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Question Paper Code: U4M26

B.E./B.Tech. DEGREE EXAMINATION, APRIL 2025

Fourth Semester

Computer Science and Design

21UMA426- PROBABILITY AND STATISTICAL TECHNIQUES

(Common to Artificial Intelligence and Data Science Engineering)

(Regulations 2021)

Duration: Three hours

Maximum: 100 Marks

PART A - (10 x 1 = 10 Marks)

1. The mean of the random variable is denoted by CO6- U

(a) $E(X)$ (b) $E(X^2)$ (c) 0 (d) 1

2. If X is the discrete random variable having the probability mass function, CO1- App
then K value is .

X	-1	0	1
P(X)	K	2K	3K

(a) $1/6$ (b) $-1/6$ (c) -1 (d) 1

3. Which of the following distribution has equal mean and Standard deviation? CO6- U

(a) Geometric (b) Poisson (c) Normal (d) Binomial

4. If $M_x(t) = (0.3 + 0.7e^t)^{10}$ then value of mean is CO6- U

(a) 30 (b) 0.21 (c) 70 (d) 21

5. If X and Y are independent, then $\text{Cov}(X, Y) =$ CO6- U

(a) 1 (b) 0 (c) 2 (d) 3

6. $\text{Var}(2X + 3) =$ CO3-App

(a) $4\text{Var}(X) + 9\text{Var}(Y)$ (b) $4\text{Var}(X)$ (c) $9\text{Var}(Y)$ (d) 0

7. Estimate is the observed value of an: CO6-U

(a) Unbiased estimator (b) Estimator (c) Estimation (d) Interval estimation

8. The distance between an estimate and estimated parameter is called _____ CO6- U
 (a) Sampling error (b) Error of estimation (c) Bias (d) standard error
9. In Chi-square the sample observations should be CO6- U
 (a) dependent (b) independent (c) equal (d) none of these
10. The mean for t-test distribution is CO6- U
 (a) $t = \frac{\bar{x}_1 - \mu}{s / \sqrt{n-1}}$ (b) $t = \frac{\bar{x}_1 + \mu}{s / \sqrt{n-1}}$ (c) $t = 0$ (d) None of the above

PART – B (5 x 2= 10Marks)

11. If the joint p.d.f of (X,Y) is given by $f(x, y) = 2, 0 \leq x \leq y \leq 1$ Compute $f(x)$ CO1-App
12. If Moment generating function $M_x(t) = \frac{5}{5-t}$, find the variance value CO2-App
13. If Correlation coefficient $\gamma = 0.9, \sigma_x = 5, \sigma_y = 2$, find the covariance value. CO3-App
14. If T is an unbiased estimator for θ , show that T^2 is a biased estimator for θ^2 . CO6-U
15. Define: Type I Error & Type II Error. CO6- U

PART – C (5 x 16= 80Marks)

16. (a) (i) The joint probability mass function of (X,Y) is given by CO1-App (8)
 $P(x, y) = k(4x + 3y) \quad x = 1, 3, 5 \quad y = 1, 2, 3$ Compute marginal distribution function, and conditional distribution
 (ii) The cumulative distribution function of a random variable X is CO1-App (8)
 $F(x) = 1 - (1+x)e^{-x}, x > 0$. Find the probability density function of X, mean and variance

Or

- (b) (i) The joint pdf CO1-App (8)

$$f(x, y) = \begin{cases} \frac{8xy}{9}, & 0 \leq x \leq y \leq 2 \\ 0 & \text{otherwise} \end{cases}$$

Compute (i) $f_x(x)$ (ii) $f_y(y)$ (iii). conditional density function

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

x	0	1	2	3	4	6	7
P(X)	a	3a	5a	7a	9a	12a	15a

Compute Mean and Variance

17. (a) (i) Compute the moment generating function of Poisson distribution and hence Compute it's mean and variance. CO2-App (8)
(ii) Four coins are tossed simultaneously. What is the probability of getting (i) exactly 2 heads (ii) atleast 2 heads (iii) atmost 2 heads CO2-App (8)

Or

- (b) (i) Compute the moment generating function of Geometric distribution and hence Compute it's mean and variance CO2- App (8)
(ii) The mileage which car owners get with a certain kind of radial tire is a random variable having an exponential distribution with mean 80,000 km. Derive the probabilities that one of these tires will last (i) at least 30,000 km and (ii) at most 40,000 km CO2- App (8)

18. (a) (i) Obtain the Correlation coefficient for the following data CO3- App (8)

X	12	15	17	18	23	16	25	27
Y	110	120	124	130	136	122	140	143

- (ii) Joint pdf of X and Y is CO3- App (8)

$$f(x, y) = \begin{cases} \frac{1}{8}(x + y), & 0 \leq x \leq 2, 0 \leq y \leq 2 \\ 0 & \text{elsewhere} \end{cases}$$

Compute Regression Equations

Or

- (b) (i) Obtain the rank Correlation coefficient for the following data: CO3-App (8)

X	10	15	12	12	12	15	14	16
Y	30	42	30	42	42	44	45	42

- (ii) If $\sigma_1 = 5$, $\sigma_2 = \sigma_3 = 4$, $r_{12} = 0.61$, $r_{23} = 0.32$, $r_{31} = 0.45$ Compute CO3-App (8)

(i) $r_{12.3}$ (ii) $R_{2.31}$ (iii) $b_{12.3}$ (iv) $b_{12.3}$

19. (a) (i) If $X_1, X_2, X_3, \dots, X_n$ are random observations on a Bernoulli variate X taking the value 1 with probability p and the value 0 with probability $(1 - p)$, show that: $\frac{\sum x_i}{n} \left(1 - \frac{\sum x_i}{n} \right)$ is a consistent estimator of $p(1 - p)$. CO4-App (8)

- (ii) An ambulance service claims that it takes on the average 8.9 minutes to reach its destination in emergency calls. To check on this claim, the agency which licenses ambulance services has them timed on 50 emergency calls, getting a mean of 9.3 minutes with a standard deviation of 1.6 minutes. What can they conclude at the level of significance? CO4-App (8)

Or

- (b) In random sampling from normal population $N(\mu, \sigma^2)$, find the maximum likelihood estimators for
- (i) μ when σ^2 is known
 - (ii) σ^2 when μ is known and
 - (iii) The simultaneous estimation of μ and σ^2 .

20. (a) (i) A certain injection administered to each of 12 patients resulted in the following increases of blood pressure: 5, 2, 8, -1, 3, 0, 6, -2, 1, 5, 0, 4 can it be classified that the injection will be, in general, accompanied by an increase in BP?

- (ii) The following table gives the number of aircraft accidents that occurred during the various days of the week. Test whether the accidents are uniformly distributed over the week.

Days	Mon	Tue	Wed	Thu	Fri	Sat
No. of accidents	42	25	28	33	34	37

Or

- (b) (i) Two independent samples of sizes 9 and 7 from a normal 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	-	-

Investigate the estimates of the population variance differ significantly at 5% level?

- (ii) In one sample of 10 observations, the sum of the squares of the deviations of the sample values from the sample mean was 120 and in another sample of 12 observations it was 314. Ensure that the test whether this difference is significant at 5% level of significance