M.Sc. Semester-II Examination 2017
Statistics (New)
Course : MSC-24
(Design of Experiments)

Time : 3 Hours **Full Marks : 40**

Questions are of value as indicated in the margin

Answer **any four** questions

1. Give two definitions of connectedness of a block design. Prove that these definitions are equivalent. 3+7=10

2. Define Q, the adjusted treatment totals. Show that (i) $Q'1_u = 0$ (ii) $E(Q) = C_\tau$ and (iii) $D(Q) = \sigma^2 C$ where l_u is a vector of ones and C is the C-matrix of the design. 1+2+3+4=10

3. (a) For a connected block design d, show that the covariance between Q and P is zero if and only if $N = rk^T / n$, where the notations have their usual meaning.

   (b) For a connected block design d, discuss in brief the testing of the null hypothesis $H_0 : \tau_1 = \tau_2 = \cdots = \tau_v$. 5+5=10

4. (a) Show that for a connected block design d with u treatments, the matrix C+aJ, where $a \neq 0$ is any scalar, is non-singular and $(C + aJ)^{-1}$ is the g-inverse of C.

   (b) let c be a vector such that Cc = p, where C is the C-matrix of a connected block design d. Show that the BLUE of $p'\tau$ is $c'Q$ and the variance of this estimator is $\sigma^2 p'c$. 5+5=10

5. (a) Let $0 = \lambda_0 < \lambda_1 \leq \cdots \leq \lambda_{v-1}$ be the eigenvalues of C, the C-matrix of a connected block design d. Show that the variance of the BLUE of an elementary contrast of treatment effects is bounded below by σ^2 / λ_{v-1} and bounded above by σ^2 / λ_1.

   (b) Give an example of an orthogonal block design whose incidence matrix is not a multiple of J_{vb}, where v is the number of treatments and b, the number of blocks. 6+4=10

6. (a) Let N be the incidence matrix of a symmetric BIB design d. By taking the inverse of NN', show that any two blocks of d intersect in λ treatments.

   (b) Prove that for a BID design (v, b, r, k, λ), the Fisher's inequality is equivalent to the inequality $b \geq v + r - k$. 5+5=10

7. (a) Discuss in detail the analysis of a 3^n experiment conducted in an RBD with b blocks.

   (b) What is meant by confounding in factorial experiment. Discuss how one can confound a factorial effect carrying 2 df in a (3^n, 3) experiment. 6+4=10
