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3 (Sem-6/CBCS) STA HC 1

2024

STATISTICS

(Honours Core)

Paper : STA-HC-6016

(Design of Experiments)

Full Marks : 60

Time : Three hours

***The figures in the margin indicate
full marks for the questions.***

1. Answer the following as directed : $1 \times 7 = 7$

(a) Name a design where principle of local control is not used.

(b) The degree of freedom for error in a $m \times m$ LSD is _____.

(c) What is a treatment contrast?

Contd.

(d) For a 2^2 factorial experiment in an r -randomised block, the sum of squares for the main effect in the analysis of variance table is _____.

(e) Write down the main effects and interaction effects for a 3^2 design with two factors A and B each at three levels 0, 1, 2.

(f) In the linear model considered in analysis of variance the error term is distributed as _____.

(g) The error df in an RBD with 4 blocks comparing 5 treatments is _____.

2. Answer the following : $2 \times 4 = 8$

(a) Define the terms 'main effect' and 'interaction effect' in relation to a 2^3 experiment.

(b) Give the layout of a 4×4 Latin square design.

(c) Show that for 2^3 factorial experiment the main effect A and interaction effect AB are mutually orthogonal contrasts.

(d) In an RBD with 6 treatments and 5 blocks, the following results were obtained :

Mean S.S due to block = 20

Mean S.S. due to treatment = 25

Total S.S = 245

Construct the ANOVA table.

3. Answer **any three** questions from the following : $5 \times 3 = 15$

(a) Explain the basic principles of experimental design giving brief explanatory note for each.

(b) Explain the concept of partial, total and balanced confoundings in factorial experiments.

(c) What is a split-plot design? Describe the situations in which a split-plot confounding rather than the general type of confounding would be more suitable.

(d) Obtain the estimate of the missing plot in a randomised block design.

(e) Give an idea of 3^2 factorial experiment.

4. Answer the following questions : **(any three)**

$$10 \times 3 = 30$$

(a) Define a Balanced Incomplete Block Design (BIBD) with parameters v, b, r, k, λ .

When do you call such a design

(i) symmetric

(ii) resolvable

(iii) affine resolvable?

Also write down the efficiency of BIBD relative to RBD. $5+5=10$

(b) The elements of control block of each of six replication of a 2^4 design are (1), ab, acd, bcd . Identify the complete subgroup and give an outline of the analysis of the data obtained from the experiment.

(c) In a Latin square design the expectation of the yield X_{ijk} of the plot in the i th row, j th column receiving the k th treatment is $\mu + \alpha_i + \beta_j + \gamma_k$ where

$\Sigma \alpha_i = 0, \Sigma \beta_j = 0, \Sigma \gamma_k = 0$ and variance of X_{ijk} is σ^2 . Show how to estimate the parameters μ, α_i, β_j and γ_k and find the variance of the estimate of α_i and β_j .

(d) In testing the value of three fertilisers N, P and K each at two levels, eight pairs of blocks of 4 plots are used. The treatment (N, P, K and NPK) are put in one block. What should be the composition of the other block for completely confounding the second order interaction? Give the analysis of variance table for the confounded factorial design. $5+5=10$

- (e) What is the use of 'missing plot technique'?

Show that in an RBD with r blocks and ' t ' treatments the analysis can be carried out by substituting the value

$$y = \frac{rB + tT - G}{(r-1)(t-1)}$$

for the missing yield, B = the actual total of the block with the missing unit, T = the total of yield of the treatment with the missing unit and G = the grand total.

Show that by using the above missing value, the treatment sum of squares is

overestimated by $[B - (t-1)y]^2 / t(t-1)$.

$$2+5+3=10$$

- (f) Find the standard error of difference between two treatment means, one of which has a missing observation in RBD. Compare the efficiency of this design with CRD. 5+5=10