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Question Paper Code: U4M24

B.E./B.Tech. DEGREE EXAMINATION, NOV 2024

Fourth Semester

Bio Medical Engineering

21UMA424 - PROBABILITY AND INFERENCE STATISTICS

(Common to Biotechnology)

(Regulations 2021)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

- Probability of an impossible event is CO6- U
(a) 1 (b) 10 (c) 0 (d) ∞
- For Binomial distribution mean is 6 and variance is 2 find $P[X=x]$ CO1- App
a) $9c_x \frac{2^x}{3} \frac{1^{n-x}}{3}$ (b) $6c_x \frac{1^x}{3} \frac{2^{n-x}}{3}$ (c) $2c_x \frac{1^x}{2} \frac{1^{n-x}}{2}$ (d) none of the above
- If X and Y are independent random variables then find $Cov(X, Y)$ CO6- U
(a) 0 (b) 1 (c) -1 (d) ∞
- The Conditional density function of Y given X is CO6- U
(a) $f(x)$ (b) $f(y/x)$ (c) $f(x/y)$ (d) $f(y)$
- Auto Correlation function is ----- function CO6- U
(a) Odd (b) Even (c) Neither Even Nor Odd (d) None of the above
- If the Random Process $\{X(t)\}$ with mean μ has Auto correlation function $R(\tau) = 16 + 9e^{-|\tau|}$ Then the mean square Variance of the process is CO3- App
(a) 16 (b) 25 (c) 29 (d) 4

7. The system is said to be stable if CO6- U
- (a) $\int_{-\infty}^{\infty} h(t) dt < \infty$ (b) $\int_{-\infty}^{\infty} h(t) dt > \infty$ (c) $\int_{-\infty}^{\infty} h(t) dt > 0$ (d) None of the above
8. The average power of the auto correlation function is $R_{xx}(\tau) = 3e^{-3|\tau|}$ CO4- App
- (a) 3 (b) 6 (c) 2 (d) 0
9. Large sample size is _____ CO6- U
- (a) 30 (b) >30 (c) <30 (d) None of the above
10. F-test is used to test for equality of _____ CO6- U
- (a) Sample Mean (b) Variance (c) Population mean (d) All the above

PART – B (5 x 2= 10 Marks)

11. A Continuous random variable with density function is given by CO1- App
- $f(x) = 6x(1-x), 0 \leq x \leq 1$ Check the above is PDF or not.
12. The joint PDF of the RV (X, Y) is given by CO2- U
- $$f(x, y) = \begin{cases} e^{-(x+y)}, & 0 < x, y < \infty \\ 0, & \text{otherwise} \end{cases}$$
- Are X And Y Independent?
13. The power spectrum of a WSS process X (t) is given by $S_{xx}(\omega) = \frac{4}{4 + \omega^2}$ Find CO3- App
- the autocorrelation.
14. Determine the power spectrum of white noise process CO4- App
15. If $S_1^2 = 8.833$ and $S_2^2 = 4.178$ then compute the value of F- ratio CO5- Ana

PART – C (5 x 16= 80 Marks)

16. (a) (i) Define Poisson distribution. Find the moment generating function and Hence find mean and variance. CO1- App (8)
- (ii) 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)

Or

- (b) A Random Variable X has the following probability distribution CO1- App (16)

X=x	0	1	2	3	4	5	6	7
P(X=x)	0	a	2a	2a	3a	a ²	2a ²	7a ² +a

Find i) 'a'

ii) $P(X < 6), P(X \geq 6) \text{ \& } P(1.5 < X < 6.5 / X > 5)$

iii) If $P(X \leq a) > \frac{1}{2}$, Find the minimum value of 'a'

iv) Distribution function of x

17. (a) If joint probability distribution function X and Y is given by CO2- Ana (16)
 $P(x, y) = k(2x + 3y)$, for $x = 0, 1, 2$ & $y = 1, 2, 3$ then find all marginal and conditional probability distribution function of X and Y. &also find $P(X+Y)$.

Or

- (b) If the joint Probability density function of X and Y is given by CO2- Ana (16)

$$f(x, y) = \frac{1}{8}(6 - x - y), \quad 0 < x < 2, 2 < y < 4$$

Find (a) $P(X < 1 \cap Y < 3)$ (b) $P(X < 1 / Y < 3)$ (c) $P(X + Y < 3)$

18. (a) (i) If the auto correlation function of the random binary CO3- App (8)

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

spectral density function.

- (ii) A stationary process has an autocorrelation function given by CO3-App (8)

$$R(\tau) = 25 + \frac{4}{1 + 6\tau^2}$$
 Find the Mean and Variance

Or

- (b) (i) If the auto correlation function of the random binary CO3- App (8)

transmission is given by $R_{xx}(\tau) = \begin{cases} 1 - |\tau| & ; |\tau| \leq 1 \\ 0 & ; else \end{cases}$ compute the

Power spectral density function.

(ii) A stationary process has an auto correlation function given by CO3-App (8)

$$R(\tau) = \frac{25\tau^2 + 36}{6.25\tau^2 + 4} \text{ compute the mean and variance}$$

19. (a) A random process X (t) having the autocorrelation function CO4- App (16)

$R_{xx}(\tau) = P e^{-\alpha|\tau|}$ Where b is a constant is applied to the input of the system with impulse response $h(t) = e^{-bt}U(t)$ where b is a constant. Find the autocorrelation of the output Y (t).

Or

(b) If X (t) is a WSS process and if CO4- App (16)

$$Y(t) = \int_{-\infty}^{\infty} h(u) X(t-u) du \text{ then}$$

$$S_{YY}(\omega) = S_{XX}(\omega) * |H(\omega)|^2$$

20. (a) Two independent samples of sizes 9 and 7 from a normal CO5- Ana (16)
population had the following values of the variables.

Sample I	18	13	12	15	12	14	16	14	15
Sample II	16	19	13	16	18	13	15		

Identify the sampling distribution, Do the estimates of the population variance differ significantly.

Or

(b) (i) The theory predicts the population of beans in the four groups A, B, C and D should be 9:3:3:1. In an experiment among 1600 beans, the numbers in the four groups were 882, 313, 287 and 118. Does the experimental result support the theory? CO5- Ana (8)

(ii) On the basis of information noted below, find out whether the new treatment is comparatively superior to the conventional one. CO5- Ana (8)
Identify the sampling distribution.

	Favorable	Non-Favorable	Total
conventional	40	70	110
New	60	30	90
Total	100	100	200