

Total No. of Printed Pages—12

6 SEM TDC STS M 1 (N/O)

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(May)

STATISTICS

(Major)

Course : 601

(Design of Experiments)

Time : 3 hours

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

(New Course)

Full Marks : 80

Pass Marks : 24

1. Select the correct alternative from the given options : 1×8=8
- (a) In ANOVA, the sum of squares divided by its degrees of freedom, gives the corresponding
- (i) variance
 - (ii) standard deviation
 - (iii) standard error
 - (iv) None of the above

- (b) For the validity of the F -test in ANOVA, one of the assumptions made is
- (i) parent population from which observations are taken is normal
 - (ii) the observations are dependent
 - (iii) various treatment effects are multiplicative in nature
 - (iv) None of the above
- (c) When all experimental units are homogeneous, the most suitable design for an experiment is
- (i) CRD
 - (ii) RBD
 - (iii) LSD
 - (iv) None of the above
- (d) A Latin square design controls
- (i) two-way variation
 - (ii) three-way variation
 - (iii) multiway variation
 - (iv) no variation

- (e) Error sum of squares in an RBD as compared to a CRD using the same material is
- (i) equal
 - (ii) less
 - (iii) more
 - (iv) Not comparable
- (f) In 2^2 -factorial design, the total treatment combinations are
- (i) 2
 - (ii) 4
 - (iii) 6
 - (iv) None of the above
- (g) If different effects are confounded in different blocks, it is said to be
- (i) conservative confounding
 - (ii) balanced confounding
 - (iii) complete confounding
 - (iv) partial confounding

- (h) A split-plot design can be extended to
- (i) double split only
 - (ii) triple split only
 - (iii) multiple split
 - (iv) All of the above

2. Answer the following in brief : 2×8=16

- (a) What do you mean by estimability of a linear parametric function?
- (b) Distinguish between fixed effect and random effect models.
- (c) Define an experimental unit.
- (d) What purpose does replication serve in experimental designs?
- (e) When do you call an experimental design a randomised design? Is Latin square design a randomised design?
- (f) What are the drawbacks of a CRD?
- (g) Explain symmetrical and asymmetrical factorial experiments.
- (h) What are the limitation of confounding?

3. (a) What is a linear model? What is meant by the term linear hypothesis? Discuss the types of linear models which form the basis of the analysis of variance technique. $2+2+5=9$

Or

State and prove Gauss-Markov theorem in the context of linear models. 9

- (b) What do you mean by analysis of variance ? What are the basic assumptions in ANOVA? What is two-way classification? Obtain the least square estimates of the parameters of two-way classification and prepare the analysis of variance table. $2+2+2+4=10$

Or

What do you mean by analysis of covariance? Illustrate with a suitable example. Work out the analysis of covariance for one-way layout (with one concomitant variable only). $2+2+6=10$

4. (a) Give the layout and analysis of a completely randomised block design and explain the situations when it is used. Discuss its demerits. $5+2+2=9$

Or

Explain how the principles of replication, randomisation and local control are used in randomised block design. Obtain the formula for estimating two missing values in an RBD with p treatments and q blocks.

$4+5=9$

- (b) Where do we use Latin Square Design (LSD)? Explain with an example. Write down the statistical model and the hypothesis of interest here. Also give the ANOVA table when one observation is missing and to be estimated. 10

Or

What do you mean by a Latin Square Design? Give the layout and analysis of an LSD. Explain why the number of treatments tested in an LSD should not be less than 3. 10

5. (a) Define main effect and interaction in factorial experiments. A complete 2^3 -experiment is replicated r times. Describe the procedure for testing the presence of different main effects and interactions. 4+5=9

Or

What is meant by confounding in a factorial experiment? Why is confounding used even at the cost of loss of information on the confounded effects? Give the layout of a 2^4 -factorial experiment where the highest order interaction effect is completely confounded. 2+2+5=9

- (b) Explain the principle of confounding in design of experiments. Suppose we have a 2^3 -experiment. With three factors each at two levels. Suppose there are three replicates each divided into 2 blocks, each block of 4 units. Show how you will confound ABC , in the first replication, AC in the second replication and BC in the third replication. 3+6=9

Or

Discuss the nature of the experimental error in split-plot design. Give the statistical model and appropriate analysis of variance table for split-plot design. 3+6=9

(Old Course)

Full Marks : 80

Pass Marks : 32

1. Select the correct alternative from the given options : 1×8=8

(a) If an experiment involves two or more treatments in which some treatments are fixed and the others are of random nature, one should choose

(i) analysis of variance model

(ii) component of variance model

(iii) mixed effect model

(iv) None of the above

(b) In ANOVA, the Cochran's theorem is used to find

(i) the sums of squares

(ii) the probability distribution of sums of squares

(iii) the expected sums of squares

(iv) None of the above

(c) In ANOVA, test of significance is done with the help of

(i) χ^2 -test

(ii) z-test

(iii) t-test

(iv) F-test

- (d) Randomization in an experiment helps to eliminate
- (i) systematic influences
 - (ii) human biases
 - (iii) dependence among observations
 - (iv) All of the above
- (e) When there occurs a missing value in an experiment, treatment sum of square has
- (i) an upward bias
 - (ii) a downward bias
 - (iii) no bias
 - (iv) None of the above
- (f) A randomized block design has
- (i) one-way classification
 - (ii) two-way classification
 - (iii) three-way classification
 - (iv) no classification
- (g) If there is a factor at four levels in a factorial experiment, one can find its
- (i) linear effect
 - (ii) quadratic effect
 - (iii) cubic effect
 - (iv) All of the above

(h) Split-plot design was first used in experiments on

(i) animals

(ii) agriculture

(iii) industry

(iv) All of the above

2. Answer the following in brief : 2×8=16

(a) Distinguish between one-way and two-way classifications.

(b) What do you understand by ANOVA of experimental data?

(c) How is the principle of randomization used in CRD?

(d) State the situation when the missing plot technique arises.

(e) What is meant by efficiency of a design?

(f) Explain symmetrical and asymmetrical factorial experiments.

(g) What is partial confounding?

(h) What are the variations usually exploited in split-plot design?

3. Answer any *two* questions : $9 \times 2 = 18$

(a) What do you mean by analysis of variance? Explain briefly the assumptions made in the analysis of variance. Discuss the fixed effect model and random effect model of analysis of variance. $2+2+5=9$

(b) State the mathematical model used in analysis of variance in a two-way classification (with one observation per cell). Explain the hypothesis to be used. Discuss the advantages of this method over one-way classification, if any. $4+2+3=9$

(c) What do you mean by analysis of covariance? Discuss the technique of analysis of covariance in RBD. $3+6=9$

4. Answer any *two* questions : $10 \times 2 = 20$

(a) Explain the terms, "randomisation", "replication" and "local control". Give the mathematical model assumed in LSD. Explain the analysis of variance table with a single missing observation. $6+4=10$

(b) Give the statistical model and the hypotheses to be tested in an RBD. Also obtain the relative efficiency of an RBD over a CRD. $6+4=10$

- (c) Explain the missing plot technique and state the situation when it arises. Apply the missing plot technique to the case when a plot of yield is missing in an RBD.

$$5+5=10$$

5. Answer any *two* questions :

$$9 \times 2 = 18$$

- (a) State the advantages of factorial experiment over a simple experiment. Give complete statistical analysis of 2^3 -design.

$$2+7=9$$

- (b) What is a treatment contrast? When are two such contrasts said to be orthogonal? Show that in a 2^3 -experiment the main effects and interaction effects are mutually orthogonal. How would you obtain the SS (sums of square) due to main effect or an interaction effect in a 2^3 -experiment?

$$3+3+3=9$$

- (c) What is a split-plot design? Why is it said that this design confounds main effects? Discuss the advantages and disadvantages of the above design.

$$2+2+5=9$$
