Reg. No.																

Question Paper Code	13707

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2025

Third Semester

Artificial Intelligence and Data Science

(Common to Computer Science and Engineering(AIML))

20BSMA302 - PROBABILITY AND STATISTICAL MODELING

Regulations - 2020

(Use of Parametric and Non Parametric test Tables are permitted)

Duration: 3 Hours — Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

		Marks	*K – Level*	*CO*
1.	If A and B are independent events then P(A/B) = (a) P(A) (b) P(B) (c) $P(A\cap B)$ (d) $\frac{P(A\cap B)}{P(B)}$	*1*	*K1*	*CO1*
2.	In a binomial distribution, what is E[X]? (a) npq (b) np (c) (n+1) pq (d) (n+1)p	*1*	*K1*	*CO1*
3.	If X and Y are independent variables then what is Cov(X,Y) (a) 0 (b) 1 (c) -1 (d) 2	*1*	*K1*	*CO2*
4.	The parameters of Bivariate normal distribution are __________. (a) $\mu, \ \rho$ (b) $\mu, \ \gamma$ (c) $\mu, \ \sigma$ (d) $x, \ s$	*1*	*K1*	*CO2*
5.	Z-test is used to test samples of size _________________. (a) Greater than 30 (b) Greater than 25 (c) Less than 30 (d) Less than 25	*1*	*K1*	*CO3*
6.	If the calculated value is less than the table value, in testing a hypothesis we (a) Reject null hypothesis (b) Accept null hypothesis (c) Accept alternative hypothesis (d) None of the above	*1*	*K1*	*CO3*
7.	In testing for the difference between two populations, it is possible to use (a) Sign test (b) Wilcoxon signed-rank test (c) Either Sign test or Wilcoxon signed-rank test (d) None of the above	*1*	*K1*	*CO4*
8.	Nonparametric statistics are also called _________________________. (a) Distribution free statistics (b) Analysis free statistics (c) Mean free statistics (d) None of these	*1*	*K1*	*CO4*
9.	A rise in prices before a festival is an example of ____________________. (a) Seasonal Variation (b) Secular Trend (c) Irregular Variations (d) Cyclical Variation	*1*	*K1*	*CO5*
10.	A time series has __________. (a) 2 components (b) 3 components (c) 4 components (d) 5 components	*1*	*K1*	*CO5*

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

		Marks	*K – Level*	*CO*
11.	The mean and variance of a binomial distribution are 4 and 4/3 respectively. Find $P(X\geq 1)$.	*2*	*K1*	*CO1*
12.	A fair coin is tossed four times. Find the probability that i) more heads than tails are occur ii) tails occur on an even number of tosses.	*2*	*K2*	*CO1*
13.	If A and B are two events with P(A) = 3/8 , P(B) = 1/2 and $P(A\cap B)$ = ¼ then find $P(A^C\cap B^C)$.	*2*	*K2*	*CO1*
14.	Define bivariate normal distribution.	*2*	*K1*	*CO2*
15.	State central limit theorem.	*2*	*K1*	*CO2*
16.	A fair die is rolled independently 10 times. Find the probability that the faces 1 to 6 occur the following respective number of times: 2, 1, 3, 1, 2, 1.	*2*	*K2*	*CO2*
17.	Define Type-I and Type-II error.	*2*	*K1*	*CO3*

18. Define parameter and statistic. *2 K1 CO3*

19. What are the advantages of Non-Parametric test? *2 K1 CO4*

20. Give the formula to find the rank correlation coefficient in case of tie rank. *2 K2 CO4*

21. Define Point estimation. *2 K1 CO5*

22. Define autocorrelation function. *2 K1 CO5*

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23. a) A random variable X has the following probability distribution. *11 K3 CO1*

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

Find (i) the value of K

(ii) $P(1.5 < X < 4.5 / X > 2)$ and

(iii) The smallest value of n for which $P(X \leq n) > \frac{1}{2}$.

OR

b) The number of accidents in a year attributed to taxi drivers in a city follows a Poisson distribution with mean equal to 3. Out of 1000 taxi drivers, find approximately thenumber of drivers with (i) no accident in a year, (ii) more than 3 accidents in a year. *11 K3 CO1*

24. a) The joint probability mass function of (X, Y) is given by $p(x, y) = k(2x + 3y)$, $x = 0, 1, 2$; $y = 1, 2, 3$. Find all the marginal and conditional probability distributions. Also, find $P(X + Y > 3)$. *11 K3 CO2*

OR

b) A life time of a certain brand of an electric bulb may be considered as a RV with mean $1200h$ and standard deviation $250\ h$. Find the probability, using central limit theorem, that the average life time of 60 bulbs exceed $1250h$. *11 K3 CO2*

25. a) The following are the number of mistakes made in 5 successive days by 4 technicians working for a photographic laboratory test at a level of significance 0.01. Test whether the difference among the four samples means can be attributed to chance. *11 K3 CO3*

Technician			
I	II	III	IV
6	14	10	9
14	9	12	12
10	12	7	8
8	10	15	10
11	14	11	11

OR

b) The lines of regression of a bivariate population are : $8x - 10y + 66 = 0$ and $40x - 18y = 214$. The variance of x is 9. Find *11 K3 CO3*

(i) The mean values of x and y

(ii) Correlation coefficient between x and y

(iii) Standard deviation of y

26. a) Apply the K-S test to check that the observed frequencies match with the expected frequencies which are obtained from Normal distribution. (Given at n=7, D(0.10)=0.438). *11 K3 CO4*

Test Score	**25-30**	**31-36**	**37-42**	**43-48**	**49-54**	**55-60**	**61-66**
Observed frequency	9	22	25	30	21	12	6
Expected frequency	6	17	32	35	18	13	4

OR

b) Two methods of instruction to apprentices is to be evaluated. A director assigns 15 randomly selected trainees to each of the two Methods. Due to drop outs, 14 complete in Batch 1 and 12 complete In Batch 2. An achievement test was given to these successful Candidates. Their scores are as follows *11 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 in effectiveness. Use Mann- Whitney test at 5% significance level.

27. a) Prove that $s^2=\frac{\Sigma(X_i-\bar{X})^2}{n}$is not an unbiased estimator of population variance σ^2. From that prove $S^2=\frac{\Sigma(X_i-\bar{X})^2}{n-1}$ is biased estimator. *11 K3 CO5*

OR

b) For the model (1-0.2B) (1-B)X_t= (1-0.5B)Z_t. Classify the model as an ARIMA (p, d, q) process. Determine whether the process is stationary and invertible. Evaluate the first three ψ weights of the model when expressed as a MA(∞) model. *11 K3 CO5*

28. a) (i) Below is the table of observed frequencies along with the frequency to the observed under anormal distribution. *6 K3 CO4*

Test Score	51-60	61-70	71-80	81-90	91-100
Observed frequency	25	85	400	380	110
Expected frequency	40	110	500	290	60

Calculate the Kolmogorov Smirnov's test statistic.

(ii) Show that $\bar{X}$is consistent estimator of μ in (μ, σ^2). *5 K3 CO5*

OR

b) (i) In 30 tosses of a coin, the following sequence of head (H) and tails (T) is obtained HTTHTHHHTHHTTHTHTHHTHTTHTHHTHT. Determine the number of runs. *6 K3 CO4*

(ii) Find the Maximum Likelihood estimator for θ if $f(x) = \frac{1}{\theta}e^{-\frac{x}{\theta}}$ x>0 ,θ>0. *5 K3 CO5*