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1411E1169

Candidate's Seat No :________

M.Sc. Sem.-3 Examination

502

Statistics

November-2025

Time : 2-30 Hours] **[Max. Marks : 70**

Note: Attempt all questions.

Q.1

(i) Discuss general structure of block designs. [7]

(ii) Show that an incomplete block design is connected if and only if the rank of its C-matrix is exactly v - 1. [7]

OR

(i) Show that a connected design is balanced if and only if all the non-zero characteristic roots of C are equal. [7]

(ii) Show that an equireplicated, equiblock-sized balanced design has its incidence matrix N, satisfying

$NN' = (r-\lambda)I_v + \lambda E_{v,v}$, where $\lambda(v-1) = r(k-1)$ [7]

Q.2

(i) Define BIBD (v,b,r,k,λ) and show that for BIBD $r(k-1) = \lambda(v-1)$. [7]

(ii) In usual notations, show that in intrablock analysis of BIBD [7]

$$Q_i = T_i - \sum_{j=1}^{b} \frac{n_{ij}B_j}{k}.$$

OR

(i) Show that for a resolvable BIBD (v,b,r,k,λ) $b \geq v+r-1$. [7]

(ii) Define Youden Square Design. Discuss its applications. [7]

Q.3

(i) Define association scheme with m classes. Describe relations between the parameters of PBIB designs. [7]

(ii) The following is the principal block of a 2^4-factorial experiment:

(0000, 0101, 1010, 1111)

Write down the other blocks and identify the confounded effects. [7]

OR

(i) Explain fractional replication with an example. [7]

(ii) Construct a 2^5 factorial design in blocks of 8 plots confounding the interactions ACD and BDE. Determine the other interactions which are also confounded. [7]

Q.4

(i) Construct partially balanced incomplete block design using double triangle. [7]

(ii) Show that the series of BIB designs with the parameters v = 4t + 1, b = 8t + 2, r = 4t, k = 2t, λ = 2t - 1 can always be constructed when 4t + 1 is a prime or a prime power. [7]

OR

(i) Define mutually orthogonal Latin squares(MOLS). Explain, how will you obtain a BIBD using MOLS. [7]

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(ii) Show that the series of symmetrical BIB designs with the parameters v = b = 4t + 3, r = k = 2t + 1, $\lambda = t$ can always be constructed when 4t + 3 is a prime or a prime power. [7]

Q. 5 Answer any seven: [14]

(i) Randomised block designs are

(A) orthogonal (B) connected (C) both (A) and (B) (D) none of the above

(ii) For an incomplete block design, $CE_{v,1}$ = ----------?

(A) $\mathbf{0}_{v,1}$ (B) $\mathbf{1}_{v,1}$ (C) $r\mathbf{1}_{v,1}$ (D) $k\mathbf{1}_{v,1}$

(iii) In a connected design the cofactors of all elements of C matrix have the same ______ value.

(iv) Balanced incomplete block designs are orthogonal designs.

(A)True (B) False

(v) Define affine resolvable design.

(vi) For which of the following set of values will a BIBD with parameters v, b, r, k, λ not exists?

(A) v = 11, b = 11, r = 5, k = 5, $\lambda = 2$ (B) v = 11, b = 11, r = 6, k = 6, $\lambda = 4$

(C) v = 5 , b = 10, r = 6, k = 3, $\lambda = 3$ (D) v = 10, b = 18, r = 9, k = 5, $\lambda = 4$

(vii) A group-divisible design is said to be singular if

(A) $r-\lambda_1=0$ (B) $k-\lambda_1=0$ (C) $b-\lambda_1=0$ (D) $r-\lambda_1=1$

(viii) Give one advantage of confounding.

(ix) In a PBIBD with $v=36,\ r=2, k=8, b=9, n_1=14, n_2=21, \lambda_1=1, \lambda_2=0$, value of P_{11}^{1} is

(A) 5 (B) 6 (C) 7 (D) 8

(x) Define PG (n, s).

(xi) Give incidence matrix of BIBD v = 7, b = 7, r = 3, k = 3, $\lambda = 1$.

(xii) Find primitive element of GF(7).

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