Dept of Mathematics and Statistics
King Fahd University of Petroleum & Minerals

AS381: Actuarial Contingencies I
Dr. Mohammad H. Omar
Final Exam Term 151 FORM A
Monday December 28 2015
8.00-10.30am

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. Do not spend too much time on any one question. If a question seems too difficult, leave it and go on.
5. 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.
6. Only answers supported by work will be considered. Unsupported guesses will not be graded.
7. 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.
8. Mobile calculators, I-pad, or communicable devices are disallowed. Use regular scientific calculators or financail calculators only. Write important steps to arrive at the solution of the following problems.

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

Question	Total Marks	Marks Obtained	Comments
1	3+3+3=9		
2	3+2+2+3=10		
3	5+5=10		
4	2+14*0.5+2=11		
5	4+1=5		
6	3*5=15		
7	6		
8	4+5=9		
9	4+1=5		
Total	80		

Extra blank page

1. (3+3+3=9 points) On the basis of the Illustrative Life Table and interest of 6%, calculate values for the benefit reserves in the following table.

Fully Discrete	**Semicontinuous**	**Fully Continuous**
${}_{10}V^{1}_{35:\overline{30}\rceil}$	${}_{10}V\left(\bar{A}_{35}\right)$	${}_{10}\bar{V}\left(\bar{A}_{35:\overline{30}\rceil}\right)$

2. (3+2+2+3=10 points) A 20 payment whole life policy with unit benefit (or face) amount was issued on a fully discrete basis to a person age 25. On the basis of your Illustrative Life Table and interest of 6%, calculate

(a) ${}_{20}P_{25}$ (b) ${}^{20}_{19}V_{25}$ (c) $Var[{}_{20}L|K(25) \geq 20]$
(d) Given that ${}^{20}_{20}V_{25} = A_{45,}$ find $Var[{}_{18}L|K(25) \geq 18]$ using the Hattendorf's theorem.

3. (5+5=10 points) On the basis of the Illustrative Life Table with the assumption of **uniform distribution of deaths** (UDD) over each year of age and $i = 0.06$, we obtained the following:

   i) $A^1_{35:\overline{20|}} = 0.041449974, \qquad A_{35:\overline{20|}} = 0.327445355, \qquad \ddot{a}_{35:\overline{20|}} = 11.881799$

   ii) $P^1_{35:\overline{20|}} = 0.003488527, \qquad P_{35:\overline{20|}} = 0.027558568$ and

   iii) $P^{(2)}_{35:\overline{20|}} = 0.027985486.$

   Calculate the following for a 20-year **endowment** insurance issued to (35) with a **unit** benefit and true **semiannual** benefit premiums:

a) The benefit reserve at the end of the **tenth year** if the benefit is payable at the **end of the year** of death.
b) The benefit reserve at the end of the **tenth year** if the benefit is payable at the **moment** of death.

4. ($2 + 14 \times 0.5 + 2 = 11$ marks) A 5 year term life insurance of 10000 is issued on a fully discrete basis to each member of a group of l_{35} persons at age 35.

   a) Trace the cash-flow expected for this group on the basis of the illustrative Life Table with interest at 6% and, as a by-product, obtain the benefit reserves.

   To help you, part of the work is already shown below. **Complete** the work by filling in the blanks with the correct numbers. (show an example calculation work for each column)

Yr h	Expected Benefit **Premiums** at Start of Year	Expected **Fund** at **Start** of Year	Expected **Interest** amount	Expected **Death** Claims	Expected Fund at Year **End**	Expected Number of Survivors at Year **End**	$10000\times {}_hV_{\overline{50:5}\rceil}^{1}$
1	2021791.02		121307.46		246184.48		2.6185
2		2263904.52	135834.27	2012179.00		93815.64	4.1311
3		2400961.39		2138149.00	406870.08	93601.83	
4			144940.98	2275775.00	284849.03	93374.25	3.0506
5		2288777.85		2426085.00		93131.64	

(b) Assume instead the contract is a 5 year **endowment** insurance of 10000 issued on a fully discrete basis to each member of a group of l_{35} persons at age 35. What should be the reserve at the end of year 5?

5. (4+1=5 marks) For a special fully discrete 20-year endowment insurance on (40):

(i) The death benefit is 1000 for the first 10 years and 2000 thereafter. The pure endowment benefit is 2000.
(ii) The annual benefit premium is 40 for each of the first 10 years and 100 for each year thereafter.
(iii) $q_{40+k} = 0.001k + 0.001$, $k = 8, 9, \ldots 13$
(iv) $i = 0.05$ and $\ddot{a}_{51:\overline{9}|} = 7.1$.
Calculate the *benefit reserve* at the end of year 10.
a)490
b) 500
c) 530
d) 550
e) 560
Show work

Hence the answer is: (__)

6. (3*5=15 points) If $S(x) = \left(1 - \frac{x}{100}\right)^{1/2}$, ...$0 \leq x \leq 100$, evaluate the following:

(a) ${}_tp_x$
(b) ${}_{17}q_{19}$
(c) ${}_{15|13}q_{36}$
(d) $\mu(36)$
(e) $E[T(36)]$.

7. (6 points) On the basis of the Illustrative Life Table and interest of 6%, **approximate** ${}_{10\frac{1}{6}}V^{\{4\}}(\bar{A}_{25})$.

8. (4+5=9 points) Assuming De Moivre's survival function with $\omega = 100$ and $i = 0.10$, calculate

(a) $\bar{A}^1_{30:\overline{10|}}$

(b) The variance of the benefit present value, at policy issue, of the insurance in (a).

9. (4+1=5 points) For a fully continuous whole life insurance of 1 on (x):

(i) $\bar{A}_x = 1/3$

(ii) $\delta = 0.10$

(iii) L is the loss at issue random variable using the premium $\bar{P}(\bar{A}_x)$ based on the equivalence principle.

(iv) $Var(L) = 1/5$

(v) L^* is the loss at issue random variable using the premium π .

(vi) $Var(L^*) = 16/45$.

Calculate π.

a) 0.05

b) 0.08

c) 0.10

d) 0.12

e) 0.15

Show work

Hence the answer is: (___)

END OF TEST PAPER