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Roll No. | | | | | | | | | | |

S. No. of Question Paper : **5559**

Unique Paper Code : **2372013602**

Name of the Paper : **Design of Experiments**

Name of the Course : **B.Sc. (H) Statistics under NEP**

Semester : **VI**

Duration : **3 Hours** Maximum Marks : **90**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt *five* questions in all.

Question **1** is compulsory.

Select *four* questions from the remaining six questions.

1. (*a*) Suppose there are v treatments to be compared, Name the design under each of the following situations :

   (*i*) There is no fertility difference among the plots

   (*ii*) The fertility changes along a particular direction

   (*iii*) The fertility changes along two perpendicular directions.

   (*b*) Derive the expression to measure the efficiency of LSD over CRD, stating clearly the assumptions used in the derivation.

P.T.O.

(*c*) Can there exist a BIBD with the following parameters :

(*i*) $b = x,\ v = 25,\ r = y,\ k = 5,\ \lambda = 1$

(*ii*) $b = x,\ v = 31,\ r = y,\ k = 4,\ \lambda = 1$

Give reasons for your answers.

(*d*) Write the first two columns of the ANOVA table for a 2^3 factorial experiment conducted in LSD.

(*e*) If some of the elements of the key block of a 2^5 factorial experiment are (1), *ab*, *c*, *d* and *ae*, then identify all the confounded effects. Write down the contents of the remaining block/s.

(*f*) Obtain treatment combinations of a 2^{5-2} design using I = ABE and I = – BCE as design generators. 6×5

2. (*a*) Explain the *three* principles of experimental design. How are these principles used in CRD ?

(*b*) Derive the expected value of squares due to errors and treatments in LSD. Also, show that under the truth of null hypothesis, the mean sum of squares due to treatments gives an unbiased estimate of error variance. 6,9

3. Give *two* reasons why the response variable in certain experiments may be missing or lost. Use the missing plot technique to describe the analysis of an RBD with 6 varieties of paddy laid out in 4 homogeneous blocks, when observation corresponding to 3rd treatment under 2nd block is missing. 15

4. (*a*) Find $(NN')^{-1}$ for a BIBD with parameters v, b, r, k, λ and show that for a symmetric BIBD :

$$(N')^{-1} = \left(N - \frac{\lambda}{r} E_{vv} \right) / (r - \lambda).$$

Hence show that NN' = N'N. Interpret the last result in terms of the number of treatments common between any two blocks in a symmetric BIBD.

(*b*) If we replace each block of a given BIBD with parameters v, b, r, k, λ by another block containing all those treatments which are not included in the original blocks, then what are the parameters of the resulting design in terms of the parameters of the original BIBD ? Is the resulting design a BIBD ? Justify your answer. 8,7

5. (*a*) Describe Yates algorithm for computing the total effects and the sum of squares due to various effects for a 3^2 factorial experiment laid out in r randomized blocks.

(*b*) A 2^3-factorial experiment with factors A, B and C is to be conducted in 4 replicates consisting of two blocks of 4 plots each. Two experimenters conduct such 4 replicate experiments on two different farms.

In experiment I, ABC is totally confounded, and in experiment II, AB, AC, BC and ABC are partially confounded.

(*i*) What are the block compositions in each replicate in the two experiments ?

(*ii*) Give the table showing the breakdown of degrees of freedom in the combined analysis of experiment I and experiment II. 6,9

6. (*a*) What is confounding ? Construct a 2 level factorial design with factors A, B, C, D and E in 4 blocks such that all the main effects and 2 factor interaction effects are estimable and so are all the 3 factor interaction effects involving both the factors A and E. Also, list all the confounded effects.

(*b*) An experiment for 6 treatment factors, each with two levels, is designed such that only a single replicate of the 64 treatment combinations is run. Suggest a suitable method for analysing such a design. Give its ANOVA table. 6,9

7. (*a*) What are fractional factorial designs ? Construct one half of the 2^3 design clearly explaining the term aliases, principal fraction and alternate fraction. Indicate how de-aliased estimates of all the effects can be obtained, if the two half fractions are run sequentially.

(*b*) Define Resolution of a design. Identify the resolution of the following designs, when two choices of generators for a 2^{6-2} design are given as (*i*) 2^{6-2} with E = ABCD, F = ABC (*ii*) 2^{6-2} with E = ABC, F = BCD. Which design would you prefer ? Give reasons for your preference and write down the alias structure of the designs to support your answer. 6,9