



QP CODE: 26019276



26019276

Reg No :

Name :

M.Sc DEGREE (CSS) EXAMINATION, MARCH 2026

Fourth Semester

M Sc ACTUARIAL SCIENCE

Core Courses - AS010402 - RISK MODELING II

2019 Admission Onwards

98F1987B

Time: 3 Hours

Weightage: 30

Part A (Short Answer Questions)

Answer any **eight** questions.

Weight 1 each.

1. Define autoregressive process.
2. Define mean of MA(1) process.
3. State Markov property.
4. Which of the following functions are $O(x)$ as $x \rightarrow 0$?
(i) x^2 (ii) e^x (iii) $e^{-x} - 1 + x$
5. Describe the effect of reinsurance on profitability.
6. How can we calculate future values using average cost per claim method?
7. What do you mean by loss ratio?
8. Uses of machine learning in everyday life
9. What is Semi-supervised learning?
10. What is boosting?

(8×1=8 weightage)

Part B (Short Essay/Problems)

Answer any **six** questions.

Weight 2 each.

11. A time series is defined by the relationship $X_t = X_{t-1} + Z_t$, where the Z_t are IID $N(0, \sigma^2)$ random variables. Determine the relationship between $\text{var}(X_t)$ and $\text{var}(X_{t-1})$, and hence comment on the stationarity of this series.

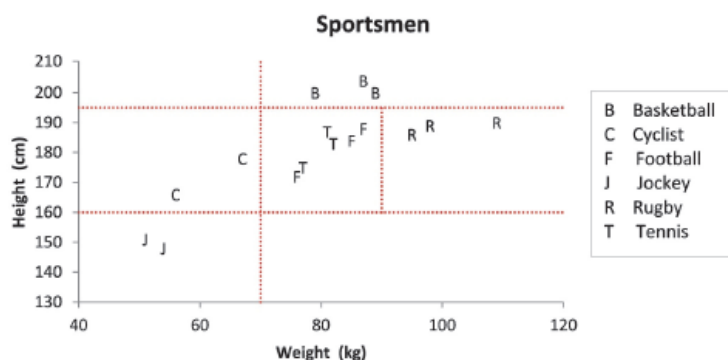




12. Show by substitution that $\gamma_k = \sum_{j=1}^p A_j z_j^{-k}$ is a solution of the given difference equation

$$\gamma_k = \sum_{j=1}^p \alpha_j \gamma_{k-j}$$

13. The aggregate claims arising during each year from a particular type of annual insurance policy are assumed to follow a normal distribution with mean $0.7P$ and standard deviation $2.0P$, where P is the annual premium. Claims are assumed to arise independently. Insurers assess their solvency position at the end of each year. A small insurer with an initial surplus of £0.1m expects to sell 100 policies at the beginning of the coming year in respect of identical risks for an annual premium of £5,000. The insurer incurs expenses of $0.2P$ at the time of writing each policy. Calculate the probability that the insurer will prove to be insolvent at the end of the coming year. Ignore interest.
14. A general insurance company is planning to set up a new class of travel insurance. It plans to start the business with £2 million and expects claims to occur according to a Poisson process with parameter 50. Individual claims are thought to have a gamma distribution with parameters $\alpha = 150$ and $\lambda = \frac{1}{4}$. A premium loading factor of 30% is applied. Explain how each the following changes to the company's model will affect the probability of ultimate ruin:
- (i) A 28% premium loading factor is applied instead
 - (ii) Individual claims are found to have a gamma distribution with parameters $\alpha = 150$ and $\lambda = \frac{1}{2}$
 - (iii) The Poisson parameter is now believed to be 60
15. Explain the general form of a run off triangle
16. What are the assumptions underlying in inflation adjusted chain ladder method.
17. Suggest how the raw data could be converted to a usable 'rectangular' format in each of the following cases:
- (a) identifying people in a photograph stored as an image file
 - (b) identifying vehicles from CCTV video footage.
18. Calculate the Gini index for each of the final nodes in the decision tree for the sportsmen and hence calculate the overall Gini index for the following tree. Comment on your answer.





(6×2=12 weightage)

Part C (Essay Type Questions)

Answer any **two** questions.

Weight 5 each.

19. (a) Define autocovariance function
 (b) Let X and Y denote any random variables.
 (i) Express $\text{cov}(X, Y)$ in terms of $E(X)$, $E(Y)$ and $E(XY)$.
 (ii) Express each of the following in terms of $\text{cov}(X, Y)$:
 (1) $\text{cov}(Y, X)$
 (2) $\text{cov}(X, c)$, where c is a constant
 (3) $\text{cov}(2X, 3Y)$
 (iii) Give an equivalent expression for $\text{cov}(X, X)$.
 (iv) Prove, using your formula in (i), that:

$$\text{cov}(X + Y, W) = \text{cov}(X, W) + \text{cov}(Y, W)$$

 (c) Prove that The autocovariance function γ_k and autocorrelation function ρ_k of a stationary random process are even functions of k , that is, $\gamma_k = \gamma_{-k}$ and $\rho_k = \rho_{-k}$
20. Let $\theta = 0.1$, $\xi = 0.3$ and individual claim amount distribution is $F(x) = 1 - e^{-x}$
 (i) Derive the formula $R = \frac{3\alpha - 2}{10(13\alpha^2 - 2\alpha)}$
 (ii) Show that the value of retention α maximises the adjustment coefficient R is 1
21. The table below shows the numbers of household insurance claims reported in each development year for accident years from 2009 to 2012.

Number of claims reported		Development Year			
		0	1	2	3
Accident Year	2009	17,500	5,000	2,250	750
	2010	21,000	6,200	2,750	
	2011	18,800	5,500		
	2012	21,300			

- (i) Use the basic chain ladder method to estimate the total ultimate number of claims arising from accidents occurring between 1 January 2009 and 31 December 2012
 (ii) Apply the model checking technique and comment on any unusually large error figures
22. Explain the important concepts in machine learning

(2×5=10 weightage)

