Reg. No.															

Question Paper Code	13737

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2025

Second Semester

Computer Science and Business Systems

24BSMA205 - STATISTICAL METHODS WITH LABORATORY

Regulations - 2024

(Use of Statistical table is permitted)

Duration: 3 Hours Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	An advertising agency wants to test the hypothesis that the proportion of adults in Pakistan who read a Sunday Magazine is 25 percent. The null hypothesis is that the proportion reading the Sunday Magazine is (a) Different from 25% (b) Equal to 25% (c) Less than 25% (d) More than 25 %	1	K2	CO1
2.	In a criminal trial, a Type I error is made when (a) a guilty defendant is acquitted (set free) (b) an innocent person is convicted (sent to jail) (c) a guilty defendant is convicted (d) an innocent person is acquitted	1	K2	CO1
3.	The regression lines pass through (a) Origin (b) $(0, y)$ (c) $(\bar{x}, \bar{y})$ (d) $(x, 0)$	1	K1	CO2
4.	If X, Y are independent then $\rho(X, Y) =$ (a) 0 (b) E(XY) (c) 1 (d) -1	1	K2	CO2
5.	An estimator is said to be consistent if (a) It always gives the same value (b) It converges in probability to the parameter (c) Its variance is zero (d) It is unbiased	1	K1	CO3
6.	If $X_{(1)} \leq X_{(2)} \leq \cdots \leq X_{(n)}$ are the order statistics, then $X_{(k)}$ is (a) Always equal to sample mean (b) The k^{th} largest observation (c) The k^{th} smallest observation (d) The mode	1	K1	CO3
7.	Wilcoxon Signed-Rank Test is used for (a) Paired nominal data (b) Paired ordinal or interval data (c) Independent samples (d) Proportions	1	K1	CO4
8.	Kendall's coefficient of concordance (W) is used to measure (a) Correlation between two variables (b) Consistency of ranks among multiple raters (c) Variance of a single population (d) Difference in medians between groups	1	K1	CO4
9.	The main purpose of using a moving average is to (a) Increase seasonality (b) Remove irregular components (c) Add random variation (d) Create exponential trends	1	K1	CO5
10.	Which of the following is a valid ARMA(1,1) model? (a) $X_t = \phi X_{t-1} + \epsilon_t + \theta$ (b) $X_t = X_{t-1} + \epsilon_t$ (c) $X_t = \epsilon_t$ (d) $X_t = a + bt + \epsilon_t$	1	K1	CO5

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

11.	Define parameter and statistic.	2	K1	CO1
12.	Define level of significance.	2	K1	CO1
13.	Define Standard error.	2	K1	CO1

14.	Write the properties of coefficient of correlation.	2	K1	CO2
15.	What are the assumptions to be made in Analysis of Variance?	2	K2	CO2
16.	Write ANOVA table for Randomized Block Design.	2	K1	CO2
17.	Give an example of a biased but consistent estimator.	2	K1	CO3
18.	What is meant by invariance property of MLE?	2	K1	CO3
19.	Give the formula to find the rank correlation coefficient in case of tie rank.	2	K1	CO4
20.	What are the assumptions made while using Wilcoxon signed rank test?	2	K1	CO4
21.	Define continuous time-series.	2	K1	CO5
22.	What are the classifications of forecasting?	2	K1	CO5

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23. a) State and prove Neyman-Pearson Lemma. — 11 K3 CO1

OR

b) (i) The means of two single large samples of 1000 and 2000 members are 67.5 inches and 68.0 inches respectively. Can the samples be regarded as drawn from the same population of standard deviation 2.5 inches? (Test at 5% level of significance). — 5 K3 CO1

(ii) In a year there are 956 births in a town A, of which 52.5% were males, while in towns A and B combined, this proportion in a total of 1406 births were 0.496. Is there any significant difference in the proportion of male births in the two towns? — 6 K3 CO1

24. a) The following table shows the corresponding values of 3 variables X_1, X_2, X_3. — 11 K3 CO2

X_1	3	5	6	8	12	14
X_2	16	10	7	4	3	2
X_3	90	72	54	42	30	12

Find the regression equation of X_3 on X_1 and X_2. Estimate the value of X_3 when X_1 = 10, X_2 = 6.

OR

b) As part of the investigation of the collapse of the roof of a building, a testing laboratory is given all the available bolts that connected the steel structure at three different positions on the roof. The forces required to shear each of these bolts (Codes values) are as follows. — 11 K3 CO2

Position 1:	90	82	79	98	83	91	92
Position 2:	105	89	93	104	91	95	86
Position 3:	83	89	80	94	92	96	93

Perform an analysis of variance to test at the 0.05 level of significance whether the differences among the sample means at the three positions are significant.

25. a) For random sampling from normal population N (μ, σ^2), find the maximum likelihood estimators for μ and σ^2. — 11 K3 CO3

OR

b) If $X_1, X_2, \ldots, X_n$ is a random sample from Bernoulli population, show that $\hat{\theta} = \frac{\sum X_i}{n}$ is a sufficient estimator of parameter θ. — 11 K3 CO3

26. a) The clothing manufacture purchased some newly designed sewing machine in the hopes that production would be increased. The production records of the random sample of the workers are shown below: *11 K3 CO4*

Workers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Old machine	28	36	27	25	38	36	40	29	32	28	20	32	32	32	36
New machine	36	40	25	32	30	32	40	28	35	23	26	31	23	34	36

Use the Wilcoxon – signed rank test to determine whether the new machines have significantly increased production. Use a 0.05 level of significance.

OR

b) A random sample of 30 students obtained the following marks in a class test. Test the hypothesis that their median score is more than 50. (Use Sign Test) *11 K3 CO4*

55	58	25	32	26	85	44	80	33	72
10	42	15	46	64	39	38	30	36	65
72	46	54	36	39	94	25	74	66	29

27. a) For each of the following models: *11 K3 CO5*

(a) $X_t = 0.3X_{t-1} + Z_t$

(b) $X_t = Z_t - 1.3Z_{t-1} + 0.4Z_{t-2}$

(c) $X_t = 0.5X_{t-1} + Z_t - 1.3Z_{t-1} + 0.4Z_{t-2}$

express the model using B notation and determine whether the model is stationary and/or invertible.

OR

b) Explain in detail about Moving average processes. *11 K3 CO5*

28. a) (i) A company has the head office at Kolkata and a branch at Mumbai. The personnel director wanted to know if the workers at the two places would like the introduction of a new plan of work and a survey was conducted for this purpose. Out of a sample of 500 workers at Kolkata, 62% favoured the new plan. At Mumbai out of a sample of 400 workers, 41% were against the new plan. Is there any significant difference between the two groups in their attitude towards the new plan at 5% level? *5 K3 CO1*

(ii) 25 individuals were sampled as to whether they like or dislike a product indicated by Y and N respectively. The resulting sample is shown by the following sequence: YYNNNNYYYNYNNYNNNNNYYYYNN. *6 K3 CO4*

Find the number of runs and test whether the responses are random at 1% level of significance.

OR

b)(i) In a survey of buying habits, 400 women shoppers are chosen at random in super market 'A' located in a certain section of the city. Their average weekly food expenditure is Rs. 250 with a standard deviation of Rs. 40. For 400 women shoppers chosen at random in super market 'B' in another section of the city, the average weekly food expenditure is Rs. 220 with a standard deviation of Rs. 55. Test at 1% level of significance whether the average weekly food expenditure of the two populations of shoppers is equal. *5 K3 CO1*

(ii) Apply the K-S test to check that the observed frequencies match with the expected frequencies which are obtained from Normal distribution. *6 K3 CO4*

Test Score:	25-30	31-36	37-42	43-48	49-54	55-60	61-66
Observed Frequency:	9	22	25	30	21	12	6
Expected Frequency:	6	17	32	35	18	13	4