Shiv Nadar University Chennai

End Semester Examinations, 2023-2024 Even

Question Paper

Name of the Program: B.Tech. AI & DS	Semester: II
Course Code & Name: MA1004 STATISTICAL FOUNDATIONS OF DATA SCIENCE	
Regulation 2021	
Time: 3 Hours	Maximum: 100 Marks

(Use of Statistical Distributions Table is permitted)

<table>
<tr><th>Q.No.</th><th>Questions</th><th>Marks</th><th>CO#</th><th>KL#</th></tr>
<tr><td>1</td><td>Two dice are thrown simultaneously. Find the probability that the sum of points on the two dice would be 7 or more.</td><td>2</td><td>CO1</td><td>KL3</td></tr>
<tr><td>2</td><td>In a group of 20 males and 15 females, 12 males and 8 females are service holders. What is the probability that a person selected at random from the group is a service holder given that the selected person is a male?</td><td>2</td><td>CO1</td><td>KL3</td></tr>
<tr><td>3</td><td>Find the expected value of X, if the probability density function of a random variable X is given by $f(x) = \frac{k}{(1+x^2)},\ if -\infty < x < \infty$.</td><td>2</td><td>CO2</td><td>KL3</td></tr>
<tr><td>4</td><td>Find the moment generating function of the random variable whose probability density function is given by $f(x) = ke^{-2x}, x \geq 0$.</td><td>2</td><td>CO2</td><td>KL3</td></tr>
<tr><td>5</td><td>The number of monthly breakdowns of a computer is a random variable having a Poisson distribution with mean equal to 1.8. Find the probability that this computer will function for a month with at least one breakdown.</td><td>2</td><td>CO3</td><td>KL3</td></tr>
<tr><td>6</td><td>A random variable X has a uniform distribution over $(-3,3)$. Compute $P(|X-2| < 2)$.</td><td>2</td><td>CO3</td><td>KL3</td></tr>
<tr><td>7</td><td>The joint distribution of (X, Y) is given by
<table>
<tr><th>X \ Y</th><th>1</th><th>3</th><th>9</th></tr>
<tr><td>2</td><td>$\frac{1}{8}$</td><td>$\frac{1}{24}$</td><td>$\frac{1}{12}$</td></tr>
<tr><td>4</td><td>$\frac{1}{4}$</td><td>$\frac{1}{4}$</td><td>0</td></tr>
<tr><td>6</td><td>$\frac{1}{8}$</td><td>$\frac{1}{24}$</td><td>$\frac{1}{12}$</td></tr>
</table>
Are X and Y independent random variables? Justify your answer.</td><td>2</td><td>CO4</td><td>KL3</td></tr>
<tr><td>8</td><td>The lines of regression are $8x - 10y + 66 = 0$ and $40x - 18y - 214 = 0$. The variance of X is 9. Find (i) the mean values of X and Y, (ii) the correlation coefficient between X and Y.</td><td>2</td><td>CO4</td><td>KL3</td></tr>
<tr><td>9</td><td>A man either drives a car or catches a train to go to office each day. He never goes two days in a row by train but if he drives one day, then the next day he is just as likely to drive again as he is to travel by train. Find the transition probability matrix.</td><td>2</td><td>CO5</td><td>KL3</td></tr>
<tr><td>10</td><td>The transition probability matrix of a Markov Chain $\{X_n : n \geq 0\}$ has 3 states 0, 1 and 2 is $P = \begin{array}{c} 0 \\ 1 \\ 2 \end{array}\begin{bmatrix} 0.75 & 0.25 & 0.00 \\ 0.25 & 0.50 & 0.25 \\ 0.00 & 0.75 & 0.25 \end{bmatrix}$ and the initial distribution is $p^{(0)} = \left(\frac{1}{3}, \frac{1}{3}, \frac{1}{3}\right)$. Find $P(X_3 = 1, X_2 = 2, X_1 = 1, X_0 = 2)$.</td><td>2</td><td>CO5</td><td>KL3</td></tr>
</table>

11	The probability that a student passes in End Semester Theory Examination is 0.9, given that he studied. The probability that he will pass in the exam without studying is 0.2. Assume the probability that the student studies for the exam is 0.75. Given that the student passed the exam, what is the probability that he not studied?	10	CO1	KL3
12	A random variable has the following probability distribution. $X = x$: -2, -1, 0, 1, 2, 3 $p(X = x)$: 0.1, k, 0.2, $2k$, 0.3, k Find (i) the value of k, (ii) mean, (iii) standard deviation, (iv) coefficient of skewness, (v) coefficient of kurtosis.	10	CO2	KL3
13	It is known that the probability of an item produced by a certain machine will be defective is 0.05. If the produced items are sent to the market in packets of 20, find the number of packets containing at least 2, exactly 2 and at most 2 defective items in a consignment of 1000 packets using (i) Binomial distribution, (ii) Poisson approximation to Binomial distribution.	10	CO3	KL3
14	(i) State the Lindeberg-Levy's form of the central limit theorem. (ii) Suppose that orders at a restaurant are independent and identically distributed random variables follows normal distribution with mean $\mu = 8$ and standard deviation $\sigma = 2$. Use the central limit theorem to estimate (a) $P(780 < X_1 + X_2 + \cdots + X_{100} < 820)$; (b) the probability that the first 100 customers spend a total of more than 840.	10	CO3	KL3
15	The joint probability mass function of (X, Y) is given by $P(x, y) = k(2x + 3y)$, $x = 0,1,2$; $y = 1,2,3$. (i) Find all the marginal and conditional probability distributions. (ii) Find the probability distribution of $X + Y$ and $P(X + Y > 3)$.	10	CO4	KL3
16	From the following data, i.) find the two regression equations. ii.) find the coefficient of correlation between the marks in Mathematics and Statistics. iii.) find the most likely marks in Statistics when marks in Mathematics are 30. Marks in Mathematics: 25, 28, 35, 32, 31, 36, 29, 38, 34, 32 Marks in Statistics: 43, 46, 49, 41, 36, 32, 31, 30, 33, 39	10	CO4	KL3
17	What is a random process? Explain its classification with examples.	10	CO5	KL2
18	A gambler has Rs. 2. He bets Rs. 1 at a time and wins Rs. 1 with probability $\frac{1}{2}$. He stops playing if he loses Rs. 2 or wins Rs. 4. i.) What is the transition probability matrix of the related Markov chain? ii.) What is the probability that he lost his money at the end of his 5^{th} play? iii.) What is the probability that the game lasts more than 7 plays?	10	CO5	KL3

KL - Bloom's Taxonomy Levels
(KL1: Remembering, KL2: Understanding, KL3: Applying, KL4: Analyzing, KL5: Evaluating, KL6: Creating)
CO - Course Outcomes
