

**B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025**

Second Semester

**Computer Science and Business Systems**

**24BSMA205 - STATISTICAL METHODS WITH LABORATORY**

Regulations - 2024

(Use of *Statistical Tables* is permitted)

Duration: 3 Hours

Max. Marks: 100

**PART - A (MCQ) (10 × 1 = 10 Marks)**

Answer ALL Questions

	Marks	K-Level	CO
1. $1 - \alpha$ is called (a) Confidence coefficient                      (b) Power of the test (c) Size of the test                              (d) Level of significance	1	K1	CO1
2. 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
3. If the multiple correlation $R_{1.23} = 0$ , then (a) $r_{12} = 0$ & $r_{13} = 0$ (b) $r_{12} = 0$ & $r_{23} = 0$ (c) $r_{23} = 0$ & $r_{13} = 0$ (d) All of the above	1	K2	CO2
4. The one-way ANOVA is used to test statistical hypotheses concerning (a) Variances                      (b) Means                      (c) Proportions                      (d) Standard deviations	1	K1	CO2
5. Which of the following methods is used to find point estimation? (a) Method of moments                      (b) Maximum likelihood estimation (MLE) (c) Least squares method                      (d) All of the above	1	K1	CO3
6. An estimator is said to be sufficient if (a) It is always unbiased                      (b) It captures all the information in the sample (c) It minimizes variance                      (d) It has high correlation with the parameter	1	K1	CO3
7. Tied ranks in Wilcoxon test are (a) Assigned highest rank                      (b) Averaged and shared (c) Ignored                                      (d) Given random ranks	1	K1	CO4
8. Mann-Whitney U test is used to compare (a) More than two independent groups                      (b) Two independent groups (c) Paired groups                                      (d) Frequencies	1	K1	CO4
9. Which equation represents a MA(1) process? (a) $X_t = \phi X_{t-1} + \epsilon_t$ (b) $X_t = \mu + \epsilon_t + \theta_1 \epsilon_{t-1}$ (c) $X_t = \epsilon_t$ (d) $X_t = X_{t-1} + \epsilon_t$	1	K1	CO5
10. Time series analysis helps to (a) Understand the behaviour of a variable in the past (b) Predict the future behaviour of a variable (c) Plan future operations (d) All of the mentioned	1	K1	CO5

**PART - B (12 × 2 = 24 Marks)**

Answer ALL Questions

11. Define is Null and alternative hypothesis.	2	K1	CO1
12. A random sample of 500 pineapples was taken from a large consignment and 65 were found to be bad. Find the standard error of proportion of bad pineapples.	2	K2	CO1
13. Given $\sigma_1 = 2.7, \sigma_2 = 2.4, \sigma_3 = 2.7; r_{12} = 0.28, r_{13} = 0.51, r_{23} = 0.49. \bar{X}_1 = 2, \bar{X}_2 = 3.5, \bar{X}_3 = 6$ . Find the regression equation $X_1$ on $X_2$ and $X_3$ .	2	K2	CO2
14. Write ANOVA table for Randomized Block Design.	2	K1	CO2

15. If  $X$  has a binomial distribution with parameters  $n$  and  $\theta$ , show that the sample proportion  $\frac{X}{n}$  is an unbiased estimator of  $\theta$ . 2 K2 CO3
16. Define asymptotically unbiased estimator. 2 K1 CO3
17. What are the assumptions made while using Wilcoxon signed rank test? 2 K1 CO4
18. Define the test that is used when more than two sets of rankings are given. 2 K1 CO4
19. Define continuous time-series. 2 K1 CO5
20. Define auto covariance function in time series. 2 K1 CO5
21. Differentiate between Parametric and Non-Parametric test. 2 K2 CO4
22. Explain Mann-Whitney U-Test. 2 K2 CO4

**PART - C (6 × 11 = 66 Marks)**

Answer ALL Questions

23. a) (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. 6 K3 CO1
- (ii) In a sample of 1000 people in Maharashtra, 540 are rice eaters and the rest are wheat eaters. Can we assume that both rice and wheat are equally popular in this State at 1% level of significance? 5 K3 CO1

**OR**

- b) The mean height of 50 male students who showed above average participation in college athletics was 68.2 inches with a standard deviation of 2.5 inches; while 50 male students who showed no interest in such participation had a mean height of 67.5 inches with a standard deviation of 2.8 inches. Test the hypothesis that male students who participate in college athletics are taller than other male students. 11 K3 CO1
24. a) Four farmers each used four types of manures for a crop and obtained the yields (in quintals) as below: 11 K3 CO2

Treatments		1	2	3	4
Farmers	A	22	16	21	12
	B	23	17	19	13
	C	21	14	18	11
	D	22	15	19	10

Is there any significant difference between i) farmers ii) manures.

**OR**

- b) Quotations of index numbers of equity share prices of certain joint stock company and prices of preference share are given below: 11 K3 CO2
- |            |      |      |      |      |      |      |      |
|------------|------|------|------|------|------|------|------|
| Equity     | 97.5 | 99.4 | 90.6 | 96.2 | 95.1 | 98.4 | 97.1 |
| Preference | 75.1 | 75.9 | 77.1 | 78.2 | 79.0 | 74.8 | 70.1 |
- Use rank correlation method to determine the relationship between equity share and preference share prices.
25. a) For random sampling from normal population  $N(\mu, \sigma^2)$ , find the maximum likelihood estimators for  $\mu$  and  $\sigma^2$ . 11 K3 CO3

**OR**

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

26. a) Three different methods of advertising a commodity were used and the respective samples of size 10 each identical outlet was taken. The increased sales were recorded as follows 11 K3 CO4

Sample I	92	79	77	93	99	93	71	87	98	90
Sample II	95	76	84	85	89	90	72	82	68	83
Sample III	81	91	75	80	78	94	100	86	88	69

Use Kendal concordance test to test the hypothesis that mean increase in sales due to three methods is same at 5% 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) Compute the acf of the ARMA (1,1) model. 11 K3 CO5

$$X_t = 0.7X_{t-1} + Z_t + 0.3Z_{t-1}$$

28. a) The nicotine content of two brands of cigarettes measured in milligrams was found to be as follows. 11 K3 CO4

Brand 1	2.1	4	6.3	5.4	4.8	3.7	6.1	3.3		
Brand 2	4.1	0.6	3.1	2.5	4	6.2	1.6	2.2	1.9	5.4

Use Mann-Whitney test to test the hypothesis at 5% level of significance that the average nicotine contents of the two brands are equal against the alternative hypothesis that they are unequal.

**OR**

- b) Apply the K-S test to check that the observed frequencies match with the expected frequencies which are obtained from Normal distribution. 11 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