AS 381, Quiz ch7 T122 Form: B

Name: _____ ID#:_____ Serial#:___

Directions: Show all work to receive full credit. You can use an approved SOA calculator or any scientific calculator. Quiz duration is 30 minutes. You may begin now. Good luck.

1. For a discrete whole life insurance of 500 on (50), you are given :
   (i) $500P(A_{50}) = 12.5$
   (ii) $500A_{61} = 220$
   (iii) $500q_{60} = 10$
   (iv) $i = 0.06$
   Calculate $500\ {}_{10}V_{50}$
   a) 89
   b) 88
   c) 87
   d) 86
   e) 85
   Work shown (4 points):

2. On the basis of the Illustrative Life Table and and interest rate of 6% and that $\bar{P}(\bar{A}_{36}) = 0.00938353$, $P(\bar{A}_{36}) = 0.009073$, and $P(A_{36}) = 0.008811$, calculate the following:
   (i) the reserve ${}_{10}\bar{V}(\bar{A}_{35})$
   (ii) the reserve ${}_{10}V(\bar{A}_{36})$
   (iii) the reserve ${}_{10}V(A_{36})$
Work shown (4 points each)+ final answer (1 each) {Hint: use 2nd illustrative life table to speed up calculations):

AS 381, Quiz Ch7 T122 Form: B

Name: _____Key_____ ID#:_____ Serial#:____

Directions: Show all work to receive full credit. You can use an approved SOA calculator or any scientific calculator. Quiz duration is 20 minutes. You may begin now. Good luck.

1. For a discrete whole life insurance of 500 on (50), you are given :
   (i) $500P(A_{50}) = 12.5$
   (ii) $500A_{61} = 220$
   (iii) $500q_{60} = 10$
   (iv) $i = 0.06$
   Calculate $500\ {}_{10}V_{50}$
   a) 89
   b) 88
   c) 87
   d) 86
   e) 85
   Work shown (4 points):
   Step 1) $500\ {}_{10}V_{50} = 500A_{60} - 500P(A_{50})\ddot{a}_{60} = 500A_{60} - 12.5\ddot{a}_{60}$ →So, we need both A_{60} and $\ddot{a}_{60}$. **Step 2)**But, we are given A_{61} instead. So, we MUST use the recursion relation $A_x = vq_x + vp_xA_{x+1}$ to get
   $500A_{60} = 500vq_{60} + 500vp_{60}A_{60+1} = 10/1.06 + (1 - 0.02) * 220/1.06 = 212.8301887$
   Step 3) With $1 = d\ddot{a}_x + A_x$, we have $\ddot{a}_x = \dfrac{1 - A_x}{d} = \dfrac{1 - 0.42566038}{0.06/1.06} = 10.146667.$
   Step 4) $500\ {}_{10}V_{50} = 500A_{60} - 12.5\ddot{a}_{60} = 212.8301887 - 12.5(10.146667) = 85.997$. So, Answer is D.

2. On the basis of the Illustrative Life Table and and interest rate of 6% and that $\bar{P}(\bar{A}_{36}) = 0.00938353$, $P(\bar{A}_{36}) = 0.009073$, and $P(A_{36}) = 0.008811$, calculate the following:
   (i) the reserve ${}_{10}\bar{V}(\bar{A}_{35})$
   (ii) the reserve ${}_{10}V(\bar{A}_{36})$
   (iii) the reserve ${}_{10}V(A_{36})$

Work shown (4 points each)+ final answer (1 each) {Hint: use both illustrative life tables to speed up calculations):

Make time lines to understand the solutions.

i) the reserve ${}_{10}\bar{V}(\bar{A}_{36})$
   Step 1) ${}_{10}\bar{V}(\bar{A}_{356}) = \bar{A}_{36+10} - \bar{P}(\bar{A}_{36})\bar{a}_{36+10} = \bar{A}_{46} - \bar{P}(\bar{A}_{36})\bar{a}_{46}$
   Step 2) Information: $\delta = \ln(1.06)$, $\bar{A}_{46} = \frac{i}{\delta}A_{46} = \frac{0.06}{\ln(1.06)}\frac{210.1176}{1000} = 0.21636$, $\bar{a}_{46} = \dfrac{1 - \bar{A}_{46}}{\delta} = \dfrac{1 - 0.21636}{\ln(1.06)} = 13.449,$
   Step 3) ${}_{10}\bar{V}(\bar{A}_{36}) = \bar{A}_{46} - \bar{P}(\bar{A}_{36})\bar{a}_{46} = 0.21636 - 0.00938353(13.449) = 0.090161$
Final answer: ${}_{10}\bar{V}(\bar{A}_{36}) = 0.090161$

ii) the reserve ${}_{10}V(\bar{A}_{36})$
   Step 1) ${}_{10}V(\bar{A}_{36}) = \bar{A}_{36+10} - P(\bar{A}_{36})\ddot{a}_{36+10} = \bar{A}_{46} - P(\bar{A}_{36})\ddot{a}_{46}$
   Step 2) Information: $\delta = \ln(1.06)$, $\bar{A}_{46} = \frac{i}{\delta}A_{46} = \frac{0.06}{\ln(1.06)}\frac{210.1176}{1000} = 0.21636$, $\ddot{a}_{46} = 13.95459$
   Step 3) ${}_{10}V(\bar{A}_{36}) = \bar{A}_{46} - P(\bar{A}_{36})\ddot{a}_{46} = 0.21636 - 0.009073(13.95459) = 0.08975$
Final answer: ${}_{10}V(\bar{A}_{36}) = 0.08975$

iii)the reserve ${}_{10}V(A_{36})$
   Step 1) ${}_{10}V(A_{36}) = A_{36+10} - P(A_{36})\ddot{a}_{36+10} = A_{46} - P(A_{36})\ddot{a}_{46}$
   Step 2) Information: $\delta = \ln(1.06)$, $P(A_{36}) = 0.008362$, $A_{46} = 210.1176/1000 = 0.2101176$, $\ddot{a}_{45} = 13.95459,$
   Step 3) ${}_{10}V(A_{36}) = A_{46} - P(A_{36})\ddot{a}_{46} = 0.2101176 - 0.008811(13.95459) = 0.087164$

Final answer: ${}_{10}\bar{V}(\bar{A}_{36}) = 0.087164$

Calculating the annual premiums

Step 1) $\bar{P}(\bar{A}_{35:30\rceil}) = \dfrac{\bar{A}_{35:30\rceil}}{\bar{a}_{35:30\rceil}} = \dfrac{\delta\overline{A}_{35:30\rceil}}{1-\overline{A}_{35:30\rceil}} = \delta\dfrac{\bar{A}_{35} -_{30} E_{35}\bar{A}_{35+30} + A^{\ 1}_{35:30\rceil}}{1-(\bar{A}_{35} -_{30} E_{35}\bar{A}_{35+30} + A^{\ 1}_{35:30\rceil})}$

Step 2) Information: $\delta = \ln(1.06)$, $\bar{A}_{35} = \frac{i}{\delta}A_{35} = \frac{0.06}{\ln(1.06)}\frac{128.7194}{1000} = 0.13254$, $\bar{A}_{65} = \frac{i}{\delta}A_{65} = \frac{0.06}{\ln(1.06)}\frac{439.7965}{1000} = 0.45286$, ${}_{30}E_{35} = v^{30}\ {}_{30}p_{35} = v^{30}\ \frac{l_{35+30}}{l_{35}} = \left(\frac{1}{1.06}\right)^{30}\ \frac{75339.63}{94206.55} = 0.139\,24$, $A^{\ 1}_{35:30\rceil} =_{30} E_{35} = 0.139\,24$

Step 3)

$$\bar{P}(\bar{A}_{35:30\rceil}) = \ln(1.06)\frac{0.13254 - 0.139\,24(0.45286) + 0.139\,24}{1-(0.13254 - 0.139\,24(0.45286) + 0.139\,24)} = 0.015\,371$$

iii)the reserve ${}_{10}\bar{V}(\bar{A}_{35:30\rceil})$

Step 1) ${}_{10}\bar{V}(\bar{A}_{35:30\rceil}) = \bar{A}_{35+10:30-10\rceil} - \bar{P}(\bar{A}_{35:30\rceil})\bar{a}_{35+10:30-10\rceil} = \bar{A}_{45:20\rceil} - \bar{P}(\bar{A}_{35:30\rceil})\bar{a}_{45:20\rceil}$

Step 2) Information: $\delta = \ln(1.06)$, $\bar{P}(\bar{A}_{35:30\rceil}) = 0.015371$,

$\bar{A}_{45:20\rceil} = \bar{A}^{\ 1}_{45:20\rceil} + A^{\ 1}_{45:20\rceil} = \bar{A}_{45} -\ {}_{20}E_{45}\bar{A}_{45+20} + A^{\ 1}_{45:20\rceil} = \bar{A}_{45} + (1 -\ {}_{20}E_{45})\bar{A}_{65}$

$\bar{A}_{45} = \frac{i}{\delta}A_{45} = \frac{0.06}{\ln(1.06)}\frac{201.2024}{1000} = 0.20718$,

$\bar{A}_{65} = \frac{i}{\delta}A_{65} = \frac{0.06}{\ln(1.06)}\frac{439.7965}{1000} = 0.45286$,

${}_{20}E_{45} = v^{20}\ {}_{20}p_{45} = v^{20}\ \frac{l_{45+20}}{l_{45}} = \left(\frac{1}{1.06}\right)^{20}\ \frac{75339.63}{91640.50} = 0.25634 = A^{\ 1}_{45:20\rceil}$

$\bar{A}_{45:20\rceil} = \bar{A}_{45} + (1 -_{20} E_{45})\bar{A}_{65} = 0.20718 + (1 - 0.25634)0.45286 = 0.54395$

$1 = \delta\overline{a}_{x:n\rceil} + \overline{A}_{x:n\rceil} \rightarrow \bar{a}_{45:20\rceil} = \dfrac{1-\bar{A}_{45:20\rceil}}{\delta} = \dfrac{1-0.54395}{\ln(1.06)} = 7.8266.$

Step 3) ${}_{10}\bar{V}(\bar{A}_{35:30\rceil}) = \bar{A}_{45:20\rceil} - \bar{P}(\bar{A}_{35:30\rceil})\bar{a}_{45:20\rceil} = 0.54395 - 0.015371(7.8266) = 0.42365$

Final answer: ${}_{10}\bar{V}(\bar{A}_{35:30\rceil}) = 0.17530$