A **Reg. No. :** | | | | | | | | | | | | |

Question Paper Code:U4M24

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

Fourth Semester

Bio Medical Engineering

21UMA424 - PROBABILITY AND INFERENTIAL STATISTICS

(Common to Bio Technology)

(Regulations 2021)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The r^{th}moment about origin is CO6- U

   (a) $\mu(X)$ (b) $\mu(X^2)$ (c) $\mu(X^r)$ (d) None of the above

2. For Binomial distribution mean is 6 and variance is 2 find P[X=x] CO1- App

   (a) ${}^{9}c_{x}\ \frac{2}{3}^{x}\ \frac{1}{3}^{n-x}$ (b) ${}^{6}c_{x}\ \frac{1}{3}^{x}\ \frac{2}{3}^{n-x}$ (c) ${}^{2}c_{x}\ \frac{1}{2}^{x}\ \frac{1}{2}^{n-x}$ (d) none of the above

3. Correlation coefficient value lies between CO6- U

   (a) -1 to 0 (b) -1 to +1 (c) 1 to 0 (d) 0 to 1

4. The regression lines of two random variables X,Y is given by CO2- Ana
   3x +y = 10, 3x+4y=12. The correlation between X, Y is

   (a) 1/2 (b)-1/2 (c)-1 (d) 1

5. Autocorrelation function is maximum at τ = CO3- App

   (a) 0 (b)1 (c) -1 (d) ∞

6. If the Random Process {X(t)} with mean has Auto correlation function CO3- App
   $R(\tau) = 16 + 9e^{-|\tau|}$ then the mean value is

   (a) 16 (b) 25 (c) 0 (d) 4

7. If X(t) is the white noise process ,then its power spectrum is given by CO6- U

(a) $S(\omega) = \frac{N_0}{4\pi}$ (b) $S(\omega) = \frac{N_0}{4}$ (c) $S(\omega) = \frac{N_0}{2}\delta(\tau)$ (d) $S(\omega) = \frac{N_0}{2}$

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. F-test is used to test for equality of _____ CO6- U

(a) Sample Mean (b) Variance (c) Population mean (d) All 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= 10Marks)

11. A Continuous random variable with density function is given by CO1-App

$f(x) = 6x(1-x), 0 \le x \le 1$ Check the above is PDF or not.

12. Find the value of K, if $f(x, y) = Kxy$ in 0 < x, y < 1 is to be the joint density function CO2-Ana

13. Compute the mean square value of the auto correlation function CO3-App

$R(\tau) = 25 + \frac{4}{1+6\tau^2}$

14. Calculate the value of the system transfer function,if the input of the system with impulse response h(t) = e^{-3t} U(t). CO4-App

15. Give two types of errors in testing a statistical hypothesis. CO5-Ana

PART – C (5 x 16= 80Marks)

16. (a) (i) A Random Variable X has the following probability distribution CO1-App (8)

X=x	0	1	2	3	4	5	6	7
P(X=x)	0	k	2k	2k	3k	k^2	$2k^2$	$7k^2+k$

Find (i) 'k'

(ii) P(X > 6), P(0 < X < 4

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

Or

(b) (i) If $f(x) = \begin{cases} \frac{k}{1+x^2}, -\infty < x < \infty \\ o \quad , elsewhere \end{cases}$ is the Probability Density Function CO1-App (8)

of a Random variable X ,

(i) Find K (ii) distribution function of F(x).

(ii) State and Prove the memoryless property for an Exponential Property — CO1-App — (8)

17. (a) If the joint probability density function of X and Y is given by $f(x,y) = 2 - x - y,\ 0 \le x \le 1, 0 \le y \le 1$ Find the correlation coefficient between X and Y. — CO2-Ana — (16)

Or

(b) If the joint Probability density function of X and Y is given by $f(x,y) = \frac{1}{8}(6 - x - y),\ 0 < x < 2, 2 < y < 4$

Find (a) $P(X < 1 \cap Y < 3)$ (b) $P(X < 1 / Y < 3)$ (c) $P(X + Y < 3)$ — CO2-Ana — (16)

18. (a) (i) If the auto correlation function of the random binary transmission is given by

$$R_{XX}(\tau) = \begin{cases} 1 - \frac{|\tau|}{T} & ; |\tau| \le T \\ 0 & ; |\tau| \ge T \end{cases}$$

Find the Power spectral density function. — CO3-App — (8)

(ii) A stationary process has an autocorrelation function given by $R(\tau) = 25 + \frac{4}{1 + 6\tau^2}$ Find the Mean and Variance — CO3-App — (8)

Or

(b) (i) If the Power spectral density of a WSS processes is given by — CO3-App — (8)

$$S(\omega) = \begin{cases} \frac{b}{a}(a - |\omega|) & ; |\omega| \le a \\ 0 & ; |\omega| > a \end{cases}$$

Find the auto correlation function of the Process

(ii) Find power spectral densities of the following auto correlation function $R(\tau) = e^{\frac{-\alpha^2\tau^2}{2}}$ — CO3-App — (8)

19. (a) If the input to a time invariant stable linear system is a wide sense stationary process. Prove that the output will also be a wide sense stationary process — CO4-App — (16)

Or

(b) A random process X (t) having the autocorrelation function $R_{xx(\tau)} = P\, e^{-\alpha|\tau|}$ 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). CO4-App (16)

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

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.