		CO	BL	Marks
1	Let $X_1, X_2, X_3, ...X_n$ be a random sample from a Poisson distribution with parameter μ. Find the maximum likelihood estimator (MLE) for μ.	CO4	L3	5
2	Let $X_1, X_2, X_3, ...X_{25}$ be a random sample from the distribution of X having mean 10 and variance 50. Find the mean and standard deviation of $Y = 7\bar{X} + 5$	CO4	L3	5
3	The coefficient of rank correlation between marks in statistics and marks in physics obtained by a certain group of students is 0.8. If the sum of squares of the difference in the ranks is given to be 33, find the number of students in the group.	CO4	L3	5
4	Derive the normal equations for fitting a line of form $y = a + bx$ to the given n data (X,Y). Also explain how to get best fit line.	CO6	L2	5
5	Define the regression coefficients and write lines of regression. Also show that correlation coefficient is geometric mean of regression coefficients.	CO6	L3	5
6	Find the correlataion coefficient $r(X, Y)$ for following seven data points: X: 1 3 4 5 7 8 10 and Y: 2 6 8 10 14 16 20 taking in respective order.	CO6	L3	5

ademic task number: 3

Course title: Probability and Statistics.

Section:

Name:

	CO	BL	Marks
nsistent estimator for μ in sampling from normal distribution,	CO4	L3	5
...X_n are choosen from a distribution having pdf, $f(x, \theta) = $ hen, find the MLE for parameter θ.	CO4	L2	5
is independent of change of scale and origin .	CO6	L2	5
e of form $y = ab^x$ to the given n data (X, Y). Derive the normal	CO6	L3	5
X, Y) for following five data points: X: 4 2 10 5 8 and Y: e order.	CO6	L3	5
or two given regresion lines $x + 2y - 5 = 0$ and $2x + 3y - 8 = 0$,	CO6	L3	5

Academic Tasks (22232)

SET: A

Course code: MTH302

Roll No.:

Academic task number: 3

Course title: Probability and Statistics.

Name:

Maximum marks: 30.

Time: 50 Minute

Section:

Question Statement	CO	BL
Check whether sample mean is consistent estimator for μ in sampling from normal distribution. $N(\mu, \sigma^2)$.	CO4	L3
If a sample units, $X_1, X_2, X_3, X_4...X_n$ are choosen from a distribution having pdf, $f(x, \theta) = \theta e^{-\theta x}$, $x > 0$ with parameter θ. Then, find the MLE for parameter θ.	CO4	L2
Show that cofficient of correlation is independent of change of scale and origin .	CO6	L2
Explain the process of fitting a curve of form $y = ab^x$ to the given n data (X, Y). Derive the normal equations.	CO6	L3
Find the correlataion coefficient $r(X, Y)$ for following five data points: X: 4 2 10 5 8 and Y: 8 12 4 10 2 taking in respective order.	CO6	L3
Write the two lines of regression. For two given regresion lines $x + 2y - 5 = 0$ and $2x + 3y - 8 = 0$, find the mean vales of X and Y.	CO6	L3

SET: B

Course code: MTH302

Roll No.:

Academic task number: 3

Course title: Probability and Statistics.
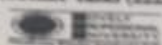
Name:

Maximum marks: 30.

Time: 50 Minutes

Section:

Q. No.	Question Statement	CO	BL	Marks
1	Let $X_1, X_2, X_3, ...X_n$ be a random sample from a Poisson distribution with parameter μ. Find the maximum likelihood estimator (MLE) for μ.	CO4	L3	5
2	Let $X_1, X_2, X_3, ...X_{25}$ be a random sample from the distribution of X having mean 10 and variance 50. Find the mean and standard deviation of $Y = 7\bar{X} + 5$	CO4	L3	5
3	The coefficient of rank correlation between marks in statistics and marks in physics obtained by a certain group of students is 0.8. If the sum of squares of the difference in the ranks is given to be 33, find the number of students in the group.	CO4	L3	5
4	Derive the normal equations for fitting a line of form $y = a + bx$ to the given n data (X,Y). Also explain how to get best fit line.	CO6	L2	5
5	Define the regression coefficients and write lines of regression. Also show that correlation coefficient is geometric mean of regression coefficients.	CO6	L3	5
6	Find the correlataion coefficient r(X, Y) for following seven data points: X: 1 3 4 5 7 8 10 and Y: 2 6 8 10 14 16 20 taking in respective order.	CO6	L3	5

u

SET: C

Course code: MTH302

Roll No.:

Academic task number: 3

Course title: Probability and Statistics.

Name:

Maximum marks: 30

Time: 50 Minutes

Section:

Q. No.	Question Statement	CO	BL	Marks
1	Let X1, X2, X3, ...Xn be a random sample taken from a distribution of X having mean μ and variance σ^2. Check whether the estimator $T = \frac{2\sum_{i=1}^{n} iX_i}{n(n+1)}$ is baised or unbalised for μ.	CO4	L3	5
2	Let $X_1, X_2, X_3, ..., X_n$ be an i.i.d. sample from an exponential distribution with the density function $f(x,\beta) = \frac{1}{\beta}e^{-\frac{x}{\beta}}$, with $0 \le x < \infty$. find the MLE of the parameter β.	CO4	L2	5
3	A population of 29 year-old males has a mean salary of 29,321 with a standard deviation of 2,120. If a sample of 100 men is taken, what is the probability their mean salaries will be less than 29,000? [Given that $P(z < -1.51) = 0.655, P(z < -0.59 = 0.2776)$]	CO4	L3	5
4	Define regression lines and then derive the normal equations for fitting a curve of form $y = a + bx + cx^2$ to the n given data points.	CO6	L3	5
5	Find the correlataion coefficient r(X, Y) for following five data points: X: -10 -5 0 5 10 and Y: 5 9 7 11 13 taking in respective order.	CO6	L2	5
6	Write lines of regression. Find the mean values of X and Y for two given regresion lines $x + 2y - 5 = 0$ and $2x + 3y - 8 = 0$.	CO6	L2	5

Question Number	Question Statement(Set B)	Course Outcome	Bloom's level	Marks per Question
Q1	Obtain the MLE of α for the distribution with probability density function $f(x,\alpha) = \alpha^x(1-\alpha)^x, x = 0,1; 0 \le \alpha \le 1$ for a sample of size n.	CO1	L3: Apply	10
Q2	Let $x_1, x_2, ..., x_n$ be a random sample from uniform population in $[0,\theta]$. Check whether that $\bar{X}$ is unbiased estimator of θ or not.	CO1	L2: Understand	5
Q3	A random sample X_1, X_2, X_3, X_4, X_5 of size 5 is drawn from normal population with unknown mean μ. Consider the following estimators to estimate μ. $Y = \frac{X_1+X_2+X_3+X_4+X_5}{5}$, $Z = \frac{X_1+X_2}{2}+X_3$, $T = \frac{3X_1+X_2-X_3}{3}$. Find the unbiased estimators among Y, Z, T and of the unbiased estimators find which is the best?	CO1	L2: Understand	5
Q4	If the mean age at death of 64 men engaged in an occupation is 52.4 years with s.d. of 10.2 years, Could it be a random sample from a population with mean 55 at 5% LOS. Also find 99% confidence limits for mean age of all men in the population. [Given: $P(|z| > 1.96) = 0.05, P(z > 1.645) = 0.05,$].	CO2	L4: Analyze	10

Question Number	Question Statement (SET A)	Course Outcome	Bloom's level	Marks per Question
Q1	The lifetime of a certain brand of an electric bulb is a random variable with mean 100 and standard deviation 30. Find the probability that Total of the life time of 30 bulbs exceeds 120.	CO4	L3: Apply	5
2	The Bernoulli random variable X takes the values 1 and 0 with respective probabilities p and $1 - p$. Let $Y = \sum_{i=1}^{n} X_i$. Show that $\frac{Y(n-Y)}{n(n-1)}$ is unbiased estimate of $p(1 - p)$.	CO4	L2: Understand	10
	Let X_1, X_2, X_3 and X_4 be random sample from $N(\mu, \sigma^2)$. If $T = \frac{-X_1 - 4X_2 + 3X_3 + 5X_4}{4}$, $\bar{X} = \frac{1}{4}\sum_{i=1}^{4} X_i$. Which is more efficient, also find efficiency of T relative to $\bar{X}$.	CO4	L2: Understand	5
	An online pizza shop delivers its 49 orders with average delivery time of 25 minutes. Is it reasonable to believe that the average mean delivery time for pizza is less than 36 minutes with a standard deviation of 15 minutes? Also find 99% confidence limits of the mean of the population.	CO5	L4: Analyze	10

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SET: D   Academic task number: 3   **Maximum marks: 30.**
Course code: MTH302   Course title: Probability and Statistics.   Time: 50 M

Roll No.:   Name: Section:

Q. No.	Question Statement	C
1	Suppose $X1, X2, ..., Xn$ are i.i.d. random variables from a distribution with density function $f(x, \sigma) = \frac{1}{2\sigma}e^{-\frac{|x|}{\sigma}}$ find the maximum likelihood estimate of σ.	C
2	Let $X_1, X_2, X_3, ...X_{25}$ be a random sample from the distribution of X having mean 10 and variance 50. Find the mean and standard deviation of $Y = 5\bar{X} + 10$	C
3	A survey found that the American family generates an average of 17.2 pounds of glass garbage each year. Assume the standard deviation of the distribution is 2.5 pounds. Find the probability that the mean of a sample of 55 families will be between 17 and 18 pounds. [Given that $P(z < -0.59 = 0.2776)$, $P(z < -1.51) = 0.655$ and $P(z < 2.37) = 0.9911$]	
4	Find the rank correlation of the following data of price of tea and price of coeffee in order pairs (X, Y): (74, 121), (88, 135), (96, 152), (70, 115), (60, 110), (80, 140), (81, 142), (50, 100) .	
5	Explain how to fit a curve of the form $y = ax^b$ to the n given data points (X_i, Y_i) with help of normal equations for fitting.	
	Find the correlataion coefficient for the following marks of six candidates in Mathematics and English. X: 70 92 80 74 65 83 and Y: 74 84 63 87 78 90 taking in respective order.	

Question Number	Question Statement (SET A)	Course Outcome	Bloom's level	Marks per Question
Q1	A distribution with unknown mean μ and variance 1.44. Use CLT to find how large a sample should be taken from the distribution in order that the probability will be at least 90% that the sample mean will be within 0.1 about the population mean. Given:$P(|z| > 1.96) = 0.05, P(z > 1.645) = 0.05]$.	CO1	L3: Apply	5
Q2	Suppose X and Y are independent random variables with the same unknown mean μ. Both X and Y have variance 36. Let $T = aX + bY$ be an estimator of μ. Find the condition on a, b such that T is unbiased estimator of μ. Also for $a = \frac{1}{3}, b = \frac{2}{3}$, find variance of T.	CO1	L2: Understand	5
Q3	If $x_1, x_2, \ldots, x_n$ is a random sample with mean μ and variance σ^2. Check whether $T = \frac{2}{(n^2-1)}\sum_{i=1}^{n} iX_i$ is consistent estimator of population mean?	CO1	L2: Understand	10
Q4	A drug was administered to 10 patients, and the increments in their blood pressure were recorded to be 2, 3, 0, 6, 4, 4, −3, 4, −2, 3, 6. Is it reasonable to believe that the drug has no change of blood pressure? [Given:$P(t > 2.262) = 0.025, P(t \geq 1.833) = 0.05]$.	CO2	L4: Analyze	10

Q4 a) In a random sampling from normal population $N(\mu, \sigma^2)$. Find the Maximum Likelihood Estimators for (i) μ when σ^2 is known. (ii) σ^2 when μ is known. **[10 Marks]**

OR

b) (i) A random sample $(X_1, X_2, X_3, X_4, X_5)$ of size five is drawn from a normal population with unknown mean μ. Consider the following estimators to estimate μ:

(a). $t_1 = \frac{X_1 + X_2 + X_3 + X_4 + X_5}{5}$

(b). $t_2 = \frac{X_1 + X_2}{2} + X_3$

(c). $t_3 = \frac{2X_1 + X_2 + \lambda X_3}{3}$

(i) Find λ such that t_3 is unbiased estimator. **[5 Marks]**

(ii) Which is the best estimator among t_1, t_2 and t_3.

(ii) Let X_1, X_2, X_3, X_4, X_5 are 5 independent observation from normal population with mean μ and variance σ^2. Consider statistic (i) $t_1 = \frac{X_1 + X_2 + X_3 + X_4 + X_5}{5}$ (ii) $t_2 = \frac{X_1 + X_2}{2} + X_3$.

Which is the best estimator among t_1 and t_2 **[5 Marks]**

Q5 a) In a partially destroyed laboratory, record of an analysis of correlation data, the following result only is legible: variance of X = 9. Regression equation: 8X−10Y+66=0 , 40X−18Y=214. What are: (i) the mean values X and Y , (ii) the correlation coefficient between X and Y and (iii) the standard deviation of Y ? **[10 Marks]**

OR

b) (i) Obtain the equation of two lines of regression for the following data.

X:	65	66	67	67	68	69	70	72
Y:	67	68	65	68	72	72	69	71

[5 Marks]

(ii) The variables X and Y are connected by the equation aX+bY+c=0.Show that the correlation between them is -1 if the signs of a and b are alike and +1 if they are different. **[5 Marks]**

Q6 a) The following figures show that the distribution of digits in numbers chosen at random from a telephone directory

Digits:	0	1	2	3	4	5	6	7	8	9
Frequency:	1026	1107	997	966	1075	933	1107	972	964	853

Test whether the digits may be taken to occur equally frequently in the directory.
{Given that tabulated $\chi^2_{0.05}$ for 9 degree of freedom = 16.919
tabulated $\chi^2_{0.05}$ for 10 degree of freedom = 18.307} **[10 Marks]**

OR

b) (i) A machinist is making engine parts with axle diameters of 0.700 inch. A random sample of 10 parts shows that a mean diameter of 0.742 inch with a Standard Deviation of 0.040 inch. Compute the statistic you would use to test whether the wok is meeting the specifications. Also state how you would proceed further? {Given that tabulated t at 0.05 level of significance for 9 and 10 degrees of freedom are 2.16 and 2.23 respectively.} **[5 Marks]**

(ii) A random sample of 16 values from a population showed a mean of 41.5 inches and the sum of squares of deviations from this mean equal to 135 square inches. Check the assumption of a mean of 43.5 inches from the population is reasonable or not at 1% level of significance. $P(X \geq 2.947) = 0.005$ of 15 degree of freedom. **[5 Marks]**

− End of Question Paper −

Q2 a) From a vessel containing 3 white and 5 black balls, 4 balls are transferred into an empty vessel. From this vessel a ball is drawn and found to be white. What is the probability that out of four balls transferred 3 are white and 1 is black? [10 Marks]

OR

b) (i) Two persons A and B, make an appointment to meet on a certain day at a certain place between 4 pm to 5 pm at random points of time and agree that each is to wait not more than 15 minutes for the other. Assuming that each is independently equally likely to arrive at any time during the hour. Find that probability that they meet? [5 Marks]

(ii) A manufacturer of air-plane parts from past experience that the probability is 0.80 that an order will be ready for shipment on time, and it is 0.70 that an order will be ready for shipment on time and will also be delivered on time. What is the probability such an order will be delivered on time given that it was ready for shipment on time. [5 Marks]

Q3 a) A coffee connoisseur claims that he can distinguish between a cup of instant coffee and a cup of percolator coffee 75% of the time. It is agreed that his claim will be accepted if he correctly identifies at least 5 of the 6 cups. Find his chances of having the claim (i) accepted, (ii) rejected, when he does have the ability he claims. [10 Marks]

OR

b) (i) In a book of 520 pages, 390 type-graphical errors occur. Assuming Poisson law for the number of errors per page, find the probability that a random sample of 5 pages will contain no error. [5 Marks]

(ii) In a book of 600 pages, 300 typo-graphical errors occur. Assuming Poisson law for the number of errors per page, find the probability that a random sample of 5 pages will contain no error. [5 Marks]

Q4 a) In a random sampling from normal population $N(\mu, \sigma^2)$. Find the Maxi... when σ^2 is known. (ii) σ^2 when μ is known.

OR

b) (i) A random sample $(X_1, X_2, X_3, X_4, X_5)$ of size five is drawn from a normal. Consider the following estimators to estimate μ:

(a). $t_1 = \frac{X_1 + X_2 + X_3 + X_4 + X_5}{5}$

(b). $t_2 = \frac{X_1 + X_2}{2} + X_3$

(c). $t_3 = \frac{2X_1 + X_2 + \lambda X_3}{3}$

(i) Find λ such that t_3 is unbiased estimator.

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Which is the best estimator among t_1 and t_2

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OR

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Q6 a) The following figures show that the distribution of digits in numbers c... irectory

igits:	0	1	2	3	4	5	6	7	8
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(ii) A random sample of 16 values from a population showed a mean of viations from this mean equal to 135 square inches. Check the assumpt oulation is reasonable or not at 1% level of significance. $P(X \geq 2.947) =$

4. What do you understand by Point Estimation? When would you say that estimate a parameter is good? Also discuss the requirements of consistency unbiasedness of estimate.

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[10 marks]

OR

4a. A random sample X_i, $i=1,2,...,5$ are independently and identically distributed as normal variables with mean μ and variance σ^2. Consider the following estimators to estimate μ:

(i) $t_1 = \dfrac{X_1 + X_2 + X_3 + X_4 + X_5}{5}$ (ii) $t_2 = \dfrac{X_1 + X_3}{2} + X_3$

Are t_1 and t_2 unbiased? State giving reasons, the estimator which is best among t_1 and t_2

[5 marks]

Q 4b. Describe the maximum likelihood method of estimation and discuss five of its optimal properties.

[5 marks]

Q 5. State the properties of regression coefficients. From the two lines of regression
X+2Y-5=0 and 2X+3Y-8=0 and Var(X)=12
Find (i) Mean values of X and Y (ii) Variance of Y and (iii) Correlation coefficient between X and Y.

[10 marks]

OR

Q 5a. Find correlation coefficient between X and Y for the following data:

X:	65	66	67	67	68	69	70	72
Y:	67	68	65	68	72	72	69	71

[5 marks]

Q 5b. What is regression analysis? How does it differ from correlation? Why there are two regression equations?

[5 marks]

Q 6. A few engineering students decide to check whether cars that use high speed petrol gives more mileage than cars that use regular petrol. They test several cars using both types of petrol in each car independently at different times. The distance travelled per litre for each car is as follows:

Regular Petrol	15	18	21	17	22	17	19	22	19	19
High Speed Petrol	18	21	25	24	25	25	21	27	24	20

a) Test at 5% level of significance that high speed petrol gives more mileage than regular petrol. Also construct 95% confidence interval.
b) Do you think any assumption needed in testing (a) have been violated? Explain.

[10 marks]

OR

5

Q 6a. In an examination of Statistics, following are the grades obtained by the students:

Grade:	A	B	C	F
No of Students:	280	100	80	20

Are these results consistent with the hypothesis that the grades are in the ratio 9:3:3:1 at 5% level of significance?

[5 marks]

Q 6b. The average milk production per cow was estimated to be 1600kg in one year with standard deviation 209kg. In order to test this, a random sample of 100 cows was taken and that gave mean as 1800kg with standard deviation 258kg. Does the sample justify the estimation about the whole herd of cows? Use 5% level of significance.

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[5 marks]

Extracts from Statistical Tables to be consulted wherever required

Statistic	d.f.	Level of Significance	Table value
F	9,9	0.05	3.18
F	10,10	0.05	2.98
t	18	0.05	2.10
t	19	0.05	2.09
t	18	0.10	1.73
t	19	0.10	1.73
x^2	1	0.05	3.84
x^2	3	0.05	7.81
x^2	4	0.05	9.49
Z (Two-tail)	-	0.05	1.96
Z (Two-tail)	-	0.05	2.58
Z (One-tail)	-	0.01	1.645
Z (One-tail)	-	0.05	2.33
		0.01	

Q2 a) From a vessel containing 3 white and 5 black balls, 4 balls are transferred into an empty vessel. From this vessel a ball is drawn and found to be white. What is the probability that out of four balls transferred 3 are white and 1 is black?

[10 Marks]

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b) (i) Two persons A and B, make an appointment to meet on a certain day at a certain place between 4 pm to 5 pm at random points of time and agree that each is to wait not more than 15 minutes for the other. Assuming that each is independently equally likely to arrive at any time during the hour. Find that probability that they meet?

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Q3 a) A coffee connoisseur claims that he can distinguish between a cup of instant coffee and a cup of percolator coffee 75% of the time. It is agreed that his claim will be accepted if he correctly identifies at least 5 of the 6 cups. Find his chances of having the claim   (i) accepted, (ii) rejected, when he does have the ability he claims.

[10 Marks]

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b) (i) In a book of 520 pages, 390 type-graphical errors occur. Assuming Poisson law for the number of errors per page, find the probability that a random sample of 5 pages will contain no error.

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(ii) In a book of 600 pages, 300 typo-graphical errors occur. Assuming Poisson law for the number of errors per page, find the probability that a random sample of 5 pages will contain no error.

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