Name_____ ID#:_ _ _ _ _ _ _ _ _   Serial #:_ _ _

Instructions.

1. Please turn off your cell phones and place them under your chair. Any student caught with mobile phones on during the exam will be considered under the **cheating rules** of the University.

2. If you need to leave the room, please do so quietly so not to disturb others taking the test. No two person can leave the room at the same time. No extra time will be provided for the time missed outside the classroom.

3. Only materials provided by the instructor can be present on the table during the exam.

4. Use the blank portions of each page for your work. Extra blank pages can be provided if necessary. If you use an extra page, indicate clearly what problem you are working on.

5. Only answers supported by work will be considered. Unsupported guesses will not be graded.

6. While every attempt is made to avoid defective questions, sometimes they do occur. In the rare event that you believe a question is defective, the instructor cannot give you any guidance beyond these instructions.

7. Mobile calculators, I-pad, or communicable devices are disallowed. Use regular scientific calculators or financial calculators only. Write important steps to arrive at the solution of the following problems.

8. Do not spend too much time on any one question. If a question seems too difficult, leave it and go on.

The test is 150 minutes, GOOD LUCK, and you may begin now!

Question	Total Marks	Marks Obtained	Comments
1	6		
2	1+5=6		
3	1+4=5		
4	6		
5	1+5=6		
6	1+4=5		
7	1+4=5		
8	1+4=5		
9	1+5=6		
Total	50		

Extra blank page

1 (6 points) A portfolio contains 98 independent policies with benefit amount $B = 1$ each. For each policy the probability q of a claim is $1/7$. Let S be the total claims for the portfolio. Using a normal approximation, estimate $Pr(S > 10)$.

Work shown (6 points):

2. (1+5=6 points) For a group of individuals all age x, you are given:

(i) 30% are smokers and 70% are non-smokers.

(ii) The constant force of mortality for smokers is 0.06.

(iii) The constant force of mortality for non-smokers is 0.03.

(iii) $\delta = 0.08$.

Calculate $Var(\bar{a}_{\overline{T_x}|})$ for an individual chosen at random from this group.

a) 14.6

b) 14.1

c) 13.8

d) 13.3

e) 13.0

Work Shown (5 points)

Hence the answer is (___)

3. (1+4 = 5 marks) You are given :

(i) $_{k|}q_x = \dfrac{0.9^{k+1}}{9}$

(ii) $i = 0.08$

(iii) The force of mortality is constant

Calculate $1000\left[\bar{P}\left(\bar{A}_x\right) - P_x\right]$

    a) 11.34

    b) 11.94

    c) 12.77

    d) 13.17

Work shown (4 points):

Hence the answer is (_ _ _)

4. (6 points) An insurer has issued a policy paying 1 unit at the end of the year of death in exchange for the payment of π at the begining of each year, provided the life survives. Assume that the insured is still alive 1 year after entering into the contract. Further assume the insurer uses $i = 0.05$ and the following mortality assumption for K:

$$_{k|}q_0 = 0.2 \quad k = 0, 1, 2, 3, 4.$$

With a level premium of 0.30272, find the reserve $_1V$ under the equivalence principle.

Work shown (6 points):

5. (1+5 = 6 marks) For a fully continuous whole life insurance of 1 on (30), you are given:

(i) The force of mortality is 0.05 in the first 10 years and 0.08 thereafter

(ii) $\delta = 0.08$

Calculate the **benefit reserve** at time 10 for this insurance.

a) 0.188
b) 0.177
c) 0.166
d) 0.155
e) 0.144

Work Shown :

$$\bar{A}_{30} = 0.05\int_0^{10} e^{-0.13t}\,dt + e^{-1.3}\left(\frac{0.08}{0.16}\right) = 0.05\cdot\frac{1-e^{-1.3}}{0.13} + e^{-1.3}(0.5)$$
$$= 0.27979 + 0.13627 = 0.41606$$
$$\bar{a}_{30} = \frac{1-\bar{A}_{30}}{\delta} = \frac{1-0.41606}{0.08} = 7.2992$$
$$\bar{P}(\bar{A}_{30}) = \frac{0.41606}{7.2992} = 0.05700$$

At time 10, (40) with $\mu = 0.08$: $\bar{A}_{40} = \frac{0.08}{0.16} = 0.5$, $\bar{a}_{40} = \frac{1}{0.16} = 6.25$

$${}_{10}\bar{V} = \bar{A}_{40} - \bar{P}(\bar{A}_{30})\,\bar{a}_{40} = 0.5 - 0.05700(6.25) = 0.5 - 0.35625 = 0.14375$$

Hence the answer is (e)

6. (1+4 = 5 marks) For a fully discrete whole life insurance of 25000 on (25), you are given

(i) $P_{25} = 0.01128$

(ii) $P_{\overset{\scriptscriptstyle 1}{25:\overline{15}|}} = 0.05107$

(iii) $P_{25:\overline{15}|} = 0.05332$

Calculate $25000\,{}_{15}V_{25}$.

a) 4540
b) 4500
c) 4460
d) 4420
e) 4380

Work shown (4 points):

$$\frac{\ddot{a}_{40}}{\ddot{a}_{25}} = \frac{P_{25:\overline{15}|} - P_{25}}{P_{25:\overline{15}|}^{\ \ 1}} = \frac{0.05332 - 0.01128}{0.05107} = \frac{0.04204}{0.05107} = 0.82317$$

$${}_{15}V_{25} = 1 - \frac{\ddot{a}_{40}}{\ddot{a}_{25}} = 1 - 0.82317 = 0.17683$$

$$25000\,{}_{15}V_{25} = 25000(0.17683) = 4420$$

Hence the answer is (d)

7. $(1+4 = 5$ marks) For a special fully discrete 2-year endowment insurance on (x):

    (i) The pure endowment is 2000

    (ii) The death benefit for year k is $(1000k)$ plus the benefit reserve at the end of year k, $k = 1, 2$.

    (iii) π is the level annual benefit premium

    (iv) $i = 0.08$

    (v) $p_{x+k-1} = 0.9,$ $k = 1, 2$

    Calculate π.

    a) 1027

    b) 1047

    c) 1067

    d) 1087

    e) 1107

    Work Shown (4 points)

<div align="right">Hence the answer is (___)</div>

8. $(1+4 = 5$ marks) For a special fully discrete 3-year term insurance on (x):

    (i) Level benefits premiums are paid at the beginning of each year

    (ii)

k	b_{k+1}	q_{x+k}
0	200000	0.03
1	150000	0.06
2	100000	0.09

    (iii) $i = 0.06$.

Calculate the initial benefit reserve for year 2. Which of the following is the closest?

    a) 6500

    b) 7500

    c) 8100

    d) 9400

    e) 10300

Work shown (4 points):

<div align="right">Hence the answer is (___)</div>

9. (1+5=6 points) For a fully discrete 2-year term insurance of 1 on (x):

(i) $q_x = 0.1$ and $q_{x+1} = 0.2$

(ii) $v = 0.9$

(iii) $_1L$ is the prospective loss random variable at time 1 using the premium determined by the equivalence principle.

Calculate $Var(_1L|K_x > 0)$.

    a) 0.05

    b) 0.07

    c) 0.09

    d) 0.11

    e) 0.13

Work Shown

Hence the answer is (_ _ _)

END OF TEST PAPER