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UNIVERSITY EXAMINATIONS 2021/2022

FOURTH YEAR, SECOND SEMESTER SPECIAL SUPPLEMENTARY EXAMINATION FOR DEGREE OF BACHELOR OF SCIENCE IN ACTUARIAL SCIENCE

SMS 3467: NON-LIFE INSURANCE

DATE: JANUARY 2023 **TIME: 2 HOURS**

INSTRUCTIONS: Answer Question ONE and any other TWO questions.

QUESTION ONE (30 MARKS)

a) Define the following terms as used in reinsurance:

i. Coinsurance (1 Mark)

ii. Cedant (1 Mark)

iii. Reinsurer (1 Mark)

b) Discuss 4 reasons why insurance companies often take out reinsurance contracts. (4 Marks)

c) The number of accidents follows a Poisson distribution with mean 12. Each accident generates 1,2, or 3 claimants with probabilities ½, 1/3, and 1/6, respectively. Calculate the expected total claim. (3 Marks)

d) For an individual over 65:

- The number of pharmacy claims is a Poisson random variable with mean 25.
- The amount of each of pharmacy claim is uniformly distributed between 5 and 95.
- The amounts of the claims and the number of claims are mutually independent.

e) Claim amounts follow a Weibull distribution such that a quarter of losses are below \$15 and a quarter are above \$80. Estimate the parameters α and γ of the 2-parameter Weibull distribution for these data. (5 Marks)

f) For a collective risk model:

- The number of losses has a Poisson distribution with mean of 2.
- The common distribution of the individual losses is:

X	P(X=x)
1	0.6
2	0.4

An insurance covers aggregate losses subject to a deductible of 3. Calculate the expected aggregate payments of the insurance. (5 Marks)

g) Claim amounts on a particular type of insurance policy follow a 2-parameter Pareto distribution with mean 270 and variance 115,600. Determine the lowest retention amount M under the excess of loss reinsurance such that the probability of a claim involving the reinsurer is 5%. (5 Marks)

QUESTION TWO (20 MARKS)

a) You are given that:

Number of claims	Probability	Claim size	Probability
0	1/5		
1	3/5	25 150	1/3 2/3
2	1/5	50 200	2/3 1/3

Assuming that the claim sizes are independent, find the mean and variance of the aggregate loss. (6 Marks)

b) A Health Maintenance Organization (HMO) currently pays full cost of any emergency room care to its client. You are given that the cost of an emergency room care has an Exponential distribution with mean 1000. The company is evaluating the possible savings of imposing a deductible of $200 per emergency room visit, to be paid by the client.

i. Calculate the resulting loss elimination ratio due to a deductible of $200. Interpret this ratio. (6 Marks)

ii. Suppose the HMO decides to impose a per loss deductible of $200 per emergency room visit, along with a policy limit of $5,000 and a coinsurance factor of 80%.

For every visit to the emergency room, calculate the expected claim amount per loss event and the expected claim amount per payment event made by the HMO. (4 Marks)

iii. Consider the case of the HMO in part (ii) above with a $200 deductible, $5,000 policy limit and an 80% coinsurance factor. Now, assume a 5% uniform inflation. Calculate the new expected claim amounts per loss and per payment. (4 Marks)

QUESTION THREE (20 MARKS)

a) Consider a policy with loss amount random variable X and an ordinary deductible, d. prove that if $X \sim$ Normal (μ, σ^2), then the expected amount paid per loss event can be written as $E[(X-d)+] = \sigma\phi\left(\frac{d-\mu}{\sigma}\right) - (d-\mu)\left[1-\Phi\left(\frac{d-\mu}{\sigma}\right)\right]$

Where $\phi(\cdot)$denotes the density of a standard Normal and $\Phi(\cdot)$ denotes the cumulative distribution function of a standard Normal. (10 Marks)

b) Prescription drug losses, S, are modeled assuming the number of claims has a geometric distribution with mean 4, and the amount of each prescription is 40. The store owner takes out an insurance cover with a deductible of 100. Calculate E [(S-100) +] assuming that S follows a Normal distribution. (10 Marks)

QUESTION FOUR (20 MARKS)

a) The table below shows the cumulative claims without adjustment for inflation, from a portfolio of insurance policies for 4 accident years:

	Development year			
Accident Year	0	1	2	3
2007	2047	3141	3209	3320
2008	2471	3712	3810	
2009	2388	3750		
2010	2580			

Assume that claim payments are made in the middle of the calendar year.

i. Use the chain ladder method to estimate the total outstanding payments up to the end of development year 3. (3 Marks)

ii. Given that the inflation rate applicable to these data is 4% per annum, use the inflation adjusted chain ladder method to estimate the total outstanding payments up to the end of development year 3 for accident year 2010 using mid-2010 prices. (5 Marks)

b) Discuss the five commonly used premium principles in general insurance. (10 Marks)

QUESTION FIVE (20 MARKS)

a) X is s discrete random variable with a probability function that is a member of the (a, b,0) class of distributions. You are given:

i. Pr(X=0)=Pr(X=1)=0.25

ii. Pr(X=2)=0.1875

Calculate Pr(X=3)

b) A certain policy has a loss random variable X whose density function is $f(x) = \frac{3}{500}x(10-x)$ where $0 < x < 10$. The coverage has a deductible of 3.

i. Compute the mean and variance of the insurance payment per loss, $Y_{L.}$ (4 Marks)

ii. Use the per loss results to obtain the mean and variance of the payment per payment event, Y^P. (4 Marks)

iii. Write out the cumulative distribution function of Y^L and Y^P. (2 Marks)

c) Discuss the key features of treaty reinsurance policies. (7 Marks)