

Dept of Mathematics and Statistics
 King Fahd University of Petroleum & Minerals
 AS482: Actuarial Contingencies 2
 Dr. Mohammad H. Omar
 Major 1 Exam Term 191 FORM A
 Wednesday Oct 2 2019
 6.00pm-7.30pm

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 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	6+5+2=13		
2	6		
3	5+4=9		
4	6+3 = 9		
5	4		
6	5+4=9		
Total	50		

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1. (6+5+2=13) Consider the accidental death model illustrated in Figure 1 below.

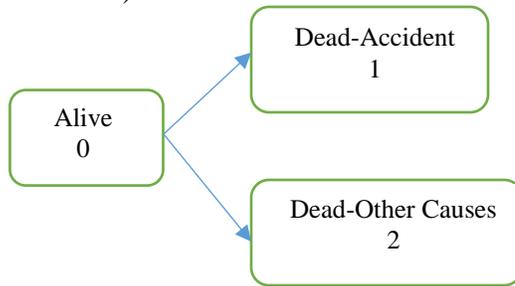


Figure 1.

Let $\mu_x^{01} = 10^{-5}$ and $\mu_x^{02} = A + Bc^x$ for all x and assume $A = 5 \times 10^{-4}$, $B = 7.6 \times 10^{-5}$, and $c = 1.09$. Calculate

- ${}_{10}p_{30}^{00}$
- ${}_{10}p_{30}^{02}$
- Is this process homogeneous or nonhomogeneous? **Why** (Justify your answer)?

2. (6 marks) An insurance company uses the model in Figure 1 above to calculate premiums for a special 10-year term life insurance policy. The basic sum insured is 100 000 but the death benefit doubles to 200 000 if death occurs as a result of an accident. The death benefit is payable immediately upon death. Premiums are paid continuously throughout the term. Using an effective rate interest of 5% per year and ignoring expenses, for a policy issued to a life aged 30, Calculate the **annual premium** for this policy.

3. (5+4 = 9 marks) In a certain country, members of its regular armed forces can leave active service (state 0) by transfer (state 1), by resignation (state 2), or by death (state 3). The transition forces are

$$\mu_x^{01} = 0.001x, \quad \mu_x^{02} = 0.01, \quad \mu_x^{03} = A + Bc^x$$

where $A = 0.001$, $B = 0.0004$ and $c = 1.07$. New recruits join only at exact age 25.

Calculate the **probability** that a new recruit is

- a) in active service at age 28.
- b) transferred before age 27.

4. (6+3 = 9 marks) You are given the following

i) probability transition matrix $P^{(k)} = \begin{bmatrix} p_{x+k} & q_{x+k} \\ 0 & 1 \end{bmatrix}$ where $p_{x+k} = 0.70 + \frac{0.2}{k+1}$

ii) $\pi_1 = (p_x \quad q_x)$

a) Find π_4

b) Express the elements of π_4 using standard actuarial notation.

5. (4 marks) You are given that $q_x^{(1)} = 0.48$, $q_x^{(2)} = 0.32$, $q_x^{(3)} = 0.16$ and each decrement is uniformly distributed over $(x, x+1)$ in the **multi-decrement context**, find the value of $p_x'^{(2)}$.

6. (5+4 = 9 marks) Consider a 3-year endowment insurance, with gross annual premium and annual expenses paid at the beginning of each year and benefits paid at the end of the year. The contingent benefit is 1000 for death (decrement 1) within the 3-year period, or at time $t = 3$ if death has not previously occurred. A withdrawal benefit (decrement 2) will be paid in the event of withdrawal from the plan at the end of any of the first three years. All parameter values for the insurance are shown in the following table.

Curtate Duration k	0	1	2
% of premium expense	0.05	0.05	0.05
Constant contract expense	30	30	30
Failure Benefit Amount	1000	1000	1000
Withdrawal Benefit Amount	300	600	0
Endowment Benefit Amount	0	0	1000
$q_{x+k}^{(1)}$	0.02	0.03	0.04
$q_{x+k}^{(2)}$	0.30	0.20	0
$p_{x+k}^{(\tau)}$	0.68	0.77	0.96

All cash flows are discounted at annual interest rate of 6%.

- Find the **gross annual premium** using the equivalence principle
- If the contract premium $G = 350$, find and complete the missing asset share ${}_kAS$ value in the table below.

Time k	0	1	2	3
Asset Shares ${}_kAS$	50	431.84		1250.82

Test Ends