

2021

STATISTICS — HONOURS

Paper : CC-13

(Design of Experiments)

Full Marks : 50

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

Group - A

Answer *any five* questions.

2×5

1. What do you understand by the term Experimental Designs?
2. How will you check the normality in fractional factorial designs?
3. Explain the term 'local control' with example.
4. Define 'contrasts' and explain their significance.
5. Why is a Latin Square design called so? How is the MSE reduced in such a design?
6. Assume you have ten wheat varieties and you plan a yield trial. List some of the points you should consider in choosing a design. Possible designs are RBD, CRD and LS.
7. What should you conclude if you find that the F-test for replications is significant in a CRD?
8. What are the reasons for choosing a split plot design in an industrial experimentation?

Group-B

Answer *any two* questions.

5×2

9. Consider the following 2^4 factorial design with factors A, B, C and D in the usual order.
Block 1 : (0,0,0,0), (0,1,0,1), (1,0,1,0), (1,1,1,1), (1,1,0,1), (0,0,1,0).
Block 2 : (0,0,1,1), (0,1,1,0), (1,0,0,1), (1,1,0,0), (1,1,1,0), (0,0,0,1).
Block 3 : (0,1,0,0), (0,1,1,1), (1,0,0,0), (1,0,1,1).
Examine whether the main effect of A is estimable.
10. What is a split plot design? Give an example of a situation where this is a natural choice. Distinguish such a design from a confounding factorial experiment.

Please Turn Over

11. Assume five treatments and four replications of a RBD. Treatment two is repeated twice in every block and treatment five is repeated three times in every block. List all the sources of variation and their degrees of freedom. Show possible randomizations of replications 1 and 2.

Group - C

Answer *any three* questions.

12. A psychologist wishes to test the effects of noise level, light level and temperature on the behaviour of monkeys. He plans to use each factor at five levels and assumes that there will be no interactions among these factors. He has 25 monkeys available and intends to use each animal just once.
- Construct a design for this experiment in such a way that all main effects can be estimated, and write down the skeleton analysis of variance table.
 - What problems will be there in interpreting the results of this experiment?
 - What would be the advantages and disadvantages of using each monkey more than once? 6+2+2
13. A car tyre company intends to test four different types of rubber improver for their effects on the wear of tyres. Four test cars are available and each improver can be tested by the company's mechanics on one tyre of each car. The cars will be driven under normal conditions for six months, after which the wear of each tyre on each car will be measured.
- Identify the experimental units, observational units and any suitable block structure for this experiment. Briefly explain your decisions.
 - Construct the design and randomize it. 4+6
14. A chemist plans to investigate the effects of three types of catalyst and four types of reagent on the rate of a chemical reaction. Before planning the experiment she seeks your advice on how to run the experiment. She has written to you as follows— "I intend to study the catalysts first and then the reagents. However, I am restricted to fewer than 50 observations in total. In the first experiment I could use 8 replicates of each catalyst and in the second experiment I could use 6 replicates of each reagent, so that I have 24 observations from each experiment. Alternatively I could use 7 replicates of each catalyst in the first experiment and 7 replicates of each reagent in the second experiment. Which of these would be best?" Make clear notes on the most important points to discuss with her, and explain the statistical motives for discussing these points. 10
15. (a) How would you test equality of all pairs of treatments in a CRD?
- To test three fertilizers N, P and K, each at two levels, 8 pairs of blocks of 4 plots are used. The treatments, N, P, K and NPK are put in one block. What should be the composition of the other block for complete confounding of the second order interactions? Give the ANOVA table for the design and indicate how we can derive our findings from that. 4+6
16. In an agricultural experiment, the farmer decides to use a randomized block design to test the effects of 5 treatments A, B, C, D and E. He uses 4 blocks of size 6 each, and replicates each of the treatments B–E once, and the treatment A twice in order to ensure more precise estimation and testing for A. Use a suitable model and give the ANOVA table for the design. Indicate how you would interpret the result you may get. Also, indicate how you would test the hypothesis that treatment A is twice as effective as treatment B, if there is no evidence that the treatments are equally effective. 10