Reg. No.																

Question Paper Code	13167

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2024

Third Semester

Artificial Intelligence and Data Science

(Common to Computer Science and Engineering (AIML) & Computer Science and Engineering (IoT))

20BSMA302 - PROBABILITY AND STATISTICAL MODELLING

Regulations - 2020

(Use of statistical table is permitted)

Duration: 3 Hours Max. Marks: 100

PART - A (MCQ) (20 × 1 = 20 Marks)

Answer ALL Questions

Question	Marks	K – Level	CO
1. In a binomial distribution, what is E[X]? (a) npq (b) np (c) (n+1) pq (d) (n+1)p	1	K1	CO1
2. What is first moment about mean? (a) 1 (b) 0 (c) μ (d) σ^2	1	K3	CO1
3. Poisson distribution is a limiting case of _____________ . (a) Negative binomial distribution (b) Binomial distribution (c) Geometric distribution (d) Exponential distribution	1	K1	CO1
4. A perfect dice is thrown twice. Then, the probability of getting a total of 9 is (a) 1/8 (b) 2/9 (c) 1/9 (d) 11/36	1	K3	CO1
5. If X and Y are independent variables then what is Cov(X,Y) (a) 0 (b) 1 (c) -1 (d) 2	1	K1	CO2
6. The parameters of bivariate normal distribution are ________. (a) $\mu, \ \rho$ (b) $\mu, \ \gamma$ (c) $\mu, \ \sigma$ (d) $x, \ s$	1	K2	CO2
7. What is E[aX+bY] ? (a) aE[X]+bE[Y] (b) $a^2E[X]+b^2E[Y]$ (c) ab{E[X]+E[Y] } (d) $a^2E[X]+b^2E[Y]+2abE[XY]$	1	K1	CO2
8. Multinomial distribution is a generalization of ____________ . (a) Poisson distribution (b) Normal distribution (c) Binomial distribution (d) Geometric distribution	1	K2	CO2
9. Probability of type I is called ___________ . (a) Consumers risk (b) Producer's risk (c) Level of significance (d) Standard error	1	K1	CO3
10. The statistical constants of population are called (a) Statistic (b) Variables (c) Constants (d) Parameter	1	K1	CO3
11. If the correlation coefficient between the two random variables is one then they are (a) Highly correlated (b) Positively correlated (c) Negatively correlated (d) No correlation	1	K1	CO3
12. 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	K2	CO3
13. The Mann-Whitney U test is a counterpart of the ________ to compare the means of two independent populations. (a) Anova (b) t-test (c) z-test (d) Chi-square test	1	K2	CO4

14. Which is used to check the uniformity of random numbers? *1 K2 CO4*
(a) The Kolmogorov-Smirnov test (b) The Kruskal-Wallis test
(c) The Mann-Whitney test (d) The Wilcoxon Signed-Rank test
15. Nonparametric statistics are also called *1 K1 CO4*
(a) Distribution free statistics (b) Analysis free statistics
(c) Mean free statistics (d) None of these
16. The sign test assumes that the *1 K1 CO4*
(a) Samples are independent (b) Samples are dependent
(c) Samples have the same mean (d) None of the above
17. Which type of estimation approach uses sample data to compute a range of possible values for a population parameter? *1 K2 CO5*
(a) Point estimation (b) Data estimation
(c) Interval estimation (d) Statistical estimation
18. Which type of estimate provides a single-value approximation of a population parameter? *1 K1 CO5*
(a) Interval estimate (b) Prediction estimate
(c) Sample estimate (d) Point estimate
19. A rise in prices before a festival is an example of *1 K1 CO5*
(a) Seasonal Variation (b) Secular Trend
(c) Irregular Variations (d) Cyclical Variation
20. A time series has *1 K1 CO5*
(a) 2 components (b) 3 components
(c) 4 components (d) 5 components

PART - B (10 × 2 = 20 Marks)

Answer ALL Questions

21. A fair coin is tossed four times. Find the probability that *2 K3 CO1*
(i) more heads than tails are occur (ii) tails occur on an even number of tosses.
22. Find *c*, if a continuous random variable *X* has the density function $f(x) = \frac{c}{1+x^2}, \infty < x < \infty$ *2 K3 CO1*
23. State central limit theorem. *2 K1 CO2*
24. 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 K3 CO2*
25. Define Type-I and Type-II error. *2 K3 CO3*
26. Write any two uses of t-distribution. *2 K1 CO3*
27. Determine the number of runs for M W MM WW MM WWW M WW MM WW MMM and also find their mean. *2 K1 CO4*
28. Give the test statistic used in Kendall test of concordance. *2 K3 CO4*
29. Define Maximum likelihood estimator. *2 K1 CO5*
30. Define auto covariance function. *2 K2 CO5*

PART - C (6 × 10 = 60 Marks)

Answer ALL Questions

31. a) A random variable *X* has the following probability distribution. *10 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 $P(X \le n) > \frac{1}{2}$.

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 the number of drivers with (i) no accident in a year, (ii) more than 3 accidents in a year.	*10*	*K3*	*CO1*
32.	a)	The joint probability density function of X and Y is given by $f(x,y) = \frac{x+y}{21}$; x=1,2,3; y=1,2. Find the covariance of (X, Y).	*10*	*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.	*10*	*K3*	*CO2*
33.	a)	The mean height and the S.D height of eight randomly chosen soldiers are 166.9 cm and 8.29 cm respectively. The corresponding values of six randomly chosen sailors are 170.3 cm and 8.50 cm respectively. Based on this data, can we conclude that soldiers are, in general, shorter than sailors?	*10*	*K2*	*CO3*
		OR			
	b)	A company appoints four salesmen A, B, C and D and observes their sales in three seasons: summer, winter and monsoon. The figures (in lakhs of Rs.) are given in the following table.	*10*	*K3*	*CO3*

Salesman

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

Carry out analysis of variance.

34.	a)	Two methods of instruction to apprentices are 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	*10*	*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.

OR

	b)	Use the sign test on the data given below to determine whether there is a statistical increase in the values produced by treatment B over those produced by treatment A:	*10*	*K3*	*CO4*

Subject	1	2	3	4	5	6	7	8	9	10
Treatment A	46	41	37	32	28	43	42	51	28	27
Treatment B	52	43	37	32	31	39	44	53	26	31

35.	a)	Find the Maximum Likelihood estimator for θ if $f(x) = \frac{1}{\theta} e^{-\frac{x}{\theta}}$ x>0 ,θ>0.	*10*	*K2*	*CO5*
		OR			
	b)	Consider the ARMA (1, 1) process given by $X_t = \alpha X_{t-1} + Z_t + \beta Z_{t-1}$ Where $\|\alpha\| < 1$ and $\|\beta\|$ <1. Derive the auto correlation function of the process.	*10*	*K2*	*CO5*

36. a) The following are the number of mistakes made in 5successive days by 4 technicians working for a photographic laboratory test at a level of significance 0.01. Test whether the differenceamong the four samples means can be attributed to chance. *10* *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) Let X and Y are two discrete random variables with joint probability mass function $P(X=x, Y=y) = \begin{cases} \frac{1}{18}(2x+y), x = 1,2\ ; y = 1,2 \\ 0 \quad\quad otherwise \end{cases}$ *10* *K3* *CO2*

Find the joint moment generating function of X and Y.