VM-22 Practical Modeling Considerations with Reinsurance

Modeling of Assets and Index Annuity Hedges with Reinsurance

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Background

- VM-22, unlike CARVM, requires the modeling of assets, including any index credit hedges for Index Annuities
- Reinsurance can add complexity to the model.
- A VM-22 model that includes reinsurance and index credit hedges will be presented.

Some Differences between CARVM and VM-22

	CARVM	VM-22
Projection Type	Liability-Only	Asset/Liability
Gross-of-Reinsurance Reserve	Worst-Case PV(Liab CFs)	Based on CTE-70 of Required Assets for Gross Liabilities
Net-of-Reinsurance Reserve	Worst-Case PV(Net Liab CFs)	Based on CTE-70 of Required Assets for Net Liabilities
Hedge Assets	Not modeled	Modeled

VM-22 Example that will be discussed today

- Product is an Index Annuity with Annual Point-to-Point crediting strategy.
  - The only hedges are index credit hedges.
  - Crediting Parameters Year 1: 100% Participation Rate, 6%, Cap, 0% Spread
  - No GMxBs

- A single policy is modeled with Issue Date = Valuation Date

- Reinsurance is 80% quota-share

- A Stochastic Reserve (SR) calculation is performed on a sample of 10 scenarios
  - Normally more scenarios would be needed. The small number of scenarios is for demonstrative purposes.
  - For each scenario, the Scenario Reserve = Starting Asset - Pre-Tax IMR (PIMR) + Greatest Present Value of Accumulated Deficiencies (GPVAD)
    - Each period, assets are adjusted (often reduced) by liability cashflows and grown with interest.
    - If these assets become negative, they are Accumulated Deficiencies.

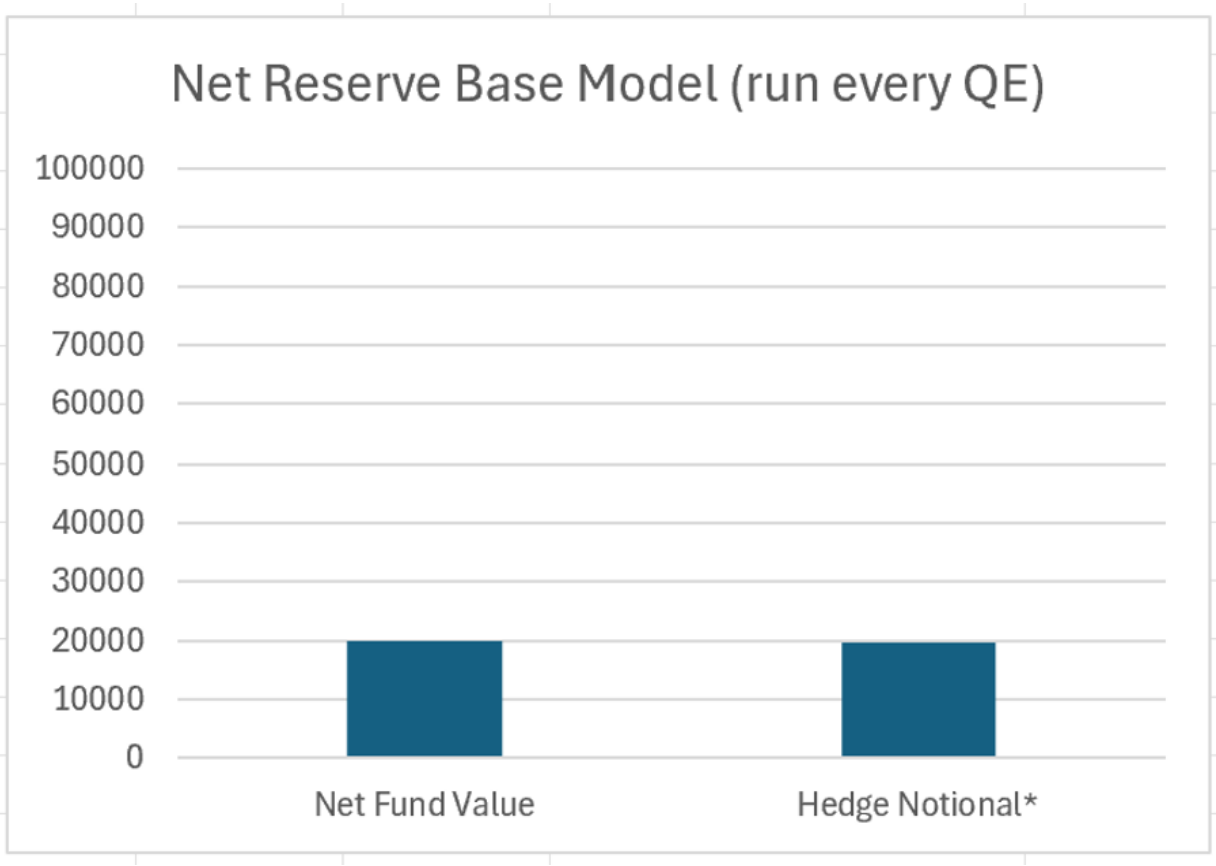
- VM-22 Reserve for this policy = SR = CTE-70(Scenario Reserve floored at CSV)

- NAER = Net Asset Earned Rate = net general account portfolio rate, net of defaults and expenses (per VM-1)
  - Hedge asset returns are included in NAER

- 2 assumptions will be reviewed:
  - Assumption 1: Index Credit Hedges
  - Assumption 2: VM-22 Gross-of-Reinsurance Asset Modeling

Assumption 1: Index Credit Hedges- Gross vs. Net

- Assume the Net-of-Reinsurance VM-22 reserve is calculated every QE
    - Gross Fund Value = $100K
    - Reinsurance is 80% (proportional) coinsurance
    - Net Fund Value = 100% - 80% = 20%*$100K = $20K
    - The direct company hedges index credits on the 20% net amount
    - The reinsurer hedges the 80% ceded amount (excluded from the Net Reserve Base Model)

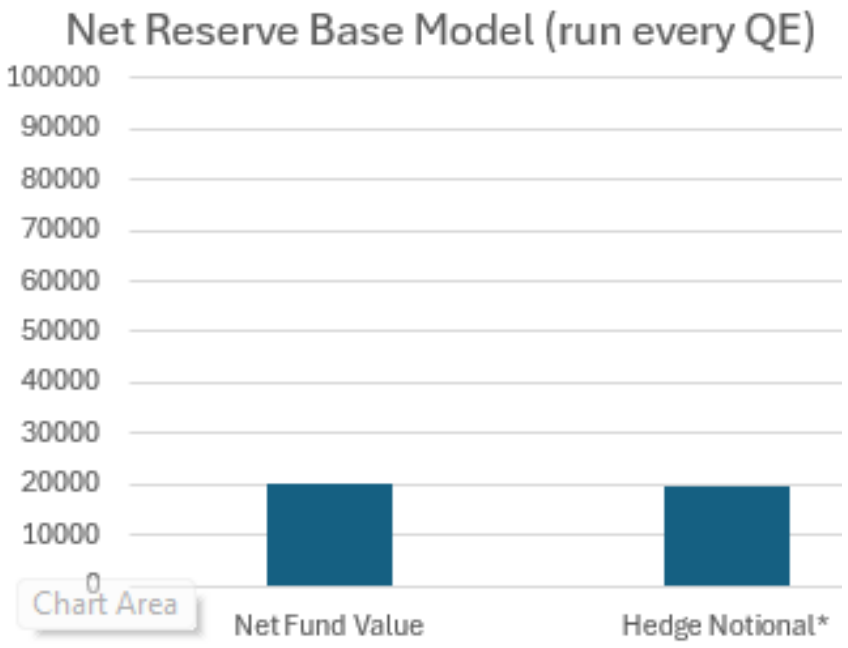


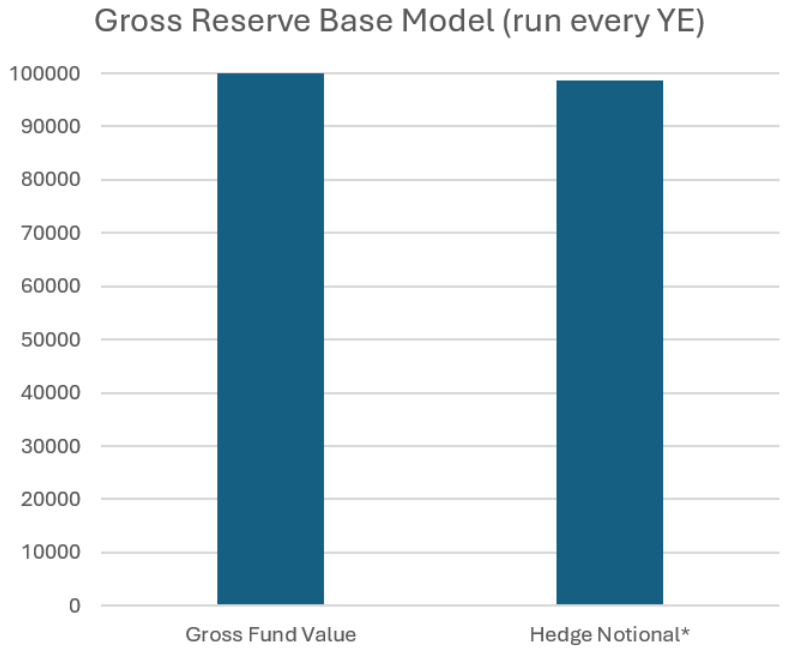
Hedge Notional = Expected Fund Value at End of 1 Yr Index Crediting Period = Fund Value Hedged(1-expected mortality rate)*(1-expected lapse rate)^(11/12)

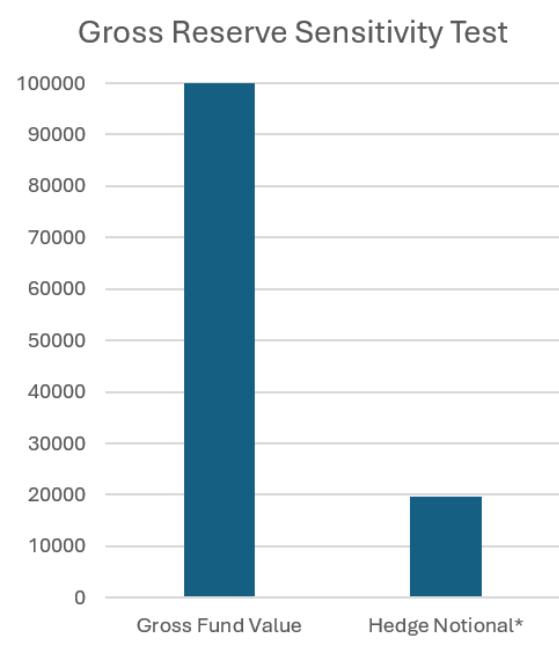
Assumption 1: Index Credit Hedges- Gross vs. Net

- Assume the Net-of-Reinsurance VM-22 reserve is run every QE

- Assume the Gross-of-Reinsurance VM-22 reserve is run every YE
  - "Gross Reserve Base Model" hedges entire fund value
  - "Gross Reserve Sensitivity" only hedges net fund value
    - (e.g. suppose the modeler forgot to change hedge notional from "net" to "gross" when setting up the "gross" model)







Hedge Notional = Expected Fund Value at End of 1 Yr Index Crediting Period = Fund Value Hedged(1-expected mortality rate)*(1-expected lapse rate)^(11/12)

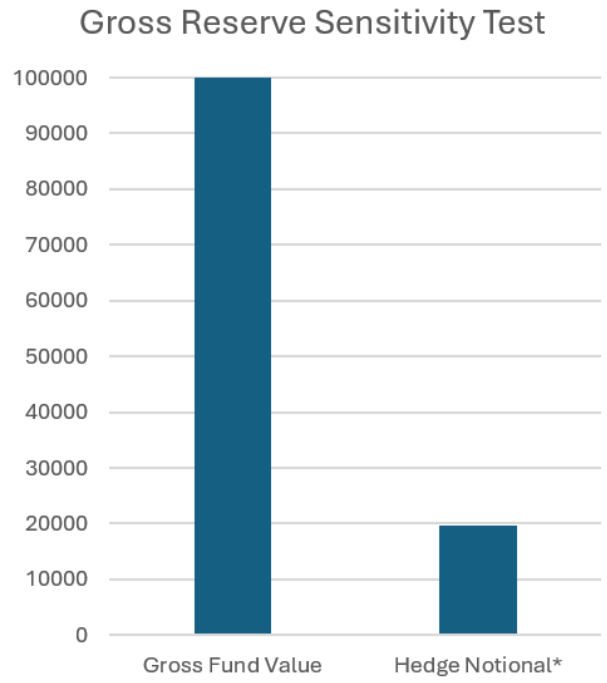
Assumption 1: Index Credit Hedges

- How might a model reviewer detect if the Gross Reserve Sensitivity Test is underhedged?
- The index credit is only partially hedged for the Sensitivity Test. Therefore, its hedge gain or loss would be less than if it were fully hedged.
  - This could make the overall earned rate (NAER) "too low" for scenarios with hedge gains and "too high" for hedge losses.
- This is indicated in the results, shown in the table below.

Earned Minus Credited Spread for Projection Year 1 by VM-22 Scenario

	Scenario 1 (Credit 6%)		Scenario 6 (Credit 0%)	
Gross-of-Reinsurance Model:	**Base Model**	**Sens Test**	**Base Model**	**Sens Test**
Earned Rate	7.75%	5.65%	2.09%	4.53%
Credited Rate	6.00%	6.00%	0.00%	0.00%
Earned Minus Credited Spread	**1.75%**	**-0.35%**	**2.09%**	**4.53%**

Sens Test has more volatile Earned Minus Credited Spread, due to underhedging



Assumption 1: Index Credit Hedges

- The previous slide focused on a single calendar year, whereas this slide shows PVs for the entire projection period.
- This slide's "PV Cred Int in Excess of Opt Bdg…" column is based on the difference between actual (indexed) Credited Interest and the Option Cost = Option Budget = NAER - Spread
- For the Sensitivity Test:
  - The PV column has a much higher CTE-70 than Average, suggesting excess Credited Interest may be associated with losses
  - The Sensitivity Test CTE-70 is higher than for the Base Model

Base Model - Gross Reserve

	SR* Unfloored at CSV	SR* Floored at CSV	PV Cred Int in Excess of Opt Bdg as % of PV Fund Value
Max	98,094	98,094	2.83%
Min	90,282	93,700	-1.17%
CTE-70		95,836	1.95%
Average		94,341	1.26%

Sensitivity Test - Gross Reserve

	SR* Unfloored at CSV	SR* Floored at CSV	PV Cred Int in Excess of Opt Bdg as % of PV Fund Value
Max	125,578	125,578	2.17%
Min	81,773	93,700	-1.30%
CTE-70		120,170	2.24%
Average		104,888	0.91%

Sensitivity Test PV has much higher CTE-70 than Average

*SR=Stochastic Reserve = Starting Asset-PIMR+GPVAD

Assumption 1: Index Credit Hedges

SRs and PVs for all 10 Scenarios

- CTE-70 = Average(worst 30% of scenarios) = Average(worst 3 scenarios)
- The CTE-70 is higher for the Sensitivity Test

Base Model - Gross Reserve

	SR* Unfloored at CSV	SR* Floored at CSV	PV Cred Int in Excess of Opt Bdg as % of PV Fund Value
10	98,094	98,094	2.83%
03	95,713	95,713	2.79%
06	93,672	93,700	0.24%
02	93,512	93,700	1.67%
07	92,809	93,700	0.45%
04	92,492	93,700	0.72%
09	91,690	93,700	1.69%
01	90,952	93,700	2.60%
08	90,840	93,700	0.78%
05	90,282	93,700	-1.17%
Max	**98,094**	**98,094**	2.83%
Min	**90,282**	**93,700**	-1.17%
CTE-70		**95,836**	1.95%
Average		94,341	1.26%

*SR=Stochastic Reserve = Starting Asset-PIMR+GPVAD

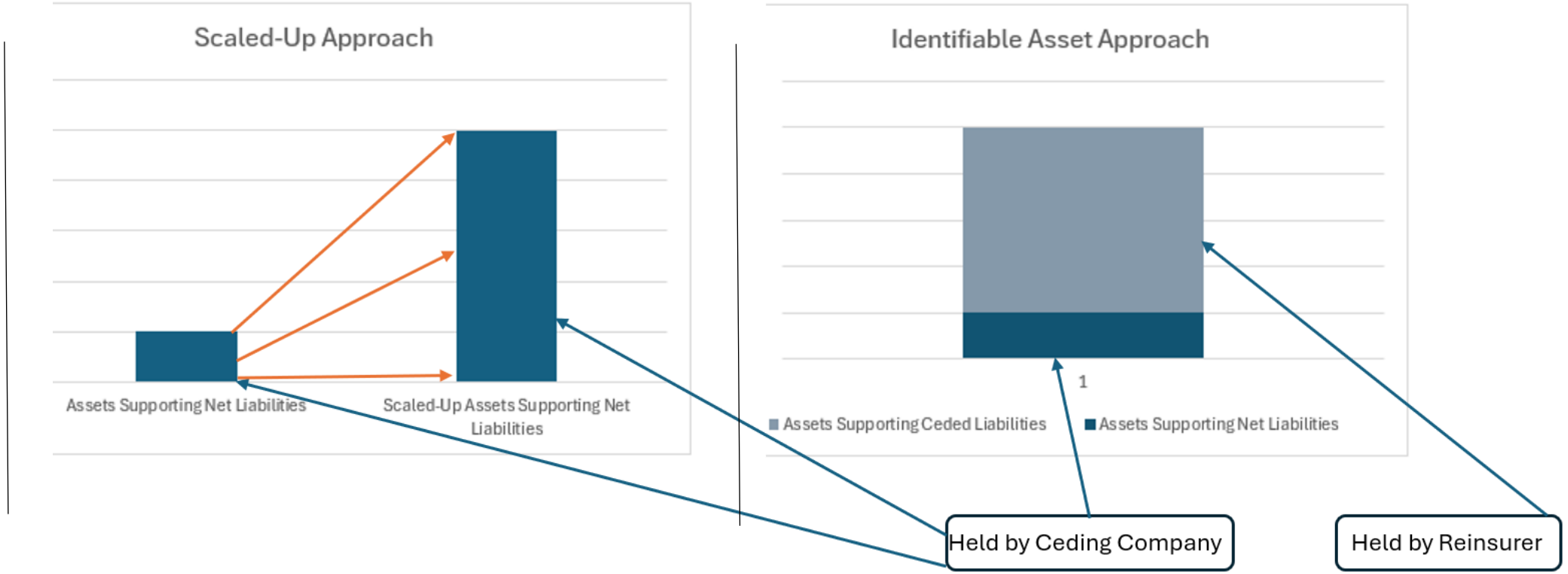
Sensitivity Test - Gross Reserve

	SR* Unfloored at CSV	SR* Floored at CSV	PV Cred Int in Excess of Opt Bdg as % of PV Fund Value
10	125,578	125,578	2.17%
03	123,520	123,520	2.30%
01	111,413	111,413	2.24%
04	102,859	102,859	0.83%
09	101,798	101,798	1.39%
02	101,475	101,475	0.89%
08	97,951	97,951	0.77%
07	96,883	96,883	0.55%
06	85,924	93,700	-0.73%
05	81,773	93,700	-1.30%
Max	**125,578**	**125,578**	2.17%
Min	**81,773**	**93,700**	-1.30%
CTE-70		**120,170**	2.24%
Average		104,888	0.91%

Sensitivity Test PV appears correlated with SR

Assumption 2: VM-22 Gross-of-Reinsurance Asset Modeling

- VM-22 Reserves Should be Calculated Post- and Pre-Reinsurance (VM-22 Section 3B)
- 2 possible approaches to model assets Gross-of-Reinsurance for VM-22:
  - **Similar Assets or Scaled-Up Approach**: For a standard coinsurance treaty, support Ceded Liabilities with assets that are similar to assets supporting net liabilities, or proportionately "scale up" assets supporting net liabilities (VM-22 Section 5.A.2.b.i)
  - **Identifiable Asset Approach**: If a treaty contains identifiable assets for ceded liabilities (e.g. for ModCo, Funds Withheld, Coinsurance with a Trust), this portfolio could be modeled (VM-22 Section 5.A.2.b.ii)
- Note that these 2 approaches might have significantly different NAERs and CTE-70s, as illustrated on the next slide.



Assumption 2: VM-22 Gross-of-Reinsurance Asset Modeling

- Example:
  - Ceded percentage = 80%
  - Yr 1 NAER supporting Net Liabilities = 5.03%
  - Yr 1 NAER supporting Ceded Liabilities = 5.78%
  - VM-22 Gross-of-Reinsurance Yr 1 NAER under proportionate "scale up" approach = **5.03%**
  - VM-22 Gross-of-Reinsurance Yr 1 NAER under "identifiable assets" approach = Wtd Avg NAER
    = 20%*5.03% + 80%*5.78% = **5.63%**

Result: A lower CTE-70 = lower Gross Reserve for the Identifiable Assets Approach.

Base Model - Gross Reserve					
	CSV	CTE-70	Avg Yr 1 Earned Rate (NAER)	Avg Yr 1 Cred Rate	Avg Yr 1 Earned Minus Cred Spread
Using Identifiable Assets Approach:	93,700	**95,827**	5.63%	3.60%	2.03%
Using Proportionate scale up approach:	93,700	**104,873**	5.03%	3.60%	1.43%

Assumption 2: VM-22 Gross-of-Reinsurance Asset Modeling

- Real World Example (JK Wang)
  - Company has Fixed Annuity block including FIA and MYGA, with 70%-80% ceded on a coinsurance basis

  Under CARVM, company calculates both Net Reserve and Ceded Reserve
  - Company purchases assets to support Net Reserve (net portfolio)
  - Reinsurer receives Ceded Reserve from company and purchases assets to support Ceded Reserve

  Under VM-22
  - Company uses “net portfolio” in “Net-of-Reinsurance” run
  - For Gross-of-Reinsurance run, “scale-up” the “net portfolio”
  - “Identifiable Assets” Approach **not** used, due to Operational challenges:
    - Asset purchase/portfolio is not included in the normal information received from reinsurer
    - Information from reinsurer would not be delivered on time for regular Quarter-End valuation timeline (Quarter-in-Area basis)
  - Reinsurer receives “Ceded PBR Reserve” and purchases assets to support ceded liability

Starting Asset to use for Impact of Aggregation

Section 6: Requirements for the Standard Projection Amount

- VM-22 Section 6.A.1.a

Guidance Note: The following outlines one method that may be used to assess the impact of aggregation. If a company plans to use a different method, they should discuss that method with their domiciliary commissioner.

The benefit of aggregation is determined using the following steps, using the same scenario used for the cumulative decrement analysis, and using prescribed assumptions and discount rates:

1. Calculate the present value of each contract's accumulated deficiency up through the duration of the aggregate GPVAD. When determining the contract accumulated deficiency: (a) contract starting assets equal CSV; (b) contract level starting assets include both separate account and general account assets, and exclude any hedge assets; (c) discount rate for the PVAD is the NAER; and (d) for a contract that terminates prior to the duration of the GPVAD, there will no longer be liability cash flows, but assets (positive or negative) continue to accumulate.

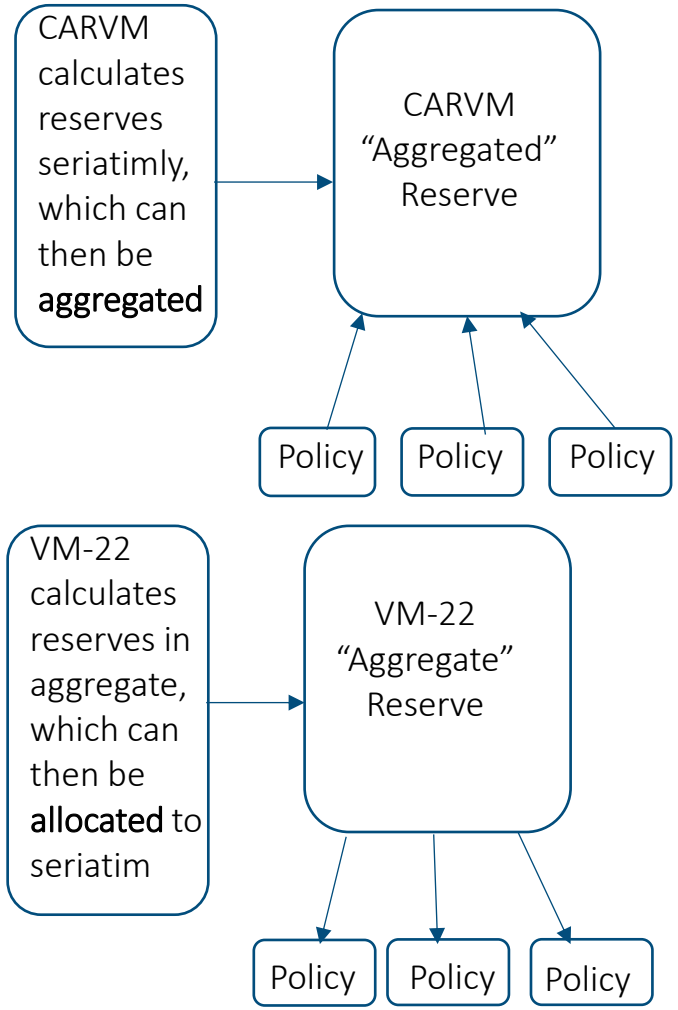
2. The impact of aggregation is the sum of the absolute value of the negative amounts from step 1 above.

Apply steps 1 and 2 above to each model point.

Starting Asset to use for Impact of Aggregation

- Real world example (JK Wang)
  - Same company in Assumption 1&2
  - Besides FIA product, company also has individual payout annuity and pension risk transfer (PRT) products, all calculated in different models and managed by different teams
  - With a standalone Accumulation Reserving Category, the reserve could be floored at the CSV.
    - To avoid this “flooring”, the Company considered creating a combined Accumulation and Payout Reserving Category.
  - The VM-22 Guidance Note for Impact of Aggregation says to set contract starting assets equal to CSV (VM-22 Section 6.A.1.a)
  - However, payout annuities often do not have a CSV
  - Company is unclear what to use as Starting asset for payout annuity, waiting for further clarification
    - Options discussed: CARVM reserve, Scenario APV, MAV, same starting asset as SR/DR run
    - Company decided not to create a combined Accumulation and Payout Reserving Category at the moment

VM-22 Section 13 Reserve Allocation & Seriatim APV



NAIC Valuation Manual, VM-22, Section 13.D.1

D. Allocated excess reserve (AER)

1. For each contract in a group of contracts, the AER is determined by allocating the excess, if any, of the group's aggregate reserve over the group's aggregate MAV to the contract in proportion to the excess of the Scenario APV over the MAV for such contract.

Sample Calculation of VM-22 Allocated Reserve for Accumulation Annuity

Policy-level reserve = Minimum Allocation Value (**MAV**) + Allocated Excess Reserve (**AER**), where:

- **MAV** = CSV (for accumulation annuity)
- **Aggregate MAV** = Sum of MAV over all policies
- **Scenario APV** = Scenario actuarial present value (APV) of the contract's liability cashflows, discounted at the NAER for the scenario with scenario reserve closest to but not greater than the aggregate reserve.
  - Note: This "closest" scenario may be different gross and net of reinsurance
- **Aggregate Scenario APV** = Sum of **Scenario APV** over all policies
- **Aggregate Reserve** = Stochastic Reserve + Deterministic Reserve

$$\mathbf{AER} = (\text{Aggregate Reserve} - \text{Aggregate MAV}) * \frac{(Scenario\ APV - MAV)}{Aggregate\ Scenario\ APV - Aggregate\ MAV}$$

Example that Allocates Gross & Net VM-22 Reserve

Consideration in reserve allocation

- Section 3.H states that the aggregate reserve shall be allocated to the contracts falling within the scope of these requirements. That allocation should be done for both the pre- and post-reinsurance ceded reserves. Source: Valuation Manual (2026 edition), Section 13
- Gross-of-Reinsurance Allocation example for Account Value Based Annuity Contracts:

		Gross CSV	**Gross APV – disc. at gross of Re NAER**	Minimum Allocation Value (MAV)	Excess of APV over MAV	Aggregate Reserve	Excess of Agreegate Reserve over Aggregate MAV	Allocated Excess reserve	Contract Level Gross Reserve
Contract	Reinsured?	(1)	**(2)**	(3) = (1)	(4) = Max[(2)-(3),0]	(5)	(6) = Max([5 total] - [3 total],0)	(7) = (4)*[6 total]/ [4 total]	(8) = (3)+(7)
1	N	95	91	95	-				95.00
2	N	92	98	92	6			6.3	98.28
3	Y - 50% Coins	90	104	90	14			14.7	104.65
4	Y - 50% Coins	88	111	88	23			24.1	112.07
Total		365	404	365	43	410	45	45	410

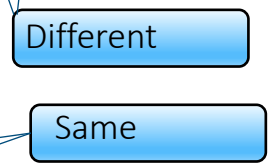
Example that Allocates Gross & Net VM-22 Reserve

Net-of-Reinsurance

		Net CSV	**Net APV – disc. At Net of Re NAER**	Minimum Allocation Value (MAV)	Excess of APV over MAV	Aggregate Reserve	Excess of Agreegate Reserve over Aggregate MAV	Allocated Excess reserve	Contract level reserve	Contract level Gross reserve * (1-ceded %)
Contract	Reinsured?	(1)	**(2)**	(3) = (1)	(4) = Max[(2)-(3),0]	(5)	(6) = Max([5 total] - [3 total],0)	(7) = (4)*[6 total]/ [4 total]	(8) = (3)+(7)	
1	N	95	87	95	-				95.00	95.00
2	N	92	94	92	2			3.1	95.07	98.28
3	Y - 50% Coinsurance	45	50	45	5			7.3	52.25	52.33
4	Y - 50% Coinsurance	44	53	44	9			13.7	57.68	56.03
Total		276	285	276	16	300	24	24	300	302

- Policy 2 has no reinsurance, but has different Net allocated Reserve vs Gross allocated Reserve due to different net vs. gross NAERs used to discount Scenario APV
- For contracts that have reinsurance, Net allocated Reserve is no longer equal to Gross allocated Reserve * (100% - Ceded %) (unlike under CARVM coinsurance)
- One possible approach: In Column 2, discount gross CFs at gross NAERs and ceded CFs at net NAERs:

Contract	Reinsured?	Net CSV	**Gross APV – disc. at Net of Re NAER * (1-ceded %)**	Aggregate Ceded Reserve	Contract Level Ceded Reserve	Contract Level Gross Reserve	Contract Level Net Reserve	Contract level Gross reserve * (1-ceded %)
		(1)	**(2)**	(3)	(4) = (3 total)*(2)/ [2 total]	(5) From Gross Run	(6) = (5) - (4)	
1	N					95.00	95.00	95.00
2	N					98.28	98.28	98.28
3	Y - 50% Coinsurance	46	51		53.2	104.65	51.44	52.33
4	Y - 50% Coinsurance	23	54		56.8	112.07	55.28	56.03
Total		69	105	110	110		300	302



Questions?

Questions about this presentation can be emailed to:

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