MACHAKOS UNIVERSITY

University Examinations for 2022/2023 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (ACTUARIAL SCIENCE)

SAC 308: GENERAL INSURANCE

DATE: 11/3/2023 **TIME: 2:00 – 5:00 PM**

INSTRUCTIONS: *Answer question* ***one*** *and any other* ***two*** questions.

QUESTION ONE (30 MARKS)

Describe the differences between excess of loss and proportional reinsurance.

(2 marks)

(a) Describe the benefits of using No-Claim Discount systems. (4 marks)

(b) An insurer believes that claims from a particular type of policy follow a Pareto distribution with parameters $\alpha = 2.5$ and $\lambda = 300$. The insurer wishes to introduce a deductible such that 25% of losses result in no claim on the insurer. Calculate the size of the deductible. (6 marks)

(c) Claim amounts on a certain type of insurance policy follow an exponential distribution with mean 100. The insurance company purchases a special type of reinsurance policy so that for a given claim X the reinsurance company pays

$$0 \quad \text{if } 0 < X < 80;$$
$$0.5X - 40 \quad \text{if } 80 \le X < 160;\ X$$
$$-\ 120 \quad \text{if } X \ge 160.$$

Calculate the expected amount paid by the reinsurance company on a randomly chosen claim. (6 marks)

(d) Explain why general insurance companies need to investigate claims experience

(4 marks)

(e) An insurer believes that claim amounts, X , on its portfolio of pet insurance policies follow an exponential distribution with mean of 200. A reinsurance policy is

arranged such that the reinsurer pays X_R, where

$$X_R = \begin{cases} 0 & X \le 50 \\ 50 \le X \le M & \\ X > M & \end{cases}$$

Calculate M such that E[X_R] = 100.

Calculate M such that E [X_R] = 100. (8 marks)

QUESTION TWO (20 MARKS)

(a.) The random variable X has an exponential distribution with mean of 1000. Individual claim amounts on a certain type of insurance policy, Y, are such that Y = X for 0 < X < 2000 and P(Y = 2000) = P(X ≥ 2000). The insurer applies a deductible of 100 on claims from this type of insurance. Calculate the mean of the distribution of individual claim amounts paid by the insurer. (6 marks)

(b.) An insurance company has a portfolio of policies, where claim amounts follow a Pareto distribution with parameters α = 3 and λ = 100. The insurance company has entered into an excess of loss reinsurance agreement with a retention of M, such that 90% of claims are still paid in full by the insurer.

(i) Calculate M. (4 marks)

(ii) Calculate the average claim amount paid by the reinsurer, on claims which involve the reinsurer. (10 marks)

QUESTION THREE (20 MARKS)

The number of claims on a portfolio of insurance policies has a Poisson distribution with mean 200. Individual claim amounts are exponentially distributed with mean 40. The insurance company calculates premiums using a premium loading of 40% and is considering entering into one of the following re-insurance arrangements:

(A) No reinsurance.

(B) Individual excess of loss insurance with retention 60 with a reinsurance company that calculates premiums using a premium loading of 55%.

(C) Proportional reinsurance with retention 75% with a reinsurance company that calculates premiums using a premium loading of 45%.

(i) Find the insurance company's expected profit under each arrangement. (8 marks)

(ii) Find the probability that the insurer makes a profit of less than 2000 under each of the arrangements using a normal approximation. (12 marks)

QUESTION FOUR (20 MARKS)

The NCD scale policy for an insurance company is:

Level 0	0%
Level 1	25%
Level 2	50%

The premium at the Level 0 is £800. The probability that a policyholder has an accident in a year is 0.2, and it is assumed that a policyholder does not have more than one accident each year.

In the event of a claim free year the policyholder moves to the next higher level of discount in the coming year or remains at Level 2.

In the event of a claim the policyholder moves to the next lower level of discount in the coming year or remains at Level 0.

Following an accident the policyholder decides whether or not to make a claim based on the claim size and the amount of premiums over the period of the next 2 policy years, assuming no more claims are made.

(i) For each discount level, find the minimum claim amount for which the policyholder will make a claim. (4 marks)

(ii) Assuming that the cost of repair for each accident has an exponential distribution with mean £600, calculate the probability that a policyholder makes a claim at each level of discount. (8 marks)

(iii) Write down the transition matrix and calculate the average premium payment for a year when the system has reached the equilibrium. (8 marks)

QUESTION FIVE (20 MARKS)

(a.) Loss amounts under a class of insurance policies follow an exponential distribution with mean 100. The insurance company wishes to enter into an individual excess of loss reinsurance arrangement with retention level M set such that 8 out of 10 claims will not involve the reinsurer.

(i.) Find the retention M. (6 marks)

For a given claim, let X_I denote the amount paid by the insurer and X_R the amount paid by the reinsurer.

(ii) Calculate E (X_I) and E (X_R). (8 marks)

(b.) Give two examples of the main types of liability insurance, stating for each example a typical insured peril. (6 marks)