



7. Which of the following is true: 1 2 2 2,12  
 (A) The mean of  $x(t)$  is the expected value of the product  $x(t_1) x(t_2)$ . (B) The mean of  $x(t)$  is the expected value of its autocorrelation  
 (C) The mean of  $x(t)$  is the expected value of its autocovariance (D) The mean of  $x(t)$  is the expected value of the random variable  $x(t)$ .
8. Treating the deterministic signal  $x(t)=f(t)$  as a stochastic process, the mean of the process is: 1 2 2 2,12  
 (A)  $f(-t)$  (B)  $f(t)$   
 (C)  $f_2(t)$  (D)  $f_3(t)$
9. The sample standard deviation is 1 2 3 2,12  
 (A) the square root of the sample variance (B) the square root of the sample mean  
 (C) the square root of the sample autocorrelation (D) the square root of the sample autocovariance
10. The runs scored by a batsman in 5 ODIs are 31, 97, 112, 63, and 12. The standard deviation is 1 2 3 2,12  
 (A) 24.79 (B) 23.79  
 (C) 25.79 (D) 26.79
11. The sample covariance matrix of a data set contains 1 2 3 2,12  
 (A) the pairwise sample covariance (B) the pairwise sample correlation  
 (C) the pairwise sample mean (D) the pairwise sample autocovariance
12. Which of the statement is true? 1 2 3 2,12  
 (A) The eigen-decomposition of the covariance matrix is not possible (B) The eigen-decomposition of the covariance matrix is possible  
 (C) The Sample covariance matrix is antisymmetric (D) Sample covariance matrix is upper triangular in nature
13. Which of the statements is true for frequency statistics? 1 1 4 2,12  
 (A) If the model is parametric, the parameters are deterministic quantities (B) If the model is parametric, the parameters are random variables  
 (C) The data is modelled as realizations from a distribution that is random (D) The data is modelled as realizations from a distribution that is infinite
14. Which of the statements is false for Bayesian estimation? 1 2 4 2,3,12  
 (A) There is a dual interpretation of the physical meaning of probability (B) There is a single interpretation of the physical meaning of probability  
 (C) The probability  $p(A)$  of an event A is an "objective" measure of the relative frequency of the occurrence of A (D) The probability  $p(A)$  is a "subjective" measure of our state of knowledge concerning the occurrence of A
15. Which of the statements is true for Bayesian estimation? 1 2 4 2,3,12  
 (A) Posterior distribution is intended to reflect our knowledge of the parameter before we gather data (B) Posterior distribution is intended to reflect our knowledge of the parameter after we gather data  
 (C) Posterior distribution is not related to Bayesian estimation (D) Lebesgue measure is used in the discrete case
16. Which of the statements is true for mean-square-error estimation (MSE)? 1 2 4 2,3,12  
 (A) The posterior mean minimizes the MSE (B) The posterior mean maximizes the MSE  
 (C) The posterior variance minimizes the MSE (D) The posterior variance maximizes the MSE

17. Which of the statements is false for Regression analysis If random variable X is the predictor, and random variable Y is the response? 1 2 5 1,2
- (A) The curve of regression of Y on X is used to describe the statistical relation between X, Y (B) The curve of regression of X on Y is used to describe the statistical relation between X, Y
- (C) It is possible that the curve is a straight line (D) if X and Y have a bivariate normal distribution, then the curve is a straight line
18. Which of the following is true for the coefficient of correlation? 1 2 5 1,2
- (A) The coefficient of correlation is not dependent on the change of scale (B) The coefficient of correlation is not dependent on the change of origin
- (C) The coefficient of correlation is not dependent on both the change of scale and change of origin (D) The coefficient of correlation is a constant quantity
19. Which of the following techniques is an analysis of the relationship between two variables to help provide the prediction mechanism? 1 2 5 1,2
- (A) Standard error (B) Correlation
- (C) Regression (D) Covariance
20. Which of the following statements is true about the arithmetic mean of two regression coefficients? 1 2 5 1,2
- (A) It is less than the correlation coefficient (B) It is equal to the correlation coefficient
- (C) It is greater than or equal to the correlation coefficient (D) It is greater than the correlation coefficient

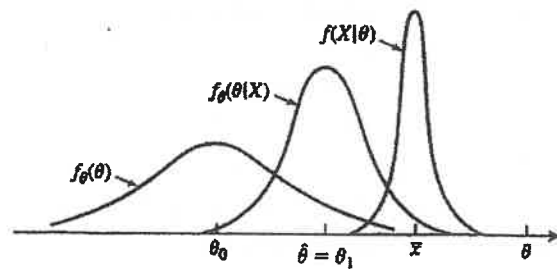
**PART – B (5 × 8 = 40 Marks)**

Marks BL CO PO

Answer ALL Questions

21. a. Independent trials, consisting of the flipping of a coin having probability p of coming up heads, are continually performed until either a head occurs or a total of n flips is made. Find an expression of the probability for 1 to n<sup>th</sup> flip. Also show that the sum of all probabilities is equal to 1. 8 2 1 1,2,12
- (OR)
- b.i. A fair coin is tossed 10000 times. What is the probability that the number of heads is between 4900 and 5100? 4 2 1 1,2,12
- ii. Over a period of 12 hours, 180 calls are made at random. What is the probability that in a four-hour interval the number of calls is between 50 and 70? 4 2 1 1,2,12
22. a. In the fair-coin experiment, we define the process X(t) as follows: X(t) = sin  $\pi t$  if heads shows, X(t) = 2t if tails shows. 8 2 2 2,12
- (i) Find mean E[x(t)]
- (ii) Find F(x, t) for t=0.25, t=0.5, t=1
- (OR)
- b. Write a note on Poisson Process, with the relation of concept of Poisson points. 8 3 2 2,12
23. a. Write a note on order statistics with the necessary mathematical expressions. 8 2 3 2,12
- (OR)
- b. Along a road 1 mile long are 3 people "distributed at random." Find the probability that no 2 people are less than a distance of d miles apart, when  $d \leq 1/2$ . 8 2 3 2,12

24. a. Suppose that  $x = \theta + v$ , where  $v$  is an  $N(0, \sigma)$  random variable and  $\theta$  is the value of an  $N(\theta_0, \sigma_0)$  random variable  $\theta$  (Fig below). Find the bayesian estimate of  $\hat{\theta}$  of  $\theta$ . 8 2 4 2,3,12



(OR)

- b. Let  $(X_1, \dots, X_n)$  be the random sample of a Bernoulli random variable.  $X$  with pmf (probability mass function) given by  $f(x; P) = p^x (1-p)^{(1-x)}$   $x=0,1$  where  $p, 0 \leq p \leq 1$  is unknown. Assume that  $p$  is a uniform random variable over  $(0, 1)$ . Find the Bayes' estimator of  $p$ . 8 3 4 2,3,12
25. a. We consider the problem of building a linear model to predict the Gross Domestic Product (GDP) of a state (Tennessee) in the US from its population and unemployment rate. We have available the following data: 8 3 5 2,3,12

	GDP (USD millions)	Population	Unemployment rate (%)
North Dakota	52 089	757 952	2.4
Alabama	204 861	4 863 300	3.8
Mississippi	107 680	2 988 726	5.2
Arkansas	120 689	2 988 248	3.5
Kansas	153 258	2 907 289	3.8
Georgia	525 360	10 310 371	4.5
Iowa	178 766	3 134 693	3.2
West Virginia	73 374	1 831 102	5.1
Kentucky	197 043	4 436 974	5.2
Tennessee	???	6 651 194	3.0

Build a linear model to predict the GDP.

(OR)

- b. For a simple linear regression model, explain the estimation of parameters with necessary mathematical expressions. 8 3 5 2,3,12

### PART – C (1 × 15 = 15 Marks)

Answer ANY ONE Question

26. Let  $x$  represent a binomial random variable with parameters  $n$  and  $p$ . Show that 15 2 1 1,2,12
- $E(x) = np$ ;
  - $E[x(x-1)] = n(n-1)p^2$ ;
  - $E[x(x-1)(x-2)] = n(n-1)(n-2)p^3$ ;
  - Compute  $E(x^2)$  and  $E(x^3)$ .
27. Explain the concept of Random Walks with necessary mathematical expressions, and also examples. Explain Wiener process. 15 2 2 1,2,12

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