1. A whole life policy on (25) has a death benefit of 100,000 for the first 20 years. The death benefit for the 20 years from age 45 to 65 is 50,000. After age 65, the death benefit is 20,000. The death benefits are payable at the end of the year of death.

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

Calculate the Actuarial Present Value for this decreasing whole life policy.

\[
APV = (100,000 - 50,000) \cdot A_{25|20} + (50,000 - 20,000) \cdot A_{25|40} + 20,000 \cdot A_{25}
\]

\[
= 50,000 \cdot (A_{25} - 20E_{25} \cdot A_{45}) + 30,000 \cdot (A_{25} - 20E_{25} \cdot 20E_{45} \cdot A_{65}) + 20,000 \cdot A_{25}
\]

\[
= 50000 \times (0.08165 - 0.29873 \times 0.20120)
\]

\[
+30000 \times (0.08165 - 0.29873 \times 0.25634 \times 0.43980)
\]

\[
+20000 \times 0.08165
\]

\[
= 4,129.42654
\]
2. Li Life Insurance Company has 2500 whole life insurance policies issued to independent lives who are all age 35. These policies all have a death benefit of 100,000 which is payable at the end of the year of death.

You are given that:
   a. Mortality follows the Illustrative Life Table
   b. \( i = 0.06 \)
   c. Deaths are uniformly distributed between integral ages.

Li has set aside assets of $33 million.

Calculate the probability that the assets set aside will be sufficient to cover the cost of the policies.

For each individual of age 35,
\[
E[Z] = 100,000 A_{35} = 100,000 \times 0.12872 = 12,872
\]
\[
\text{Var}(Z) = 100,000^2 \cdot \left[ \frac{2 A_{35}}{A_{35}^2} - \left( A_{35}^2 \right) \right]
\]
\[
= 100,000^2 \times \left( 0.03488 - 0.12872^2 \right) = 183,111,616
\]

The entire portfolio, \( P \), is normally distributed with
\[
\mu = 2500 \cdot E[Z] = 32,180,000
\]
\[
\sigma^2 = 2500 \cdot \text{Var}(Z) = 4.57779 \times 10^{11}
\]
\[
\Pr(P < 33\text{mi})
\]
\[
= \Pr \left( z = \frac{P - \mu}{\sigma} < \frac{33,000,000 - 32,180,000}{\sqrt{4.57779 \times 10^{11}}} = 1.21 \right)
\]
\[
= 0.8869
\]
1. A whole life policy on (25) has a death benefit of 100,000 for the first 20 years. The death benefit for the 20 years from age 45 to 65 is 50,000. After age 65, the death benefit is 20,000. The death benefits are payable at the end of the year of death.

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

Calculate the Actuarial Present Value for this decreasing whole life policy.

\[ APV = (100,000 - 50,000) \cdot A_{\overline{20}}^{25} + (50,000 - 20,000) \cdot A_{\overline{40}}^{25} + 20,000 \cdot A_{25} \]

\[ = 50,000 \cdot (A_{25} - 20 E_{25} \cdot A_{45}) + 30,000 \cdot (A_{25} - 20 E_{25} \cdot 20 E_{45} \cdot A_{45}) + 20,000 \cdot A_{25} \]

\[ = 50000 \times (0.08165 - 0.29873 \times 0.20120) \]

\[ + 30000 \times (0.08165 - 0.29873 \times 0.25634 \times 0.43980) \]

\[ + 20000 \times 0.08165 \]

\[ \approx 4,129.42654 \]
2. \( Z \) is the present value random variable for a whole life insurance on (60) with a death benefit of 1000 payable at the moment of death.

You are given that:
  a. Mortality follows the Illustrative Life Table
  b. \( i = 0.06 \)
  c. Deaths are uniformly distributed between integral ages.

Calculate the \( \Pr(Z > E[Z]) \).

\[
Z = 1000 \cdot v^{T_{60}}
\]

\[
E[Z] = 1000\overline{A}_{60} = \frac{i}{\delta} \cdot 1000A_{60} = 1.02971 \times 369.13 = 380.09685
\]

\[
\Pr(Z > E[Z]) = \Pr(1000v^{T_{60}} > 380.09685)
\]

\[
= \Pr\left(T_{60} < \frac{\ln(0.38009685)}{\ln(v)} = 16.60112\right)
\]

\[
= \overline{q}_{60}
\]

\[
= 1 - \frac{l_{76,60112}}{l_{60}}
\]

\[
= 1 - \frac{(1 - 0.60112) \cdot l_{76} + 0.60112 \cdot l_{77}}{l_{60}}
\]

\[
= 1 - \frac{0.39888 \times 5,117,152 + 0.60112 \times 4,828,182}{8,188,074}
\]

\[
= 0.39626
\]