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PBA Corner

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NET PREMIUM RESERVE FOR TERM INSURANCE

VM-20 Section 3 specifies the requirements for the “floor” reserve within the context of a principle-based valuation. Section 3.B.4 specifically defines this reserve for term insurance. These requirements include some familiar and some not-so-familiar concepts. I present a detailed walk-through of the net premium reserve (NPR) for a sample 20-year level premium term insurance policy with insurance coverage to age 95, followed by a discussion of how the NPR for an issue year cohort of policies may compare to current CRVM reserves as projected from the valuation date.

The single policy case study is a male preferred risk, issued at age 40. The guaranteed gross premium per unit for this case study, during the level premium period, is \$1.66. Premiums following the 20-year level premium period increase significantly and follow an annually increasing premium schedule. There are no nonforfeiture values for this policy. The premise of the following paragraphs is that VM-20 is operative for this term policy and the policy is issued during 2013.

Step 1: Determine valuation assumptions

Assumptions of mortality, lapse and interest are specified in Section 3.C. For purposes of this demonstration I use the 2001 CSO ALB Male Nonsmoker Ultimate mortality rates. These rates are allowed, among other 2001 CSO table versions, as appropriate for use with NPR valuation. It should be noted that this policy could potentially be valued using a different table after issue. The guidance note in 3.C.1 suggests that should adoption of a new valuation mortality table occur, this new table would apply to previously valued policies. The note leaves the details of implementing mortality unlocking to be addressed by future Valuation Manual versions.

The valuation lapse rate schedule is provided by Section 3.C.3 and depends upon the length of the level premium period and the step up in rates following the level premium period. For the sample policy, the valuation lapse assumption is 6 percent during the initial level premium period; 80 percent shock lapse at the end of the level premium period and 10 percent thereafter. In this case, the step up in premiums following the level premium period exceeds 400 percent.

The valuation interest rate for this policy follows the familiar SVL formula, adjusted upward by 150 basis points, not to exceed 125 percent of the starting rate. For this demonstration, I assume a 2013 issue, which means the valuation interest rate would be limited to:

Table 1: Net Premium Reserve Assumptions

| Assumption | Basis |
|-------------------------|--|
| Mortality | 2001 CSO Male Nonsmoker ALB Ultimate |
| Lapse | 6% during 20-year level premium period, with 80% shock lapse at end of level premium period; 10% thereafter. |
| Interest | 4.5% |
| Benefit, Premium Timing | Semi-Continuous |

VM-20 Reference: 3.C.

Table 2: Gross Premium and Adjusted Gross Premium, per unit of insurance

| Policy Year | Gross Premium | Adjusted Gross Premium |
|-------------|------------------|------------------------|
| 1 | \$1.66 | \$0 |
| 2-5 | \$1.66 | \$1.494 (=90% X GP) |
| 6-20 | \$1.66 | \$1.66 |
| 21+ | Guar GP per unit | Guar GP per unit |

VM-20 Reference: Adjusted Premiums defined in 3.B.4.b.

$\text{Min}(0.035+0.015; 1.25*0.035) = 0.04375$ or 0.045 after rounding to the nearest quarter of 1 percent.

Step 2: Calculate adjusted gross premiums

Rather than the actual guaranteed gross premium, it is a vector of adjusted gross premiums on which the valuation net premiums are based. For the sample policy, the adjusted gross premiums are specified as shown in Table 2. The adjustments made to the gross premium can be thought of as an expense allowance component.

Step 3a: Calculate valuation net premiums

Similar to current CRVM techniques, the valuation net premiums are expressed as a uniform percentage of the respective adjusted gross premiums. The uniform percentage is determined at issue and provides for the equivalence, at issue, of the present value of valuation net premiums and the present value of future benefits plus an amount equal to \$2.50 per \$1,000 of insurance for the first policy year only (also an expense allowance component). For the sake of brevity, Table 3a shows

only the first 10 policy years' detail for the initial uniform percentage calculation.

The term "initial" uniform percentage is my own, and I use it since, for policies subject to the shock lapse assumption, VM-20 requires a limiting relationship between the present value of benefits (PVB) and present value of valuation net premiums (PVP) for periods following the shock lapse. In order to determine this ratio, an initial determination of the valuation net premiums is established. In this case, that initial determination is 148.5 percent of the adjusted gross premiums.

Step 3b: Revise valuation net premiums

Evaluating the [PVP/PVB] ratio for periods following the shock lapse (years 21 through maturity) produces a ratio in excess of the stipulated 135 percent. For the sample policy, this ratio is 427.3 percent. Were this ratio less than or equal to 135 percent, the valuation net premiums determined in Step 3a above would suffice.

Table 3a: Determining Initial Uniform Percentage

| Policy Year | Adj GP | PVAdjGP _t | PVB _t | Expense Amount | Initial Uniform Percentage | Initial NP (1.485xAdj GP) |
|-------------|--------|----------------------|------------------|----------------|----------------------------|---------------------------|
| 1 | \$0.00 | 20.191 | 27.480 | \$2.50 | 148.5% | \$0.00 |
| 2 | 1.494 | 20.191 | 25.993 | | | 2.22 |
| 3 | 1.494 | 18.849 | 24.539 | | | 2.22 |
| 4 | 1.494 | 17.644 | 23.107 | | | 2.22 |
| 5 | 1.494 | 16.562 | 21.690 | | | 2.22 |
| 6 | 1.66 | 15.590 | 20.281 | | | 2.47 |
| 7 | 1.66 | 14.622 | 18.888 | | | 2.47 |
| 8 | 1.66 | 13.753 | 17.521 | | | 2.47 |
| 9 | 1.66 | 12.973 | 16.206 | | | 2.47 |
| 10 | 1.66 | 12.273 | 14.966 | | | 2.47 |

VM-20 Reference: Uniform Percentage defined in 3.B.4.a.

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Table 3b(i): Revising the Uniform Percentage to Comply with 3.B.4.a.

| Policy Year | Adj GP | Initial NP (148.5%) | PVP ^{Initial} | PVB | Renewal Period Ratio | Revised NP (46.9% x Adj GP) | PVP ^{Rev'd} | Revised Renewal Period Ratio |
|-------------|---------|---------------------|------------------------|-------|----------------------|-----------------------------|----------------------|------------------------------|
| 21 | \$26.98 | \$40.07 | 11.952 | 2.797 | 427.3% | \$12.66 | 3.775 | 135.0% |
| 22 | 29.74 | 44.16 | | | | 13.95 | | |
| 23 | 32.92 | 48.89 | | | | 15.44 | | |
| 24 | 36.52 | 54.23 | | | | 17.13 | | |
| 25 | 40.52 | 60.17 | | | | 19.01 | | |
| 26 | 44.90 | 66.68 | | | | 21.06 | | |
| 27 | 49.64 | 73.72 | | | | 23.29 | | |
| 28 | 54.72 | 81.26 | | | | 25.67 | | |
| 29 | 60.24 | 89.46 | | | | 28.26 | | |
| 30 | 66.36 | 98.54 | | | | 31.13 | | |

VM-20 Reference: Uniform Percentage defined in 3.B.4.a.

In the sample policy, however, there must be two uniform percentages: one for the level premium period and one for the period following the shock lapse. Described below are steps used to derive the ‘bifurcated’ uniform percentages. Again, table data shown is truncated for the sake of brevity.

- i. Uniformly reduce the valuation net premiums for periods following the level premium period such that PVP/PVB is 135 percent. Table 3b(i) shows periods beginning with policy year 21. The uniform percentage of adjusted gross premiums that satisfies the 135 percent limitation is 46.9 percent $((1.35/4.273)*1.485)$.
- ii. Because the valuation net premiums for periods following the shock lapse were reduced, the valuation net premium for the initial level period must now be increased such that, for all years from issue, the PVP at issue is equivalent to the PVB plus \$2.50 per \$1,000 of insurance. Using the appropriate algebraic equivalencies, one can solve for the revised initial period valuation net premium.

Where: $A = (X \cdot L) + U$

A = present value of valuation net premiums policy years from issue where the net premium used is based on the initial uniform percent, as in Table 3a.

X = variable to solve

L = present value of valuation net premiums over the initial level premium period (years 1-20 in this

example) where the net premium used is based on the initial uniform percent, as in Table 3a

U = present value of valuation net premiums over the period following the shock lapse and where the net premium used is based on the bifurcated uniform percent for that period, as in Table 3b(i).

For the sample policy, solving for X results in 1.453, which implies a revised uniform percent (the companion to the 46.9 percent above) of 215.8 percent (= 1.453*the original uniform percent in Step 3a or (1.453*148.5 percent)).

Step 4: Calculate terminal NPRs

As per Section 3.B.4, the NPR is simply the actuarial present value of future benefits less the actuarial present value of future valuation net premiums determined in the steps above. Table 4 lists the terminal NPR for the level premium period. Also presented is a representative CRVM reserve on the same valuation basis and assuming use of supportable X-factors to eliminate deficient premium reserves. The NPR method does not consider any premium deficiency characteristics of the policy since the deterministic reserve component is designed to cover this. Note that 2013 issues under the CRVM method use 3.5 percent valuation interest whereas VM-20 allows 4.5 percent. The CRVM method also does not allow lapse rates whereas VM-20 does.

Chart 4 on page 24 shows the pattern of the terminal NPR (blue), and the pattern of the current CRVM segmented terminal reserve (dashed).

Table 3b(ii): Revising the Uniform Percentage to Comply with 3.B.4.a.

| Policy Year | Adj GP | PVAdjGP _t | PVB _t | Expense Amount | Revised Uniform Percentage | Revised NP |
|-------------|--------|----------------------|------------------|----------------|----------------------------|------------|
| 1 | \$0.00 | 20.191 | 27.480 | \$2.50 | 215.8% | \$0.00 |
| 2 | 1.494 | 20.191 | 25.993 | | | 3.22 |
| 3 | 1.494 | 18.849 | 24.539 | | | 3.22 |
| 4 | 1.494 | 17.644 | 23.107 | | | 3.22 |
| 5 | 1.494 | 16.562 | 21.690 | | | 3.22 |
| 6 | 1.66 | 15.590 | 20.281 | | | 3.58 |
| 7 | 1.66 | 14.622 | 18.888 | | | 3.58 |
| 8 | 1.66 | 13.753 | 17.521 | | | 3.58 |
| 9 | 1.66 | 12.973 | 16.206 | | | 3.58 |
| 10 | 1.66 | 12.273 | 14.966 | | | 3.58 |

VM-20 Reference: Uniform Percentage defined in 3.B.4.a.

Chart 5 on page 24 shows a similar comparison, but for an issue year cohort where the valuation date is two years after issue. This model office represents a variety of issue dates within the issue year and Chart 5 includes consideration of the effect of the cash value floor for both methods. In this case, the policy nonforfeiture values are \$0, so the cash value floor is equal to the remaining cost of insurance for the period, in this case, simply one-half of the valuation cost of insurance.

Step 5: Deterministic Exclusion Test

Complicating things a bit are the differences to the NPR calculation required by Section 6.B. of VM-20. In evaluating the block of policies under the Deterministic Exclusion Test, there are two modifications to the steps above:

1. In determining the valuation lapse rates, Section 6.B.5.b. requires lapses set to 0 percent for this contract since it is subject to the NPR of Section 3.A.1; and
2. Because the sample case is subjected to shock lapse rates, the comparison of guaranteed gross premiums to valuation net premiums is performed only during the initial premium period (first 20 years in this case).

The Deterministic Exclusion Test is intended to be performed over a group of policies considering periods from the valuation date forward. For demonstration, Table 5 on page 24 provides the comparison of the NPR valuation net premium calculated considering the two modifications for the Deterministic Exclusion Test

Table 4: Terminal Reserves

| Policy Year | PVB _t | PVP _t | NPR (PVB _t - PVP _t) | CRVM _t |
|-------------|------------------|------------------|---|-------------------|
| 0 | \$27.48 | \$29.98 | -2.50 | 0 |
| 1 | 28.94 | 33.38 | -4.44 | 0 |
| 2 | 30.42 | 33.58 | -3.16 | 2.13 |
| 3 | 31.91 | 33.81 | -1.90 | 4.17 |
| 4 | 33.36 | 34.07 | -0.70 | 6.11 |
| 5 | 34.76 | 34.36 | 0.39 | 7.90 |
| 6 | 36.07 | 34.30 | 1.77 | 9.52 |
| 7 | 37.30 | 34.24 | 3.06 | 10.98 |
| 8 | 38.46 | 34.18 | 4.28 | 12.30 |
| 9 | 39.61 | 34.12 | 5.49 | 13.52 |
| 10 | 40.68 | 34.06 | 6.62 | 14.59 |
| 11 | 41.61 | 34.00 | 7.61 | 15.44 |
| 12 | 42.31 | 33.94 | 8.37 | 16.01 |
| 13 | 42.69 | 33.89 | 8.80 | 16.22 |
| 14 | 42.63 | 33.85 | 8.79 | 15.98 |
| 15 | 41.98 | 33.82 | 8.16 | 15.15 |
| 16 | 40.57 | 33.81 | 6.76 | 13.65 |
| 17 | 38.30 | 33.82 | 4.47 | 11.41 |
| 18 | 35.08 | 33.86 | 1.22 | 8.44 |
| 19 | 30.80 | 33.92 | -3.13 | 4.68 |
| 20 | 118.44 | 159.89 | -41.45 | 0 |

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Chart 4

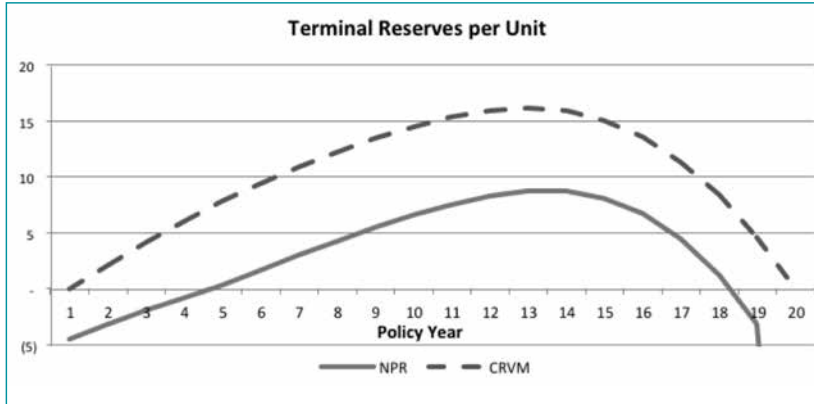


Chart 5

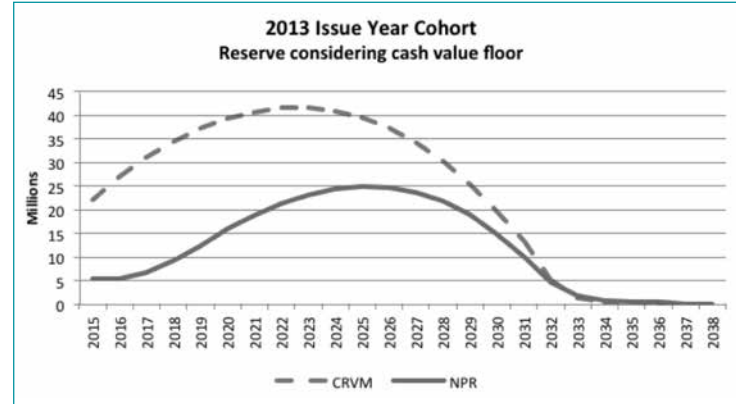


Table 5: Deterministic Exclusion Test

| Policy Year | Guaranteed Gross Premium | Valuation Net Premium | |
|----------------------|--------------------------|------------------------------|-------------------|
| | | Deterministic Exclusion Test | NPR determination |
| 1 | \$1.66 | \$0.00 | \$0.00 |
| 2-5 | 1.66 | 3.61 | 3.22 |
| 6-20 | 1.66 | 4.01 | 3.58 |
| At issue sum: | \$33.20 | \$74.59 | \$66.58 |

to the guaranteed gross premiums for the sample policy. For this policy, and under the assumptions used, there is approximately a 12 percent increase in the valuation net premium per unit when deriving the net premium used for comparison to the guaranteed gross premiums under the Deterministic Exclusion Test. When summed from issue over the level premium period, the comparison amounts are: \$33.20 of guaranteed gross premium and \$74.59 of valuation net premium under the Deterministic Exclusion Test. However, in practice, the test is intended to be performed over a group of policies, so the actual test result depends on the comparison in aggregate. Should the group of policies fail, the Deterministic Reserve is a required component of the minimum reserve for the group.

OTHER CONSIDERATIONS

Although the NPRs and the Deterministic Exclusion Test can be performed today on currently issued policy groups, there are two considerations to keep in mind.

1. It is anticipated the 2014 Commissioners Standard Ordinary valuation mortality table will be required for use at about the same time as the Valuation Manual operative date, and
2. Valuation interest rates for use in calculating NPR may be different.

Even so, preliminary calculations can be performed as indicators of whether certain policy groups may pass or fail this exclusion test. ■