt{\frac{q*(1-q)}{Number\ of\ Policies\ *Study\ Years}}/q$
        - Study Years: 5 years was selected to represent a company's typical experience study period.
        - q per 1K: represents the experience mortality rate in the first projection year expressed per 1,000 lives. This value is calculated from initial inforce cells from the

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experience mortality tables (2017 CSO tables for individual life, 2016 group life experience table for group life).

- q: experience mortality rate in the first projection year, derived from "q per 1K".

b. Natural Mortality Volatility: Assumes that there is natural volatility around the mortality mean.

- NatVol(σ) = $2.2\%/\sqrt{Study\ Years}$
- The 2.2% implied annual volatility was derived from an insured age-weighted regression on U.S. Social Security data from 1950 to 2014.
- Study Years: the natural mortality volatility scales down with the number of years in a company's study period. 5 years was selected to represent a company's typical experience study period.

c. Overall Level Mortality Volatility: The statistical sampling and natural volatility components are combined assuming independence.

- $\sigma_L = \sqrt{\text{Cred}(\sigma)^2 + \text{NatVol}(\sigma)^2}$

d. Level Mortality Mean: The average pricing error is assumed to be 0.00%.

- $\mu_L = 0.00\%$

3. ***Trend Risk:*** The risk that future mortality improvement is different than assumed. Historically, both mortality improvement (MI) and MI volatility have differed by historical period, gender, and age, among others. While average MI over long periods tends to stabilize, period to period MI can be quite different. An improvement distribution that captures these characteristics was developed while balancing the desire for simplicity. Deviation in mortality improvement is modeled across male/female and young/ middle/old ages as correlated normally distributed random variables. An MI deviation is generated for each cohort in each year of each scenario. This allows for large differences year-to-year consistent with historical data.

MI Deviation	Male	Female
Young (<45)	$D_{Y,M}$	$D_{Y,F}$
Middle(45-79)	$D_{M,M}$	$D_{M,F}$
Old(80+)	$D_{O,M}$	$D_{O,F}$

$[D_{Y,M}, D_{M,M}, \ldots, D_{O,F}] \sim N(\mu, \Sigma)$

Where:

- μ = zero vector = [0, 0, …, 0]
- ∑ = covariance matrix calibrated with social security data 1950+

a. Years Since Study: 3 years was selected to represent a typical time period since a company's last mortality experience study was completed. Mortality improvement is stochastically projected 3 years from the experience study table date to the model start date.

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b. Covariance Matrix: Historical mortality improvement and covariance between gender and age was calibrated from insured age-weighted U.S. Social Security data from 1950 to 2014, consistent with the data source for level risk. The covariance matrix is shown in the following table, and the resulting correlations are shown as well.

		Males			Females		
Covariance		Young	Middle	Old	Young	Middle	Old
Males	Young	0.00085	0.00018	0.00016	0.00050	0.00015	0.00012
	Middle	0.00018	0.00023	0.00027	0.00016	0.00017	0.00024
	Old	0.00016	0.00027	0.00050	0.00018	0.00025	0.00048
Females	Young	0.00050	0.00016	0.00018	0.00055	0.00019	0.00019
	Middle	0.00015	0.00017	0.00025	0.00019	0.00019	0.00027
	Old	0.00012	0.00024	0.00048	0.00019	0.00027	0.00056

		Male	Male	Male	Female	Female	Female
Correlation		Young	Middle	Old	Young	Middle	Old
Male	Young	1.00000	0.41796	0.24114	0.73152	0.37883	0.16771
Male	Middle	0.41796	1.00000	0.79815	0.45102	0.79461	0.68000
Male	Old	0.24114	0.79815	1.00000	0.34168	0.79350	0.90577
Female	Young	0.73152	0.45102	0.34168	1.00000	0.59030	0.34196
Female	Middle	0.37883	0.79461	0.79350	0.59030	1.00000	0.81325
Female	Old	0.16771	0.68000	0.90577	0.34196	0.81325	1.00000

c. Cholesky Decomposition Matrix: The covariance matrix was translated for model input through Cholesky Decomposition using Python.

		Males			Females		
Chol Decomp Matrix		Young	Middle	Old	Young	Middle	Old
Males	Young	0.02921	0.00000	0.00000	0.00000	0.00000	0.00000
	Middle	0.00632	0.01375	0.00000	0.00000	0.00000	0.00000
	Old	0.00537	0.01708	0.01321	0.00000	0.00000	0.00000
Females	Young	0.01715	0.00375	0.00168	0.01545	0.00000	0.00000
	Middle	0.00528	0.00976	0.00386	0.00384	0.00644	0.00000
	Old	0.00396	0.01583	0.01390	0.00250	0.00445	0.00841

4. ***Catastrophe Risk:*** The risk of a short-term spike in mortality or a longer-term increase in mortality from a currently unknown health event. This risk includes 3 components: a pandemic risk distribution, a terrorism risk distribution, and an unknown sustained risk distribution.

   a. *Pandemic Risk:* The risk of a one-year increase in mortality from a new pandemic, such a new flu strain. The distribution is discrete and was calibrated from historical observations and multiple sources: current RBC, Swiss Re's model, Solvency II, U.S. Centers for Disease Control and Prevention (CDC)/Department of Health and Human Services Pandemic Severity Assessment Framework (PSAF). Rates are expressed as deaths per 1,000 lives and are applied as an add-on

Annl. Prob	Dths/1K
0.50%	1.5
0.50%	0.7
0.50%	0.55
0.50%	0.35
0.50%	0.2
0.50%	0.1
0.50%	0.05
96.50%	0

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across all ages if triggered. Multiple pandemics may occur in a given scenario.

b. *Terrorism Risk:* The risk of a one-year increase in mortality from a terrorism event. The discrete distribution was calibrated based on U.S. life insurer experience from the Sept 11, 2011 terrorism events. The rate is expressed as deaths per 1,000 lives and is applied as an add-on across all ages if triggered. Multiple terrorism events may occur in a given scenario.

Annl. Prob	Dths/1K
5.00%	0.05
95.00%	0

c. *Unknown Sustained Risk:* The risk of a sustained increase in mortality from an unknown health event. The discrete distribution was calibrated from two historical health events impacting the U.S. population: HIV and opioid abuse. The mortality increase is defined as a percentage increase applied across all ages if triggered. If the event is triggered in the scenario it continues for the lesser of the maximum duration assumption and remainder of the projection period. A 10-year period was selected for the maximum duration based on the historical events and to provide for an event lasting up to a decade. The maximum duration assumption is relevant only when modeling projection periods longer than this assumption. Given the sustained nature of the event, it can only occur once per scenario.

Max Duration	10
Annl. Prob	Scalar
2.50%	5.0%
97.50%	0.0%

Reserve Mortality Margin

- ***Load (Margin):*** A 5% load was used for the load built into reserve mortality rates. This is intended to represent the margin companies have to absorb moderately adverse mortality experience through the conservatism built into statutory reserve calculations. This assumption was used in the current RBC factors and was deemed to remain consistent with moderately adverse experience. Capital is thus determined for 95th percentile experience above moderately adverse outcomes as represented by the 5% load.

Experience Mortality Improvement

- Experience mortality improvement is set equal to the 2017 SOA mortality improvement scale for use with Actuarial Guideline (AG) 38 and VM-20. The rates vary by age and gender and are converted to lognormal rates for input in the model.

Lapse Rates

- Lapse rates are set for each product type and vary by issue age, policy duration and underwriting class. For the recommended individual life capital factors, the simulated lapses are a weighted average of the four product types. For a given risk exposure period, results are insensitive to the product type (including lapses) as shown in Sensitivity 4 under the Model Sensitivities section.
    - **10-Year Term:** Lapse rates were developed using a combination of the SOA/LIMRA U.S. Individual Life Insurance Persistency Study for 2005-2007 and the SOA/RGA[2] Report on the Lapse and Mortality Experience of Post-Level Premium Period Term Plans (2014). The 10-

[2] Reinsurance Group of America

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Year Term product is assumed to be a level term product for 10 years. Lapse rates spike beginning in year 10 at the end of the level term period.

- **20-Year Term:** Lapse rates were developed using a combination of the SOA/LIMRA U.S. Individual Life Insurance Persistency Study for 2005-2007 and the SOA/RGA Report on the Lapse and Mortality Experience of Post-Level Premium Period Term Plans (2014). The 20-Year Term product is assumed to be a level term product for 20 years. Lapse rates spike beginning in year 20 at the end of the level term period.
- **Permanent Whole Life:** Lapse rates were developed using the SOA/LIMRA U.S. Individual Life Insurance Persistency Study for 2005-2007. The Permanent Whole Life product is assumed to be a whole life product. Lapse rates are higher in early policy years and grade down with policy duration.
- **Accumulation Universal Life:** Lapse rates were developed using the SOA/LIMRA U.S. Individual Life Insurance Persistency Study for 2005-2007. The UL product is assumed to be a cash value accumulation universal life product. Lapse rates are higher in early policy years and grade down with policy duration.
- **Group:** Lapse rates were set equal to 10 Year Term rates for the first 5 policy durations. Durations 6 and later were assumed to remain constant. Sensitivity testing demonstrated that group life results are relatively insensitive to lapse rates.

Post Level Term Mortality

- Mortality experience for 10-year and 20-year term products following the level premium period is set through these assumptions through actual to expected ratios. Mortality rates spike following the level premium period because healthy insureds find new coverage, while unhealthy insureds are more likely to keep the coverage due to insurability concerns. The post-level term mortality actual to expected rates were developed using the SOA/RGA Report on the Lapse and Mortality Experience of Post-Level Premium Period Term Plans (2014).

Experience Mortality Rates

- **Individual Life:** Experience mortality rates were set using the 2017 CSO Unloaded Age Nearest Birthday (ANB) tables and vary by gender, smoking status, and underwriting class. Each table is structured as select and ultimate by issue ages 18-95 and select period policy durations 1-25. The 10 individual life tables have the following naming convention:
  - **Gender:** Male (M) or Female (F)
  - **Smoking Status:** Non-smoker (NS) or Smoker (SM)
  - **Underwriting Class:** Super Preferred (1), Preferred (2 for NS, 1 for SM), Residual (3 for NS, 2 for SM)
- **Group Life:** Experience mortality rates were developed using the SOA 2016 Group Life Experience Committee Report study. The table is structured by gender (male and female) and attained age.

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Reserve Factors

- **Permanent Life:** Reserve factors for permanent life (whole life and cash value accumulation universal life) plans were developed using the 2017 CSO tables with a 3.5% interest rate and vary by gender and smoking status. Each table is structured as by issue ages 20-75 in 5-year increments and policy durations 1-101. The 4 individual life tables have the following naming convention:
    - **Gender:** Male (M) or Female (F)
    - **Smoking Status:** Non-smoker (NS) or Smoker (SM)
- **Term Life:** Reserve factors for term life (level term 10 and level term 20) plans were developed using the 2017 CSO tables with a 4.5% interest rate and vary by gender, smoking status, and underwriting class. Each table is structured as by issue ages 20-75 in 5-year increments and policy durations 1-10 for level term 10 and 1-20 for level term 20. The 20 individual life tables have the following naming convention:
    - **Product:** Level Term 10 (LT10) or Level Term 20 (LT20)
    - **Gender:** Male (M) or Female (F)
    - **Smoking Status:** Non-smoker (NS) or Smoker (SM)
    - **Underwriting Class:** Super Preferred (1), Preferred (2 for NS, 1 for SM), Residual (3 for NS, 2 for SM)
- **Group Life:** Reserves for group life were set simply as a yearly renewable term (YRT) reserve equal to ½ of the mortality rate for a given cohort based on gender and attained age. A separate table of factors was not needed.

Capital Factor Quantification Method

The capital need, expressed as a dollar amount, is determined as the GPVAD at the 95th percentile of the stochastic distribution of scenarios over the remaining lifetime of a block of business while appropriately reflecting the pricing flexibility to adjust current mortality rates. Statutory losses are defined as the after-tax quantification of gross death benefits minus reserves released minus mortality margin present in reserves. The after-tax statutory losses are discounted to the present by using 20-year averages for U.S. swap rates. By selecting the largest present value accumulated loss across all projection years, the solved for capital ensures survival at all projection periods. Earlier period losses are not allowed to be offset by later period gains to reduce capital. The 95th percentile is the regulator accepted statistical safety level used for Life RBC C-2 mortality risk to identify weakly capitalized companies. The after-tax capital needs are translated to a factor expressed as a percentage of the initial NAR and are shown as amount per $1,000 of NAR. The pre-tax factor is determined by taking the after-tax factor divided by (1 minus the tax rate).

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Model Results

Overall Results and Recommended C-2 Factors

The recommended pre-tax factors per $1,000 of retained NAR are shown in Table 1 below. Business assumed by reinsurers is treated as direct for reinsurer financial statements. The factors are differentiated by individual & industrial life and group & credit life, consistent with the current framework. The modeling focused on individual and group life, and the work group evaluated the continued appropriateness of applying the factors to industrial life and credit life business. It is recommended that industrial life and credit life continue to be mapped to individual and group life, respectively, as the product attributes are similar. The factors are rounded to the nearest 0.05 to recognize the randomness inherent in the model (see Impact of Random Number Seed for additional information). Three size bands are recommended to represent inforce blocks of small, medium, and large sizes. This reflects combining the two middle categories in the current framework. The size bands continue to be relevant and appropriate as a material portion of life insurers are represented within each category.

Within individual & industrial life, the factors are differentiated into three product categories: ULSG, term life, and all other life. The product definitions are consistent with the annual statement – analysis of operations by line of business – individual life insurance and VM-20. The differences by product category are the sole result of applying different risk exposure periods to an aggregate life inforce block. As described in Sensitivity 4 Individual Life Products under Model Sensitivities, the model produces consistent results by product for a given risk exposure period, as expressing the factor as a percentage of net amount at risk neutralizes product differences.

ULSG factors are the highest due to the longest current mortality rate guarantees and are based on a 20-year risk exposure period for a mature inforce block. Term life factors are based on a typical 10-year risk exposure period for a mature inforce block. The industry is concentrated in 10-, 20- and 30-year level term. All other life factors are based on a 5-year risk exposure period and assume inforce pricing may be adjusted following adverse mortality experience due to the presence of non-guaranteed elements. Examples are universal life products without secondary guarantees and participating whole life products.

Within group & credit life, the factors are differentiated into two categories based on the remaining length of the premium term based on company records by group contract. The two categories are remaining rate terms over 3 years and remaining rate terms 3 years and under. The remaining rate terms over 3 years category is represented by a 5-year risk exposure period, and the remaining rate terms 3 years and under is represented by a 3-year risk exposure period. The risk exposure periods recognize a time lag between when experience emerges and when pricing is adjusted.

Table 1 - Recommended C-2 Life Mortality Factors

Pre-Tax RBC C-2 Factors	Individual & Industrial Life				Group & Credit Life		
Per $1,000 of Inforce NAR	Universal Life with Secondary Guarantee (ULSG)	Term Life	All Other Life	% of Individual Life Insurers*	Remaining Rate Terms Over 3 Years	Remaining Rate Terms 3 Years and Under	% of Group Life Insurers*
First $500M	3.90	2.70	1.90	43%	1.80	1.30	54%
Next $24.5B	1.65	1.10	0.75	36%	0.70	0.45	33%
> $25B	1.10	0.75	0.50	21%	0.45	0.30	12%

* as of 2019 annual statement reporting

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Table 2 and Table 3 compare the recommended factors versus the current RBC factors in place as of 12/31/2020.

Table 2 - Individual & Industrial Life Comparison Versus Current RBC							
Pre-Tax RBC C-2 Factors	Individual & Industrial Life				Change vs Current RBC		
Per $1,000 of Inforce NAR	Current RBC	ULSG	Term	All Other	ULSG	Term	All Other
First $500M	2.23	3.90	2.70	1.90	75%	21%	-15%
Next $4.5B	1.46	1.65	1.10	0.75	13%	-25%	-49%
Next $20B	1.17	1.65	1.10	0.75	41%	-6%	-36%
> $25B	0.87	1.10	0.75	0.50	26%	-14%	-43%

The overall individual life industry impact would be a modest decrease with industry exposure by NAR concentrated in term life business amongst large insurers. Factors increase for ULSG due to the long-term risk exposure period to current mortality rates. As indicated in Exhibit 1, factors decrease for products with near-term inforce pricing flexibility (i.e., all other category). Small ULSG and term carriers would experience an increase on retained business. However, reinsurance is typically used to transfer/mitigate the mortality risk.

Table 3 - Group & Credit Life Comparison Versus Current RBC					
Pre-Tax RBC C-2 Factors	Group & Credit Life			Change vs Current RBC	
Per $1,000 of Inforce NAR	Current RBC	Remaining Rate Terms Over 3 Years	Remaining Rate Terms 3 Years and Under	Remaining Rate Terms Over 3 Years	Remaining Rate Terms 3 Years and Under
First $500M	1.75	1.80	1.30	3%	-26%
Next $4.5B	1.16	0.70	0.45	-40%	-61%
Next $20B	0.87	0.70	0.45	-20%	-48%
> $25B	0.76	0.45	0.30	-41%	-61%

The overall group industry impact would be a significant decrease in C-2 capital. The factors decrease for all but one category: small size for longer rate terms which stays about the same. Group life factors decreased due to the decades-long decline in experience mortality rates, and the risk exposure periods remain shorter term as compared to individual life.

Credit for Group Life Premium Stabilization Reserves

The current RBC formula includes a 50% credit for group life premium stabilization reserves to offset the group life C-2 requirement. This component was reviewed by the work group. Based on a theoretical framework and professional experience, the 50% factor was deemed to be an appropriate offset to the capital requirement.

Correlation with Longevity C-2

The updated Life C-2 mortality modeling was completed consistent with the development of the adopted Longevity C-2 factors and correlation factor. Therefore, the work group opines that additional review of the adopted correlation factor is not necessary because of the updates to the Life C-2 mortality factors being recommended by this work group.

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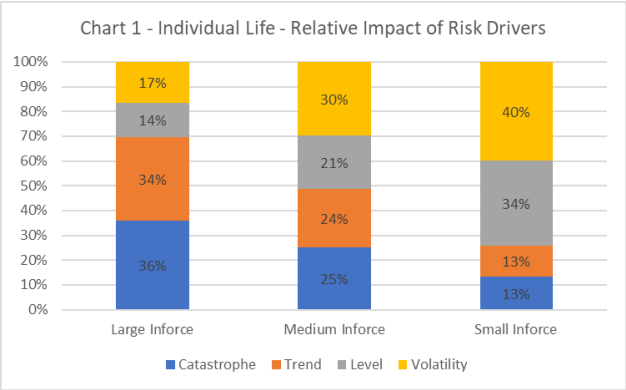
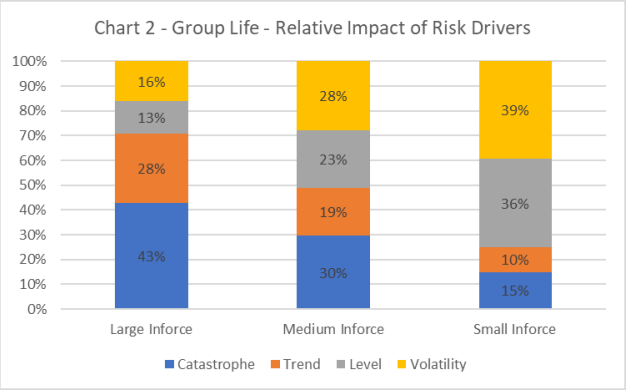
Attribution Analysis

The model mortality risk components were analyzed to determine the relative contribution to the overall recommended factors. Charts 1 and 2 below show the results of the attribution analysis for individual and group life. Individual and group life have similar breakdowns by inforce block size with small differences due to the inforce mix, experience mortality rates and other assumptions. For small inforce blocks, the primary mortality risk drivers are volatility and level risks. For large inforce blocks, catastrophe and trend risks become the primary drivers. For medium inforce blocks, the risks are relatively balanced between categories.





95th Percentile Mortality Increase

The 95th percentile capital factors were translated into overall mortality increases (% increase vs experience mortality) for the projection period. Table 4 highlights the results. As expected, the higher the capital factor, the larger the mortality increase. Differences between individual and group life are due to lapse assumptions. Group life has a higher overall lapse rate, which translates into a larger mortality increase needed to reproduce a given capital factor.

Table 4 - Capital Factors Expressed as an Overall % Mortality Increase

	Inforce Block Size		
	Large	Medium	Small
Individual Life	8%	10%	22%
Group Life	10%	14%	31%

Model Sensitivities

Various sensitivity tests were performed to understand the results of the model under alternative assumptions. Most of the sensitivities were based on the individual life large inforce block size for a 5-year exposure period. However, the sensitivities are similar for group life (if applicable), for the small and medium inforce block sizes, and for different risk exposure periods.

1. Random Number Seed

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The model results vary slightly depending on the initial random number seed selected as shown in the table below. As a result of these fluctuations even when running 10,000 scenarios, the recommendation was to round the factors to the nearest 0.05.

Sensitivity 1 - Impact of Random Number Seed	
Pre-Tax RBC C-2 Factors	Individual Life - Large Size
Per $1,000 of Inforce NAR	Fluctuation
RN Seed 5	0.03
RN Seed 15	0.03
RN Seed 35	0.04
RN Seed 45	0.04
RN Seed 55	0.02
RN Seed 65	0.04
RN Seed 75	0.03
RN Seed 85	0.04
RN Seed 95	0.03

2. Mortality Load (Margin)

Sensitivities under alternative mortality loads of 2.5% and 0% are shown in the table below. Lowering the mortality load increases the factor as this assumption is used to represent the amount of mortality margin embedded in statutory reserves. The 5% assumption maps to a 1 standard deviation moderately adverse standard at approximately the 85th percentile. For smaller inforce blocks the 5% mortality load covers less than 1 standard deviation of mortality experience due to the volatility and level risks present with low mortality credibility.

Sensitivity 2 - Reserve Mortality Load Assumption			
Pre-Tax RBC C-2 Factors	Individual Life - Large Size		
Per $1,000 of Inforce NAR	Factor	Difference	Percentile
5% Reserve Mortality Load	0.50	-	≈ 85th
2.5% Reserve Mortality Load	0.69	0.19	≈ 70th
0% Reserve Mortality Load	0.91	0.41	50th

3. Attained Age

Model results are stable for most of the initial attained age categories. The exception is for older attained ages where the factors increase due to higher mortality rates. Exposure to attained ages 65 and older is relatively small in the assumed inforce mixes based on industry data. However, if a company is concentrated in older age inforce business, then it is subject to higher mortality risk. The recommended factors are not differentiated by attained age due to the low percentage of inforce policies at older attained ages and the data not being readily available in the annual statements.

Sensitivity 3 - Results by Initial Attained Age						
Pre-Tax RBC C-2 Factors	Individual Life - Large Size			Group Life - Large Size		
Per $1,000 of Inforce NAR	Factor	Difference	% of Inforce	Factor	Difference	% of Inforce
Inforce Mix	0.50	-	100%	0.47	-	100%
Age 25	0.47	-0.03	7%	0.46	0.00	11%
Age 35	0.50	0.00	16%	0.50	0.03	24%
Age 45	0.49	0.00	29%	0.45	-0.02	29%
Age 55	0.50	0.00	28%	0.47	0.00	25%
Age 65	0.62	0.12	15%	0.59	0.12	10%
Age 75	1.37	0.87	6%	1.39	0.93	1%

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4. Individual Life Products

Model results by individual life product type are relatively stable as shown in the table below. Expressing the capital factors as a percentage of net amount at risk neutralizes product differences. For example, term life products have higher relative net amounts at risk than permanent life products for mature blocks, but the mortality risk is proportionate to the net amount at risk. Therefore, term products will tend to have higher dollar amounts of capital per policy or per unit of face amount due to being subject to higher net amounts at risk.

Given the small product differences, the recommended factors were developed by differentiating the projection period on an entire mix of inforce business containing all products. The risk exposure period as represented by the projection period is the critical variable in recognizing product differences.

As discussed in the *Limitations* section, product features are modeled at a very basic level and consider differences in base statutory reserves, lapses, post level term mortality experience, face amounts and attained ages.

Sensitivity 4 - Results by Product Type			
Pre-Tax RBC C-2 Factors	Individual Life - Large Size		
Per $1,000 of Inforce NAR	Factor	Difference	% of Inforce
Inforce Mix	0.50	-	100%
Level Term 10	0.51	0.01	25%
Level Term 20	0.43	-0.07	25%
Whole Life	0.47	-0.03	35%
Universal Life	0.42	-0.08	15%

5. Longer Projection Periods

The length of the projection period is a key assumption and is intended to represent the risk exposure period to current mortality rates over the remaining lifetime of a block of business. The impact of longer projection periods is shown in the table and chart below. Mortality risk increases with projection period as it exposes a company increasingly to trend risk and longer-term mortality shocks.

Sensitivity 5 - Results by Projection Period		
Pre-Tax RBC C-2 Factors	Individual Life - Large Size	
Per $1,000 of Inforce NAR	Factor	Difference
5-Year Projection	0.50	-
10-Year Projection	0.76	0.26
15-Year Projection	0.97	0.47
20-Year Projection	1.10	0.61
30-Year Projection	1.30	0.80

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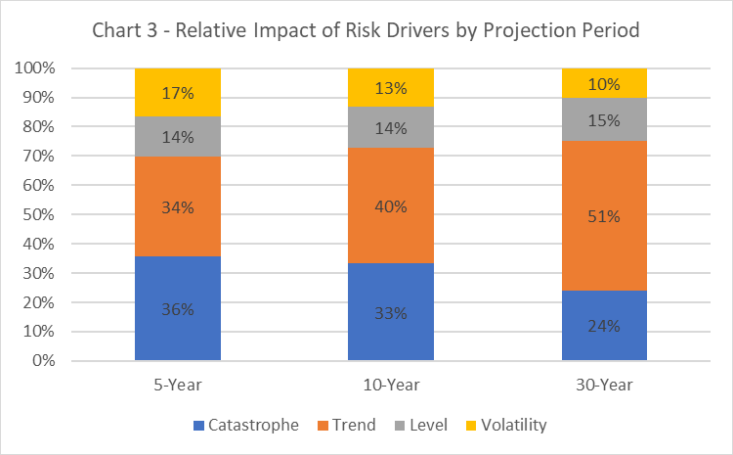

6. Gender

Model results by gender are small as shown in the table below.

Sensitivity 6 - Results by Gender			
Pre-Tax RBC C-2 Factors	Individual Life - Large Size		
Per $1,000 of Inforce NAR	Factor	Difference	% of Inforce
Inforce Mix	0.50	-	100%
Female	0.45	-0.04	45%
Male	0.51	0.01	55%

7. Underwriting Class

Model results were measured for the best underwriting class (lowest experience mortality) and worst underwriting class (highest experience mortality), which highlights that factor increase slightly with higher experience mortality. However, it's important to note that the mortality risk assumptions would be different if they were calibrated by underwriting class (versus the approach used to develop assumptions appropriate for the entire industry / inforce mix). Arguably, companies concentrated in exposure to less healthy / lower underwriting classes would be subject to higher mortality risk due to the higher experience mortality rates. The recommended factors are not differentiated by underwriting class due to the low percentage of inforce policies at residual underwriting classes and the data not being readily available in the annual statements.

Sensitivity 7 - Results by Underwriting Class			
Pre-Tax RBC C-2 Factors	Individual Life - Large Size		
Per $1,000 of Inforce NAR	Factor	Difference	% of Inforce
Inforce Mix	0.50	-	100%
Non-Smoker Best Class	0.46	-0.03	35%
Smoker Residual Class	0.63	0.13	7%

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8. Face Amount

The model was run with the smallest and largest face amounts which confirmed the impact of the face amount assumptions is small.

Sensitivity 8 - Results by Face Amount			
Pre-Tax RBC C-2 Factors	Individual Life - Large Size		
Per $1,000 of Inforce NAR	Factor	Difference	% of Inforce
Inforce Mix	0.50	-	100%
Smallest Face ($17.5K)	0.45	-0.05	19%
Largest Face ($7.5M)	0.45	-0.05	0.3%

9. Discount Rate

The impact of an alternative (higher) discount rate was assessed, and the impact is small. The longer the projection period, the greater the impact.

Sensitivity 9 - Impact of Discount Rate		
Pre-Tax RBC C-2 Factors	Individual Life - Large Size	
Per $1,000 of Inforce NAR	Factor	Difference
3.5% Discount Rate - 5-Year	0.50	-
5% Discount Rate - 5-Year	0.48	-0.01
3.5% Discount Rate - 10-Year	0.76	-
5% Discount Rate - 10-Year	0.72	-0.04
3.5% Discount Rate - 20-Year	1.10	-
5% Discount Rate - 20-Year	1.00	-0.11

10. Tax Rate

The pre-tax factors are impacted very slightly by the tax rate through discounting (after-tax cash flows are discounted at an after-tax discount rate). The impact becomes slightly greater with longer projection periods. There is obviously a direct impact to the after-tax factors and RBC amounts based on the applicable corporate tax rate.

Sensitivity 10 - Impact of Tax Rate		
Pre-Tax RBC C-2 Factors	Individual Life - Large Size	
Per $1,000 of Inforce NAR	Factor	Difference
21% Tax Rate	0.50	-
35% Tax Rate	0.51	0.01

11. Larger Number of Inforce Policies

A sensitivity test was performed with an even larger number of inforce policies to assess the impact. The volatility risk component is directly impacted by the inforce policies assumption. At 5 million inforce policies, the factor ends up a little lower. However, the volatility risk component can't go lower than 0. Therefore, increasing the number of inforce policies beyond 1 million or even 5 million won't materially decrease the large size factors.

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Sensitivity 11 - Impact of Larger Number of Inforce Policies		
Pre-Tax RBC C-2 Factors	Individual Life - Large Size	
Per $1,000 of Inforce NAR	Factor	Difference
1 Million Policies	0.50	-
5 Million Policies	0.43	-0.06

12. Larger Retention Limit

A larger retention limit increases the large size pre-tax factor slightly due to increased fluctuation from the large face amounts inforce. This assumption is used primarily to control for inforce block size. Smaller inforce blocks are characterized by smaller retention limits as companies tend to reinsure mortality risk in excess of the capability to retain the risk on the balance sheet. If a company were to be concentrated in very large face amounts and a small amount of inforce policies, then it would be subject to higher mortality risk due to volatility.

Sensitivity 12 - Impact of Larger Retention Limit		
Pre-Tax RBC C-2 Factors	Individual Life - Large Size	
Per $1,000 of Inforce NAR	Factor	Difference
$1 Million Retention	0.50	-
$10 Million Retention	0.54	0.04

13. Group Life Lapse Rates

A sensitivity test was performed with lower group life lapses to confirm that results are insensitive to this assumption. A 4% average annual lapse rate was assumed for sensitivity versus base lapse rates around 8% per year. The results confirmed that changes to this assumption do not materially change the results.

Sensitivity 13 - Impact of Lower Group Life Lapses - 5-Year		
Pre-Tax RBC C-2 Factors	Group Life - Large Size	
Per $1,000 of Inforce NAR	Factor	Difference
Base Lapse Rates	0.466	-
4% Lapse Rates	0.474	0.007

14. Unknown Catastrophe Risk Probability

During the development of the unknown sustained catastrophe component, there was much debate surrounding the probability of the event occurring. There were arguments for both a 2.5% and 5% annual probability with the 2.5% ultimately being the work group's recommendation. As shown in the table below, increasing the annual probability from 2.5% to 5.0% has only a modest impact on the factor. The reason for this result resides in the cumulative probabilities over the projection period. Since the factor is determined at the 95th percentile, both assumptions result in the unknown risk event being triggered (i.e. cumulative probabilities greater than 5%). The annual probability assumption therefore impacts the length of the event as once the event is triggered it is sustained for the rest of the projection period. A higher probability assumption increases the likelihood of a longer event occurring.

Sensitivity 14 - Unknown Catastrophe Risk Probability			
Pre-Tax RBC C-2 Factors	Individual - Large Size		Cumulative
Per $1,000 of Inforce NAR	Factor	Difference	Probability
2.5% Annual Probability	0.50	-	12%
5% Annual Probability	0.53	0.03	23%

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15. Individual Life Lapses

    As with group life, results are relatively insensitive to lapse rates. While a separate sensitivity test is not shown here, differences in lapses are reflected in the product differences (see sensitivity test 4).

Comparison Versus Other Capital Regimes

The work group reviewed characteristics of non-U.S. based capital regimes to evaluate the mortality risks covered and capital requirements versus the results of this project. Other capital regimes have different intended purposes, so differences were expected. The reviews of other capital regimes confirmed that the U.S. Life RBC model includes the same mortality risk types and at an overall magnitude in the proximity of other regimes. One overall difference versus other regimes is that internal company-based modeling is used (or there is the company option to use).

- *Canada Life Insurance Capital Adequacy Test:* The Canadian framework assesses the same mortality risk components as the U.S. Life RBC model: volatility, level, trend, and catastrophe risks. The framework differs in that the capital requirement is unique to each individual company and is determined through company determined modeling.

- *International Association of Insurance Supervisors (IAIS) Insurance Capital Standard (ICS):* The IAIS framework uses a stress-based framework with shocks to the level of mortality (+10%), the trend in mortality, and the volatility in mortality. There is a separate catastrophe risk component equating to an additional 1 death per thousand. This framework is also completed through modeling by each individual entity. Management responses to mortality events are reflected in the modeling. The ICS separately has a basic capital requirement equating to a factor of 0.56 per thousand of NAR.

- *Solvency II:* This framework applies mortality stresses assessed at the 99.5th confidence interval. The standard formula applies a 15% mortality rate increase and is intended to cover volatility, trend, and level risks. The catastrophe risk is modeled as an additional 1.5 deaths per thousand. Companies have the option to use an approved internal model in place of the standard formula.

- *Standard & Poor's (S&P) Ratings Model*: S&P uses a factor-based approach in assessing U.S. life insurer ratings. For mortality risk, the ratings model recognizes inforce block size differences, and the factors scale down with increasing inforce block size. For the BBB category, the capital factors range from 0.57 per thousand of NAR for the largest inforce blocks (> $100B NAR) to 2.29 per thousand of NAR for the smallest inforce blocks (< $1B NAR). Arguably, having capital below BBB levels is indicative of being weakly capitalized as a company would be rated below investment grade.

Validation and Peer Review

Model assumptions were developed by the work group through reviewing current mortality research and studies applicable to the U.S. life insurance industry. The assumptions were discussed, reviewed, and agreed upon through the work group's bi-weekly calls. Model results and sensitivities were also reviewed extensively by the work group. The work group also provided several updates to the NAIC Life Risk-Based Capital Working Group throughout the project and feedback was obtained from regulators.

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The model was independently peer reviewed by a member of the work group. The peer review confirmed that the calculations performed by the model were reasonable for the intended purpose and were being applied as intended. The detailed results of the peer review are documented separately by the work group.

Additional detailed documentation on model assumptions, output structure and modeling methodology was created by the work group and may be made available upon request.

Limitations

The model is intended to stochastically project through stochastic simulation the run-off of inforce life insurance blocks typical of U.S. life insurers in order to develop capital factors for use in the NAIC RBC formula for C-2 life insurance mortality risk. Other uses outside of this intended purpose may not be appropriate.

Product features in the model were developed at a very basic level and consider differences in base statutory reserves, lapses, post level term mortality experience, face amounts and attained ages. The model is not designed to replicate detailed product and inforce block characteristics unique to individual companies. In particular, ULSG products were not directly modeled. The work group concluded based on the modeling that the capital factors are insensitive to product differences for a given risk exposure period. The recommendation to differentiate based on product is an indirect way to get at the length of mortality rate guarantee, utilizes the current reporting structure of the annual statements, and is aligned with principles based reserving differentiation.

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