STAT 472
Fall 2014
Test 2
November 11, 2014

1. (6 points) You are given:

   i. \( A_{x+2} = 0.450 \)
   ii. \( i = 0.04 \)
   iii. \( q_x = 0.015 \)
   iv. \( q_{x+1} = 0.020 \)

Calculate \( \ddot{a}_x \).
2. A special life annuity IMMEDIATE is sold to Clara who is (80). The annuity pays 100 at the END of one year if Clara is alive and pays 200 at the END of two years if Clara is alive. No other payments are made.

Let $Y$ be the present value random variable for this annuity.

You are given that $v = 0.95$, $q_{80} = 0.06$, $q_{81} = 0.1$ and $q_{82} = 0.15$

a. (2 points) Calculate $\Pr(Y = 0)$.

b. (5 Points) Calculate $E[Y]$. 
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c. (7 points) Calculate $Var[Y]$.
3. Jack who is (85) purchases a whole life annuity due with annual payments of 2000.

You are given:

i. \( i = 0.07 \)

ii. The following mortality table:

\[
\begin{array}{|c|c|}
\hline
\text{Age } x & q_x \\
\hline
85 & 0.25 \\
86 & 0.50 \\
87 & 1.00 \\
\hline
\end{array}
\]

Let \( Y \) be the present value random variable for this annuity.

a. (5 points) Calculate the actuarial present value of Jack’s annuity.

b. (9 points) Calculate \( Var[Y] \).  


Li Life Insurance Company sells 10,000 annuities identical to this annuity to independent lives all age 85. The Company’s Chief Actuary, Anji, wants to know the 90% confidence interval for the present value of payments to be made under these 10,000 annuities.

c. (7 points) Assuming the normal distribution, calculate the 90% confidence interval.
4. Mayfawny who is (40) purchases a special whole life policy. The policy pays a death benefit at the end of the year of death. The death benefit for the first ten years is 100,000. The death benefit for the following 15 years is 250,000. The death benefit thereafter is 150,000.

Mayfawny is considering paying for this whole life with either annual net premiums or monthly net premiums. She only wants to pay net premiums until she is 60 years old.

You are given:
   i. Mortality follows the illustrative life table.
   ii. \( i = 0.06 \)

a. (8 points) The actuarial present value of this special whole life insurance is 27,900 to the nearest 100. Calculate the actuarial present value to the nearest 1.

b. (6 points) If Mayfawny pays annual net premiums for 20 years, calculate the annual premium for this whole life using the equivalence principle.
c. (7 points) If Mayfawny pays monthly net premiums for 20 years, calculate the monthly net premium using the equivalence principle. Use the two term Woolhouse formula in completing your calculations.

d. (4 points) If you take the amount of net premium that you would pay in a year under Part c., it is greater than the amount of net premium that you would pay in a year under Part b. Explain the two reasons that this is true. Do not provide a mathematical demonstration that this is true. Explain what the two reasons are.
5. Jana who is (20) purchases a whole life policy with a death benefit of 10,000 payable at the moment of death. Jana pays for this whole life policy with net premiums payable continuously as long as she is alive.

You are given:

i. Mortality follows that Illustrative Life Table.
ii. \( i = 0.06 \)
iii. Deaths are uniformly distributed between integral ages.
iv. Premiums are determined using the equivalence principle.

a. (8 points) The annual net premium rate for Jana’s policy is 40 to the nearest 5. Calculate the annual net premium rate for Jana’s policy to the nearest 0.01.

b. (10 points) Calculate the standard deviation of the loss at issue random variable, \( L_0^n \).
6. (10 points) Let $Y$ be the present value random variable for a whole life annuity due issued to (70) that pays 100 per year.

You are given that mortality follows the Illustrative Life Table with $i = 0.06$.

Calculate the $\Pr(Y < 1000)$. 
7. (6 points) A whole life insurance issued to \((x)\) pays a death benefit of 100,000 at the end of the year of death. The annual net premium payable during the lifetime of \((x)\) is \(P\).

You are given:

i. \(1000A_x = 200\)

ii. \(i = 0.10\)

Calculate \(P\).