

EXAM MLC QUESTIONS OF THE WEEK

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Week of February 25/08

A special fully discrete whole life insurance with face amount \$100,000 is issued to (40).

The annual benefit premium for the first 10 years is $100,000P_{40:\overline{10}|} = 359.40$

and for the next 10 years the annual benefit premium is $100,000P_{50:\overline{10}|} = 798.76$.

After that (from age 60) the annual benefit premium is π for life. Mortality follows the Illustrative Table from the Exam MLC Tables at the SOA website, with annual effective rate of interest of 6%.

Find ${}_{40}V$, the 40-th year terminal benefit reserve for this policy.

The solution can be found below.

Week of February 25/08 - Solution

The premium for the first 10 years satisfies the relationship

$$100,000P_{\overline{40:\overline{10}|}} \cdot \ddot{a}_{\overline{40:\overline{10}|}} = 100,000A_{\overline{40:\overline{10}|}},$$

and the premium for the second 10 years satisfies the relationship

$$100,000P_{\overline{50:\overline{10}|}} \cdot \ddot{a}_{\overline{50:\overline{10}|}} = 100,000A_{\overline{50:\overline{10}|}}.$$

Therefore, for the first 20 years, the APV of premium is equal to the APV of benefit,

$$\begin{aligned} & 100,000[P_{\overline{40:\overline{10}|}} \cdot \ddot{a}_{\overline{40:\overline{10}|}} + v^{10} {}_{10}p_{40} \cdot P_{\overline{50:\overline{10}|}} \cdot \ddot{a}_{\overline{50:\overline{10}|}}] \\ &= 100,000[A_{\overline{40:\overline{10}|}} + v^{10} {}_{10}p_{40} \cdot A_{\overline{50:\overline{10}|}}] = 100,000A_{\overline{40:\overline{20}|}}. \end{aligned}$$

It then follows that the 20-th year terminal benefit reserve is 0, ${}_{20}V = 0$.

This can be seen retrospectively:

$$\begin{aligned} {}_{20}V &= \text{actuarial accumulated premium for first 20 years} \\ &\quad - \text{actuarial accumulation of benefit for first 20 years} \\ &= \frac{1}{v^{20} {}_{20}p_{40}} \times [\text{APV of premium for first 20 years} - \text{APV of benefit for first 20 years}] \\ &= \frac{1}{v^{20} {}_{20}p_{40}} \times 0 = 0. \end{aligned}$$

It then follows that $\pi \cdot \ddot{a}_{60} = 100,000A_{60}$, so that π is the level annual benefit premium for a 100,000 insurance issued to (60). The 40-th year terminal reserve would be the reserve 20 years after age 60, which is the same as the 20-th year reserve on the 100,000 whole life policy issued at age 60, ${}_{40}V = 100,000 \cdot {}_{20}V_{60}$.

From the Illustrative Table, we get ${}_{20}V_{60} = 1 - \frac{\ddot{a}_{80}}{\ddot{a}_{60}}$, so ${}_{40}V = 47,018.50$.