King Fahd University of Petroleum & Minerals

Second Major Examination

Faculty: Science	Department: Mathematics
Semester: 172	Course Name: Actuarial Risk & Credibility Theory
Instructor: Abedalhay Elmughrabi	Course No: AS 483
Exam Date: April 4th, 2018	Exam Time: 02:00 PM – 04:00 PM

Student Name:	ID No.:

Question No.	Question Full Marks	Question Obtained Marks
1	10 points	
2	10 points	
3	10 points	
4	10 points	
5	10 points	
6	10 points	
7	10 points	
8	10 points	
9	10 points	
10	10 points	
Total	100	Obtained Total:

Exam Instructions

1. Fill in all information required.

2. The exam is composed of **10** questions.

3. Only the following is allowed to be on your desk: SOA approved calculator, pen/pencil, eraser, and sharpener.

4. Calculators cannot be exchanged during the examination.

5. No use of smart devices with communications capabilities (mini laptops, pens, watches, phones, etc.)

6. Cell phones must be turned off and placed under your bench facedown.

7. No questions are allowed during the exam.

8. All material related to the course should be put away

9. Final correct answers have significant weights

10. Answers without calculations/steps will receive zero marks.

11. Be clean, neat and tidy, else your work may not be marked

12. Students must not communicate with one another in any manner whatsoever during the examination.

GOOD LUCK

Question 1 (10 Points):

You are given:

- Ground-up losses follow a lognormal distribution with parameters $\mu = 7$ and $\sigma = 2$.
- There is an ordinary deductible of 2000.
- 10 losses are expected each year. ·
- The number of losses and the individual loss amounts are independent.

    A. (5 points) Determine the loss elimination ratio (LER) for the deductible.

B. (5 points) Determine the expected number of annual losses that exceed the deductible if all loss amounts increased uniformly by 20%, but the deductible remained the same.

Questions 2 (10 Points):

You are given:
- (i) At time 4 hours, there are 5 working light bulbs.
- (ii) The 5 bulbs are observed for p more hours.
- (iii) Three light bulbs burn out at times 5, 9, and 13 hours, while the remaining light bulbs are still working at time 4 + p hours.
- (iv) The distribution of failure times is uniform on $(0, \omega)$.
- (iv) The maximum likelihood estimate of ω is 29.

Determine p.

Questions 3 (10 Points):

You are given: (i) Losses follow a Burr distribution with α = 2.
(ii) A random sample of 15 losses is:

195 255 270 280 350 360 365 380 415 450 490 550 575 590 615

 (iii) The parameters γ and θ are estimated by percentile matching using the smoothed empirical estimates of the 30th and 65th percentiles. Calculate the estimate of γ.

Questions 4 (10 Points):

You are given:

    (i)   Losses are uniformly distributed on (0,θ) with θ > 150.

    (ii)   The policy limit is 150.

    (iii)   A sample of payments is:

        14,   33,   72,   94,   120,   135,   150,   150

Estimate θ by matching the average sample payment to the expected payment per loss.

Questions 5 (10 Points):

You are given:
- An aggregate loss distribution has a compound Poisson distribution with expected number of claims equal to 1.25.
- Individual claim amounts can take only the values 1, 2 or 3, with equal probability.

Determine the probability that aggregate losses exceed 3.

Questions 6 (10 Points):

You are given:
- An aggregate loss distribution has a compound Poisson distribution with expected number of claims equal to 1.25.
- Individual claim amounts can take only the values 1, 2 or 3, with equal probability.

Calculate the expected aggregate losses if an aggregate deductible of 1.6 is applied.

Questions 7 (10 Points):

For aggregate losses $S = X_1 + X_2 + \ldots + X_N$, you are given:
· N has a Poisson distribution with mean 500.
· $X_1, X_2, \ldots$ have mean 100 and variance 100.
· $N, X_1, X_2 \ldots$ are mutually independent.

You are also given:

· For a portfolio of insurance policies, the loss ratio is the ratio of aggregate losses to aggregate premiums collected.

· The premium collected is 1.1 times the expected aggregate losses.

Using the normal approximation to the compound Poisson distribution, calculate the probability that the loss ratio exceeds 0.95.

Questions 8 (10 Points):

For a tyrannosaur with a taste for scientists:

(i) The number of scientists eaten has a binomial distribution with q = 0:6
and m = 8:
(ii) The number of calories of a scientist is uniformly distributed on (7000; 9000):
(iii) The numbers of calories of scientists eaten are independent, and are independent
of the number of scientists eaten.

Calculate the probability that two or more scientists are eaten and exactly
two of those eaten have at least 8000 calories each.

Questions 9 (10 Points):

For a stop-loss insurance on a three person group:
(i) Loss amounts are independent.
(ii) The distribution of loss amount for each person is:

Loss Amount (X)	Probability (X)
0	0.4
1	0.3
2	0.2
3	0.1

(iii) The stop-loss insurance has a deductible of 1 for the group.

Calculate the net stop-loss premium.

Questions 10 (10 Points):

For a special investment product, you are given:

(i) All deposits are credited with 75% of the annual equity index return,

subject to a minimum guaranteed crediting rate of 3%.

(ii) The annual equity index return is normally distributed with a mean of

8% and a standard deviation of 16%.

(iii) For a random variable X which has a normal distribution with mean μ

and standard deviation σ, you are given the following limited expected values:

$E(X \wedge 3\%)$		
	$\mu=6\%$	$\mu=8\%$
$\sigma=12\%$	-0.43%	0.31%
$\sigma=16\%$	-1.99%	-1.19%
$E(X \wedge 4\%)$		
	$\mu=6\%$	$\mu=8\%$
$\sigma=12\%$	0.15%	0.95%
$\sigma=16\%$	-1.43%	-0.58%

Calculate the expected annual crediting rate.