1. A fully discrete 20 year term insurance policy to (70) has a death benefit of 50,000. The net premium is calculated using the equivalence principle.

You are given that mortality follows the Illustrative Life Table with interest at 6%.

Calculate the $10_3 V^n$.

\[
P_{V^n} = PVB
\]

\[
P \cdot \dd{70}{20} = 50,000 \cdot A_{70|20|}
\]

\[
\Rightarrow P = \frac{50,000 \cdot A_{70|20|}}{\dd{70}{20}} = \frac{50,000 \cdot (A_{70} - 20E_{70} \cdot A_{90})}{\dd{70}{20} \cdot A_{90}}
\]

\[
= \frac{50 \times (514.95 - 0.04988 \times 793.46)}{8.5693 - 0.04988 \times 3.6488} \approx 2,833.88180
\]

\[
10_3 V^n = 50,000 \cdot A_{80|10|} - P \cdot \dd{80}{10}
\]

\[
= 50,000 \cdot (A_{80} - 10E_{80} \cdot A_{90}) - P \cdot (\dd{80}{10} \cdot A_{90})
\]

\[
= 50 \times (665.75 - 0.15100 \times 793.46) - 2833.88180 \times (5.9050 - 0.15100 \times 3.6488)
\]

\[
\approx 12,124.19
\]

\[
11_3 V^n = \frac{(10_3 V^n + P)(1+i) - DB \cdot q_{80}}{p_{80}}
\]

\[
= \frac{(12,124.19 + 2,833.88180) 	imes 1.06 - 50,000 \times 0.08030}{1 - 0.08030} \approx 12,874.37
\]

\[
10_3 V^n = 0.7(P + 10_3 V^n) + 0.3\cdot 11_3 V^n
\]

\[
= 0.7(2833.88 + 12124.18542) + 0.3(12847.36257) \approx 14,324.85
\]
2. You are given:

   a. \(1000A_{s0} = 200\)
   
   b. \(1000A_{s1} = 210\)
   
   c. \(v = 0.92\)

Let \(1000 \cdot \text{ } P^{FPT}_{x+1}\) be the first year net premium using the Full Preliminary Term reserve method for a fully discrete whole life policy on \((50)\) with a death 1000. Also let \(1000P^{FPT}_{x+1}\) be the net premium in years two and later using the Full Preliminary Term reserve method for a fully discrete whole life policy on \((50)\) with a death 1000.

Calculate \(1000P^{FPT}_{x+1} - 1000 \cdot \text{ } P^{FPT}_{x+1}\).

\[A_{s0} = vq_{s0} + vp_{s0} \cdot A_{s1}\]
\[0.2 = 0.92 \cdot q_{s0} + 0.92 \cdot (1 - q_{s0}) \cdot 0.21\]
\[0.2 = 0.1932 + 0.7268q_{s0}\]
\[\Rightarrow q_{s0} = \frac{0.2 - 0.1932}{0.7268} \approx 0.0093561\]

\[1000 \cdot \text{ } P^{FPT}_{x+1} = 1000 \cdot v \cdot q_{s0} = 1000 \times 0.92 \times 0.0093561 \approx 8.60759\]

\[\ddot{a}_{s1} = \frac{1 - A_{s1}}{d} = \frac{1 - 0.21}{1 - 0.92} = 9.875\]

\[1000 \cdot \text{ } P^{FPT}_{x+1} = \frac{1000 \cdot A_{s1}}{\ddot{a}_{s1}} = \frac{210}{9.875} = 21.26582\]

\[1000P^{FPT}_{x+1} - 1000 \cdot \text{ } P^{FPT}_{x+1} = 21.26582 - 8.60759 = 12.65823\]
1. A fully discrete whole life policy to (50) has a death benefit of 750,000. Gross premiums are paid annually for the life of the insured and are calculated using the equivalence principle.

You are given that mortality follows the Illustrative Life Table with interest at 6%.

The policy also has expenses of 50% of gross premiums the first year and 10% of gross premiums each year thereafter. Additionally, there is annual maintenance at the beginning of each year of 40.

Calculate the expense reserve at the end of the 5th year.

\[
PVP = PVB + PVE
\]

\[
G \cdot \dd{a}{50} = 750,000A_{50} + 40\%G + 10\%G \cdot \dd{a}{50} + 40 \cdot \dd{a}{50}
\]

\[
G = \frac{750,000A_{50} + 40 \cdot \dd{a}{50}}{90\% \cdot \dd{a}{50} - 40\%} = \frac{750 \times 249.05 + 40 \times 13.2668}{0.9 \times 13.2668 - 0.4} \approx 16,231.90851
\]

\[
5V^s = PVFB + PVFE - PVFP
\]

\[
= 750,000 \cdot A_{55} + 10\% \cdot G \cdot \dd{a}{55} + 40 \cdot \dd{a}{55} - G \cdot \dd{a}{55}
\]

\[
= 750 \times 305.14 + (\dd{-0.9 \times 16,231.90851 + 40}) \times 12.2758
\]

\[
= 50,000.33579
\]

\[
PVP = PVB
\]

\[
P \cdot \dd{a}{50} = 750,000 \cdot A_{50}
\]

\[
P = \frac{750,000 \cdot A_{50}}{\dd{a}{50}} = \frac{750 \times 249.05}{13.2668} \approx 14,079.3183
\]

\[
5V^v = PVFB - PVFP
\]

\[
= 750,000 \cdot A_{55} - P \cdot \dd{a}{55}
\]

\[
= 750 \times 305.14 - 14,079.3183 \times 12.2758
\]

\[
= 56,020.10443
\]

\[
5V^r = 5V^s - 5V^v = 50,000.33579 - 56,020.10443 = -6,019.75864
\]
2. A fully discrete whole life policy to (60) has a death benefit of 50,000. The net benefit reserves are calculated using the Full Preliminary Term reserve method.

You are given that mortality follows the Illustrative Life Table with interest at 6%.

Calculate \( 12V^{FPT} \).

\[
PVP = PVB
\]
\[
P^{FPT} \cdot \ddot{a}_{61} = 50,000 \cdot A_{61}
\]
\[
\Rightarrow P^{FPT} = \frac{50,000 \cdot A_{61}}{\ddot{a}_{61}} = \frac{50 \times 382.79}{10.9041} \approx 1,755.25720
\]

\[
12V^{FPT} = PVFB - PFVP
\]
\[
= 50,000 \cdot A_{72} - P^{FPT} \cdot \ddot{a}_{72}
\]
\[
= 50 \times 545.60 - 1755.25720 \times 8.0278
\]
\[
= 13,189.14628
\]