VALLIAMMAI ENGEINEERING COLLEGE

(S.R.M.NAGAR, KATTANKULATHUR-603 203)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

QUESTION BANK

M. E – Computer Science Engineering

1918104 - APPLIED PROBABILITY AND STATISTICS

I SEMESTER

Regulation – 2019

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Prepared by

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VALLIAMMAI ENGNIEERING COLLEGE

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Year & Semester	:	**I / I**
Section	:	**CSE**
Subject Code	:	**1918104**
Subject Name	:	**APPLIED PROBABILITY AND STATISTICS**
Degree & Branch	:	**M.E – CSE**
Staff in charge	:	**Ms. B. VASUKI**

UNIT- I ONE DIMENSIONAL RANDOM VARIABLES

Q.No.	Question	Bloom's Taxonomy Level	Domain
	PART – A		
1)	A continuous random variable X has a pdf f(x) = $3x^2$, $0 \le x \le 1$, Find a and b such that $P(x \le a) = P(x > a)$ and $P(x > b) = 0.05$	BTL-2	Understanding
2)	The first 4 moments about 3 are 1 and 8. Find the mean and variance	BTL-3	Applying
3)	If the distribution function of a random variable X is given by F(x) = $\begin{cases} 1-\frac{4}{x^2}, & x \ge 2 \text{ , 0 for } x \le 2, \end{cases}$ $find\ P(5 < x < 6)$	BTL-2	Understanding
4)	If a random variable X has MGF $M_X(t) = \frac{2}{2-t}$ Find the mean of X	BTL-2	Understanding
5)	Find the mean and variance of the binomial distribution	BTL-3	Applying
6)	If X is a continuous RV with p.d.f. f(x) =2x ,0 <x< 1 , then find the pdf of the RV Y = X^3	BTL-5	Evaluating
7)	If the probability mass function of a random variable X is given by p(X = r) = kr^3, where r = 1,2,3,4. Find the value of k and distribution function of X.	BTL-2	Understanding
8)	A continuous random variable X has a density function given by f(x) = k(1+x) , 2<x<5. Find the value of k.	BTL-5	Evaluating
9)	The first four moments of a distribution about 4 are 1 ,4,10 and 45 respectively. Show that the mean is 5 and variance is 3.	BTL-6	Creating
10)	$If\ f(x) = \begin{cases} kx^2 & ,0 < x < 3 \\ 0, otherwise \end{cases}$ Find the value of X ,then find the value of K	BTL-3	Applying
11)	The random variable X has a Binomial distribution with parameters n =20, p =0.4 .Determine P (X = 3).	BTL-3	Applying
12)	If the probability is 0.05 that a certain kind of measuring device will show excessive drift , what is the probability that the sixth measuring device tested will be the first to show excessive drift?	BTL-3	Applying
13)	If a RV has the probability density $f(x) = \begin{cases} 2e^{-2x} & for\ x > 0 \\ 0, for\ x \le 0 \end{cases}$, find the probabilities that will take a value between 1 and 3.	BTL-2	Understanding

14)	A RV X has the p.d.f. $f(x) = \begin{cases} xe^{-x} \ for \ x > 0 \\ 0, for \ x \leq 0 \end{cases}$. Find the CDF of X	BTL-2	Understanding
15)	If the RV X takes the values 1 ,2,3 and 4 such that 2P(X = 1)=3P(X =2) =P (X =3) = 5 P (X =4) find the probability distribution .	BTL-2	Understanding
16)	If X is the poisson random variable such that p[X=1]=P[X=2] , Find E[x]	BTL-2	Understanding
17)	Show that the function $f(x) = \begin{cases} e^{-x}, x \geq 0 \\ 0, \quad x < 0 \end{cases}$ is a probability density function of a continuous random variable X.	BTL-6	Creating
18)	Obtain the moment generating function of Geometric distribution.	BTL-1	Remembering
19)	Given that the p.d.f of a random variable X is f(x) = kx, 0 < x < 1 , find k		
20)	Find the Binomial distribution for which the mean is 4 and variance is 3.	BTL-3	Applying
21)	The mean of Binomial distribution is 20 and standard deviation is 4. Find the parameters of the distribution.	BTL-1	Remembering
22)	The probability that a candidate can pass in an examination is 0.6. What is the probability that he will pass in third trial?	BTL-2	Understanding
23)	A continuous random variable X has p.d.f $f(x) = 2x, 0 \leq x \leq 1$. Find $P(X > 05)$.	BTL-6	Creating
24)	The number of hardware failures of a computer system in a week of operations has the following p.d.f, Calculate the value of K. No. of failures: 0, 1, 2, 3, 4, 5, 6 Probability: K, 2 K, 2 K, K, 3 K, K, 4 K	BTL-3	Applying
25)	The number of hardware failures of a computer system in a week of operations has the following p.d.f, Find the mean of the number of failures in a week. No. of failures: 0, 1, 2, 3, 4, 5, 6 Probability: .18, .28, .25, .18, .06, .04, .01	BTL-1	Remembering
	PART – B		
1a)	Buses arrive at a specific stop at 15 minutes intervals starting at 7a.m.If a passenger arrives at a random time that is uniformly distributed between 7 and 7.30 am , find the probability that he waits 1) less than 5 minutes for a bus and 2) atleast 12 minutes for a bus .	BTL-2	Understanding
1b)	Obtain the moment generating function of the Poisson distribution and hence find its mean and variance.	BTL-3	Applying
2)	A manufacturer of certain product knows that 5 % of his product is defective .If he sells his product in boxes of 100 and guarantees hat not more than 10 will be defective ,what is the approximate probability that a box will fail to meet the guaranteed quality?	BTL-3	Applying
3a)	A continuous random variable X has a probability density function f(x) = kx^2e^{-x}, x > 0, find k, mean and variance	BTL-1	Remembering
3b)	In a company, 5% defective components are produced .What is the probability that at least 5 components are to be examined in order to get 3 defectives?	BTL-5	Evaluating
4a)	The diameter of an electric cable, say X is assumed to be a continuous random variable with pdf f(x) = 6x (1-x) , 0 ≤ x ≤ 1. Check that f(x) is a pdf and determine a such that P(X < a) = P(X> a)	BTL-4	Analyzing
4b)	Let the random variable X assumes the value r with the probability law p(X = r) = p q^{r-1}, r = 1,2,3…. Find the moment generation function of X and hence its mean.	BTL-1	Remembering

<table>
<tr><td>5a)</td><td>The probability mass function of a discrete R. V X is given as
<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><td>8</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><td>17a</td></tr></table>Find (i) the value of a , (ii) $P(X < 3)$, (iii) Mean of X and (iv) Variance of X.</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>5b)</td><td>Find the MGF, mean, variance of Geometric distribution.</td><td>BTL-1</td><td>Remembering</td></tr>
<tr><td>6a)</td><td>If X is Uniformly distributed over (0 ,10), find the probability that
(i) X < 2 (ii) X > 8 (iii) 3 <X <9?</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>6b)</td><td>If the pdf of a random variable X is f(x) = 2x, 0 < x < 1. Find the pdf of Y = e^{-x}</td><td>BTL-5</td><td>Evaluating</td></tr>
<tr><td>7)</td><td>A discrete RV X has the probability function given below
X : 0 1 2 3 4 5 6 7
P(x) : 0 a 2a 2a 3a a^2 $2a^2$ $7a^2 + a$
Find (i) Value of a (ii) p (X <6) , P (X ≥ 6) , P (0 < X < 4) (iii) Distribution function.</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>8)</td><td>Find the MGF of Binomial distribution and hence find its mean and variance</td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>9a)</td><td>The p.d.f of a random variable X is given by f(x) = kx (2-x), 0 ≤ x≤ 1, Find k, mean, variance and rth moment.</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>9b)</td><td>4 coins were tossed simultaneously. What is the probability of getting (i) 2 heads, (ii) at least 2 heads, (iii) at most 2 heads.</td><td>BTL-5</td><td>Evaluating</td></tr>
<tr><td>10a)</td><td>A random variable X has a uniform distribution over (-3,3) compute P(X<2), P([x]<2) , P([x-2]≤ 2).</td><td>BTL-5</td><td>Evaluating</td></tr>
<tr><td>10b)</td><td>A random variable 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>0.1</td><td>k</td><td>0.2</td><td>2k</td></tr></table>Find i) k ii) P(X<2) iii) P(-2 < X < 2) iv) P(X > 1).</td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>11)</td><td>State and Prove memoryless property of Exponential distribution.</td><td>BTL-1</td><td>Remembering</td></tr>
<tr><td>12)</td><td>Find the first three moments about the origin ,Mean, Variance for the data
<table><tr><td>X</td><td>-2</td><td>-1</td><td>3</td></tr><tr><td>P(X)</td><td>1/2</td><td>1/4</td><td>1/4</td></tr></table></td><td>BTL-1</td><td>Remembering</td></tr>
<tr><td>13a)</td><td>An insurance company found that only 0.005% of the population is involved in a certain type of accident each year. If its 2000 policy holders were randomly selected from the population. What is the probability that not more than two of its clients are involved in such an accident next year?</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>13b)</td><td>Assume that 50% of all engineering students are good in mathematics. Determine the probabilities that among 18 engineering students
1) (i) Exactly 10, (ii) at least 10 are good in mathematics</td><td>BTL-4</td><td>Analyzing</td></tr>
<tr><td>14</td><td>Find the Moment Generating function,,mean. variance for uniform distribution</td><td>BTL-1</td><td>Remembering</td></tr>
<tr><td>15</td><td>Find the MGF of Exponential distribution and hence find its mean and variance</td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>16a)</td><td>Let X be a random variable with pdf f(x) $= \frac{1}{3}e^{\frac{-x}{3}}$, $x \geq 0$ Find the moment generating function of X and hence find its mean and variance.</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>16b)</td><td>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</td><td>BTL-6</td><td>Creating</td></tr>
</table>

<table>
<tr><td></td><td>number of alpha particles emitted from 1 gram is (i) at most 6 (ii) at least 2 and (iii) at least and</td><td></td><td></td></tr>
<tr><td>17a)</td><td>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.</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>17b)</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>
(i) Find the value of k, (ii) P(X<1), (iii) $P(-1< X \le 2)$ (iv) cdf</td><td>BTL-1</td><td>Remembering</td></tr>
<tr><td>18a)</td><td>The probability mass function of a RV X is given by $P(X = r) = kr^3, r = 1,2,3,4$. Find (i) the value of k (ii) $P(\frac{1}{2} < X < \frac{5}{2} / X > 1)$</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>18b)</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.
<u>PART – C</u></td><td>BTL-1</td><td>Remembering</td></tr>
<tr><td>1)</td><td>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, (iii) 1 or 2 girls and iv) no girls</td><td>BTL-6</td><td>Creating</td></tr>
<tr><td>2)</td><td>If a random variable X has p.d.f $f(x) = \begin{cases} \frac{1}{4}, & |X| < 2 \\ 0, & Otherwise \end{cases}$
Find (i) $P(X < 1)$, (ii) $P(|X| > 1)$, (iii) $P(2X + 3 > 5)$.</td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>3)</td><td>State and Prove memoryless property of Geometric distribution</td><td>BTL-1</td><td>Remembering</td></tr>
<tr><td>4)</td><td>The probability distribution of an infinite discrete distribution is given by $P[X = j] = \frac{1}{2^j}$ (j = 1,2,3…) Find (i)Mean of X, (ii)P [X is even], (iii) P(X is odd).</td><td>BTL-1</td><td>Remembering</td></tr>
<tr><td>5</td><td>Derive the MGF, mean and variance of Gamma distribution</td><td>BTL-1</td><td>Remembering</td></tr>
<tr><td colspan="4">UNIT – II TWO DIMENSIONAL RANDOM VARIABLES</td></tr>
<tr><td colspan="4"><u>PART –A</u></td></tr>
<tr><td>1)</td><td>Define Two dimensional Discrete random variables.</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>2)</td><td>.
Define Two dimensional Continuous random variables.</td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>3)</td><td>If the joint pdf of (X,Y) is $f(x, y) = 6e^{-2x-3y}$, $x \ge 0, y \ge 0$, find the marginal density of X and conditional density of Y given X.</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>4)</td><td>The joint pdf of (X,Y) is given by $f(x, y) = e^{-(x+y)}, 0 \le x, y < \infty$. Find the marginal density function of X.</td><td>BTL-3</td><td>Applying</td></tr>
</table>

<table>
<tr><td>5)</td><td>.Given the joint density function of X and Y as
$f(x,y) = \frac{1}{2}e^{-y}, 0 < x < 2, y > 0$
$= 0,$ elsewhere
find the distribution function of (X+Y).</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>6)</td><td>The following table gives the joint probability distribution of X and Y.
<table>
<tr><td>X \ Y</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td>1</td><td>0.1</td><td>0.1</td><td>0.2</td></tr>
<tr><td>2</td><td>0.2</td><td>0.3</td><td>0.1</td></tr>
</table>
Find a) marginal density function of X. b) marginal density of Y.</td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>7)</td><td>The joint probability mass function of (X,Y) is given by
P(x,y) = K (2x+3y), $x = 0, 1, 2$, $y = 1,2,3$.
<table>
<tr><td>X \ Y</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td>0</td><td>3K</td><td>6K</td><td>9K</td></tr>
<tr><td>1</td><td>5K</td><td>8K</td><td>11K</td></tr>
<tr><td>2</td><td>7K</td><td>10K</td><td>13K</td></tr>
</table>
Find the marginal probability distribution of X</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>8)</td><td>Find the value of k, if $f(x,y) = k(1-x)(1-y)$, for 0< x, y<1, is to be a joint density function.</td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>9)</td><td>Let X be a random variable with pdf $f(x) = \frac{1}{2}, -1 \le x \le 1$, and let $Y=X^2$.
Prove that correlationco-efficient between X and Y is zero.</td><td>BTL-4</td><td>Analyzing</td></tr>
<tr><td>10)</td><td>When will the two regression lines be at right angles?</td><td>BTL-4</td><td>Analyzing</td></tr>
<tr><td>11)</td><td>Find the mean values of the variables X and Y and correlation co- efficient from the following regression equations
2Y – X – 50 = 0 ; 3Y – 2X – 10 = 0</td><td>BTL-4</td><td>Analyzing</td></tr>
<tr><td>12)</td><td>The correlation co-efficient between two random variables X and Y is $r = 0.6$. If $\sigma_X = 1.5$, $\sigma_Y = 2$, $\overline{X} = 10$ and $\overline{Y} = 20$, find the regression of (i) Y on X and (ii) X and Y.</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>13)</td><td>The following results were worked out from scores in Maths (X) and Statistics (Y) of students in an examination:
<table>
<tr><td></td><td>X</td><td>Y</td></tr>
<tr><td>Mean</td><td>39.5</td><td>47.5</td></tr>
<tr><td>Standard deviation</td><td>10.8</td><td>17.8</td></tr>
</table>
Pearson’s correlation co-efficient = +0.42. Find both the regression lines. Use these regressions and estimate the value of Y for X</td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>14)</td><td>The co-efficient of correlation between x and y is 0.48. Their covariance is 36. The variance of x is 16. Find the standard deviation of y.</td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>15)</td><td>If x, y denote the deviations of the variates from the arithmetic means and if $r = 0.5, \sum xy = 120, \sigma_y = 8, \sum x^2 = 90$, find n, the number of items.</td><td>BTL-3</td><td>Applying</td></tr>
</table>

16)	Find the marginal density function of X and Y if f(x,y) = 8xy; 0 < x < 1, 0 < y < x.	BTL-4	Analyzing
17)	If the random variable X is uniformly distributed over (-1, 1), find the density function of $Y = \sin\left(\frac{\pi x}{2}\right)$	BTL-3	Applying
18)	The bivariate random variable X and has pdf f(x,y) = kxy, for 0 < x < 4, 1 < y < 5. Find k	BTL-4	Analyzing
19)	The two lines of regression are 8x – 10y +66 = 0, 40x – 18y – 214 =0, Find the mean value of X and Y	BTL-4	Analyzing
20)	The two regression lines are 4x – 3y +33 = 0, 20x – 9 y = 107, var(x) = 25, Find the mean of x and y.	BTL-2	Understanding
21)	Write the condition for two random variables to be independent.	BTL-4	Analyzing
22)	Find the probability distribution of X + Y from the bi-variate distribution of (X,Y) given below: X \ Y: 1, 2 X = 1: 0.4, 0.2 X = 2: 0.3, 0.1	BTL-2	Understanding
23)	The joint pdf of a bivariate RV (X,Y) is given by $f(x,y) = \begin{cases} 4xy & 0<x<1,\ 0<y<1 \\ 0, & \text{otherwise} \end{cases}$ Find *P(X+Y<1).*	BTL-3	Applying
24)	Consider the two – dimensional density function. $f(x,y) = \frac{8}{9}xy,\ 1<x<y<3,$ 0 outside Find the marginal density function of X.	BTL-2	Understanding
25)	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-1	Remembering
	PART – B		
1)	The two dimensional RV(X,Y) has the joint density $f(x,y) = 8xy,\ 0<x<y<1$ $=0$, otherwise (i) Find $P(X<1/2 \cap Y<1/4)$, (ii) Find the marginal and conditional distributions, and (iii) Are X and Y independent? Give reasons for your answer.	BTL-2	Understanding
2)	If the joint pdf of a two – dimensional RV (X,Y) is given by $f(x,y) = K(6-x-y);\ 0<x<2,\ 2<y<4$ $= 0$, elsewhere find (i) the value of K, (ii) $P(X<1, Y<3)$ (iii) $P(X+Y<3)$ (iv) $P(X<1/Y<3)$	BTL-3	Applying
3a)	Determine the value of C that makes the function $F(x, y) = C(x+y)$ a joint probability density function over the range 0 < x < 3 and $x < y < x + 2$. Also determine the following. i) $P(X < 1, Y < 2)$ ii) $P(Y > 2)$ iii) $E[X]$	BTL-4	Analyzing
3b)	If the joint pdf of a two dimensional RV (X,Y) is given	BTL-2	Understanding

<table>
<tr><td></td><td>$$f(x,y) = x^2 + \frac{xy}{3}\ ;\quad 0<x<1, 0<y<2$$
$$= 0,\ \text{elsewhere}$$
(i) P(X > ½), (ii) P(Y<X) and (iii) P(Y< ½ / X < ½).</td><td></td><td></td></tr>
<tr><td>4a)</td><td>If X and Y are two random variables having joint probability mass function given by f(x,y) = (2x+y)/27, x = 0,1,2 and y = 0,1,2. Find the marginal distribution function of X and Y.</td><td>BTL-4</td><td>Analyzing</td></tr>
<tr><td>4b)</td><td>The joint distribution of X_1 and X_2 is given by
$$f(x_1,x_2) = \frac{x_1+x_2}{21}, x_1 = 1,2 \text{ and } 3\ ;\ x_2 = 1 \text{ and } 2.$$
the marginal distributions of X_1 and X_2.</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>5a)</td><td>If the joint probability density function of (X,Y) is f(x,y) = x + y, 0 < x < 1, 0<y <1, find the probability function of U = XY</td><td>BTL-4</td><td>Analyzing</td></tr>
<tr><td>5b)</td><td>Three balls are drawn at random without replacement from a box containing 2 white, 3 red and 4 black balls. If X denotes the number of white balls drawn and X denotes the number of red balls drawn, find the joint probability distribution of (X, Y).</td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>6a)</td><td>The joint probability distribution function of two random variables X and Y is $f(x,y) = x+y \quad 0<x<1,\ 0<y<1$
$= 0, \quad \text{otherwise}$ Find the correlation co-efficient n x and y</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>6b)
r_{UV}</td><td>Let X_1 and X_2 be two independent RVs with means 5 and 10 and S.D's 2 and 3 respectively. Obtain r_{UV}
where $U = 3X_1 + 4X_2$ and $V = 3X_1 - X_2$.</td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>7a)</td><td>For the following data taken from 10 observations, find out the regression equations of X on Y and Y on X: ΣX=250, ΣY = 300, ΣXY = 7900, ΣX^2 = 6500 and ΣY^2 = 10,000 Hence find r.</td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>7b)</td><td>Find the co-efficient of correlation and obtain the lines of regression from the data given below;
<table><tr><td>x :</td><td>62</td><td>64</td><td>65</td><td>69</td><td>70</td><td>71</td><td>72</td><td>74</td></tr><tr><td>y :</td><td>126</td><td>125</td><td>139</td><td>145</td><td>165</td><td>152</td><td>180</td><td>208</td></tr></table></td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>8a)</td><td>The joint distribution function of X and Y is given by
$F(x,y) = (1-e^{-x})(1-e^{-y})$, x,y>0
i) Find the probability density function of X and Y.
ii) Find the marginal density function of X and Y
iii) Are X and Y independent.
iv) Find P(1 < X < 3, 1< Y < 2).</td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>8b)</td><td>A two dimensional random variable (X,Y) have a bivariate distribution given by P(X=x, Y = y) = x^2 + y/32
for x = 0,1,2,3 and y = 0,1. Find the marginal distribution of X and Y.</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>9a)</td><td>If X and Y are independent variates uniformly distributed in (0,1) find the distribution of XY.</td><td>BTL-1</td><td>Remembering</td></tr>
<tr><td>9b)</td><td>Two random variable X and Y have the following joint probability density function f(x,y) = {2-x-y, $0 \le x \le 1$, $0 \le y \le 1$,; 0 otherwise . Find the correlation coefficient of X and Y.</td><td>BTL-5</td><td>Evaluating</td></tr>
<tr><td>10a)</td><td>If (X,Y) is a two – dimensional random variable uniformly distributed</td><td>BTL-3</td><td>Applying</td></tr>
</table>

	over the triangular region R bounded by y = 0, x = 3 and y = $\frac{4}{3}x$, find r_{XY}.		
10b)	If the joint pdf of (X,Y) is given by p(x,y) = k (2x + 3y) , x = 0,1,2; y = 1,2,3. Find the marginal distributions of X and Y.	BTL-3	Applying
11a)	Show that the following function satisfies the properties of a joint probability mass function X : 1 1.5 1.5 2.5 3 Y : 1 2 3 4 5 $F_{xy}(x,y)$: ¼ 1/8 ¼ ¼ 1/8 Determine the following i) P(X< 2.5, Y <3) ii) P(X < 2.5) iii) P(Y < 3) iv) P(X > 1.8, Y= 4.7) v) E(X), E(Y), Var(X), Var(Y) vi) Marginal probability distribution of the random variable X vii) Conditional probability distribution of Y given that X = 1.58	BTL-4	Analyzing
11b)	The joint density function of X and Y is $f(x,y) = \begin{cases} e^{-(x+y)}, & 0 \le x, y \le \infty \\ 0 & otherwise \end{cases}$ Are X and Y independent.	BTL-4	Analyzing
12a)	In a partially destroyed laboratory data, only the equations giving the two lines of regression of y on x and x on y are available and are respectively 7x – 16y + 9 =0, 5y – 4x -3 = 0, calculate the coefficient of correlation.	BTL-6	Creating
12b)	If the probability of a two discrete random variable X and Y is given by f(x,y) = $\begin{cases} k(x+2y), & x = 0,1,2 \text{ and } y = 0,1,2 \\ 0 & otherwise \end{cases}$ i) Find k ii) Find the marginal distributions and conditional distribution of Y for X = x	BTL-5	Evaluating
13a)	The joint probability density function of a two dimensional random variable (X,Y) is given by f(x,y) = $\begin{cases} 4xye^{-(x^2+y^2)}, & x \ge 0, y \ge 0 \\ 0 & otherwise \end{cases}$ Find the density function of U = $\sqrt{x^2+y^2}$	BTL-5	Evaluating
13b)	Find the marginal density function of X and Y if f(x,y) = $\frac{2}{5}(2x+3y)$, $0 \le x \le 1,\ 0 \le y \le 1$.	BTL-4	Analyzing
14a)	The joint density function of two random variables X and Y is given by $f(x,y) = \begin{cases} \frac{1}{3}(3x^2+xy), & 0 < x < 1, 0 < y < 2 \\ 0 & otherwise \end{cases}$ Find P(X+Y>1)	BTL-3	Applying
14b)	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 conditional distribution of Y given X = 1 also find the conditional distribution of X given Y = 1.	BTL-3	Applying
15)	Find the Coefficient of Correlation between industrial production and export using the following table : Production (X): 14, 17, 23, 21, 25 Export (Y): 10, 12, 15, 20, 23	BTL-4	Analyzing

<table>
<tr><td>16)</td><td>The joint pdf of a two dimensional random variable (X, Y) is
$f(x,y) = xy^2 + \frac{x^2}{8}, 0 \le x \le 2, 0 \le y \le 1.$
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></tr>
<tr><td>17)</td><td>From the following table for bi-variate 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-3</td><td>Applying</td></tr>
<tr><td>18)</td><td>If f(x, y) = $\frac{6-x-y}{8}$, $0 \le x \le 2$, , $2 \le y \le 4$ for a bi-variate R.V (X, Y).
Find the correlation coefficient ρ</td><td>BTL-4</td><td>Analyzing</td></tr>
<tr><td></td><td><u>PART –C</u></td><td></td><td></td></tr>
<tr><td>1)</td><td>The joint probability distribution of X and Y is given by the following table.
<table>
<tr><th>X\ Y</th><th>1</th><th>3</th><th>9</th></tr>
<tr><td>2</td><td>1/8</td><td>1/24</td><td>1/12</td></tr>
<tr><td>4</td><td>1/4</td><td>1/4</td><td>0</td></tr>
<tr><td>6</td><td>1/8</td><td>1/24</td><td>1/12</td></tr>
</table>
(i) Find the probability distribution of Y
(ii) Find the conditional distribution of Y given X =2
(iii) X andY independent?</td><td>BTL-4</td><td>Analyzing</td></tr>
<tr><td>2)</td><td>If the joint distribution function of X and Y is given by
F(x,y) = { $(1 - e^{-x})(1 - e^{-y})$ for x>0, y >0
0 otherwise
(i) Find the marginal densities of X and Y
(ii) X and Y are independent
(iii) P(1 < X < 3, 1 < Y < 2)</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>3)</td><td>Calculate the Karl Pearson's coefficient of correlation.

Price : 10 11 13 15 18
Demand : 60 52 48 40 30</td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>4)</td><td>If X and Y each follow an exponential distribution with parameter 1 and are independent, find the pdf of U = X - Y</td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>5)</td><td>From the following data , Find (i)The two regression equations (ii) The coefficient of correlation between the marks in Mathematics and Statistics (iii) The most likely marks in Statistics when marks in Mathematics are 30
Marks in Maths : 25 28 35 32 31 36 29 38 34 32
Marks in Statistics: 43 46 49 41 36 32 31 30 33 39</td><td>BTL-3</td><td>Applying</td></tr>
</table>

UNIT – III ESTIMATION THEORY			
PART –A			
1)	Define estimator.	BTL-1	Remembering
2)	Distinguish between point estimation and interval estimation.	BTL-1	Remembering
3)	Mention the properties of a good estimator.	BTL-1	Remembering
4)	Define confidence coefficient.	BTL-1	Remembering
5)	Define estimate	BTL-2	Understanding
6)	Define confidence limits for a parameter.	BTL-1	Remembering
7)	Define estimation	BTL-1	Remembering
8)	Explain how do you calculate 95% confidence interval for the average of the population?	BTL-3	Applying
9)	Write the normal equations for fitting a straight line by the method of least squares.	BTL-2	Understanding
10)	An automobile repair shop has taken a random sample of 40 services that the average service time on an automobile is 130 minutes with a standard deviation of 26 minutes. Compute the standard error of the mean.	BTL-4	Analyzing
11)	Two variables X and Y have the regression lines 3X + 2Y - 26 = 0, 6X + Y - 31 = 0, Find the mean value of X and Y.	BTL-4	Analyzing
12)	State any two properties of regression lines.	BTL-4	Analyzing
13)	Define unbiasedness of a good estimator.	BTL-1	Remembering
14)	Let the lines of regression concerning two variables x and y be given by y = 32 – x and x = 13 – 0.25y. Obtain the values of the means.	BTL-2	Understanding
15)	What are the merits and demerits of the least square method.	BTL-1	Remembering
16)	Find the maximum likelihood estimates for the population mean when the population variance is known for random sampling from a normal population.	BTL-6	Creating
17)	What is meant by maximum likelihood estimator ?	BTL-1	Remembering
18)	Give the normal equations to fit the parabola $y = a + bx + cx^2$	BTL-2	Understanding
19)	Can Y = 5 +2.8x and X = 3 – 0.5 y be the estimated regression equations of y on x and x on y respectively ? Explain.	BTL-4	Analyzing
20)	Obtain the maximum likelihood estimator of $f(x,\theta) = (1+\theta)x^{\theta}, 0 < x < 1$ based on a random sample of size x.	BTL-3	Applying
21)	What is the level of significance in testing of hypothesis?	BTL-4	Analyzing
22)	State the conditions under which a binomial distribution becomes a normal distribution	BTL-4	Analyzing
23)	Define point estimate	BTL-2	Understanding
24)	Define interval estimate	BTL-2	Understanding
25)	Write the characteristics of a good estimator	BTL-2	Understanding
	PART –B		
1)	Fit a straight line y = a + bx to the following data, using principle of least squares x : 1 2 3 4 6 8 y : 2.4 3 3.6 4 5 6	BTL-2	Understanding

<table>
<tr><td>2)</td><td>Find the most likely price in Bombay corresponding to the price of Rs. 70 at Calculate Correlation coefficient between the prices of commodities in the two cities is 0.8.from the following :
<table>
<tr><td></td><td>Calcutta</td><td>Bombay</td></tr>
<tr><td>Average Price</td><td>65</td><td>67</td></tr>
<tr><td>Standard deviation</td><td>2.5</td><td>3.5</td></tr>
</table></td><td>BTL-5</td><td>Evaluating</td></tr>
<tr><td>3)</td><td>Fit a straight line y = ax +c to the following data.
<table>
<tr><td>X</td><td>1</td><td>3</td><td>5</td><td>7</td><td>9</td><td>11</td><td>13</td><td>15</td><td>17</td></tr>
<tr><td>y</td><td>10</td><td>15</td><td>20</td><td>27</td><td>31</td><td>35</td><td>30</td><td>35</td><td>40</td></tr>
</table></td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>4)</td><td>Find the regression line of Y on X for the data
<table>
<tr><td>x</td><td>1</td><td>4</td><td>2</td><td>3</td><td>5</td></tr>
<tr><td>y</td><td>3</td><td>1</td><td>2</td><td>5</td><td>4</td></tr>
</table></td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>5)</td><td>Fit a parabola of second degree to the following data.
X : 0 1 2 3 4
Y : 1 5 10 22 38</td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>6)</td><td>In random sampling from normal population $N(\mu , \sigma^2)$, find the maximum likelihood estimator for μ when σ^2 is known.</td><td>BTL-1</td><td>Remembering</td></tr>
<tr><td>7)</td><td>The random variable X takes the value 1 and 0 with respective probabilities θ and $1 - \theta$. If $x_1, x_2, \dots x_n$ of X are independent observations , $T = X_1 + X_2 + \dots X_n$ then show that T(n-T) /n(n-1) is an unbiased estimator of $\theta(\theta -1)$.</td><td>BTL-1</td><td>Remembering</td></tr>
<tr><td>8)</td><td>Let x1,x2…..xn denote a random sample from the distribution with pdf
$f(x,\theta) = \theta x^{\theta-1}, \quad 0<x<1, \quad \theta>0$
$\qquad 0 \quad$ Elsewhere
prove that the product u1(x1,x2,….xn) = x1,x2…xn is a sufficient estimator for θ.
i) Let x1,x2,….xn be a random sample from uniform population on $[0,\theta]$. Find a sufficient estimator for θ.
ii) Show that for a rectangular population $f(x,\theta) = 1/\theta, \; 0 < x < \infty$
$\qquad 0 \quad$ elsewhere
Find the maximum likelihood estimator for θ.</td><td>BTL-4</td><td>Analyzing</td></tr>
<tr><td>9)</td><td>For a random sampling from a normal population find the maximum likelihood estimators for
i) The population mean, when the population variance is known.
ii) The population variance, when the population mean is known.
iii) The simultaneous estimation of both the population mean and variance.</td><td>BTL-1</td><td>Remembering</td></tr>
<tr><td>10)</td><td>Obtain the lines of regression
<table>
<tr><td>X</td><td>150</td><td>152</td><td>155</td><td>157</td><td>160</td><td>161</td><td>164</td><td>166</td></tr>
<tr><td>Y</td><td>154</td><td>156</td><td>158</td><td>159</td><td>160</td><td>162</td><td>161</td><td>164</td></tr>
</table></td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>11)</td><td>The price of a commodity during 93-98 are given below. Fit a parabola $y = a + bx + cx^2$ to these data. Calculate the trend values, estimate the period of the commodity for the year 1999.
<table>
<tr><td>x</td><td>1993</td><td>1994</td><td>1995</td><td>1996</td></tr>
<tr><td>y</td><td>100</td><td>107</td><td>128</td><td>140</td></tr>
</table></td><td>BTL-4</td><td>Analyzing</td></tr>
<tr><td>12)</td><td>The following data relate to the marks of 10 students in the internal test and the university examination for the maximum of 50 in each.
Internal Marks : 25 28 30 32 35 36 38 39 42 45
UniversityMarks : 20 26 29 30 25 18 26 35 35</td><td>BTL-1</td><td>Remembering</td></tr>
</table>

<table>
<tr><td></td><td>46
a) Obtain the equations of the lines of regression
b) The most likely internal mark for the university mark of 25
c) The most likely university mark for the internal mark of 30.</td><td></td><td></td></tr>
<tr><td>13)</td><td>Find the maximum likelihood estimate for the parameter λ of a poisson distribution on the basis of a sample of size n. Also find its variance. Show that the sample mean x is sufficient for estimating the parameter λ of the poisson distribution.</td><td>BTL-1</td><td>Remembering</td></tr>
<tr><td>14)</td><td>Fit a straight line y = a + bx for the following data by the principle of least squares.
X : 0 1 2 3 4
Y : 1 1.8 3.3 4.5 6.3
Also find the value of y when x = 1.5</td><td>BTL-4</td><td>Analyzing</td></tr>
<tr><td>15a)</td><td>A random sample (X_1,X_2,X_3,X_4,X_5) of size 5 is drawn from a population with unknown mean μ.
Consider the following estimators to estimate μ.
$t_1=\frac{(x_1+x_2+x_3+x_4+x_5)}{5}$, $t_2=\frac{(x_1+x_2)}{2}+X_3$ and $t_3=\frac{(2x_1+x_2+\lambda x_3)}{3}$ where λ
is such that t_3 is an unbiased estimator of μ. Find λ. Are t_1 and t_2 unbiased ? State giving reason, the estimator which is best among t_1,t_2,and t_3.</td><td>BTL-1</td><td>Remembering</td></tr>
<tr><td>15b)</td><td>Let $X_1,X_2,\ldots X_n$ be a random sample of size n from a normal distribution with known variance. Obtain the maximum likelihood estimator of μ.</td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>16a)</td><td>Let $X_1,X_2\ldots X_n$ be a random sample size n from the Poisson distribution $f(x/\lambda)=\frac{\lambda^x e^{-\lambda}}{x!}$ where $0\le\lambda\le\infty$. Obtain the maximum likelihood estimator of λ</td><td>BTL-5</td><td>Evaluating</td></tr>
<tr><td>16b)</td><td>For the double poisson distribution P(X = x) =
$\frac{1}{2}\frac{e^{-m_1}m_1^x}{x!}+\frac{1}{2}\frac{e^{-m_2}m_2^x}{x!}, x=0,1,2...$ Show that the estimates for m_1 and m_2 by the method of moments are $\mu_1\pm\sqrt{\mu_2'-\mu_1'-\mu_1'^2}$</td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>17a)</td><td>The following are the measurements of the air velocity and evaporation coeffiecient of burning fuel droplets in an impulse engine

Air Velocity (cm/s) :20 60 100 140 180 220 260 300 340 380

Evaporation Coeff : 0.18 0.37 0.35 0.78 0.56 0.75 1.18 1.36 1.17 1.65
Fit a straight line to these data by the method of least squares, and use it to estimate the evaporation coefficient of a droplet when the air velocity is 190 cm/s.</td><td>BTL-4</td><td>Analyzing</td></tr>
<tr><td>17b)</td><td>Fit an equation of the form $y = ab^x$ to the following data
<table><tr><td>x</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>y</td><td>144</td><td>172.8</td><td>207.4</td><td>248.8</td><td>298.5</td></tr></table></td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>18)</td><td>Obtain the equation of regression lines y = ax + b from the following data, using the method of least squares.
<table><tr><td>X</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>y</td><td>1</td><td>1.8</td><td>3.3</td><td>4.5</td><td>6.3</td></tr></table></td><td>BTL-3</td><td>Applying</td></tr>
</table>

	PART –C		
1)	Prove that the ML estimator of the parameter α of the population having pdf $f(x,\alpha) = 2/\alpha^2 (\alpha - x)$. $0 < x < \alpha$ for the sample of unit size is 2x, x being the sample value. Show also that the estimator is not unbiased.	BTL-1	Remembering
2)	Fit a straight line trend of the form $y = a + bx$ to the data given below by the method of least squares and predict the value of y when x = 70 x: 71, 68, 73, 69, 67, 65, 66, 67 y: 69, 72, 70, 70, 68, 67, 68, 64	BTL-3	Applying
3)	Fit the model $y = ax^b$ to the following data. X: 1, 2, 3, 4, 5, 6 y: 2.98, 4.26, 5.21, 6.10, 6.80, 7.50	BTL-3	Applying
4)	If the two variables x and y have the regression lines $3x + 2y = 26$ and $6x + y = 31$. Find i) Find the mean value of x and y ii) Find the correlation coefficient of x and y.	BTL-5	Evaluating
5)	Fit a straight line for the following data by the method of least squares x: 1979, 1980, 1981, 1982, 1983, 1984, 1985 y: 672, 824, 968, 1205, 1464, 1758, 2058	BTL-5	Evaluating

UNIT – IV TESTING OF HYPOTHESIS

	PART –A		
1)	What is the essential difference between confidence limits and tolerance limits?	BTL-1	Remembering
2)	Define Null hypothesis.	BTL-1	Remembering
3)	Define level of significance	BTL-1	Remembering
4)	Define Type-I error and Type-II error?	BTL-1	Remembering
5)	Define student's t-test for difference of means of two samples.	BTL-1	Remembering
6)	Write down the formula of test statistic'z' to test the significance of difference between proportions	BTL-2	Understanding
7)	Write the application of t-test	BTL-3	Applying
8)	Define Alternative hypothesis.	BTL-3	Applying
9)	State the important properties of 't' distribution.	BTL-1	Remembering
10)	Write the application of Chi-Square-test.	BTL-1	Remembering
11)	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-4	Analyzing
12)	Write the application of 'F' test	BTL-3	Applying
13)	Define a 'F' variate	BTL-1	Remembering
14)	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-3	Applying
15)	A sample of size 13 gave an estimated population variance of 3.0 while another sample of size15 gave an estimate of 2.5. Could both samples be from populations with the same variance?	BTL-3	Applying
16)	Give the main use of chi-square test.	BTL-1	Remembering
17)	What are the properties of "F" test.	BTL-1	Remembering
18)	Write the procedure for testing a statistical hypothesis	BTL-2	Understanding
19)	Write the standard error of any four sampling distribution	BTL-2	Understanding
20)	What is the difference between small sample and large sample.	BTL-2	Understanding
21)	What are the expected frequencies of 2x2 contingency table?	BTL-1	Remembering

<table>
<tr><td></td><td><table><tr><td>a</td><td>b</td></tr><tr><td>c</td><td>d</td></tr></table></td><td></td><td></td></tr>
<tr><td>22)</td><td>What is the assumption of t-test?</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>23)</td><td>What are the parameters and statistics in sampling</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>24)</td><td>Write the formula for test statistic for a single propotion</td><td>BTL-1</td><td>Remembering</td></tr>
<tr><td>25)</td><td>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? ($Z_{0.05} = 1.645$).</td><td>BTL-3</td><td>Applying</td></tr>
<tr><td colspan="4"><u>PART – B</u></td></tr>
<tr><td>1a)</td><td>A sample of 900 members has a mean 3.4 c.m and standard deviation 2.61 c.m. Is the sample from a large population of mean 3.25 c.ms and standard deviation of 2.61c.ms?(Test at 5% L.O.S)</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>1b)</td><td>Before an increase in excise duty on tea, 800 persons out of a sample of 1000 persons were found to be tea drinkers. After an increase in duty, 800 people were tea drinkers in a sample of 1200 people. Using standard error of proportion, State whether there is a significant decrease in the consumption of tea after the increase in excise duty.</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>2a)</td><td>A manufacturer claimed that at least 95% of the equipment which he supplied to a factory conformed to specifications. An examination of a sample of 200 pieces of equipment revealed that 18 were faulty. Test his claim at 5% level of significance</td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>2b)</td><td>A machine produces 16 imperfect articles in a sample of 500. After machine is overhauled, it produces 3 imperfect articles in a batch of 100. Has the machine been improved?</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>3a)</td><td>In a big city 325 men out of 600 men were found to be smokers. Does this information support the conclusion that the majority of men in this city are smokers?</td><td>BTL-5</td><td>Evaluating</td></tr>
<tr><td>3b)</td><td>Examine whether the difference in the variability in yields is significant at 5% LOS, for the following.<table><tr><td></td><td>Set of 40 Plots</td><td>Set of 60 Plots</td></tr><tr><td>Mean yield per Plot</td><td>1258</td><td>1243</td></tr><tr><td>S.D. per Plot</td><td>34</td><td>28</td></tr></table></td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>4a)</td><td>The means of 2 large samples 1000 and 2000 members are 67.5 inches and 68.0 inchesrespectively. Can the samples be regarded as drawn from the same population of standard deviation 2.5 inches?</td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>4b)</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>BTL-4</td><td>Analyzing</td></tr>
</table>

<table>
<tr><td>5a)</td><td>Samples of two types of electric bulbs were tested for length of life and following data wereobtained.
<table><tr><td></td><td>Type I</td><td>Type II</td></tr><tr><td>Sample Size</td><td>8</td><td>7</td></tr><tr><td>Sample Mean</td><td>1234hrs</td><td>1036hrs</td></tr><tr><td>Sample S.D</td><td>36hrs</td><td>40hrs</td></tr></table>Is the difference in the means sufficient to warrant that type I is superior to type II regarding the length of life?</td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>5b)</td><td>Two independent samples of 8 and 7 items respectively had the following Values of the variable (weight in kgs.)
Sample I : 9 11 13 11 15 9 12 14
Sample II: 10 12 10 14 9 8 10
Use 0.05 level of significance to test whether it is reasonable to assume that thevariances of the two population's sample are equal.</td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>6)</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.(gms)
Diet A : 5 6 8 1 12 4 3 9 6 10
Diet B : 2 3 6 8 10 1 2 8 - -
Does it show superiority of diet A over diet B ? (Use F-test)</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>7)</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 :
Regular : 56 62 63 54 60 51 67 69 58
Part-time: 62 70 71 62 60 56 75 64 72 68 66
Examine whether the marks obtained by regular students and part-time students differ significantly at 5% and 1% levels of significance.</td><td>BTL-3</td><td>Applying</td></tr>
<tr><td>8)</td><td>Two independent samples of size 8 and 7 contained the following values
Sample 1 : 29 18 11 21 14 12 14 14
Sample 2 : 11 14 15 19 13 10 12
Test if the two populations have the same variance.</td><td>BTL-4</td><td>Analyzing</td></tr>
<tr><td>9a)</td><td>The average income of a person was Rs. 210 with S.D of Rs. 10 in a sample 100 people of a city. For another sample of 150 persons the average income was Rs. 220 with S.D of Rs. 12. Test whether there is any significant difference between the average income of the localities?</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>9b)</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>Test whether the samples have come from the same normal population.</td><td>BTL-2</td><td>Understanding</td></tr>
<tr><td>10)</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
Test whether the data are consistent with the hypothesis that the binomial law holds and that the chance
of a male birth is equal to that of female birth, namely p = ½ = q.</td><td>BTL-4</td><td>Analyzing</td></tr>
</table>

11) Given the following table for hair colour and eye colour, find the value of Chi-square. Is there good association between hair colour and eye colour?

		Hair colour			
		Fair	Brown	Black	Total
Eye colour	Blue	15	5	20	40
	Grey	20	10	20	50
	Brown	25	15	20	60
	Total	60	30	60	150

BTL-4 | Analyzing

12a) Out of 800 graduates in a town 800 are females, out of 1600 graduate employees 120 are females. Use chi square to determine if any distinction is made in appointment on the basis of sex. Value of chi square at 5% level for 1 d.f is 3.84

BTL-2 | Understanding

12b) 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.

Sample I	21	24	25	26	27	-
Sample II	22	27	28	30	31	36

BTL-4 | Analyzing

13) 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.

Days	Sun	Mon	Tues	Wed	Thu	Fri	Sat
No. of accidents	14	16	08	12	11	9	14

BTL-2 | Understanding

14) Two researchers A and B adopted different techniques while rating the students level. Can you say that the techniques adopted by them are significant at 5% level?

Researchers	Below average	Average	Above average	Genius	Total
A	40	33	25	2	100
B	86	60	44	10	200
Total	126	93	69	12	300

BTL-5 | Evaluating

15a) From the following two sample values, find out whether they have come from the same population at 5% level.

Sample I : 17 27 18 25 27 29 27 23 17

Sample II : 16 16 20 16 20 17 15 21

BTL-3 | Applying

15b) 5 coins were tossed 320 times. The number of heads observed is given below:

No. of heads	0	1	2	3	4	5
Observed frequencies	15	45	85	95	60	20

Examine whether the coin is unbiased .Use 5% level of significance

BTL-3 | Applying

16a) It is desired to determine whether there is less variability in the silver plating done by Company I than that done by Company 2. If independent random samples of size 1 of the two companies work yield $s_1 = 0.035$ mil and $s_2 = 0.062$ mil, test the null hypothesis $\sigma_1^2 = \sigma_2^2$ against the alternative hypothesis $\sigma_1^2 < \sigma_2^2$ at the 0.05 level of significance.

BTL-5 | Evaluating

16b)	The Lapping process which is used to grind certain silicon wafers to the proper thickness is acceptable only if σ, the population standard deviation of the thickness of dice cut from the wafers, is atmost 0.50 mil. Use 0.05 level of significance to test the null hypothesis $\sigma = 0.50$ against the alternative hypothesis $\sigma > 0.50$, if the thickness of 15 dice cut from such wafers have a standard deviation of 0.64 mil. .	BTL-3	Applying
17a)	Given a sample mean of 83, a sample standard deviation of 12.5 and a sample size of 22, test the hypothesis that the value of the population mean is 70 against the alternative that it is more than 70. Use the 0.05 significance level.	BTL-6	Creating
17b)	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: Number of persons | Drug | No drug | Total Cured | 65 | 55 | 120 Not cured | 35 | 45 | 80 Total | 100 | 100 | 200 Test whether the drug is effective or not?.	BTL-6	Creating
18)	To determine whether there really is a relationship between an employee's performance in the company's training program and his or her ultimate success in the job, the company takes a sample of 400 cases from its very extensive files and obtains the results shown in the following table : Performances in the training Program | Below Average | Average | Above Average | Total Poor | 23 | 60 | 29 | 112 Average | 28 | 79 | 60 | 167 Very good | 9 | 49 | 63 | 121 Total | 60 | 188 | 152 | 400 Using the 0.01 level of significance to test the null hypothesis that performance in the training program and success in the job are independent	BTL-3	Applying
	PART C		
1)	The means of two random samples of size 9 and 7 are 196.42 and 198.92 respectively. The sum of the squares of the deviation from the mean are 26.94 and 18.73 respectively. Can the sample be considered to have been drawn from the same normal population.	BTL-2	Understanding
2)	Two horses A and B were tested according to the time (in seconds) to run a particular track with the following results. Horse A | 28 | 30 | 32 | 33 | 33 | 29 | 34 Horse B | 29 | 30 | 30 | 24 | 27 | 27 | - Test whether you can discriminate between two horses. You can use the fact that 5 % value of t for 11 degrees of freedom is 2.2	BTL-4	Analyzing
3)	An ample analysis of examination results of 500 students was made. It was found that 220 students had failed. 170 had secured a third class, 90 were placed in second class and 20 got first class. Do these figures commensurate with the general examination result which is in the ration	BTL-6	Creating

	4 : 3:2:1 for the various categories respectively.		
4)	Random samples of 400 men and 600 women were asked whether they would like to have a flyover near their residence. 200 men and 325 women were in favour of the proposal. Test the hypothesis that proportions of men and women in favour of the proposal are same at 5 % level.	BTL-3	Applying
5)	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?		
	UNIT – V MULTIVARIATE ANALYSIS		
	PART A		
1)	Define random vector.	BTL-1	Remembering
2)	Define covariance matrix	BTL-1	Remembering
3)	State the properties of multivariate normal density.	BTL-1	Remembering
4)	Define Principal component analysis.	BTL-1	Remembering
5)	Define total population variance.	BTL-1	Remembering
6)	State the general objectives of principal components analysis.	BTL-3	Applying
7)	Define the expected value of a random matrix.	BTL-1	Remembering
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-3	Applying
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-4	Analyzing
10)	If $X = \begin{pmatrix} 42 & 4 \\ 52 & 5 \\ 48 & 4 \end{pmatrix}$ Find $\bar{x}$.	BTL-4	Analyzing
11)	Define second principle component.	BTL-1	Remembering
12)	If X_1 and X_2 are two uncorrelated random variables, then what is the correlation coefficient matrix.	BTL-2	Understanding
13)	Define multivariate analysis.	BTL-1	Remembering
14)	State random matrices.	BTL-1	Remembering
15)	Establish the condition density of bivariate normal distribution.	BTL-4	Analyzing
16)	Explain correlation of variables and components.	BTL-4	Analyzing
17)	Enumerate rescaling the principal components.	BTL-5	Evaluating
18)	Define first principal component.	BTL-1	Remembering
19)	What is the formula to compute the population variance due to k^{th} principal component.	BTL-2	Understanding
20)	Explain the principal components obtained from standardized variables.	BTL-2	Understanding
21)	Define correlation coefficient in terms of variance and covariance	BTL-2	Understanding
22)	Write the matrix notation for principal component from standardized variables	BTL-4	Analyzing
23)	Write any one theorem about principal component.	BTL-1	Remembering
24)	Write any two properties of multivariate normal distribution.	BTL-5	Evaluating

25)	Write the multivariate normal density function.	BTL-1	Remembering
	PART – B		
1)	Compute the covariance matrix with the following data. <table><tr><td>X1 X2</td><td>0</td><td>1</td><td>$P_1(x_1)$</td></tr><tr><td>-1</td><td>0.24</td><td>0.06</td><td>0.3</td></tr><tr><td>0</td><td>0.16</td><td>0.14</td><td>0.3</td></tr><tr><td>1</td><td>0.40</td><td>0</td><td>0.4</td></tr></table>	BTL-2	Understanding
2)	Explain partitioning the covariance matrix.	BTL-1	Remembering
3)	Explain the mean vector and covariance matrix for linear combination of random variables	BTL-1	Remembering
4)	Discuss Bivariate normal density.	BTL-1	Remembering
5)	Prove that the correlation coefficient between the components are the eigen values – eigen vector pairs for sigma.	BTL-4	Analyzing
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
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-5	Evaluating
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-2	Understanding
9)	Discuss principal components from standardized variables.	BTL-1	Remembering
10)	Explain principal component population.	BTL-1	Remembering
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-5	Evaluating
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

13)	Prove that If Σ is positive definite so that Σ^{-1} exists the $\Sigma e =$ $\lambda e = \Sigma^{-1} e = \left(\frac{1}{\lambda}\right) e$ so (λ, e) is an eigen value – eigen vector pair for Σ corresponding to the pair $(\frac{1}{\lambda}, e)$ for Σ^{-1}, also Σ^{-1} is positive definite.	BTL-3	Applying
14)	Prove that the distribution of two linear combination of the components of a random vector.	BTL-4	Analyzing
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
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
17)	Compute the principal component to the variance covariance matrix $\Sigma = \begin{pmatrix} 1 & 4 \\ 4 & 100 \end{pmatrix}$	BTL-3	Applying
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
	PART C		
1)	Compute the principal components to the following 3 x 3 variance covariance matrix for n = 20. $A = \begin{pmatrix} 2.8889 & 9.8968 & -1.8120 \\ 9.8968 & 201.0183 & -5.65553 \\ -1.8210 & -5.6553 & 3.6276 \end{pmatrix}$	BTL-3	Applying
2)	Prove that all the subsets of X are normally distributed	BTL-3	Applying
3)	Explain the distribution of a subset of a normal random vector	BTL-1	Remembering
4)	Explain the conditional density of bivariate normal distribution	BTL-1	Remembering
5)	Explain Multivariate Analysis	BTL-4	Analyzing

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