

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

AS482: Actuarial Contingencies I  
Dr. Mohammad H. Omar  
Major 3 Exam Term 131 FORM A  
Sunday Dec 8 2013  
5.30pm-7.00pm

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 or SOA approved scientific calculators or financial calculators only. Write important steps to arrive at the solution of the following problems.

The test is 90 minutes, GOOD LUCK, and you may begin now!

Question	Total Marks	Marks Obtained	Comments
1	5+5+5=15		
2	3+4=7		
3	3+3+3=9		
4	6+3=9		
5	1+4=5		
6	1+4=5		
Total	50		

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1. (5+5+5=15 points) For each interest rate scenario,  $j$ , in the Table below, the interest rate  ${}_j i_k$  (expressed as percentages) for each year is given. The mortality rate,  $q_{x+k-1}$ , for each year of age is also given.

year	mortality rates	interest	rate ${}_j i_k$	for
$k$	$q_{x+k-1}$	scenario 1	scenario 2	scenario 3
1	0.03	6%	6%	6%
2	0.04	7	6	5
3	0.05	8	6	4

Find the actuarial present value of a three-year endowment insurance issued at age  $x = 65$  for a benefit amount of \$5000.

**Solution:**

2. (3+4=7 points) In connection with taking over a client's retirement account, the client agrees to invest \$300000 of that account with your firm for three years, starting two years from now.

$n$	$f_{n,1}$
0	4.0%
1	5.0
2	6.0
3	7.0
4	8.0

(a) According to the interest rates above, what rate of interest can be **locked in** for the investment period?

(b) What spot-rate **transactions** should be entered into today in order to lock in the yield found in part

(a)? Include the term and principle amount of the two transactions.

**Solution:**

3. (3+3+3=9 points) At time  $t$  a variable UL contract has 100 units invested in Fund A, with unit value 20, and 200 units invested in Fund B, with unit value 10. The market value of Fund A is 10 000 000 and that Fund B is 5 000 000. From time  $t$  to time  $t + 1$ , Fund A increases by 20% and Fund B decreases by 10%.
- (a) Find the **unit value** of Fund A and Fund B at time  $t + 1$ .
- (b) Find the **market value** of Fund A and Fund B at time  $t + 1$ .
- (c) A premium payment of 2000 is made at time  $t$ , allocated equally to Fund A and Fund B. Find the **account value** of the contract at time  $t + 1$ .

**Solution:**

4. (6+3=9 points) Consider the UL contract of face amount 100000 issued to  $(x)$  with contributions, mortality rates, and withdrawal rates as described below.

Year $t$	Contribution	$q_{[x]+t-1}^{(d)}$	$q_{[x]+t-1}^{(w)}$
1	20000	0.001	0.02
2	25000	0.002	0.02
3	25000	0.003	0.03
4	30000	0.004	0.04
5	20000	0.005	0.05

Assume that withdrawals occur **only** at the end of the policy year. Assume also 5% annual interest rate,

- (a) Calculate the actuarial present value of the **premiums**.
- (b) Suppose the contract pays the face amount as a pure endowment benefit upon survival to the end of five years. Find the actuarial present value of the **pure endowment** benefit.

**Solution:**

5. (1+4=5 points) For a 4-year pure endowment contract issued to (30), you are given:

- (i) Net annual premiums are payable at the beginning of each year as long as the policyholder is alive..
- (ii) The benefit of \$1000 is payable at the end of the fourth year if the policyholder is alive.
- (iii) The following forward interest rates:

$t$	0	1	2	3
$f(t, 4)$	0.05	0.06	0.02	0.06

- (iv) The following death probabilities:

$x$	30	31	32	33
$q_x$	0.001	0.002	0.003	0.004

Calculate the net annual **premium**.

- a) 200
- b) 210
- c) 220
- d) 230
- e) 240

Work Shown (4 points):

Hence the answer is ( \_\_ )

6. (1+4=5 points) For a universal life policy, you are given:

(i) The account value on 1 January 2012 is \$10000.

(ii) The policyholder pays a premium of \$1000 on 1 April 2012. No more premiums are paid in the same year.

(iii) The expense charge is \$50 + 3% of the premium.

(iv) The cost of insurance deducted from the premium is \$200.

(v) The credited interest rate for year 2012 is 8% per annum effective.

Assume the policy is still in force on 31 December 2012. Calculate the **account value** on 31 December 2012.

a) \$11312

b) \$11563

c) \$11619

d) \$11915

e) \$12280

Work Shown (4 points):

Hence the answer is ( \_ \_ )

END OF TEST PAPER