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Question Paper Code:U4M22

B.E./B.Tech. DEGREE EXAMINATION, NOV 2023

Fourth Semester

Electronics and Communication Engineering

21UMA422 - PROBABILITY STATISTICS AND MATHEMATICAL STRUCTURES

(Regulations 2021)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. If A and B are independent events then $P(A \cap B) =$ CO6- U
(a) 0 (b) $P(A) \cdot P(B)$ (c) $P(A) + P(B)$ (d) $P(A) - P(B)$
2. If X and Y are independent random variables then $\text{Cov}(X, Y)$ is CO6- U
(a) 0 (b) 1 (c) -1 (d) ∞
3. The degrees of freedom for Normal distribution is _____ CO6- U
(a) $(n-1)(n-2)$ (b) $n-2$ (c) $n-3$ (d) $n-1$
4. F-test is used to test for equality of _____ CO6- U
(a) Sample Mean (b) Variance (c) Population Mean (d) Difference of means
5. SSE for Two way design is CO6- U
(a) $TSS-SSC$ (b) 0 (c) $TSS-SSC-SSR$ (d) $TSS-SSC-SSR-SSK$
6. The degrees of freedom for the variation due to error term in one way classification is CO6- U
(a) $N-1$ (b) $N-2$ (c) $(N-C)$ (d) $C-1$
7. Autocorrelation function is maximum at $\tau =$ CO6- U
(a) 0 (b) 1 (c) -1 (d) ∞
8. Mean Square value of the auto correlation function $R(\tau) = 16 + 9e^{-|\tau|}$ CO4- App
(a) 16 (b) 25 (c) 0 (d) 4

9. $P \vee (P \rightarrow Q)$ is Equivalent to CO5- App
 (a) Q (b)P (c) T (d) F
10. How many “T” are occurred in $(Q \wedge (P \rightarrow Q)) \rightarrow P$ CO5- App
 (a) 4 (b) 3 (c) 1 (d) 2

PART – B (5 x 2= 10Marks)

11. The mean and standard deviation of the binomial distribution 20 and 4 respectively, Calculate the value of the parameter ‘n’. CO1- App
12. If $S_1^2 = 8.833$ and $S_2^2 = 4.178$ then compute the value of F- ratio CO2- Ana
13. For a one way classification on 10 observations involving 3 treatments the sum of squares of treatment and sum of squares of total are 6 and 40 respectively, compute the value of the F – ratio CO3- Ana
14. State any two properties of an auto correlation function CO4 -App
15. Derive R from the premises $P \rightarrow Q, Q \rightarrow R$ and P CO5- App

PART – C (5 x 16= 80Marks)

16. (a) (i) The number of monthly breakdowns of a computer is a R.V. having a Poisson distribution with mean equal to 1.8. Find the Probability that his computer will function for a month (a) Without a breakdown (b) With only one breakdown (c) With at least one breakdown CO1- App (8)

- (ii) A Random Variable X has the following probability distribution CO1- App (8)

X=x	0	1	2	3	4	5	6	7	8
P(X=x)	a	3a	5a	7a	9a	11a	13a	15a	17a

Using the probability mass function, calculate the following
 (i) ‘a’ (ii) $P(X < 3), P(X \geq 3)$ (iii) $(0 < X < 5)$ (iv) distribution function.

Or

- (b) (i) In a large consignment of electric bulbs 10 % are defective. A random sample 20 bulbs are taken for inspection. Find the probability that (i) all are good bulbs (ii) exactly three defective bulbs. CO1- App (8)
- (ii) Using the probability mass function of exponential distribution , CO1- App (8)
 Compute the moment generating function and hence find mean and variance

17. (a) Two researchers A and B adopted different techniques while rating the student's level. Identify the Sampling distribution; Can you say that the techniques adopted by them are significant? CO2- Ana (16)

Researchers	Below Average	Average	Above Average	Genius	Total
A	40	33	25	2	100
B	86	60	44	10	200
Total	126	93	69	12	300

Or

- (b) (i) Two horses A and B were tested according to time (in seconds) to run on a particular track with the following results: CO2- Ana (8)

Horse A	28	30	32	33	33	29	34
Horse B	29	30	30	24	27	29	---

Identify the sampling distribution, test whether horse A is running faster than B at 5% level

- (b) (ii) In one sample of 8 observations the sum of the squares of the deviations of the sample values from the sample mean was 84.4 and another sample of 10 observations it was 102.6, Test whether the difference significant at 5% level of significance CO2- Ana (8)

18. (a) The following is a Latin square of a design, when four varieties of seeds are being tested, Analyze the given data Set up the analysis of variance table and State your conclusion. CO3- Ana (16)

A 105	B 95	C 125	D 115
C 115	D 125	A 105	B 105
D 115	C 95	B 105	A 115
B 95	A 135	D 95	C 115

Or

- (b) A company appoints 4 salesman A,B,C and D and observes their sales in 3 seasons: Summer, winter and Monsoon. The figures (in lakhs of Rs.) are given in the following table: CO3- Ana (16)

		A	B	C	B
Season	Summer	45	40	38	37
	Winter	43	41	45	38
	Monsoon	39	39	41	41

Carry out an analysis of Variance.

19. (a) (i) If the auto correlation function of the random binary transmission CO4- App (8)

is given by $R_{xx}(\tau) = \begin{cases} 1 - \frac{|\tau|}{T} & ; |\tau| \leq T \\ 0 & ; |\tau| \geq T \end{cases}$ Compute the Power spectral

density function.

- (ii) Using the properties of auto correlation function, compute the CO4- App (8)

Mean , Mean Square value and Variance of $R(\tau) = 16 + \frac{3}{1 + 5\tau^2}$

Or

- (b) Given the power spectral density of the continuous process, CO4- App (16)

$\frac{\omega^2 + 2}{\omega^4 + 13\omega^2 + 36}$ Compute the auto correlation function and hence find

the mean square value of the process..

20. (a) (i) Compute the PCNF and PDFN for $(\neg P \rightarrow R) \wedge (Q \leftrightarrow P)$ CO5- App (8)

- (ii) Using rules of inference theory and CP Rule, derive. CO5- App (8)

$$P \rightarrow (Q \rightarrow S), \neg R \vee P, Q \Rightarrow R \rightarrow S$$

Or

- (b) (i) Construct the truth table of $\neg(P \vee (Q \wedge R)) \leftrightarrow ((P \vee Q) \wedge (P \rightarrow R))$ CO5- App (8)

- (ii) Prove that following Premises are inconsistent: CO5- App (8)

If Raj misses many classes through illness than he fails high school.

If Raj fails high school then he is uneducated.

If Raj reads a lot of books then he is not uneducated.

Raj misses many classes through illness and reads a lot of books