

Longevity Risk Task Force (LRTF) Update

Paul Navratil, MAAA, FSA
Chairperson, Longevity Risk Task Force
American Academy of Actuaries



AMERICAN ACADEMY of ACTUARIES

Objective. Independent. Effective.™

NAIC 2019 Spring National Meeting—Life Risk-based Capital (E) Working Group—Orlando, Fla.

Discussion Topics

- Preliminary Factor Proposal
- Objectives & Analysis Approach
- Field Study Results & Longevity Factor Calibration
- Next Steps



Preliminary Proposal Summary

- Recommend capital structure with longevity C-2 factors applied to base Statutory Reserves
 - ▣ Factor applied to present value of benefits for longevity reinsurance
- Propose that updated C-2 mortality factors (e.g., C-2a) and new C-2 longevity factors (e.g., C-2b) be implemented concurrently along with a covariance adjustment within C-2.
- Anticipated factors (working version below) vary with the total size of company reserves for in scope products, where reserves are a proxy for the credibility and volatility of company-specific longevity

<u>Total Reserves</u> <u>(in scope products)</u>	<u>C-2 Longevity</u> <u>After-Tax Factor</u>
up to \$250M	1.35%
next \$250M	0.85%
next \$500M	0.75%
over \$1B	0.70%



Objective & Philosophy

- The objective of our work is to develop a recommended method to incorporate longevity risk into the NAIC's Life Risk-Based Capital (LRBC) formula.
- The scope of our work is LRBC. Statutory Reserves reflect longevity risk through prescribed mortality assumptions and asset adequacy testing requirements.
- Our proposal was developed in line with the overall objective of LRBC as being a tool for regulators to identify potentially weakly capitalized companies.
 - We took a practical approach in developing an initial longevity risk factor for LRBC that is not intended to precisely reflect all drivers nor align to an internal view of economic capital for all companies
- We balanced several competing objectives in developing a longevity risk factor within LRBC:
 - Clear linkage of the calculation to statutory financial statements & regulatory ability to audit calculation
 - Accuracy and reasonability of the charge as a measure of longevity risk at the company level
 - Simplicity of the calculation
 - Consistency with the existing RBC framework



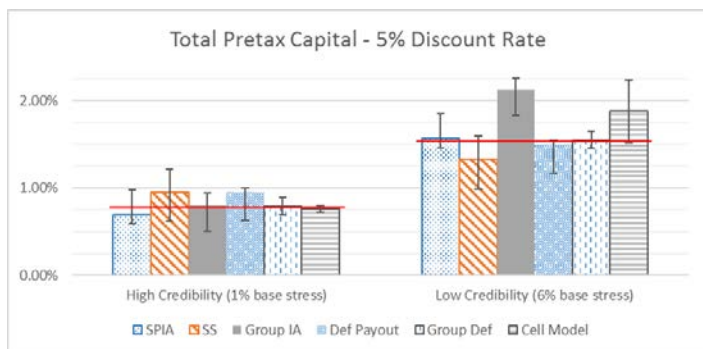
Overall Approach

- Scope to include longevity risk to payout annuity products and pension risk transfers. Other products such as variable annuities (VA), long-term care (LTC), and traditional deferred accumulation annuities are out of scope at this time. (Additional scope detail in Appendix)
- Based on discussions with the National Association of Insurance Commissioners (NAIC) Longevity Risk Subgroup, our analysis begins with the premise that LRBC is intended to cover tail risk in excess of the risk covered by Statutory Reserves.
 - Our work assumes Statutory Reserves adequately fund moderately adverse risk measured at the 85th percentile and that LRBC covers longevity risk from the 85th percentile to the 95th percentile level
 - Our work assumes LRBC covers longevity risk over the lifetime of the policy
- RBC is intended to cover losses from increased longevity over the policy lifetime, summarized into two components for analysis:
 - Mortality Trend Risk—risk that future mortality improvements are greater than anticipated
 - Mortality Level Risk—error in initial mortality assumptions, including credibility of starting mortality rate assumption and volatility of individual company longevity outcomes
- Losses due to longevity risk are measured as the impact on reserves from stressed longevity assumptions.
- Loss amounts are expressed as a capital factor to be applied to the Statutory Reserves.



Field Study Results (Summary)

- Academy Field Study asked participating companies to run the impact of level and trend stresses to actual company reserves to confirm the calibration of the longevity risk charge. (Additional detail in Appendix)
- Results reflected the combined impact of the requested trend and level stresses, assuming independence.
- Results confirmed many expectations from our cell testing and resolved some outstanding questions with a combined impact that was comparable across products and ages (detail not included below).
- Field study indicated low prevalence of contingent deferred annuities where no benefits are payable if annuitant does not survive to benefit commencement. Our cell testing indicated greater risk as a percentage of reserves for this structure, and is a potential future enhancement.
- Red lines show recommended pre-tax LRBC factors.



Note: Error bars show result from 25th and 75th percentile responses.

“Cell Model” reflects expected study result derived from a simple reserve cell testing model constructed by the LRTF and shown for comparison. Cell model error bars are based on sensitivity tests of different assumed age distributions.

Field study requested mortality level shocks of 1% and 6% to represent companies with high and low credibility of mortality experience data.



AMERICAN ACADEMY of ACTUARIES

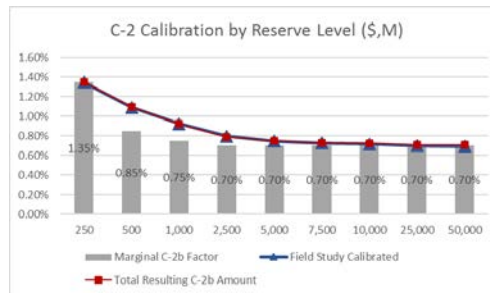
Objective. Independent. Effective.™

© 2019 American Academy of Actuaries. All rights reserved.
May not be reproduced without express permission.

Preliminary Factor Implementation

- Factors to be applied to Statutory Reserves for products in scope to determine C-2b longevity risk amount
- Factors and breakpoints were chosen to closely match total risk derived from the Field Study calibration
 - Simple approach with four factors shown provides results which closely match calibration from Field Study
 - Each factor applies at the margin to reserves in excess of the breakpoint, avoiding discontinuities in total C-2b for companies with reserves just above vs. below a breakpoint

Reserve Level (\$,M)	Calibrated Field Study Results	Marginal C-2b Factor	Total C-2b
250	1.35%	1.35%	1.35%
500	1.09%	0.85%	1.10%
1,000	0.92%	0.75%	0.92%
2,500	0.80%	0.70%	0.79%
5,000	0.75%	0.70%	0.74%
7,500	0.73%	0.70%	0.73%
10,000	0.72%	0.70%	0.72%
25,000	0.70%	0.70%	0.71%
50,000	0.69%	0.70%	0.70%



Sample Company Impacts

- Introduction of “C-2b” charge is effective in identifying companies with concentrated exposure to longevity risk, and has appropriately smaller impact on companies with balanced risk exposures.
- Illustration shown using distribution of RBC amounts from aggregate 2017 Life RBC (additional calculation details provided in Appendix)
- Sample impacts shown for companies with Concentrated Longevity exposure (C-2b 3x greater than C-2a), Balanced Longevity exposure (C-2b equal to C-2a), and Low Longevity exposure (C-2a 5x greater than C-2b)
- Sample impacts also shown under a range of covariance assumptions between longevity and mortality

	<u>Baseline</u>	<u>Concentrated Longevity</u>			<u>Balanced Longevity</u>			<u>Low Longevity Exposure</u>		
<i>C2a Mortality/Other Insurance Risk</i>		25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1
<i>C2b Longevity Insurance Risk</i>	n/a	75.4	75.4	75.4	25.1	25.1	25.1	5.0	5.0	5.0
<i>Longevity - Mortality Correlation</i>	n/a	0%	-25%	-50%	0%	-25%	-50%	0%	-25%	-50%
<i>C-2 Insurance Risk</i>	25.1	79.5	73.3	66.5	35.6	30.8	25.1	25.6	24.4	23.0
Calculated CAL RBC Ratio	517%	393%	407%	423%	496%	506%	517%	516%	518%	521%



Longevity Reinsurance

- This is a recurring premium product where a reinsurer is responsible for annuity payments based on actual longevity of covered lives in exchange for a premium stream (generally representing expected payments plus a fee).
- There were not enough Field Study responses from companies with Longevity Reinsurance for the LRTF to receive results.
- Although the product structure might not be common, we recommend it remaining in scope for longevity C-2 because the longevity risk is the same as a traditional single premium annuity product.
- There are two important adjustments needed to capture the longevity C-2 consistently with single premium annuities:
 1. **Capital Factor must be applied to the Present Value of annuity benefits under Statutory assumptions**
 - Under a net premium reserve methodology which reflect future premiums, reserves are zero at inception and remain much lower over time than reserves for a comparable Single Premium Immediate Annuity (SPIA)
 - The Statutory Reserve for a SPIA equals the full present value (PV) of benefits, so this is the comparable basis applicable for this product
 2. **Premium amounts excluded from Statutory Reserves should be netted against C-2 capital**
 - A net premium reserve methodology typically excludes a portion of future premiums to prevent a negative initial reserve
 - These excluded premiums are a source of funding for adverse longevity outcomes more severe than provided for in reserves
 - This allows for consistency with funded products where assets from the initial premium are available to fund capital
 - It is appropriate for future fees to fund reserves and capital because claims are only due if premiums are paid



Covariance

- The LRTF together with the Academy C-2 Mortality Work Group plan to develop an approach to reflect the correlation between mortality and longevity risk within C-2.
- The LRTF plans to limit the scope of this effort to mortality and longevity risk.
 - The correlation between longevity and mortality is significant and we believe should be considered concurrent with the implementation of a longevity risk charge
- The covariance proposal will take into consideration the specific risks (i.e., basis/credibility, volatility, trend) considered in both the development of the longevity risk factors as well as by the Academy C-2 Mortality Work Group.



LRTF Next Steps

- Complete recommendation of covariance between C-2 mortality and C-2 longevity
- Complete more detailed documentation of analysis and recommendations
- Address questions & feedback from regulators and interested parties



Appendix



Key Assumptions

- **Statutory Reserves** are adequate and cover risks at the 85th percentile
- **Discount rate** of 5% (pre-tax) is used to calculate the present value loss amount from increased longevity. 5% rate was chosen to be consistent with the discount rate applied elsewhere in RBC (C-1 Bond Factors). Sensitivity analysis has been provided to illustrate the impact of a 4% discount rate.
- **Tax rate** of 21% used to calculate after-tax capital factors from pre-tax loss amounts. Tax adjustment applied to both the loss amount as well as the discount rate.
- **Mortality distribution** for future insured annuitants can be represented by the distribution of historical population mortality.
 - No differences in the volatility and probability distribution shape for insured mortality compared to the general population
 - Volatility and distribution of possible future improvements is consistent with the volatility of post-WWII historical improvements
 - Mortality improvements are normally distributed; this normal distribution was used to determine the 85th and 95th percentiles
 - 20 years is an appropriate period of time to calibrate an improvement stress that is applied for the entire lifetime of policies
 - Overlapping 20-year historical periods were assumed independent in developing the distribution of 20-year mortality improvements



Key Assumptions (Continued)

- **Independence** between Trend Risk and Level Risk, and among Level Risk components (Credibility, Population Volatility and Historical Trend). Each component was separately quantified then combined assuming the components were independent.
- **Old Age Calibration** showed similar absolute level of improvement rate volatility as younger ages. Mortality improvement stress was assumed to be a multiplicative factor of the baseline mortality improvement, resulting in a larger multiple (1.40x vs 1.16x) for older ages because the baseline mortality improvement is lower.
- **Policy Size Distribution** based on a 2009–2013 Individual Payout Annuity Mortality study by the Society of Actuaries (SOA) was used to adjust the volatility of deaths on a count basis to volatility on a dollar reserve basis.
- **Average reserve per policy** of \$50,000 and **average block mortality rate** of 2% were assumed in scaling factors derived from the number of company experience period deaths to a total company reserve basis. This does not impact the overall quantification of longevity risk on a life count exposure basis, just the approach to scaling the factor from a life count to a Statutory Reserves basis.



Trend Stress Calibration

- Based on 20-year historical population improvement data.
 - Field study calibration originally based on data 1900–2013; subsequently adjusted to reflect recent population volatility post-WWII 1946–2013 (to exclude war impacts and reflect that total population mortality volatility has declined as population size has increased).
 - Data fit to a normal distribution to determine stresses for 85th and 95th percentiles (Based on regulator input and preference for normal distribution considering the limited number of non-overlapping 20-year historical periods. Use of CTE70 vs CTE90 levels would result in very similar stresses.)
- Multiplicative stress applied to valuation mortality improvement scale.
 - Greater stress used for older (>85) ages to reflect similar absolute trend volatility on a smaller average level of trend
 - Recommendation reflects 80% of Field Study requested trend stress after adjusting to 1946+ calibration
 - 16% stress to mortality improvement for ages <85 (resulting in a 1.16x multiple to improvement rates)
 - 40% stress to mortality improvement for ages 85+ (resulting in a 1.40x multiple to improvement rates)

	Avg AA/G2	1900-2013 Calibration (95th - 85th)			1946 - 2013 Calibration (95th - 85th)			Field Study	Final Stress
		85th %	95th %	/ Avg	85th %	95th %	/ Avg	Stress	Applied
All ages 35+	1.17%	1.27%	1.49%	19%	1.31%	1.47%	13%		
Ages 35 - 84	1.19%	1.41%	1.63%	19%	1.45%	1.60%	13%	20%	16%
Ages 85+	0.59%	1.00%	1.28%	47%	1.09%	1.34%	43%	50%	40%



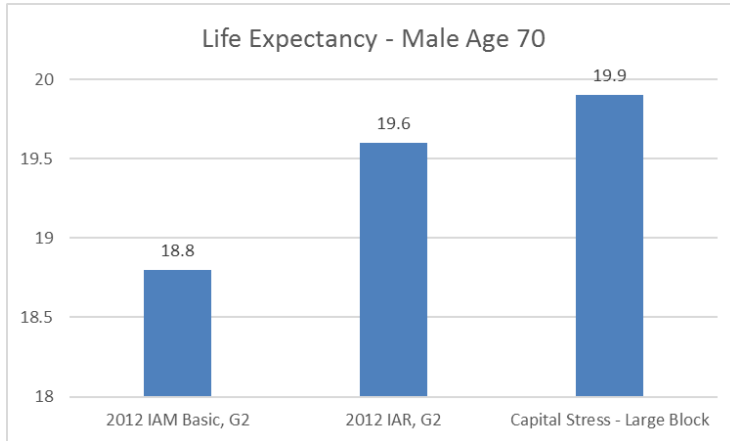
Starting Mortality Level Stress Calibration

- Total Mortality Level Stress varies with the size and credibility of company mortality experience.
 - ▣ Larger companies with more insured lives will have less variability in company-specific outcomes
 - ▣ There remains fundamental population volatility that does not diversify away with size
- Overall mortality level stress varies between 0.7% and 6.0% of initial mortality rates.
- Mortality Level Stress was quantified using three largely independent components:
 1. Credibility Risk – captures credibility and volatility of insurer population specific mortality
 2. Volatility of Population Mortality – underlying volatility that is not diversified with larger blocks
 3. Trend Adjustment – impact of error in trend applied from experience period to valuation date

# Exp Yrs:	5	5	5
# Deaths	500	2,100	100,000
A. Credibility	5.8%	2.8%	0.4%
B. Pop Volatility	0.5%	0.5%	0.5%
C. Trend Shift	0.4%	0.4%	0.4%
Total Level Stress	5.8%	2.9%	0.7%



Life Expectancy Benchmark



- We've estimated life expectancy impacts of the capital stresses to provide further insight into the calibration results.
- For Age 70 annuitants, the capital provides for an additional 0.3-0.4 years of life expectancy beyond reserve mortality.
- This is in addition to 0.7-0.8 additional years of life expectancy in 2012 Individual Annuity Reserving (IAR) Table reserve mortality relative to 2012 Individual Annuity Mortality (IAM) Basic Table.
- *Reserve life expectancy comparison estimated under the assumption that IAM Basic table is an appropriate best estimate; actual best estimates will vary by block of business.*

	2012 IAM Basic, G2	2012 IAR, G2		Capital Stress - Large Block	
Male, Age 50	37.8	38.7	0.9	39.4	0.7
Male, Age 70	18.8	19.6	0.8	19.9	0.3
Male, Age 90	5.2	5.7	0.5	5.7	0.1
Female, Age 50	39.7	40.6	0.9	41.2	0.6
Female, Age 70	20.4	21.1	0.7	21.5	0.4
Female, Age 90	6.1	6.6	0.5	6.7	0.1



After-Tax Capital Factor

- Two adjustments were made to convert from pre-tax to after-tax factors:
 1. Loss amount was multiplied by 0.79 (1-21% tax rate)
 2. Discount rate was also multiplied by 0.79 factor (5% pre-tax rate adjusted down to 3.95%)
- The baseline recommendation reflects a 5% pre-tax discount rate to be consistent with the discount rate applied elsewhere in LRBC (e.g., recommended C-1 Bond factors).
- Because the impact of longevity risk is increased in a low-interest-rate environment, it may be appropriate to consider a lower discount rate (such as 4%) for longevity risk capital. Note: stochastic modeling of interest rates was considered but not used as the basis for a recommendation due to the model complexity it would have required.

Capital Factor

	5% Discount Rate		4% Discount Rate
	Pre-Tax	After-Tax	After-Tax
High Credibility	0.80%	0.71%	0.78%
Low Credibility	1.55%	1.37%	1.48%



Factor Scaling

- Recommend factor that varies by total Statutory Reserves for in-scope products
 - Size of in-scope product reserves used as a proxy for credibility and volatility of company mortality experience; a better measure would be total annual deaths, however this is not available in statutory statements
 - A key assumption in scaling risk based on total annual deaths to a reserve basis is the average reserve per policy **which will vary considerably across blocks of business**; \$50,000 amount used below is used to illustrate a scaling approach and is not necessarily an average
 - Chart below shows the total capital calibrated from the Field Study stresses (*first and last columns*) mapped to corresponding total Statutory Reserve levels. Additional calibration points were added based on the relative total risk calculated from the cell testing model to calibrate at other reserve levels

# Exp Yrs:	5	5	5	5
# Deaths	475	1,000	10,000	25,000
Total Level Stress	6.00%	4.15%	1.43%	1.01%
Calibrated Total After Tax Capital ▼	1.37%	1.09%	0.75%	0.71%
Avg Qx	2.0%	2.0%	2.0%	2.0%
# Life Exposures	4,750	10,000	100,000	250,000
Avg Reserve/policy	\$ 50,000	\$ 50,000	\$ 50,000	\$ 50,000
Total Reserve Level (\$,M)	\$ 238	\$ 500	\$ 5,000	\$ 12,500



AMERICAN ACADEMY OF ACTUARIES

Objective. Independent. Effective.™

© 2019 American Academy of Actuaries. All rights reserved.
May not be reproduced without express permission.

Products In and Out of Scope

Scope includes annuity products with life contingent payments where benefits are expected to be distributed in the form of an annuity.

- It does not include annuity products for which payments are certain only (non-life contingent).
- It does not include deferred annuities that have an annuitization option, but are not required to annuitize.
- It does not include variable annuities or contingent deferred annuities which are captured in C3 Phase 2 testing.

Product in scope include:

- **Single Premium Immediate Annuities (SPIAs) and Other Payout Annuities:** Annuities issued to individuals (not groups) in which a single premium is paid and a benefit payment is paid periodically during the time the person is alive, including deferred annuities that have moved to a payout stage.
- **Structured Settlements:** Annuities issued to individuals as part of a legal settlement in which a single premium is paid and benefit payments are paid periodically during the time the person is alive. Many structured settlement contracts involve substandard mortality.
- **Longevity Reinsurance:** A product offered to pension plan sponsors (or direct writers) in which the insurer (or reinsurer) makes payments to the pension plan sponsor (or direct writer) in the event that actual mortality experience of the pensioners is better (i.e., they live longer) than a defined level of experience per the contract (or, for a longevity swap, the payments are also made in the opposite direction in the event that actual mortality experience of the pensioners is worse, and may be based on a defined index). In exchange for these payments, the insurer or reinsurer may receive a periodic fee.
- **Group Immediate Annuities:** Annuities issued to groups in which a single premium is paid (in cash or in-kind assets) and benefit payments are paid to specified members of the group periodically during the time they are individually alive.
- **Deferred Payout Annuities (DPAs):** Annuities issued to individuals in which premiums or deposits are made over a specified deferral period. At the end of the deferral period, benefit payments are paid to the individual periodically during the time the person is alive.
- **Group Deferred Payout Annuities:** This product is defined as annuities issued to groups in which premiums or deposits are made over a specified deferral period. At the end of the deferral period, benefit payments are paid to members of the group periodically during the time the person is alive.



Field Study Overview

- Conducted by the Academy Research Task Force (ARTF) (now Research Committee).
- LRTF developed instructions and a template completed by participating companies
- Tested the impact to Statutory Reserves of stresses in base mortality rates and mortality improvement rates for policies inforce on December 31, 2017.
- Field Study template was at a granular level to understand how drivers such as product type, valuation discount rate, policy duration, age, and gender impact risk.
- Results were submitted to ARTF from 19 companies.
- Company data kept confidential, only aggregated results with average, 25th, and 75th percentile responses for each requested cell shared with the LRTF.



Field Study Details

Run A – 2017 CARVM Valuation Basis (assumed to be 85th percentile)

- 2012 IAM Table (1994 Group Annuity Reserving (GAR) Table)
- Projection Scale G2 (Projection Scale AA for Group business)

Run B/C – 95th Percentile Stress – basis and volatility risk

- 2012 IAM Table (1994 GAR for Group business), all rates adjusted for our defined basis risk stress event (99% factor for run B high credibility/large block or 94% factor for run C low credibility/small block)
- Projection Scale G2 (Projection Scale AA for Group business)

Run D – 95th Percentile Stress – trend risk

- 2012 IAM Table (1994 GAR for Group business)
- Projection Scale G2 (Projection Scale AA for Group business), all improvement factors adjusted for our defined trend stress event (0.20%/0.50% stress for under/over age 85)

$$\text{Capital} = [(\text{Run B/C} - \text{Run A})^2 + (\text{Run D} - \text{Run A})^2]^{1/2}$$



Sample Company Impacts Detail

- Illustrated distribution of RBC risk based on aggregate 2017 Life RBC
- Existing Formula: $CAL\ RBC = C0 + [(C1o+C3a)^2 + (C1cs+C3c)^2 + (C2)^2 + (C3b)^2 + (C4b)]^{1/2} + C4a$
- Illustrated Formula Update: $C2 = [C2a^2 + C2b^2 + 2*C2a*C2b*Corr_{a,b}]^{1/2}$

	2017 Aggregated Life RBC(\$,B)	Concentrated Longevity Exposure Company Example			Balanced Longevity Exposure Company Example			Low Longevity Exposure Company Example		
C-0 Asset Risk Affiliates	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5	21.5
C-1cs Asset Risk - Common Stock	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9
C-1o Asset Risk - All Other	43.7	43.7	43.7	43.7	43.7	43.7	43.7	43.7	43.7	43.7
C-2a Mortality/Other Insurance Risk		25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1	25.1
C-2b Longevity Insurance Risk		75.4	75.4	75.4	25.1	25.1	25.1	5.0	5.0	5.0
Longevity - Mortality Correlation		0%	-25%	-50%	0%	-25%	-50%	0%	-25%	-50%
C-2 Insurance Risk	25.1	79.5	73.3	66.5	35.6	30.8	25.1	25.6	24.4	23.0
C-3a Interest Rate Risk	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3
C-3b Health Credit Risk	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
C-3c Market Risk	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3
C-4a Business Risk	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
C-4b Business Risk Admin Expenses	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Calculated CAL RBC	101.8	133.9	129.3	124.4	106.1	104.0	101.8	102.0	101.6	101.1
Reported Aggregate CAL RBC	112.7									
Total Adjusted Capital	526.6	526.6	526.6	526.6	526.6	526.6	526.6	526.6	526.6	526.6
Calculated CAL RBC Ratio	517%	393%	407%	423%	496%	506%	517%	516%	518%	521%



Questions?

Additional Questions, contact:

Paul Navratil, MAAA, FSA
Chairperson, Longevity Risk Task Force
(LRTF)

Ian Trepanier
Life Policy Analyst
American Academy of Actuaries
trepanier@actuary.org



AMERICAN ACADEMY of ACTUARIES

Objective. Independent. Effective.™

© 2019 American Academy of Actuaries. All rights reserved.
May not be reproduced without express permission.