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Reg. No. | | | | | | | | | | | | |

Question Paper Code	12106

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2023

Third Semester

Artificial Intelligence and Data Science

20BSMA302 - PROBABILITY AND STATISTICAL MODELLING

(Regulations 2020)

Duration: 3 Hours | Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

Marks, K-Level, CO

1. State Bayes' theorem. *2, K1,CO1*
2. A continuous RV. X follows the probability law $f(x) = Ax^2$, $0 \le x \le 1$. Determine A and find the probability that X lies between 0.2 and 0.5. *2, K2,CO1*
3. The joint pdf of the random variable (X, Y) is $f(x,y)=\begin{cases} cxy & ,0<x<2;0<y<2 \\ 0 & ,otherwise \end{cases}$. Find the value of c. *2, K2,CO2*
4. Define covariance between two random variables. *2, K1,CO2*
5. Define level of significance. *2, K1,CO3*
6. What are the applications of F-test? *2, K1,CO3*
7. Differentiate between Parametric and non-Parametric tests. *2, K2,CO4*
8. When to use Mann-Whitney U-Test. *2, K1,CO4*
9. Write down the components of time series. *2, K1,CO5*
10. Define Point estimate. *2, K1,CO5*

PART - B (5 × 16 = 80 Marks)

Answer ALL Questions

11. a) (i) The number of telephone calls received in an office during lunch hour has the probability function given below, *8,K3,CO1*

No. of calls: x	0	1	2	3	4	5	6
Probability: $p(x)$	0.05	0.2	0.25	0.2	0.15	0.1	0.05

(a) Verify that it is really a probability distribution (b) Find the probability that there will be three (or) more calls (c) Find the probability that there will be an odd number of calls.

(ii) For a binomial distribution mean and standard deviation are 6 and $\sqrt{2}$ respectively. Find the first two terms of the distribution. *8,K3,CO1*

OR

b) (i) If the p.d.f of a continuous random variable X is $f(x)=\begin{cases} c(3+2x), & if\ 0<x<2 \\ 0, & otherwise \end{cases}$. Find (a) the value of ' c ', (b) Distribution function and (c) $E(X)$. 8,K3,CO1

(ii) The slum clearance authorities in a city installed 2000 electric lamps in a newly constructed town ship. If the lamps have an average life of 1000 burning hours with standard deviation of 200 hours, (a) what number of lamps might be expected to fail in the first 700 burning hours? (b) after what period of burning hours would you expect 10 percent of the lamps would have been failed? (Assume that the life of the lamps follows a normal distributions) 8,K3,CO1

12. a) (i) The joint p.d.f of X and Y is given by $g(x,y)=\begin{cases} e^{-(x+y)}, & x\geq 0, y\geq 0 \\ 0, & elsewhere \end{cases}$. Are X and Y independent? 8,K3,CO2

(ii) Let $X_1, X_2, \ldots, X_n$ be Poisson variates with parameter $\lambda=2$. Let $S_n = X_1 + X_2 + \ldots + X_n$, where $n=75$. Find $P[120 \leq S_n \leq 160]$. 8,K3,CO2

OR

b) (i) Find the covariance between X and Y if the joint probability density of X and Y is $f(x,y)=\begin{cases} 2 & for\ x>0\ ,\ y>0\ ,\ x+y<1 \\ 0 & ;elsewhere \end{cases}$. 8,K3,CO2

(ii) The joint distribution of (X, Y), where X and Y are discrete is given in the following table 8,K3,CO2

X \ Y	0	1	2
0	0.1	0.04	0.06
1	0.2	0.08	0.12
2	0.2	0.08	0.12

Find the marginal pmf of X and Y and $E(XY)$.

13. a) (i) A mathematics test was given to 50 girls and 75 boys. The girls got an average grade of 76 with a S.D. of 6, while boys got an average of 82 with a S.D. of 2. Test whether there is any significant difference between the performance of boys and girls. 8,K3,CO3

(ii) The heights of 10 males of a given locality are found to be 70, 67, 62, 68, 61, 68, 70, 64, 64, 66 inches. Is it reasonable to believe that the average height is greater than 64 inches? 8,K3,CO3

OR

b) A company appoints four salesmen A, B, C and D and observes their sales in three seasons: summer, winter and monsoon. The figures (in lakhs of Rs.) are given in the following table. Carry out analysis of variance. 16,K3,CO3

		Salesman			
		A	B	C	D
Seasons	Summer	45	40	38	37
	Winter	43	41	45	38
	Monsoon	39	39	41	41

14 a) Two methods of instruction to apprentices are to be evaluated. A director assigns 15randomly selected trainees to each of the two Methods. Due to drop outs, 14 complete in Batch 1 and 12 complete In Batch 2.An achievements test was given to these successful Candidates. Their scores are as follows. *16,K3,CO4*

Method I : 70, 90, 82, 64, 86, 77, 84, 79, 82, 89, 73, 81, 83, 66

Method II : 86, 78, 90, 82, 65, 87, 80, 88, 95, 85, 76, 94

Test whether the two methods have significant difference ineffectiveness. Use Mann-Whitney test at 5% significance level.

OR

b) The following are the numbers of hours that 10 students studied for an examination and scores that they obtained: *16,K3,CO4*

No .of hours studied (x)	8	5	11	13	10	5	18	15	2	8
Score (y)	56	44	79	72	70	54	94	85	33	65

Calculate Spearman's rank correlation r_S. Also, test at the 0.01 LOS whether the value obtained r_S is significant.

15. a) (i) If $X_1, X_2, \ldots, X_n$ constitute a random sample, prove that *8,K3,CO5*

$S^2 = \dfrac{\sum_{i=1}^{n}(X_i - \bar{X})^2}{n-1}$ is an unbiased estimator of the finite variance σ^2 for random samples from infinite population.

(ii) Find the maximum likelihood estimator for the parameter λ of a Poisson distribution on the basis of a sample size n. *8,K3,CO5*

OR

b) Derive ARIMA model equation of order (p,q,d). *16,K3,CO5*