INDIAN STATISTICAL INSTITUTE

Assignmnets in lieu of Semester Examinations 2020

MStat I year Design and Analysis of Experiments

Answer all questions. Each question carries 3 marks.

Keep answers brief, no proofs needed.

Due date for submission: June 30, 2020. Total Marks: 30

1. Eight objects are to be weighed using a weighing balance with two pans. Eight observations will be taken in all, observations being independent and with a constant variance. Give the design matrix of a weighing design which will allow the best linear unbiased estimates of the weights to have the lowest variance across all possible 8×8 design matrices. The full design matrix must be shown.

2. Let A be the group of residue classes modulo 3 with elements $0, 1, 2$ and let there be 3 treatments corresponding to each element of A. For example, corresponding to element 0, the 3 treatments are $0_1,\ 0_2,\ 0_3$. Consider the 4 initial blocks:

$$(1_1,\ 2_1,\ 0_2),\ (1_2,\ 2_2,\ 0_3),\ (1_3,\ 2_3,\ 0_1),\ (0_1,\ 0_2,\ 0_3).$$

   Check that these initial blocks may be developed to form a BIB design.

3. Construct a BIB design by developing the blocks in 2 above and give its parameters.

4. Using the BIB design constructed above, construct a BIB with $v = 9,\ b = 12,\ k = 6$.

5. You are to plan an experiment to study the effect of 2 different culture-mediums and 3 different experiment times on the growth of a particular virus. Each day, six observations can be taken under identical conditions and the experiment is to be continued for 3 days. Suggest a design for this factorial experiment.

6. In the context of a $3 \times 2 \times 4$ factorial experiment with factors F_1, F_2 and F_3, write down the expression for the contrasts belonging to the main effect F_2 and interaction $F_1F_2F_3$.

7. Consider the 3×4 factorial arranged in a design d with 12 blocks, as shown below: (Blocks are shown as columns)

00	00	00	01	01	01	02	02	02	03	03	03
11	12	13	10	12	13	10	11	13	10	11	12
22	23	21	23	20	22	21	23	20	22	20	21

   Derive the C matrix of d and show that d has OFS and balance.

8. Construct an orthogonal array $OA(9, 4, 3, 2)$ starting from 2 mutually orthogonal Latins squares of order 3.

9. What is a main effect plan, or equivalently, a Resolution III plan?

10. From the $OA(9, 4, 3, 2)$ constructed in question 9 above, obtain a 9-run main effect plan for a 3^4 factorial.