Total number of printed pages–7

1 (Sem–5/FYUGP) STA02MJ

2025

STATISTICS

(Major)

Paper : STA0500204

(Design of Experiments–2)

Full Marks : 60

Time : 2½ hours

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

1. Answer the following as directed : 1×8=8

   (a) The analysis of variance procedure is appropriate for testing equivalence of a set of two or more populations _____ .
   (Fill in the blank)

   (b) Suppose we have factor A which has P classes and total number of observations be n, then mean square for error is equal to

   (i) $\frac{SSE}{P-1}$

(ii) $\frac{SSE}{n-P}$

(iii) $\frac{SSE}{n-1}$

(iv) None of the above

(c) The process of dividing heterogeneous experimental area into a number of homogeneous block is known as _____. *(Fill in the blank)*

(d) A completely randomized design is used when all experimental units are

(i) Homogeneous

(ii) Heterogeneous

(iii) None of the above

(e) The method of confounding is a device to reduce the size of

(i) Experiments

(ii) Blocks

(iii) Replications

(f) For a 2^3 factorial experiment in an π randomised block, the sum of squares for the main effect A in the analysis of variance table is _____. *(Fill in the blank)*

(g) In a 2^4 factorial experiment with the four factors A, B, C, D each at two levels, the interaction effects ACD and BCD is confounded. Name the other factor which is also confounded.

(h) Name the design where main effect is confound.

2. Answer ***any six*** questions from the following : 2×6=12

(a) Write a note on the assumptions made in a linear model in analysis of variance.

(b) What are the different types of statistical model for experimental designs ?

(c) What is treatment contrast ?

(d) Explain why there cannot be a 2×2 L.S.D.

(e) In an RBD, the yield of the plot for 1st treatment and 1st block is 50*kg*. Mean of the first treatment is 25*kg*, mean of the first block is 12*kg*, grand mean is 10*kg*. Find the estimate of error component for the corresponding plot.

(f) In a partially confounded 2^3 factorial experiment, the control blocks of two replications are given below :

(i)

(1)	a	bc	abc

(ii)

(1)	b	ac	abc

Identify the confounded effects and write down the other blocks of the replications.

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

(h) What do you mean by the term 'efficiency' in a design of experiment ?

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

(j) In a split plot design with A at 5 levels in main plots and 4 levels of B in sub-plots having 3 replications, find the sub-plot error degrees of freedom.

3. Answer ***any four*** questions from the following : 5×4=20

(a) Define 'experimental error'. What are its main sources ? What methods are adopted to increase the accuracy of an experiment ? 2+1+2=5

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

(c) Discuss the efficiency of LSD in comparison to RBD.

(d) Give an analysis of variance table for randomised block design and state the assumption and the hypothesis to be tested.

(e) Write a note on the advantages and disadvantages of confounding.

(f) Complete the following table for the analysis of variance of a LSD :

Source of variation	d.f.	SS	MS	F
Row	–	72	–	2
Column	–	–	36	–
Treatment	–	180	–	–
Error	6	–	12	
Total	–	–		

(g) In the usual notation for one way classification prove that :

$$E\left[\sum_{j=1}^{n_i}\left(x_{ij}-\bar{x}_{i.}\right)^2\right]=\left(n_i-1\right)\sigma^2$$

(h) What is a split plot design ? Why is it said that in a split plot design main effect is confounded ? 2+3=5

4. Answer ***any two*** questions from the following : 10×2=20

(a) Starting from a linear model show the breakup of the total sum of squares into different component SS in CRD. Also give the AOV table. 7+3=10

(b) What is a partially confounding design ? Discuss its analysis with special reference to the 2^3 factorial design. 2+8=10

(c) Write a note on missing plot technique. Obtain the formula for estimating a single missing value in an RBD with p treatments and q blocks. 3+7=10

(d) Suppose you want to confound the four factor interaction *ABCD* in a 2^4 factorial experiment with the factors *A*, *B*, *C* and *D* in a replication.

Write the contents of the treatment combinations of the blocks. Which one is called key block ? Can you confound *ABCD* and *ABC* simultaneously in a replication ? Give reasons.

Suppose you want to confound the three factor interactions *ABC* and *BCD* in a replication. Then write down the contents of different blocks. 3+1+2+4=10

(e) Show how the use of the concomitant variable reduce the error sum of squares in RBD. Also discuss the analysis of the data in such case. 3+7=10