ECONOMIC SCENARIO GENERATOR WORK GROUP UPDATE ON MODEL OFFICE TESTING

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VM-21 ESG Model Office Testing

Variable Annuities with Guaranteed Lifetime Withdrawal Benefit (GLWB) and Guaranteed Minimum Death Benefit (GMDB)

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American Academy of Actuaries

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Agenda

1. Product Specifications
2. Reserve Method
3. Liability Assumptions
4. Asset Assumptions
5. Caveats

Product Specifications

- Variable Annuity with a GLWB and GMDB (details on next slide)
- Seven-year surrender charge period
- Single model point issued to a male age 60 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 rebalancing to maintain 80/20 mix.

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 PH fund value, or 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%	charges are calculated on the roll-up benefit base, deducted monthly from fund value
GLWB withdrawal rate %			
Attained Age 59-64	4.00%		WD percentages applied to max(fund value, benefit base) based on att age at time of
Attained Age 65-69	5.00%		income election, which defines the lifetime max annual income amount.
Attained Age 70-74	5.50%		5-year waiting period from issue required prior to income election.
Attained Age 75-79	5.75%		
Attained Age 80+	6.00%		

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. Any excess WD's taken above the lifetime WD amount cause a prorata reduction in the Benefit Base and effect the income amount.

Product Specifications

Examples of potential GLWB lifetime income benefits at different income election ages and return scenarios									
year	EoY attained age	EoY Guaranteed Benefit Base	annual BB return	cum annlzd geom mean BB return	annual GLWB income %	annual GLWB $	approx life exp. years	approx life exp. att age	total income over life exp
0	60	100,000			(as of election attained				
1	61	105,000	5.00%	5.00%	age; then stays level				
2	62	110,250	5.00%	5.00%	for life)				
3	63	115,763	5.00%	5.00%					
4	64	121,551	5.00%	5.00%					
5	65	127,628	5.00%	5.00%	5.00%	6,381	23.4	88.4	149,417
6	66	134,010	5.00%	5.00%	5.00%	6,700	22.5	88.5	150,615
7	67	140,710	5.00%	5.00%	5.00%	7,036	21.5	88.5	151,600
8	68	147,746	5.00%	5.00%	5.00%	7,387	20.6	88.6	152,357
9	69	155,133	5.00%	5.00%	5.00%	7,757	19.7	88.7	152,872
10	70	162,889	5.00%	5.00%	5.50%	8,959	18.8	88.8	168,446
11	71	162,889	0.00%	4.54%	5.50%	8,959	17.9	88.9	160,420
12	72	162,889	0.00%	4.15%	5.50%	8,959	17.0	89.0	152,503
13	73	162,889	0.00%	3.82%	5.50%	8,959	16.2	89.2	144,711
14	74	162,889	0.00%	3.55%	5.50%	8,959	15.3	89.3	137,061
15	75	162,889	0.00%	3.31%	5.75%	9,366	14.5	89.5	135,455
16	76	162,889	0.00%	3.10%	5.75%	9,366	13.6	89.6	127,796
17	77	162,889	0.00%	2.91%	5.75%	9,366	12.8	89.8	120,324
18	78	162,889	0.00%	2.75%	5.75%	9,366	12.1	90.1	113,052
19	79	162,889	0.00%	2.60%	5.75%	9,366	11.3	90.3	105,991
20	80	162,889	0.00%	2.47%	6.00%	9,773	10.6	90.6	103,461

Reserve Method

- Reserve and C3P2 Risk-Based Capital (RBC) and Total Asset Requirement (TAR) calculated per VM-21:
- Reserve = Stochastic Reserve + Additional Standard Projection Amount (ASPA), where
  - Stochastic Reserve = Conditional Tail Expectation (CTE)70 of 10,000 Scenario Reserves
  - Scenario Reserve 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 liability cash flows are paid off to the end of the projection for the scenario
  - Discount rate = net earned rates on additional assets backing GPVAD
  - ASPA = add-on 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:
  - C3 amount = max(0, 25% * ((CTE98 + ASPA - Statutory Reserve) x (1-Federal Income Tax (FIT) rate) - (Statutory Reserve - Tax Reserve) x FIT rate))

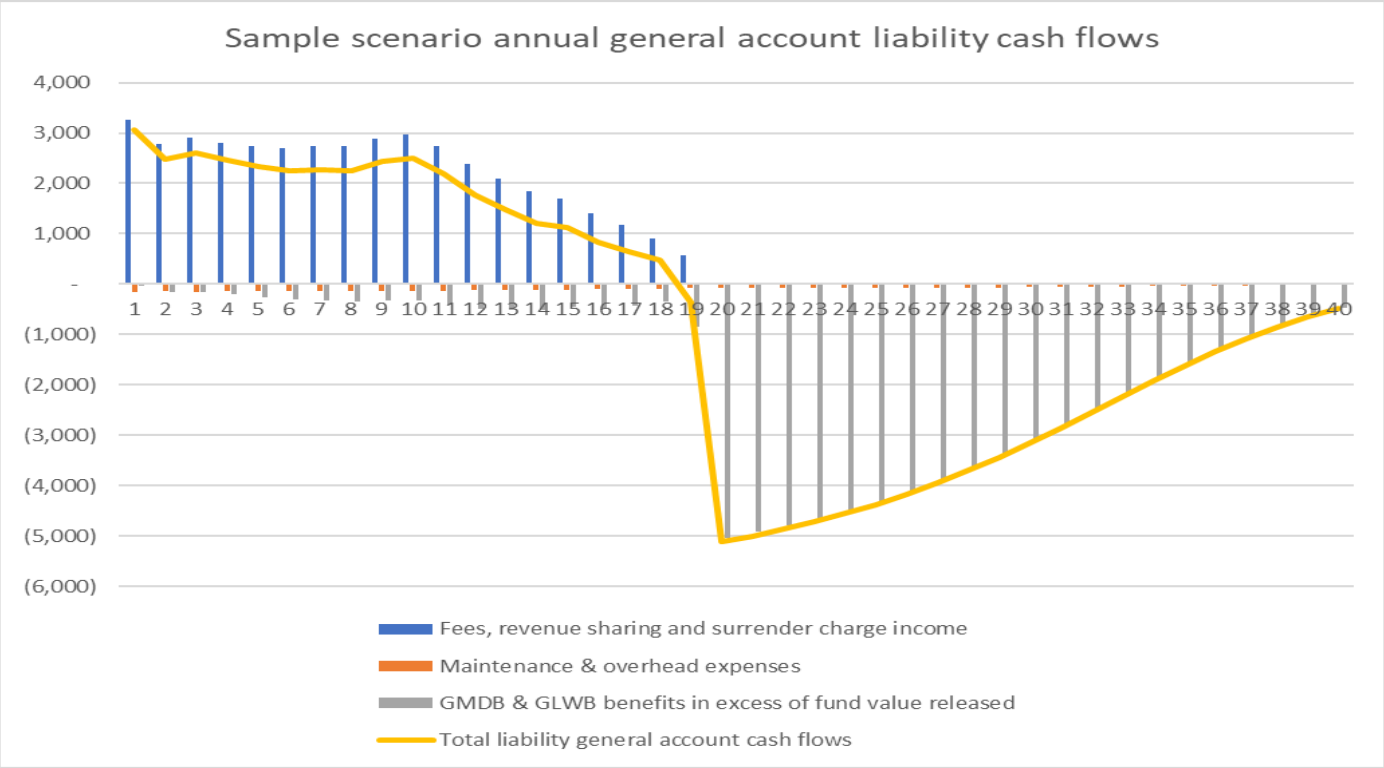
Liability Assumptions

- Used ASPA prescribed assumptions for lapse, mortality and expense (broadly reflects average industry experience)
  - Lapse rates decrease as guaranteed benefit is in the money
    - (In-the-money (ITM)(t) for GLWB defined as PV future income benefits(t) > current fund value(t))
  - Mortality 2012 IAM, improvement scale G2, VM-21 ASPA Fx factors
  - Expense
    - $100 per policy + 7bp on fund value annual maintenance & overhead
  - Exception to ASPA assumptions used for GLWB income election:
    - Simplified from ASPA WD delay cohort method (many multiple election dates) to one or two dates (e.g., 100% elect at year 10, or a mix of election year 5, 10, 15 cohorts)

Asset Assumptions

- Starting asset amount = CSV, all in the separate account funds
  - General account investments occur gradually over first ~10-20 years (depending on scenarios) as fee revenues (net of expenses and any excess GMDB payments) are collected, to fund future guaranteed benefits
- General account investment/reinvestment strategy
  - Invest 50%/50% in AA/A non-callable corporate bonds
    - Use prescribed tables (from VM-20) for defaults/spreads
    - 9 basis points (bp) annual investment expense
  - Maturity mix 30/20/10/7/5/1-year bonds; starts longer and shortens over time to maintain reasonable match to liability cash flows (next slide shows sample liability cash flow profile)
  - If there is a shortfall, borrow at same strategy as reinvestment ("negative assets approach"); initial "CARVM allowance" borrowing at 7-year bond rate
- Initially no hedging or reinsurance modeled. Considering adding this but time may not permit.

Sample scenario liability cash flow profile



Developed by the Academy Economic Scenario Generator Work Group

Caveats

- Intended as illustrative limited data points for assessing materiality and relative impact to reserve and C3 RBC levels from a change to the scenarios
- Not intended to:
  - Cover wide variety of annuity products available on the market
  - Reflect a full distribution of issue ages / genders within the given product
  - Thoroughly test all the underlying assumptions

VM-20 Model Office

Jason Kehrberg, MAAA, FSA

Agenda

1. Reserve Methodology
2. Product Specifications
3. Liability Assumptions
4. Asset Assumptions
5. Caveats

Reserve Methodology

- VM-20 reserve = Max (SR, DR, NPR), where
  - SR = Stochastic Reserve
  - DR = Deterministic Reserve
  - NPR = Net Premium Reserve

- DR: Model office uses method "B," which solves for minimum starting assets to ensure all liability cashflows are paid off to the end of projection
  - DR is omitted from the model office if a deterministic scenario (i.e., Stochastic Exclusion Test scenario #12) is not provided

- SR: CTE70 of Scenario Reserves (Starting assets + GPVAD)
  - 1,000 scenarios picked out of 10,000 with Academy methodology
  - Use starting assets solved from the DR run (if DR > SR), or solve for starting assets within 2% of the SR (if SR > DR)

Product Specifications

- Universal Life product with a Secondary Guarantee (ULSG)
- Crediting rate is based on General Account (GA) portfolio rates (see asset slide for GA reinvestment strategy)
- Guaranteed minimum crediting rate = 3.25%
- Guaranteed to not lapse until age 110 if minimum premiums are paid (even if policyholder fund value is exhausted)
- Cost of insurance risk charges based on 2015 Valuation Basic Table (VBT) Relative Risk (RR) 100 mortality table
- 2% premium tax
- $64 annual expense charges (with 2% inflation)
- Acquisition fees = $214 + $1.20 per 1,000 of face amount
- 20-year surrender charge period
- Single model point issued at valuation date to a female non-smoker age 45 with $1 million face amount

Product Illustration

Policy Period	Age at Yr End	Regular Premium	Premium Tax	Risk Charge	Expense Charge	Interest Credited (3.25%)	Fund Period End	CSV Period End
Y1	46	$8,507	$170	$208	$1,478	$241	$6,892	-$18,856
Y2	47	$8,507	$170	$266	$64	$489	$15,388	-$7,266
Y3	48	$8,507	$170	$410	$65	$763	$24,013	$4,652
Y4	49	$8,507	$170	$629	$67	$1,039	$32,694	$16,426
Y5	50	$8,507	$170	$709	$68	$1,320	$41,573	$28,200
Y10	55	$8,507	$170	$1,222	$75	$2,823	$89,089	$80,706
Y15	60	$8,507	$170	$2,108	$83	$4,461	$140,703	$135,713
Y20	65	$8,507	$170	$3,458	$91	$6,198	$195,283	$194,385
Y25	70	$8,507	$170	$5,251	$101	$7,951	$250,137	$250,137
Y30	75	$8,507	$170	$8,549	$111	$9,598	$300,943	$300,943
Y35	80	$8,507	$170	$15,495	$123	$10,686	$332,270	$332,270
Y40	85	$8,507	$170	$30,659	$136	$10,110	$306,906	$306,906
Y45	90	$8,507	$170	$75,039	$150	$4,774	$116,499	$116,499
Y47	92	$8,507	$170	$111,723	$156	$223	-$68,145	-$68,145
Y50	95	$8,507	$170	$155,800	$166	$0	-$466,791	-$466,791
Y55	100	$8,507	$170	$262,440	$183	$0	-$1,502,075	-$1,502,075
Y60	105	$8,507	$170	$384,500	$202	$0	-$3,147,149	-$3,147,149
Y65	110	$8,507	$170	$476,860	$223	$0	-$5,326,136	-$5,326,136

Liability Assumptions

- Mortality
  - 2015 VBT RR 100 Gender / Smoker distinct Age Last Birthday
  - VM-20 2019 mortality improvement to valuation date
  - Prescribed industry mortality provisions for adverse deviations (PAD)
- Lapse
  - Canadian Institute of Actuaries (CIA) Term to 100 Gender distinct / Smoker distinct
- Expense
  - Consistent with 2020 Generally Recognized Expense Table (GRET) factors with 2% inflation and 5% expense margin

Asset Assumptions

- Starting asset portfolio
  - 50%/50% in AA/A 20-year corporate bonds
  - Amount scaled to the calculated VM-20 reserve at valuation date

- General account reinvestment strategy
  - Invest positive cashflows 50%/50% in AA/A 20-year corporate bonds
    - Use 2020 prescribed VM-20 tables for defaults/spreads
  - If there is a shortfall:
    - Sell from existing assets until exhausted
    - Otherwise, borrow at 3-month Treasury + 1%

20 Year Corporate Bond Spreads	AA	A	50/50 Mix
Current (Table F)	0.89%	1.10%	**0.99%**
Long Term (Table H)	1.30%	1.53%	**1.42%**

Caveats

- Intended as an illustrative single data point 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

Questions?

- Please contact lifeanalyst@actuary.org.