3 (Sem–6) STS M 2

2020

STATISTICS

(Major)

Paper : 6·2

(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 : 1×7=7

(a) For one-way classified data with equal number of observation $(n_1 = n_2 = ... n_k = n)$ per class to compare the class means two at a time we are to calculate —

(i) $t_{\alpha/2,\, k(n-1)} \times \sqrt{\frac{MSE}{k}}$ *(ii)* $t_{\alpha/2,\, (n-1)} \times \sqrt{\frac{2MSE}{n}}$

(iii) $t_{\alpha/2,\, k(n-1)} \times \sqrt{\frac{2MSE}{n}}$ *(iv)* None of the above.

(Choose the correct option)

Contd.

(b) If r is the number of replications for each treatment then variance of difference between two treatment means is given by —

(i) σ^2/r^2

(ii) σ/r^2

(iii) $2\sigma^2/r^2$

(iv) None of the above.

(Choose the correct option)

(c) What will be the error d.f. in a RBD to compare 5 treatments in 4 blocks, having one missing observation ?

(d) In a 4×4 LSD, the following results were obtained —

Row MS = 87 Column MS = 52

Treatment MS = 457 Total SS = 1943

Compute error MS.

(e) The Concept of Confounding —

(i) is not deliberately introduced in factorial experiment

(ii) is deliberately introduced in factorial experiment

(iii) is sometimes deliberately introduced and sometimes not

(iv) None of the above.

(Choose the correct option)

(f) What will be the total number of factorial effects in 2^n factorial experiment ?

(g) In a split-plot design —

(i) main effect is confounded

(ii) interaction effect is confounded

(iii) sometimes main effect is confounded and sometimes interaction effect is confounded

(iv) None of the above.

2. Answer the following : 2×4=8

(a) With 3 factors A, B, C each at 2 levels, write the factorial effects. Also give the layout of a replication if interaction BC is confounded.

(b) Write the linear model of an one-way classified data when there is a concomitant variable.

(c) Explain why there cannot be a 2×2 LSD.

(d) In a factorial experiment there are two factors V and M. The factor V is to be applied at three levels v_1, v_2, v_3 and the factor M is to be applied at 4 levels m_1, m_2, m_3, m_4. Construct the layout of the experiment in split-plot design, using 3 replications.

Or

State *any two* limitations of A.O.V.

3. Answer ***any three*** of the following : 5×3=15

(a) Discuss the types of model and their underlying assumptions that are associated with the Analysis of Variance (AOV) technique.

(b) Show that in RBD treatment and error effects are mutually orthogonal.

(c) The part of the AOV table of a RBD is given below :

Source of variation	d.f.	MS
Blocks	3	60
Treatments	4	36
error	12	30

Test the significance of treatment variation and examine how far your conclusion would change when Block classification is not taken into consideration.

Given —

$F_{0.05;\nu_1,\nu_2} = 3.26$ for $\nu_1 = 4, \nu_2 = 12$

$F_{0.01;\nu_1,\nu_2} = 5.41$ for $\nu_1 = 4, \nu_2 = 12$

$F_{0.05;\nu_1,\nu_2} = 3.06$ for $\nu_1 = 4, \nu_2 = 15$

$F_{0.01;\nu_1,\nu_2} = 4.89$ for $\nu_1 = 4, \nu_2 = 15$

(d) An agricultural field was laid out in a LSD for comparing 5 varieties of paddy. Due to the negligence of the caretaker, the crop in one of the border-lying plots was damaged by cattle long before harvesting. Describe the procedure you would adopt to analyse the resulting yield-data, briefly indicating the basic theory of involved therein.

(e) What is balanced factorial design ? Give the confounding subgroups for a 2^4 balanced design in 6 replications in 4 blocks of size 4 each.

4. *(a)* What do you mean by efficiency of a design? Discuss how efficiency of a design can be increased. Obtain an expression for efficiency of LSD over RBD. 2+2+6=10

Or

For a RBD with one missing observation, let V_1 and V_2 denote respectively the correct treatment SS and the treatment SS for the completed data. Which one is greater? Justify your answer. 10

(b) Discuss the necessity of confounding in factorial design. How does partial confounding differ from complete confounding? Give your answer with suitable illustration. 3+4+3=10

Or

Obtain the expression for unrestricted residual sum of square in case of analysis of covariance for two-way classified data. 10

(c) The content of one of the block in a 2^5 factorial experiment involving the factors *A*, *B*, *C*, *D* and *E* tested in block of size 8 are —

(*abc* *abcde* *c* *ad* *be* *cde* *ae* *bd*)

give the contents of the principal block and hence identify the confounded effects. Discuss the analysis of the experiment assuming 5 such replications. Further indicate what you would do under the following two different situations —

(i) All 2nd order interactions are of equal importance

(ii) Experimental material does not permit to have more than one replication. 2+2+4+1+1=10

Or

Find the standard error of difference between two treatment means when one of them has a missing observation in RBD. 10

———