Mortality Table Development Update 2014 VBT/CSO

American Academy of Actuaries and Society of Actuaries
Joint Project Oversight Group

November 14, 2014

Agenda

- 2014 VBT Aggregate Table Exposure
- 2014 VBT Relative Risk Tables VBT Improvement Factors
- 2014 CSO Development
- PBR Margin Development
- Additional research

Regulatory Mortality in Development

Table	Regulatory Use
2014 VBT Basic Tables	AG38, VM-20 Deterministic and Stochastic reserves
2014 VBT Relative Risk Tables	AG38, VM-20 Deterministic and Stochastic reserves
Annual mortality improvement factors	AG38, VM-20 Deterministic and Stochastic reserves (to valuation date only)
2014 CSO	• Net premium reserves • Tax reserves • Nonforfeiture determination • Basis for 7702/7702A • Cap for universal life cost of insurance charges
PBR Margins	VM-20 Deterministic and Stochastic reserves
GI/SI/Preneed *	CRVM reserves

* Not discussed within this report.

2014 Valuation Basic Table (VBT) Development

2014 VBT Development Status

- Aggregate or Primary tables exposed for comment
  - Comment period ended with 1 comment letter received
  - Incorporating comments into RR tables
- Relative risk (RR) tables
  - Exposure targeted for end of November
- New Underwriting Criteria Scoring Tool (UCT)
  - Exposure targeted for end of November/beginning of December

2014 VBT Primary Table Exposure Comments

- One comment letter received from ACLI
- 5 primary comments
  1. Uneven Mortality Selection at Certain Ages
  2. Composite unismoke table Needed
  3. Non-level mortality improvement by class
  4. Post level term mortality anti-selection adjustments
  5. Improve table from 2014 to 2017

2014 VBT Primary Table Exposure Comments

1. Uneven Mortality Selection at Certain Ages
   - **Issue:** The mortality selection factors do not generally decrease by attained age for certain issue ages. For issue age 20 male nonsmoker, the ratio of select to ultimate mortality was 64% in duration 1, increasing to 71% by duration 3, then decreasing to 49% at duration 13 only to then increase to 100% at duration 26. The pattern results in anomalies of the resulting reserves between the ultimate table and the select and ultimate table at these ages.

   - **Response:** We agree there is a disconnect at the younger ages where the juvenile rates blend in with the young adult rates. We intend to move the juvenile rates to an aggregate or unismoker basis which should resolve this issue.

2014 VBT Primary Table Exposure Comments

2. Composite Ultimate Table Needed
   - **Issue:** Noted two areas where distortions appear to be occurring due to the lack of a composite ultimate table.
     - Juvenile Mortality – The table structure does not allow for a grading to smoker/nonsmoker split tables when those distinctions become available at age 18. Since companies do not normally distinguish smoking habits below that age, a discontinuity appears when ultimate tables are used.
     - Anomaly of rates at ages 40 -43, which appears to be another consequence of the handling of juvenile mortality noted above, the ultimate mortality rates show a significant drop from ages 41-43. If a composite ultimate table is not created, there may be a need to smooth or somehow reduce this discontinuity. Again, this is primarily important where ultimate rates are generally used.

   - **Response:** We agree and are in the process of developing a unismoker table. The juvenile rates for issue ages below 18 will be adjusted to only be on a unismoker basis.

2014 VBT Primary Table Exposure Comments

3. Non-uniform Mortality Improvement by Class
   - **Issue:** Male nonsmoker shows marked mortality improvement whereas other classifications show only moderate or no improvement.
   - **Response:** The data supports the mortality improvement assumptions applied. We will expand the information to provide further details in the final report.

2014 VBT Primary Table Exposure Comments

4. Post level term mortality anti-selection adjustments
   - **Issue:** The 2014 VBT incorporates post-level term experience and then provides certain adjustments. Why was such experience not simply eliminated, which seems possible based on the comments on slide 18 of the joint Academy-Society PowerPoint. We would also like to understand the basis for the adjustment factors that were applied.

   - **Response:** The ILEC data collection had information on whether the business was issued as term or other than term; however, it did not further distinguish between the length of the level premium period. Therefore, estimation had to be used. Further information will be provided in the final report to discuss the basis for the adjustment factors.

2014 VBT Primary Table Exposure Comments

5. Improve table from 2014 to 2017

- **Issue:** The 2014 VBT was developed by projecting mortality rates to 2014. At the Summer NAIC National Meeting, NAIC leadership shifted the planned effective date of PBR one year to 2017. We suggest that LATF direct the POG to project the rates forward three more years to 2017 to coincide with the new expected PBR effective date.

- **Response:** There is concern projecting both the VBT and CSO forward to 2017 as companies may want to begin using the VBT prior to 2017. One possibility is to have the VBT start at either 2014 as it is or project to 2015. The CSO start date could be projected to 2017.

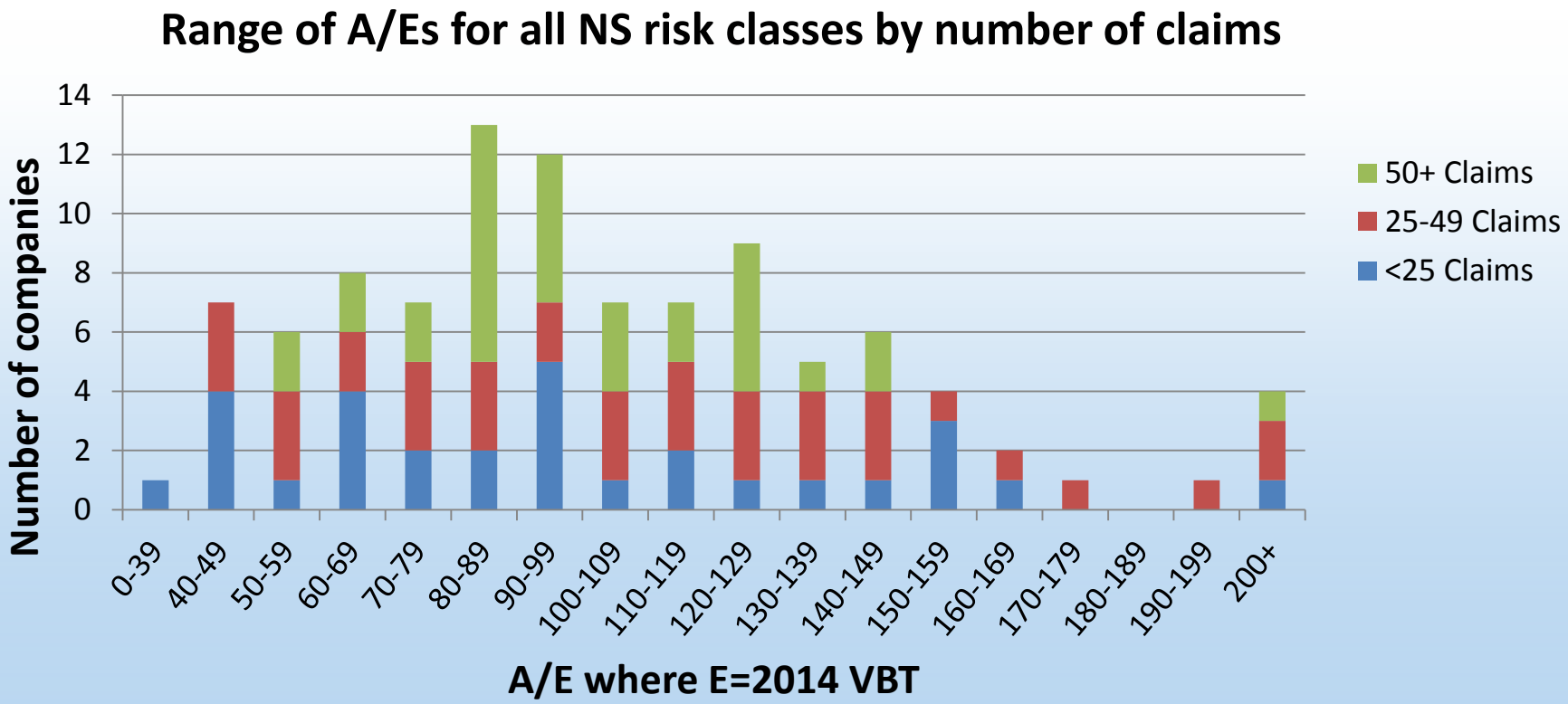
  Mortality improvement factors will be published annually to true-up the VBT to the current valuation year from the start date of the table.

  If the published mortality improvement factors differ from what was used to project for the CSO, it could result in a slight disconnect between the CSO and the VBT in 2017.

2014 VBT RR Tables

- Table structure same as 2008 VBT
  - 10 NS/4 SM tables
  - M/F/Unisex
  - ANB, ALB
  - Select & Ultimate, Ultimate only
- NS risk relativity different from 2008 VBT
- SM risk relatively likely to remain same as 2008 VBT
- No Unismoker relative risk tables

Determination of Relativity for RR Tables - Nonsmoker



Resulting NS RR tables = RR 50, 60, 70, 80, 90, 100, 110, 125, 150, 175

E = 2014 VBT with, for each company, the mortality improvement that is built in to the VBT removed from the midpoint of each company's data period removed

Mortality Improvement Factor

- Factors that apply to VBT to project forward from start date to valuation date
  - Published on SOA website annually
  - First published for 2013
  - Currently apply to the 2008 VBT for AG38, Section 8D reserve calculations that utilize VM-20 methodology for the mortality assumption

2014 CSO Development – Preferred Structure Tables

- 2014 VBT as base
- Uses different RR table structure
  - 3 NS
  - 2SM

  - Similar to 2001 CSO Preferred Structure Tables
  - NS and SM classes, when weighted together equal 2014 VBT aggregate NS and SM mortality, respectively

- Omega age of 121 – same as 2001 CSO
- The underlying VBT preferred structure tables and margin structure are still in development

Considered 4 purposes for a Margin

Consideration		Resolution
1	Confidence of experience study	• Not a concern for 2014 CSO (underlying study is credible) • Significantly more data than in prior underlying studies • 439% increase in exposure by amount over data underlying 2001 CSO (52% increase by count)
2	Variation of individual company's experience relative to the mean	• There is considerable variability by company • A/E by amount ranges for NS risks from < 40% to > 200%
3	Random fluctuation due to smaller exposure	• Not practical to vary loadings by size of company exposure • Purpose of capital and surplus
4	Unknown variation such as catastrophic events	• Purpose of capital and surplus

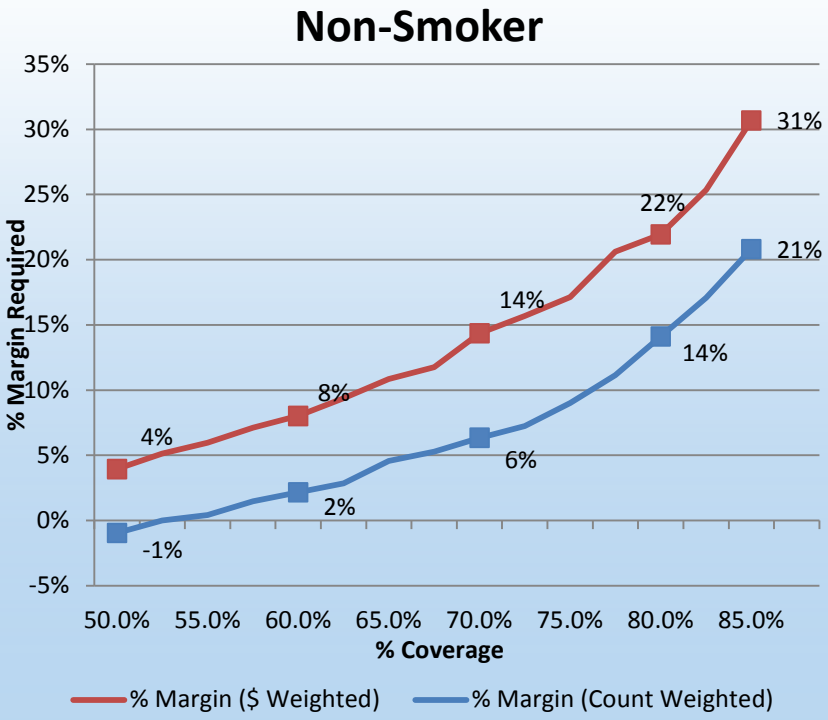
2014 CSO Development - Margin

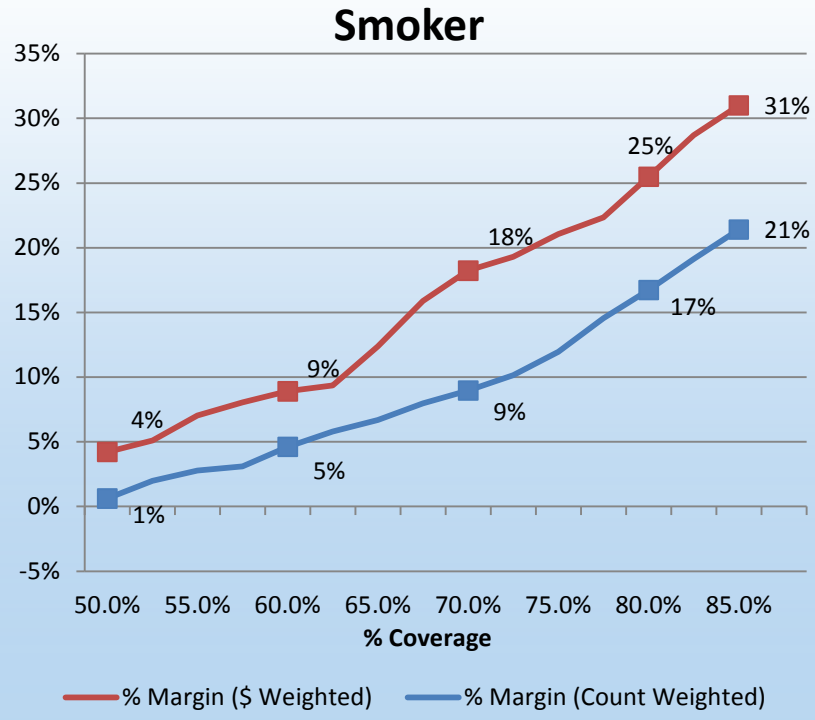
- NAIC LATF guidance:
  - Margins consistent with 2001 CSO
  - To cover the claims or mortality experience from at least 70% - 79% of the contributing companies (in the underlying mortality study)

- Purpose of margin to cover the variation of an individual company's mortality around the mean (company variation)

Approximate Margin Required For A Given Coverage Level in 2002-2009 study

The required margin levels to cover specified percentages of the contributing companies to the 2002-2009 studies are shown in the tables below:





Note: In process of re-running with proposed margin and with unismoke basis, where applicable, to ensure results in the 70%-79% coverage of contributing companies' claim experience.

CSO Margin Structure

- ~15% margin covers experience for 70-79% of contributing companies at aggregate level
- 2001 CSO Margin structure:

$$\frac{0.0056 - 0.00016(x+t) + 0.00008(x+t)^2}{e_{[x]+t}}$$

CSO Margin Structure Comparisons

CSO Table	Underlying Experience	% Companies Covered by Margin	Structure of Margin
80 CSO*	1970-1975	Over 50%	$\frac{0.35 - 0.00025x + 0.000009x^2}{e_x}$
2001 CSO**	1990-1995	70% - 79%	$\frac{0.0056 - 0.00016(x+t) + 0.00008(x+t)^2}{e_{[x]+t}}$
2001 CSO Preferred Structure	1990-1995	Same as 2001 CSO	Same as 2001 CSO
2014 CSO	2002 - 2009	70% - 79%	Proposing a graded flat % rather than prior structures

* Margins were calculated for the unismoker ultimate rates and then used for both SM & NS ultimate rates.

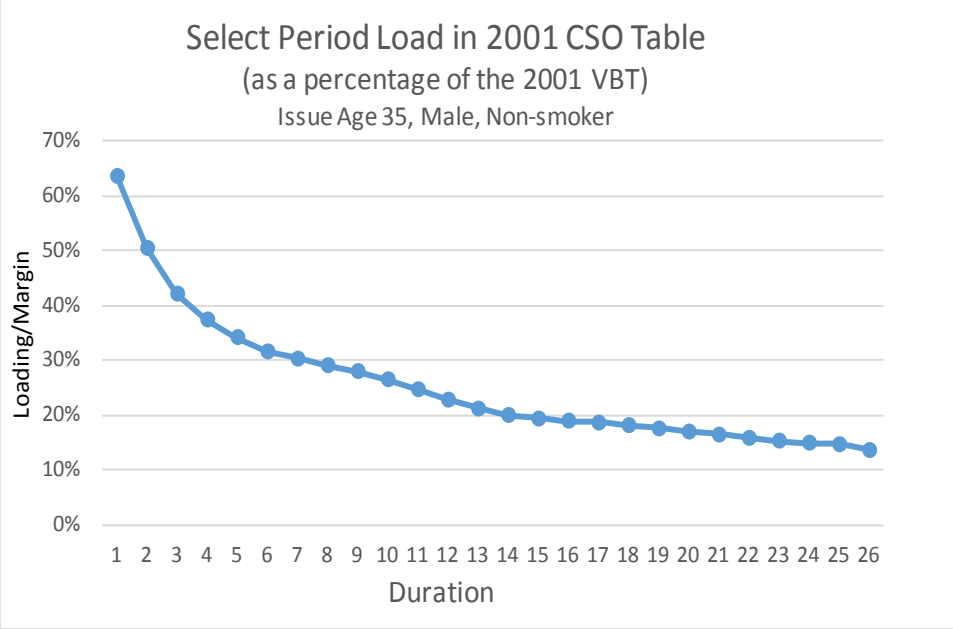
** The formula margin for attained age 100 was graded to 0 at attained age 120.

CSO Margin Structure, cont'd

Using similar structure as 2001 CSO

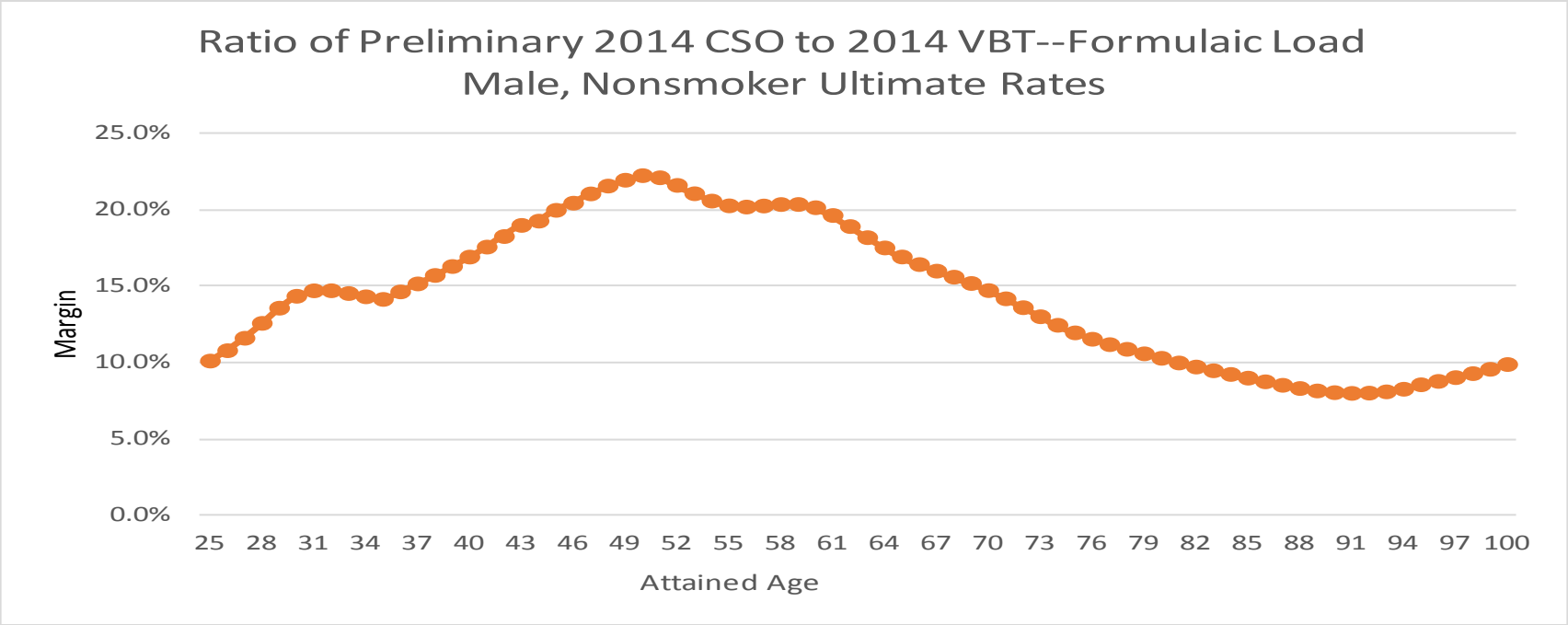
- Results in margins that are extremely high during the select period and issue ages where there is the highest level of credibility
  - A few potential reasons for this:
    - Based on ultimate mortality
    - Based on studies with considerably less exposure in select period

The loads underlying the 2001 CSO Table were highest in the early durations of the select period



CSO Margin Structure, cont'd

- Formulaic loads similar to those used for the 2001 CSO result in margins which are considerably higher at the ages where we have the highest credibility



CSO Margin Structure, cont'd

- Given the level of credibility and amount of select period data, analyzing impact of more of a flat percentage load

- Additional complication considering high number of tables to load (Select & Ultimate, Ultimate, Non-smoker, Smoker, Preferred Risk Tables, etc.)

CSO Margin Structure, cont'd

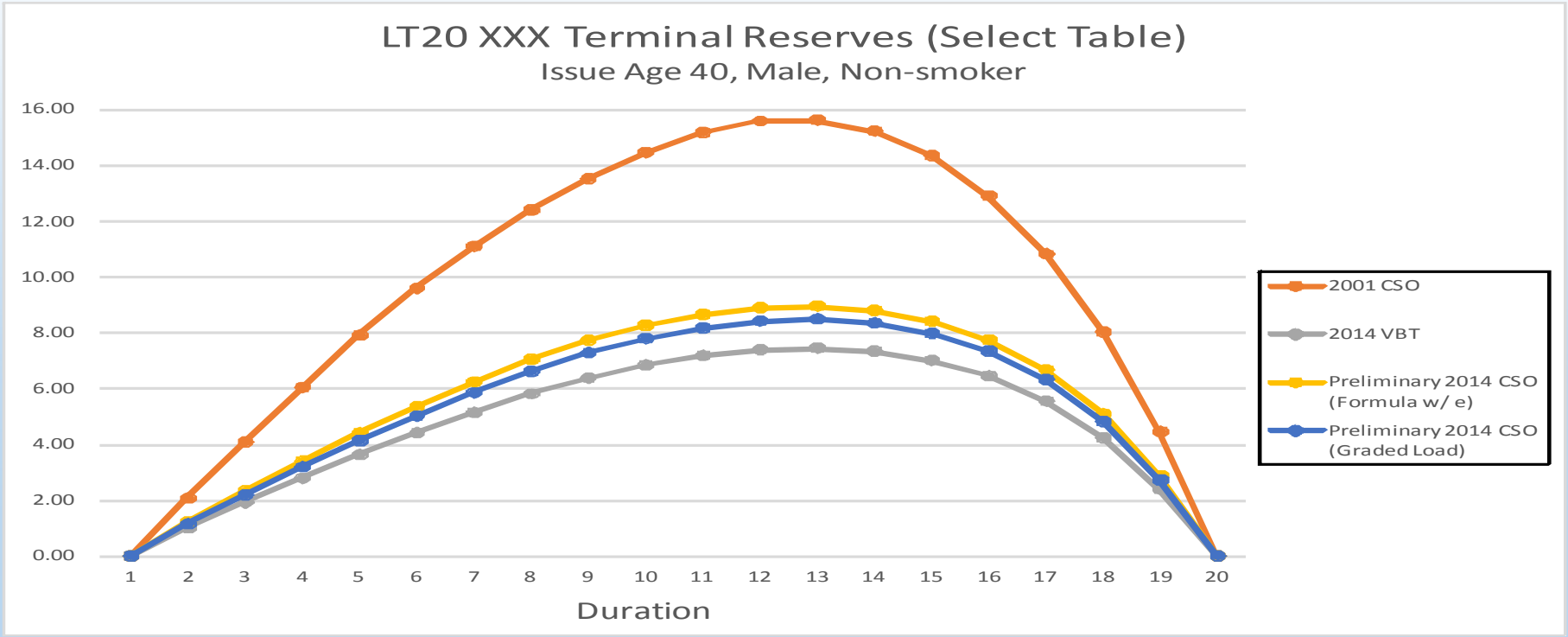
- Analyzed flat % margin of 15%
  - Results in margins that were too high at the oldest ages
    - Higher ages grade to omega rate of 1.00

CSO Margin Structure, cont'd

- Proposing a graded % load
  - Results in absolute load increasing by age but percentage load decreasing by age
  - Appears to result in more intuitive pattern in load by age than other methods
  - Simple to understand and administer for all the table variations
    - Easier to maintain appropriate relationships between the various tables

Comparison of Reserves by Load Structure

- Margins under either the graded premium or percentage load structure result in reasonable reserve level for 20YT but further study required



PBR Margins

- Apply for VM-20 Deterministic and Stochastic reserves
- Vary by attained age and level of credibility in company's mortality segment
- 0% credibility = CSO margin

Application of Credibility in VM-20

- For risk factors (such as mortality), to which statistical credibility theory may apply, the company shall establish assumptions by combining relevant company experience with industry experience data.

Credibility Formula for Mortality

- Uses a credibility factor Z, which varies from 0 to 1:
- We compared two methods currently in use:
  1) Limited Fluctuation Method
  2) Bühlmann Empirical Bayesian

Limited Fluctuation

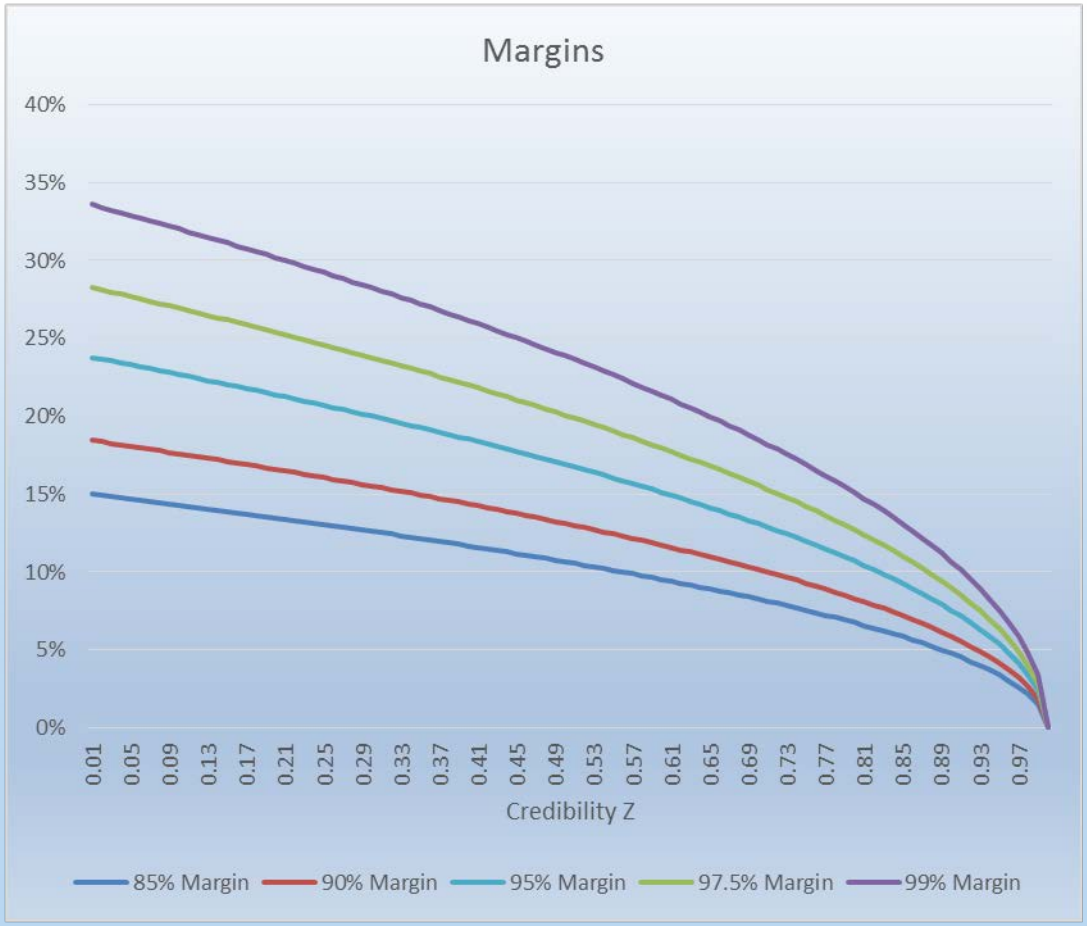
- Uses only the policy by policy experience study results of a single block
- Each company can calculate its own Z factor(s) for the company as a whole or any subset of experience
- Will result in full credibility for many insurance companies:
  - Expected number of claims required for full credibility is the required sample size to produce 95% confidence interval.
- Does not consider variation between companies
- Credibility Factor $Z = \min\{1, rm/z\sigma\}$
  - r = error margin (5% in VM-20)
  - z = normal distribution quantile (95% in VM-20)
  - m = mortality ratio
  - σ = standard deviation of the mortality ratio
- Assumes that the expected basis is appropriate

Bühlmann

- Uses both the variances of observations within each company and between companies.
- Credibility Factor Z = n/(n + k)
  - n = # of exposure units
  - k = expected value of the process variance/variance of the hypothetical means
    - i.e., average of the variances between companies/variance of the company means
- Does not assume that the expected basis is appropriate

Calculated Margins for Various Confidence Levels

- Based on the Bühlmann method
- Level of margin varies by confidence level and credibility factor Z



Practical Approaches

- Bühlmann method, although more robust, requires that a statistical agent calculates the credibility factor Z
  - Margins can be set by formula given an expected basis and a confidence level
- Alternatively, companies could use the Limited Fluctuation method despite its drawbacks

Question for LATF?

- Can there be two separate margin bases within VM-20 based on the credibility method chosen?
  - For companies that want to use the Limited Fluctuation credibility measure – use a prescribed table-based margin similar in structure to table published currently in VM-20
  - For companies that want to use the Bühlmann values calculated by the statistical agent based on contributions compared to industry table – use a factor-based margin
    - Refinement for companies that contribute a lot of data
    - For future tables, most companies will have this option

Further Study Required

- SOA study currently underway to further analyze the impact of the proposed tables (CSO and PBR margins) on reserves
  - Net premium reserves and impact under a range of products
  - Interaction with deterministic reserve under VM-20
  - Tax reserves
  - Prevailing table – Does ultimate table still produce the lowest overall level of reserves?
  - Impact on 7702/7702A
- Impact on minimum required nonforfeiture benefits?
- Impact of improving to 2017 rather than 2014