Hall Ticket Number

Q.B. No. 100025

Booklet Code : **A**

Marks : 100

DL-323-STAT

Time : 120 Minutes

Paper-II

Signature of the Candidate

Signature of the Invigilator

INSTRUCTIONS TO THE CANDIDATE
(Read the Instructions carefully before Answering)

1. Separate Optical Mark Reader (OMR) Answer Sheet is supplied to you along with Question Paper Booklet. Please read and follow the instructions on the OMR Answer Sheet for marking the responses and the required data.
2. The candidate should ensure that the **Booklet Code printed on OMR Answer Sheet and Booklet Code supplied are same.**
3. **Immediately on opening the Question Paper Booklet by tearing off the paper seal, please check for *(i)* The same booklet code (A/B/C/D) on each page. *(ii)* Serial Number of the questions (1-100), *(iii)* The number of pages and *(iv)* Correct Printing.** In case of any defect, please report to the invigilator and ask for replacement of booklet with same code within five minutes from the commencement of the test.
4. Electronic gadgets like Cell Phone, Calculator, Watches and Mathematical/Log Tables are not permitted into the examination hall.
5. **There will be 1/4 negative mark for every wrong answer.** However, if the response to the question is left blank without answering, there will be no penalty of negative mark for that question.
6. Record your answer on the OMR answer sheet by using Blue/Black ball point pen to darken the appropriate circles of (1), (2), (3) or (4) corresponding to the concerned question number in the OMR answer sheet. Darkening of more than one circle against any question automatically gets invalidated and will be treated as wrong answer.
7. Change of an answer is **NOT** allowed.
8. Rough work should be done only in the space provided in the Question Paper Booklet.
9. **Return the OMR Answer Sheet and Question Paper Booklet to the invigilator before leaving the examination hall.** Failure to return the OMR sheet and Question Paper Booklet is liable for criminal action.

This Booklet consists of **17** Pages for **100** Questions **+2** page of Rough Work **+1** Title Page i.e. Total **20** pages

1. Let X and Y be two independent events with $P(X) = 0.3$ and $P(Y) = 0.4$, then probability that 'Y' occurs but 'X' does not is :

(1) 0.12 (2) 0.18

(3) 0.28 (4) 0.75

2. A problem is given to three students whose probabilities of solving independently are 1/2, 1/3 and 1/4 respectively. What is the probability that none of them solves the problem ?

(1) 3/10 (2) 5/7

(3) 2/7 (4) 7/10

3. The set of discontinuity points of a distribution function is :

(1) atmost countable (2) countable

(3) infinite (4) finite

4. The distribution of the heights of female college students approximated by a Normal Curve with a mean of 65 inches and a s.d. equal to 3 inches. What proportion of college female students are between 65 and 67 inches tall ?

(1) 0.75 (2) 0.5

(3) 0.25 (4) 0.17

5. A medical treatment has a success rate of 8 out of 10. Two patients will be treated with this treatment. Assuming the results are independent for the two patients, what is the probability that neither one of them will be successfully cured ?

(1) 0.04 (2) 0.5

(3) 0.36 (4) 0.32

6. Which of the following relations among Convergence of a sequence of random variables does *not* hold good ?

(1) Convergence in rth mean implies convergence in sth mean for $r > s$

(2) Convergence in probability implies convergence in mean.

(3) Almost sure convergence implies convergence in probability.

(4) Convergence in probability implies convergence in distribution.

7. The condition $V(T_n) \to 0$ as $n \to \infty$ for an unbiased estimator T_n to be a consistent estimator is :

(1) Sufficient only

(2) Necessary and sufficient

(3) Neither necessary nor sufficient

(4) Necessary only

8. If $X_1 X_2 ... X_n$ is a random sample of size 'n' drawn from a $N(\mu, \sigma^2)$. Population and $S^2 = \frac{1}{n-1}\sum_{i=1}^{n}(xi - \bar{x})^2$, then $V(S^2)$ is given by :

(1) $\frac{1}{n}\sigma^4$ (2) $\frac{2}{n}\sigma^4$

(3) $\frac{2}{(n-1)}\sigma^4$ (4) $\frac{1}{(n-1)}\sigma^4$

9. Which of the following theorem is known as classical central limit theorem ?

(1) Lindberg-Feller (2) Lindberg-Levy

(3) Liapunov (4) Demoivre-Laplace

10. Let $\{x_n\}$ be a sequence of *i.i.d* random variables and for $n \geq 1$, let $S_n = \sum_{K=1}^{n} X_k$. Then $\frac{S_n}{n} \xrightarrow{a.s.} \mu$ if and only if $|E(x)| < \infty$, where $\mu = E(x)$. Then by which name this law of large numbers is known as :

(1) Bernoulli's (2) Chebychev's

(3) Khintchine's (4) Kolmogorov's

11. Let $X_1\ X_2\ ...\ X_n$ be a random sample from a distribution with *c.d.f* F(.). For a fixed t, the estimator T_n for $F(t)$ defined by $T_n = \frac{1}{n}$ (Number of $X_i \leq t$) is :

(1) Consistent but not unbiased (2) Unbiased but not consistent

(3) Unbiased and consistent (4) Neither consistent nor unbiased

12. If $\hat{\theta}_1$ is a most efficient estimator and $\hat{\theta}_2$ is any other estimator with efficiency e, then the correlation coefficient between $\hat{\theta}_1$ and $\hat{\theta}_2$ is :

(1) e^2 (2) e^{-2}

(3) $e^{-1/2}$ (4) $e^{1/2}$

13. An aperiodic Markov chain with stationary transition probability on the state space {1, 2, 3, 4, 5} must have :

(1) At least one positive recurrent state

(2) At least one transient state

(3) At least one null recurrent state

(4) At least one positive recurrent and at least one null recurrent state

14. A right skewed continuous distribution used to determine the sampling distribution of the sample variance is the :

(1) Normal distribution (2) Chi-square distribution

(3) Binomial distribution (4) Uniform distribution

15. If $Y = 5X + 10$ and $X \sim N\ (12, 25)$, then mean of Y is :

(1) 50 (2) 60

(3) 70 (4) 135

16. Which of the following is *not* an example of a discrete probability distribution?

(1) The number of bedrooms in a house

(2) The number of bathrooms in a house

(3) The sale or purchase price of a house

(4) Whether or not a home has a swimming pool in it

17. If you roll a pair of dice, what is the probability that at least one of the dice is a 4 or the sum of the dice is :

(1) 13/36 (2) 14/36

(3) 16/36 (4) 15/36

18. In hypergeometric distribution, the trials are :

(1) Independent (2) Dependent

(3) Collectively Exhaustive (4) Additive

19. A random variable exponentially distributed with mean time between occurs is equal to 32 minutes. The probability that the time between the next two occurrences between 30 and 40 minutes is :

(1) 0.1051 (2) 0.2051

(3) 0.6051 (4) 0.7051

20. Service time at a fast food restaurant follows a Normal distribution, with a mean of 5 minutes and a s.d. of 1 minute. The restaurant's policy is that if a customer is not served within a maximum time period, they would not be charged for the food ordered. The management wishes to provide this incentive program to at most 10% of the customers. The maximum guaranteed waiting time should be set at :

(1) 6.28 min (2) 6.65 min

(3) 7.33 min (4) 6.96 min

21. Which of the following distribution is suitable to model the length of time that elapses before the first employee passes through the security door of a company ?

(1) Normal (2) Exponential

(3) Uniform (4) Poisson

22. The waiting time for an ATM machine is found to be uniformly distributed between 1 and 5 minutes. What is the probability of waiting between 2 and 4 minutes to use the ATM ?

(1) 0.20 (2) 0.25

(3) 0.50 (4) 0.75

23. If X, Y, Z denote three jointly distributed random variables with joint density function, then :

$$f(x,y,z) = \begin{cases} K(x^2 + yz); 0 \le x \le 1, 0 \le y \le 1, 0 \le Z \le 1 \\ 0; \quad \text{otherwise} \end{cases}$$

Then value of K is :

(1) 7/12 (2) 9/12

(3) 12/9 (4) 12/7

24. An unbiased estimator T_n is UMVUE for θ, then for every u.b.e. T_n^* of θ, which one is *true* ?

(1) $V_\theta(T_n) \ge V_\theta(T_n^*) \forall\theta$ (2) $V_\theta(T_n) \le V_\theta(T_n^*) \forall\theta$

(3) $V_\theta(T_n) = V_\theta(T_n^*) \forall\theta$ (4) $V_\theta(T_n) = V_\theta(T_n^*) = 1 \forall\theta$

25. If X_1, X_2, X_3 is a random sample of size 3 from a population with mean μ and variance σ^2, what is the value of λ for which $T_3 = 1/3\ (\lambda X_1 + X_2 + X_3)$ is an u.b.e. for μ ?

(1) 1/4 (2) 1/3

(3) 1/2 (4) 1

26. Let X be a random variable with density $f(x) = \frac{1}{2} \exp\{-|x|\}; -\infty < x < \infty$. Then the expected value of $|x|$ is :

(1) 1/2 (2) 0

(3) –1/2 (4) –1

27. Cramer Rao inequality gives :

(1) An upper bound for the variance of any estimator

(2) A lower bound for the variance of a most powerful estimator

(3) An upper bound for the variance of an u.b.e.

(4) A lower bound for the variance of an u.b.e.

28. An estimator with large variance is preferred in which one of the following ?

(1) X~Gamma (1, β) (2) X~U (0, θ)

(3) X~Gamma $(0, \frac{1}{\theta})$ (4) X~Gamma $(0, \frac{1}{\beta})$

29. Cramer Rao lower bound of variance for the parameter 'θ' of the distribution with p.d.f. $f(x, \theta) = \frac{1}{\pi} \frac{1}{1+(x-\theta)^2}$ where $-\infty < x < \infty$ is :

(1) $\frac{1}{n}$ (2) $\frac{2}{n}$

(3) $\frac{1}{n^2}$ (4) $\frac{2}{n^2}$

30. The least square method is applied to obtain :

(1) Best linear unbiased estimator (2) Residual error

(3) Biased estimator (4) Simple estimation

31. If X is a Poisson $(x; \lambda)$, then the sufficient statistic for λ is :

(1) λ_i (2) ΣX_i

(3) ΣX_i^2 (4) $\frac{1}{\Sigma X_i}$

32. If $X_1\ X_2\ .....\ X_n$ is a random sample from the uniform distribution $f(x;\ \theta) = \frac{1}{\theta} 0 < x < \theta$, then $Y = \max\ (X_1\ X_2\ .....\ X_n)$ is a :

(1) Sufficient estimator of θ (2) Consistent estimator of θ

(3) Efficient estimator of θ (4) Unbiased estimator of θ

33. Let $X_1\ X_2\ .....\ X_n$ be a random sample from a density $f(x;\ \theta)$. If $S = s(X_1\ X_2\ ......X_n)$ is a complete sufficient statistic and $T^1 = t$ (s), a function of S, is an unbiased estimate of $\tau(\theta)$, T^1 is .... of $\tau(\theta)$.

(1) UMVUE (2) BLUE

(3) an unbiased estimator (4) Bayes estimator

34. The average growth of a certain variety of pine tree is 10.1 inches in 3 years. A biologist claims that a new variety will have a greater growth in 3 years. A random sample of 25 of the new variety has an average 3 year growth of 10.8 inches and a s.d. of 2.1 inches. The appropriate null and alternative hypotheses to test the biologists claim are :

(1) $H_0 : \mu = 10.1$ (Vs) $H_1 : \mu < 10.1$

(2) $H_0 : \mu = 10.1$ (Vs) $H_1 : \mu \neq 10.1$

(3) $H_0 : \mu = 10.8$ (Vs) $H_1 : \mu > 10.8$

(4) $H_0 : \mu = 10.1$ (Vs) $H_1 : \mu > 10.1$

35. For testing $H_0 : \sigma = \sigma_0$ in a Normal population $N(0, \sigma^2)$, a critical region based on sample $X_1\ X_2\ ....X_n$ is $\Sigma X_i^2 < K$. Which alternative hypothesis provides uniformly most powerful test ?

(1) $\sigma > \sigma_0$ (2) $\sigma < \sigma_0$

(3) $\sigma^2 = \sigma_0^2$ (4) $\sigma \neq \sigma_0$

36. The claimed average life of electric bulbs is 2000 hours with a s.d. = 250 hours. To make 95% sure that the bulbs should not fall below the claimed average life by more than 5%, the sample size should be :

(1) 16 (2) 18

(3) 24 (4) 41

37. Consider the problem of testing H_0 : X~ Normal with mean 0 and variance ½ against H_1 : X~ Cauchy (0, 1). Then for testing H_0 against H_1, the most powerful size α Test :

(1) Does not exist

(2) Rejects H_0 if and only if $|x| < C_3$ where C_3 is such that the test is of size α

(3) Rejects H_0 if and only if $|x| < C_4$ or $|x| > C_5$, $C_4 < C_5$ where C_4 and C_5 are such that the test is of size α

(4) Rejects H_0 if and only if $|x| > C_2$ where C_2 is such that the test is of size α

38. Let X_1 X_2..............X_n be a random sample from uniform $(0, 5\theta)$, $\theta > 0$. Defining $X(1) = \text{Min}\ \{X_1\ X_2....X_n\}$ and $X_n = \text{Max}\ \{X_1, X_2.....X_n\}$. Then maximum likelihood estimator of θ is :

(1) $X_{(1)}/5$ (2) $X_{(n)}$

(3) $X_{(1)}$ (4) $X_{(n)}/5$

39. X_1 X_2 ...... X_n are independently and identically distributed random variables, which follow Binomial distribution $(1, p)$, to test $H_0 : p = 1/2$ (Vs) $H_1 : p = 3/4$, with size $\alpha = 0.01$, consider the test $\phi = \begin{cases} 1 & \text{if } \sum_{i=1}^{n} X_i > C_n \\ 0 & \text{otherwise} \end{cases}$, then which is *true* out of the following statements :

(1) As $n \to \infty$, Power of the test converges to one

(2) As $n \to \infty$, Power of the test converges twice

(3) As $n \to \infty$, Power of the test converges to half

(4) As $n \to \infty$, Power of the test converges to three-fourth

40. Consider a triangular region 'R', with vertices (0, 0), (0, θ,), (θ, 0) where $\theta > 0$. A sample of size n is selected at random from this region R. Denote the sample as $((X_i\ Y_i) : i = 1, 2\ .....\ n)$. Then denoting $X_{(n)} = \text{Max}\ \{X_1, X_2\ ....\ X_n\}$ and $Y_n = \text{Max}\ \{Y_1, Y_2.....Y_n\}$, which of the following statements is *true* ?

(1) $X_{(n)}$ and $Y_{(n)}$ are independent

(2) MLE of θ is $\dfrac{X_{(n)} + Y_{(n)}}{2}$

(3) MLE of θ is $\underset{1 \le i \le n}{\text{Max}}\ (X_i + Y_i)$

(4) MLE of θ is max $\{X_{(n)}, Y_{(n)}\}$

41. Neyman-Pearson lemma provides :

(1) An unbiased test (2) A most powerful test

(3) An admissible test (4) Sufficient test

42. If (X_1 X_2 .... X_n) is a random sample from U(0, θ), then the maximum likelihood estimator of θ is :

(1) Sample mean (2) Sample median

(3) Sample minimum (4) Sample maximum

43. Which of the following is the MLE of $P(X_1 \geq 1)$, given that $\{X_1, X_2 ......X_n\}$ is a random sample from the probability density function $f(x;\theta)=\frac{1}{\theta}\exp\left\{\frac{-x}{\theta}\right\}$; $x > 0$ and $x = 0$ otherwise ?

(1) $\exp\{-X\}$ (2) $1-\exp(-\bar{X})$

(3) $1-\exp\left\{-\frac{1}{\bar{X}}\right\}$ (4) $\exp\left\{-\frac{1}{\bar{X}}\right\}$

44. In Wilcoxon Mann-Whitney Test for two samples of sizes n_1 and n_2 the value of U could vary from :

(1) 0 to $n_1 n_2$ (2) 0 to $n_1 + n_2$

(3) Min (n_1, n_2) to $n_1 n_2$ (4) Min (n_1, n_2) to $n_1 + n_2$

45. What is the non-parametric equivalent to two way Analysis of variance ?

(1) Friedman test (2) Wald-Wolfowitz test

(3) Kruskal–Wallis test (4) Wilcoxon Mann–Whitney test

46. Ranks are not used in which of the following non-parametric tests ?

(1) Friedman test (2) Kolmogorov-Smirnov test

(3) Kruskal–Wallis test (4) Mann–Whitney U test

47. You have to conduct a study comparing Army, Navy and RAF Cadets on a measure of leadership skills. There are unequal group sizes and the data is skewed so you need to use a Non-parametric test; which test you choose ?

(1) Mann–Whitney test (2) Kruskal–Wallis test

(3) Wilcoxon test (4) Friedman test

48. The critical difference for multiple comparisons in Friedman's test with usual notation is :

(1) $Z\sqrt{\frac{rk^2(r+1)}{6}}$ (2) $Zr\sqrt{\frac{k(k+1)}{6}}$

(3) $ZK\sqrt{\frac{r(k+1)}{4}}$ (4) $Z\sqrt{\frac{rk(k+1)}{6}}$

49. Kruskal–Wallis test differs from that of Friedman test in respect of :

(1) Null Hypothesis about treatment effects

(2) Ranking procedures

(3) The distribution of test statistic

(4) Alternative hypothesis about the treatment effects

50. If the sample size in Wald–Wolfowitz runs test is large, the variate R is distributed with mean :

(1) $\frac{2m}{m+n}+1$ (2) $\frac{2n}{m+n}+1$

(3) $\frac{2mn}{m+n}+1$ (4) $\frac{2mn}{m+n}$

51. Relative efficiency in Non-parametric tests is the ratio of :

(1) Size of the samples   (2) Power of two tests

(3) Size of two tests   (4) Average statistics

52. What is the formula for Kruskal–Wallis based upon ?

(1) Ranks   (2) Deviations

(3) Means   (4) Categories

53. In a Wilcoxon's signed Rank test, the sample size is large, the statistic T^+ is distributed with mean :

(1) $n(n - 1)/4$ (2) $n(2n + 1)/4$

(3) $n(n + 1)/4$ (4) $n(n + 1)/2$

54. The Eigen values of the matrix [0 1 1; 10 1; 110] is :

(1) −1, 1 and 2   (2) 1, 1 and −2

(3) −1, −1 and 2   (4) 1, 1 and 2

55. PCA is used for :

(1) Supervised classification

(2) Unsupervised classification

(3) Semi-supervised classification

(4) Cannot be used for classification

56. The scatter matrix of the transformed feature vector is given by the expression under multivariate context :

(1) $\sum_{K=1}^{N}(x_k-\mu)(x_k-\mu)^1$ (2) $\sum_{K=1}^{N}(x_k-\mu)^1(x_k-\mu)$

(3) $\sum_{K=1}^{N}(\mu-x_k)(\mu-x_k)^1$ (4) $\sum_{K=1}^{N}(\mu-x_k)^1(\mu-x_k)$

57. Linear Discriminant Analysis is :

(1) Unsupervised learning (2) Supervised learning

(3) Semi-supervised learning (4) Problem specific

58. If S_w is singular and N < D, its rank is at most (N is total number of samples, D dimension of data, C is number of classes) :

(1) N + C (2) N

(3) C (4) N – C

59. Discriminant function in case of arbitrary covariance matrix and all parameters are class dependent is given by $(X^1W_iX + W_i^1X + W_{io}) = 0$, then the value of W is :

(1) $-\frac{1}{2}\sum_i^{-1}$ (2) $\sum_i^{1}\mu_i$

(3) $-\frac{1}{2}\sum_i^{-1}\mu_i$ (4) $-\frac{1}{4}\sum_i^{-1}$

60. The Eigen vectors of $\begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$ are :

(1) (1 1 1), (1 0 1) and (1 1 0) (2) (1 1 –1), (1 0 –1) and (1 1 0)

(3) (–1 1 –1), (1 0 1) and (1 1 0) (4) (1 1 1) (1 0 1) and (–1 1 0)

61. The K^{th} pair of canonical variables is the pair of linear combinations U_k and V_k having unit variances, which maximise the correlation among all choices that are uncorrelated with the :

(1) Previous (K − 1) Canonical variable pairs

(2) K Canonical variables

(3) (K + 1) pair of Canonical pair of variables

(4) (K + 3) pair of Canonical variables

62. For a Random sample of 9 persons, the average pulse rate is $\bar{x} = 76$ beats per minute, and the sample s.d. is s = 5, then standard error of the sample mean is :

(1) 0.557 (2) 0.745

(3) 1.667 (4) 2.778

63. If the sample sizes are small or the within stratum ratios are approximately equal it is better to use :

(1) Separate estimators (2) Combined ratio estimators

(3) Separate ratio estimators (4) Weighted ratio estimators

64. The estimated variance of $\hat{\mu}_{yl}$ under Regression estimation is :

(1) $\frac{N-n}{Nn} * MSE$

(2) $\frac{N}{N-n} * MSE$

(3) $\frac{n}{N} * MSE$

(4) $\frac{Nn}{N-n} * MSE$ (Where MSE is mean square error)

65. Let y_i for i = 1, 2 ..... N_1 be the value of a population unit and $y_i : a + bi$ where a and b are constants. Let V_{st}, V_{sys}, V_{SR} be the variance of stratified sample, systematic sample and simple Random sample respectively, then the ratio of $V_{st} : V_{sy} : V_{SR}$ is :

(1) $n : n^2 : 1$ (2) $1 : n : n^2$

(3) $1 : n^2 : n$ (4) $n^2 : n : 1$

66. Let N be the number of units in a population from which a sample of size n is to be selected. Let 'ρ' be the inter-class correlation between the units of the same systematic samples, then the relative precision of systematic sample mean with simple random sample mean (V_{sys}/V_{SR}) is :

(1) $\frac{(N-n)}{(N-1)}(1-\rho(n-1))$ (2) $\frac{(N-1)}{(N-n)}[N-\rho(n-1)]$

(3) $\frac{(N-1)}{(N-n)}[1+\rho(n-1)]$ (4) $\frac{(N-n)}{(N-1)}[N-\rho(n-1)]$

67. Which one of the following allocation procedures can be used when no other information except that on the total number of units in the stratum is given?

(1) Optimum allocation (2) Neyman allocation

(3) Equal allocation (4) Proportional allocation

68. In Horvitz–Thompson estimation the first order inclusion probability is given by :

(1) $\pi_i = P\{i \in A\} = \sum_{A;i \in A} P(A)$ (2) $\pi_i = P\{i \in A\} = \sum_{A;i \in A} P(A) - 0.5$

(3) $1 - \pi_i = P\{i \in A\} = \sum_{A;i \in A} P(A)$ (4) $1 + \pi_i = P\{i \in A\} = \sum_{A;i \in A} P(A)$

69. Horvitz–Thompson estimator are :

(1) Consistency and asymptotic Normal

(2) Consistency and u.b.e.

(3) Efficient and u.b.e.

(4) Asymptotic Normal and efficient

70. The Horvitz–Thompson estimator for the total $Y = \sum_{i=1}^{N} y_i$ is given by :

(1) $\sum_{i \in A} y_i$ (2) $\sum_{i \in A} \frac{y_i}{\pi_i}$

(3) $\sum_{i \in A} \pi_i$ (4) $\sum_{i \in A} y_i - \pi_i$

71. For which Regression assumption does the Durbinwatson statistic test follows :

(1) Linearity (2) Homoscedasticity

(3) Multicollinearity (4) Independence of errors

72. Suppose you have the following data with one real value input variable and one real value output variable. What is leave-one out cross validation mean square error in case of linear regression ($Y = bX + c$) ?

X (I.V)	0	2	3
Y (D.V)	2	2	1

(1) 10/27 (2) 20/27

(3) 50/27 (4) 49/27

73. Suppose we have generated the data with help of polynomial regression of degree 3 (degree 3 will perfectly fit this data). Now consider below points and choose the option based on these points :

(*i*) Simple Regression will have high bias and low variance

(*ii*) Simple Regression will have low bias and high variance

(*iii*) Polynomial of degree 3 will have low bias and high variance

(*iv*) Polynomial of degree 3 will have low bias and low variance

(1) only (*i*) (2) (*i*) and (*iii*)

(3) (*i*) and (*iv*) (4) (*ii*) and (*iv*)

74. Factorial experiments :

(1) Include two or more dependent variables

(2) Include two or more independent variables

(3) Focus on unmeasured factors

(4) Focus on organismic factors

75. In a (v, k, λ) – BIBD, every point occurs in exactly :

(1) $r = \frac{\lambda(v-1)}{(k-1)}$ blocks (2) $r = \frac{\lambda(k-1)}{(v-1)}$ blocks

(3) $r = \frac{\lambda}{(v-1)(k-1)}$ blocks (4) $r = \frac{v-1}{\lambda(k-1)}$ blocks

76. Which of the following methods do we use to best fit the data in logistic regression ?

(1) Least square error (2) Maximum likelihood

(3) Euclidean distance (4) Mahalanobis distance

77. The BIBD and PBIB designs result in all treatments having the :

(1) BIBD < PBIBD variance

(2) PBIBD has small variance than BIBD

(3) Same variance

(4) BIBD variance $\neq$ PBIBD variance

78. Imagine we conducted a 3-way independent ANOVA. How many sources of variance would we have ?

(1) 3 (2) 7

(3) 8 (4) 4

79. A factorial design in which both independent variables involve random assignment referred to as a .... factorial design.

(1) Within subjects (2) Mixed

(3) Correlated-groups (4) Between subjects

80. Expanding a 2 * 2 design to a 4 * 2 design means going from .... groups (in the 2 * 2) to .... groups (in the 4 * 2).

(1) 2; 4 (2) 4; 6

(3) 4; 8 (4) 2; 8

81. Consider the following L. P. P : Max Z = x_1+5/2 x_2 subject to $5x_1 + 3x_2 \le 15; -x_1 + x_2 \le 1; 2x_1 + 5x_2 \le 10, x_1, x_2 \ge 0$. The problem has :

(1) An unbounded solution (2) Infinitely many optimal solutions

(3) No feasible solution (4) A unique solution

82. Max $z = 3x + 4y$ subject to $x \ge 0,\ y \ge 0,\ x \le 3, \frac{1}{2}x + y \le 4;\ x + y \le 5$

(1) The optimal value is 19

(2) (3, 3) is an extreme point of the feasible region

(3) (3, 5/2) is an extreme point of the feasible region

(4) The optimal value is 18

83. A simplex is a :

(1) Convex polyhedron (2) Half plane

(3) Hull (4) Envelope

84. Which of the following statements is *not* true ?

(1) A degenerate solution can never be optimum

(2) LPP can be used in solving a game

(3) Degeneracy in LPP may arise at the initial stage

(4) Degeneracy may be a temporary phenomenon

85. Identify the *wrong* statement :

(1) If the primal is minimisation problem, its dual will be a maximisation problem.

(2) Columns of the constraint coefficients in the primal problem become columns of the constraint coefficients in the dual

(3) For an unrestricted primal variable, the associated dual constraint is an equation

(4) If a constraint in a maximisation type of primal problem is a "less than or equal to" type, the corresponding dual variable is non-negative

86. Both transportation and assignment problems are members of a category of LP problems called :

(1) Shipping problems (2) Routing problems

(3) Network flow problem (4) Logistic problems

87. An assignment problem can be viewed as a special case of transportation problem in which the capacity from each source is :

(1) 1; 1 (2) Infinity; Infinity

(3) 0; 0 (4) 1000 ; 1000

88. If a salesman starts from city 1, then any permutation of cities 2, 3 ..... n represents the number of possible ways of his tour, then number of tours ?

(1) $(n - 1)!$ (2) $n!$

(3) $(n + 1)!$ (4) $\frac{1}{n!}$

89. The dual of the primal is the LPP of determining $W^1 \in R^m$ so as to minimise :

(1) $g(w) = b^1 w$ (2) $g(w) = wb$

(3) $g(w) = w^1 b$ (4) $g(w) = w^1 bw$

90. Problems with n jobs and 2 machines can be solved graphically and the chart is called :

(1) Idle chart (2) Control chart

(3) Bar chart (4) Gantt chart

91. Player B

Player A $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ with pay-off matrix, the value of the game is :

(1) 1 (2) 2

(3) 3 (4) 4

92. In Modulo method using the formula $X_{i+1} = X_i$ a (modulo m), the simulated numbers generated lie between :

(1) (0, 1) (2) (0, m)

(3) (0, m–1) (4) (–5, 5)

93. Box Muller formulae for generating a standard Normal deviate is :

(1) $(-2 \log_e u_1)^{1/2} \cos (2 \pi u_2)$ (2) $(\log_e u_1)^{1/2} \cos (2 \pi)$

(3) $\frac{(-2 \log_e u_1)}{\cos (2 \pi u_2)}$ (4) $(2 \log_e u_1)(\cos 2 \pi u_2)$

94. In dominance property of a game .... rows and .... columns are removed.

(1) (dominated; dominating) (2) (2; 3)

(3) (3; 2) (4) (2; 2)

95. Game theory is concerned with :

(1) Predicting the results of bets placed on games like roulette

(2) The way in which a player can win every game

(3) The choice of an optimal strategy in conflict situations

(4) Utility maximisation by firms in perfectively competitive markets

96. In a M|M|1 Queuing model under equilibrium the mean arrival rate is 3 and mean service rate is 4. What is the probability that the server is busy ?

(1) 0.25 (2) 0.75

(3) 0 (4) 0.5

97. Consider an M|M|1 queue with arrivals as a Poisson process at a rate of 8 per hour and a service time which is exponentially distributed at a rate of 6 minutes per customer. The waiting time of a customer in the queue has :

(1) A gamma distribution with p.d.f. $f(x) = \begin{cases} \dfrac{(10)^8 x^7 e^{-10x}}{7!}; & \text{for } x > 0 \\ 0 & ; \text{otherwise} \end{cases}$

(2) A distribution function given by $f(x) = \begin{cases} 1-(0.8)e^{-2x}; & \text{for } x > 0 \\ 0 & ; \text{otherwise} \end{cases}$

(3) mean waiting time of 4 minutes

(4) mean waiting time of 20 minutes

98. Let $\{x_n\}$ be a Markovian chain on S = {1, 2, 3} with the following transition probability matrix $P = \begin{bmatrix} 0 & 2/3 & 1/3 \\ 1/2 & 0 & 1/2 \\ 1/2 & 1/2 & 0 \end{bmatrix}$, then which of the following properties hold good for $\{x_n\}$?

(1) $\{x_n\}$ is irreducible

(2) All states are aperiodic

(3) All states are persistent

(4) $\{x_n\}$ is irreducible and all states are aperiodic and persistent

99. If $P_{ii}^{(n)} = 1$ for all values of n, then the state i is called .... state.

(1) Reflecting (2) Absorbing

(3) Communicating (4) Periodic

100. In a Queuing process with mean arrival rate λ, if L and W denote the expected number of units and expected waiting time in the system at the steady state, then Little's formula is :

(1) $W = L\lambda$ (2) $L = \lambda^2 W$

(3) $W = \lambda^2 L$ (4) $L = \lambda W$

Space for Rough Work

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