SASTRA DEEMED UNIVERSITY

(A University under section 3 of the UGC Act, 1956)

End Semester Examinations

July-2022

Course Code: **MAT244**

Course: **STATISTICAL MODELLING**

Question Paper No. :**U1307** Duration: **3** hours

Max. Marks:**100**

(Use of statistical tables is permitted)

PART - A

Answer all the questions **10 x 2 = 20 Marks**

1. Explain the term 'Auto correlation'.
2. Name the following special ARIMA models: (a) ARIMA(0,1,0) (b) ARIMA(0,1,1) with constant.
3. What is a critical region and when is it called the most powerful critical region?
4. Explain the terms: (a) Producer's risk (b) Consumer's risk.
5. List the assumptions of ANOVA.
6. Write any two points that distinguish parametric tests from non-parametric tests.
7. Which test is used for judging the randomness of a sample on the basis of the order in which the sample is taken? How do you find the mean for such a test?

8. Write the formula to find Spearman's coefficient of rank correlation for repeated ranks, explaining the correction factor.

9. What is a raw data type in R? How do you convert any given data type to raw data type? Give example.

10. Write the basic syntax for creating an array in R, explaining the parameters.

PART - B

Answer all the questions **4 x 15 = 60 Marks**

11. From the following data, obtain the multiple correlation coefficients $R_{1.23}$ & $R_{2.13}$.

X_1	22	15	27	28	30	42	40
X_2	12	15	17	15	42	15	28
X_3	13	16	12	18	22	20	12

(OR)

12. Explain how identification, estimation and forecasting a parameter, is done using ARIMA model.

13. How do you measure the efficiency of other estimators compared to the most efficient estimator?
Random samples X_1, X_2, X_3, X_4 of size 4 are drawn from a normal population with unknown mean μ. Consider the following estimators to estimate μ:
(a) $t_1 = \frac{X_1+X_2+X_3+X_4}{4}$

(b) $t_2 = X_1 + \frac{X_2+X_3}{3}$

(c) $t_3 = \frac{5X_1+2X_2+\lambda X_3}{3}$

where λ is such that t_3 is an unbiased estimator of μ. Find λ. Are t_1 & t_2 unbiased? Which is the best estimator among the three? Give reasons.

(OR)

14. Define a likelihood function. Find the Maximum Likelihood Estimator for the parameter λ of a Poisson distribution on the basis of a sample of size n.

15. The following data represents the number of units of tablet production (in thousands) per day by 5 different technicians by using 4 different types of machines.

Machines → Technicians	A	B	C	D
P	54	48	57	46
Q	56	50	62	53
R	44	46	54	42
S	53	48	56	44
T	48	52	59	48

Use 2-way ANOVA techniques (coding method, subtracting each value by 40) to

(a) Test whether the mean productivity of the different machines are the same.

(b) Test whether the five technicians differ with respect to the mean productivity.

(OR)

16. Suppose a company implemented a quality- control program and has been operating under it for 2 years. The company's president wants to determine whether the worker productivity has increased considerably since the installation of the program. Analyze the above, using the Wilcoxon's signed rank test for the following data at $\alpha = 0.01$.

Worker	1	2	3	4	5	6	7	8	9	10
	11	12	13	14	15	16	17	18	19	20
Before	5	4	9	6	3	8	7	10	3	7

	2	5	4	5	8	7	9	5	4	3
After	11	9	9	8	5	7	9	9	7	9
	6	10	9	7	9	6	10	8	5	6

17. (a) Define a function in R and write its structure. Also write the structure of nested functions.
    (b) List any 4 inbuilt mathematical functions in R and explain its input and output operations by giving examples. (7 + 8)

(OR)

18. (a) Define a matrix in R. Write the syntax for creating a matrix.
    (b) Write R code to create a matrix A with numbers 3 to 17 which has 3 rows and by row is true.
    (c) What is the difference between 'cbind(1:4,5:8)' and 'rbind(1:4,5:8)'?
    (d) Subset a matrix B of order 3 x 3 from the matrix A defined above.
    (e) Include row names and row columns for the matrix B as R1, R2, R3 and C1, C2, C3 respectively.

PART - C

Answer the following **1 x 20 = 20 Marks**

19. (a) Create a data frame called 'studentdata' with the Register number, Name, Age and Mode of transport for 15 students, and display the output using a for loop.
    (b) Children in an orthodontia study were asked to rate how they felt about their teeth on a 5-point scale. A Survey was administered before and after treatment. Use the sign test to evaluate whether these data provide evidence that orthodontic treatment improves children's image of their teeth.

How do you feel about your teeth?
1. Wish I could change them.
2. Don't like, but can put up with them.

3. No particular feelings one way or the other.
4. I am satisfied with them.
5. Consider myself fortunate in this area.

Child	1	2	3	4	5	6	7	8	9	10
	11	12	13	14	15	16	17	18	19	20
Before	1	1	3	2	4	1	3	1	1	4
	1	1	1	2	1	2	1	1	4	3
After	5	4	1	3	4	4	5	5	4	4
	1	4	4	4	4	5	4	5	4	5

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