May 2007 SOA Course MLC Examination, Problem No. 10

For whole life insurances of 1000 on (65) and (66):

(i) Death benefits are payable at the end of the year of death.

(ii) The interest rate is 0.10 for 2008 and 0.06 for 2009 and thereafter.

(iii) \( q_{65} = 0.010 \) and \( q_{66} = 0.012 \).

(iv) The actuarial present value on December 31, 2007 of the insurance on (66) is 300. Calculate the actuarial present value on December 31, 2007 of the insurance on (65).

A. 279  
B. 284  
C. 289  
D. 293  
E. 298

Solution.
The problem does not clearly state this, but you need to assume that the two lives, (65) and (66), follow the same mortality pattern of dependence on age, so that after one year (65) will become 66 years old and have the same mortality pattern as the current (66) has now. Using the recursive relationships for life insurance, and using the standard life insurance single benefit premium symbols for plans of insurance with \( i = 6\% \), we can write the actuarial present value on December 31· 2007 of the insurance on (65) as

\[
1000 \cdot 1.10^{-1} \cdot q_{65} + 1000 \cdot 1.10^{-1} \cdot p_{65} \cdot A_{66} = \frac{10}{1.1} + \frac{990A_{65}}{1.1}.
\]

But we cannot calculate this unless we find \( A_{66} \). From the information given about the cost of insurance for (66), we have

\[
300 = 1000 \cdot 1.10^{-1} \cdot q_{66} + 1000 \cdot 1.10^{-1} \cdot p_{66} \cdot A_{67} = \frac{12}{1.1} + \frac{988A_{67}}{1.1}.
\]

This gives

\[
330 = 12 + 988A_{67},
\]
or

\[
A_{67} = \frac{330 - 12}{988} = \frac{318}{988} = \frac{159}{494}.
\]

From the standard recursive relationship with 6% interest

\[
A_{66} = 1.06^{-1} \cdot q_{66} + 1.06^{-1} \cdot p_{66} \cdot A_{67} = \frac{0.012}{1.06} + \frac{0.988}{1.06} \cdot \frac{159}{494} = 0.31132075.
\]
Now we can calculate the quantity desired as
\[ \frac{10}{1.1} + \frac{990A_{66}}{1.1} = \frac{10}{1.1} + \frac{990}{1.1} \cdot 0.31132075 \approx 289.279588. \]

Answer C.

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