(DO NOT OPEN THIS QUESTION BOOKLET BEFORE TIME OR UNTIL YOU ARE ASKED TO DO SO)

(MPH/PHD/URS–EE–2019)
Subject : STATISTICS

Code **A**

Sr. No. **10005**

SET–"X"

Time : 1¼ Hours   Total Questions : 100   Max. Marks : 100

Roll No. _____ (in figure)_____ (in words)

Name : _____   Father's Name : _____

Mother's Name : _____   Date of Examination : _____

(Signature of the candidate)   (Signature of the Invigilator)

CANDIDATES MUST READ THE FOLLOWING INFORMATION/ INSTRUCTIONS BEFORE STARTING THE QUESTION PAPER.

1. Candidates are required to attempt any 75 questions out of the given 100 multiple choice questions of 4/3 marks each. No credit will be given for more than 75 correct responses.

2. The candidates must return the Question book-let as well as OMR answer-sheet to the Invigilator concerned before leaving the Examination Hall, failing which case of use of unfair-means / mis-behaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.

3. Keeping in view the transparency of the examination system, carbonless OMR Sheet is provided to the candidate so that a copy of OMR Sheet may be kept by the candidate.

4. Question Booklet along-with answer key of all the A,B,C and D code shall be got uploaded on the university website after the conduct of Entrance Examination. In case there is any discrepancy in the Question Booklet/Answer Key, the same may be brought to the notice of the Controller of Examination in writing/through E. Mail within 24 hours of uploading the same on the University Website. Thereafter, no complaint in any case, will be considered.

5. The candidate MUST NOT do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question book-let itself. Answers MUST NOT be ticked in the Question book-let.

6. There will be no negative marking. Each correct answer will be awarded 4/3 mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.

7. Use only Black or Blue **BALL POINT PEN** of good quality in the OMR Answer-Sheet.

8. BEFORE ANSWERING THE QUESTIONS, THE CANDIDATES SHOULD ENSURE THAT THEY HAVE BEEN SUPPLIED CORRECT AND COMPLETE BOOK-LET. COMPLAINTS, IF ANY, REGARDING MISPRINTING ETC. WILL NOT BE ENTERTAINED 30 MINUTES AFTER STARTING OF THE EXAMINATION.

Question No.	Questions
1.	If quartile deviation of a set of observations is given as 6.4 and the value of first quartile is 5. What is the value of the third quartile ? (1) 12 (2) 15.3 (3) 17.8 (4) 20.2
2.	The mean and median of a non-symmetric distribution is 16 and 18 respectively. If standard deviation is 5, then the skewness of the distribution is (1) 0 (2) −1.2 (3) 1.5 (4) 2.1
3.	Suppose X follows a Normal distribution with mean 50 and variation 25. What is the standard score corresponds to 58 ? (1) 1.2 (2) 1.6 (3) 1.8 (4) .2.1
4.	If the p-value of the test is larger than the level of significance, it indicates (1) Strong evidence in support of alternative hypothesis (2) Strong evidence against alternative hypothesis (3) Strong evidence in support of null hypothesis (4) Strong evidence against null hypothesis
5.	Consider the following statements : I. If S is closed and δ is admissible, then every risk function is convex II. If S is closed, then S will not have a limit point III. If S is closed from below, then $S \notin E_k$ Which of the above is correct ? (1) Only I is correct (2) Only II is correct (3) Both I and II is correct (4) Both II and III is correct

Question No.	Questions	
6.	In the analysis of RBD with b blocks and v treatments, the error degrees of freedom are (1) b (v – 1) (2) v (b – 1) (3) (b – 1) (v – 1) (4) b (v – 1)	
7.	Consider the following statements : I. A complete class of decision rules contains only admissible decision rules II. A minimal complete class of decision rule contains only admissible decision rules III. A minimal complete class of decision rule is always complete Which of the above is correct ? (1) Only I is correct (2) Only II is correct (3) Both I and II is correct (4) Both II and III is correct	
8.	The special case of Birth-Death process with $\lambda_n = n\lambda$ and there is no death is called the _____ process (1) Immigration (2) Poisson Process (3) Linear growth (4) Yule-Furry	
9.	Wishart distribution is a generalization of (1) Normal distribution (2) t-distribution (3) Chi-square distribution (4) Beta distribution	

Question No.	Questions
10.	Let $\{X_n, Y_n\}$, n = 1, 2, ..., be a sequence of random variables. Then $\|X_n - Y_n\| \xrightarrow{P} 0$ and $Y_n \xrightarrow{L} Y$ implies (1) $X_n \xrightarrow{L} X$ (2) $X_n \xrightarrow{L} Y$ (3) $Y_n \xrightarrow{L} X$ (4) $X_n Y_n \xrightarrow{L} Y$
11.	The Upper Confidence Level and Lower Confidence Level of a particular process is given as 12 and 8 respectively. If variance of the process is given as 16, then what is the sampel size of the process ? (1) 36 (2) 28 (3) 25 (4) 18
12.	If X~ Poisson (4) and Y~ Poisson (3), and X and Y are independent. What is the value of $E[X|(X+Y)]$, if n = 10 ? (1) 3.45 (2) 4.32 (3) 5.23 (4) 5.71
13.	The value of m so that the vector (m, 3, 1) is a linear combination of the vectors (3, 2, 1) and (2, 1, 0) is : (1) 1 (2) 3 (3) 5 (4) 7
14.	Given the following statements about a one parameter exponential family of distribution : I. It always admits sufficient statistics. II. The moment estimator $\hat{\theta}$ based on sufficient statistics is CAN for θ. III. The asymptotic variance zero every time. Which of the above are correct : (1) Only I and II are correct (2) Only I and III are correct (3) Only II and III are correct (4) All are correct

Question No.	Questions
15.	If the mean value function of a renewal proces is m(t) = 2t, t ≥ 0, what is the value of M (T) ? (1) 2 (2) t (3) t^2 (4) $2t^2$
16.	The following statements given in respect of Maximum Likelihood Estimation (MLE) : I. MLE's are always unique. II. MLE's are not necessarily unbiased III. MLE's satisfies invariance property, provided the transformation is one-to-one. Which of the above are correct : (1) Only I and II are correct (2) Only I and III are correct (3) Only II and III are correct (4) All are correct
17.	Consider the following statements : I. Least square estimators are unbiased for all general linear models II. Under fairly general conditions, the estimates obtained by method of moments will have asymptotically normal distribution for large n. III. The minimum chi-square estimators are not necessarily consistent. Which of the above are correct ? (1) Only I and II are correct (2) Only I and III are correct (3) Only II and III are correct (4) All are correct

Question No.	Questions
18.	The matrix $\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$ is (1) Positive definite (2) Negative definite (3) Positive semi definite (4) Negative semi definite
19.	Let N(t) be a Poisson process with constant intensity function on R. What is the covariance of N(s) and N(t) ? (1) λs, if $s < t$ (2) $\lambda (t\text{-}s)$, if $s < t$ (3) $\lambda (s\text{-}t)$, if $(t < s)$ (4) $\lambda (s\text{+}t)$
20.	A bag contains 5 black, 6 red and 3 white balls. If a ball is drawn at random, what is the probability that it is not a white ball ? (1) 11/14 (2) 13/14 (3) 38/55 (4) 27/35
21.	Every sequence $\{X_n\}$ of independent random variables with uniformly bounded variances obeys (1) Borel-Cantelli lemma (2) Cauchy's criterion (3) WLLN (4) SLLN
22.	If V be a collection of vectors, then V is said to be subspace, if (1) V is closed under multiplication (2) V is closed under multiplication and addition (3) V is closed under scalar multiplication (4) V is closed under addition and scalar multiplication
23.	Let X be a random variable with pgf P(S). Then the pgf of 3X−1 is (1) SP(S) (2) S/P(S) (3) P(S)/S (4) P(S³)/S

Question No.	Questions
24.	The relationship between number of beers consumed (x) and blood alcohol content (y) was studied in 16 male college students by using least squares regression. The following regression equation was obtained from this study : $y^\wedge = -0.0127 + 0.0180\,x$. The above equation implies that : (1) each beer consumed increases blood alcohol by 1.27% (2) on average it takes 1.8 beers to increase blood alcohol content by 1% (3) each beer consumed increased blood alcohol by an average of amount of 1.8% (4) None of these.
25.	With the usual notations, find p for a binomial random variable X, if $n = 6$ and if $9\,P(X = 1) = P(X = 2)$. (1) 12/15 (2) 18/23 (3) 19/27 (4) 9/14
26.	The quadratic form $6x_1^2 + 3x_2^2 + 14x_3^2 + 4x_2\,x_3 + 18x_1x_3 + 4x_1x_2$ is (1) Negative definite (2) Positive definite (3) Positive semi definite (4) Negative semi definite
27.	Let T be CAN for θ so that $T \sim AN(\theta, \sigma_T^2(\theta)/a_n^2)$ and let Ψ be a differentiable function such that $\dfrac{d\Psi}{d\theta}$ is continuous and non vanishing then $\Psi(T)$ is CAN for $\Psi(\theta)$ with asymptotic variance : (1) $\left(\dfrac{d\Psi}{d\theta}\right)^2 \sigma_T^2(\theta)$ (2) $\left(\dfrac{d\Psi}{d\theta}\right)^2 a_n^2\, \sigma_T^2(\theta)$ (3) $\left(\dfrac{d\Psi}{d\theta}\right)^2 \dfrac{\sigma_T^2(\theta)}{a_n^2}$ (4) $\left(\dfrac{d\Psi}{d\theta}\right)^2 \dfrac{\sigma_T^4(\theta)}{a_n^4}$

Question No.	Questions
28.	If the percent of trend for a year in a time series is greater than 100%, it indicates that (1) The actual time series value lies below the trend line and the relative cyclical residual is positive (2) The actual time series value lies below the trend line and the relative cyclical residual is negative (3) The actual time series value lies above the trend line and the relative cyclical residual is negative (4) The actual time series value lies above the trend line and the relative cyclical residual is positive
29.	If 3, 8, 5, 4 and 10 are exponential samples with mean θ. The Fisher information function evaluated at $\theta = 2$ is (1) 0.50 (2) 0.80 (3) 1.20 (4) 1.25
30.	The ratio of number of replication required in CRD and RBD for the same amount of information is (1) 3:2 (2) 5:3 (3) 5:4 (4) 3:5
31.	Which one is the improper prior for p, the probability of success in Bernoulli distribution ? (1) $g(p) = 1$ (2) (B) $g(p) = \dfrac{1}{\beta(a, b)} p^{a-1} (1 - p)^{b-1}, a > 0, b > 0$ (3) $g(p) = 2p$ (4) $g(p) = c, c \neq 1$

Question No.	Questions
32.	If $A = \begin{bmatrix} 3 & -7 \\ -4 & 1 \end{bmatrix}$, then the determinant of $A^3 + 3A^2 + 12A$ is (1) -2900 (2) -29500 (3) -3000 (4) -39500
33.	The Cramer-Rao lower bound for $\Psi(\theta) = e^{-\theta}$ in Poisson distribution with parameter θ is (1) $\dfrac{\theta}{n} e^{-2\theta}$ (2) $\dfrac{n}{\theta} e^{-2\theta}$ (3) $\dfrac{2\theta}{n} e^{-2\theta}$ (4) $\dfrac{\theta^2}{n} e^{-2\theta}$
34.	Let $X_1, X_2, \ldots, X_n$ be iid Poisson (μ). Then the UMVUE of $P(X = 0)$ is (1) $\left(1 - \dfrac{1}{\bar{x}}\right)^n$ (2) $\left(1 - \dfrac{n}{\bar{x}}\right)^n$ (3) $\left(1 - \dfrac{1}{n}\right)^{\Sigma x}$ (4) $\left(1 - \dfrac{1}{n}\right)^{\bar{x}}$
35.	If 3, 8, 5, 4 and 10 are exponential samples with mean θ. Then the score function evaluate at $\theta = 4$ is (1) 0.36 (2) 0.40 (3) 0.56 (4) 0.68

Question No.	Questions
36.	Consider the following statements : I. For an estimator to be consistent, the unbiasedness of the estimator is necessary II. If the variance of an estimator attains the Crammer-Rao lower bound, the estimator is consistent. III. A UMVUE is unique, if it exists Which of the above are correct ? (1) Only I is correct (2) Only II is correct (3) Only III is correct (4) None is correct
37.	If 12, 18, 8, 22, and 15 are random samples for $N(\mu, \sigma^2)$. An unbiased estimator of σ^2 is Given by (1) 20 (2) 25 (3) 29 (4) 33
38.	One of the eigenvalues of the given matrix is : $$\begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$$ (1) 2 (2) 3 (3) 5 (4) 10
39.	The range of the real values of x satisfying $8 - 3x \le 5$ and $4x + 5 \le -7$ is (1) (–3, 1) (2) (–1, 1) (3) (0, 3) (4) empty

Question No.	Questions
40.	The 2×2 matrix corresponding to the complex number $3 + 5i$ is (1) $\begin{bmatrix} 3 & 5 \\ 5 & 3 \end{bmatrix}$ (2) $\begin{bmatrix} -3 & 5 \\ 5 & -3 \end{bmatrix}$ (3) $\begin{bmatrix} 3 & -5 \\ 5 & -3 \end{bmatrix}$ (4) $\begin{bmatrix} 3 & -5 \\ 5 & 3 \end{bmatrix}$
41.	If $n = 15$, $\sum x = 480$, $\sum x^2$, then the standard deviation of $y = 5x - 10$ is (1) 100 (2) 96.82 (3) 47.56 (4) 112.88
42.	Let X_1, X_2, ... be iid Poisson (λ) random variables. If $S_n = \sum_{k=1}^{n} X_k$. If $\lambda = 1$ and $n = 64$, then The value of $P\{50 < S_n < 80\}$ is approximately (1) 0.7329 (2) 0.8321 (3) 0.7884 (4) 0.9348
43.	Consider a discrete classification with n_1, n_2, n_3, n_4 as the number of observations in each cell such that $\sum_{i=1}^{3} n_i = n$. The cell probabilities are respectively given as θ^2, $\theta(1-\theta)$, $\theta(1-\theta)$ and $(1-\theta)^2$. What is the MLE of θ is (1) $\dfrac{n_4}{2n}$ (2) $\dfrac{2n_1 + n_2}{n_1 + n_3}$ (3) $\dfrac{2n_1 + n_3}{n_1 + n_2 + n_4}$ (4) $\dfrac{2n_1 + n_2 + n_3}{2n}$

Question No.	Questions
44.	Let X be a random variable having the probability function : $$f(x, \theta) = \binom{n}{x} \theta^x (1-\theta)^{n-x}, \quad x = 0, 1, 2, \ldots, n.$$ If $d(x) = \dfrac{x}{n}$, then the risk function $R(\theta, d)$ under squared error loss function is : (1) $\dfrac{\theta(\theta-1)}{n}$ (2) $\dfrac{\theta(\theta+1)}{n}$ (3) $\dfrac{\theta(1-\theta)}{n}$ (4) $\dfrac{\theta^2}{n}$
45.	Let $X_1, X_2, \ldots$ be iid Bernoulli with parameter (λ). If apriori it is known that $\lambda \in [1/4, 3/4]$. If $\overline{X} \geq \dfrac{3}{4}$. What is the MLE of λ ? (1) 1/4 (2) 1/2 (3) 3/4 (4) 1
46.	After taking a sample and computing $\overline{x}$, a statistician says that he is 88% confident that the population mean lies between 106 and 122. What does he really mean ? (1) The probability is 0.88 that $\mu = 114$, the midpoint of the interval (2) The probability is 0.88 that μ is between 106 and 122 (3) 88% of the intervals calculated from samples of this size will contain μ (4) Both (2) and (3)

Question No.	Questions
47.	The measure of Kurtosis of t-distribution is (1) $\dfrac{n-2}{n-3}$ (2) $\dfrac{3(n-2)}{n-4}$ (3) $\dfrac{3(n-2)}{n+4}$ (4) $\dfrac{n+2}{n+4}$
48.	For a particular hypothesis test, the probabilities of type I and II errors are respectively, 0.05 and 0.09. The power of this test is (1) 0.95 (2) 0.14 (3) 0.86 (4) 0.91
49.	Let X_1, X_2, ... X_n be iid with $f(x) = \theta x^{\theta-1}$, $0 < x < 1$, $\theta > 0$. Then the Cramer-Rao Lower Bound for estimating θ is (1) $n\theta$ (2) $\dfrac{\theta}{n}$ (3) $\dfrac{\theta^2}{n}$ (4) $\dfrac{\theta^2}{n^2}$
50.	For a queuing model of M/M/1(∞)/FCFS model, the probability of nth realization is obtained as (1) $\rho^n(1-\rho)$ (2) $\rho(1-\rho)$ (3) $\rho(1-\rho)^n$ (4) $\rho^n(1-\rho)^{n-1}$
51.	The following values of the function f (x) for values of x are given : f (1) = = 4, f (2) = 5, f (7) = 5, and f (8) = 4. What is the value of f (6) ? (1) 5.13 (2) 5.28 (3) 5.67 (4) 5.88

Question No.	Questions
52.	If Δ and E are the difference operators defined as usual, then what is the value of $\dfrac{\Delta^2}{E^2}$? (1) $\dfrac{1}{E^2} - \dfrac{2}{E}$ (2) $\dfrac{1}{E^2} - \dfrac{2}{E} - 1$ (3) $\dfrac{1}{E^2} - \dfrac{2}{E} + 1$ (4) $\dfrac{1}{E^2} + \dfrac{2}{E} + 1$
53.	Given $y_0 = -12$, $y_2 = 4$, $y_3 = 6$, and $y_4 = 12$. What is the value of y_1 using Newton's Formula ? (1) 0 (2) 1 (3) 2 (4) 3
54.	A magazine claims that 25% of its readers are college students. Of a random sample of 200 readers, 42 are college students. It is to be tested at a 0.10 level of significance whether the proportion of college students among all the readers of the magazine is not equal to 0.25. What is the conclusion ? (1) The proportion of college students among the readers of the magazine is 0.25 (2) The sample data are incorrect (3) The proportion of college students among the readers of the magazine is less than 0.25 (4) The proportion of college students among the readers of the magazine is more than 0.25

Question No.	Questions
55.	The variance of Hyper geometric distribution with N = 20, n = 5 and M = 12 is given by (1) 1.34 (2) 1.28 (3) 1.02 (4) 0.95
56.	A random sample of 100 articles are taken from a batch of 2000 articles shows that the average diameter of the articles is 0.354 and standard deviation 0.048. What is the 95% confidence interval for the average diameter of the batch ? (1) (0.2934, 0.4235) (2) (0.3448, 0.3632) (3) (0.3021, 0.3824) (4) (0.3923, 0.4212)
57.	A multiple regression relationship contains two independent variables. The standard error of estimate is 4.8 and error sum of squares is 576. What is the sample size ? (1) 24 (2) 25 (3) 26 (4) 28
58.	Given the following joint density function : $$f(x, y) = \lambda^2 e^{-\lambda y}, \ 0 \le x \le y < \infty$$ What is $E(Y \mid X)$? (1) $x + 1/\lambda$ (2) $x - 1/\lambda$ (3) $2x + \lambda$ (4) $2x - \lambda$
59.	Let X has the distribution function $$F(x) = \begin{cases} 0, & x < 0, \\ x/2, & 0 \le x \le 2, \\ 1, & x > 2. \end{cases}$$ Let $Y = X^2$, then what is the value of $P(X \le 2Y)$? (1) 1/2 (2) 2/3 (3) 3/4 (4) 4/7

Question No.	Questions	
60.	The percent of total variation of the dependent variable Y explained by the set of independent variable X is measured by (1) Coefficient of correlation (2) Coefficient of skewness (3) Coefficient of determination (4) Standard error	
61.	A car manufacturer had to recall the lot produced from one of its assembly line over a specific period of time due to quality-control problems that were not discovered during final inspection procedures. This is an example of (1) Type I error (2) Type II error (3) Both (1) and (2) (4) Neither (1) nor (2)	
62.	The number of runs in XYYXYXX is : (1) 2 (2) 3 (3) 4 (4) 5	
63.	You have carried out a one way ANOVA. There are significant differences between the three groups you are testing. How might you conduct your pairwise comparisons ? (1) F test (2) Least significance differences (LSD) (3) Z test (4) Chi-square test	
64.	Suppose there is interest in comparing the median response time for three independent groups learning a specific task. The appropriate nonparameteric procedure is (1) Kruskal-Wallis (2) Wilcoxon Signed-Rank (3) Run test (4) Sign test	

Question No.	Questions
65.	What is the value of $2x^{(4)} + 3x^{(2)} + x^{(1)} - 7$ evaluated at $x = 5$? (1) 289 (2) 294 (3) 298 (4) 302
66.	Degrees of freedom for chi-square in case of contingency table of order (4×3) are : (1) 12 (2) 9 (3) 8 (4) 6
67.	A small sample has been taken from a normally distributed population and the sample mean has been found to be 62. The upper limit of a 95 percent confidence interval for population mean is 81.60. The population variance is known to be 2,400. What is the sample size ? (1) 24 (2) 30 (3) 36 (4) 64
68.	Consider the following results on a correlation study : Regression equations : $6y = 5x + 90$ and $15x = 8y + 130$ and Variance of $X = 4$. What is the coefficient of correlation betwene X and Y ? (1) 0.45 (2) 0.67 (3) 0.78 (4) 0.88
69.	Basu's theorem is useful in determining the statistic V which is (1) Independent of sufficient statistic T (2) Linear function of U and T (3) Monotone in U for fixed t (4) None of these

Question No.	Questions
70.	The nonparameteric test equivalent of a one-way ANOVA is (1) Wilcoxon Signed Rank test (2) Wilcoxon Rank Sum Test (3) Kruskall-Wallis Test (4) Ansari-Bradley test
71.	The summary of two variables are given as follows : $\sum x_i = 53$, $\sum x_i^2 = 297$, $\sum y_i = 277.5$, $\sum y_i^2 = 9941.25$, $\sum x_i y_i = 1630$ and $n = 12$. What is the value of slope ? (1) 2.5 (2) 3.6 (3) 4.8 (4) 6.4
72.	The wind pressure p corresponding to velocity v is given by the following data : <table><tr><td>v</td><td>10</td><td>20</td><td>30</td><td>40</td></tr><tr><td>p</td><td>1.2</td><td>2.0</td><td>4.5</td><td>8.0</td></tr></table> What is the value of p when v = 25, according to Newton's formula ? (1) 2.32 (2) 2.89 (3) 3.08 (4) 4.02
73.	If a, b, c are the roots of the cubic equation $x^3 + px^2 + qx + r = 0$, then the value of $a^3 + b^3 + c^3$ is (1) $-3r - pqr$ (2) $-3r - p^2 + rq$ (3) $-3r - p^3 + 3pq$ (4) $P^3 + 3rq$

Question No.	Questions
74.	If $A = \begin{bmatrix} 3 & -7 \\ -4 & 1 \end{bmatrix}$, then the determinant of $A^3 + 3A^2 + 12A$ is (1) 29000 (2) -29500 (3) 30000 (4) -39500
75.	If V be a collection of vectors, then V is said to be subspace, if (1) V is closed under multiplication (2) V is closed under multiplication and addition (3) V is closed under scalar multiplication (4) V is closed under addition and scalar multiplication
76.	If the number of variables in a non-homogeneous system $AX = B$ is n, then the system possesses a unique solution if : (1) $\rho(A) < \rho[A, B]$ (2) $\rho(A) > \rho[A, B]$ (3) $\rho(A) = \rho[A, B] < n$ (4) $\rho(A) < \rho[A, B] = n$
77.	The series $\dfrac{x}{1+x} + \dfrac{x^2}{1+x^2} + \dfrac{x^3}{1+x^3} + \ldots$ is (1) Divergent (2) Convergent for all values of x (3) Convergent for $0 < x < 1$ (4) Convergent for $x > 1$
78.	If $^{2n+1}P_{n-1} : {}^{2n-1}P_n = 3 : 5$, then the value of **n** is equal to (1) 1 (2) 2 (3) 3 (4) 4

Question No.	Questions
79.	Consider the following statements : I. A non-singular matrix is congruent to its inverse II. Every normal triangular matrix is not diagonal Which of the above are correct ? (1) Only I (2) Only II (3) Both I and II (4) None of the above
80.	If S is a set of vectors containing the zero vector, then (1) $0 \in S$ (2) $0 \notin S$ (3) 0 may or may not be is S (4) S is linearly independent
81.	The Rank of the quadratic form : $2x_1^2 + x_2^2 - 3x_3^2 - 4x_1x_3 - 8x_2x_3 + 12x_1x_2$ is (1) 0 (2) 1 (3) 2 (4) 3
82.	The value of $\int_0^\infty x^4 e^{-x} \, dx$ is (1) 2 (2) 4 (3) 6 (4) 12
83.	What is the value of $\lim\limits_{x \to 0} \dfrac{a^x - 1}{x}$? (1) $\text{Log}\,(a - 1)$ (2) $\log_e(a)$ (3) $a \log_e(a)$ (4) $a / \log_e(a)$

Question No.	Questions
84.	Certain values of x and y are as given below : | X	0	0.25	0.5	0.75	1.0
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y	1.0	0.9394	0.7788	0.5694	0.3678	 According to Simpson's $(1/3)^{rd}$ rule what is the value of $\int_0^1 y\,dx$? (1) 0.7429 (2) 0.7457 (3) 0.7467 (4) 0.7477
85.	If $u = x^3 - 3xy^2$, then what is the value of $f(z)$, if $z = x + iy$? (1) z^3 (2) $z^3 - ic$ (3) $z^3 + ic$ (4) ic
86.	If $f(z)$ is a continuous function in a region D and if the integral $\int f(z)\,dz$ taken round any simple closed contour in D is zero then $f(z)$ is an analytic function inside D. This theorem is due to (1) Morea (2) Cauchy (3) Lio-Ville (4) Laurent
87.	If a function $f(z)$ is analytic for all finite values of z and $|z| \to \infty$, and $|f(z)| = A\,(|z|^k)$, then $f(z)$ is a polynomial of degree (1) $< k$ (2) $\leq k$ (3) $> k$ (4) $\geq k$

Question No.	Questions
88.	If $f(z) = \dfrac{z^4 + 2z^3 + 3z^2 + 4z + 5}{z^2}$, then (1) $z = 0$ is a pole of order 1 (2) $z = 0$ is a pole of order 2 (3) $z = 0$ is a pole of order 3 (4) $z = 0$ is a pole of order 4
89.	For the series, 29, 12, 26, 19, 24, 36, 21, 33, and 35; the value of the first quartile is (1) 20 (2) 21 (3) 22 (4) 23
90.	Given $\dfrac{dy}{dx} = y^2 + 1$, $y(0) = 0$. What is $y(0.2)$? (1) 0.187 (2) 0.194 (3) 0.198 (4) 0.203
91.	Consider the following regression problem : $Y_i = \alpha + \beta_i + \epsilon_i$; $i = 1, 2, \ldots, n$. Here ϵ_i ; $i = 1, 2, \ldots, n$, are i.i.d. $N(0, 1)$ random variables. It is assumed that $\alpha \neq 0$ and β is known. If $\hat{\alpha}_n$ is the MLE of α, which of the following statements is true ? (1) $\lim_{n \to \infty} E(\hat{\alpha}_n) \neq \alpha$ (2) $\lim_{n \to \infty} E(\hat{\alpha}_n) = 0$ (3) $\lim_{n \to \infty} V(\hat{\alpha}_n) = \infty$ (4) $\lim_{n \to \infty} V(\hat{\alpha}_n) = 0$

Question No.	Questions
92.	Let $X_1, X_2, ..., X_n$ be a random sample from $f(x, \theta)$, a probability density function or a probability mass function. Define $(n-1)\, s_n^2 = \sum_{i=1}^{n} (X_i - \overline{X}_n)^2$, where $\overline{X}_n$ is a sample mean. Then s_n^2 is unbiased for θ if (1) $f(x, \theta) = \dfrac{e^{-\theta}\, \theta^x}{x!}$, $x = 0, 1, ..., $ and $\theta > 0$ (2) $f(x, \theta) = \dfrac{e^{-\frac{x}{\theta}}}{\theta}$, $x > 0, \theta > 0$ (3) $(x, \theta) = \theta\, e^{-\theta x}$, $x > 0, \theta > 0$ (4) none of the above
93.	Let $X_1, X_2, ..., X_n$ be a random sample from uniform $U(\theta - 5, \theta - 3)$ distribution. Let $X_{(1)}$ and $X_{(n)}$ denote the smallest and largest of the sample values. Then which of the following is true ? (1) $(X_{(1)}, X_{(n)})$ is complete sufficient for θ (2) $X_1 + X_2 - 2X_3$ is an ancillary statistic (3) $X_{(n)} + 3$ is unbiased for θ (4) $X_{(1)} +$ is not consistent for θ
94.	A simple random sample (without replacement) of size n is drawn from a finite population of size N (>6). What is the probability that the 4^{-th} population unit is included in the sample but the 6^{-th} population unit is not included in the sample ? (1) $\dfrac{n(n-1)}{N(N-1)}$ (2) $\dfrac{n(N-n)}{N(N-1)}$ (3) $\dfrac{(n-1)(N-n+1)}{N(N-1)}$ (4) n/N

Question No.	Questions
95.	Consider the following statements : I. The bias of ratio estimator for population mean becomes zero if the regression of Y on X passes through the origin. II. The ratio estimator of population mean is more efficient than sample mean when the correlation coefficient between X and Y is greater than zero. Which of the above statements is/are correct ? (1) I only (2) II only (3) Both I and II (4) Neither I nor II
96.	The unbiased estimator of population total Y due to Horvitz and Thompson is (1) $\sum_{i \in S} \dfrac{Y_i}{1 - \pi_i}$ (2) $\sum_{i \in S} \dfrac{Y_i}{\pi_i}$ (3) $N \sum_{i \in S} \dfrac{Y_i}{1 - \pi_i}$ (4) $N \sum_{i \in S} \dfrac{Y_i}{\pi_i}$
97.	Which one of the following is a correct statement ? (1) The regression estimator is superior to the mean per unit estimator in some cases. (2) The regression estimator and the mean per unit estimator both being equally efficient if $\rho = 0$. (3) Regression estimator is always better than ratio estimator. (4) The regression estimator will, in general be more efficient than the post-stratified estimator.

Question No.	Questions
98.	The pgf of a certain distribution is given as $P(s) = 3s^2 - 2s + 6$. What is the mean of this distribution ? (1) 2 (2) 3 (3) 4 (4) 5
99.	Three samples of 5, 4, and 5 motor car tyres are drawn respectively from three brands P, Q, and R manufactures by the three machines. The life time of these tyres (in '000 miles) are given below : P : 45 42 43 44 42 Q : 41 40 42 43 R : 44 42 38 43 39 What is the mean sum of squares between samples ? (1) 5.7 (2) 6.2 (3) 7.9 (4) 8.7
100.	A test which minimizes two types of errors is called : (1) minimax test (2) optimum test (3) unbiased test (4) similar test

(MPH/PHD/URS–EE–2019)
Subject : STATISTICS

Code **C** B

Sr. No. **10003**

SET–"X"

Time : 1¼ Hours   Total Questions : 100   Max. Marks : 100

Roll No. _____ (in figure)_____ (in words)

Name : _____

Father's Name : _____

Mother's Name : _____

Date of Examination : _____

(Signature of the candidate)

(Signature of the Invigilator)

**CANDIDATES MUST READ THE FOLLOWING INFORMATION/
INSTRUCTIONS BEFORE STARTING THE QUESTION PAPER.**

1. Candidates are required to attempt any 75 questions out of the given 100 multiple choice questions of 4/3 marks each. No credit will be given for more than 75 correct responses.

2. The candidates must return the Question book-let as well as OMR answer-sheet to the Invigilator concerned before leaving the Examination Hall, failing which case of use of unfair-means / mis-behaviour will be registered against him / her in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.

3. Keeping in view the transparency of the examination system, carbonless OMR Sheet is provided to the candidate so that a copy of OMR Sheet may be kept by the candidate.

4. Question Booklet along-with answer key of all the A,B,C and D code shall be got uploaded on the university website after the conduct of Entrance Examination. In case there is any discrepancy in the Question Booklet/Answer Key, the same may be brought to the notice of the Controller of Examination in writing/through E. Mail within 24 hours of uploading the same on the University Website. Thereafter, no complaint in any case, will be considered.

5. The candidate MUST NOT do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question book-let itself. Answers MUST NOT be ticked in the Question book-let.

6. There will be no negative marking. Each correct answer will be awarded 4/3 mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.

7. Use only Black or Blue **BALL POINT PEN** of good quality in the OMR Answer-Sheet.

8. BEFORE ANSWERING THE QUESTIONS, THE CANDIDATES SHOULD ENSURE THAT THEY HAVE BEEN SUPPLIED CORRECT AND COMPLETE BOOK-LET. COMPLAINTS, IF ANY, REGARDING MISPRINTING ETC. WILL NOT BE ENTERTAINED 30 MINUTES AFTER STARTING OF THE EXAMINATION.

Question No.	Questions
1.	The Upper Confidence Level and Lower Confidence Level of a particular process is given as 12 and 8 respectively. If variance of the process is given as 16, then what is the sampel size of the process ? (1) 36 (2) 28 (3) 25 (4) 18
2.	If X~ Poisson (4) and Y~ Poisson (3), and X and Y are independent. What is the value of $E[X \mid (X + Y)]$, if n = 10 ? (1) 3.45 (2) 4.32 (3) 5.23 (4) 5.71
3.	The value of m so that the vector (m, 3, 1) is a linear combination of the vectors (3, 2, 1) and (2, 1, 0) is : (1) 1 (2) 3 (3) 5 (4) 7
4.	Given the following statements about a one parameter exponential family of distribution : I. It always admits sufficient statistics. II. The moment estimator $\hat{\theta}$ based on sufficient statistics is CAN for θ. III. The asymptotic variance zero every time. Which of the above are correct : (1) Only I and II are correct (2) Only I and III are correct (3) Only II and III are correct (4) All are correct
5.	If the mean value function of a renewal proces is m(t) = 2t, t ≥ 0, what is the value of M (T) ? (1) 2 (2) t (3) t^2 (4) $2t^2$

Question No.	Questions
6.	The following statements given in respect of Maximum Likelihood Estimation (MLE) : I. MLE's are always unique. II. MLE's are not necessarily unbiased III. MLE's satisfies invariance property, provided the transformation is one-to-one. Which of the above are correct : (1) Only I and II are correct (2) Only I and III are correct (3) Only II and III are correct (4) All are correct
7.	Consider the following statements : I. Least square estimators are unbiased for all general linear models II. Under fairly general conditions, the estimates obtained by method of moments will have asymptotically normal distribution for large n. III. The minimum chi-square estimators are not necessarily consistent. Which of the above are correct ? (1) Only I and II are correct (2) Only I and III are correct (3) Only II and III are correct (4) All are correct
8.	The matrix $\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$ is (1) Positive definite (2) Negative definite (3) Positive semi definite (4) Negative semi definite

Question No.	Questions
9.	Let $N(t)$ be a Poisson process with constant intensity function on R. What is the covariance of $N(s)$ and $N(t)$? (1) λs, if $s < t$ (2) $\lambda (t\text{-}s)$, if $s < t$ (3) $\lambda (s\text{-}t)$, if $(t < s)$ (4) $\lambda (s+t)$
10.	A bag contains 5 black, 6 red and 3 white balls. If a ball is drawn at random, what is the probability that it is not a white ball ? (1) 11/14 (2) 13/14 (3) 38/55 (4) 27/35
11.	Consider the following regression problem : $Y_i = \alpha + \beta_i + \epsilon_i$; $i = 1, 2, ..., n$. Here ϵ_i ; $i = 1, 2, ..., n$, are i.i.d. $N(0, 1)$ random variables. It is assumed that $\alpha \neq 0$ and β is known. If $\hat{\alpha}_n$ is the MLE of α, which of the following statements is true ? (1) $\lim_{n \to \infty} E(\hat{\alpha}_n) \neq \alpha$ (2) $\lim_{n \to \infty} E(\hat{\alpha}_n) = 0$ (3) $\lim_{n \to \infty} V(\hat{\alpha}_n) = \infty$ (4) $\lim_{n \to \infty} V(\hat{\alpha}_n) = 0$
12.	Let $X_1, X_2, ..., X_n$ be a random sample from $f(x, \theta)$, a probability density function or a probability mass function. Define $(n-1) s_n^2 = \sum_{i=1}^{n} (X_i - \overline{X}_n)^2$, where $\overline{X}_n$ is a sample mean. Then s_n^2 is unbiased for θ if (1) $f(x, \theta) = \dfrac{e^{-\theta} \theta^x}{x!}$, $x = 0, 1, ...$, and $\theta > 0$ (2) $f(x, \theta) = \dfrac{e^{-\frac{x}{\theta}}}{\theta}$, $x > 0$, $\theta > 0$ (3) $(x, \theta) = \theta\, e^{-\theta x}$, $x > 0$, $\theta > 0$ (4) none of the above

Question No.	Questions
13.	Let $X_1, X_2, ..., X_n$ be a random sample from uniform $U(\theta - 5, \theta - $ distribution. Let $X_{(1)}$ and $X_{(n)}$ denote the smallest and largest of the samp values. Then which of the following is true ? (1) $(X_{(1)}, X_{(n)})$ is complete sufficient for θ (2) $X_1 + X_2 - 2X_3$ is an ancillary statistic (3) $X_{(n)} + 3$ is unbiased for θ (4) $X_{(1)} + $ is not consistent for θ
14.	A simple random sample (without replacement) of size n is drawn from finite population of size N (>6). What is the probability that the 4 population unit is included in the sample but the 6$^{\text{th}}$ population unit not included in the sample ? (1) $\dfrac{n(n-1)}{N(N-1)}$ (2) $\dfrac{n(N-n)}{N(N-1)}$ (3) $\dfrac{(n-1)(N-n+1)}{N(N-1)}$ (4) n/N
15.	Consider the following statements : I. The bias of ratio estimator for population mean becomes zero if t regression of Y on X passes through the origin. II. The ratio estimator of population mean is more efficient than samp mean when the correlation coefficient between X and Y is great than zero. Which of the above statements is/are correct ? (1) I only (2) II only (3) Both I and II (4) Neither I nor II

Question No.	Questions
16.	The unbiased estimator of population total Y due to Horvitz and Thompson is (1) $\sum_{i \in S} \frac{Y_i}{1 - \pi_i}$ (2) $\sum_{i \in S} \frac{Y_i}{\pi_i}$ (3) $N \sum_{i \in S} \frac{Y_i}{1 - \pi_i}$ (4) $N \sum_{i \in S} \frac{Y_i}{\pi_i}$
17.	Which one of the following is a correct statement ? (1) The regression estimator is superior to the mean per unit estimator in some cases. (2) The regression estimator and the mean per unit estimator both being equally efficient if $\rho = 0$. (3) Regression estimator is always better than ratio estimator. (4) The regression estimator will, in general be more efficient than the post-stratified estimator.
18.	The pgf of a certain distribution is given as $P(s) = 3s^2 - 2s + 6$. What is the mean of this distribution ? (1) 2 (2) 3 (3) 4 (4) 5

Question No.	Questions
19.	Three samples of 5, 4, and 5 motor car tyres are drawn respectively fro— three brands P, Q, and R manufactures by the three machines. The li— time of these tyres (in '000 miles) are given below : P : 45 42 43 44 42 Q : 41 40 42 43 R : 44 42 38 43 39 What is the mean sum of squares between samples ? (1) 5.7 (2) 6.2 (3) 7.9 (4) 8.7
20.	A test which minimizes two types of errors is called : (1) minimax test (2) optimum test (3) unbiased test (4) similar test
21.	The summary of two variables are given as follows : $\sum x_i = 53$, $\sum x_i^2 = 297$, $\sum y_i = 277.5$, $\sum y_i^2 = 9941.25$, $\sum x_i y_i = 1630$ an— $n = 12$. What is the value of slope ? (1) 2.5 (2) 3.6 (3) 4.8 (4) 6.4

Question No.	Questions
22.	The wind pressure p corresponding to velocity v is given by the following data : 	v	10	20	30	40	 	p	1.2	2.0	4.5	8.0	 What is the value of p when v = 25, according to Newton's formula ? (1) 2.32 (2) 2.89 (3) 3.08 (4) 4.02
23.	If a, b, c are the roots of the cubic equation $x^3 + px^2 + qx + r = 0$, then the value of $a^3 + b^3 + c^3$ is (1) $-3r - pqr$ (2) $-3r - p^2 + rq$ (3) $-3r - p^3 + 3pq$ (4) $P^3 + 3rq$
24.	If $A = \begin{bmatrix} 3 & -7 \\ -4 & 1 \end{bmatrix}$, then the determinant of $A^3 + 3A^2 + 12A$ is (1) 29000 (2) -29500 (3) 30000 (4) -39500
25.	If V be a collection of vectors, then V is said to be subspace, if (1) V is closed under multiplication (2) V is closed under multiplication and addition (3) V is closed under scalar multiplication (4) V is closed under addition and scalar multiplication

Question No.	Questions
26.	If the number of variables in a non-homogeneous system $AX = B$ is n, then the system possesses a unique solution if : (1) $\rho (A) < \rho [A, B]$ (2) $\rho (A) > \rho [A, B]$ (3) $\rho (A) = \rho [A, B] < n$ (4) $\rho (A) < \rho [A, B] = n$
27.	The series $\dfrac{x}{1+x} + \dfrac{x^2}{1+x^2} + \dfrac{x^3}{1+x^3} + \dots$ is (1) Divergent (2) Convergent for all values of x (3) Convergent for $0 < x < 1$ (4) Convergent for $x > 1$
28.	If $^{2n+1}P_{n-1} : {}^{2n-1}P_n = 3 : 5$, then the value of **n** is equal to (1) 1 (2) 2 (3) 3 (4) 4
29.	Consider the following statements : I. A non-singular matrix is congruent to its inverse II. Every normal triangular matrix is not diagonal Which of the above are correct ? (1) Only I (2) Only II (3) Both I and II (4) None of the above
30.	If S is a set of vectors containing the zero vector, then (1) $0 \in S$ (2) $0 \notin S$ (3) 0 may or may not be is S (4) S is linearly independent

Question No.	Questions
31.	The following values of the function f (x) for values of x are given : f (1) = = 4, f (2) = 5, f (7) = 5, and f (8) = 4. What is the value of f (6) ? (1) 5.13 (2) 5.28 (3) 5.67 (4) 5.88
32.	If Δ and E are the difference operators defined as usual, then what is the value of $\dfrac{\Delta^2}{E^2}$? (1) $\dfrac{1}{E^2} - \dfrac{2}{E}$ (2) $\dfrac{1}{E^2} - \dfrac{2}{E} - 1$ (3) $\dfrac{1}{E^2} - \dfrac{2}{E} + 1$ (4) $\dfrac{1}{E^2} + \dfrac{2}{E} + 1$
33.	Given $y_0 = -12$, $y_2 = 4$, $y_3 = 6$, and $y_4 = 12$. What is the value of y_1 using Newton's Formula ? (1) 0 (2) 1 (3) 2 (4) 3
34.	A magazine claims that 25% of its readers are college students. Of a random sample of 200 readers, 42 are college students. It is to be tested at a 0.10 level of significance whether the proportion of college students among all the readers of the magazine is not equal to 0.25. What is the conclusion ? (1) The proportion of college students among the readers of the magazine is 0.25 (2) The sample data are incorrect (3) The proportion of college students among the readers of the magazine is less than 0.25 (4) The proportion of college students among the readers of the magazine is more than 0.25

Question No.	Questions
35.	The variance of Hyper geometric distribution with $N = 20$, $n = 5$ and $M = 12$ is given by (1) 1.34 (2) 1.28 (3) 1.02 (4) 0.95
36.	A random sample of 100 articles are taken from a batch of 2000 articles shows that the average diameter of the articles is 0.354 and standard deviation 0.048. What is the 95% confidence interval for the average diameter of the batch ? (1) (0.2934, 0.4235) (2) (0.3448, 0.3632) (3) (0.3021, 0.3824) (4) (0.3923, 0.4212)
37.	A multiple regression relationship contains two independent variables. The standard error of estimate is 4.8 and error sum of squares is 576. What is the sample size ? (1) 24 (2) 25 (3) 26 (4) 28
38.	Given the following joint density function : $$f(x, y) = \lambda^2 e^{-\lambda y},\ 0 \le x \le y < \infty$$ What is $E(Y|X)$? (1) $x + 1/\lambda$ (2) $x - 1/\lambda$ (3) $2x + \lambda$ (4) $2x - \lambda$
39.	Let X has the distribution function $$F(x) = \begin{cases} 0, & x < 0, \\ x/2, & 0 \le x \le 2, \\ 1, & x > 2. \end{cases}$$ Let $Y = X^2$, then what is the value of $P(X \le 2Y)$? (1) 1/2 (2) 2/3 (3) 3/4 (4) 4/7

Question No.	Questions
40.	The percent of total variation of the dependent variable Y explained by the set of independent variable X is measured by (1) Coefficient of correlation (2) Coefficient of skewness (3) Coefficient of determination (4) Standard error
41.	Which one is the improper prior for p, the probability of success in Bernoulli distribution ? (1) $g(p) = 1$ (2) (B) $g(p) = \dfrac{1}{\beta(a, b)} p^{a-1}(1-p)^{b-1}, a > 0, b > 0$ (3) $g(p) = 2p$ (4) $g(p) = c, c \neq 1$
42.	If $A = \begin{bmatrix} 3 & -7 \\ -4 & 1 \end{bmatrix}$, then the determinant of $A^3 + 3A^2 + 12A$ is (1) -2900 (2) -29500 (3) -3000 (4) -39500
43.	The Cramer-Rao lower bound for $\Psi(\theta) = e^{-\theta}$ in Poisson distribution with parameter θ is (1) $\dfrac{\theta}{n} e^{-2\theta}$ (2) $\dfrac{n}{\theta} e^{-2\theta}$ (3) $\dfrac{2\theta}{n} e^{-2\theta}$ (4) $\dfrac{\theta^2}{n} e^{-2\theta}$

Question No.	Questions
44.	Let $X_1, X_2, ..., X_n$ be iid Poisson (μ). Then the UMVUE of $P(X = 0)$ is (1) $\left(1 - \dfrac{1}{\bar{x}}\right)^n$ (2) $\left(1 - \dfrac{n}{\bar{x}}\right)^n$ (3) $\left(1 - \dfrac{1}{n}\right)^{\Sigma x}$ (4) $\left(1 - \dfrac{1}{n}\right)^{\bar{x}}$
45.	If 3, 8, 5, 4 and 10 are exponential samples with mean θ. Then the score function evaluate at $\theta = 4$ is (1) 0.36 (2) 0.40 (3) 0.56 (4) 0.68
46.	Consider the following statements : I. For an estimator to be consistent, the unbiasedness of the estimator is necessary II. If the variance of an estimator attains the Crammer-Rao lower bound, the estimator is consistent. III. A UMVUE is unique, if it exists Which of the above are correct ? (1) Only I is correct (2) Only II is correct (3) Only III is correct (4) None is correct
47.	If 12, 18, 8, 22, and 15 are random samples for $N(\mu, \sigma^2)$. An unbiased estimator of σ^2 is Given by (1) 20 (2) 25 (3) 29 (4) 33

Question No.	Questions
48.	One of the eigenvalues of the given matrix is : $$\begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$$ (1) 2 (2) 3 (3) 5 (4) 10
49.	The range of the real values of x satisfying $8 - 3x \le 5$ and $4x + 5 \le -7$ is (1) $(-3, 1)$ (2) $(-1, 1)$ (3) $(0, 3)$ (4) empty
50.	The 2×2 matrix corresponding to the complex number $3 + 5i$ is (1) $\begin{bmatrix} 3 & 5 \\ 5 & 3 \end{bmatrix}$ (2) $\begin{bmatrix} -3 & 5 \\ 5 & -3 \end{bmatrix}$ (3) $\begin{bmatrix} 3 & -5 \\ 5 & -3 \end{bmatrix}$ (4) $\begin{bmatrix} 3 & -5 \\ 5 & 3 \end{bmatrix}$
51.	Every sequence $\{X_n\}$ of independent random variables with uniformly bounded variances obeys (1) Borel-Cantelli lemma (2) Cauchy's criterion (3) WLLN (4) SLLN
52.	If V be a collection of vectors, then V is said to be subspace, if (1) V is closed under multiplication (2) V is closed under multiplication and addition (3) V is closed under scalar multiplication (4) V is closed under addition and scalar multiplication

Question No.	Questions
53.	Let X be a random variable with pgf P(S). Then the pgf of 3X–1 is (1) SP(S) (2) S/P(S) (3) P(S)/S (4) P(S³)/S
54.	The relationship between number of beers consumed (x) and blood alcohol content (y) was studied in 16 male college students by using least squares regression. The following regression equation was obtained from this study : $y^\wedge = -0.0127 + 0.0180\,x$. The above equation implies that : (1) each beer consumed increases blood alcohol by 1.27% (2) on average it takes 1.8 beers to increase blood alcohol content by 1% (3) each beer consumed increased blood alcohol by an average of amount of 1.8% (4) None of these.
55.	With the usual notations, find p for a binomial random variable X, if n = 6 and if 9 P (X = 1) = P (X = 2). (1) 12/15 (2) 18/23 (3) 19/27 (4) 9/14
56.	The quadratic form $6x_1^2 + 3x_2^2 + 14x_3^2 + 4x_2 x_3 + 18x_1x_3 + 4x_1x_2$ is (1) Negative definite (2) Positive definite (3) Positive semi definite (4) Negative semi definite

Question No.	Questions
57.	Let T be CAN for θ so that $T \sim AN(\theta, \sigma^2_T(\theta)/a_n^2)$ and let Ψ be a differentiable function such that $\dfrac{d\Psi}{d\theta}$ is continuous and non vanishing then $\Psi(T)$ is CAN for $\Psi(\theta)$ with asymptotic variance : (1) $\left(\dfrac{d\Psi}{d\theta}\right)^2 \sigma^2_T(\theta)$ (2) $\left(\dfrac{d\Psi}{d\theta}\right)^2 a_n^2 \sigma^2_T(\theta)$ (3) $\left(\dfrac{d\Psi}{d\theta}\right)^2 \dfrac{\sigma^2_T(\theta)}{a_n^2}$ (4) $\left(\dfrac{d\Psi}{d\theta}\right)^2 \dfrac{\sigma^4_T(\theta)}{a_n^4}$
58.	If the percent of trend for a year in a time series is greater than 100%, it indicates that (1) The actual time series value lies below the trend line and the relative cyclical residual is positive (2) The actual time series value lies below the trend line and the relative cyclical residual is negative (3) The actual time series value lies above the trend line and the relative cyclical residual is negative (4) The actual time series value lies above the trend line and the relative cyclical residual is positive
59.	If 3, 8, 5, 4 and 10 are exponential samples with mean θ. The Fisher information function evaluated at $\theta = 2$ is (1) 0.50 (2) 0.80 (3) 1.20 (4) 1.25
60.	The ratio of number of replication required in CRD and RBD for the same amount of information is (1) 3:2 (2) 5:3 (3) 5:4 (4) 3:5

Question No.	Questions
61.	If $n = 15$, $\sum x = 480$, $\sum x^2$, then the standard deviation of $y = 5x - 10$ is (1) 100 (2) 96.82 (3) 47.56 (4) 112.88
62.	Let X_1, X_2, ... be iid Poisson (λ) random variables. If $S_n = \sum_{k=1}^{n} X_k$. If $\lambda = 1$ and $n = 64$, then The value of $P \{50 < S_n < 80\}$ is approximately (1) 0.7329 (2) 0.8321 (3) 0.7884 (4) 0.9348
63.	Consider a discrete classification with n_1, n_2, n_3, n_4 as the number o observations in each cell such that $\sum_{i=1}^{3} n_i = n$. The cell probabilities ar respectively given as θ^2, $\theta(1-\theta)$, $\theta(1-\theta)$ and $(1-\theta)^2$. What is the MLE o θ is (1) $\dfrac{n_4}{2n}$ (2) $\dfrac{2n_1 + n_2}{n_1 + n_3}$ (3) $\dfrac{2n_1 + n_3}{n_1 + n_2 + n_4}$ (4) $\dfrac{2n_1 + n_2 + n_3}{2n}$
64.	Let X be a random variable having the probability function : $$f(x, \theta) = \binom{n}{x} \theta^x (1-\theta)^{n-x}, \quad x = 0, 1, 2, ..., n.$$ If $d(x) = \dfrac{x}{n}$, then the risk function $R(\theta, d)$ under squared error los function is : (1) $\dfrac{\theta(\theta-1)}{n}$ (2) $\dfrac{\theta(\theta+1)}{n}$ (3) $\dfrac{\theta(1-\theta)}{n}$ (4) $\dfrac{\theta^2}{n}$

Question No.	Questions
65.	Let X_1, X_2, ... be iid Bernoulli with parameter (λ). If apriori it is known that $\lambda \in [1/4, 3/4]$. If $\bar{X} \geq \frac{3}{4}$. What is the MLE of λ ? (1) 1/4 (3) 3/4 (2) 1/2 (4) 1
66.	After taking a sample and computing $\bar{x}$, a statistician says that he is 88% confident that the population mean lies between 106 and 122. What does he really mean ? (1) The probability is 0.88 that $\mu = 114$, the midpoint of the interval (2) The probability is 0.88 that μ is between 106 and 122 (3) 88% of the intervals calculated from samples of this size will contain μ (4) Both (2) and (3)
67.	The measure of Kurtosis of t-distribution is (1) $\dfrac{n-2}{n-3}$ (2) $\dfrac{3(n-2)}{n-4}$ (3) $\dfrac{3(n-2)}{n+4}$ (4) $\dfrac{n+2}{n+4}$
68.	For a particular hypothesis test, the probabilities of type I and II errors are respectively, 0.05 and 0.09. The power of this test is (1) 0.95 (3) 0.86 (2) 0.14 (4) 0.91

Question No.	Questions
69.	Let $X_1, X_2, ... X_n$ be iid with $f(x) = \theta x^{\theta - 1}$, $0 < x < 1$, $\theta > 0$. Then the Cramer-Rao Lower Bound for estimating θ is (1) $n\theta$ (2) $\dfrac{\theta}{n}$ (3) $\dfrac{\theta^2}{n}$ (4) $\dfrac{\theta^2}{n^2}$
70.	For a queuing model of M/M/1(∞)/FCFS model, the probability of nth realization is obtained as (1) $\rho^n (1 - \rho)$ (2) $\rho (1 - \rho)$ (3) $\rho (1 - \rho)^n$ (4) $\rho^n (1 - \rho)^{n-1}$
71.	A car manufacturer had to recall the lot produced from one of its assembly line over a specific period of time due to quality-control problems that were not discovered during final inspection procedures. This is an example of (1) Type I error (2) Type II error (3) Both (1) and (2) (4) Neither (1) nor (2)
72.	The number of runs in XYYXYXX is : (1) 2 (2) 3 (3) 4 (4) 5
73.	You have carried out a one way ANOVA. There are significant differences between the three groups you are testing. How might you conduct your pairwise comparisons ? (1) F test (2) Least significance differences (LSD) (3) Z test (4) Chi-square test

Question No.	Questions
74.	Suppose there is interest in comparing the median response time for three independent groups learning a specific task. The appropriate nonparameteric procedure is (1) Kruskal-Wallis (2) Wilcoxon Signed-Rank (3) Run test (4) Sign test
75.	What is the value of $2x^{(4)} + 3x^{(2)} + x^{(1)} - 7$ evaluated at $x = 5$? (1) 289 (2) 294 (3) 298 (4) 302
76.	Degrees of freedom for chi-square in case of contingency table of order (4×3) are : (1) 12 (2) 9 (3) 8 (4) 6
77.	A small sample has been taken from a normally distributed population and the sample mean has been found to be 62. The upper limit of a 95 percent confidence interval for population mean is 81.60. The population variance is known to be 2,400. What is the sample size ? (1) 24 (2) 30 (3) 36 (4) 64
78.	Consider the following results on a correlation study : Regression equations : $6y = 5x + 90$ and $15x = 8y + 130$ and Variance of $X = 4$. What is the coefficient of correlation betwene X and Y ? (1) 0.45 (2) 0.67 (3) 0.78 (4) 0.88

Question No.	Questions
79.	Basu's theorem is useful in determining the statistic V which is (1) Independent of sufficient statistic T (2) Linear function of U and T (3) Monotone in U for fixed t (4) None of these
80.	The nonparameteric test equivalent of a one-way ANOVA is (1) Wilcoxon Signed Rank test (2) Wilcoxon Rank Sum Test (3) Kruskall-Wallis Test (4) Ansari-Bradley test
81.	If quartile deviation of a set of observations is given as 6.4 and the valu of first quartile is 5. What is the value of the third quartile ? (1) 12 (2) 15.3 (3) 17.8 (4) 20.2
82.	The mean and median of a non-symmetric distribution is 16 and 1 respectively. If standard deviation is 5, then the skewness of th distribution is (1) 0 (2) –1.2 (3) 1.5 (4) 2.1
83.	Suppose X follows a Normal distribution with mean 50 and variation 2 What is the standard score corresponds to 58 ? (1) 1.2 (2) 1.6 (3) 1.8 (4) 2.1

Question No.	Questions
84.	If the p-value of the test is larger than the level of significance, it indicates (1) Strong evidence in support of alternative hypothesis (2) Strong evidence against alternative hypothesis (3) Strong evidence in support of null hypothesis (4) Strong evidence against null hypothesis
85.	Consider the following statements : I. If S is closed and δ is admissible, then every risk function is convex II. If S is closed, then S will not have a limit point III. If S is closed from below, then $S \notin E_k$ Which of the above is correct ? (1) Only I is correct (2) Only II is correct (3) Both I and II is correct (4) Both II and III is correct
86.	In the analysis of RBD with b blocks and v treatments, the error degrees of freedom are (1) $b(v-1)$ (2) $v(b-1)$ (3) $(b-1)(v-1)$ (4) $b(v-1)$
87.	Consider the following statements : I. A complete class of decision rules contains only admissible decision rules II. A minimal complete class of decision rule contains only admissible decision rules III. A minimal complete class of decision rule is always complete Which of the above is correct ? (1) Only I is correct (2) Only II is correct (3) Both I and II is correct (4) Both II and III is correct

Question No.	Questions
88.	The special case of Birth-Death process with $\lambda_n = n\lambda$ and there is no deat is called the _____ process (1) Immigration (2) Poisson Process (3) Linear growth (4) Yule-Furry
89.	Wishart distribution is a generalization of (1) Normal distribution (2) t-distribution (3) Chi-square distribution (4) Beta distribution
90.	Let $\{X_n, Y_n\}$, $n = 1, 2, ...$, be a sequence of random variables. The $\|X_n - Y_n\| \xrightarrow{P} 0$ and $Y_n \xrightarrow{L} Y$ implies (1) $X_n \xrightarrow{L} X$ (2) $X_n \xrightarrow{L} Y$ (3) $Y_n \xrightarrow{L} X$ (4) $X_n Y_n \xrightarrow{L} Y$
91.	The Rank of the quadratic form : $2x_1^2 + x_2^2 - 3x_3^2 - 4x_1x_3 - 8x_2x_3 + 12x_1$ is (1) 0 (2) 1 (3) 2 (4) 3
92.	The value of $\int_0^\infty x^4 e^{-x} dx$ is (1) 2 (2) 4 (3) 6 (4) 12

Question No.	Questions
93.	What is the value of $\lim\limits_{x \to 0} \dfrac{a^x - 1}{x}$? (1) Log $(a-1)$ (2) $\log_e (a)$ (3) $a \log_e (a)$ (4) $a/\log_e (a)$
94.	Certain values of x and y are as given below : <table><tr><td>X</td><td>0</td><td>0.25</td><td>0.5</td><td>0.75</td><td>1.0</td></tr><tr><td>y</td><td>1.0</td><td>0.9394</td><td>0.7788</td><td>0.5694</td><td>0.3678</td></tr></table> According to Simpson's $(1/3)^{rd}$ rule what is the value of $\int_0^1 y \, dx$? (1) 0.7429 (2) 0.7457 (3) 0.7467 (4) 0.7477
95.	If $u = x^3 - 3xy^2$, then what is the value of $f(z)$, if $z = x + iy$? (1) z^3 (2) $z^3 - ic$ (3) $z^3 + ic$ (4) ic
96.	If $f(z)$ is a continuous function in a region D and if the integral $\int f(z)\,dz$ taken round any simple closed contour in D is zero then $f(z)$ is an analytic function inside D. This theorem is due to (1) Morea (2) Cauchy (3) Lio-Ville (4) Laurent

Question No.	Questions
97.	If a function f(z) is analytic for all finite values of z and $\lvert z \rvert \to \infty$, an $\lvert f(z) \rvert = A\,(\lvert z \rvert^{\,k})$, then f(z) is a polynomial of degree (1) < k (2) $\leq$ k (3) > k (4) $\geq$ k
98.	If $f(z) = \dfrac{z^4 + 2z^3 + 3z^2 + 4z + 5}{z^2}$, then (1) z = 0 is a pole of order 1 (2) z = 0 is a pole of order 2 (3) z = 0 is a pole of order 3 (4) z = 0 is a pole of order 4
99.	For the series, 29, 12, 26, 19, 24, 36, 21, 33, and 35; the value of the firs quartile is (1) 20 (2) 21 (3) 22 (4) 23
100.	Given $\dfrac{dy}{dx} = y^2 + 1$, y (0) = 0. What is y (0.2) ? (1) 0.187 (2) 0.194 (3) 0.198 (4) 0.203

(MPH/PHD/URS–EE–2019)
Subject : STATISTICS

Code **B** `C`

Sr. No. **10002**

SET–"X"

Time : 1¼ Hours   Total Questions : 100   Max. Marks : 100

Roll No. _____ (in figure)_____ (in words)

Name : _____ Father's Name : _____

Mother's Name : _____ Date of Examination : _____

(Signature of the candidate)   (Signature of the Invigilator)

CANDIDATES MUST READ THE FOLLOWING INFORMATION/ INSTRUCTIONS BEFORE STARTING THE QUESTION PAPER.

1. Candidates are required to attempt any 75 questions out of the given 100 multiple choice questions of 4/3 marks each. No credit will be given for more than 75 correct responses.

2. The candidates must return the Question book-let as well as OMR answer-sheet to the Invigilator concerned before leaving the Examination Hall, failing which case of use of unfair-means / mis-behaviour will be registered against him / her in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.

3. Keeping in view the transparency of the examination system, carbonless OMR Sheet is provided to the candidate so that a copy of OMR Sheet may be kept by the candidate.

4. Question Booklet along-with answer key of all the A,B,C and D code shall be got uploaded on the university website after the conduct of Entrance Examination. In case there is any discrepancy in the Question Booklet/Answer Key, the same may be brought to the notice of the Controller of Examination in writing/through E. Mail within 24 hours of uploading the same on the University Website. Thereafter, no complaint in any case, will be considered.

5. The candidate MUST NOT do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question book-let itself. Answers MUST NOT be ticked in the Question book-let.

6. There will be no negative marking. Each correct answer will be awarded 4/3 mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.

7. Use only Black or Blue **BALL POINT PEN** of good quality in the OMR Answer-Sheet.

8. BEFORE ANSWERING THE QUESTIONS, THE CANDIDATES SHOULD ENSURE THAT THEY HAVE BEEN SUPPLIED CORRECT AND COMPLETE BOOK-LET. COMPLAINTS, IF ANY, REGARDING MISPRINTING ETC. WILL NOT BE ENTERTAINED 30 MINUTES AFTER STARTING OF THE EXAMINATION.

Question No.	Questions
1.	If $n = 15$, $\sum x = 480$, $\sum x^2$, then the standard deviation of $y = 5x - 10$ is (1) 100 $\qquad\qquad$ (2) 96.82 (3) 47.56 $\qquad\qquad$ (4) 112.88
2.	Let X_1, X_2, ... be iid Poisson (λ) random variables. If $S_n = \sum_{k=1}^{n} X_k$. If $\lambda = 1$ and $n = 64$, then The value of $P\{50 < S_n < 80\}$ is approximately (1) 0.7329 $\qquad\qquad$ (2) 0.8321 (3) 0.7884 $\qquad\qquad$ (4) 0.9348
3.	Consider a discrete classification with n_1, n_2, n_3, n_4 as the number of observations in each cell such that $\sum_{i=1}^{3} n_i = n$. The cell probabilities are respectively given as θ^2, $\theta(1-\theta)$, $\theta(1-\theta)$ and $(1-\theta)^2$. What is the MLE of θ is (1) $\dfrac{n_4}{2n}$ (2) $\dfrac{2n_1 + n_2}{n_1 + n_3}$ (3) $\dfrac{2n_1 + n_3}{n_1 + n_2 + n_4}$ (4) $\dfrac{2n_1 + n_2 + n_3}{2n}$

Question No.	Questions
4.	Let X be a random variable having the probability function : $$f(x, \theta) = \binom{n}{x} \theta^x (1-\theta)^{n-x}, \quad x = 0, 1, 2, \ldots, n.$$ If $d(x) = \dfrac{x}{n}$, then the risk function $R(\theta, d)$ under squared error loss function is : (1) $\dfrac{\theta(\theta-1)}{n}$ (2) $\dfrac{\theta(\theta+1)}{n}$ (3) $\dfrac{\theta(1-\theta)}{n}$ (4) $\dfrac{\theta^2}{n}$
5.	Let $X_1, X_2, \ldots$ be iid Bernoulli with parameter (λ). If apriori it is known that $\lambda \in [1/4, 3/4]$. If $\overline{X} \geq \dfrac{3}{4}$. What is the MLE of λ ? (1) 1/4 (2) 1/2 (3) 3/4 (4) 1
6.	After taking a sample and computing $\overline{x}$, a statistician says that he is 88 confident that the population mean lies between 106 and 122. What do he really mean ? (1) The probability is 0.88 that $\mu = 114$, the midpoint of the interval (2) The probability is 0.88 that μ is between 106 and 122 (3) 88% of the intervals calculated from samples of this size w contain μ (4) Both (2) and (3)

Question No.	Questions
7.	The measure of Kurtosis of t-distribution is (1) $\dfrac{n-2}{n-3}$ (2) $\dfrac{3(n-2)}{n-4}$ (3) $\dfrac{3(n-2)}{n+4}$ (4) $\dfrac{n+2}{n+4}$
8.	For a particular hypothesis test, the probabilities of type I and II' errors are respectively, 0.05 and 0.09. The power of this test is (1) 0.95 (2) 0.14 (3) 0.86 (4) 0.91
9.	Let $X_1, X_2, \ldots X_n$ be iid with $f(x) = \theta x^{\theta-1}$, $0 < x < 1$, $\theta > 0$. Then the Cramer-Rao Lower Bound for estimating θ is (1) $n\theta$ (2) $\dfrac{\theta}{n}$ (3) $\dfrac{\theta^2}{n}$ (4) $\dfrac{\theta^2}{n^2}$
10.	For a queuing model of M/M/1(∞)/FCFS model, the probability of nth realization is obtained as (1) $\rho^n(1-\rho)$ (2) $\rho(1-\rho)$ (3) $\rho(1-\rho)^n$ (4) $\rho^n(1-\rho)^{n-1}$
11.	Every sequence $\{X_n\}$ of independent random variables with uniformly bounded variances obeys (1) Borel-Cantelli lemma (2) Cauchy's criterion (3) WLLN (4) SLLN

Question No.	Questions
12.	If V be a collection of vectors, then V is said to be subspace, if (1) V is closed under multiplication (2) V is closed under multiplication and addition (3) V is closed under scalar multiplication (4) V is closed under addition and scalar multiplication
13.	Let X be a random variable with pgf P(S). Then the pgf of 3X–1 is (1) SP(S) (2) S/P(S) (3) P(S)/S (4) $P(S^3)/S$
14.	The relationship between number of beers consumed (x) and blood alcohol content (y) was studied in 16 male college students by using least squares regression. The following regression equation was obtained from this study : $y^{\wedge} = -0.0127 + 0.0180\, x$. The above equation implies that : (1) each beer consumed increases blood alcohol by 1.27% (2) on average it takes 1.8 beers to increase blood alcohol content by 1% (3) each beer consumed increased blood alcohol by an average of amount of 1.8% (4) None of these.
15.	With the usual notations, find p for a binomial random variable X, if n = 6 and if 9 P (X = 1) = P (X = 2). (1) 12/15 (2) 18/23 (3) 19/27 (4) 9/14
16.	The quadratic form $6x_1^2 + 3x_2^2 + 14x_3^2 + 4x_2 x_3 + 18x_1 x_3 + 4x_1 x_2$ is (1) Negative definite (2) Positive definite (3) Positive semi definite (4) Negative semi definite

Question No.	Questions
17.	Let T be CAN for θ so that $T \sim AN\left(\theta, \sigma^2_T(\theta)/a_n^2\right)$ and let Ψ be a differentiable function such that $\dfrac{d\Psi}{d\theta}$ is continuous and non vanishing then $\Psi(T)$ is CAN for $\Psi(\theta)$ with asymptotic variance : (1) $\left(\dfrac{d\Psi}{d\theta}\right)^2 \sigma^2_T(\theta)$ (2) $\left(\dfrac{d\Psi}{d\theta}\right)^2 a_n^2\, \sigma^2_T(\theta)$ (3) $\left(\dfrac{d\Psi}{d\theta}\right)^2 \dfrac{\sigma^2_T(\theta)}{a_n^2}$ (4) $\left(\dfrac{d\Psi}{d\theta}\right)^2 \dfrac{\sigma^4_T(\theta)}{a_n^4}$
18.	If the percent of trend for a year in a time series is greater than 100%, it indicates that (1) The actual time series value lies below the trend line and the relative cyclical residual is positive (2) The actual time series value lies below the trend line and the relative cyclical residual is negative (3) The actual time series value lies above the trend line and the relative cyclical residual is negative (4) The actual time series value lies above the trend line and the relative cyclical residual is positive
19.	If 3, 8, 5, 4 and 10 are exponential samples with mean θ. The Fisher information function evaluated at $\theta = 2$ is (1) 0.50 (2) 0.80 (3) 1.20 (4) 1.25
20.	The ratio of number of replication required in CRD and RBD for the same amount of information is (1) 3:2 (2) 5:3 (3) 5:4 (4) 3:5

Question No.	Questions
21.	If quartile deviation of a set of observations is given as 6.4 and the value of first quartile is 5. What is the value of the third quartile ? (1) 12 (2) 15.3 (3) 17.8 (4) 20.2
22.	The mean and median of a non-symmetric distribution is 16 and 18 respectively. If standard deviation is 5, then the skewness of the distribution is (1) 0 (2) −1.2 (3) 1.5 (4) 2.1
23.	Suppose X follows a Normal distribution with mean 50 and variation 25. What is the standard score corresponds to 58 ? (1) 1.2 (2) 1.6 (3) 1.8 (4) 2.1
24.	If the p-value of the test is larger than the level of significance, it indicate (1) Strong evidence in support of alternative hypothesis (2) Strong evidence against alternative hypothesis (3) Strong evidence in support of null hypothesis (4) Strong evidence against null hypothesis
25.	Consider the following statements : I. If S is closed and δ is admissible, then every risk function is conve II. If S is closed, then S will not have a limit point III. If S is closed from below, then $S \notin E_k$ Which of the above is correct ? (1) Only I is correct (2) Only II is correct (3) Both I and II is correct (4) Both II and III is correct

Question No.	Questions
26.	In the analysis of RBD with b blocks and v treatments, the error degrees of freedom are (1) b (v − 1) (2) v (b − 1) (3) (b − 1) (v − 1) (4) b (v − 1)
27.	Consider the following statements : I. A complete class of decision rules contains only admissible decision rules II. A minimal complete class of decision rule contains only admissible decision rules III. A minimal complete class of decision rule is always complete Which of the above is correct ? (1) Only I is correct (2) Only II is correct (3) Both I and II is correct (4) Both II and III is correct
28.	The special case of Birth-Death process with $\lambda_n = n\lambda$ and there is no death is called the _____ process (1) Immigration (2) Poisson Process (3) Linear growth (4) Yule-Furry
29.	Wishart distribution is a generalization of (1) Normal distribution (2) t-distribution (3) Chi-square distribution (4) Beta distribution

Question No.	Questions
30.	Let $\{X_n, Y_n\}$, n = 1, 2, ..., be a sequence of random variables. Then $\|X_n - Y_n\| \xrightarrow{P} 0$ and $Y_n \xrightarrow{L} Y$ implies (1) $X_n \xrightarrow{L} X$ (2) $X_n \xrightarrow{L} Y$ (3) $Y_n \xrightarrow{L} X$ (4) $X_n Y_n \xrightarrow{L} Y$
31.	Consider the following regression problem : $Y_i = \alpha + \beta_i + \epsilon_i$; i = 1, 2, ..., n. Here ϵ_i ; i = 1, 2, ..., n, are i.i.d. N (0, 1) random variables. It is assumed that $\alpha \neq 0$ and β is known. If $\hat{\alpha}_n$ is the MLE of α, which of the following statements is true ? (1) $\lim_{n \to \infty} E(\hat{\alpha}_n) \neq \alpha$ (2) $\lim_{n \to \infty} E(\hat{\alpha}_n) = 0$ (3) $\lim_{n \to \infty} V(\hat{\alpha}_n) = \infty$ (4) $\lim_{n \to \infty} V(\hat{\alpha}_n) = 0$
32.	Let $X_1, X_2, ..., X_n$ be a random sample from f (x, θ), a probability density function or a probability mass function. Define $(n - 1) s_n^2 = \sum_{i=1}^{n} (X_i - \overline{X}_n)^2$, where $\overline{X}_n$ is a sample mean. Then s_n^2 is unbiased for θ if (1) $f(x, \theta) = \dfrac{e^{-\theta} \theta^x}{x!}$, x = 0, 1, ..., and $\theta > 0$ (2) $f(x, \theta) = \dfrac{e^{-\frac{x}{\theta}}}{\theta}$, x > 0, $\theta > 0$ (3) $(x, \theta) = \theta\, e^{-\theta x}$, x > 0, $\theta > 0$ (4) none of the above

Question No.	Questions
33.	Let X_1, X_2, ..., X_n be a random sample from uniform $U(\theta - 5, \theta - 3)$ distribution. Let $X_{(1)}$ and $X_{(n)}$ denote the smallest and largest of the sample values. Then which of the following is true ? (1) $(X_{(1)}, X_{(n)})$ is complete sufficient for θ (2) $X_1 + X_2 - 2X_3$ is an ancillary statistic (3) $X_{(n)} + 3$ is unbiased for θ (4) $X_{(1)} +$ is not consistent for θ
34.	A simple random sample (without replacement) of size n is drawn from a finite population of size N (>6). What is the probability that the 4^{-th} population unit is included in the sample but the 6^{-th} population unit is not included in the sample ? (1) $\dfrac{n(n-1)}{N(N-1)}$ (2) $\dfrac{n(N-n)}{N(N-1)}$ (3) $\dfrac{(n-1)(N-n+1)}{N(N-1)}$ (4) n/N
35.	Consider the following statements : I. The bias of ratio estimator for population mean becomes zero if the regression of Y on X passes through the origin. II. The ratio estimator of population mean is more efficient than sample mean when the correlation coefficient between X and Y is greater than zero. Which of the above statements is/are correct ? (1) I only (2) II only (3) Both I and II (4) Neither I nor II

Question No.	Questions
36.	The unbiased estimator of population total Y due to Horvitz and Thompson is (1) $\sum_{i \in S} \dfrac{Y_i}{1 - \pi_i}$ (2) $\sum_{i \in S} \dfrac{Y_i}{\pi_i}$ (3) $N \sum_{i \in S} \dfrac{Y_i}{1 - \pi_i}$ (4) $N \sum_{i \in S} \dfrac{Y_i}{\pi_i}$
37.	Which one of the following is a correct statement ? (1) The regression estimator is superior to the mean per unit estimator in some cases. (2) The regression estimator and the mean per unit estimator both bein equally efficient if $\rho = 0$. (3) Regression estimator is always better than ratio estimator. (4) The regression estimator will, in general be more efficient than t post-stratified estimator.
38.	The pgf of a certain distribution is given as $P(s) = 3s^2 - 2s + 6$. What is t mean of this distribution ? (1) 2 (2) 3 (3) 4 (4) 5

Question No.	Questions
39.	Three samples of 5, 4, and 5 motor car tyres are drawn respectively from three brands P, Q, and R manufactures by the three machines. The life time of these tyres (in '000 miles) are given below : P : 45 42 43 44 42 Q : 41 40 42 43 R : 44 42 38 43 39 What is the mean sum of squares between samples ? (1) 5.7 (2) 6.2 (3) 7.9 (4) 8.7
40.	A test which minimizes two types of errors is called : (1) minimax test (2) optimum test (3) unbiased test (4) similar test
41.	A car manufacturer had to recall the lot produced from one of its assembly line over a specific period of time due to quality-control problems that were not discovered during final inspection procedures. This is an example of (1) Type I error (2) Type II error (3) Both (1) and (2) (4) Neither (1) nor (2)
42.	The number of runs in XYYXYXX is : (1) 2 (2) 3 (3) 4 (4) 5

Question No.	Questions
43.	You have carried out a one way ANOVA. There are significant differences between the three groups you are testing. How might you conduct your pairwise comparisons ? (1) F test (2) Least significance differences (LSD) (3) Z test (4) Chi-square test
44.	Suppose there is interest in comparing the median response time for three independent groups learning a specific task. The appropriate nonparameteric procedure is (1) Kruskal-Wallis (2) Wilcoxon Signed-Rank (3) Run test (4) Sign test
45.	What is the value of $2x^{(4)} + 3x^{(2)} + x^{(1)} - 7$ evaluated at $x = 5$? (1) 289 (2) 294 (3) 298 (4) 302
46.	Degrees of freedom for chi-square in case of contingency table of order (4×3) are : (1) 12 (2) 9 (3) 8 (4) 6
47.	A small sample has been taken from a normally distributed population and the sample mean has been found to be 62. The upper limit of a 95 percent confidence interval for population mean is 81.60. The population variance is known to be 2,400. What is the sample size ? (1) 24 (2) 30 (3) 36 (4) 64

Question No.	Questions
48.	Consider the following results on a correlation study : Regression equations : $6y = 5x + 90$ and $15x = 8y + 130$ and Variance of $X = 4$. What is the coefficient of correlation betwene X and Y ? (1) 0.45 (2) 0.67 (3) 0.78 (4) 0.88
49.	Basu's theorem is useful in determining the statistic V which is (1) Independent of sufficient statistic T (2) Linear function of U and T (3) Monotone in U for fixed t (4) None of these
50.	The nonparameteric test equivalent of a one-way ANOVA is (1) Wilcoxon Signed Rank test (2) Wilcoxon Rank Sum Test (3) Kruskall-Wallis Test (4) Ansari-Bradley test
51.	Which one is the improper prior for p, the probability of success in Bernoulli distribution ? (1) $g(p) = 1$ (2) (B) $g(p) = \dfrac{1}{\beta\,(a,\,b)}\, p^{a-1}\,(1-p)^{b-1}$, $a > 0$, $b > 0$ (3) $g(p) = 2p$ (4) $g(p) = c$, $c \neq 1$

Question No.	Questions
52.	If $A = \begin{bmatrix} 3 & -7 \\ -4 & 1 \end{bmatrix}$, then the determinant of $A^3 + 3A^2 + 12A$ is (1) -2900 (2) -29500 (3) -3000 (4) -39500
53.	The Cramer-Rao lower bound for $\Psi(\theta) = e^{-\theta}$ in Poisson distribution with parameter θ is (1) $\dfrac{\theta}{n} e^{-2\theta}$ (2) $\dfrac{n}{\theta} e^{-2\theta}$ (3) $\dfrac{2\theta}{n} e^{-2\theta}$ (4) $\dfrac{\theta^2}{n} e^{-2\theta}$
54.	Let $X_1, X_2, \ldots, X_n$ be iid Poisson (μ). Then the UMVUE of $P(X = 0)$ is (1) $\left(1 - \dfrac{1}{\bar{x}}\right)^n$ (2) $\left(1 - \dfrac{n}{\bar{x}}\right)^n$ (3) $\left(1 - \dfrac{1}{n}\right)^{\Sigma x}$ (4) $\left(1 - \dfrac{1}{n}\right)^{\bar{x}}$
55.	If 3, 8, 5, 4 and 10 are exponential samples with mean θ. Then the score function evaluate at $\theta = 4$ is (1) 0.36 (2) 0.40 (3) 0.56 (4) 0.68

Question No.	Questions
56.	Consider the following statements : I. For an estimator to be consistent, the unbiasedness of the estimator is necessary II. If the variance of an estimator attains the Crammer-Rao lower bound, the estimator is consistent. III. A UMVUE is unique, if it exists Which of the above are correct ? (1) Only I is correct (2) Only II is correct (3) Only III is correct (4) None is correct
57.	If 12, 18, 8, 22, and 15 are random samples for $N(\mu, \sigma^2)$. An unbiased estimator of σ^2 is Given by (1) 20 (2) 25 (3) 29 (4) 33
58.	One of the eigenvalues of the given matrix is : $$\begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$$ (1) 2 (2) 3 (3) 5 (4) 10
59.	The range of the real values of x satisfying $8 - 3x \le 5$ and $4x + 5 \le -7$ is (1) (-3, 1) (2) (-1, 1) (3) (0, 3) (4) empty

Question No.	Questions
60.	The 2×2 matrix corresponding to the complex number $3 + 5i$ is (1) $\begin{bmatrix} 3 & 5 \\ 5 & 3 \end{bmatrix}$ (2) $\begin{bmatrix} -3 & 5 \\ 5 & -3 \end{bmatrix}$ (3) $\begin{bmatrix} 3 & -5 \\ 5 & -3 \end{bmatrix}$ (4) $\begin{bmatrix} 3 & -5 \\ 5 & 3 \end{bmatrix}$
61.	The summary of two variables are given as follows : $\sum x_i = 53$, $\sum x_i^2 = 297$, $\sum y_i = 277.5$, $\sum y_i^2 = 9941.25$, $\sum x_i y_i = 1630$ an $n = 12$. What is the value of slope ? (1) 2.5 (2) 3.6 (3) 4.8 (4) 6.4
62.	The wind pressure p corresponding to velocity v is given by the followin data : <table><tr><td>v</td><td>10</td><td>20</td><td>30</td><td>40</td></tr><tr><td>p</td><td>1.2</td><td>2.0</td><td>4.5</td><td>8.0</td></tr></table> What is the value of p when v = 25, according to Newton's formula ? (1) 2.32 (2) 2.89 (3) 3.08 (4) 4.02
63.	If a, b, c are the roots of the cubic equation $x^3 + px^2 + qx + r = 0$, then t value of $a^3 + b^3 + c^3$ is (1) $-3r - pqr$ (2) $-3r - p^2 + rq$ (3) $-3r - p^3 + 3pq$ (4) $P^3 + 3rq$

Question No.	Questions
64.	If $A = \begin{bmatrix} 3 & -7 \\ -4 & 1 \end{bmatrix}$, then the determinant of $A^3 + 3A^2 + 12A$ is (1) 29000 (2) -29500 (3) 30000 (4) -39500
65.	If V be a collection of vectors, then V is said to be subspace, if (1) V is closed under multiplication (2) V is closed under multiplication and addition (3) V is closed under scalar multiplication (4) V is closed under addition and scalar multiplication
66.	If the number of variables in a non-homogeneous system $AX = B$ is n, then the system possesses a unique solution if : (1) $\rho(A) < \rho[A, B]$ (2) $\rho(A) > \rho[A, B]$ (3) $\rho(A) = \rho[A, B] < n$ (4) $\rho(A) < \rho[A, B] = n$
67.	The series $\dfrac{x}{1+x} + \dfrac{x^2}{1+x^2} + \dfrac{x^3}{1+x^3} + \ldots$ is (1) Divergent (2) Convergent for all values of x (3) Convergent for $0 < x < 1$ (4) Convergent for $x > 1$
68.	If $^{2n+1}P_{n-1} : {}^{2n-1}P_n = 3 : 5$, then the value of **n** is equal to (1) 1 (2) 2 (3) 3 (4) 4

Question No.	Questions
69.	Consider the following statements : I. A non-singular matrix is congruent to its inverse II. Every normal triangular matrix is not diagonal Which of the above are correct ? (1) Only I (2) Only II (3) Both I and II (4) None of the above
70.	If S is a set of vectors containing the zero vector, then (1) $0 \in S$ (2) $0 \notin S$ (3) 0 may or may not be is S (4) S is linearly independent
71.	The Rank of the quadratic form : $2x_1^2 + x_2^2 - 3x_3^2 - 4x_1x_3 - 8x_2x_3 + 12x_1x_2$ is (1) 0 (2) 1 (3) 2 (4) 3
72.	The value of $\int_0^\infty x^4 e^{-x} \, dx$ is (1) 2 (2) 4 (3) 6 (4) 12
73.	What is the value of $\lim_{x \to 0} \dfrac{a^x - 1}{x}$? (1) Log $(a-1)$ (2) $\log_e (a)$ (3) $a \log_e (a)$ (4) $a/\log_e (a)$

Question No.	Questions
74.	Certain values of x and y are as given below : | X	0	0.25	0.5	0.75	1.0
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y	1.0	0.9394	0.7788	0.5694	0.3678	 According to Simpson's $(1/3)^{rd}$ rule what is the value of $\int_0^1 y\, dx$? (1) 0.7429 (2) 0.7457 (3) 0.7467 (4) 0.7477
75.	If $u = x^3 - 3xy^2$, then what is the value of $f(z)$, if $z = x + iy$? (1) z^3 (2) $z^3 - ic$ (3) $z^3 + ic$ (4) ic
76.	If $f(z)$ is a continuous function in a region D and if the integral $\int f(z)\, dz$ taken round any simple closed contour in D is zero then $f(z)$ is an analytic function inside D. This theorem is due to (1) Morea (2) Cauchy (3) Lio-Ville (4) Laurent
77.	If a function $f(z)$ is analytic for all finite values of z and $|z| \to \infty$, and $|f(z)| = A\,(|z|^k)$, then $f(z)$ is a polynomial of degree (1) $< k$ (2) $\leq k$ (3) $> k$ (4) $\geq k$

Question No.	Questions
78.	If $f(z) = \dfrac{z^4 + 2z^3 + 3z^2 + 4z + 5}{z^2}$, then (1) $z = 0$ is a pole of order 1 (2) $z = 0$ is a pole of order 2 (3) $z = 0$ is a pole of order 3 (4) $z = 0$ is a pole of order 4
79.	For the series, 29, 12, 26, 19, 24, 36, 21, 33, and 35; the value of the firs quartile is (1) 20 (2) 21 (3) 22 (4) 23
80.	Given $\dfrac{dy}{dx} = y^2 + 1$, $y(0) = 0$. What is $y(0.2)$? (1) 0.187 (2) 0.194 (3) 0.198 (4) 0.203
81.	The Upper Confidence Level and Lower Confidence Level of a particula process is given as 12 and 8 respectively. If variance of the process i given as 16, then what is the sampel size of the process ? (1) 36 (2) 28 (3) 25 (4) 18
82.	If $X \sim$ Poisson (4) and $Y \sim$ Poisson (3), and X and Y are independent. What the value of $E[X \mid (X + Y)]$, if $n = 10$? (1) 3.45 (2) 4.32 (3) 5.23 (4) 5.71

Question No.	Questions
83.	The value of m so that the vector (m, 3, 1) is a linear combination of the vectors (3, 2, 1) and (2, 1, 0) is : (1) 1 (2) 3 (3) 5 (4) 7
84.	Given the following statements about a one parameter exponential family of distribution : I. It always admits sufficient statistics. II. The moment estimator $\hat{\theta}$ based on sufficient statistics is CAN for θ. III. The asymptotic variance zero every time. Which of the above are correct : (1) Only I and II are correct (2) Only I and III are correct (3) Only II and III are correct (4) All are correct
85.	If the mean value function of a renewal proces is m(t) = 2t, t $\geq$ 0, what is the value of M (T) ? (1) 2 (2) t (3) t^2 (4) $2t^2$
86.	The following statements given in respect of Maximum Likelihood Estimation (MLE) : I. MLE's are always unique. II. MLE's are not necessarily unbiased III. MLE's satisfies invariance property, provided the transformation is one-to-one. Which of the above are correct : (1) Only I and II are correct (2) Only I and III are correct (3) Only II and III are correct (4) All are correct

Question No.	Questions
87.	Consider the following statements : I. Least square estimators are unbiased for all general linear models II. Under fairly general conditions, the estimates obtained by method of moments will have asymptotically normal distribution for large n. III. The minimum chi-square estimators are not necessarily consistent. Which of the above are correct ? (1) Only I and II are correct (2) Only I and III are correct (3) Only II and III are correct (4) All are correct
88.	The matrix $\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$ is (1) Positive definite (2) Negative definite (3) Positive semi definite (4) Negative semi definite
89.	Let $N(t)$ be a Poisson process with constant intensity function on R. What is the covariance of $N(s)$ and $N(t)$? (1) λs, if $s < t$ (2) $\lambda (t\text{-}s)$, if $s < t$ (3) $\lambda (s\text{-}t)$, if $(t < s)$ (4) $\lambda (s+t)$
90.	A bag contains 5 black, 6 red and 3 white balls. If a ball is drawn at random, what is the probability that it is not a white ball ? (1) 11/14 (2) 13/14 (3) 38/55 (4) 27/35
91.	The following values of the function $f(x)$ for values of x are given : $f(1) = = 4$, $f(2) = 5$, $f(7) = 5$, and $f(8) = 4$. What is the value of $f(6)$? (1) 5.13 (2) 5.28 (3) 5.67 (4) 5.88

Question No.	Questions
92.	If Δ and E are the difference operators defined as usual, then what is the value of $\dfrac{\Delta^2}{E^2}$? (1) $\dfrac{1}{E^2} - \dfrac{2}{E}$ (2) $\dfrac{1}{E^2} - \dfrac{2}{E} - 1$ (3) $\dfrac{1}{E^2} - \dfrac{2}{E} + 1$ (4) $\dfrac{1}{E^2} + \dfrac{2}{E} + 1$
93.	Given $y_0 = -12$, $y_2 = 4$, $y_3 = 6$, and $y_4 = 12$. What is the value of y_1 using Newton's Formula ? (1) 0 (2) 1 (3) 2 (4) 3
94.	A magazine claims that 25% of its readers are college students. Of a random sample of 200 readers, 42 are college students. It is to be tested at a 0.10 level of significance whether the proportion of college students among all the readers of the magazine is not equal to 0.25. What is the conclusion ? (1) The proportion of college students among the readers of the magazine is 0.25 (2) The sample data are incorrect (3) The proportion of college students among the readers of the magazine is less than 0.25 (4) The proportion of college students among the readers of the magazine is more than 0.25
95.	The variance of Hyper geometric distribution with $N = 20$, $n = 5$ and $M = 12$ is given by (1) 1.34 (2) 1.28 (3) 1.02 (4) 0.95

Question No.	Questions
96.	A random sample of 100 articles are taken from a batch of 2000 articles shows that the average diameter of the articles is 0.354 and standard deviation 0.048. What is the 95% confidence interval for the average diameter of the batch ? (1) (0.2934, 0.4235) (2) (0.3448, 0.3632) (3) (0.3021, 0.3824) (4) (0.3923, 0.4212)
97.	A multiple regression relationship contains two independent variables. The standard error of estimate is 4.8 and error sum of squares is 576. What is the sample size ? (1) 24 (2) 25 (3) 26 (4) 28
98.	Given the following joint density function : $f(x, y) = \lambda^2 e^{-\lambda y}, \ 0 \leq x \leq y < \infty$ What is $E(Y \mid X)$? (1) $x + 1/\lambda$ (2) $x - 1/\lambda$ (3) $2x + \lambda$ (4) $2x - \lambda$
99.	Let X has the distribution function $$F(x) = \begin{cases} 0, & x < 0, \\ x/2, & 0 \leq x \leq 2, \\ 1, & x > 2. \end{cases}$$ Let $Y = X^2$, then what is the value of $P(X \leq 2Y)$? (1) 1/2 (2) 2/3 (3) 3/4 (4) 4/7
100.	The percent of total variation of the dependent variable Y explained by the set of independent variable X is measured by (1) Coefficient of correlation (2) Coefficient of skewness (3) Coefficient of determination (4) Standard error

(MPH/PHD/URS–EE–2019)
Subject : STATISTICS

Code **D**

Sr. No. **10008**

SET–"X"

Time : 1¼ Hours   Total Questions : 100   Max. Marks : 100

Roll No. _____ (in figure) _____ (in words)

Name : _____   Father's Name : _____

Mother's Name : _____   Date of Examination : _____

_____
(Signature of the candidate)

_____
(Signature of the Invigilator)

CANDIDATES MUST READ THE FOLLOWING INFORMATION/ INSTRUCTIONS BEFORE STARTING THE QUESTION PAPER.

1. Candidates are required to attempt any 75 questions out of the given 100 multiple choice questions of 4/3 marks each. No credit will be given for more than 75 correct responses.

2. The candidates must return the Question book-let as well as OMR answer-sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means / mis-behaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.

3. Keeping in view the transparency of the examination system, carbonless OMR Sheet is provided to the candidate so that a copy of OMR Sheet may be kept by the candidate.

4. Question Booklet along-with answer key of all the A, B, C and D code shall be got uploaded on the university website after the conduct of Entrance Examination. In case there is any discrepancy in the Question Booklet/Answer Key, the same may be brought to the notice of the Controller of Examination in writing/through E. Mail within 24 hours of uploading the same on the University Website. Thereafter, no complaint in any case, will be considered.

5. The candidate MUST NOT do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question book-let itself. Answers MUST NOT be ticked in the Question book-let.

6. There will be no negative marking. Each correct answer will be awarded 4/3 mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.

7. Use only Black or Blue **BALL POINT PEN** of good quality in the OMR Answer-Sheet.

8. BEFORE ANSWERING THE QUESTIONS, THE CANDIDATES SHOULD ENSURE THAT THEY HAVE BEEN SUPPLIED CORRECT AND COMPLETE BOOK-LET. COMPLAINTS, IF ANY, REGARDING MISPRINTING ETC. WILL NOT BE ENTERTAINED 30 MINUTES AFTER STARTING OF THE EXAMINATION.

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19.	Let X has the distribution function $\quad F(x) = \begin{cases} 0, & x < 0, \\ x/2, & 0 \leq x \leq 2, \\ 1, & x > 2. \end{cases}$ Let $Y = X^2$, then what is the value of $P(X \leq 2Y)$? (1) 1/2 (2) 2/3 (3) 3/4 (4) 4/7
20.	The percent of total variation of the dependent variable Y explained by the set of independent variable X is measured by (1) Coefficient of correlation (2) Coefficient of skewness (3) Coefficient of determination (4) Standard error
21.	Which one is the improper prior for p, the probability of success in Bernoulli distribution ? (1) $g(p) = 1$ (2) (B) $g(p) = \dfrac{1}{\beta(a, b)} \, p^{a-1}(1-p)^{b-1}, \ a > 0, \ b > 0$ (3) $g(p) = 2p$ (4) $g(p) = c, \ c \neq 1$

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22.	If $A = \begin{bmatrix} 3 & -7 \\ -4 & 1 \end{bmatrix}$, then the determinant of $A^3 + 3A^2 + 12A$ is (1) -2900 (2) -29500 (3) -3000 (4) -39500
23.	The Cramer-Rao lower bound for $\Psi(\theta) = e^{-\theta}$ in Poisson distribution with parameter θ is (1) $\dfrac{\theta}{n} e^{-2\theta}$ (2) $\dfrac{n}{\theta} e^{-2\theta}$ (3) $\dfrac{2\theta}{n} e^{-2\theta}$ (4) $\dfrac{\theta^2}{n} e^{-2\theta}$
24.	Let $X_1, X_2, \ldots, X_n$ be iid Poisson (μ). Then the UMVUE of $P(X = 0)$ is (1) $\left(1 - \dfrac{1}{\overline{X}}\right)^n$ (2) $\left(1 - \dfrac{n}{\overline{X}}\right)^n$ (3) $\left(1 - \dfrac{1}{n}\right)^{\Sigma x}$ (4) $\left(1 - \dfrac{1}{n}\right)^{\overline{x}}$
25.	If 3, 8, 5, 4 and 10 are exponential samples with mean θ. Then the score function evaluate at $\theta = 4$ is (1) 0.36 (2) 0.40 (3) 0.56 (4) 0.68

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26.	Consider the following statements : I. For an estimator to be consistent, the unbiasedness of the estimator is necessary II. If the variance of an estimator attains the Crammer-Rao lower bound, the estimator is consistent. III. A UMVUE is unique, if it exists Which of the above are correct ? (1) Only I is correct (2) Only II is correct (3) Only III is correct (4) None is correct
27.	If 12, 18, 8, 22, and 15 are random samples for $N(\mu, \sigma^2)$. An unbiased estimator of σ^2 is Given by (1) 20 (2) 25 (3) 29 (4) 33
28.	One of the eigenvalues of the given matrix is : $$\begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$$ (1) 2 (2) 3 (3) 5 (4) 10
29.	The range of the real values of x satisfying $8 - 3x \leq 5$ and $4x + 5 \leq -7$ is (1) (–3, 1) (2) (–1, 1) (3) (0, 3) (4) empty

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30.	The 2 × 2 matrix corresponding to the complex number 3 + 5i is (1) $\begin{bmatrix} 3 & 5 \\ 5 & 3 \end{bmatrix}$ (2) $\begin{bmatrix} -3 & 5 \\ 5 & -3 \end{bmatrix}$ (3) $\begin{bmatrix} 3 & -5 \\ 5 & -3 \end{bmatrix}$ (4) $\begin{bmatrix} 3 & -5 \\ 5 & 3 \end{bmatrix}$
31.	The Upper Confidence Level and Lower Confidence Level of a particular process is given as 12 and 8 respectively. If variance of the process is given as 16, then what is the sampel size of the process ? (1) 36 (2) 28 (3) 25 (4) 18
32.	If X~ Poisson (4) and Y~ Poisson (3), and X and Y are independent. What is the value of E [X	(X + Y)], if n = 10 ? (1) 3.45 (2) 4.32 (3) 5.23 (4) 5.71
33.	The value of m so that the vector (m, 3, 1) is a linear combination of the vectors (3, 2, 1) and (2, 1, 0) is : (1) 1 (2) 3 (3) 5 (4) 7
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39.	Let $N(t)$ be a Poisson process with constant intensity function on R. Wh is the covariance of $N(s)$ and $N(t)$? (1) λs, if $s < t$ (2) $\lambda (t-s)$, if $s < t$ (3) $\lambda (s-t)$, if $(t < s)$ (4) $\lambda (s+t)$
40.	A bag contains 5 black, 6 red and 3 white balls. If a ball is drawn at rando what is the probability that it is not a white ball ? (1) 11/14 (2) 13/14 (3) 38/55 (4) 27/35
41.	Consider the following regression problem : $Y_i = \alpha + \beta_i + \epsilon_i$; $i = 1, 2, ...,$ Here ϵ_i ; $i = 1, 2, ..., n$, are i.i.d. $N(0, 1)$ random variables. It is assum that $\alpha \neq 0$ and β is known. If $\hat{\alpha}_n$ is the MLE of α, which of the followi statements is true ? (1) $\lim_{n \to \infty} E(\hat{\alpha}_n) \neq \alpha$ (2) $\lim_{n \to \infty} E(\hat{\alpha}_n) = 0$ (3) $\lim_{n \to \infty} V(\hat{\alpha}_n) = \infty$ (4) $\lim_{n \to \infty} V(\hat{\alpha}_n) = 0$

Question No.	Questions
42.	Let $X_1, X_2, ..., X_n$ be a random sample from $f(x, \theta)$, a probability density function or a probability mass function. Define $(n-1) s_n^2 = \sum_{i=1}^{n} (X_i - \overline{X}_n)^2$, where $\overline{X}_n$ is a sample mean. Then s_n^2 is unbiased for θ if (1) $f(x, \theta) = \dfrac{e^{-\theta} \theta^x}{x!}$, $x = 0, 1, ..., $ and $\theta > 0$ (2) $f(x, \theta) = \dfrac{e^{-\frac{x}{\theta}}}{\theta}$, $x > 0, \theta > 0$ (3) $(x, \theta) = \theta\, e^{-\theta x}$, $x > 0, \theta > 0$ (4) none of the above
43.	Let $X_1, X_2, ..., X_n$ be a random sample from uniform $U(\theta - 5, \theta - 3)$ distribution. Let $X_{(1)}$ and $X_{(n)}$ denote the smallest and largest of the sample values. Then which of the following is true ? (1) $(X_{(1)}, X_{(n)})$ is complete sufficient for θ (2) $X_1 + X_2 - 2X_3$ is an ancillary statistic (3) $X_{(n)} + 3$ is unbiased for θ (4) $X_{(1)} +$ is not consistent for θ
44.	A simple random sample (without replacement) of size n is drawn from a finite population of size N (>6). What is the probability that the 4th population unit is included in the sample but the 6th population unit is not included in the sample ? (1) $\dfrac{n(n-1)}{N(N-1)}$ (2) $\dfrac{n(N-n)}{N(N-1)}$ (3) $\dfrac{(n-1)(N-n+1)}{N(N-1)}$ (4) n/N

Question No.	Questions
45.	Consider the following statements : I. The bias of ratio estimator for population mean becomes zero if th regression of Y on X passes through the origin. II. The ratio estimator of population mean is more efficient than samp mean when the correlation coefficient between X and Y is great than zero. Which of the above statements is/are correct ? (1) I only (2) II only (3) Both I and II (4) Neither I nor II
46.	The unbiased estimator of population total Y due to Horvitz and Thompso is (1) $\sum_{i \in S} \dfrac{Y_i}{1 - \pi_i}$ (2) $\sum_{i \in S} \dfrac{Y_i}{\pi_i}$ (3) $N \sum_{i \in S} \dfrac{Y_i}{1 - \pi_i}$ (4) $N \sum_{i \in S} \dfrac{Y_i}{\pi_i}$
47.	Which one of the following is a correct statement ? (1) The regression estimator is superior to the mean per unit estimato in some cases. (2) The regression estimator and the mean per unit estimator both bein equally efficient if $\rho = 0$. (3) Regression estimator is always better than ratio estimator. (4) The regression estimator will, in general be more efficient than th post-stratified estimator.

Question No.	Questions
48.	The pgf of a certain distribution is given as $P(s) = 3s^2 - 2s + 6$. What is the mean of this distribution ? (1) 2 (2) 3 (3) 4 (4) 5
49.	Three samples of 5, 4, and 5 motor car tyres are drawn respectively from three brands P, Q, and R manufactures by the three machines. The life time of these tyres (in '000 miles) are given below : P : 45 42 43 44 42 Q : 41 40 42 43 R : 44 42 38 43 39 What is the mean sum of squares between samples ? (1) 5.7 (2) 6.2 (3) 7.9 (4) 8.7
50.	A test which minimizes two types of errors is called : (1) minimax test (2) optimum test (3) unbiased test (4) similar test
51.	A car manufacturer had to recall the lot produced from one of its assembly line over a specific period of time due to quality-control problems that were not discovered during final inspection procedures. This is an example of (1) Type I error (2) Type II error (3) Both (1) and (2) (4) Neither (1) nor (2)

Question No.	Questions
52.	The number of runs in XYYXYXX is : (1) 2 (2) 3 (3) 4 (4) 5
53.	You have carried out a one way ANOVA. There are significant differences between the three groups you are testing. How might you conduct your pairwise comparisons ? (1) F test (2) Least significance differences (LSD) (3) Z test (4) Chi-square test
54.	Suppose there is interest in comparing the median response time for three independent groups learning a specific task. The appropriate nonparameteric procedure is (1) Kruskal-Wallis (2) Wilcoxon Signed-Rank (3) Run test (4) Sign test
55.	What is the value of $2x^{(4)} + 3x^{(2)} + x^{(1)} - 7$ evaluated at $x = 5$? (1) 289 (2) 294 (3) 298 (4) 302
56.	Degrees of freedom for chi-square in case of contingency table of order (4×3) are : (1) 12 (2) 9 (3) 8 (4) 6
57.	A small sample has been taken from a normally distributed population and the sample mean has been found to be 62. The upper limit of a 95 percent confidence interval for population mean is 81.60. The population variance is known to be 2,400. What is the sample size ? (1) 24 (2) 30 (3) 36 (4) 64

Question No.	Questions
58.	Consider the following results on a correlation study : Regression equations : $6y = 5x + 90$ and $15x = 8y + 130$ and Variance of $X = 4$. What is the coefficient of correlation betwene X and Y ? (1) 0.45 (2) 0.67 (3) 0.78 (4) 0.88
59.	Basu's theorem is useful in determining the statistic V which is (1) Independent of sufficient statistic T (2) Linear function of U and T (3) Monotone in U for fixed t (4) None of these
60.	The nonparameteric test equivalent of a one-way ANOVA is (1) Wilcoxon Signed Rank test (2) Wilcoxon Rank Sum Test (3) Kruskall-Wallis Test (4) Ansari-Bradley test
61.	The Rank of the quadratic form : $2x_1^2 + x_2^2 - 3x_3^2 - 4x_1x_3 - 8x_2x_3 + 12x_1x_2$ is (1) 0 (2) 1 (3) 2 (4) 3
62.	The value of $\int_0^\infty x^4 e^{-x}\, dx$ is (1) 2 (2) 4 (3) 6 (4) 12

Question No.	Questions
63.	What is the value of $\lim_{x \to 0} \frac{a^x - 1}{x}$? (1) Log (a – 1) (2) $\log_e$ (a) (3) a $\log_e$ (a) (4) a/$\log_e$ (a)
64.	Certain values of x and y are as given below : | X	0	0.25	0.5	0.75	1.0
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y	1.0	0.9394	0.7788	0.5694	0.3678	 According to Simpson's (1/3)rd rule what is the value of $\int_0^1 y\, dx$? (1) 0.7429 (2) 0.7457 (3) 0.7467 (4) 0.7477
65.	If u = x^3 – 3xy^2, then what is the value of f(z), if z = x + iy ? (1) z^3 (2) z^3 – ic (3) z^3 + ic (4) ic
66.	If f(z) is a continuous function in a region D and if the integral $\int$ f(z) dz taken round any simple closed contour in D is zero then f(z) is an analytic function inside D. This theorem is due to (1) Morea (2) Cauchy (3) Lio-Ville (4) Laurent

Question No.	Questions
67.	If a function $f(z)$ is analytic for all finite values of z and $|z| \to \infty$, and $|f(z)| = A\,(|z|^k)$, then $f(z)$ is a polynomial of degree (1) $< k$ (2) $\leq k$ (3) $> k$ (4) $\geq k$
68.	If $f(z) = \dfrac{z^4 + 2z^3 + 3z^2 + 4z + 5}{z^2}$, then (1) $z = 0$ is a pole of order 1 (2) $z = 0$ is a pole of order 2 (3) $z = 0$ is a pole of order 3 (4) $z = 0$ is a pole of order 4
69.	For the series, 29, 12, 26, 19, 24, 36, 21, 33, and 35; the value of the first quartile is (1) 20 (2) 21 (3) 22 (4) 23
70.	Given $\dfrac{dy}{dx} = y^2 + 1$, $y(0) = 0$. What is $y(0.2)$? (1) 0.187 (2) 0.194 (3) 0.198 (4) 0.203

Question No.	Questions
71.	If $n = 15$, $\sum x = 480$, $\sum x^2$, then the standard deviation of $y = 5x - 10$ is (1) 100 (2) 96.82 (3) 47.56 (4) 112.88
72.	Let X_1, X_2, ... be iid Poisson (λ) random variables. If $S_n = \sum_{k=1}^{n} X_k$. If $\lambda = 1$ and $n = 64$, then The value of $P\{50 < S_n < 80\}$ is approximately (1) 0.7329 (2) 0.8321 (3) 0.7884 (4) 0.9348
73.	Consider a discrete classification with n_1, n_2, n_3, n_4 as the number of observations in each cell such that $\sum_{i=1}^{3} n_i = n$. The cell probabilities are respectively given as θ^2, $\theta(1-\theta)$, $\theta(1-\theta)$ and $(1-\theta)^2$. What is the MLE of θ is (1) $\dfrac{n_4}{2n}$ (2) $\dfrac{2n_1 + n_2}{n_1 + n_3}$ (3) $\dfrac{2n_1 + n_3}{n_1 + n_2 + n_4}$ (4) $\dfrac{2n_1 + n_2 + n_3}{2n}$

Question No.	Questions
74.	Let X be a random variable having the probability function : $$f(x, \theta) = \binom{n}{x} \theta^x (1-\theta)^{n-x}, \quad x = 0, 1, 2, \ldots, n.$$ If $d(x) = \dfrac{x}{n}$, then the risk function $R(\theta, d)$ under squared error loss function is :
	(1) $\dfrac{\theta(\theta-1)}{n}$ (2) $\dfrac{\theta(\theta+1)}{n}$
	(3) $\dfrac{\theta(1-\theta)}{n}$ (4) $\dfrac{\theta^2}{n}$
75.	Let $X_1, X_2, \ldots$ be iid Bernoulli with parameter (λ). If apriori it is known that $\lambda \in [1/4, 3/4]$. If $\overline{X} \geq \dfrac{3}{4}$. What is the MLE of λ ?
	(1) 1/4 (2) 1/2
	(3) 3/4 (4) 1
76.	After taking a sample and computing $\overline{x}$, a statistician says that he is 88% confident that the population mean lies between 106 and 122. What does he really mean ?
	(1) The probability is 0.88 that $\mu = 114$, the midpoint of the interval
	(2) The probability is 0.88 that μ is between 106 and 122
	(3) 88% of the intervals calculated from samples of this size will contain μ
	(4) Both (2) and (3)

Question No.	Questions
77.	The measure of Kurtosis of t-distribution is (1) $\dfrac{n-2}{n-3}$ (2) $\dfrac{3(n-2)}{n-4}$ (3) $\dfrac{3(n-2)}{n+4}$ (4) $\dfrac{n+2}{n+4}$
78.	For a particular hypothesis test, the probabilities of type I and II error are respectively, 0.05 and 0.09. The power of this test is (1) 0.95 (2) 0.14 (3) 0.86 (4) 0.91
79.	Let $X_1, X_2, \ldots X_n$ be iid with $f(x) = \theta x^{\theta-1}, 0 < x < 1, \theta > 0$. Then the Cramer Rao Lower Bound for estimating $\dot\theta$ is (1) $n\theta$ (2) $\dfrac{\theta}{n}$ (3) $\dfrac{\theta^2}{n}$ (4) $\dfrac{\theta^2}{n^2}$
80.	For a queuing model of M/M/1(∞)/FCFS model, the probability of n$^\text{t}$ realization is obtained as (1) $\rho^n(1-\rho)$ (2) $\rho(1-\rho)$ (3) $\rho(1-\rho)^n$ (4) $\rho^n(1-\rho)^{n-1}$
81.	Every sequence $\{X_n\}$ of independent random variables with uniformly bounded variances obeys (1) Borel-Cantelli lemma (2) Cauchy's criterion (3) WLLN (4) SLLN

Question No.	Questions
82.	If V be a collection of vectors, then V is said to be subspace, if (1) V is closed under multiplication (2) V is closed under multiplication and addition (3) V is closed under scalar multiplication (4) V is closed under addition and scalar multiplication
83.	Let X be a random variable with pgf P(S). Then the pgf of 3X–1 is (1) SP(S) (2) S/P(S) (3) P(S)/S (4) $P(S^3)/S$
84.	The relationship between number of beers consumed (x) and blood alcohol content (y) was studied in 16 male college students by using least squares regression. The following regression equation was obtained from this study : $y\hat{} = -0.0127 + 0.0180 x$. The above equation implies that : (1) each beer consumed increases blood alcohol by 1.27% (2) on average it takes 1.8 beers to increase blood alcohol content by 1% (3) each beer consumed increased blood alcohol by an average of amount of 1.8% (4) None of these.
85.	With the usual notations, find p for a binomial random variable X, if $n = 6$ and if $9 P (X = 1) = P (X = 2)$. (1) 12/15 (2) 18/23 (3) 19/27 (4) 9/14
86.	The quadratic form $6x_1^2 + 3x_2^2 + 14x_3^2 + 4x_2 x_3 + 18x_1 x_3 + 4x_1 x_2$ is (1) Negative definite (2) Positive definite (3) Positive semi definite (4) Negative semi definite

Question No.	Questions
87.	Let T be CAN for θ so that $T \sim AN\ (\theta, \sigma^2_T(\theta)/a_n^2)$ and let Ψ be a differentiab function such that $\dfrac{d\Psi}{d\theta}$ is continuous and non vanishing then $\Psi(T)$ is CA for $\Psi(\theta)$ with asymptotic variance : (1) $\left(\dfrac{d\Psi}{d\theta}\right)^2 \sigma^2_T(\theta)$ $\qquad$ (2) $\left(\dfrac{d\Psi}{d\theta}\right)^2 a_n^2\,\sigma^2_T(\theta)$ (3) $\left(\dfrac{d\Psi}{d\theta}\right)^2 \dfrac{\sigma^2_T(\theta)}{a_n^2}$ $\qquad$ (4) $\left(\dfrac{d\Psi}{d\theta}\right)^2 \cdot \dfrac{\sigma^4_T(\theta)}{a_n^4}$
88.	If the percent of trend for a year in a time series is greater than 100 it indicates that (1) The actual time series value lies below the trend line and the relati cyclical residual is positive (2) The actual time series value lies below the trend line and the relati cyclical residual is negative (3) The actual time series value lies above the trend line and the relati cyclical residual is negative (4) The actual time series value lies above the trend line and the relati cyclical residual is positive
89.	If 3, 8, 5, 4 and 10 are exponential samples with mean θ. The Fish information function evaluated at $\theta = 2$ is (1) 0.50 $\qquad$ (2) 0.80 (3) 1.20 $\qquad$ (4) 1.25
90.	The ratio of number of replication required in CRD and RBD for the sar amount of information is (1) 3:2 $\qquad$ (2) 5:3 $\qquad$ (3) 5:4 $\qquad$ (4) 3:5

Question No.	Questions
91.	If quartile deviation of a set of observations is given as 6.4 and the value of first quartile is 5. What is the value of the third quartile ? (1) 12 (2) 15.3 (3) 17.8 (4) 20.2
92.	The mean and median of a non-symmetric distribution is 16 and 18 respectively. If standard deviation is 5, then the skewness of the distribution is (1) 0 (2) –1.2 (3) 1.5 (4) 2.1
93.	Suppose X follows a Normal distribution with mean 50 and variation 25. What is the standard score corresponds to 58 ? (1) 1.2 (2) 1.6 (3) 1.8 (4) 2.1
94.	If the p-value of the test is larger than the level of significance, it indicates (1) Strong evidence in support of alternative hypothesis (2) Strong evidence against alternative hypothesis (3) Strong evidence in support of null hypothesis (4) Strong evidence against null hypothesis
95.	Consider the following statements : I. If S is closed and δ is admissible, then every risk function is convex II. If S is closed, then S will not have a limit point III. If S is closed from below, then $S \notin E_k$ Which of the above is correct ? (1) Only I is correct (2) Only II is correct (3) Both I and II is correct (4) Both II and III is correct

Question No.	Questions
96.	In the analysis of RBD with b blocks and v treatments, the error degr of freedom are (1) b (v − 1) (2) v (b − 1) (3) (b − 1) (v − 1) (4) b (v − 1)
97.	Consider the following statements : I. A complete class of decision rules contains only admissible decis rules II. A minimal complete class of decision rule contains only admiss decision rules III. A minimal complete class of decision rule is always complete Which of the above is correct ? (1) Only I is correct (2) Only II is correct (3) Both I and II is correct (4) Both II and III is correct
98.	The special case of Birth-Death process with $\lambda_n = n\lambda$ and there is no dea is called the _____ process (1) Immigration (2) Poisson Process (3) Linear growth (4) Yule-Furry
99.	Wishart distribution is a generalization of (1) Normal distribution (2) t-distribution (3) Chi-square distribution (4) Beta distribution
100.	Let $\{X_n, Y_n\}$, n = 1, 2, ..., be a sequence of random variables. Th $\|X_n - Y_n\| \xrightarrow{P} 0$ and $Y_n \xrightarrow{L} Y$ implies (1) $X_n \xrightarrow{L} X$ (2) $X_n \xrightarrow{L} Y$ (3) $Y_n \xrightarrow{L} X$ (4) $X_n Y_n \xrightarrow{L} Y$

Answer Key of M.Phil/Ph.D 2019 (Statistics)

Sr. No.	Set A	Set B	Set C	Set D
1	3	1	2	4
2	2	4	4	3
3	2	3	4	3
4	4	1	3	2
5	1	3	3	4
6	3	3	3	4
7	4	1	2	3
8	2	3	1	4
9	3	1	3	1
10	2	1	1	4
11	1	4	4	3
12	4	1	4	3
13	3	2	4	1
14	1	2	3	1
15	3	1	2	4
16	3	2	2	2
17	1	2	3	4
18	3	3	4	1
19	1	1	4	3
20	1	3	2	3
21	4	4	3	4
22	4	3	2	2
23	4	3	2	1
24	3	2	4	3
25	2	4	1	2
26	2	4	3	3
27	3	3	4	3
28	4	4	2	2
29	4	1	3	4
30	2	4	2	4
31	4	3	4	1
32	2	3	1	4
33	1	1	2	3
34	3	1	2	1
35	2	4	1	3
36	3	2	2	3
37	3	4	2	1
38	2	1	3	3
39	4	3	1	1
40	4	3	3	1
41	2	4	4	4
42	4	2	4	1
43	4	1	2	2
44	3	3	1	2
45	3	2	3	1
46	3	3	4	2
47	2	3	2	2
48	1	2	2	3
49	3	4	1	1
50	1	4	3	3
51	3	4	4	4
52	3	4	2	4
53	1	4	1	2
54	1	3	3	1

55	4	2	2	3
56	2	2	3	4
57	4	3	3	2
58	1	4	2	2
59	3	4	4	1
60	3	2	4	3
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87	2	4	1	3
88	2	2	3	4
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91	4	4	3	3
92	1	3	3	2
93	2	2	1	2
94	2	3	1	4
95	1	3	4	1
96	2	1	2	3
97	2	2	4	4
98	3	2	1	2
99	1	1	3	3
100	3	4	3	2