

MATH 3631
Actuarial Mathematics II
Class Test 1 - 3:35-4:50 PM
Wednesday, 17 February 2016
Time Allowed: 1 hour
Total Marks: 100 points

Please write your name and student number at the spaces provided:

Name: _____ Student ID: _____

- There are ten (10) written-answer questions here and you are to answer all ten. Each question is worth 10 points.
- Please provide details of your workings in the appropriate spaces provided; partial points will be granted.
- Please write legibly.
- Anyone caught writing after time has expired will be given a mark of zero.

Question No. 1:

For a life (x) with standard mortality, you are given:

- $\ddot{a}_x = 10.13$ when calculated at $\delta = 3.0\%$
- $\ddot{a}_x = 9.17$ when calculated at $\delta = 4.5\%$

A fully discrete whole life insurance policy with death benefit of \$10,000 is issued to a life (x) considered substandard risk with force of mortality:

$$\mu_{x+t}^s = \mu_{x+t} + 0.015,$$

where μ_{x+t} is the force of mortality for a standard risk.

Calculate the net annual premium for this substandard life if $\delta = 3.0\%$.

Question No. 2:

For a special fully discrete 20-year endowment insurance on (45) , you are given:

- The death benefit is \$100 plus the return of all net annual premiums accumulated with interest at 4% to the end of the year of death.
- The endowment benefit is 200.
- $i = 4\%$
- $A_{45:\overline{20}|}^1 = 0.3692$
- ${}_{20}p_{45} = 0.4312$
- Premiums are calculated based on the actuarial equivalence principle.

Calculate the net annual premium for this policy.

Question No. 3:

For a 10-year term life insurance policy issued to (50), you are given:

- The death benefit of \$100 is payable at the end of the year of death.
- A level premium is paid at the beginning of each year during the term of the policy.
- Mortality follows the **Illustrative Life Table**.
- $i = 0.06$
- Net premium is calculated according to the actuarial equivalence principle.

Calculate the net premium reserve at the end of year 5.

Question No. 4:

For a fully discrete whole life insurance policy of \$10,000 issued to (45), you are given:

- The only expense, incurred at policy issue, is \$100.
- Mortality follows the Illustrative Life Table.
- $i = 0.06$
- Gross premium is determined according to the actuarial equivalence principle.

Calculate the gross premium reserve at the end of year 10.

Question No. 5:

For a fully discrete whole life insurance of \$100,000 on (40) , you are given:

- The gross premium reserve at time 10 is \$16,025 and at time 11 is \$17,830.
- The gross annual premium is \$2,660.
- $i = 0.04$
- Renewal expenses, incurred at the beginning of each year, consist of 50 plus 3% of gross annual premium.
- There is an expense of \$250 incurred at time death benefit is paid.

Calculate the probability that a 50-year-old will survive one year.

Question No. 6:

For a fully discrete whole life insurance of \$1,000 on (35), you are given:

- First year expenses are 25% of the gross premium plus 75.
- Renewal expenses are 5% of the gross premium plus 25.
- All expenses are incurred at the beginning of the policy year.
- Gross premiums are calculated using the actuarial equivalence principle.
- Deaths are uniformly distributed over each year of age.
- Mortality follows the Illustrative Life Table.
- $i = 0.06$

Calculate the gross premium reserve at the end of 0.75 years.

Question No. 7:

For a special single premium 10-year endowment insurance on (55) , you are given:

- The death benefit, payable at the end of the year of death, is equal to \$2,000 plus the benefit reserve.
- The endowment benefit, payable at the end of 10 years if alive, is \$5,000.
- $q_{55+k} = 0.01$, for $k = 0, 1, 2, \dots$
- $i = 0.05$

Calculate the single benefit premium for this policy.

Question No. 8:

Suppose you are interviewing for an actuarial position at a major life insurance company. One of your interviewers is a qualified actuary with an FSA. She asked you about what you have learned from your class in ‘Actuarial Mathematics’ about reserves. Specifically, she asked ‘why do you think every actuary should know about reserves and their calculations?’

How would you respond? Bullet points are acceptable. No formulas, and only words, please. Just like the song titled ‘The Word’ by the Beatles says “Say the word and you’ll be free, say the word and be like me, say the word I’m thinking of”.

Question No. 9:

For a fully discrete whole life insurance of \$100 issued to (50), you are given:

- $i = 0.04$
- $\ddot{a}_{50} = 11.0$ and $\ddot{a}_{60} = 8.0$
- ${}_8p_{50} = 0.750$ ${}_9p_{50} = 0.714$ ${}_{10}p_{50} = 0.676$ ${}_{11}p_{50} = 0.638$
- L_{10} denotes the prospective loss random variable at the end of 10 years.

Calculate the probability that the benefit reserve at the end of 10 years will not be sufficient to cover L_{10} .

Question No. 10:

For a fully discrete whole life insurance of \$10 issued to (55), you are given:

- $i = 0.05$
- $A_{55} = 0.5768$
- $\ddot{a}_{55} = 8.8872$
- $A_{63} = 0.6771$
- ${}^2A_{63} = 0.4883$
- L_8 denotes the prospective loss random variable at the end of 8 years.

Calculate $\text{Var}[L_8]$.

EXTRA PAGE FOR ADDITIONAL OR SCRATCH WORK