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6 SEM TDC STS M 1 (N/O)

2017

(May)

STATISTICS

(Major)

Course : 601

(Design of Experiments)

The figures in the margin indicate full marks for the questions

(New Course)

Full Marks : 80
Pass Marks : 24

Time : 3 hours

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

(a) If $\underset{\sim}{l} = (l_1, l_2, \ldots, l_p)'$ is a linear function of parameters, then

$$\underset{\sim}{l}'\underset{\sim}{\beta} = l_1\beta_1 + l_2\beta_2 + \ldots + l_p\beta_p$$

is called a/an

(i) estimable parametric function

(ii) linearly estimable function

(iii) linear parametric function

(iv) All of the above

(b) 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) mixed effect model

(iii) component of variance model

(iv) random effect model

(c) The factors like spacing, date of sowing and breeds are often used as

(i) experimental units

(ii) blocks

(iii) replicates

(iv) treatments

(d) A Latin square in which the letters occur in alphabetical order is called a/an

(i) orthogonal Latin square

(ii) conjugate Latin square

(iii) reduced Latin square

(iv) Graeco-Latin square

(e) The error sum of squares in RBD as compared to CRD using the same material is

(i) less

(ii) more

(iii) equal

(iv) not comparable

(f) When there occurs a missing value in an experiment, the treatment sum of square has

(i) a downward bias

(ii) an upward bias

(iii) no bias

(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) When do we use analysis of covariance?

(d) What purpose does replication serve in experimental designs?

(e) What is the importance of Latin square design?

(f) Write the procedure of estimating single missing observation in RBD.

(g) Explain symmetrical and asymmetrical factorial experiments.

(h) Write the special features of a split-plot design.

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) Starting from a fixed effects linear model, show the breakup of the total sums of squares (SS) into different component SS, in a two-way classified data. Give the analysis of variance table. Find also the expectation of error mean square. 10

Or

Estimate the parameters of the fixed effects model of analysis of variance for one-way classified data with one observation per cell and write down the analysis of variance table.

4. (a) When do you recommend randomized block design in an agricultural experiment? Outline the statistical analysis of an RBD where p treatments are tested in q blocks. 2+7=9

Or

What do you mean by orthogonal design? Give an example of non-orthogonal design. Show that in an RBD treatment and error effects are mutually orthogonal.

Obtain the formula for estimating two missing values in an RBD with p treatments and q blocks. 2+1+2+4=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 assumptions and applications of an LSD. Discuss how randomization is done in such a design. Find the efficiency of this design in comparison to an RBD. 1+3+2+4=10

5. (a) Explain total and partial confoundings in factorial experiment. When do you call the partial confounding as balanced confounding?

A 2^4-experiment is conducted in 5 replications of 4 blocks each, the factors used being *A*, *B*, *C*, *D*. For each replication, the elements of one of the blocks are *a*, *bc*, *acd*, *bd*. Identify the confounding subgroup and indicate the analysis of the experiment. 3+1+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) Define main effects and interactions 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 are the variations usually exploited 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

Time : 3 hours

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

(a) In ANOVA, the test of significance is done with the help of
- *(i)* t-test
- *(ii)* χ^2-test
- *(iii)* F-test
- *(iv)* All of the above

(b) In analysis of variance model, the main aim of random effect model is
- *(i)* to estimate the effects
- *(ii)* to estimate the variability among the different factors
- *(iii)* to find the variation among the error effects
- *(iv)* All of the above

(c) Principle of local control of an experimental design
- *(i)* reduces the experimental error
- *(ii)* validates the estimate of error
- *(iii)* reduces the precision of the design
- *(iv)* None of the above

(d) A completely randomized design is known as

(i) asymmetric design

(ii) single-block design

(iii) non-restricted design

(iv) All of the above

(e) The error d.f. for an RBD with 6 treatments in 4 blocks with two missing observations is

(i) 13

(ii) 14

(iii) 12

(iv) None of the above

(f) A Latin square design is a

(i) one-restrictional design

(ii) two-restrictional design

(iii) three-restrictional design

(iv) non-restrictional design

(g) If different effects are confounded in different blocks, it is said to be

(i) complete confounding

(ii) partial confounding

(iii) balanced confounding

(iv) None of the above

(h) The ANOVA table in a partially confounded factorial experiment contains

(i) all the treatment effects

(ii) the confounded effects only

(iii) the unconfounded effects only

(iv) None of the above

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

(a) Write the mathematical model used in analysis of variance in a one-way classification.

(b) Complete the following ANOVA table :

Source	*d.f.*	*SS*	*MSS*	*F*
Treatment	4	—	526·69	6·586
Error	—	—	—	
Total	32	—		

(c) Draw the Fisher's diagram showing the various principles of design of experiments.

(d) What is meant by local control and experimental error in a design of experiment?

(e) What are the drawbacks of a CRD?

(f) Why should not the number of treatments tested in LSD be less than three?

(g) Explain the purpose of confounding in factorial experiment.

(h) Mention the merits of a split-plot design.

3. (a) Discuss the role of ANOVA technique in statistical analysis. Describe the procedure of one-way classification of analysis of variance and obtain its ANOVA table. 3+6=9

(b) Explain the analysis of covariance technique with examples. In what respects does analysis of variance differ from analysis of covariance? 4+5=9

Or

Describe the procedure of two-way classification with one observation per cell and construct its analysis of variance table. State the underlying assumptions and show how data may sometimes be transformed to make the assumptions hold. 5+2+2=9

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

(a) Define an experimental unit. Explain in what way the local control increases the efficiency of an experimental design. Explain the missing plot technique and state the situation when it arises.

2+4+3+1=10

(b) What is Latin square design? Give the analysis of variance of this design. Obtain the efficiency of this design as compared to RBD. 10

(c) What is meant by RBD? Describe the layout and analysis of an RBD. What are its advantages and disadvantages? 10

5. Answer any *two* questions : 9×2=18

(a) What is meant by confounding in a factorial experiment and why do we confound the higher order interaction effect in general? Give the ANOVA table for a 2^3-factorial experiment with r replications in which the highest order interaction effect is completely confounded. 4+5=9

(b) Define the following terms in the context of factorial experiments : 3×3=9

(i) Main effects and interactions

(ii) Total and partial confounding

(iii) Yates' method

(c) What is a split-plot design? Why is it said that this design confounds main effects? Give the analysis of this design. 2+2+5=9

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