LONGEVITY RISK TASK FORCE UPDATE (LRTF)

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NAIC SPRING MEETING 2018
Agenda

- Status Update
- Field Study Details
- Next Steps
Status Update

- LRTF has a proposed methodology for NAIC consideration in developing longevity risk factors (generally to be applied to reserves) in risk-based capital (RBC)
  - Factors derived by stressing both base mortality and mortality improvement at a 95th %ile level to get a total asset requirement, and deducting the 85th %ile reserve to get capital
  - Risks included are credibility (basis), volatility, and trend
- To date, determination of the factors has been based on a simple Excel model for new issues only
- Next step is to test the approach using actual inforce blocks through a field study
Field Study Overview

- The Academy Research Task Force (ARTF) has approved the study to be conducted by the Academy.
- LRTF has developed instructions and a template to be completed to enable the Academy to conduct a field study on individual and group annuities (excluding deferred, indexed, and variable).
- Company data will be kept confidential, and only aggregated results will be shared with the LRTF.
- ARTF will solicit participation from a sample of companies with longevity products.
- Any company interested in participating is welcome.
Field Study Overview

- Currently gathering public data on all companies with material blocks of individual and/or group annuities to identify potential participants
- Will select a random sample from that data, and adjust using judgment to enable inclusion of all material product types (e.g., pension risk transfer)
- Anticipate sending out requests for participation shortly after this NAIC meeting
- Request Dec. 31, 2017 statutory CARVM reserve amounts calculated using “current” and stressed assumptions, under a range of valuation interest rate, issue age, duration since issue, and gender combinations
- Anticipate companies will need 2-3 weeks elapsed time to perform runs and 1-2 hours to complete template
Field Study Details

Run A – 2017 CARVM Valuation Basis (assumed to be 85th percentile)
- 2012 IAM Table (1994 GAR for Group business)
- 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)

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

- Conduct field study and evaluate results
- Develop a proposed approach for the Longevity Risk Subgroup to consider for longevity RBC factors
- Determine proposed approach to correlation with other risks (most significantly, C2)
- Continue to evaluate approach for a potential RBC charge for lifetime income benefits
Appendix

Prior Updates provided to NAIC Life Risk Based Capital Committee

Other Background Information
Current Approach

- Focused on a longevity risk charge for payout annuities (including deferred payout)
- Statutory reserves are generally intended to be at the 85th percentile level
  - Formulaic plus any additional reserves from asset adequacy testing (AAT)
- RBC factors generally cover risks in excess of reserves up to a 95th percentile event
  - Capital requirements are established under the assumption that statutory reserves are adequate; RBC is not a balance sheet item and is not intended to make up for shortfalls in reserves. Stresses up to the 85th percentile are assumed to be covered in reserves.
  - The longevity risk stress event will include both basis risk (risk that actual company mortality varies from the table) and trend risk (risk that actual mortality improvement varies from assumed).
  - Based on its nature, trend risk stress event looks at a relatively long time horizon.
- RBC longevity risk charge will be based on difference between “current” statutory reserve and statutory reserve calculated under a longevity stress, converted to a factor.
Risks To Be Included

- LRTF previously determined that focus should be on trend risk only (mortality improvement), and used historical data to develop a stress event for mortality improvement based on the 95\textsuperscript{th} less the 85\textsuperscript{th} percentile result (0.25\% up to age 85; 0.50\% age 85-104)

- Current reserve basis (2012 IAM) appears to only include a margin for basis risk

- Therefore, LRTF determined that charge should consider both basis risk and trend risk
Components of Basis Risk

Valuation Table vs. Company Mortality

- Prescribed statutory valuation mortality may not be conservative enough for all business
- AAT Testing already covers this risk

Company Mortality Experience Assumption vs. True Company Mortality Basis

I. **Credibility Risk**—difference between the true underlying mortality basis and company experience due to the limited amount of experience data. Size of this risk declines as the quantity of experience increases

II. **Volatility of True Mortality**—true underlying mortality rates have volatility and change from year to year even with fully credible data

III. **Mortality Trend Adjustment**—mortality experience over a multi-year period must be translated to a base table year using a mortality improvement assumption. Basis risk will result to the extent this assumed improvement differs from actual underlying improvement.
I. Credibility Risk

- Full credibility is often defined as 95% confidence that an assumption is within 5% of the true value.
- Some error margin always exists even with long experience from a fully credible block of business.
- Figures below use Longley-Cook credibility formula to estimate this error margin.
- Adjusted for credibility by amount of insurance in force using data underlying the 2012 IAM table development.

### One-sided confidence interval for $\mu$

<table>
<thead>
<tr>
<th># of Deaths</th>
<th>85%</th>
<th>95%</th>
<th>99%</th>
<th>95th - 85th</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>14.0%</td>
<td>22.2%</td>
<td>31.4%</td>
<td>8.2%</td>
</tr>
<tr>
<td>500</td>
<td>9.9%</td>
<td>15.7%</td>
<td>22.2%</td>
<td>5.8%</td>
</tr>
<tr>
<td>1,082</td>
<td>6.7%</td>
<td>10.7%</td>
<td>15.1%</td>
<td>4.0%</td>
</tr>
<tr>
<td>3,000</td>
<td>4.0%</td>
<td>6.4%</td>
<td>9.1%</td>
<td>2.4%</td>
</tr>
<tr>
<td>10,000</td>
<td>2.2%</td>
<td>3.5%</td>
<td>5.0%</td>
<td>1.3%</td>
</tr>
<tr>
<td>100,000</td>
<td>0.7%</td>
<td>1.1%</td>
<td>1.6%</td>
<td>0.4%</td>
</tr>
<tr>
<td>200,000</td>
<td>0.5%</td>
<td>0.8%</td>
<td>1.1%</td>
<td>0.3%</td>
</tr>
</tbody>
</table>
II. Volatility of True Mortality

- This results from year-to-year volatility in true population mortality rates in the experience study period.
- Using data and analysis from the LRTF’s prior work on trend risk, the annual volatility of population mortality in the U.S. is 2.9% at 1 standard deviation.
- This result is scaled to multi-year experience periods using the assumption that each years’ volatility is independent.
- Longer experience periods will reduce this risk component as the impact of volatility in any single year is diminished.

### Volatility of Underlying Population Mortality Rate $\mu$

Annual volatility of mortality rate (improvement rate) from trend risk work: 2.9%

<table>
<thead>
<tr>
<th># of Exp Yrs</th>
<th>85%</th>
<th>95%</th>
<th>99%</th>
<th>95th - 85th</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.0%</td>
<td>4.8%</td>
<td>6.7%</td>
<td>1.8%</td>
</tr>
<tr>
<td>3</td>
<td>1.7%</td>
<td>2.8%</td>
<td>3.9%</td>
<td>1.0%</td>
</tr>
<tr>
<td>5</td>
<td>1.3%</td>
<td>2.1%</td>
<td>3.0%</td>
<td>0.8%</td>
</tr>
<tr>
<td>10</td>
<td>1.0%</td>
<td>1.5%</td>
<td>2.1%</td>
<td>0.6%</td>
</tr>
</tbody>
</table>
III. Trend Adjustment

- Risk results from differences between actual and assumed mortality improvement during the experience period that is used to adjust mortality experience to the base table effective date.

- Quantification uses mortality trend stress work previously completed by group (aggregate M/F results across all ages based on the normal model at 85th and 95th percentile relative to mean improvement).

- Trend stress is applied for ½ of the experience period—trending from the mid-point of the experience period to the end point.

- Longer experience periods will increase this component as the possibility for error in trending older experience to the valuation date increases.

<table>
<thead>
<tr>
<th>Mortality Trend Adjustment</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Trend Stress:</td>
<td>0.38%</td>
<td>0.60%</td>
<td>(from Trend Stress work, normal model)</td>
</tr>
<tr>
<td># of Exp Yrs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>85%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>95%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>95th - 85th</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.2%</td>
<td>0.3%</td>
<td>0.1%</td>
</tr>
<tr>
<td>3</td>
<td>0.6%</td>
<td>0.9%</td>
<td>0.3%</td>
</tr>
<tr>
<td>5</td>
<td>1.0%</td>
<td>1.5%</td>
<td>0.6%</td>
</tr>
<tr>
<td>10</td>
<td>1.9%</td>
<td>3.0%</td>
<td>1.1%</td>
</tr>
</tbody>
</table>
The three components are independent, so aggregate basis risk measured as \((I^2 + II^2 + III^2)^{1/2}\)

Overall risk is not that sensitive to the length of experience period given the trade-off between Annual Volatility and Trend Adjustment as the experience period lengthens.

Credibility adjustment declines with experience, but aggregate basis risk quickly becomes dominated by components B and C for large blocks of business.

Aggregate basis risk is independent of mortality trend risk

<table>
<thead>
<tr>
<th># of Exp Yrs:</th>
<th>3</th>
<th>3</th>
<th>3</th>
<th>5</th>
<th>5</th>
<th>5</th>
<th>10</th>
<th>10</th>
<th>10</th>
</tr>
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<tbody>
<tr>
<td># of Deaths</td>
<td>500</td>
<td>3,000</td>
<td>100,000</td>
<td>500</td>
<td>3,000</td>
<td>100,000</td>
<td>500</td>
<td>3,000</td>
<td>100,000</td>
</tr>
<tr>
<td>I. Credibility</td>
<td>5.8%</td>
<td>2.4%</td>
<td>0.4%</td>
<td>5.8%</td>
<td>2.4%</td>
<td>0.4%</td>
<td>5.8%</td>
<td>2.4%</td>
<td>0.4%</td>
</tr>
<tr>
<td>II. Volatility</td>
<td>1.0%</td>
<td>1.0%</td>
<td>1.0%</td>
<td>0.8%</td>
<td>0.8%</td>
<td>0.8%</td>
<td>0.6%</td>
<td>0.6%</td>
<td>0.6%</td>
</tr>
<tr>
<td>III. Trend Adjustment</td>
<td>0.3%</td>
<td>0.3%</td>
<td>0.3%</td>
<td>0.6%</td>
<td>0.6%</td>
<td>0.6%</td>
<td>1.1%</td>
<td>1.1%</td>
<td>1.1%</td>
</tr>
<tr>
<td>Total Basis</td>
<td>5.9%</td>
<td>2.6%</td>
<td>1.1%</td>
<td>5.9%</td>
<td>2.6%</td>
<td>1.0%</td>
<td>5.9%</td>
<td>2.7%</td>
<td>1.3%</td>
</tr>
</tbody>
</table>

Result is a qx aggregate basis risk stress event ranging from approximately 1% to 6% depending on block size
Determining Trend Risk Tail Event

- LRTF analyzed historical population data over the period 1900-2013 using Social Security population data
- Calculated 1-, 5-, 10-, 20-, and 40-year rates of improvement by age bucket and gender
- Fit historical improvement data to a normal distribution to evaluate use of a normal model
- Developed a 95th percentile improvement event, focused on the 20-year historical period
- Evaluated difference between 95th percentile and 85th percentile for use in RBC
Distribution of Mortality Improvement Data

Below is the distribution of annual and 20-year mortality improvement data from 1940-2013 used to develop the shock event

*Annual is improvement over historical one-year periods
*20 year is improvement over historical 20-year periods, converted to an annual rate
Due to the stated need to establish a charge within a reasonable timeframe, and the additional uncertainty associated with certain aspects of longevity risk, the following items are being deferred for future consideration:

- Health products with longevity risk
- Lifetime income products attached to variable annuities
- Consideration of the impact of significant medical advancements to the extent they do not already manifest in the historical data used to determine the stress events
For more information

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