



QP CODE: 25047462



25047462

Reg No :

Name :

M.Sc DEGREE (CSS) EXAMINATION, NOVEMBER 2025

Third Semester

M Sc ACTUARIAL SCIENCE

Core Course - AS010302 - RISK MODELLING - I

2019 ADMISSION ONWARDS

2D8FB18F

Time: 3 Hours

Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

Weight 1 each.

1. Details of two-parameter Pareto distribution.
2. Derive the relationship between gamma and chi-squared distribution and if $X \sim \text{Gamma}(10,4)$ calculate $P(X > 4.375)$.
3. Losses arising from a portfolio follow a Pareto distribution with parameters $\alpha = 3$ and $\lambda = 3000$. Calculate the probability that a randomly chosen loss amount exceeds the mean loss amount.
4. Write a short note about Proportional reinsurance.
5. What is the expression for Y if only a layer between M and 2M is reinsured.?
6. Losses from a group of travel insurance policies are assumed to follow a Pareto distribution with parameters $\alpha = 4$ and $\lambda = 3000$. Next year losses are expected to increase by 3%, and the insurer has decided to introduce a policy excess of 100 per claim. Calculate the probability that a loss next year is borne entirely by the policyholder.
7. Briefly explain the attributes of short term insurance contracts.
8. Derive the moment generating function of collective risk model S.
9. The annual aggregate claims from a risk have a compound Poisson distribution with parameter 250. Individual claim amounts have a Pareto distribution with parameters $\alpha = 5$ and $\lambda = 900$. The insurer effects proportional reinsurance with a retained proportion of 75%.

Calculate the mean and variance of the net claims for the direct insurer and the reinsurer.
10. Briefly explain the important differences between the individual risk model and the collective risk model.

(8×1=8 weightage)





Part B (Short Essay/Problems)

Answer any **six** questions.

Weight 2 each.

11. Derive the formula for the MGF of a standard normal random variable.
12. Develop a formula for $E(X)$. Suppose that $X \sim Pa(\alpha, \lambda)$.
13. Suppose that claim amounts are uniformly distributed over the interval (0,500). The insurer effects individual excess of loss reinsurance with a retention limit of 375. Calculate the expected amounts paid by the insurer and the reinsurer in respect of a single claim.
14. What is the affect of inflation in the cost of insurance.?
15. (i) Define the two conditions that must hold for a risk to be insurable.
(ii) Describe the different risk criteria that would be considered desirable by a general insurer.
16. The aggregate claim amount from a portfolio has a compound negative binomial distribution.

(i) Show that if $S = X_1 + X_2 + \dots + X_N$, then:

$$M_S(t) = M_N[\log M_X(t)]$$

(ii) If N has Type 2 negative binomial distribution with $k = 3$ and $p = 0.9$, and X has a gamma distribution with $\alpha = 11$ and $\lambda = 0.1$, determine an expression for $M_S(t)$.

17. A portfolio of policies consists of one-year term assurances on 100 lives aged exactly 30 and 200 lives aged exactly 40. The probability of a claim during the year on any one of the lives is 0.0004 for the 30 year olds and 0.001 for the 40 year olds.

If the sum assured on a life aged x is uniformly distributed between $1,000(x - 10)$ and $1,000(x + 10)$. calculate the variance of the aggregate claims from this portfolio during the year assuming that policies are independent with regard to claims.

18. Suppose that the Poisson parameter, λ , will be equal to 0.1 or to 0.3 with equal probability.
 - (i) Calculate the mean and variance (in terms of m_1 and m_2) of the aggregate claims from a policy chosen at random from the portfolio.
 - (ii) Calculate the mean and variance (in terms of m_1, m_2 and n) of the aggregate claims from the whole portfolio.

(6×2=12 weightage)

Part C (Essay Type Questions)

Answer any **two** questions.

Weight 5 each.

19. An insurance company uses an exponential distribution to model the cost of repairing insured vehicles that are involved in accidents, and the average cost of repairing a random sample of 1,000 vehicles is £2,200. A breakdown of the repair costs revealed the following numbers in different bands:





Repair cost, £	Observed number
0 – 1,000	200
1,000 – 2,000	300
2,000 – 3,000	250
3,000 – 4,000	150
4,000 – 5,000	100
5,000+	0

We can use this information to test whether the exponential distribution provides a good model for the individual repair costs.(use chi-square).

20. Claims arising from a particular portfolio have a Pareto distribution with parameters $\alpha = 5$ and $\lambda = 300$. The insurer effects individual excess of loss reinsurance with a retention limit of 80.
- (i) Calculate the insurer's expected claim amount before and after reinsurance.
- (ii) Calculate the mean amount paid by the reinsurer on claims in which it is involved.
21. Obtain the expression for mean, variance and coefficient of skewness for a compound binomial distribution.
22. A portfolio consists of 500 independent risks. For the i th risk, with probability $1-q_i$, there are no claims in one year, and with probability q_i there is exactly one claim ($0 < q_i < 1$). For all risks, if there is a claim, it has mean μ , variance σ^2 and moment generating function $M(t)$. Let T be the total amount claimed on the whole portfolio in one year.

(i) Determine the mean and variance of T .

The amount claimed in one year on risk i is approximated by a compound Poisson random variable with Poisson parameter q_i and claims with the same mean μ , the same variance σ^2 , and the same moment generating function $M(t)$ as above. Let T' denote the total amount claimed on the whole portfolio in one year in this approximate model.

(ii) Determine the mean and variance of T' , and compare your answers to those in (i).

Assume that $q_i = 0.02$ for all i , and if a claim occurs, it is of size μ with probability one.

(iii) Derive the moment generating function of T , and show that T has a compound binomial distribution.

(iv) Determine the moment generating function of the approximating T' , and show that T' has a compound Poisson distribution.

(2×5=10 weightage)

