



QP CODE: 25050519



25050519

Reg No :

Name :

MSc DEGREE (CSS) EXAMINATION DECEMBER 2025

First Semester

M Sc ACTUARIAL SCIENCE

Core Courses - AS010101 - ACTUARIAL STATISTICS - I

2019 Admission Onwards

A9E3A950

Time: 3 Hours

Weightage: 30

Part A (Short Answer Questions)

Answer any **eight** questions.

Weight 1 each.

1. Show that $\frac{1}{n-1} \times \sum (x_i - \bar{x})^2 = \frac{1}{n-1} \times (\sum x_i^2 - n\bar{x}^2)$
2. What are the various measures of dispersion?
3. What is the difference between mutually exclusive and exhaustive events?
4. What is a geometric distribution in statistics?
5. What is the difference between discrete and continuous probability distributions?
6. X has a Poisson distribution with mean 5 and Y has a Poisson distribution with mean 10. If $\text{cov}(X, Y) = -12$, calculate the variance of Z where $Z = X - 2Y + 3$.
7. What do you mean by convolutions?
8. What is meant by sampling in statistics?
9. Calculate $E(X/Y = 10)$ for the joint distribution:

		Y		
		10	20	30
X	1	0.2	0.2	0.1
	2	0.2	0.3	0

10. Identify the population, the sample and the statistical inference in each of the following examples:
 - (i) You are studying 10 cities to establish whether air pollution levels are acceptable in UK cities.
 - (ii) You are analysing the burglary claims for last January to get a feel for what the total range of claims might be for the whole year.

(8×1=8 weightage)





Part B (Short Essay/Problems)

Answer any **six** questions.

Weight 2 each.

11. The punctuality of bus has been investigated by considering a number of bus journeys. In the sample, 60% of bus had a destination of Manchester, 20% Birmingham and 20% Edinburgh. The probabilities of a bus arriving late in Manchester, Edinburgh or Birmingham are 30% , 20% and 25% respectively. If a late bus is picked at random from the group under consideration, what is the probability that it terminated in Manchester?
12. In a certain constituency, 30% of the voters are “blue collar” workers, of whom 46% voted Conservative at the last United Kingdom election. Of the remaining voters, 36% voted Conservative.
Consider a voter selected at random from those who voted Conservative in this constituency. What is the probability that this voter is a “blue collar” worker?
13. The number of home insurance claims a company receives in a month is distributed as a Poisson random variable with mean 2. Calculate the probability that the company receives exactly 30 claims in a year. Treat all months as if they are of equal length.
14. Using the PDF of gamma distribution find the mean and variance.
15. Use a series expansion to derive $E(X)$, $E(X^2)$ and $E(X^3)$, where the MGF of X is given by:
 $M_x(t) = (1 - \frac{t}{5})^{-1} \quad t < 5$
16. (i) If the moment generating function of X is $M_X(t)$, then derive an expression for the moment generating function of $2X + 3$ in terms of $M_X(t)$.
(ii) Hence, if X is normally distributed with mean μ and variance σ^2 , derive the distribution of $2X + 3$.
17. (i) A random sample of 10 observations is drawn from a normal distribution with mean μ and standard deviation 15. Independently, a random sample of 25 observations is drawn from a normal distribution with mean μ and standard deviation 12. Let $\bar{X}$ and $\bar{Y}$ denote the respective sample means.
Evaluate $P(\bar{X} - \bar{Y} > 3)$.
(ii) Calculate:
(a) $P(F_{6,8} > 6.371)$
(b) $P(F_{7,12} > 0.3748)$.
18. A random sample $x_1, \dots, x_{10}$ is drawn from a $N(5,4)$ distribution. Evaluate:
(i) $P[\sum X > 60]$
(ii) $P[\sum (X - \bar{X})^2 > 34]$
(iii) $P[\bar{X} > 4 \text{ and } (\frac{1}{9} \sum (X - \bar{X})^2)^{\frac{1}{2}} < 2.6]$

(6×2=12 weightage)

Part C (Essay Type Questions)

Answer any **two** questions.

Weight 5 each.





19. (a) A box of chocolates contains 10 milk chocolates and 6 plain chocolates. A chocoholic eats three chocolates. Calculate the probability that:
- (i) all three are milk chocolates
 - (ii) exactly one is a plain chocolate.
- (b) The punctuality of trains has been investigated by considering a number of train journeys. In the sample, 60% of trains had a destination of Manchester, 20% Birmingham and 20% Edinburgh. The probabilities of a train arriving late in Manchester, Edinburgh or Birmingham are 30% , 20% and 25% respectively. If a late train is picked at random from the group under consideration, what is the probability that it terminated in Manchester?
20. (a) Derive the mean and variance of poisson distribution
- (b) A random variable X has a $Poi(3.6)$ distribution.
- (i) Calculate the mode of the probability distribution.
 - (ii) Calculate the standard deviation of the distribution.
 - (iii) State, with reasons, whether the distribution is positively or negatively skewed.
21. Calculate $P(X < 8)$ if:
- (i) X is the number of claims examined up to and including the fourth claim that exceeds £20,000. The probability that any claim received exceeds £20,000 is 0.3 independently of any other claim.
 - (ii) X is the number of deaths in the coming year amongst a group of 500 policyholders. Each policyholder has a 0.01 probability of dying in the coming year independently of any other policyholder.
 - (iii) X is the number of phone calls made before an agent makes the first sale. The probability that any phone call leads to a sale is 0.01 independently of any other call.
22. (i) Given that X and Y are continuous random variables, prove from first principles that:
 $E(Y) = E[E(Y|X)]$
- (ii) The random variable X has a gamma distribution with parameters $\alpha = 3$ and $\lambda = 2$. Y is a related variable with conditional mean and variance of:
- $$E(Y | X = x) = 3x + 1 \qquad \text{var}(Y | X = x) = 2x^2 + 5$$
- Calculate the unconditional mean and standard deviation of Y .

(2×5=10 weightage)

