SRM VALLIAMMAI ENGEINEERING COLLEGE

SRM Nagar, Kattankulathur – 603 203.

(An Autonomous Institution)

DEPARTMENT OF COMPUTER APPLICATIONS

QUESTION BANK

I SEMESTER

MA4121 – APPLIED PROBABILITY AND STATISTICS

Regulation – 2024

Academic Year 2024- 2025

Prepared by

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SRM VALLIAMMAI ENGEINEERING COLLEGE

DEPARTMENT OF MATHEMATICS

QUESTION BANK

SUBJECT : MA4121 – APPLIED PROBABILITY AND STATISTICS
SEM / YEAR : I / I year MCA

UNIT I -LINEAR ALGEBRA - Vector spaces – Norms – Inner Products - QR factorization - Generalized Eigen vectors - Singular value decomposition and applications – Pseudo inverse - Least squares method.

Q.No.	Question	Bloom's Taxonomy Level	Competence	Course Outcome
	PART – A			
1.	Define Real Symmetric Matrix.	BTL -1	Remembering	CO 1
2	Define Vector Space	BTL -2	Understanding	CO 1
3	Define Subspace of a vector space	BTL -2	Understanding	CO 1
4	Define direct sum of two subspaces.	BTL -1	Remembering	CO 1
5	In a Vector Space V (F) if αv=0 then either α=0 or v=0 prove.	BTL -2	Understanding	CO 1
6	Is $\{(1,4,-6),(1,5,8),(2,1,1),(0,1,0)\}$ is a linearly independent subset of R^3 ? Justify your answer	BTL -1	Remembering	CO 1
7.	Find the sum and product of all Eigen values of $\begin{bmatrix} 1 & 2 & -2 \\ 1 & 0 & 3 \\ -2 & -1 & -3 \end{bmatrix}$	BTL -2	Understanding	CO 1
8.	Define Least square method.	BTL -1	Remembering	CO 1
.9	Find the least square solution to the system $\boldsymbol{x_1 + x_2 = 3}$, $\boldsymbol{-2x_1 + 3x_2 = 1}$ ***and*** $\boldsymbol{2x_1 - x_2 = 2}$	BTL -2	Understanding	CO 1
10	Define Hermitian Matrix.	BTL -1	Remembering	CO 1
11	Write short note on Singular value decomposition of complex matrix A.	BTL -1	Remembering	CO 1
12	State Singular value decomposition theorem.	BTL -1	Remembering	CO 1
13	If A is a nonsingular matrix, then what is A^+?	BTL -2	Understanding	CO 1
14.	If the sum of two eigenvalues and trace of a 3x3 matrix A are equal find the value of |A|.	BTL -1	Remembering	CO 1
15.	Let $\boldsymbol{A} = \begin{pmatrix} \mathbf{1} & \mathbf{1} \\ \mathbf{1} & \mathbf{3} \end{pmatrix} = \boldsymbol{A_1}$ .Compute A_2 using QR algorithm.	BTL -2	Understanding	CO 1
16.	Discuss the nature of the quadratic form $6x^2+3y^2+3z^2-4xy-2yz+4zx$.	BTL -2	Understanding	CO 1
17.	If the eigen values of the matrix A of order 3X3 are 2,3 and 1, then find the determinant of A	BTL -2	Understanding	CO 1
18.	Find the sum and product of the Eigen values of the matrix $\begin{bmatrix} 2 & 2 & 0 \\ 2 & 2 & 1 \\ -7 & 2 & -3 \end{bmatrix}$.	BTL -1	Remembering	CO 1

19.	Check whether the given matrix is positive definite or not $\begin{pmatrix} \mathbf{3} & \mathbf{1} & \mathbf{-1} \\ \mathbf{1} & \mathbf{3} & \mathbf{-1} \\ \mathbf{-1} & \mathbf{-1} & \mathbf{5} \end{pmatrix}$	BTL -1	Remembering	CO 1
20.	Give the nature of quadratic form without reducing into canonical form $x_1^2 - 2x_1x_2 + x_2^2 + x_3^2$	BTL -1	Remembering	CO 1
21.	Find the characteristic equation of $A = \begin{pmatrix} 1 & -2 \\ -5 & 4 \end{pmatrix}$	BTL -2	Understanding	CO 1
22.	Find the characteristic equation of $A = \begin{bmatrix} \mathbf{3} & \mathbf{5} \\ \mathbf{-2} & \mathbf{-4} \end{bmatrix}$.	BTL -1	Remembering	CO 1
23.	Give the nature of the quadratic form without converting whose matrix is $\begin{pmatrix} -1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -2 \end{pmatrix}$.	BTL -2	Understanding	CO 1
24.	Find the generalized inverse of $\begin{bmatrix} 1 & 1 \\ 0 & 1 \\ 1 & 0 \end{bmatrix}$	BTL -1	Remembering	CO 1
25.	Write down the matrix of the quadratic form $2x^2 + 8z^2 + 4xy + 10xz - 2yz$	BTL -2	Understanding	CO 1
	PART – B			
1.	Determine whether the following set is linearly dependent or linearly independent $\begin{pmatrix} 1 & 0 \\ -2 & 1 \end{pmatrix}, \begin{pmatrix} 0 & -1 \\ 1 & 1 \end{pmatrix}, \begin{pmatrix} -1 & 2 \\ 1 & 0 \end{pmatrix}$ and $\begin{pmatrix} 2 & 1 \\ 2 & -2 \end{pmatrix}$ generate $M_{2\times2}(R)$	BTL -3	Applying	CO 1
2.	If x, y and z are vectors in a vector space V such that $x + z = y + z$, then prove that $x = y$ i) The additive identity for any $x \in V$ is unique ii) The additive inverse is unique	BTL -2	Understanding	CO 1
3.	Show that the set ,S={(1,3,-4,2),(2,2,-4,0),(1,-3,2,-4),(-1,0,1,0)} is linearly dependent of the other vectors	BTL -3	Applying	CO 1
4.(a)	Determine whether the following subset of vector space $R^3(R)$ is a subspace $W_1=\{(a_1, a_2, a_3): 2a_1-7a_2+a_3=0\}$	BTL -3	Applying	CO 1
4.(b)	Illustrate that set of all diagonal matrices of order $n \times n$ is a subspace of the vector space $M_{n\times n}(F)$, where $M_{n\times n}$ is the set of all square matrices over the field F	BTL -3	Applying	CO 1
5.	Find the QR factorization of A = $\begin{pmatrix} 3 & 2 \\ 4 & 5 \end{pmatrix}$	BTL -2	Understanding	CO 1
6.	Find the QR factorization of A = $\begin{bmatrix} \mathbf{0} & \mathbf{0} & \mathbf{5} \\ \mathbf{0} & \mathbf{4} & \mathbf{1} \\ \mathbf{1} & \mathbf{1} & \mathbf{1} \end{bmatrix}$	BTL -2	Understanding	CO 1
7.	Find the QR factorization of A = $\begin{bmatrix} \mathbf{1} & \mathbf{1} & \mathbf{-1} \\ \mathbf{1} & \mathbf{0} & \mathbf{0} \\ \mathbf{1} & \mathbf{1} & \mathbf{1} \end{bmatrix}$	BTL -4	Analyzing	CO 1
8.	Obtain the singular value decomposition of $\begin{pmatrix} 2 & 2 \\ -1 & 1 \end{pmatrix}$	BTL -2	Understanding	CO 1
9.	Construct the singular value decomposition for $\begin{pmatrix} 1 & 1 & 3 \\ 1 & 1 & 3 \end{pmatrix}$	BTL -4	Analyzing	CO 1

10.	Obtain the singular value decomposition of A $\begin{bmatrix} 2 & -1 \\ -2 & 1 \\ 4 & -2 \end{bmatrix}$	BTL -3	Applying	CO 1
11.	Obtain the singular value decomposition $\begin{pmatrix} 1 & 1 & 0 \\ 0 & 1 & 1 \end{pmatrix}$	BTL -3	Applying	CO 1
12.	Find the least square line fitted to the data (1,1),(2,2),(3,2),(4,3).	BTL -3	Applying	CO 1
13.	Solve the following system of equations in the least square sense $x_1 + x_2 + x_3 = 1$; $x_1 + x_2 + x_3 = 2$; $x_1 + x_2 + x_3 = 3$.	BTL -4	Analyzing	CO 1
14.	Solve the following system of equations in the least square sense $2x_1 + 2x_2 - 2x_3 = 1$, $2x_1 + 2x_2 - 2x_3 = 3$, $-2x_1 - 2x_2 + 6x_3 = 2$	BTL -3	Applying	CO 1
15.	Fit a straight line in the least square sense to the following data **X: -3 -2 -1 0 1 2 3** **Y: 8 12 17 25 26 32 40**	BTL -4	Analyzing	CO 1
16.	Fit a straight line in the least square sense to the following data **X: -3 -2 -1 0 1 2 3** **Y: 10 15 19 27 28 34 42**	BTL -4	Analyzing	CO 1
17.	Find the eigen values and eigen vectors of the matrix $A = \begin{pmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{pmatrix}$	BTL -3	Applying	CO 1
18.	Find the Eigen values and Eigen vectors of the matrix $\begin{pmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{pmatrix}$	BTL -4	Analyzing	CO 1

UNIT – II PROBABILITY AND RANDOM VARIABLES: Probability–Axioms of probability–Conditional probability–Baye's theorem-Random variables-Probability function–Moments–Moment generating functions and their properties–Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions–Function of a random variable.

Q.No.	Question	Bloom's Taxonomy Level	Competence	Course Outcome
	PART – A			
1.	What is the use of Baye's theorem?	BTL-2	Understanding	CO 2
2.	Mention the properties of a discrete probability distribution.	BTL-2	Understanding	CO 2
3.	Check whether the function given by $f(x) = \frac{x+2}{25}$ for x=1,2,3,4,5 can serve as the probability distribution of a discrete random variable.	BTL-2	Understanding	CO 2
4.	If the random variable X takes the values 1,2,3 and 4 such that $2P(X=1) = 3P(X=2) = P(X=3) = 5P(X=4)$, find the probability distribution of X	BTL-1	Remembering	CO 2

<table>
<tr><td>5.</td><td>The RV X has the following probability distribution:<table><tr><td>x</td><td>-2</td><td>-1</td><td>0</td><td>1</td></tr><tr><td>P(x)</td><td>0.4</td><td>k</td><td>0.2</td><td>0.3</td></tr></table>Find k and the mean value of X</td><td>BTL-2</td><td>Understanding</td><td>CO 2</td></tr>
<tr><td>6.</td><td>If $f(x) = K(x + x^2)$ in $1 < x < 5$ is a pdf of a continuous random variables. Find the value of K.</td><td>BTL-1</td><td>Remembering</td><td>CO 2</td></tr>
<tr><td>7.</td><td>The p.d.f of a continuous random variable X is $f(x) = k(1+x)$, $2 < x < 5$ Find k.</td><td>BTL-1</td><td>Remembering</td><td>CO 2</td></tr>
<tr><td>8.</td><td>For a continuous distribution $f(x) = k(x - x^2), 0 \le x \le 1$, where k is a constant. Find k.</td><td>BTL-2</td><td>Understanding</td><td>CO 2</td></tr>
<tr><td>9.</td><td>If $f(x) = kx^2, 0 < x < 3$, is to be a density function, find the value of k.</td><td>BTL-2</td><td>Understanding</td><td>CO 2</td></tr>
<tr><td>10.</td><td>If the probability that a target is destroyed on any one shot is 0.5, Find the probability that it would be destroyed an 6^{th} attempt.</td><td>BTL-2</td><td>Understanding</td><td>CO 2</td></tr>
<tr><td>11.</td><td>The mean of Binomial distribution is 20 and standard deviation is 4. Find the parameters of the distribution.</td><td>BTL-2</td><td>Understanding</td><td>CO 2</td></tr>
<tr><td>12.</td><td>The mean and variance of binomial distribution are 5 and 4. Determine the distribution.</td><td>BTL-1</td><td>Remembering</td><td>CO 2</td></tr>
<tr><td>13.</td><td>If 3% of the electric bulbs manufactured by a company are defective, Find the probability that in a sample of 100 bulbs exactly 5 bulbs are defective.</td><td>BTL-2</td><td>Understanding</td><td>CO 2</td></tr>
<tr><td>14.</td><td>Messages arrive at a switchboard in a poisson manner at an average rate of six per hour. Find the probability for exactly two messages arrive within one hour.</td><td>BTL-1</td><td>Remembering</td><td>CO 2</td></tr>
<tr><td>15.</td><td>The number of monthly breakdowns of a computer is a random variable having Poisson distribution with mean 1.8. Find the probability that this computer will function for a month with only one breakdown.</td><td>BTL-2</td><td>Understanding</td><td>CO 2</td></tr>
<tr><td>16.</td><td>If X is a Poisson variate such that $2P(X = 0) + P(X = 2) = 2P(X = 1)$, find E(X)</td><td>BTL-1</td><td>Remembering</td><td>CO 2</td></tr>
<tr><td>17.</td><td>The probability that a candidate can pass in an examination is 0.6. What is the probability that he will pass in third trial?</td><td>BTL-2</td><td>Understanding</td><td>CO 2</td></tr>
<tr><td>18.</td><td>If $f(x) = \frac{x^2}{3}, -1 < x < 2$ is the pdf of the random variable X ,then find p(0<x<1)</td><td>BTL-1</td><td>Remembering</td><td>CO 2</td></tr>
<tr><td>19.</td><td>If the probability that an applicant for a driver's license will pass the road test on any given trial is 0.8, what is the probability that he will finally pass the test on the fourth trial</td><td>BTL-2</td><td>Understanding</td><td>CO 2</td></tr>
<tr><td>20.</td><td>If X has uniform distribution in (-3,3), find $P(|x - 2| < 2)$</td><td>BTL-1</td><td>Remembering</td><td>CO 2</td></tr>
<tr><td>21.</td><td>Let X be a random variable with moment generating function $M_X(t) = \frac{(2e^t + 1)^4}{81}$.Find its mean and variance.</td><td>BTL-2</td><td>Understanding</td><td>CO 2</td></tr>
</table>

<table>
<tr><td>22.</td><td>A Random variable X is uniformly distributed between 3 and 15. Find the variance of X.</td><td>BTL-1</td><td>Remembering</td><td>CO 2</td></tr>
<tr><td>23.</td><td>A continuous RV X has the density function $ce^{-\frac{x}{5}}, x > 0$. Find c. Create E(x) and Var(X)</td><td>BTL-2</td><td>Understanding</td><td>CO 2</td></tr>
<tr><td>24.</td><td>If X is a normal random variable with mean 3 and variance 9, find the probability that X lies between 2 and 5.</td><td>BTL-1</td><td>Remembering</td><td>CO 2</td></tr>
<tr><td>25.</td><td>A normal distribution has mean μ = 20 and standard deviation σ = 10. Evaluate $(15 \le X \le 40)$.</td><td>BTL-1</td><td>Evaluating</td><td>CO 2</td></tr>
<tr><td colspan="4">PART –B</td><td></td></tr>
<tr><td>1(a)</td><td>A random variable X has the following probability distribution:
<table><tr><td>X</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr><tr><td>P(X)</td><td>0</td><td>k</td><td>$2k$</td><td>$2k$</td><td>$3k$</td><td>k^2</td><td>$2k^2$</td><td>7</td></tr></table>Find (i) the value of k
(ii) $P(1.5 < X < 4.5 / X > 2)$</td><td>BTL-2</td><td>Understanding</td><td>CO 2</td></tr>
<tr><td>1(b)</td><td>Find the MGF of Binomial distribution and hence find its mean and variance</td><td>BTL-2</td><td>Remembering</td><td>CO 2</td></tr>
<tr><td>2(a)</td><td>The probability mass function of a discrete R. V X is given in the following table:
<table><tr><td>X</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td></tr><tr><td>P(X=x)</td><td>0.1</td><td>K</td><td>0.2</td><td>$2k$</td><td>0.3</td><td>k</td></tr></table>Find (1) Find the value of k, (2) P(X<1),(3) $P(-1 < X \le 2)$</td><td>BTL-2</td><td>Understanding</td><td>CO 2</td></tr>
<tr><td>2(b)</td><td>Obtain the MGF of Poisson distribution and hence find its mean and variance</td><td>BTL-2</td><td>Remembering</td><td>CO 2</td></tr>
<tr><td>3(a)</td><td>The probability mass function of a discrete random variable X is given in the following table
<table><tr><td>X</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td></tr><tr><td>P(X)</td><td>a</td><td>3a</td><td>5a</td><td>7a</td><td>9a</td><td>11a</td><td>13a</td><td>15a</td></tr></table>Find (i) the value of a , (ii) $P(X < 3)$, (iii) Mean of X, (iv) Variance of X.</td><td>BTL-4</td><td>Analyzing</td><td>CO 2</td></tr>
<tr><td>3(b)</td><td>Deduce the MGF of a geometric distribution and hence find the mean and variance</td><td>BTL-4</td><td>Analyzing</td><td>CO 2</td></tr>
<tr><td>4(a)</td><td>If the discrete random variable X has the probability function given by the table.
<table><tr><td>x</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>$P(x)$</td><td>$k/3$</td><td>$k/6$</td><td>$k/3$</td><td>$k/6$</td></tr></table>Find the value of k and Cumulative distribution of X.</td><td>BTL-3</td><td>Applying</td><td>CO 2</td></tr>
<tr><td>4(b)</td><td>Derive the MGF of Uniform distribution and hence deduce the mean and variance</td><td>BTL-3</td><td>Applying</td><td>CO 2</td></tr>
<tr><td>5(a)</td><td>If the probability mass function of a random variable X is given by $P(X=x) = kx^3$, x=1,2,3,4. Find the value of k, mean and variance of X.</td><td>BTL-4</td><td>Analyzing</td><td>CO 2</td></tr>
<tr><td>5(b)</td><td>Deduce the MGF of Exponential distribution and hence find its mean and variance</td><td>BTL-4</td><td>Analyzing</td><td></td></tr>
<tr><td>6(a)</td><td>Find the MGF , mean and variance of the random variable X has the pdf</td><td>BTL-4</td><td>Analyzing</td><td></td></tr>
</table>

	$f(x)=\begin{cases} x, 0<x<1 \\ 2-x, 1<x<2 \\ 0, otherwise \end{cases}$			CO 2
6(b)	State and prove the memory less property of exponential distribution	BTL-4	Analyzing	CO 2
7(a)	In a large consignment of electric bulbs, 10 percent are defective. A random sample of 20 is taken for inspection. Find the probability that i) all are good bulbs ii) atmost there are 3 defective bulbs iii) exactly there are 3 defective bulbs.	BTL-3	Applying	CO 2
7(b)	A manufacturer of pins knows that 2% of his products are defective. If he sells pins in boxes of 100 and guarantees that not more than 4 pins are defective, what is the probability that a box fail to meet the guaranteed quality.	BTL-3	Applying	CO 2
8.	In a bolt factory machines A, B, C manufacture respectively 25%, 35% and 40% of the total of their output 5, 4, 2 percent are defective bolts. If A bolt is drawn at random from the product and is found to be defective, what are the probabilities that is was manufactured by machines A, B and C?	BTL-4	Analyzing	CO 2
9(a)	If a random variable X has p.d.f $f(x)=\begin{cases} \frac{1}{4}, & \vert X\vert<2 \\ 0, & Otherwise \end{cases}$ Find (a) $P(X<1)$ (b) $P(\vert X\vert>1)$ (c) $P(2X+3>5)$.	BTL-4	Analyzing	CO 2
9(b)	Out of 2000 families with 4 children each, Find how many family would you expect to have i) at least 1 boy ii) 2 boys.	BTL-4	Analyzing	
10.(a)	Find the MGF of the random variable X having the probability density function f(x) = $\begin{cases} \frac{x}{4}e^{-\frac{x}{2}}, & x>0 \\ 0 & , \text{otherwise} \end{cases}$. Also find the mean and variance	BTL-4	Analyzing	CO 2
10(b)	4 coins were tossed simultaneously. What is the probability of getting (i) 2 heads, (ii) at least 2 heads, (iii) at most 2 heads.	BTL-4	Analyzing	CO 2
11.(a)	A random variable X has c.d.f $F(x)=\begin{cases} 0, if x<-1 \\ a(1+x), if -1<x<1 \\ 1, if x\geq 1 \end{cases}$. Find the value of a. Also P(X>1/4) and $P(-0.5\leq X\leq 0)$.	BTL-3	Applying	CO 2
11(b)	The atoms of a radioactive element are randomly disintegrating. If every gram of this element, on average, emits 3.9 alpha particles per second, then what is the probability that during the next second the number of alpha particles emitted from 1 gram is (1) at most 6 (2) at least 2 and (3) at least and at most5	BTL-3	Applying	CO 2

12.	If $f(x) = \begin{cases} ax, & 0 \le x \le 1 \\ a, & 1 \le x \le 2 \\ 3a - ax, & 2 \le x \le 3 \\ 0, & elsewhere \end{cases}$ is the p.d.f of X. Calculate (i) The value of a , (ii) The cumulative distribution function of X (iii) If X_1, X_2 and X_3 are 3 independent observations of X. Find the probability that exactly one of these 3 is greater than 1.5?	BTL-4	Analyzing	CO 2
13.(a)	The Probability distribution function of a R.V. X is given by $f(x) = \frac{4x(9-x^2)}{81}, \ 0 \le x \le 3$. Find the mean, variance.	BTL-3	Applying	CO 2
13.(b)	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 (1) without breakdown (2) with only one breakdown and (3) with at least one breakdown.	BTL-3	Applying	CO 2
14.(a)	Messages arrive at a switch board in a Poisson manner at an average rate of 6 per hour. Find the probability that exactly 2 messages arrive within one hour, no messages arrives within one hour and at least 3 messages arrive within one hour	BTL-4	Analyzing	CO 2
14(b)	An electrical firm manufactures light bulbs that have a life, before burn out, that is normally distributed with mean equal to 800 hours and a standard deviation of 40 hours. Find the probability that a bulb burns between 778 and 834 hours.	BTL-4	Analyzing	CO 2
15.(a)	The time (in hours) required to repair a machine is exponentially distributed with parameter $\lambda = 1/2$. (a) What is the probability that the repair time exceeds 2 hours? (b) What is the conditional probability that a repair time exceeds at least 10 hours that its distribution exceeds 9 hours?	BTL-3	Applying	CO 2
15(b)	Let X be a Uniformly distributed R. V. over [-5, 5]. Evaluate (i) $P(X \le 2)$ (ii) $P(\|X\|>2)$ (iii) Cumulative distribution function of X (iv) Var(X)	BTL-3	Applying	CO 2
16.(a)	Buses arrive at a specified stop at 15 minutes interval starting at 7am that is, 7,7:15,7:30,7:45, and so on, If a passenger arrives at the stop at a random time that is uniformly distributed between 7 and 7:30 am, evaluate the probability that he waits (a) Less than 5 minutes for a bus and (b) At least 12 minutes for a bus	BTL-4	Analyzing	CO 2
16(b)	The marks obtained by a number of students for a certain subject is assumed to be normally distributed with mean 65 and standard deviation 5. If 3 students are taken at random	BTL-4	Analyzing	CO 2

	from this set Find the probability that exactly 2 of them will have marks over 70?			
17.	In a test on 2000 electric bulbs, it was found that the life of a particular make, was normally distributed with an average life of 2040 hours and Standard Deviation of 60 hours. Find the number of bulbs likely to burn for (i) more than 2150 hours (ii) less than 1950 hours and (iii) more than 1920 hours burs less than 2160 hours.	BTL-3	Applying	CO 2
18.	The length of time a person speaks over phone follows exponential distribution with mean 6 mins. What is the probability that the person will talk for (1) more than 8 mins (2) between 4 and 8 mins.	BTL-4	Analyzing	CO 2

UNIT – III TWO DIMENSIONAL RANDOM VARIABLES Joint distributions – Marginal and conditional distributions – Function of two dimensional random variables – Regression Curve – Correlation.

Q.No.	Question	Bloom's Taxonomy Level	Competence	Course Outcome
	PART – A			
1.	The joint probability distribution of X and Y is given by $p(x,y)=\frac{x+y}{21}$, x = 1,2,3; y = 1, 2. Find the marginal probability distributions of X	BTL-2	Understanding	CO 3
2.	The joint probability function (X,Y) is given by $P(x,y)=k(2x+3y)$, $x = 0,1,2$ $y = 1,2,3$, Find the value of K.	BTL-2	Understanding	CO 3
3.	Find the probability distribution of X + Y from the bivariate distribution of (X,Y) given below: X \ Y: 1, 2 1: 0.4, 0.2 2: 0.3, 0.1	BTL-2	Understanding	CO 3
4.	If the joint pdf of X and Y is given by f(x,y)=2,in $0\le x<y\le 1$, Find E(X)	BTL-1	Remembering	CO 3
5.	Find the marginal distributions of X and Y from the bivariate distribution of (X,Y) given below: X \ Y: 1, 2 1: 0.1, 0.2 2: 0.3, 0.4	BTL-2	Understanding	CO 3
6.	Find the value of k,if the joint density function of (X,Y) as $f(x,y)=\begin{cases}k(1-x)(1-y), 0<x<4, 1<y<5\\ 0, otherwise\end{cases}$	BTL-1	Remembering	CO 3

7.	If the joint probability density function of a random variable X and Y is given by $f(x,y) = \begin{cases} \frac{x^3y^3}{16}, 0 < x < 2, 0 < y < 2 \\ 0, \quad otherwise \end{cases}$. Obtain the marginal density function of X.	BTL-1	Remembering	CO 3
8.	The joint pdf of the random variable (X,Y) is given by $f(x,y) = Kxye^{-(x^2+y^2)}, x > 0, y > 0$ Find the value of K.	BTL-1	Remembering	CO 3
9.	The joint probability density function of a random variable (X,Y) is $f(x,y) = k\,e^{-(2x+3y)}, x \geq 0,\ y \geq 0$. Point out the value of k.	BTL-2	Understanding	CO 3
10.	If the joint pdf of (X, Y) is $f(x,y) = \begin{cases} \frac{1}{4}, 0 < x, y < 2 \\ 0, \quad otherwise \end{cases}$. Find $P(X + Y \leq 1)$	BTL-1	Remembering	CO 3
11.	Let X and Y be random variables with joint density function f(x,y) $= \begin{cases} 4xy, \ 0 < x < 1, \ 0 < y < 1 \\ 0, \ otherwise \end{cases}$ formulate the value of E(XY)	BTL-2	Understanding	CO 3
12.	Let the joint density function of a random variable X and Y be given by $f(x,y) = 8xy,\ 0 < y \leq x \leq 1$.Calculate the marginal probability function of X	BTL-1	Remembering	CO 3
13.	What is the condition for two random variables are independent?	BTL-2	Understanding	CO 3
14.	If the joint probability density function of X and Y is $f(x,y) = e^{-(x+y)}, x, y \geq 0$.Are X and Y independent	BTL-1	Remembering	CO 3
15.	State any tow properties of correlation coefficient	BTL-2	Understanding	CO 3
16.	Write the angle between the regression lines	BTL-1	Remembering	CO 3
17.	The regression equations are x + 6y = 14 and 2x + 3y = 1. Evaluate the correlation coefficient between X & Y **.**	BTL-1	Remembering	CO 3
18.	If $\bar{X} = 970$, $\bar{Y} = 18, \sigma_x = 38$, $\sigma_y = 2$ and r = 0.6 , Find the line of regression of X on Y.	BTL-2	Understanding	CO 3
19.	In a partially destroyed laboratory, record of an analysis of correlation data, the following results only are legible; Variance of X = 9; Regression equations are 8X - 10Y + 66 = 0 and 40X-18Y = 214. Find the mean values of X and Y?	BTL-1	Remembering	CO 3
20.	The regression equations are 3x + 2y = 26 and 6x + y = 31. Find the correlation coefficient**.**	BTL-2	Understanding	CO 3
21.	State the relationship between correlation coefficient and Regression coefficient.	BTL-1	Remembering	CO 3
22.	Prove that $-1 \leq r_{xy} \leq 1$	BTL-2	Understanding	CO 3
23.	The equations of two regression lines are 3x+2y=19 and 3y+9x=46. Obtain the mean of X and Y.	BTL-1	Remembering	CO 3
24.	The equations of two regression lines are 3x+2y=19 and 3y+9x=46. Derive the correlation coefficient between X and Y.	BTL-1	Remembering	CO 3
25.	State the equations of two regression lines.	BTL-2	Understanding	CO 3
PART –B				

<table>
<tr>
<td>1.(a)</td>
<td>From the following table for bivariate distribution of (X, Y). Find
(i) $P(X \le 1)$ (ii)$P(Y \le 3)$ (iii) $P(X \le 1, Y \le 3)$ (iv)$P(X \le 1/ Y \le 3)$ (v) $P(Y \le 3/ X \le 1)$ (vi)$P(X + Y \le 4)$
<table>
<tr><th>X \ Y</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>$\frac{1}{32}$</td><td>$\frac{2}{32}$</td><td>$\frac{2}{32}$</td><td>$\frac{3}{32}$</td></tr>
<tr><td>1</td><td>$\frac{1}{16}$</td><td>$\frac{1}{16}$</td><td>$\frac{1}{8}$</td><td>$\frac{1}{8}$</td><td>$\frac{1}{8}$</td><td>$\frac{1}{8}$</td></tr>
<tr><td>2</td><td>$\frac{1}{32}$</td><td>$\frac{1}{32}$</td><td>$\frac{1}{64}$</td><td>$\frac{1}{64}$</td><td>0</td><td>$\frac{2}{64}$</td></tr>
</table>
</td>
<td>BTL-2</td>
<td>Understanding</td>
<td>CO 3</td>
</tr>
<tr>
<td>2.(a)</td>
<td>The two dimensional random variable (X, Y) has the joint probability mass function $f(x, y) = \frac{x+2y}{27}, x = 0,1,2; y = 0,1,2$. Find the marginal distributions of X and Y. Also find the conditional distribution of Y given
X = 1 also find the conditional distribution of X given Y = 1.</td>
<td>BTL-3</td>
<td>Applying</td>
<td>CO 3</td>
</tr>
<tr>
<td>2.(b)</td>
<td>The joint pdf a bivariate R.V(X, Y) is given by
$$f(x, y) = \begin{cases} Kxy \ , & 0 < x < 1, 0 < y < 1 \\ 0 \ , & otherwise \end{cases}$$
(1) Find K. (2) Find P(X+Y<1). (3) Are X and Y independent R.V's.</td>
<td>BTL-3</td>
<td>Applying</td>
<td>CO 3</td>
</tr>
<tr>
<td>3.(a)</td>
<td>If the joint pdf of (X, Y) is given by P(x, y) = K(2x+3y), x=0, 1, 2, 3,
y = 1, 2, 3 Find all the marginal probability distribution. Also find the probability distribution of X+Y.</td>
<td>BTL-3</td>
<td>Applying</td>
<td>CO 3</td>
</tr>
<tr>
<td>3.(b)</td>
<td>The joint pdf of the RV (X,Y) is given by $f(x, y) = kxye^{-(x^2+y^2)}$,
$x > 0, y > 0$. Find the value of k. Also prove that X and Y are independent</td>
<td>BTL-4</td>
<td>Analyzing</td>
<td>CO 3</td>
</tr>
<tr>
<td>4.(a)</td>
<td>The following table represents the joint probability distribution of the discrete RV (X,Y). Find all the marginal and conditional distributions.
<table>
<tr><th>Y</th><th>X</th><th></th><th></th></tr>
<tr><td></td><td>1</td><td>2</td><td>3</td></tr>
<tr><td>1</td><td>1/2</td><td>1/6</td><td>0</td></tr>
<tr><td>2</td><td>0</td><td>1/9</td><td>1/5</td></tr>
<tr><td>3</td><td>1/18</td><td>1/4</td><td>2/15</td></tr>
</table>
</td>
<td>BTL-2</td>
<td>Understanding</td>
<td>CO 3</td>
</tr>
<tr>
<td>5.</td>
<td>Find the marginal distribution of X and Y and also P($P(X \le 1, Y \le 1)$,</td>
<td>BTL-2</td>
<td>Understanding</td>
<td>CO 3</td>
</tr>
</table>

<table>
<tr><td></td><td>$P(X \le 1), P(Y \le 1)$. Check whether X and Y are independent. The joint probability mass function of X and Y is
<table>
<tr><td>X \ Y</td><td>0</td><td>1</td><td>2</td></tr>
<tr><td>0</td><td>0.10</td><td>0.04</td><td>0.02</td></tr>
<tr><td>1</td><td>0.08</td><td>0.20</td><td>0.06</td></tr>
<tr><td>2</td><td>0.06</td><td>0.14</td><td>.30</td></tr>
</table></td><td></td><td></td><td></td></tr>
<tr><td>6.</td><td>The joint pdf of two dimensional random variables (X,Y) is given by
$f(x,y)=\begin{cases}25e^{-5y}, 0<x<0.2, y>0\\ 0, otherwise\end{cases}$ Find the covariance of x and y.</td><td>BTL-4</td><td>Analyzing</td><td>CO 3</td></tr>
<tr><td>7.</td><td>If the joint pdf of a two-dimensional RV(X,Y) is give n by
$f(x,y)=\begin{cases}x^2+\frac{xy}{3}; 0<x<1, 0<y<2\\ 0,\ elsewhere\end{cases}$. Find (i) $P\left(X>\frac{1}{2}\right)$
(ii) $P(Y<\frac{1}{2}, X<\frac{1}{2})$ (iii)$P\left(Y<\frac{1}{2} / X<\frac{1}{2}\right)$</td><td>BTL-3</td><td>Applying</td><td>CO 3</td></tr>
<tr><td>8.</td><td>The joint pdf of a two dimensional random variable (X, Y) is given by
$f(x,y)=xy^2+\frac{x^2}{8}, 0\le x\le 2, 0\le y\le 1$. Compute
(i) $P\left(X>1 / Y<\frac{1}{2}\right)$ (ii)$P\left(Y<\frac{1}{2}/X>1\right)$ (iii) $P(X+Y)\le 1$.</td><td>BTL-3</td><td>Applying</td><td>CO 3</td></tr>
<tr><td>9.(a)</td><td>(b)The joint pdf of X and Y is given by
f(x,y)=$\begin{cases}kx(x-y), 0<x<2, -x<y<x\\ 0,\quad otherwise\end{cases}$
(i)Find K (ii) Find $f_x(x)$ and $f_y(y)$</td><td>BTL-3</td><td>Applying</td><td>CO 3</td></tr>
<tr><td>10.</td><td>Find the Coefficient of Correlation between industrial production and export using the following table
<table>
<tr><td>Production (X)</td><td>14</td><td>17</td><td>23</td><td>21</td><td>25</td></tr>
<tr><td>Export (Y)</td><td>10</td><td>12</td><td>15</td><td>20</td><td>23</td></tr>
</table></td><td>BTL-3</td><td>Applying</td><td>CO 3</td></tr>
<tr><td>11.</td><td>Find the correlation coefficient for the following heights of fathers X,their sons Y and also find the equations of regression lines. Hence find the height of son when the height of father is 71
<table>
<tr><td>X</td><td>65</td><td>66</td><td>67</td><td>67</td><td>68</td><td>69</td><td>70</td><td>72</td></tr>
<tr><td>Y</td><td>67</td><td>68</td><td>65</td><td>68</td><td>72</td><td>72</td><td>69</td><td>71</td></tr>
</table></td><td>BTL-3</td><td>Applying</td><td>CO 3</td></tr>
<tr><td>12.</td><td>Obtain the lines of regression
<table>
<tr><td>X</td><td>50</td><td>55</td><td>50</td><td>60</td><td>65</td><td>65</td><td>65</td><td>60</td><td>60</td></tr>
<tr><td>Y</td><td>11</td><td>14</td><td>13</td><td>16</td><td>16</td><td>15</td><td>15</td><td>14</td><td>13</td></tr>
</table></td><td>BTL-2</td><td>Understanding</td><td>CO 3</td></tr>
</table>

13.	If $f(x,y) = \frac{6-x-y}{8}$, $0 \le x \le 2$, , $2 \le y \le 4$ for a bivariate random variable (X,Y), Evaluate the correlation coefficient ρ.	BTL-3	Applying	CO 3
14.	Two random variables X and Y have the joint density function $f(x,y) = x + y, 0 \le x \le 1, 0 \le y \le 1$. Evaluate the Correlation coefficient between X and Y.	BTL-4	Analyzing	CO 3
15.	The two regression lines are 4x-5y+33=0 and 20x-9y=107. Find the mean of X and Y. Also find the correlation coefficient between them	BTL-4	Analyzing	CO 3
16.	If X and Y each follow an exponential distribution with parameter 1 and are independent, find the pdf of U = X-Y.	BTL-3	Applying	CO 3
17.	If X and Y independent Random Variables with pdf $e^{-x}, x \ge 0$ and $e^{-y}, y \ge 0$. Devise the density function of $U = \frac{X}{X+Y}$ and $V = X + Y$. Are they independent?	BTL-3	Applying	CO 3
18.	Two random variables X and Y have the following joint probability density function $f(x,y) = \begin{cases} x + y; 0 \le x \le 1, 0 \le y \le 1 \\ 0, \ otherwise \end{cases}$. Find the probability density function of the random variable U = XY.	BTL-4	Analyzing	CO 3

UNIT – IV TESTING OF HYPOTHESIS

Sampling distributions – Type I and Type II errors – Small and Large samples - Tests based on Normal ,t and F distributions for testing of mean, variance and proportion – Test for independence of attributes and goodness of fit.

Q.No.	Question	Bloom's Taxonomy Level	Competence	Course Outcome
	PART – A			
1.	Define Statistics	BTL-1	Remembering	CO 4
2.	Define Parameter.	BTL-1	Remembering	CO 4
3.	Explain null and alternate hypothesis.	BTL-1	Remembering	CO 4
4.	Mention the various steps involved in testing of hypothesis.	BTL-1	Remembering	CO 4
5.	What is the essential difference between confidence limits and tolerance limits?	BTL-1	Remembering	CO 4
6.	Define Standard Error.	BTL-1	Remembering	CO 4
7.	Define Type I and Type II error.	BTL-1	Remembering	CO 4
8.	What are the parameters and statistics in sampling.	BTL-2	Understanding	CO 4
9.	Define level of significance.	BTL-2	Understanding	CO 4
10.	What is the test statistic for single proportion test?	BTL-2	Understanding	CO 4
11.	A random sample of 25 cups from a certain coffee dispensing machine yields a mean x = 6.9 occurs per cup. Use 0.05 level of significance to test, on the average, the machine dispense $\mu = 7.0$ ounces against the null hypothesis that, on the average, the machine dispenses $\mu < 7.0$ ounces.	BTL-1	Remembering	CO 4

	Assume that the distribution of ounces per cup is normal, and that the variance is the known quantity σ^2=0.01 ounces			
12.	Twenty people were attacked by a disease and only 18 were survived. The hypothesis is set in such a way that the survival rate is 85% if attacked by this disease. Will you reject the hypothesis that it is more at 5% level.($Z_{0.05} = 1.645$).	BTL-2	Understanding	CO 4
13.	In a large city A, 20 percent of a random sample of 900 school boys had a slight physical defect. In another large city B, 18.5 percent of a random sample of 1600 school boys had some defect. Is the difference between the proportions significant?	BTL-2	Understanding	CO 4
14.	A standard sample of 200 tins of coconut oil gave an average weight of 4.95 kg with a standard deviation of 0.21 kg. Do we accept that the net weight is 5 kg per tin at 5% level of significance?	BTL-2	Understanding	CO 4
15.	Write down the formula of test statistic 't' to test the significance of difference between the population mean and sample mean.	BTL-2	Understanding	CO 4
16.	Write down the formula of test statistic 't' to test the significance of difference between two sample means.	BTL-1	Remembering	CO 4
17.	What are the applications of t-test?	BTL-1	Remembering	CO 4
18.	What is the assumption of t-test?	BTL-1	Remembering	CO 4
19.	Write the application of 'F' test.	BTL-1	Remembering	CO 4
20.	Define 'F' variate.	BTL-1	Remembering	CO 4
21.	What are the properties of "F" test?	BTL-1	Remembering	CO 4
22.	Write the formula for the chi- square test of goodness of fit of a random sample to a hypothetical distribution.	BTL-1	Remembering	CO 4
23.	State the main use of ψ^2-test	BTL1	Remembering	CO 4
24.	What are the expected frequencies of 2x2 contingency table? a | b c | d	BTL2	Understanding	CO 4
25.	State any two applications of ψ^2-test.	BTL1	Remembering	CO 4
	PART –B			
1(a)	A sample of 100 students is taken from a large population. The mean height of the students in this sample is 160cms. Can it be reasonably regarded that this sample is from a population of mean 165 cm and standard deviation 10 cm?	BTL-2	Understanding	CO 4
1(b)	The heights of 10 males of a given locality are found to be 70, 67, 62, 68, 61, 68, 70, 64, 64, 66 inches. Is it reasonable to believe that the average height is greater than 64 inches?	BTL-2	Understanding	CO 4
2.	Given the following table for hair color and eye color, identify the value of Chi-square. Is there good association between hair color and eye color? Hair color	BTL-1	Remembering	CO 4

<table>
<tr><td></td><td colspan="2"><table>
<tr><td rowspan="5">Eye color</td><td></td><td>Fair</td><td>Brown</td><td>Black</td><td>Total</td></tr>
<tr><td>Blue</td><td>15</td><td>5</td><td>20</td><td>40</td></tr>
<tr><td>Grey</td><td>20</td><td>10</td><td>20</td><td>50</td></tr>
<tr><td>Brown</td><td>25</td><td>15</td><td>20</td><td>60</td></tr>
<tr><td>Total</td><td>60</td><td>30</td><td>60</td><td>150</td></tr>
</table></td><td></td><td></td></tr>
<tr><td>3.</td><td>Two independent samples of sizes 8 and 7 contained the following values.
<table>
<tr><td>Sample I</td><td>19</td><td>17</td><td>15</td><td>21</td><td>16</td><td>18</td><td>16</td><td>14</td></tr>
<tr><td>Sample II</td><td>15</td><td>14</td><td>15</td><td>19</td><td>15</td><td>18</td><td>16</td><td></td></tr>
</table>Test if the two populations have the same mean.</td><td>BTL3</td><td>Applying</td><td>CO 4</td></tr>
<tr><td>4.</td><td>Two independent samples of 8 and 7 items respectively had the following Values of the variable (weight in kgs.) Use 0.05 LOS to test
<table>
<tr><td>Sample I</td><td>9</td><td>11</td><td>13</td><td>11</td><td>15</td><td>9</td><td>12</td><td>14</td></tr>
<tr><td>Sample II</td><td>10</td><td>12</td><td>10</td><td>14</td><td>9</td><td>8</td><td>10</td><td></td></tr>
</table>Whether the variances of the two population’s sample are equal.</td><td>BTL3</td><td>Applying</td><td>CO 4</td></tr>
<tr><td>5(a)</td><td>Two random samples gave the following results:
<table>
<tr><td>Sample</td><td>Size</td><td>Sample mean</td><td>Sum of squares of deviation from the mean</td></tr>
<tr><td>1</td><td>10</td><td>15</td><td>90</td></tr>
<tr><td>2</td><td>12</td><td>14</td><td>108</td></tr>
</table>Analyze whether the samples have come from the same normal population</td><td>BTL3</td><td>Applying</td><td>CO 4</td></tr>
<tr><td>5(b)</td><td>The mean braking strength of the cables supplied by manufacture is 1800 with S.D 100. By a new technique in the manufacturing process it is claimed that the breaking strength of the cable has increased. To test this claim a sample of 50 cables is tested and is found that the mean braking strength is 1850. Can we support the claim at 1% level of significance</td><td>BTL3</td><td>Applying</td><td>CO 4</td></tr>
<tr><td>6.</td><td>In a certain factory there are two independent processes manufacturing the same item. The average weight in a sample of 250 items produced from one process is found to be 120 Ozs, with a standard deviation of 12 Ozs, while the corresponding figures in a sample of 400 items from the other process are 124 and 14. Is the difference between the two sample means significant?</td><td>BTL3</td><td>Applying</td><td>CO 4</td></tr>
<tr><td>7.</td><td>Records taken of the number of male and female births in 800 families having four Children are as follows :
Number of male births : 0 1 2 3 4
Number of female births : 4 3 2 1 0
Number of Families : 32 178 290 236 64
Infer whether the data are consistent with the hypothesis that the binomial law holds the chance of a male birth is equal to female birth, namely p = ½ = q.</td><td>BTL4</td><td>Analyzing</td><td>CO 4</td></tr>
</table>

<table>
<tr><td>8.</td><td>A survey of 320 families with 5 children each revealed the following distribution
<table><tr><td>Boys</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr><tr><td>Girls</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>Families</td><td>14</td><td>56</td><td>110</td><td>88</td><td>40</td><td>12</td></tr></table>Is this result consistent with the hypothesis that male and female births are equally probable?</td><td>BTL3</td><td>Applying</td><td>CO 4</td></tr>
<tr><td>9.</td><td>The nicotine content in milligram of two samples of toboco where found to be as follows
Sample 1 24 27 26 21 25
Sample 2 27 30 28 31 22 36
Can it be said that this samples where from normal population with the same mean.</td><td>BTL-1</td><td>Remembering</td><td>CO 4</td></tr>
<tr><td>10.</td><td>A group of 10 rats fed on diet A and another group of 8 rats fed on diet B, Recorded the following increase the following increase in weight.(gm)
<table><tr><td>Diet A</td><td>5</td><td>6</td><td>8</td><td>1</td><td>12</td><td>4</td><td>3</td><td>9</td><td>6</td><td>10</td></tr><tr><td>Diet B</td><td>2</td><td>3</td><td>6</td><td>8</td><td>10</td><td>1</td><td>2</td><td>8</td><td>-</td><td>-</td></tr></table>Find the variances are significantly different. (Use F-test)</td><td>BTL-2</td><td>Understanding</td><td>CO 4</td></tr>
<tr><td>11.</td><td>Mechanical engineers testing a new arc welding technique, classified welds both with respect to appearance and an X-ray inspection
<table><tr><td>X-ray/Appearance</td><td>Bad</td><td>Normal</td><td>Good</td></tr><tr><td>Bad</td><td>20</td><td>7</td><td>3</td></tr><tr><td>Normal</td><td>13</td><td>51</td><td>16</td></tr><tr><td>Good</td><td>7</td><td>12</td><td>21</td></tr></table>Test for independence using 0.05 level of significance.</td><td>BTL3</td><td>Applying</td><td>CO 4</td></tr>
<tr><td>12.</td><td>A sample of 200 persons with a particular disease was selected. Out of these, 100 were given a drug and the others were not given any drug. The result are as follows:
<table><tr><td>Number of persons</td><td>Drug</td><td>No drug</td><td>Total</td></tr><tr><td>Cured</td><td>65</td><td>55</td><td>120</td></tr><tr><td>Not cured</td><td>35</td><td>45</td><td>80</td></tr><tr><td>Total</td><td>100</td><td>100</td><td>200</td></tr></table>Test whether the drug is effective or not?</td><td>BTL-2</td><td>Understanding</td><td>CO 4</td></tr>
<tr><td>13.</td><td>The following data gives the number of aircraft accidents that occurred during the various days of a week. Find whether the accidents are uniformly distributed over the week
<table><tr><td>Days</td><td>Sun</td><td>Mon</td><td>Tues</td><td>Wed</td><td>Thu</td><td>Fri</td><td>Sat</td></tr><tr><td>No. of accid ents</td><td>14</td><td>16</td><td>08</td><td>12</td><td>11</td><td>9</td><td>14</td></tr></table></td><td>BTL3</td><td>Applying</td><td>CO 4</td></tr>
<tr><td>14.</td><td>The nicotine content in milligram of two samples of tobacco where found to be as follows, test the significant difference between means of the two samples.</td><td>BTL4</td><td>Analyzing</td><td>CO 4</td></tr>
</table>

<table>
<tr><td></td><td><table><tr><td>Sample I</td><td>21</td><td>24</td><td>25</td><td>26</td><td>27</td><td>-</td></tr><tr><td>Sample II</td><td>22</td><td>27</td><td>28</td><td>30</td><td>31</td><td>36</td></tr></table></td><td></td><td></td><td></td></tr>
<tr><td>15.</td><td>The marks obtained by a group of 9 regular course students and another group of 11 part time course students in a test are given below :<table><tr><td>Sample I</td><td>56</td><td>62</td><td>63</td><td>54</td><td>60</td><td>51</td><td>67</td><td>69</td><td>58</td><td></td><td></td></tr><tr><td>Sample II</td><td>62</td><td>70</td><td>71</td><td>62</td><td>60</td><td>56</td><td>75</td><td>64</td><td>72</td><td>68</td><td>66</td></tr></table>Examine whether the marks obtained by regular students and part-time students differ significantly at 5% levels of significance</td><td>BTL3</td><td>Applying</td><td>CO 4</td></tr>
<tr><td>16(a)</td><td>A simple sample of heights of 6400 Englishmen has a mean of 170cms and a standard deviation of 6.4cms, while a simple sample of heights of 1600 Americans has a mean of 172 cm and a standard deviation of 6.3cms. Do the data indicate that Americans are, on the average, taller than Englishmen?</td><td>BTL4</td><td>Analyzing</td><td>CO 4</td></tr>
<tr><td>16(b)</td><td>The theory predicts that the population of beans in the four groups A, B, C and D should be 9:3:3:1. In an experiment among 1600 beans, the number in the four groups was 882,313,287 and 118. Do the experimental results support the survey?</td><td>BTL4</td><td>Analyzing</td><td>CO 4</td></tr>
<tr><td>17(a)</td><td>The mean population of a random sample of 4000 villages in Jaipur district was found to be 400 with a standard deviation of 12. The mean population of a random sample of 400 villages in Meerut district was found to be 395 with standard deviation of 15. Is the difference between the two district's means statistically significant?</td><td>BTL3</td><td>Applying</td><td>CO 4</td></tr>
<tr><td>17(b)</td><td>In a sample of 8 observations, the sum of squares of deviation of the sample values from the sample mean was 84.4 and in the other sample of 10 observations it was 102.6. Test whether this difference is significant at 5% level, given that the 5% point of F for v1=7 and v2=9 defers of freedom is 3,27</td><td>BTL3</td><td>Applying</td><td>CO 4</td></tr>
<tr><td>18.</td><td>Test of fidelity and selectivity of 190 radio receivers produced the results shown in the following table
Fidelity<table><tr><td>Selectivity</td><td>Low</td><td>Average</td><td>High</td></tr><tr><td>Low</td><td>6</td><td>12</td><td>32</td></tr><tr><td>Average</td><td>33</td><td>61</td><td>18</td></tr><tr><td>High</td><td>13</td><td>15</td><td>0</td></tr></table>Use 0.01 level of significance to test whether there is a relationship between fidelity and selectivity.</td><td>BTL4</td><td>Analyzing</td><td>CO 4</td></tr>
<tr><td colspan="5">UNIT – V MULTIVARIATE ANALYSIS Random Vectors and matrices - Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components – Population principal components – Principal components – Population principal components – Principal components from standardized variables.</td></tr>
</table>

Q.No.	Question	Bloom's Taxonomy Level	Competence	Course Outcome
	PART – A			
1.	Define random vector.	BTL-1	Remembering	CO 5
2.	Define covariance matrix	BTL-1	Remembering	CO 5
3.	State the properties of multivariate normal density.	BTL-2	Understanding	CO 5
4.	Define Principal component analysis.	BTL-1	Remembering	CO 5
5.	Define total population variance.	BTL-2	Understanding	CO 5
6.	State the general objectives of principal components analysis.	BTL-2	Understanding	CO 5
7.	Define the expected value of a random matrix.	BTL-1	Remembering	CO 5
8.	$If \sum = \begin{pmatrix} 4 & 1 & 2 \\ 1 & 9 & -3 \\ 2 & -3 & 25 \end{pmatrix} \; and \; V^{1/2} = \begin{pmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 5 \end{pmatrix}$ find ρ	BTL-2	Understanding	CO 5
9.	If $\sum = \begin{pmatrix} 4 & 1 & 2 \\ 1 & 9 & -3 \\ 2 & -3 & 25 \end{pmatrix}$ Find the standard deviation matrix $V^{1/2}$	BTL-2	Understanding	CO 5
10.	If $X = \begin{pmatrix} 42 & 4 \\ 52 & 5 \\ 48 & 4 \end{pmatrix}$ Find $\bar{x}$.	BTL-2	Understanding	CO 5
11.	Define second principle component.	BTL-1	Remembering	CO 5
12.	If X_1 and X_2 are two uncorrelated random variables, then what is the correlation coefficient matrix.	BTL-2	Understanding	CO 5
13.	Define multivariate analysis.	BTL-1	Remembering	CO 5
14.	State random matrices.	BTL-1	Remembering	CO 5
15.	Establish the condition density of bivariate normal distribution.	BTL-2	Understanding	CO 5
16.	Explain correlation of variables and components.	BTL-2	Understanding	CO 5
17.	Enumerate rescaling the principal components.	BTL-2	Understanding	CO 5
18.	Define first principal component.	BTL-1	Remembering	CO 5
19.	What is the formula to compute the population variance due to k^{th} principal component.	BTL-2	Understanding	CO 5
20.	Explain the principal components obtained from standardized variables.	BTL-2	Understanding	CO 5
21.	Define correlation coefficient in terms of variance and covariance	BTL-2	Understanding	CO 5
22.	Write the matrix notation for principal component from standardized variables	BTL-2	Understanding	CO 5
23.	Write any one theorem about principal component.	BTL-1	Remembering	CO 5
24.	Write any two properties of multivariate normal distribution.	BTL-2	Understanding	CO 5
25.	Write the multivariate normal density function.	BTL-1	Remembering	CO 5
	PART –B			
1.	Compute the covariance matrix with the following data.	BTL-2	Understanding	CO 5

X1 / X2	0	1	$P_1(x_1)$
-1	0.24	0.06	0.3
0	0.16	0.14	0.3
1	0.40	0	0.4

2.	Explain partitioning the covariance matrix.	BTL-2	Remembering	CO 5
3.	Explain the mean vector and covariance matrix for linear combination of random variables	BTL-3	Applying	CO 5
4.	Discuss Bivariate normal density.	BTL-3	Applying	CO 5
5.	Prove that the correlation coefficient between the components are the eigen values – eigen vector pairs for sigma.	BTL-4	Analyzing	CO 5
6.	Consider the random vector $X' = \{X_1, X_2\}$ The discrete random variable X_1 have the following probability function : X_1 : -1 0 1 $P_1(X_1)$: 0.3 0.3 0.4 and X_2 have the following probability function X_2 : 0 1 $P_1(X_1)$: 0.8 0.2	BTL-3	Applying	CO 5
7.	Let the random variables X_1, X_2 and X_3 have the covariance matrix $\sum = \begin{pmatrix} 1 & -2 & 0 \\ -2 & 5 & 0 \\ 0 & 0 & 2 \end{pmatrix}$ Determine the principal components of $Y_1, Y_2, {}_3$	BTL-4	Analyzing	CO 5
8.	Let X_{3x1} be $N_3(\mu, \sigma)$ with $\sum = \begin{pmatrix} 4 & 1 & 0 \\ 1 & 3 & 0 \\ 0 & 0 & 2 \end{pmatrix}$ Are X_1, X_2 independent? What about (X_1, X_2) and X_3.	BTL-3	Applying	CO 5
9.	Discuss principal components from standardized variables.	BTL-4	Analyzing	CO 5
10.	Explain principal component population.	BTL-3	Applying	CO 5
11.	Let X be distributed as $N_3(\mu, \Sigma)$ where $\mu' = (1,-1,2)$ and $\Sigma = \begin{pmatrix} 4 & 0 & -1 \\ 0 & 5 & 0 \\ -1 & 0 & 2 \end{pmatrix}$ which of the following random variables are independent ? Explain i) X_1 and X_2 ii) X_1 and X_3 iii) X_2 and X_3 iv) (X_1, X_3) and X_2	BTL-4	Analyzing	CO 5
12.	For the covariance matrix $\Sigma = \begin{pmatrix} 1 & 4 \\ 4 & 100 \end{pmatrix}$ the derived correlation matrix P = $\begin{pmatrix} 1 & 0.4 \\ 0.4 & 1 \end{pmatrix}$, Show that the principal components obtained from covariance and correlation matrices are different.	BTL-3	Applying	CO 5

13.	Prove that If $\sum$ is positive definite so that $\sum^{-1}$ exists the $\sum$ e = $\lambda e = \Sigma^{-1} e = \left(\frac{1}{\lambda}\right) e$ so (λ, e) is an eigen value – eigen vector pair for $\sum$ corresponding to the pair $(\frac{1}{\lambda}, e)$ for Σ^{-1}, also Σ^{-1} is positive definite.	BTL-3	Applying	CO 5
14.	Prove that the distribution of two linear combination of the components of a random vector.	BTL-4	Analyzing	CO 5
15.	Compute the principal components to the following matrix $A = \begin{pmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{pmatrix}$	BTL-3	Applying	CO 5
16.	Compute the principal components to the following matrix $A = \begin{pmatrix} 5 & 0 & 3 \\ 4 & 2 & 5 \\ 2 & -2 & -2 \end{pmatrix}$	BTL-3	Applying	CO 5
17.	Compute the principal component to the variance covariance matrix $\Sigma = \begin{pmatrix} 1 & 4 \\ 4 & 100 \end{pmatrix}$	BTL-3	Applying	CO 5
18.	If $\sum = \begin{pmatrix} 25 & -2 & 4 \\ -2 & 4 & 1 \\ 4 & 1 & 9 \end{pmatrix}$ then find (i) $V^{1/2}$ and ρ (ii) Show that $V^{1/}\rho V^{1/2} = \rho$	BTL-3	Applying	CO 5