UPDATE ON MODEL OFFICE ECONOMIC SCENARIO GENERATOR (ESG) TESTING

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Presentation to Life Actuarial Task Force - March 17, 2022

Background

- The Academy's Economic Scenario Work Group (ESWG) developed two model offices (Universal Life with Secondary Guarantees (ULSG) and Variable Annuities (VA))

- The National Association of Insurance Commissioners' (NAIC's) ESG Drafting Group asked the ESWG to use its model offices to test the impact of selected economic scenario sets on statutory reserves and capital

- Statutory reserves and capital are expected to increase under the NAIC's new "low-for-long" interest rate criteria (which the AIRG does not meet)

- The ESWG provided an overview of its model offices on the 3/3/22 LATF call

- This 3/17/22 presentation to LATF provides actual model office results for the economic scenario sets that have been selected by the Drafting Group

  - ULSG/VM-20
  - VA/VM-21

- The ESWG is available to run additional economic scenario sets through its model offices as needed

Update on ULSG/VM-20 Model Office ESG Testing

Jason Kehrberg, MAAA, FSA

Agenda for VM-20 Model Office Update

1. Changes and New Info
2. December 2020 Stochastic Reserves
3. Scenario Reserve Distributions
4. Sample Scenario Projections
5. December 2019 Stochastic Reserves
6. Preliminary Conclusions
7. Caveats

VM-20 Model Office – Changes Since 3/3/22

- Guaranteed minimum crediting rate = 2% (was 3.25%; done to be more in line with current ULSG products, many of which use 1%)

- Units increased so premiums = $12,000 each anniversary (was $8,507; a scaling choice that won't impact comparisons between results)

- Borrowing rate = 105% of 1-year Treasury rate to be consistent with GPVAD discount rate (was 3-month Treasury rate + 1%)

- No other changes since 3/3/22

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VM-20 Model Office – Additional Info

- Using a single model point issued on the valuation date to a female non-smoker age 45

- Using annual reinvestment frequency
  - Cash flows within year accumulate with interest at 3-month Treasury rate

- Assuming investment expense of 10 basis points (provided for completeness since not in 3/3/22 overview presentation; not a key assumption)

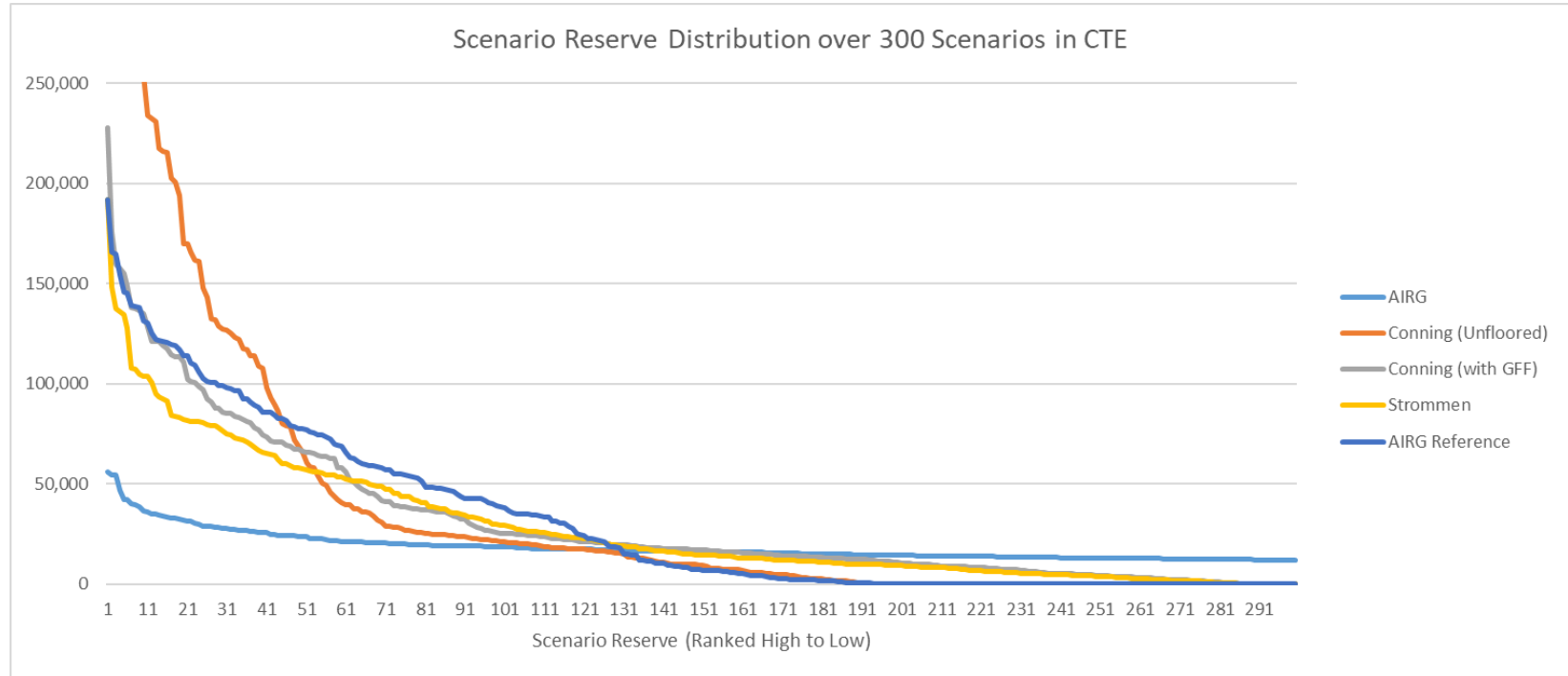- Solving for starting assets solved within 0.1% of reserve

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December 2020 Stochastic Reserves

Scenario Set	Stochastic Reserve	Initial Reserve / $12K Annual Premium
Academy Interest Rate Generator (AIRG)	18,511	154%
Conning Oct21 Calibration (Unfloored)	39,193	327%
Conning with Generalized Fractional Floor	31,812	265%
Strommen with Shadow Rate Model Floor	28,556	238%
ACLI Reference Model v1.1	31,659	264%

Scenario Reserve Distributions

Scenario Reserve Distribution over 300 Scenarios in CTE

- AIRG
- Conning (Unfloored)
- Conning (with GFF)
- Strommen
- AIRG Reference

Scenario Reserve (Ranked High to Low)

- Note: Conning (Unfloored) line goes as high as 536,865, but graph is cut off to help with the scale

Sample Scenario Projections

- The graphs on the next 6 slides are samples of a good scenario, followed by the worst* scenarios for each of the 5 scenario sets
  - *Only 1,000 out of 10,000 scenarios were run
- Each scenario has the same general pattern of flows:
  - Premiums collected in early years builds up the asset base
  - Deaths and lapses over time decrease the incoming premiums and increase the outgoing claims
- Blue line is the projection of total assets
- Black line (dotted) is the Discount rate = 105% of 1 Year Treasury rate (prescribed)
- Orange line is a present value to valuation date of (-total assets)
  - Referred to as the "Present value of accumulated deficiencies" (PVAD)
  - The maximum PVAD referred to as the Greatest PVAD (GPVAD)

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Sample Good Scenario

Academy Interest Rate Generator, Scenario #2640
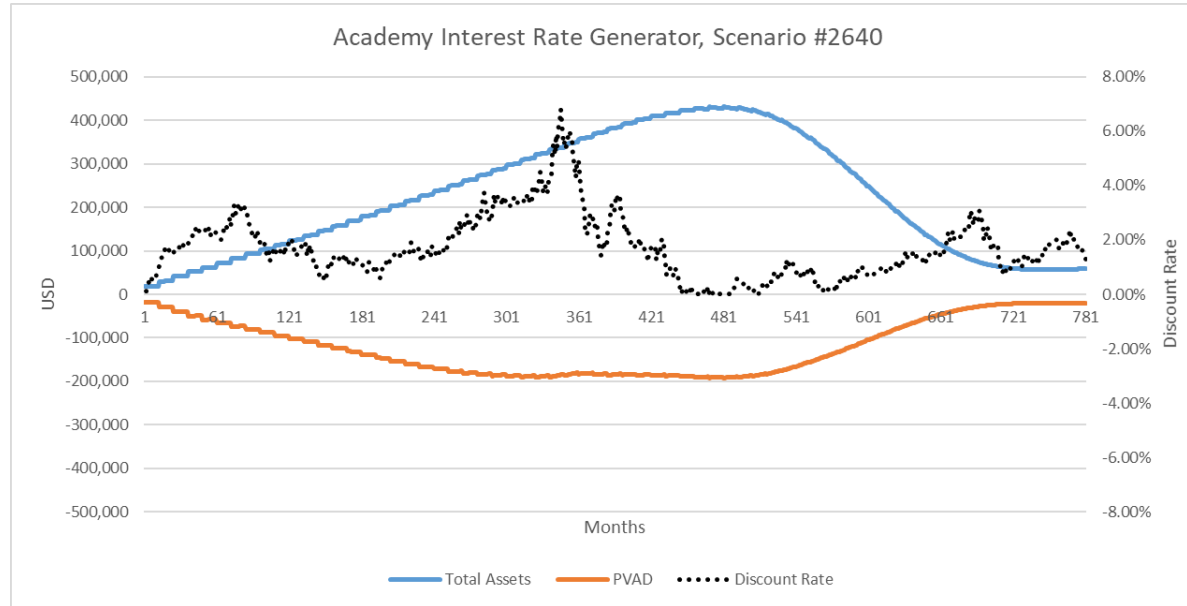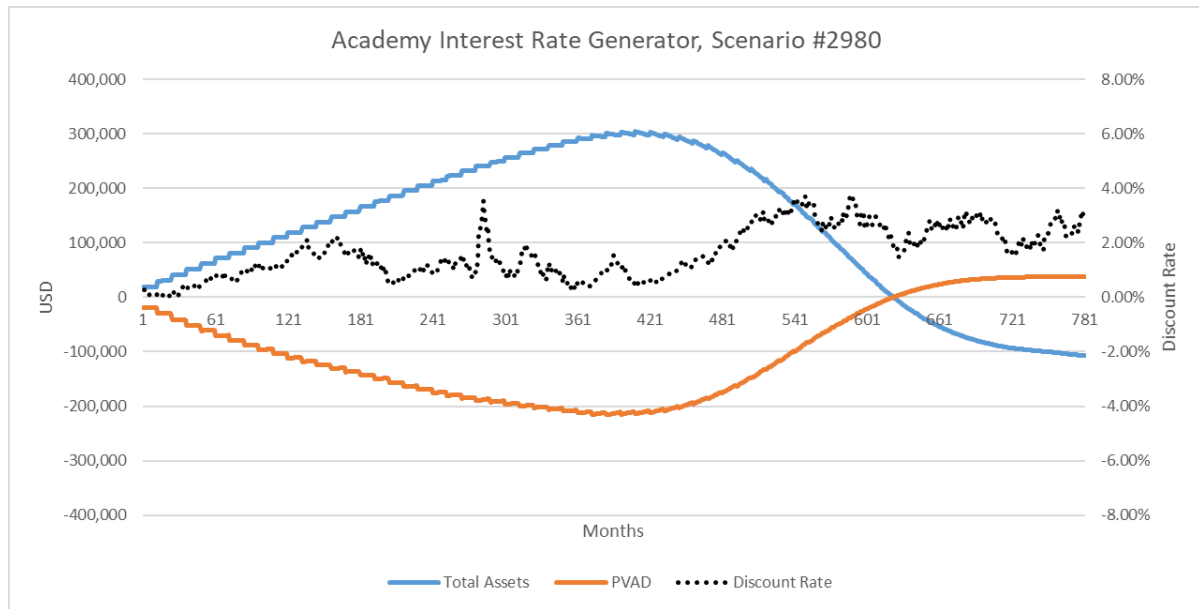
Starting Assets = 18,511

GPVAD = -18,511

Scenario Reserve = 0

- Assets remain positive, and PVAD remains lower than the negative of starting assets

AIRG, Worst Scenario

Academy Interest Rate Generator, Scenario #2980

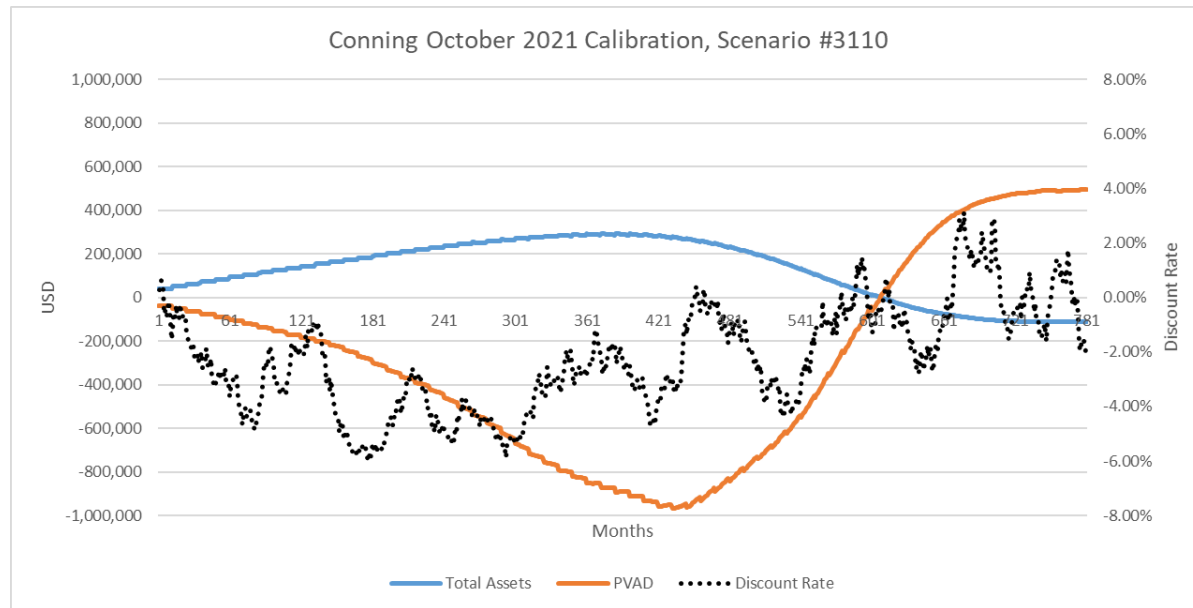Starting Assets = 18,511

GPVAD = 34,424

Scenario Reserve = 55,935

- Relatively higher 1-Year Treasury discount rates reduces the GPVAD

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Conning (Unfloored), Worst Scenario

Conning October 2021 Calibration, Scenario #3110

Starting Assets = 39,202

GPVAD = 497,663

Scenario Reserve = 536,865

- Very negative 1-Year discount rates over many years leads to extremely large GPVAD

Conning (with GFF), Worst Scenario

Conning with Generalized Fractional Floor, Scenario #588
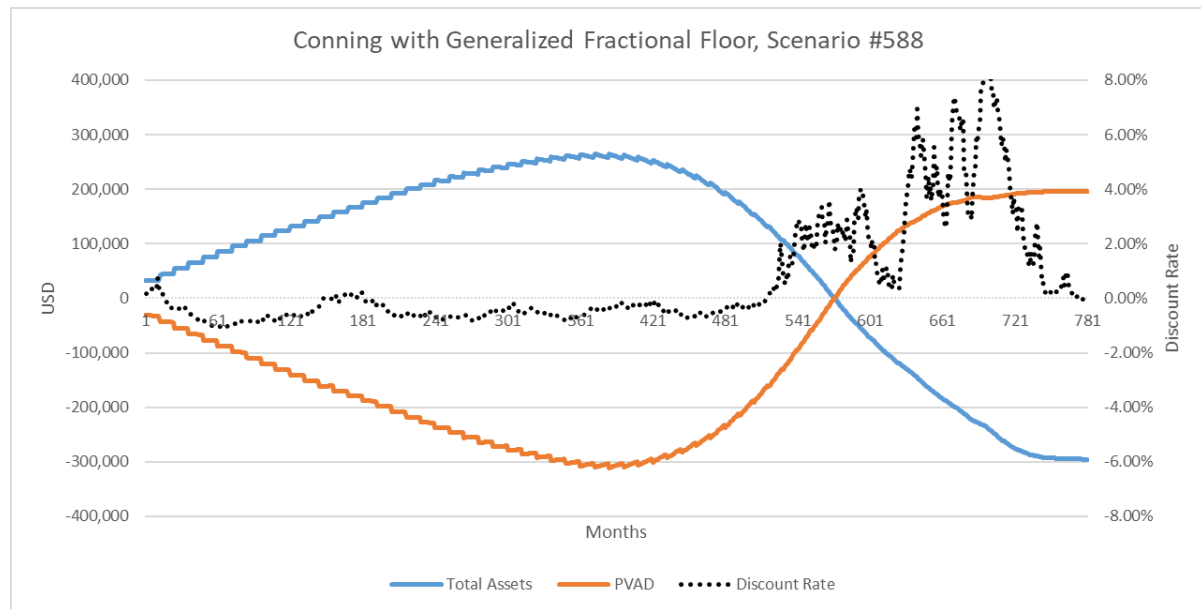
Starting Assets = 31,828

GPVAD = 195,913

Scenario Reserve = 227,741

- This scenario has several years where the GA asset portfolio is earning less than the 2% minimum crediting

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Strommen, Worst Scenario

Strommen with Shadow Rate Model, Scenario #588
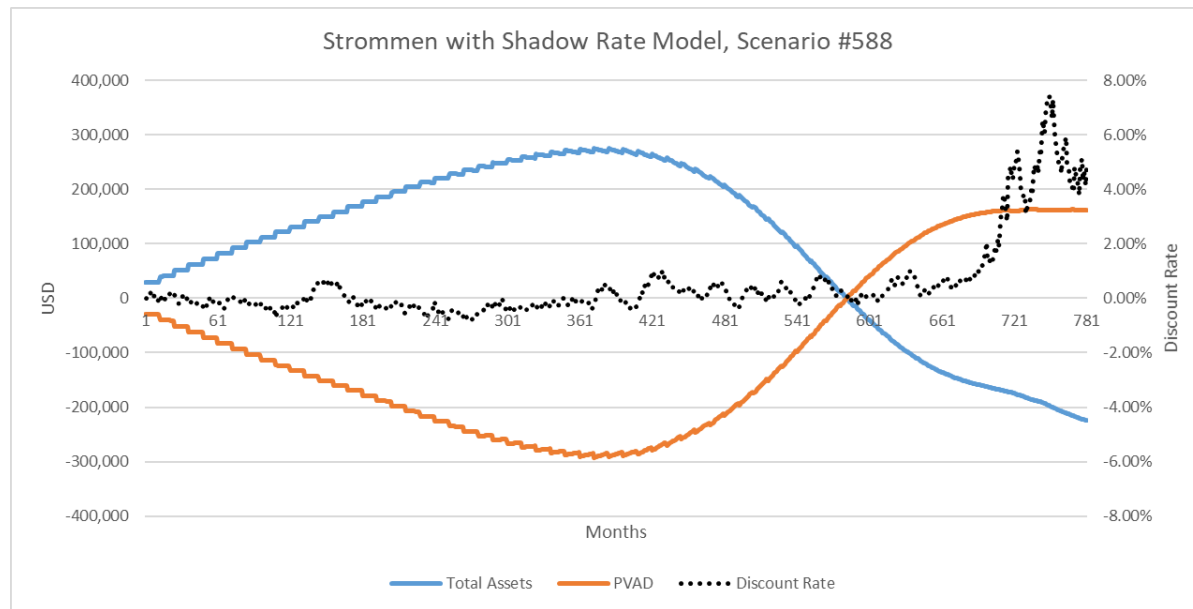
Starting Assets = 28,561

GPVAD = 163,055

Scenario Reserve = 191,616

- Similar to the last slide, but a little less asset deficiency

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ACLI Reference, Worst Scenario

ACLI Reference Model, Scenario #7143
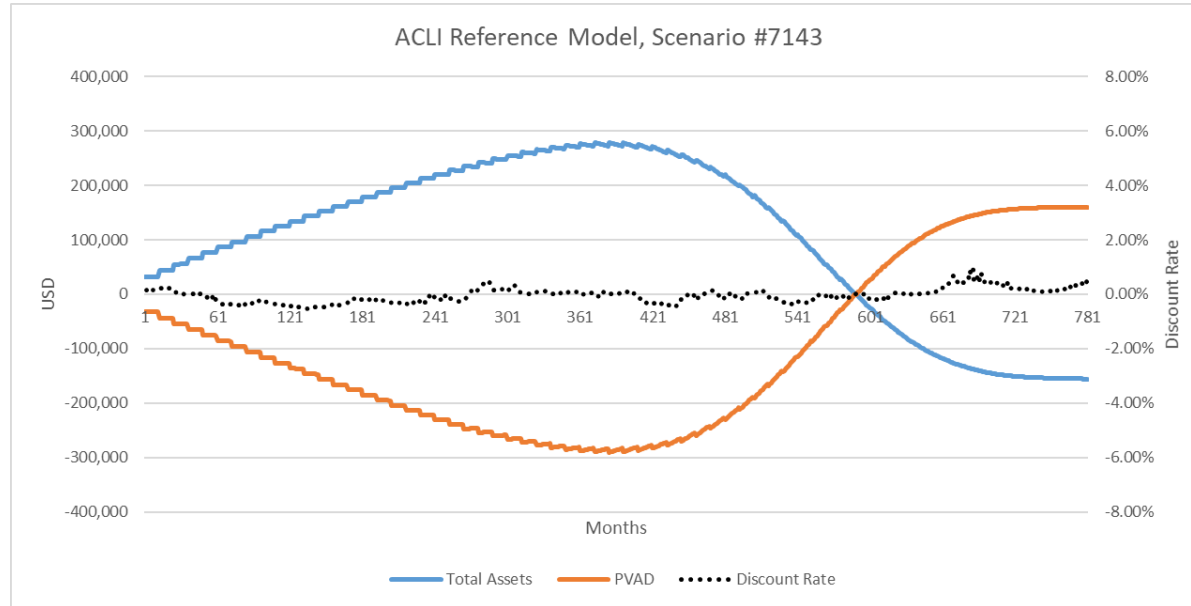
Starting Assets = 31,666

GPVAD = 160,211

Scenario Reserve = 191,877

- Similar to the last 2 slides, but discount rates remain near 0%

December 2019 Stochastic Reserves

Scenario Set	Stochastic Reserve	% Change vs. 2020
Academy Interest Rate Generator (AIRG)	15,200	-17.9%
Conning Oct21 Calibration (Unfloored)	TBD	N/A
Conning with Generalized Fractional Floor	TBD	N/A
Strommen with Shadow Rate Model Floor	TBD	N/A
ACLI Reference Model v1.1	22,786	-28.0%

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Preliminary Conclusions

- Impact to reserves expected to be very large under any of the scenario sets considered
  - Primarily due to the new "low-for-long" requirements, which are not present in the current AIRG
  - High premiums used in this model office is very conservative and limits the value of the secondary guarantee
  - Lower premiums would strengthen the secondary guarantee and make the product riskier, which would be expected to produce even greater impacts
- Conning's unfloored scenarios produces some extreme scenario reserves
  - Primarily due to discounting deficiencies at 105% of 1-Year Treasury, which can be extremely negative

Caveats

- Intended as an illustrative single data point (single model point issued on valuation date; no future sales) for assessing materiality and relative impact to reserve levels and volatility from a change to the scenarios

- Selected ULSG product has exposure to interest rates only, no exposure to equity or bond fund returns

- Not intended to:
  - Cover wide variety of life products available on the market
  - Reflect a full distribution of issue ages / genders within the given product
  - Thoroughly test all the underlying assumptions
  - Be used as a basis for assessing appropriateness of an Economic Scenario Generator

Update on VA/VM-21 ESG Model Office Testing

Albert Zlogar, MAAA, FSA

Agenda for VA Model Office Update

1. Product specification and model updates since 3/3/22
2. Listing of product specifications and assumptions
3. VM-21 Reserve and C3P2 Total Asset Requirement (TAR) method description
4. Sample Scenario Reserve calculations
5. Summary of results – all scenario sets
6. Preliminary conclusions
7. Large Cap Equity Fund return comparisons
8. Scenario reserve distributions
9. Preliminary sensitivity testing
10. Caveats

VM-21 Model Office – Changes Since 3/3/22

- ☐ Guaranteed Lifetime Withdrawal Benefit (GLWB) maximum lifetime withdrawal percentages by attained age band at income election were reduced at ages 70+ to be more in line with current products. The attained age 70 percentage used for these tests was reduced from 5.50% to 5.00%.

- ☐ Model refinement made to more accurately calculate discounting of accumulated asset deficiencies to calculate GPVAD (refined net earned rate vector on additional assets (NAER), etc.)

- ☐ No other changes since 3/3/22

- ☐ The current product specifications and assumptions used for these test results are shown in the next 4 slides

Product Specifications

- Variable Annuity with a GLWB and Guaranteed Minimum Death Benefit (GMDB) (details on next slide)

- Seven-year surrender charge period

- Single model point issued to age 60 male on the valuation date with single premium of $100,000

- Premium/fund allocation: all of the single premium is invested in separate account funds, allocated 80% U.S. large cap equity and 20% long term U.S. corporate bond funds

  - Monthly fund rebalancing to maintain 80/20 mix.

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Product Specifications

Variable Annuity Base contract	
Issue age	60
Single premium at issue	$100,000
Fund allocation	80% US large cap equity / 20% US LT Corp bond, rebalanced monthly
M&E risk charges (annlzd.)	1.30% (applied to fund value)
Inv mgmt fee (annlzd)	0.75% (half of this fee comes back to company as guaranteed revenue sharing)
Surrender charge period	7 years
SC % of deposit	8, 7, 6, 5, 4, 3, 2%

Guaranteed Benefits	GLWB	GMDB	
Benefit Base Rollup %	5%	5%	Benefits based on Max [actual fund value, premium accum. at 5% compounded]
Rollup period	10 years	Up to age 80	Guaranteed Minimum Benefit base stops accumulating at 5% after this period
Ratchet or reset	No	No	If time allows, may test a ratchet benefit enhancement (max anniv value)
Withdrawals	Pro-rata[1]	Pro-rata	
Rider charge (annlzd.)	1.20%	0.30%	calculated on the roll-up benefit base, deducted monthly from fund value
GLWB withdrawal rate %			
Attained Age 59-64	4.00%		WD percent applied to max(fund value, benefit base) based on att age at time
Attained Age 65-74	5.00%		of income election, which defines the lifetime max annual income amount.
Attained Age 75-79	5.25%		5-year waiting period from issue required prior to income election.
Attained Age 80+	5.50%		

1. Prorata reduction in guaranteed benefit base for any WDs taken in excess of (a) or (b), where (a) is the annual 10% free WD amount prior to income election, and (b) is the GLWB guaranteed annual withdrawal amount after income election. Upon income election, the fund value reduces dollar for dollar as WD's are taken until fund value exhausts to zero. Excess WD's taken above the lifetime WD amount cause a prorata reduction in the Benefit Base and effect the income amount.

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Liability Assumptions

- Used VM-21 prescribed Additional Standard Projection Amount (ASPA) assumptions for lapse, mortality and expense (broadly reflects average industry experience):

  - Lapse rates decrease as guaranteed benefit is more in the money and zero when fund value exhausts, and reflect policy duration (pre/post SC period, ultimate)
    - In-the-moneyness(t) for GLWB defined as GAPV future income benefits(t) > current fund value(t)
    - GAPV discount rate is 10 year UST as of the valuation date

  - Mortality 2012 IAM, improvement scale G2, VM-21 ASPA Fx factors

  - Expense: $100 per policy + 7bp on fund value annual maintenance & overhead

- Exception to prescribed ASPA assumptions used for GLWB income election:
  - Instead of ASPA WD delay cohort method (many multiple election date cohorts), assumed 100% election at end of contract year 10 (highest guaranteed benefit base roll-up duration), at attained age 70 in this case
  - Assumed 100% of maximum GLWB withdrawal percentage (applied to max of EoY 10 fund value or benefit base) is taken as lifetime income amount at year 10 election
  - Both of the above (timing and amount) are more conservative than prescribed and industry experience and were assumed for initial modeling convenience and time constraints
    - Industry experience shows multiple election dates occur as well as < 100% of max WD rate taken

- No other partial withdrawals, Required Minimum Distributions (RMDs) or non-conforming/excess withdrawals assumed other than the GLWB withdrawals

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Asset Assumptions

- Starting asset amount = separate account cash surrender value

- No starting general account investments, and there is initial borrowing of the SA surrender charge amount to top-up separate account to the full $100k deposit – borrowed at initial 7-year bond rate with monthly P&I paydown

- General account investment/reinvestment strategy:
  - Invest positive cash flows in 50%/50% mix of AA/A non-callable corporate bonds
    - Use prescribed tables (from VM-20) for spreads (current and long term) and default costs
    - 9 basis points (bp) annual investment expense
  - Bond maturity mix 1 to 30 years; starts longer and shortens over time to maintain reasonable match to liability cash flows
  - If there is a shortfall, borrow at same strategy/rates as reinvestment ("negative assets approach"), therefore borrowing rates are the same as reinvestment rates

- Initially no hedging or reinsurance was modeled, as there has not been time to reflect this.

- Monthly model time steps, 40 projection years (when no material liabilities remain)

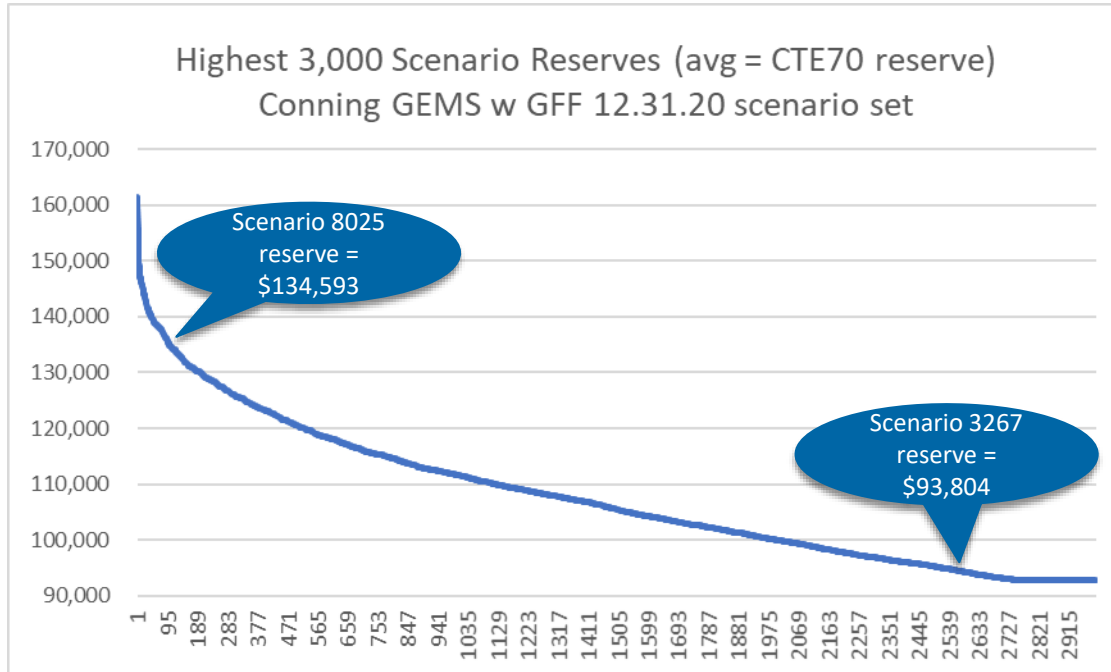- 10,000 scenarios were run for each scenario set

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VM-21 Reserve Method Description

- Reserve and C3P2 Risk-Based Capital (RBC) and TAR calculated per VM-21:

- Reserve = Stochastic Reserve + Additional Standard Projection Amount (ASPA), where

  - Stochastic Reserve = Conditional Tail Expectation (CTE)70 of 10,000 <u>Scenario Reserves</u>

  - <u>Scenario Reserve</u> for this model segment = Max (aggregate cash surrender value (CSV), Starting Assets + Greatest Present Value of Accumulated Deficiencies (GPVAD))

  - Starting assets = CSV, so scenario GPVAD is portion of reserve held in general account to ensure all guaranteed liability cash flows and expenses (in excess of those funded by separate account) are paid off to the end of the projection for the scenario

  - Discount rates to calculate GPVAD = net earned rates on additional available assets invested up front to back the GPVAD (NAER)

  - ASPA = add-on to stochastic reserve if base assumptions are less conservative than prescribed assumptions (not applicable for these tests, i.e., ASPA=0, since assumptions used are not less conservative than prescribed)

- C3P2 RBC uses macro tax adjustment (MTA) method in these tests:

  - C3 amount = max(0, 25% * [(CTE98 + ASPA - Statutory Reserve) x (1-Federal Income Tax (FIT) rate) – (Statutory Reserve - Tax Reserve) x FIT rate)])

Sample Scenario Reserve Calculations

Highest 3,000 Scenario Reserves (avg = CTE70 reserve)
Conning GEMS w GFF 12.31.20 scenario set

Scenario 8025 reserve = $134,593

Scenario 3267 reserve = $93,804

Before discussing the full scenario set results, it is useful to review the mechanics and key amounts of the scenario reserve calculation.

The next 3 slides discuss and show graphs of this detail for 2 of the 3,000 scenario reserves comprising the CTE70 stochastic reserve.

Sample Scenario Reserve Calculations

- The next 2 slides and graphs illustrate the calculations for high and low scenario reserve amounts (driven by scenario fund returns, interest rates, investment yields and borrowing costs)

- Each has the same general pattern of starting and projected asset amounts and flows, particularly for the CTE70 scenarios:

- Green line is the separate account assets (fund value); starts at deposit and grows or declines based on scenario fund returns net of fees, and as fund value is released on surrender, death and GLWB withdrawal payments while fund value is positive

- Blue line is the general account assets/deficiencies prior to the scenario reserve assets added in. Starts negative (initial SA SC borrowing) and grows in early years as fee income is invested (net of expenses and some GMDB and GLWB claims in excess of fund value released). Then declines after separate account fund value exhausts and continuing GMDB + GLWB claims and expenses are paid out. Declines below zero (accumulated deficiency) for many of the CTE70 scenarios.

- Orange line is the PV of the blue line assets and deficiencies, discounted at the net earned rates on additional assets (NAER). The greatest of the projected year-end PV of negative of the deficiencies (GPVAD) is the scenario reserve needed to be invested up front to eliminate the blue line projection year-end deficiencies.

- Yellow line is the new projection of the blue line general account assets but now including the initial scenario reserve assets and shows the projected year-end deficiencies have been eliminated.

- Tables of separate account returns and NAER discount rates driving the results are also shown.

High Reserve Scenario
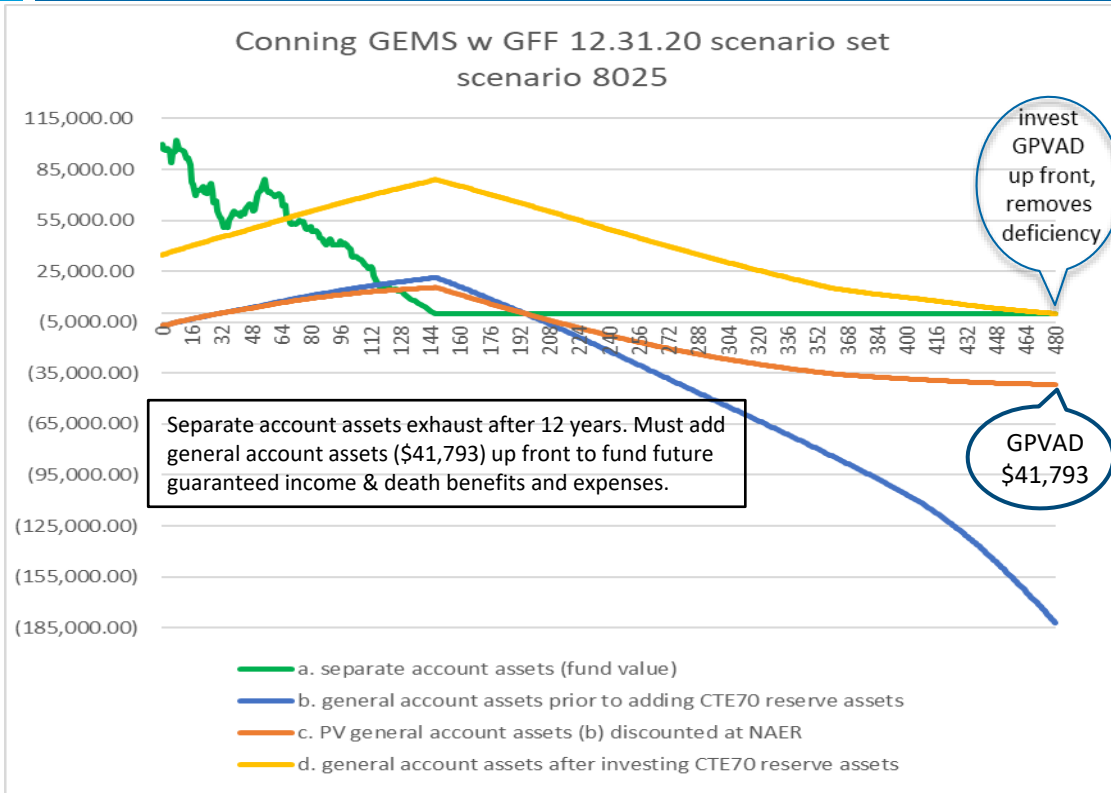
cumulative annualized SA fund returns based on scenario wealth ratios			annzld cum NAER
large cap equity fund	LT corp bond fund	fund value wtd avg	GPVAD disc rate
1 year	4.65%	-7.33%	2.36%	2.57%
5 years	-0.57%	1.48%	0.15%	2.61%
10 years	-12.13%	0.54%	-9.44%	2.65%
15 years	-7.53%	1.22%	-6.45%	2.68%
20 years	-4.55%	1.84%	-4.88%	2.73%
30 years	-6.54%	2.22%	-3.28%	2.91%
40 years	-4.01%	3.18%	-2.47%	3.75%
fund value exhausts over 12.3 years			

Summary:

- Starting assets = $92,800 separate account CSV
- $41,793 additional general account assets needed to fund future guaranteed benefit claims, expenses and repayment of initial SA SC borrowing
- Total scenario reserve = $134,593

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Low Reserve Scenario

Conning GEMS w GFF 12.31.20 scenario set scenario 3267

Separate account assets last for 20 years. Must add relatively small amount of general account assets ($1,004) up front to fund future guaranteed income & death benefits and expenses.

invest GPVAD up front, removes deficiency

GPVAD $1,004

- a. separate account assets (fund value)
- b. general account assets prior to adding CTE70 reserve assets
- c. PV general account assets (b) discounted at NAER
- d. general account assets after investing CTE70 reserve assets

	cumulative annualized SA fund returns based on scenario wealth ratios			annzld cum NAER
	large cap equity fund	LT corp bond fund	fund value wtd avg	GPVAD disc rate
1 year	-6.65%	-13.89%	-8.03%	2.57%
5 years	0.30%	2.11%	0.88%	2.62%
10 years	2.38%	3.69%	2.84%	2.69%
15 years	4.29%	2.96%	4.25%	2.72%
20 years	-0.25%	1.13%	0.61%	2.68%
30 years	1.97%	2.55%	0.41%	2.69%
40 years	2.71%	1.73%	0.31%	2.72%
fund value exhausts at year 20				

Summary:
- Starting assets = $92,800 separate account CSV
- $1,004 additional general account assets needed to fund future guaranteed benefit claims, expenses and repayment of initial SA SC borrowing
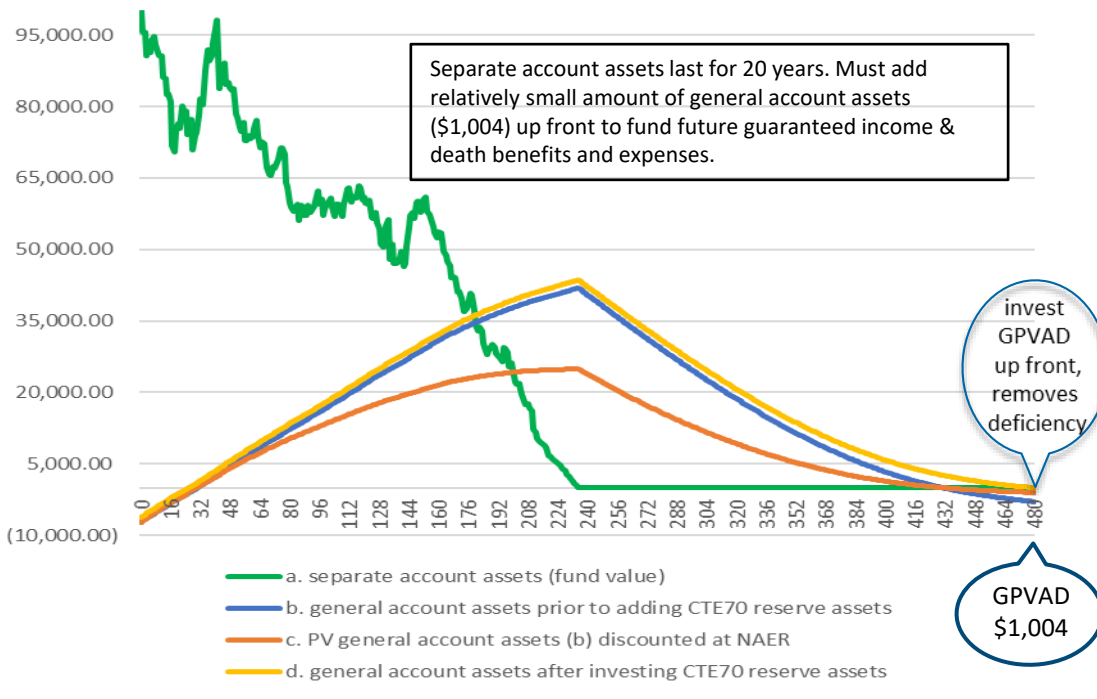- Total scenario reserve = $93,804

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Summary of Results – All Scenario Sets

The next 2 slides summarize the:

- Stochastic CTE70 reserves and
- C3 Phase 2 Total Assets Required (TAR)

For the following scenario sets tested:

1. AIRG scenarios
2. ACLI reference SLV model (version 1)
3. Conning GEMS with Generalized Fractional Floor (GFF)
4. Strommen with Shadow Rate Floor (version 4B)
5. Conning GEMS unfloored 12/31/2020 valuation date scenarios developed in October 2021

In addition, a "hybrid" set of scenarios was tested for 3, 4 and 5 above, by replacing the U.S. large cap equity fund scenarios with the AIRG U.S. large cap equity fund scenarios (as an initial simplistic rough test to get a feel for impact of removing the equity risk premium linkage to overnight UST scenario rates).

Summary of Results - CTE70 Reserves

VA with GLWB and GMDB	Reserves (gen. acct. resv is excess over CSV)			
Scenario Set (used full 10,000)	**12/31/2019 CTE70 Reserve**	**Ratio to CSV**	**12/31/2020 CTE70 Reserve**	**Ratio to CSV**
1 Academy Interest Rate Generator (AIRG)	95,854	103.3%	98,491	106.1%
2 ACLI Reference Model V1.0	96,146	103.6%	98,515	106.2%
3 Conning with Generalized Fractional Floor	TBD		107,860	116.2%
4 Strommen with Shadow Rate Model Floor	TBD		108,971	117.4%
5 Conning Oct21 Calibration (Unfloored)	TBD		110,825	119.4%
3 hybrid Conning with GFF, using AIRG equity scens			97,406	105.0%
4 hybrid Strommen with SRF, using AIRG equity scens				
5 hybrid Conning Oct 21 unfl, using AIRG equity scens				

Hybrid scenario results are a simplistic initial rough test to get an initial feel for the impact of removing the equity risk premium linkage to scenario short term overnight UST rates.

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Summary of Results – C3P2 TAR

VA with GLWB and GMDB	C3P2 TAR			
Scenario Set (used full 10,000)	**12/31/2019 C3P2 TAR**	**Ratio to CSV**	**12/31/2020 C3P2 TAR**	**Ratio to CSV**
1 Academy Interest Rate Generator (AIRG)	99,268	107.0%	103,082	111.1%
2 ACLI Reference Model V1.0	99,769	107.5%	103,202	111.2%
3 Conning with Generalized Fractional Floor	TBD		113,470	122.3%
4 Strommen with Shadow Rate Model Floor	TBD		114,226	123.1%
5 Conning Oct21 Calibration (Unfloored)	TBD		116,209	125.2%
3 hybrid Conning with GFF, using AIRG equity scens			101,811	109.7%
4 hybrid Strommen with SRF, using AIRG equity scens				
5 hybrid Conning Oct 21 unfl, using AIRG equity scens				

Hybrid scenario results are a simplistic initial rough test to get an initial feel for the impact of removing the equity risk premium linkage to scenario short term overnight UST rates.

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Preliminary Conclusions

□ Impact to reserves is very large under the 3 Conning ESG scenario sets (Oct unfloored, GFF, Strommen SRF) relative to current AIRG or ACLI reference model

- ▫ Ratios of reserves and TAR to CSV are significantly higher - general account reserves are almost triple the AIRG & ACLI reserves for GEMS GFF and Strommen SRF, and more than triple using the GEMS unfloored set

- ▫ The 3 Conning scenario sets have lower equity returns at 12/31/2020 in part due to very low (zero and negative) short overnight rates, as Conning's equity risk premium (ERP) used in the return scenario generation is linked to overnight interest rate. The AIRG and ACLI reference equity return ESGs do not have this linkage.

- ▫ Specifically the GEMS Large Cap expected equity return is roughly the Overnight Rate plus a fixed ERP. The link happens at every node of the simulation, so the short-term expected equity return is constantly changing. Early year very low and negative Overnight simulated rates can materially reduce the simulated equity returns. As the average yields rise in these scenarios, there will be a general rise in the average Large Cap return, but the overall impact cumulative appears to be lower returns as shown on slide 36 which compares left tail equity returns across the sets (left tail more relevant for this particular product).

- ▫ At 12/31/2019 the short term rates were >100bp higher than at 12/31/2020, so it will be interesting to see these 2019 results when scenarios are available
  - ■ Would expect to see potential "artificial"/non-economic changes in reserves and TAR 2019 versus 2020 using Conning scenarios just due to this rate linkage impact on equity scenarios, and

  - ■ Higher procyclical volatility with rate linkage – e.g., in force blocks at 12/31/2019 will be deeper in money at 12/31/2020 and the 2020 equity return scenarios would have been significantly lower than 12/31/2019

  - ■ May result in higher hedge costs depending on hedging target (e.g., if hedging statutory results)

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Preliminary Conclusions

- Reserves and TAR for the 3 Conning scenario sets also higher due to the "low for long" interest rate requirements, which are not present in the current AIRG

- Initial impressions are that for the Conning scenarios (GEMS GFF, Strommen SRF, Oct unfloored), the low equity return scenarios are more of a driver of the large reserve and TAR impacts than the low for long interest rate scenarios for this particular product, but still analyzing all of the scenario results to confirm (these tests were only just recently run).

  - (Although as noted on prior slide the overnight interest rates are one of the drivers of the equity returns)

- For example the "hybrid" scenario results shown (using Conning GEMS GFF interest rate and LT corporate bond fund returns but using AIRG equity returns) have reserve and TAR amounts that are very similar to the AIRG and ACLI reference model results.

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Comparison of Equity Scenarios

U.S.Large Cap equity total return scenarios 12/31/2020 - annualized cumulative geometric mean returns (derived using cumulative wealth ratios)

percentile	5 years	10 years	15 years	20 years	30 years	5 years	10 years	15 years	20 years	30 years	5 years	10 years	15 years	20 years	30 years
	Conning GEMS with GFF 12/31/2020					**AIRG 12/31/2020 (same as 12/31/2019)**					**Conning GEMS GFF minus AIRG**				
50.00%	5.28%	5.45%	5.65%	5.81%	6.08%	7.70%	7.75%	7.65%	7.66%	7.59%	-2.42%	-2.30%	-1.99%	-1.85%	-1.50%
10.00%	-4.22%	-1.85%	-0.58%	0.24%	1.36%	-1.53%	1.12%	2.35%	2.98%	3.84%	-2.69%	-2.97%	-2.92%	-2.74%	-2.48%
5.00%	-7.44%	-4.41%	-2.61%	-1.52%	-0.14%	-4.35%	-0.87%	0.65%	1.74%	2.81%	-3.10%	-3.54%	-3.26%	-3.25%	-2.95%
2.50%	-10.46%	-7.02%	-4.22%	-3.04%	-1.36%	-6.74%	-2.34%	-0.65%	0.58%	1.82%	-3.72%	-4.68%	-3.57%	-3.62%	-3.18%
0.50%	-16.64%	-11.80%	-8.38%	-5.95%	-3.84%	-11.10%	-5.23%	-2.90%	-1.41%	0.00%	-5.54%	-6.56%	-5.48%	-4.54%	-3.84%
min	-33.78%	-24.27%	-19.36%	-14.89%	-9.53%	-17.82%	-9.59%	-6.73%	-4.43%	-2.49%	-15.96%	-14.67%	-12.63%	-10.46%	-7.04%
mean	5.74%	6.38%	6.88%	7.28%	8.03%	8.73%	8.83%	8.82%	8.82%	8.81%	-2.99%	-2.44%	-1.94%	-1.53%	-0.78%
	Strommen 4B with SRF 12/31/2020					**AIRG 12/31/2020 (same as 12/31/2019)**					**Strommen 4B minus AIRG**				
50.00%	5.18%	5.11%	5.22%	5.37%	5.64%	7.70%	7.75%	7.65%	7.66%	7.59%	-2.52%	-2.64%	-2.43%	-2.29%	-1.95%
10.00%	-4.21%	-1.99%	-0.86%	0.13%	1.16%	-1.53%	1.12%	2.35%	2.98%	3.84%	-2.69%	-3.11%	-3.21%	-2.85%	-2.68%
5.00%	-7.58%	-4.55%	-2.67%	-1.67%	-0.24%	-4.35%	-0.87%	0.65%	1.74%	2.81%	-3.23%	-3.68%	-3.33%	-3.40%	-3.05%
2.50%	-10.23%	-7.01%	-4.40%	-3.24%	-1.49%	-6.74%	-2.34%	-0.65%	0.58%	1.82%	-3.49%	-4.67%	-3.75%	-3.82%	-3.30%
0.50%	-16.84%	-11.55%	-8.83%	-5.98%	-4.07%	-11.10%	-5.23%	-2.90%	-1.41%	0.00%	-5.74%	-6.32%	-5.93%	-4.57%	-4.07%
min	-33.40%	-23.68%	-18.42%	-13.98%	-9.69%	-17.82%	-9.59%	-6.73%	-4.43%	-2.49%	-15.58%	-14.09%	-11.70%	-9.55%	-7.20%
mean	5.59%	5.89%	6.19%	6.47%	7.02%	8.73%	8.83%	8.82%	8.82%	8.81%	-3.14%	-2.94%	-2.63%	-2.35%	-1.78%
	Conning GEMS Oct21 unfloored 12/31/2020					**AIRG 12/31/2020 (same as 12/31/2019)**					**Conning GEMS Oct21 unfloored minus AIRG**				
50.00%	5.49%	5.18%	5.20%	5.26%	5.47%	7.70%	7.75%	7.65%	7.66%	7.59%	-2.21%	-2.57%	-2.45%	-2.40%	-2.12%
10.00%	-4.25%	-2.30%	-1.33%	-0.66%	0.30%	-1.53%	1.12%	2.35%	2.98%	3.84%	-2.72%	-3.42%	-3.68%	-3.64%	-3.54%
5.00%	-7.42%	-4.99%	-3.33%	-2.47%	-1.22%	-4.35%	-0.87%	0.65%	1.74%	2.81%	-3.07%	-4.12%	-3.98%	-4.21%	-4.04%
2.50%	-10.51%	-7.57%	-5.26%	-3.98%	-2.47%	-6.74%	-2.34%	-0.65%	0.58%	1.82%	-3.78%	-5.23%	-4.61%	-4.56%	-4.28%
0.50%	-16.42%	-12.08%	-9.44%	-7.20%	-5.12%	-11.10%	-5.23%	-2.90%	-1.41%	0.00%	-5.31%	-6.85%	-6.55%	-5.79%	-5.12%
min	-34.79%	-25.90%	-20.78%	-16.01%	-10.29%	-17.82%	-9.59%	-6.73%	-4.43%	-2.49%	-16.97%	-16.31%	-14.05%	-11.57%	-7.81%
mean	6.00%	6.29%	6.66%	7.03%	7.81%	8.73%	8.83%	8.82%	8.82%	8.81%	-2.73%	-2.53%	-2.16%	-1.79%	-1.00%

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AMERICAN ACADEMY of ACTUARIES
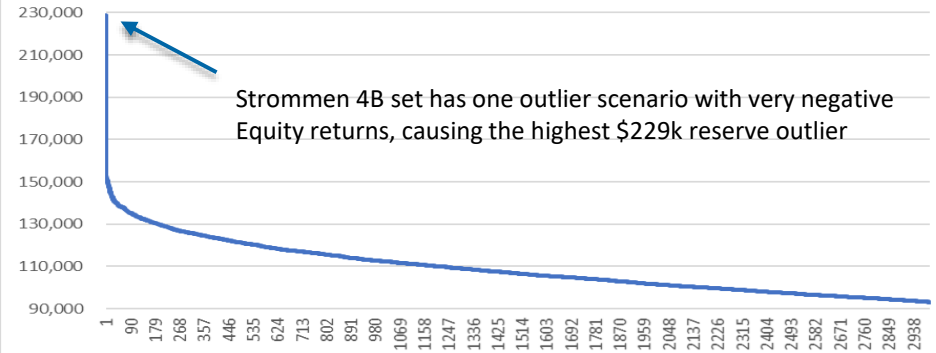
Objective. Independent. Effective.™
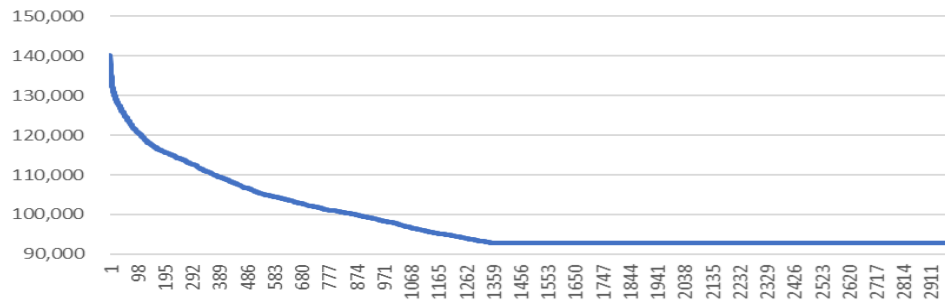
Scenario Reserve Distributions

Highest 3,000 Scenario Reserves (avg = CTE70 reserve)
Conning GEMS w GFF 12.31.20 scenario set

Highest 3,000 Scenario Reserves (avg = CTE70 reserve)
Strommen 4B w SRF 12.31.20 scenario set

Strommen 4B set has one outlier scenario with very negative
Equity returns, causing the highest $229k reserve outlier

Highest 3,000 Scenario Reserves (avg = CTE70 reserve)
ACLI ref model V1 12.31.20 scenario set

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Preliminary Sensitivity Tests

Sensitivity Tests for one scenario	EoY 40 accumulated deficiency	GPVAD	annualized NAER disc rate over 40 years	EoY 40 accumulated deficiency	GPVAD	annualized NAER disc rate over 40 years
1 Conning GFF scenario #8025 (base case)	(182,096)	41,793	3.75%	change from base case:		
2 +25bp parallel shift up all UST rates	(187,776)	38,933	4.00%	(5,680)	(2,861)	0.25%
3 -25bp parallel shift down all UST rates	(176,485)	44,861	3.49%	5,611	3,068	-0.25%
4 +25 bp higher equity fund total returns (80% alloc)	(180,449)	41,415	3.75%	1,647	(378)	0.00%
5 +25bp rate shift and +25bp equity returns	(186,006)	38,566	4.00%	(3,910)	(3,228)	0.25%

Initial comments:

2   Accumulated deficiency is worse when rates are higher due to higher borrowing costs, but GPVAD (general account reserve) is lower. Some of this can be caused by differences in NAER vector for the initial GPVAD investment ("additional assets") and the ongoing ongoing emerging average earned rates and borrowing rates on the other general account assets from fee income investments and deficiency borrowing. Thus can have a lower reserve (higher NAER) even though ending deficiency is worse. Still reviewing.

3   Accumulated deficiency is less when rates are lower due to lower borrowing costs, but GPVAD (general account reserve) is higher.

2 & 3   Thus the reserve impact is slighlty asymmetric for UST sensitivity ($3,068 higher reserve for test 3 versus $2,861 lower reserve for test 2).

4   Relatively low favorable impact of the higher equity returns for this scenario - separate account still declines quickly to zero even after adding +25bp to very low returns. Also the required rebalancing to maintain 80/20 fund mix dampens the beneficial effect of the higher equity fund return sensitivity as as it moves some of the higher return to the LT corporate bond fund each month.

5   Combined impact is close to sum of the parts tests 2+4.

Note - similar sensitivity impacts for other scenarios will be different - depending on level of general and separate account assets, etc. More analysis to come, using different scenarios and other senstivities.

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Caveats

- Intended as an illustrative single data point (single representative model point issued on valuation date; no future sales; not an in-force block) for assessing materiality and relative impact to reserve levels and volatility from a change to the scenarios
  - Companies should consider testing their own products using their own models.

- Not intended to:
  - Cover wide variety of products available on the market
  - Reflect a full distribution of issue ages / genders within the given product
  - Reflect different starting in-force block conditions (guaranteed benefit moneyness, etc.)
  - Thoroughly test all the underlying assumptions
  - Be used as a basis for assessing appropriateness of an Economic Scenario Generator

Questions?

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