Date: 12/13/21

Virtual Meeting

LIFE RISK-BASED CAPITAL (E) WORKING GROUP
Thursday, December 16, 2021
12:00 – 1:00 p.m. ET / 11:00 a.m. – 12:00 p.m. CT / 10:00 – 11:00 a.m. MT / 9:00 – 10:00 a.m. PT

ROLL CALL

Philip Barlow, Chair	District of Columbia	William Leung	Missouri
Jennifer Li	Alabama	Derek Wallman	Nebraska
Thomas Reedy	California	Seong-min Eom	New Jersey
Wanchin Chou	Connecticut	Bill Carmello	New York
Sean Collins	Florida	Andrew Schallhorn	Oklahoma
Vincent Tsang	Illinois	Mike Boerner/Rachel Hemphill	Texas
Mike Yanacheak/Carrie Mears	Iowa	Tomasz Serbinowski	Utah
Fred Andersen	Minnesota		

NAIC Support Staff: Dave Fleming`

AGENDA

1. Consider Adoption of Guidance Document on Bond Factor Changes—*Philip Barlow (DC)*

   - American Council of Life Insurer's Comment Letter — Attachment 1
   - Guidance Document — Attachment 2

2. Continue Discussion of the American Academy of Actuaries' C2 Mortality Work Group Recommendation—*Philip Barlow (DC)* — Attachments 2 & 3

3. Discuss Any Other Matters Brought Before the Working Group—*Philip Barlow (DC)*

4. Adjournment

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ACLI
Financial Security for Life

Brian Bayerle
Senior Actuary

December 9, 2021

Mr. Philip Barlow
Chair, NAIC Life Risk-Based Capital (E) Working Group (Life RBC)

Re: Life Risk-Based Capital (E) Working Group Exposure on Bond Factor Changes

Dear Mr. Barlow:

The American Council of Life Insurers (ACLI) appreciates the opportunity to submit the following comments on the Life Risk-Based Capital (E) Working Group (Life RBC) Exposure on Bond Factor Changes (Exposure).

ACLI is supportive of the bond factor memo to explain that the C-1 Bond Factor changes may lead to decreases in RBC ratios. We ask if it would be appropriate to also note that the C-2 Longevity Factor charge also is going into effect for the first time this yearend and may reduce RBC ratios for certain companies.

We appreciate the consideration of our comments and look forward to discussing on a future call. Thank you.

Sincerely,

B Bayerle

cc: Dave Fleming, NAIC

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NATIONAL ASSOCIATION OF INSURANCE COMMISSIONERS

MEMORANDUM

TO: Financial Examiners and Other State Insurance Regulators

FROM: Philip Barlow, Chair of the Life Risk-Based Capital (E) Working Group

DATE: ~~Nov. 9~~Dec. 16, 2021

RE: Interpretation of the 2021 Life Risk-Based Capital (RBC) Results in Light of the 2021 Bond Factor Changes

Purpose and Intended Audience for this Document

This document is intended to assist financial examiners and other state insurance regulators as they review the results of 2021 RBC calculations for life insurers in light of the 2021 bond factor changes. There were also changes related to longevity risk, real estate and reinsurance that state insurance regulators may want to consider but this document is specifically addressing the bond factor changes as they have the most potential to impact the action level, including through the trend test.

More detailed information about this topic is contained in the minutes of the Life Risk-Based Capital (E) Working Group, and related documents are included on the websites for both the Working Group and the Capital Adequacy (E) Task Force. The changes to the Life RBC formula factors for bonds were adopted by the Working Group on June 11 and by the Task Force on June 30.

Executive Summary

The work to update the RBC charges applied to bonds has been ongoing for several years and reflects the efforts of many participants. The Working Group appreciates the considerable work of the American Academy of Actuaries (Academy) on this project, as well as the work done by Moody's Analytics on behalf of the American Council of Life Insurers (ACLI). The Working Group discussed the proposals presented during numerous conference calls over the past year. The Working Group also reviewed estimates of the impact the proposals would have had on the RBC results for life insurers' year-end 2020 filings. The Working Group concluded that both proposals presented a sound and appropriate update to the factors applied to bonds, and it ultimately adopted the proposal presented by Moody's.

How should the effects of the change in bond factors be factored into the interpretation of RBC results?

The estimated impact of the change in bond factors the Working Group reviewed on individual companies and the life insurance industry in aggregate indicated less than a 2% increase in the authorized control level (ACL) RBC on an aggregate basis. However, a small number of companies experienced a much larger impact when the 2019 results were recalculated with the new factors. The Life RBC Trend Test (LR035) will be affected by the change in bond factors and may be an area where this change is most evident. The Trend Test calculates a margin, which is the excess of total adjusted capital (TAC) over ACL RBC, for each of the current year, prior year, and third prior year. To the extent that the current year margin is lower than the prior year or third prior year margin, regulatory action may be indicated.

For the 2021 Trend Test, the margin for 2021 is compared to the margins for 2020 and 2018. As noted, a company's ACL RBC is expected to be increased for 2021 compared to prior years. The changes to ACL RBC due to the change in bond factors may cause some companies to trigger the Trend Test for 2021, solely because of the change in bond factors.

If state insurance regulators find that a life insurer has triggered the Trend Test, triggers an Action Level for 2021, or has a significant decline in its RBC ratio from 2020 to 2021, they could have additional discussions with the company and request additional calculations. It is likely that companies would have done some analysis of significant changes in ACL RBC, and that analysis could be shared with state insurance regulators.

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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

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[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

Contents

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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.

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

<u>Overall Results and Recommended C-2 Factors</u>

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 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 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.

Introduction

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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.

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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 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 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).

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

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.

- ***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.

<u>Initial Inforce Assumptions</u>

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.

- ***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.

<u>Mortality Risk Drivers</u>

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.

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

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+)	$D_{O,M}$	$D_{O,F}$

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

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.

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

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%

<u>Reserve Mortality Margin</u>

- ***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.

<u>Experience Mortality Improvement</u>

- 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.

<u>Lapse Rates</u>

- 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

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.

<u>Credit for Group Life Premium Stabilization Reserves</u>

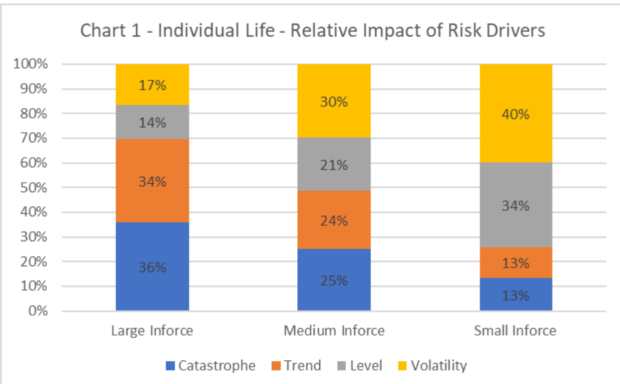
The current RBC formula includes a 50% credit for group life premium stabilization reserves to offset the group life C-2 requirement. This component was reviewed by the work group. Based on a theoretical framework and professional experience, the 50% factor was deemed to be an appropriate offset to the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

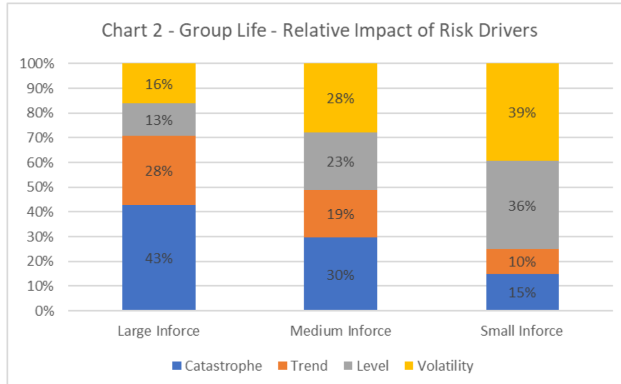
<u>Correlation with Longevity C-2</u>

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.

<u>Attribution Analysis</u>

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.





<u>95th Percentile Mortality Increase</u>

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

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%

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.

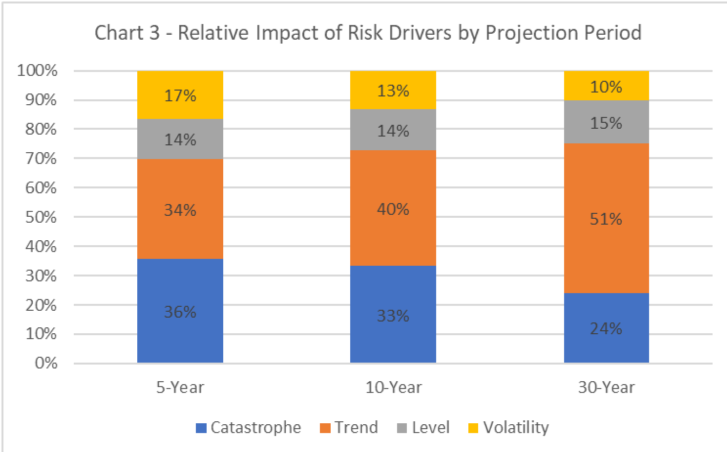
As discussed in the *Limitations* section, product features are modeled at a very basic level and consider differences in base statutory reserves, lapses, post level term mortality experience, face amounts and attained ages.

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



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%

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.

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.

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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Academy C-2 Mortality Work Group Recommendation

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National Association of Insurance Commissioners (NAIC) Life Risk-Based Capital (E) Working Group (LRBCWG)—November 9, 2021

Agenda

- Review Life RBC C-2 mortality overall approach and current risk-based capital (RBC) factors
- Present recommendation on updated C-2 factors
  - Structural changes to factor categories
  - Updated factors under the recommended structure
- Appendix:
  - Methodology, assumption, and risk distribution comparisons
  - Validation, peer review, limitations

Life RBC C-2 Mortality Overall Approach (1 of 2)

- 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
- C-2 requirement covers mortality risk up to the 95th percentile covering adverse experience in excess of the amount covered in statutory reserves
- C-2 requirement includes mortality risks related to:
  - Volatility Risk—natural statistical deviations in experienced mortality
  - Level Risk—error in experience mortality assumption
  - Trend Risk—adverse mortality trend
  - Catastrophe Risks
    - Large temporary mortality increase from a severe event such as a pandemic or terrorism
    - Sustained mortality increase from an unknown risk

Life RBC C-2 Mortality Overall Approach (2 of 2)

- Evaluate mortality risks using stochastic simulation of projected statutory losses
- Discount after-tax cash flows (at 2.765% after-tax discount rate [3.5% pre-tax])
- Express capital requirement using a factor-based approach applied to Net Amount at Risk (NAR) and convert to pre-tax

C-2 Life Mortality Risk-Based Capital

	Current Pre-Tax RBC Factors	
Per $1000 of NAR	**Individual & Industrial Life**	**Group & Credit Life**
First $500M	2.23	1.75
Next $4.5B	1.46	1.16
Next $20B	1.17	0.87
>$25B	0.87	0.78

- The C-2 component of RBC represents 17-18% of total life industry risk-based capital

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What Changed and Didn't Change from the Original Work*

What Changed

- Expanded categories to three product categories for individual life and two categories for remaining rate terms for group life
- Addition of a catastrophe terrorism component
- Addition of a catastrophe unknown sustained risk component, replaces severe adverse HIV scenarios in original work
- Lower experience mortality rates
- Lower discount rates (2.765% after-tax versus 6% in original work)
- Inforce assumptions reflecting current U.S. life insurers (demographic, product, lapses, etc.) and group specific assumptions
- Mortality risk assumptions calibrated to latest research and studies
- New model developed in Excel VBA; stochastic capabilities are much greater today than the early 1990's

What Didn't Change

- Statistical safety level – 95th percentile over 5 years for individual life products with inforce pricing flexibility
- Capital is determined for losses in excess of reserve mortality – 5% margin in statutory reserve mortality is consistent with one standard deviation

* See the Appendix for a detailed comparison of the current and original work

Pre-Tax C-2 Factor Recommendation versus Current RBC

Risk Component	Large Inforce Size >$25B NAR	Small Inforce Size ≤$500M NAR	Key Updates
HIV Scenarios	↓ 45%	↓ 25%	- Removal of discrete HIV scenarios
Level	↓ 25%	↑ 5%	- Lower experience mortality rates, reducing risk with large credible blocks
Trend	↑ 20%	↑ 10%	- Greater range of mortality trends and differences by age/sex cohort - Risk increases with longer exposure periods
Catastrophe	↑ 10%	↑ 5%	- Similar pandemic severity - Addition of 9/11-type terrorism event (+1%) - Addition of unknown sustained risk event (+4-9%)
Capital Quantification Method	↑ 10%	↑ 5%	- Update to greatest present value of accumulated deficiencies (GPVAD) - Loss quantified as death benefits minus reserves released
Volatility	↑ 0%	↓ 5%	- Similar results as the original model
Length of Risk Exposure Period	↑ varies	↑ varies	- Factors increase based on the length of the current mortality rate risk exposure period - This is a critical variable for differentiating mortality risk

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Lower Experience Mortality Rates

- The new model uses a distribution of rating classes using 2017 CSO tables
- 2017 Commissioners Standard Ordinary (CSO) mortality rates are significantly lower (50%-90%) than “88% of the 1975-80 Basic Table” used previously due to decades of mortality improvement in the U.S.
- An example at a typical age highlights the significant decrease

Comparison of Experience Mortality Rates, Example	
Rates Per 1,000	
Age 45, Male	
Table	Duration 1
88% of 1975-80 Basic Table	1.08
2017 CSO Unloaded Composite	0.48
% Difference	*-56%*

- Similar % decreases also occur at different gender, ages and underwriting classes
- Experience mortality manifests through the level risk component

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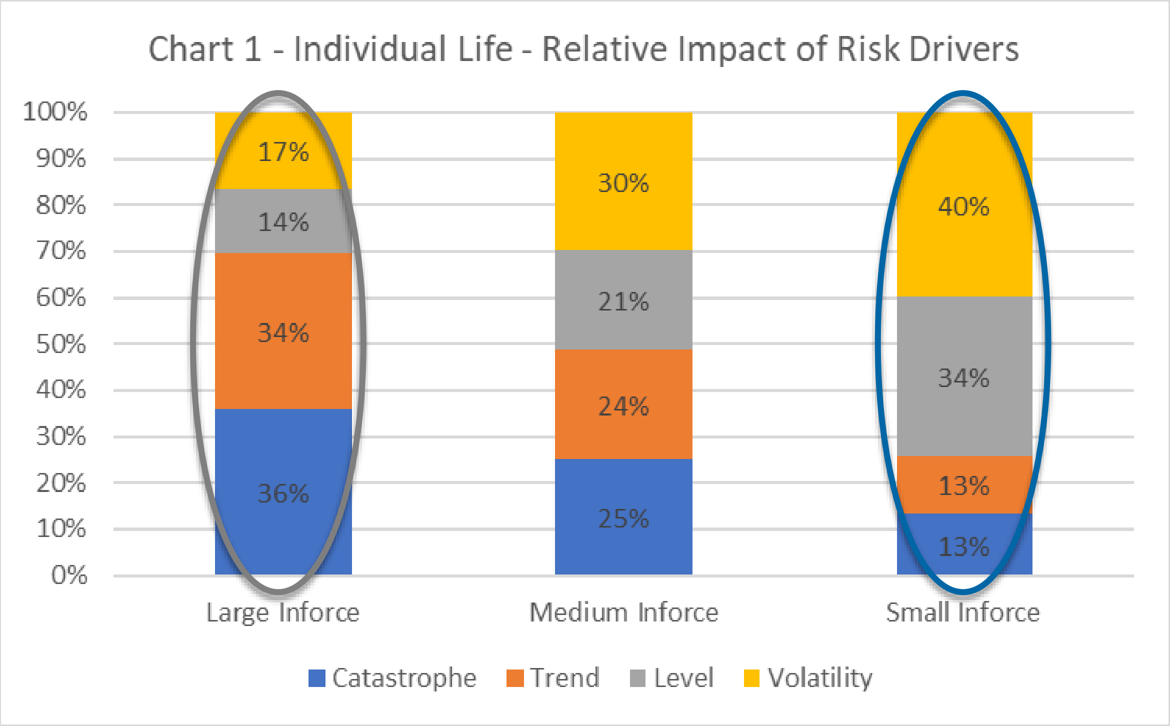
C-2 Factor Attribution by Mortality Risk Individual Life - 5-Year Projection Period Example



- Risks for large inforce blocks are spread proportionately between volatility/level, trend, and catastrophe
- Smaller inforce blocks are subject to higher volatility and level risks, which results in higher factors versus larger blocks

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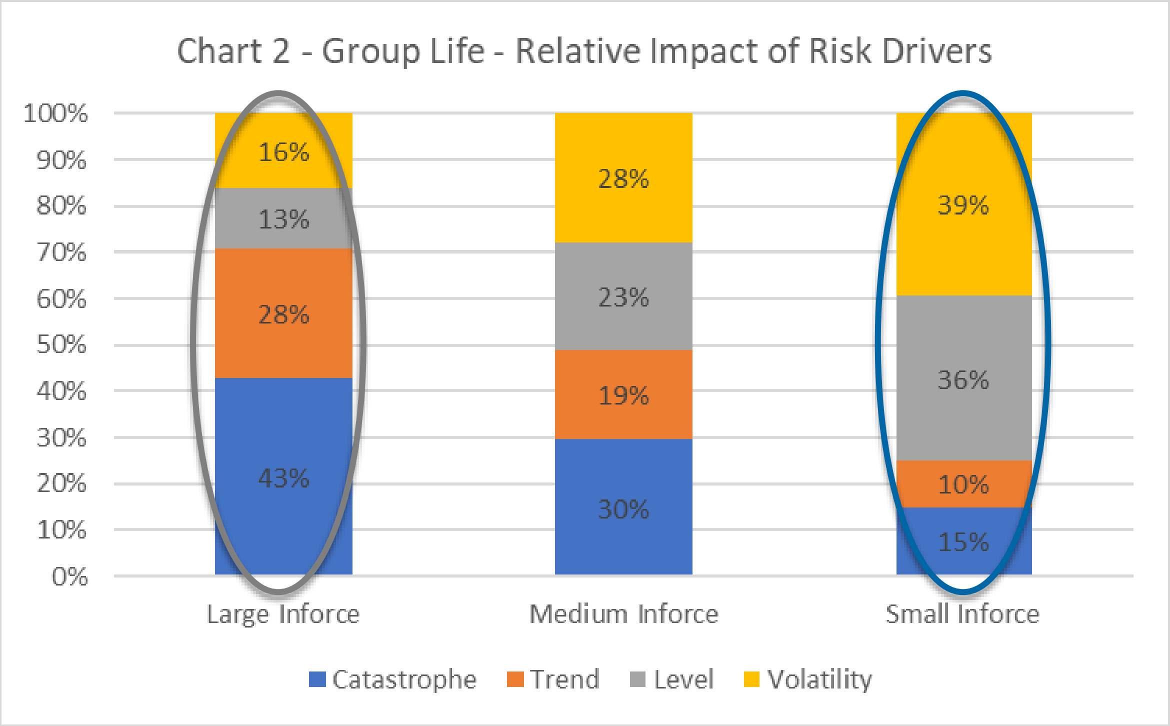
C-2 Factor Attribution by Mortality Risk
Group Life - 5-Year Projection Period Example



- Risks for large inforce blocks are spread proportionately between volatility/level, trend, and catastrophe
- Smaller inforce blocks are subject to higher volatility and level risks, which results in higher factors versus larger blocks

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Expanded Categories to Three Products for Individual Life and Two Categories for Remaining Rate Terms for Group Life

Original 1990s Work

- 1993 factors used a 5-year risk exposure period for all individual life business and a 3-year risk exposure period for group life because it assumed that management actions would occur to reset current mortality rates to reflect emerging experience

Expanded Categories to Three Products for Individual Life and Two Categories for Remaining Rate Terms for Group Life

Current Work

- For individual life, management action to reset current mortality rates may be limited or non-existent for products that offer longer term mortality rate guarantees (e.g., Universal Life with Secondary Guarantees (ULSG), Level Term)
- For group life, there are varying lengths of premium rate terms in the marketplace
- Factors aligned with the remaining risk exposure period of current mortality rates on an inforce block is appropriate. This risk differentiation can be accomplished by varying factors by product for individual life and by remaining premium term for group life.
- **The recommendation is to expand factors into additional categories to reflect the current mortality rate risk exposure period over the remaining lifetime of an inforce block of business**
  - **For individual life insurance, the recommendation is to differentiate into three product categories with definitions consistent with the annual statement – analysis of operations by line of business – individual life insurance and VM-20**
  - **For group life insurance, the recommendation is to differentiate into two categories by remaining length of the rate term based on company records by group contract**

Two New Catastrophe Components

- A terrorism component was developed based on industry experience from the September 11, 2001 terrorist attacks
  - Component assumes a 5% annual probability of an extra 0.05 deaths per 1,000.
- As shared at the September 11, 2020 LRBCWG meeting, a new catastrophe component was developed for a sustained mortality increase from an unknown risk, which serves as a replacement for the adverse HIV scenarios in the original work
  - Component is intended to cover unknown risks that could materialize in the insured population
  - The component assumes a 2.5% annual probability of a 5% sustained severe mortality increase
    - In follow up to a question at the 9/11/20 meeting, sensitivity testing was performed at a 5% annual probability, which has a very modest impact (within rounding to the nearest 0.05)
  - If the event occurs, it is sustained for the remainder of the projection period up to a maximum period of 10 years
  - Without this component the recommended factors would be about 0.1 lower
- **The recommendation is to include these two new catastrophe components.**

Recommended Updated C-2 Factors

	Pre-Tax Life RBC C-2 Factors				
Per $1000 of NAR	**Individual & Industrial Life**			**Group & Credit Life**	
	Universal Life with Secondary Guarantees	Term Life	All Other Life	Remaining Rate Terms Over 3 Years	Remaining Rate Terms 3 Years and Under
First $500M (Small)	3.90	2.70	1.90	1.80	1.30
Next $24.5B (Medium)	1.65	1.10	0.75	0.70	0.45
>$25B (Large)	1.10	0.75	0.50	0.45	0.30

Individual Life: New categorization would be determined based on the categories specified in the annual statement analysis of operations by line of business and consistent with VM-20

- 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.

Group Life: New categorization would be determined based on company records for the remaining premium rate terms by group contract

- One category is for remaining premium rate terms greater than 3 years and is represented by a 5-year exposure period
- The other category is remaining premium rate terms 3 years and under and is represented by a 3-year exposure period

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Recommendation on Updated C-2 Factors

	Pre-Tax Life RBC C-2 Factors						
Per $1000 of NAR	**Individual & Industrial Life**				**Group & Credit Life**		
	Universal Life with Secondary Guarantee	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 (Small)	3.90	2.70	1.90	43%	1.80	1.30	54%
Next $24.5B (Medium)	1.65	1.10	0.75	36%	0.70	0.45	33%
>$25B (Large)	1.10	0.75	0.50	21%	0.45	0.30	12%

- Size bands were reviewed, and **the recommendation is to combine the current middle two categories ($500M-$5B and $5B-$25B) into one category ($500M-$25B)**
- **The recommendation is to continue categorizing industrial life with individual life and credit life with group life**
- **The recommendation is to continue with the 50% credit given for group premium stabilization reserves**

* As of 2019 annual statement reporting

Recommendation vs Current RBC Individual & Industrial Life Impacts

	Pre-Tax Life RBC C-2 Factors						
Per $1000 of NAR	**Individual & Industrial Life**				**Change vs Current RBC**		
	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				+41%	-6%	-36%
>$25B	0.87	1.10	0.75	0.50	+26%	-14%	-43%

- Overall individual life industry impact would be a modest decrease with industry exposure by NAR concentrated in Term business amongst large insurers
- Factors increase for ULSG
- Factors decrease for products with 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

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Recommendation vs Current RBC Group & Credit Life Impacts

	Pre-Tax Life RBC C-2 Factors				
Per $1000 of NAR	**Group & Credit Life**			**Change vs Current RBC**	
	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			-20%	-48%
>$25B	0.76	0.45	0.30	-41%	-61%

- Overall group industry impact would be a significant decrease in C-2 capital
- 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 exposure periods remain shorter term as compared to individual life
- C-2 is reduced by up to 50% of premium stabilization reserves

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C-2 Factors as an Overall Mortality Increase and Observations Versus Other Capital Regimes

	Overall Mortality Increase	
Inforce Block Size	**Individual & Industrial Life – 5-year**	**Group & Credit Life – 5-year**
Small	+22%	+31%
Medium	+10%	+14%
Large	+8%	+10%

- Table translates factors to an overall mortality percentage increase for a 5-year risk exposure period
- Percentage increases are similar for other risk exposure periods with cumulative magnitudes being greater for longer periods
  - For example, a 10% increase for 10 years is more severe than a 10% increase for 5 years
- Factors were reviewed against other capital regimes, including Canada, International Capital Standards (ICS), Solvency II and rating agency
  - Mortality risk drivers are consistent
  - Confirmed magnitudes are reasonable for the 95th percentile

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Sensitivity Testing: Other Attributes that Increase Mortality Risk

- The model was extensively sensitivity tested, and the following attributes increase mortality risk for companies concentrated in these areas
- The C-2 Mortality Work Group doesn't recommend differentiating RBC factors by these attributes; however, they may be useful to regulators when reviewing potentially weakly capitalized companies
- **Older Attained Ages:** capital needs per unit of net amount at risk increase for attained ages 65 and older due to increasing mortality rates
- **Substandard/Classified Underwriting Classes:** capital needs are higher due to higher mortality rates on unhealthier/riskier lives

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Summary of Recommendations

- The Academy C-2 Life Mortality Work Group recommends the factors shown on Slide 14 which reflect
  1. Expanding factors into additional categories to reflect the current mortality rate risk exposure period over the remaining lifetime of an inforce block of business
     - For individual life insurance, the recommendation is to differentiate into three product categories with definitions consistent with the annual statement – analysis of operations by line of business – individual life insurance and VM-20
     - For group life insurance, the recommendation is to differentiate into two categories by the remaining length of the premium term based on company records by group contract
  2. Including the two new catastrophe components for 1) terrorism (expressed as a 5% annual probability of an extra 0.05 deaths per 1,000) and 2) the risk of a sustained mortality increase from an unknown event (expressed as a 2.5% annual probability of a 5% sustained mortality increase)
  3. Combining the current middle two size categories into one category
  4. Continue categorizing industrial life with individual life and credit life with group life
  5. Continue with the 50% credit given for group life premium stabilization reserves
- The work group opines that additional review of the adopted correlation factor with longevity C-2 is not necessary as the Life C-2 modeling was completed consistently with longevity

Proposed Timeline

- A proposed timeline for a year-end 2022 implementation
  - By end of Q4 2021: expose recommended final factors
  - By end of Q1 2022: structural changes are adopted
  - By end of Q2 2022: updated factors are adopted
  - Year-end 2022: factors are implemented for year-end 2022 annual statements

Questions?

Additional Questions, contact:

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Chris Trost, Chairperson C-2 Mortality Work Group

Ryan Fleming, Vice Chair C-2 Mortality Work Group

Appendix: Method and Assumption Comparison

Item	Original Work	Recommendation
General Method	Monte Carlo Model – Present Value (PV) of Death Benefits	Monte Carlo Model – PV of Statutory Losses • Loss defined as death benefits minus reserves released
Capital Quantification	PV[95^{th}] – 105%*PV[Expected] • 5% margin/load assumed in reserve mortality	GPVAD[95^{th}] • Greatest present value of accumulated deficiencies (GPVAD) • 5% margin/load assumed in reserve mortality
Length of Exposure Period	5 years (3 years for Group) ▪ Assumed exposure past 5 years could be offset through management actions (raise premium, adjust non-guaranteed elements, etc.)	5, 10, and 20 years for Individual Life 3 and 5 years for Group Life
Discount rate	6% after-tax	2.765% after-tax (3.5% pre-tax)
Experience Mortality	88% of 1975-1980 Male Basic Table ▪ 15Y Select & Ultimate Structure ▪ Male/Female not explicitly modelled ▪ Underwriting adjustments applied based on generation	2017 Unloaded Commissioners' Standard Ordinary Table (CSO) for Individual Life ▪ 25Y Select & Ultimate structure ▪ Gender distinct – Male/Female ▪ 5 underwriting classes (3 non-smoker/2 smoker) SOA 2016 Group Life Experience Study for Group Life ▪ Gender distinct – Male/Female
Mortality Improvement	Unknown source ▪ 1.00%	2017 Improvement Scale for VM-20 ▪ Varies by gender and age

Appendix: Risk Distribution Approach Comparison

Risk	Original Work	Recommendation
Volatility	Binomial(Policies, q)	Binomial(Policies, q)
Level	Implicit from Discrete Scenarios: ▪ 7 *Competitive Pressures* scenarios – risk of overoptimistic pricing assumptions ▪ 15 AIDS scenarios – early 90's estimates of the impact of AIDS on insured mortality (could fit in level, trend, or catastrophe)	LR~N(0, σ_{Lev}); $\sigma_{Lev} = \sqrt{\sigma_{Cred}^2 + \sigma_{MVol}^2}$ ▪ Two independent components: • Credibility/statistical sampling volatility (σ_{Cred}) • True mortality volatility (σ_{MVol}) ▪ Continuous normal distribution
Trend	Discrete Distribution ▪ 7 scenarios adjust mortality improvement assumption	$[MI_1, MI_2, \ldots, MI_{C6}] \sim N(\mu, \Sigma)$ ▪ 6 gender/age group improvement variables (MI_n) ▪ Correlated normally distributed random variables
Catastrophe	Discrete Distribution ▪ Pandemic	3 Discrete Distributions ▪ Pandemic – calibrated from multiple sources ▪ Terrorism – 5% probability of additional 0.05 / 1K ▪ Unknown Risk – 2.5% probability of a sustained 5% increase

Appendix: Model Validation, Peer Review, Limitations

- **<u>Validation:</u>** 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.
- **<u>Peer Review:</u>** 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.
- **<u>Limitations:</u>** The model is intended to stochastically project through Monte Carlo 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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Appendix:
Prior Work Group Presentations to Life RBC

- September 2020
- December 2019
- June 2019
- April 2019
- August 2018
- August 2017

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