1. Richard (25) buys a whole life insurance policy with a death benefit of 10,000 paid at the end of the year of death. Richard’s policy requires annual net benefit premiums to be paid for 20 years.

You are given that:

a. Mortality follows the Illustrative Life Table.

b. \( i = 6\% \)

c. \( V \) is the net benefit reserve at time \( t \).

Calculate \( _{15}V \).

Solution:

\[
PVP = PVB
\]

\[
P\bar{a}_{25:20} = 10,000A_{25} \implies P = \frac{10,000A_{25}}{\bar{a}_{25} - \bar{e}_{25} \cdot \bar{a}_{25}} = \frac{(10,000)(0.08165)}{16.2242 - (0.29873)(14.1121)} = 67.99411
\]

\[
_{15}V = 10,000A_{40} - P\bar{a}_{40:3} = (10,000)(0.16132) - (67.99411)[14.8166 - (0.73529)(14.1121)] = 1311.30
\]

\[
_{16}V = 10,000A_{41} - P\bar{a}_{41:4} =
\]

\[
(10,000)(0.16869) - (67.99411)[14.6864 - (1.06^{-4})(\frac{9.164.051}{9.287.264})](14.1121)] = 1438.27
\]

\[
_{156}V = (0.4)(_{15}V + P) + (0.6)(_{16}V) = (0.4)(1311.30 + 67.99411) + (0.6)(1438.27) = 1414.68
\]
2. A whole life policy is issued to (73) with a death benefit of 100,000 payable at the end of the year of death.

Annual gross premiums are payable for the lifetime of the insured and are determined using the equivalence principle.

You are given that:

a. Mortality follows the Illustrative Life Table.

b. \( i = 6\% \)

c. Expenses are:

i. 200 per policy in year 1 and 50 per policy in year 2 and later.

ii. 50% of premium in the first year and 8% of premium in year 2 and later.

Calculate the expense reserve at the end of the 12th year.

Solution:

\[
P^e = \frac{100,000A_{73}}{\ddot{a}_{73}} = \frac{(100,000)(0.56093)}{7.7568} = 7231.46
\]

\[
P^e\ddot{a}_{73} = 100,000A_{73} + 150 + 50\ddot{a}_{73} + 0.42P + 0.08P\ddot{a}_{73}
\]

\[
P^e = \frac{100,000A_{73} + 150 + 50\ddot{a}_{73}}{0.92\ddot{a}_{73} - 0.42} = \frac{(100,000)(0.56093) + 150 + (50)(7.7568)}{(0.92)(7.7568) - 0.42} = 8431.91
\]

\[
i_2V^n = 100,000A_{85} - P\ddot{a}_{85} = (100,000)(0.73407) - (7231.46)(4.6980) = 39,433.59
\]

\[
i_2V^e = 100,000A_{85} + 50\ddot{a}_{85} + 0.08P\ddot{a}_{85} - P\ddot{a}_{85} =
\]

\[
(100,000)(0.73407) + [50 - 0.92(8431.91)](4.6980) = 37,197.85
\]

\[
V^e = V^n + V^e = 37,197.85 - 39,433.59 = -2235.74
\]

OR

\[
P^e = P^e - P^n = 8431.91 - 7231.46 = 1200.45
\]

\[
V^e = PVFB + PVFE - PVFF^e = 50\ddot{a}_{85} + (0.08)P^e\ddot{a}_{85} - P^e\ddot{a}_{85} =
\]

\[
[50 + (0.08)(8431.91) - 1200.45](4.6980) = -2235.74
\]
1. Richard (25) buys a whole life insurance policy with a death benefit of 10,000 paid at the end of the year of death. Richard’s policy requires annual net benefit premiums to be paid during his lifetime.

You are given that:

a. Mortality follows the Illustrative Life Table.

b. $i = 6\%$

c. $V^{\text{FPT}}$ is the net benefit reserve at time $t$ calculated under the Full Preliminary Term method.

Calculate $V^{\text{FPT}}_{15}$.

Solution:

$$V^{\text{FPT}}_{15} = PVFB - PVFP^{\text{FPT}}_{15}$$

$$P^{\text{FPT}}_{x+1} = \frac{10,000 \cdot A_{x+1}}{\ddot{a}_{x+1}} = \frac{(10,000)(0.08543)}{16.1574} = 52.8376$$

$$V^{\text{FPT}}_{15} = 10,000 \cdot A_{0} - 52.8376 \ddot{a}_{0} - (10,000)(0.16132) - (52.8376)(14.8166) = 829.79$$
2. A whole life policy is issued to (68) with a death benefit of 100,000 payable at the end of the year of death.

Annual gross premiums are payable for the lifetime of the insured and are determined using the equivalence principle.

You are given that:

a. Mortality follows the Illustrative Life Table.

b. \( i = 6\% \)

c. Expenses are:
   i. 200 per policy in year 1 and 50 per policy in year 2 and later.
   ii. 50% of premium in the first year and 8% of premium in year 2 and later.

Calculate the Asset Share at the end of the 2\(^{nd}\) year for this policy.

Solution:

First we need the gross premium:

\[
PVP = PVB + PVE
\]

\[
P \cdot \bar{a}_{68} = 100,000 \cdot A_{68} + 150 + 50\bar{a}_{68} + 0.42P + 0.08P \bar{a}_{68}
\]

\[
P = \frac{100,000 \cdot A_{68} + 150 + 50\bar{a}_{68}}{0.92\bar{a}_{68} - 0.42} = \frac{(100,000)(0.48453) + 150 + (50)(9.1066)}{(0.92)(9.1066) - 0.42} = 6164.60
\]

Now we find asset shares:

\[
AS_0 = 0
\]

\[
AS_1 = \frac{[AS_0 + P(1-e_i) - X_1^{BOY}](1+i) - S_i \cdot q_x}{1-q_x} = \frac{[0 + (6164.60)(0.50) - 200](1.06) - (100,000)(0.02779)}{1 - 0.02779} = 284.134
\]

\[
AS_2 = \frac{[AS_1 + P(1-e_i) - X_2^{BOY}](1+i) - S_{i+1} \cdot q_{x+1}}{1-q_{x+1}} = \frac{[284.134 + (6164.60)(0.92) - 50](1.06) - (100,000)(0.03037)}{1 - 0.03037} = 3323.45
\]