



Post Graduate School  
Indian Agricultural Research Institute, New Delhi  
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Discipline : Agricultural Statistics

Discipline Code : 06

Roll No. \_\_\_\_\_

**Please Note:**

- (i) This question paper contains 12 pages. **Please check whether all the pages are printed in this set.** Report discrepancy, if any, **immediately** to the invigilator.
- (ii) *There shall be **NEGATIVE** marking for **WRONG** answers in the **Multiple Choice** type questions (No. 1 to 95) which carry one mark each. For every wrong answer 0.25 mark will be deducted.*

**PART – I (General Agriculture)**

**Multiple choice questions (No. 1 to 30). Choose the correct answer (a, b, c or d) and enter your choice in the circle (by shading with a pencil) on the OMR - answer sheet as per the instructions given on the answer sheet.**

1. Which of the following crops have been approved for commercial cultivation in India?
  - a) Bt cotton and Bt brinjal
  - b) Bt cotton and Golden Rice
  - c) Bt maize and Bt cotton
  - d) Bt cotton only
2. This year (2010-11) the expected food grain production in India is
  - a) 212 million tonnes
  - b) 220 million tonnes
  - c) 235 million tonnes
  - d) 250 million tonnes
3. The genome of which of the following crops is still not completely sequenced?
  - a) Rice
  - b) Soybean
  - c) Sorghum
  - d) Wheat
4. According to the Approach Paper to the 12<sup>th</sup> Five Year Plan, the basic objective of the 12<sup>th</sup> Plan is
  - a) Inclusive growth
  - b) Sustainable growth
  - c) Faster, more inclusive and sustainable growth
  - d) Inclusive and sustainable growth
5. To address the problems of sustainable and holistic development of rainfed areas, including appropriate farming and livelihood system approaches, the Government of India has set up the
  - a) National Rainfed Area Authority
  - b) National Watershed Development Project for Rainfed Areas
  - c) National Mission on Rainfed Areas
  - d) Command Area Development and Water Management Authority
6. Which of the following sub-schemes are not covered under the Rashtriya Krishi Vikas Yojana?
  - a) Extending the Green Revolution to eastern India
  - b) Development of 60,000 pulses and oilseeds villages in identified watersheds
  - c) National Mission on Saffron
  - d) National Mission on Bamboo
7. The minimum support price for the common variety of paddy announced by the Government of India for the year 2010-11 was
  - a) ₹ 1030
  - b) ₹ 1000
  - c) ₹ 980
  - d) ₹ 950
8. According to the Human Development Report 2010 of the United Nations, India's rank in terms of the human development index is
  - a) 119
  - b) 134
  - c) 169
  - d) 182

9. Which of the following does not apply to SRI method of paddy cultivation?
- Reduced water application
  - Reduced plant density
  - Increased application of chemical fertilizers
  - Reduced age of seedlings
10. Which organic acid, often used as a preservative, occurs naturally in cranberries, prunes, cinnamon and cloves?
- Citric acid
  - Benzoic acid
  - Tartaric acid
  - Lactic acid
11. Cotton belongs to the family
- Cruciferae
  - Anacardiaceae
  - Malvaceae
  - Solanaceae
12. Photoperiodism is
- Bending of shoot towards source of light
  - Effect of light/dark durations on physiological processes
  - Movement of chloroplast in cell in response to light
  - Effect of light on chlorophyll synthesis
13. Ergot disease is caused by which pathogen on which host?
- Claviceps purpurea* on rye
  - Puccinia recondita* on wheat
  - Drechlara sorokiniana* on wheat
  - Albugo candida* on mustard
14. Rocks are the chief sources of parent materials over which soils are developed. Granite, an important rock, is classified as
- Igneous rock
  - Metamorphic rock
  - Sedimentary rock
  - Hybrid rock
15. Which one of the following is a *Kharif* crop?
- Pearl millet
  - Lentil
  - Mustard
  - Wheat
16. The coefficient of variation (C.V.) is calculated by the formula
- $(\text{Mean}/\text{S.D.}) \times 100$
  - $(\text{S.D.}/\text{Mean}) \times 100$
  - $\text{S.D.}/\text{Mean}$
  - $\text{Mean}/\text{S.D.}$
17. Which of the following is commonly referred to as muriate of potash?
- Potassium nitrate
  - Potassium chloride
  - Potassium sulphate
  - Potassium silicate
18. Inbred lines that have same genetic constitution but differ only at one locus are called
- Multi lines
  - Monohybrid
  - Isogenic lines
  - Pure lines
19. For applying 100 kg of nitrogen, how much urea would one use?
- 45 kg
  - 111 kg
  - 222 kg
  - 333 kg
20. The devastating impact of plant disease on human suffering and survival was first realized by epidemic of
- Brown spot of rice in Bengal
  - Late blight of potato in USA
  - Late blight of potato in Europe
  - Rust of wheat in India
21. The species of rice (*Oryza*) other than *O. sativa* that is cultivated is
- O. rufipugon*
  - O. longisteminata*
  - O. glaberrima*
  - O. nivara*
22. The enzyme responsible for the fixation of  $\text{CO}_2$  in mesophyll cells of C-4 plants is
- Malic enzyme
  - Phosphoenol pyruvate carboxylase
  - Phosphoenol pyruvate carboxykinase
  - RuBP carboxylase
23. Which one of the following is a 'Vertisol'?
- Black cotton soil
  - Red sandy loam soil
  - Sandy loam sodic soil
  - Submontane (Tarai) soil
24. What is the most visible physical characteristic of cells in metaphase?
- Elongated chromosomes
  - Nucleus visible but chromosomes not
  - Fragile double stranded loose chromosomes
  - Condensed paired chromosomes on the cell plate
25. All weather phenomena like rain, fog and mist occur in
- Troposphere
  - Mesosphere
  - Ionosphere
  - Ozonosphere

26. Which of the following elements is common to all proteins and nucleic acids?
- Sulphur
  - Magnesium
  - Nitrogen
  - Phosphorous
27. Silt has intermediate characteristics between
- Sand and loam
  - Clay and loam
  - Loam and gravel
  - Sand and clay
28. Certified seed is produced from
- Nucleus seed
  - Breeder seed
  - Foundation seed
  - Truthful seed
29. Seedless banana is an
- Autotriploid
  - Autotetraploid
  - Allotriploid
  - Allotetraploid
30. Which one of the following is used to test the goodness-of-fit of a distribution?
- Normal test
  - t-test
  - Chi-square test
  - F-test

### PART – II (Subject Paper)

Multiple choice questions (No. 31 to 95). Choose the correct answer (a, b, c or d) and enter your choice in the circle (by shading with a pencil) on the OMR - answer sheet as per the instructions given on the answer sheet.

31. If A and B are two independent events, then  $P(\bar{A} \cap \bar{B})$  is equal to
- $P(\bar{A}) P(\bar{B})$
  - $1 - P(A \cup B)$
  - $[1 - P(A)][1 - P(B)]$
  - All the above
32. If the letters of the word 'UNIVERSITY' are randomly arranged, the probability that the two I's do not come together is
- 1/5
  - 2/5
  - 3/5
  - 4/5
33. The probability of intersection of two mutually exclusive events is always
- Zero
  - Infinity
  - One
  - Depends on individual probability of the events
34. If  $A \subset B$ , the probability  $P(A|B)$  is equal to
- 0
  - 1
  - $\frac{P(A)}{P(B)}$
  - $\frac{P(B)}{P(A)}$
35. If X and Y are two random variables, then
- $E\{(XY)^2\} = E(X^2) E(Y^2)$
  - $E\{(XY)^2\} \leq E(X^2 Y^2)$
  - $E\{(XY)^2\} \geq E(X^2) E(Y^2)$
  - $E\{(XY)^2\} \leq E(X^2) E(Y^2)$
36. A random variable X takes only three values -1, 0 and 1 such that  $P(X=0)$  is  $\frac{1}{2}$ . Then  $E(X^2)$  is
- $\frac{2}{3}$
  - $\frac{1}{3}$
  - $\frac{1}{2}$
  - 1
37. An approximate relation between mean deviation about mean and standard deviation of a normal distribution is
- 5 M.D. = 4 S.D.
  - 4 M.D. = 5 S.D.
  - 3 M.D. = 3 S.D.
  - 3 M.D. = 2 S.D.
38. If  $X \sim B(n, p)$  then  $Y = n - x$  is
- $B(2n, p)$
  - $B(n, 1-p)$
  - $B(n, p)$
  - $B(2n, 1-p)$
39. If  $X_1, X_2, \dots, X_{20}$  be a random sample from  $N_5(\mu, \Sigma)$  then  $20(\bar{X} - \mu)' \Sigma^{-1} (\bar{X} - \mu)$  will be
- $\chi_5^2$
  - $\chi_{20}^2$
  - $\chi_5^2(\delta), \delta = \mu' \Sigma^{-1} \mu$
  - $\chi_{20}^2(\delta), \delta = \mu' \Sigma^{-1} \mu$
40. If  $X \sim N(\mu, \sigma^2)$ , the maximum probability at the point of inflexion of normal distribution is
- $\frac{1}{\sqrt{2\pi}} e^{-1/2}$
  - $\frac{1}{\sqrt{2\pi}} e^{1/2}$
  - $\frac{1}{\sigma\sqrt{2\pi}} e^{-1/2}$
  - $\frac{1}{\sigma\sqrt{2\pi}} e^{-1/2\sigma^2}$

41. Maximum height of the student's t-distribution curve at the point  $t=0$  is

- a)  $\frac{1}{B\{\frac{1}{2}, \frac{n-1}{2}\}}$
- b)  $\frac{1}{\sqrt{n-1} B\{\frac{1}{2}, \frac{n-1}{2}\}}$
- c)  $\frac{1}{\sqrt{n-1} B\{\frac{1}{2}, \frac{1}{2}\}}$
- d)  $\sqrt{n-1} B\{\frac{1}{2}, \frac{n-1}{2}\}$

42. The relation between statistics  $t$  and  $\chi^2$  is

- a)  $t_1^2 = \chi_\infty^2$
- b)  $t_n^2 = \chi_1^2$
- c)  $t_\infty^2 = \chi_1^2$
- d)  $t_1^2 = \chi_1^2$

43. If the moment generating function of a distribution is  $(q+pe^t)^n$ , the variance of the distribution is

- a)  $2n$
- b)  $pq$
- c)  $npq$
- d)  $pq/n$

44. The moment generating function of a random variable  $X$  is,

$$M_x(t) = \frac{2}{5} + \frac{1}{3} e^{2t} + \frac{4}{15} e^{3t}$$

The expected value of  $X$  is

- a)  $9/5$
- b)  $11/5$
- c)  $17/15$
- d)  $22/15$

45. If  $X$  is a standard normal variate, then  $\frac{1}{2} X^2$  is a gamma variate with parameters

- a)  $1, \frac{1}{2}$
- b)  $\frac{1}{2}, 1$
- c)  $\frac{1}{2}, \frac{1}{2}$
- d)  $1, 1$

46. Stratified sampling is

- a) Always more efficient than simple random sampling
- b) At least equally efficient as simple random sampling
- c) Less efficient than simple random sampling
- d) Can be less, equally or more efficient than simple random sampling

47. Discriminant function

- a) Maximizes the difference between populations
- b) Minimizes the difference between populations
- c) is always a linear function of the components of the random vector under study
- d) None of the above

48. In simple random sampling without replacement, the probability that a specified unit is selected at the second draw from a population of size  $N$  is

- a)  $\frac{1}{N}$
- b)  $\frac{1}{N-1}$
- c)  $\frac{1}{N-2}$
- d)  $\frac{1}{\{N(N-1)\}}$

49. Weighted mean gives higher value than the arithmetic mean value if

- a) Larger weights are given to smaller observations and smaller weights are given to larger units
- b) Equal weights are assigned to each observation
- c) Smaller weights are given to smaller values and larger weights to larger values
- d) Given statement is incorrect

50. Maximum likelihood estimators are

- a) Unbiased and consistent
- b) Biased and consistent
- c) Consistent but not necessarily unbiased
- d) Biased and inconsistent

51. Let  $\{X_n, n \geq 0\}$  be a Markov chain with one step transition probability  $p_{ij}^{(n)} = P(X_{m+n}=j/X_m=i)$ ,  $i, j \in S$ , then

- a)  $p_{ij}^{(2)} = \sum_{k \in S} p_{ik}^{(1)} p_{kj}^{(2)}$
- b)  $p_{ij}^{(2)} = \sum_{k \in S} p_{ik}^{(1)} p_{kj}^{(1)}$
- c)  $p_{ij}^{(3)} = \sum_{k \in S} p_{ik}^{(1)} p_{kj}^{(1)}$
- d) None of the above

52. Which of the following is a simple hypothesis?
- A random variable follows a normal distribution with mean  $\mu=0$
  - A random variable follows a normal distribution with mean  $\mu=\mu_0$
  - A random variable follows a normal distribution with mean  $\mu=\mu_0$  and standard deviation  $\sigma=\sigma_0$
  - None of the above
53. In case of two stage sampling with unequal first stage units
- No unbiased estimator of population mean exists
  - Unbiased estimator may not be better than biased estimator
  - Sample mean is unbiased estimator of population mean
  - None of the above
54. Stratified sampling is a valuable tool for
- Cases of small differences in strata means
  - Getting a small sample from the population
  - Higher accuracy
  - Highly skewed population
55. Given independent random samples  $X_i$ 's and  $Y_i$ 's ( $i, j=1, 2, \dots, n$ ) from two normal populations having means  $\mu_1=\alpha+\beta$  and  $\mu_2=\alpha-\beta$  and common variance  $\sigma^2=1$ , then MLE of  $\alpha$  and  $\beta$  are
- $\frac{\bar{x}-\bar{y}}{2n}, \frac{\bar{x}+\bar{y}}{2n}$
  - $\frac{\bar{x}+\bar{y}}{2n}, \frac{\bar{x}-\bar{y}}{2n}$
  - $\frac{\bar{x}+\bar{y}}{2}, \frac{\bar{x}-\bar{y}}{2}$
  - $\frac{\bar{x}-\bar{y}}{2}, \frac{\bar{x}+\bar{y}}{2}$
56. If  $T$  is unbiased and consistent estimator of  $\theta$ , then for estimation of  $\sqrt{\theta}, \sqrt{T}$  is
- Biased and consistent estimator
  - Unbiased and consistent estimator
  - Biased and not consistent estimator
  - Unbiased and not consistent estimator
57. Log transform is used when
- Mean is proportional to variance
  - Mean is proportional to standard deviation
  - Square of mean is proportional to standard deviation
  - Mean and standard deviations are inversely related
58. A population is divided into clusters and it has been found that all items within a cluster are alike. Which of the following sampling procedure would you adopt?
- Simple random sampling
  - Cluster sampling
  - Systematic sampling
  - Stratified sampling
59. Circular systematic sampling was first used by
- W.G. Cochran
  - M.H. Hansen
  - D.B. Lahiri
  - P.C. Mahalanobis
60. If  $T_1$  and  $T_2$  are two most efficient estimators with the same variance  $S^2$  and the correlation between them is  $\rho$ , the variance of  $(T_1+T_2)/2$  is equal to
- $S^2$
  - $\rho S^2$
  - $(1+\rho)S^2/4$
  - $(1+\rho)S^2/2$
61. In estimating the parameters of a linear function, most commonly used method of estimation is
- Maximum likelihood method
  - Least square method
  - Method of minimum chi-square
  - Method of moments
62. For the distribution,
- $$f(x; \theta) = \frac{1}{\theta}; 0 \leq x \leq \theta$$
- a sufficient estimator for  $\theta$ , based on a sample  $X_1, X_2, \dots, X_n$  is
- $\frac{\sum_{i=1}^n X_i}{n}$
  - $\sqrt{\sum_{i=1}^n X_i^2}$
  - $\max(X_1, X_2, \dots, X_n)$
  - $\min(X_1, X_2, \dots, X_n)$
63. A test procedure is said to be biased if
- The power of the test for any value of the alternative is not smaller than the level of significance
  - The power is zero everywhere
  - The power is less than the level of significance for some value of the alternative
  - The power is one everywhere
64. Size of critical region is known as
- Power of the test
  - Size of type II error
  - Critical value of the test statistics
  - Size of the test

65. Neyman-Pearson lemma provides
- An unbiased test
  - A most powerful test
  - An admissible test
  - Minimax test
66. If the sample size is large in Wilcoxon's signed rank test, the statistic  $T^+$  is distributed with variance
- $n(n-1)(2n-1)/24$
  - $n(n+1)(2n+1)/24$
  - $n(2n+1)/12$
  - $n(n-1)(2n+1)/12$
67. In a  $(2^3, 2^2)$  experiment with 3 replications, the interaction ABC is confounded. The error degrees of freedom in the analysis of variance will be
- 16
  - 14
  - 12
  - 10
68. The interaction confounded in the following two blocks of a single replication of a factorial experiment is
- |         |       |      |      |     |
|---------|-------|------|------|-----|
| Block 1 | (abc) | (c)  | (ab) | (1) |
| Block 2 | (ac)  | (bc) | (a)  | (b) |
- AB
  - AC
  - BC
  - ABC
69. Use of randomization in Design of Experiment was first introduced at
- I.A.S.R.I., New Delhi
  - I.S.I, Barrackpore
  - United States Department of Agriculture
  - Rothamsted Experimental Station
70. Transformation to stabilize variance is done to ensure that
- The distribution is known
  - The computation is easy
  - The variance could be estimated
  - The variance is independent of population parameters
71. What will be the gene frequency of the recessive gene at equilibrium if the fitness of homozygote relative to heterozygotes is as follows
- |       |      |      |
|-------|------|------|
| AA    | Aa   | aa   |
| 0.733 | 1.00 | 0.60 |
- 0.40
  - 0.50
  - 0.60
  - 0.80
72. Covariance between full sibs is
- $\frac{1}{4} V_A + \frac{1}{4} V_D$
  - $\frac{1}{4} V_A + \frac{1}{2} V_D$
  - $\frac{1}{2} V_A + \frac{1}{4} V_D$
  - $\frac{1}{2} V_A + \frac{1}{2} V_D$
73. Progeny testing is used for
- Judging the breeding value of dams and sires
  - Judging the breeding value of sires and evaluation of sire's merit
  - Evaluation of sire's and dam's merit
  - Judging the breeding value of sires and evaluation of dam's merit
74. If for a binomial distribution  $b(n,p)$ , mean=4, variance=4/3, the probability  $P(X \geq 5)$  is equal to
- $(2/3)^6$
  - $(2/3)^5(1/3)$
  - $(1/3)^6$
  - $4.(2/3)^6$
75. If the ties occur in the Kruskal-Wallis test with usual notations, the correction C for ties is
- $\sum T / n(n^2-1)$
  - $\sum T / k(n^2-1)$
  - $\sum T / k n(n-1)$
  - $\sum T / k n^2(n-1)$
76. Under proportional allocation, the size of the sample from each stratum depends on
- Population size
  - Total sample size
  - Size of the stratum
  - All of the above
77. Response to selection
- $R = h^2S$
  - $R = hS$
  - $R = S$
  - $R = 2hS$
78. Indirect selection is better than direct selection when
- $r_A h_y > h_x$
  - $r_A h_y < h_x$
  - $h_y > h_x$
  - $h_x > h_y$
79. A test cross is
- Always a backcross
  - A backcross only when the parent is homozygous dominant
  - A cross between heterozygous
  - A cross between two individuals which are homozygous recessive

80. In the case of tight linkage, which of the following is least efficient?
- Method of maximum likelihood
  - Emerson's method
  - Product formula
  - Method of the linear function
81. The total number of Latin squares that can be obtained of order 3 are
- 16
  - 12
  - 9
  - 3
82. Which of the following is false regarding the information matrix (C) of a block design?
- Its row sum is always zero
  - It is a non-singular matrix
  - One of its eigen values is zero
  - Its column sum is always zero
83. Let  $v, b, r, k, \lambda$  be the parameters of a BIB design and  $T_i, i=1, \dots, v$  be the effect of the  $i$ -th treatment. Let the three contrasts of treatment effects be defined as follows with variances  $V_1, V_2$  and  $V_3$ , respectively:
- $$\frac{T_1 - T_2}{\sqrt{2}}, \quad \frac{T_1 + T_2 - 2T_3}{\sqrt{6}}, \quad \frac{T_1 + T_2 + T_3 - 3T_4}{\sqrt{12}}$$
- Which of the following is true?
- $V_1 > V_2 > V_3$
  - $V_1 < V_2 < V_3$
  - $V_1 = V_2 > V_3$
  - $V_1 = V_2 = V_3$
84. There are two bags. One bag contains 4 red and 5 black balls and the other contains 5 red and 4 black balls. One ball is to be drawn from either of the two bags. The probability of drawing a black ball is
- 1
  - 16/81
  - 1/2
  - 10/81
85. An urn A contains 5 white and 3 black balls and B contains 4 white and 4 black balls. An urn is selected and a ball is drawn from it, the probability that the ball is white is
- 9/8
  - 9/16
  - 5/32
  - 5/16

86. The density function of the continuous random variable  $X$  is  $f(x)=1/2, -1 < X < 1$  and zero, otherwise. The variance of  $|X|$  is equal to
- 1/2
  - 1/3
  - 1/4
  - 1/12
87. Given  $f(x,y) = Kxy, 0 < x < 1, 0 < y < 1$  is a p.d.f., the covariance between  $X$  and  $Y$  is
- 4/9
  - 2/3
  - 1/18
  - 0
88. Let  $t_{\alpha/2}$  be the  $\alpha\%$  value of  $t$  (for two tailed test) with  $n$  d.f. and  $F_\alpha$  the upper  $\alpha\%$  value of  $F_{1,n}$ . Then we have
- $t_\alpha^2 = F_{\alpha/2}$
  - $t_{\alpha/2}^2 = F_\alpha$
  - $t_\alpha^2 = F_\alpha$
  - $t_{\alpha/2}^2 = F_{\alpha/2}$
89. In a tri-variate distribution, if all the total correlation coefficients are equal, say 'r', then  $r_{12.3}$  is equal to
- r
  - $r/(1+r^2)$
  - $r/(1-r)$
  - $r/(1+r)$
90. Let  $\mathbf{S} \sim W_p(K, \Sigma)$ , be a  $p$ -variate Wishart distribution. For  $p=1, W_1(K, \sigma^2)$  follows
- $\chi_K^2$  distribution
  - $\sigma^2 \chi_K^2$  distribution
  - Snedecor's  $F$ -distribution with 1,  $p$  degrees of freedom
  - Non-central  $\chi_K^2$  distribution
91. Let  $L$  and  $P$  denote the convergence in law and in probability, respectively. Which of the following statements is not correct for the sequence of random variables  $\{X_n\}$ ?
- $X_n \xrightarrow{P} X \Rightarrow X_n \xrightarrow{L} X$
  - $X_n \xrightarrow{L} K \Rightarrow X_n \xrightarrow{P} K$ , where  $K$  is a constant
  - $X_n \xrightarrow{P} X, X_n \xrightarrow{P} Y \Rightarrow P(X=Y) = 1$
  - $X_n \xrightarrow{P} K \not\Rightarrow X_n \xrightarrow{L} K$ , where  $K$  is a constant

92. The treatment  $\times$  block incidence matrix of a block design is

$$N_{5 \times 6} = \begin{pmatrix} 1 & 1 & 1 & 1 & 1 & 1 \\ 2 & 2 & 2 & 2 & 2 & 2 \\ 1 & 1 & 1 & 1 & 1 & 1 \\ 3 & 3 & 3 & 3 & 3 & 3 \\ 1 & 1 & 1 & 1 & 1 & 1 \end{pmatrix}$$

Which of the following statements is not correct?

- a) The design is proper  
 b) The design is non-orthogonal  
 c) The design has varying replications  
 d) The design is orthogonal
93. The mode of the geometric distribution  $(\frac{1}{2})^x$  for  $X=1,2,\dots$  is  
 a) 1  
 b) 0  
 c)  $\frac{1}{2}$   
 d) Does not exist
94. Repeatability sets an upper limit of  
 a) Heritability  
 b) Genetic correlation  
 c) Linkage  
 d) Phenotypic correlation
95. Which of the following statements about confidence intervals is incorrect?  
 a) If we keep the sample size fixed, the confidence interval gets wider as we increase the confidence coefficient  
 b) A confidence interval for a mean always includes in it the sample mean  
 c) If the population standard deviation increases, the confidence interval decreases in width  
 d) If we keep the confidence coefficient fixed, the confidence interval gets narrower as we increase the sample size

**Note: In this paper, there are no questions from Q. No. 96 to 130; leave OMR answer sheet blank against Q. No. 96 to 130.**

**Matching type questions (No. 131 to 140); all questions carry equal marks. Choose the correct answer (a, b, c, d or e) for each sub-question (i, ii, iii, iv and v) and enter your choice in the circle (by shading with a pencil) on the OMR - answer sheet as per the instructions given on the answer sheet.**

131. If the exponential distribution is given as  $f(x) = e^{-x}, 0 \leq x < \infty$

- i) Mean of the distribution a) 4  
 ii) Variance of the distribution b) 2  
 iii) Third moment of the distribution c) 1  
 iv) Pearson's constant  $\beta$  d) 1  
 v) Standard deviation of the distribution e) 1

132. The characteristic function of

- i) Chi-square distribution a)  $(1-it)^{-n}$   
 ii) Gamma distribution ( $\alpha=1$ ) b)  $e^{-it^2}$   
 iii) Standard normal distribution c)  $(1-2it)^{-1/2}$   
 iv) Cauchy distribution ( $\alpha=1, \beta=1$ ) d)  $e^{it-|t|}$   
 v) Poisson distribution (parameter,  $\lambda=1$ ) e)  $e^{(e^{it}-1)}$

- 133.

- i) Cluster sampling a) Unbiased estimates  
 ii) Systematic sampling b) Biased estimates  
 iii) Horvitz-Thompson estimator c) Easy to apply  
 iv) Non-response d) Frame of sampling units is not available  
 v) Hansen-Hurwitz technique in mail survey e) Negative estimator of variance

- 134.

- i) Method of moment a) J. Neyman  
 ii) Least square theory b) Karl Pearson  
 iii) Sequential probability ratio test c) R.A. Fisher  
 iv) Testing of hypothesis d) A. Wald  
 v) Testing of independence of attributes e) C.F. Gauss



135.

- i) Intraclass correlation for a population is -0.2
- ii) Intraclass correlation for a population is 0.28
- iii) In two stage sampling every first stage unit is selected
- iv) Per unit cost of collecting information on auxiliary variable is more than per unit cost of collecting information on study variable
- v) Correlation coefficient between study variable and auxiliary variable is 0.6, coefficient of variation (C.V.) of study variable is 4.2, C.V. of auxiliary variable is 4.1
- a) Simple random sampling should be preferred over two phase sampling
- b) Stratified sampling
- c) Cluster sampling should be preferred over simple random sampling
- d) Ratio estimator will be more efficient than simple mean for estimating population mean from sample selected through simple random sampling without replacement
- e) Simple random sampling should be preferred over cluster sampling

136. In statistical genetics

- i) Correlation between father and son  $r_{FS}$  a)  $1/2$
- ii) Correlation between daughter and daughter  $r_{DD}$  b) 0
- iii) Correlation between son and daughter  $r_{SD}$  c)  $3/4$
- iv) Correlation between son and son  $r_{SS}$  d)  $\frac{1}{2\sqrt{2}}$
- v) Correlation between first cousin e)  $1/8$

137. Design of Experiments

- i) The linear combination  $-3T_1 - T_2 + T_3 + 3T_4$  of four treatments is a a) (K-1)
- ii) Completely randomized design yields maximum degrees of freedom for b) Contrast
- iii) Among K treatments, the number of orthogonal contrasts can at most be c) Error
- iv) If A is a fixed effect having p levels, then  $\sum_{i=1}^p \alpha_i$  is equal to d) Systematic designs
- v) The experimental designs not involving any randomization process are called e) Zero

138.

- i)  $T^2$ -statistic a) Mahalanobis
- ii)  $D^2$ -statistic b) Fisher
- iii) Discriminant function c) Centroid method
- iv) Cluster analysis d) Hotelling
- v) Factor analysis e) Grouping

139.

- i) Testing equality of two means from normal populations with unknown variance and small sample size a)  $\chi^2$  test
- ii) Testing equality of several means b) F-test
- iii) Testing equality of two variances c) Analysis of variance
- iv) Testing equality of several variances d) t-test
- v) Testing independence of attributes e) Bartlett test

140.

- i) Run test a) Goodness of fit
- ii) Kolmogorov-Smirnov test (one sample) b) Analysis of one way classification
- iii) Mood's test c) Central tendency
- iv) Kruskal-Wallis test d) Randomness of observations
- v) Wilcoxon signed rank test e) Equality of measures of dispersion

Short questions (No. 141 to 146); each question carries FIVE marks. Write answers, including computation / mathematical calculations if any, in the space provided for each question on the question paper itself.

141. Let  $X_1$  and  $X_2$  have the joint p.d.f.

$$f(x_1, x_2) = 2, \quad 0 < x_1 < x_2 < 1 \\ = 0, \quad \text{otherwise}$$

Show that the conditional variance of  $X_1$  given  $X_2 = x_2$  is  $x_2^2/12$

142. Let  $X_1, X_2, \dots, X_n$  denote a random sample from a distribution with p.d.f.

$$f(x; \theta) = \theta x^{\theta-1}, \quad 0 < x < 1, \theta > 0 \\ = 0, \quad \text{otherwise}$$

Obtain a sufficient statistics for  $\theta$ .

143. Show that in estimating mean for random sampling from a normal population, sample mean is more efficient than sample median.

144. In a large random mating population, show that both gene frequencies and the genotypic frequencies remain constant from generation to generation in the absence of migration, mutation and selection.

145. Construct a BIBD with  $v=9$ ,  $b=12$ ,  $r=4$ ,  $k=3$  and  $\lambda=1$  using MOLS and give its complementary design along with its parameters.

146. For a data, following results were obtained

$$r_{12} = \frac{2}{5} \quad r_{23} = \frac{1}{5} \quad r_{13} = -\frac{1}{2}$$

Interpret the result.