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(b) How is the efficiency of a design is measured?

Derive the expression to measure the efficiency of LSD over RBD, taking columns of LSD as blocks, stating clearly the assumption used in the derivation. (9,9)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5841

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Unique Paper Code : 2374000008

Name of the Paper : Survey Sampling and Design of Experiments

Name of the Course : **GE**

Semester : VI (NEP-UGCF)

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **five** questions in all. Question number **1** is compulsory.
3. Do remaining **four** questions from **Section A** and **B**, selecting **two** questions from each section.
3. Use of simple non-programable calculator is allowed.

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1. (a) Following is the incomplete ANOVA table for 3 treatments and total 24 observations Identify the design and complete the ANOVA table

Source of Variation	Degrees of freedom	Sum of squares	Mean sum of Squares	F - ratio
Treatments	-	60	-	-
Error	-	90	-	
Total		-		

- (b) An agricultural scientist wants to study the effect of four varieties of wheat V_1, V_2, V_3, V_4 on crop yield. A field is divided into 20 plots. The varieties are assigned to the plots at random, each variety being grown on five plots. Since soil fertility varies across the field, the field is divided into five blocks of equal size.

Identify and explain the following :

1. Name and Number of treatments

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- (b) Define (a) treatment contrast (b) orthogonal treatment contrast.

Let $X = ((1) - (a) + (b) - (abc))$, $Y = ((abc) + (b) - (a) - (1))$, $Z = ((a) - (1) - (b) + (abc))$ be the linear combinations of treatment means.

- (i) Are X, Y, Z contrast?

- (ii) Which of these XY, YZ and ZX are orthogonal? (9,9)

7. (a) Explain Yates technique for calculating sum of squares due to main effects and interaction effects in case of 2^3 factorial experiment with r replications. Also write down the corresponding ANOVA table.

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(b) Obtain the layout of following designs

(i) A CRD with three treatments A, B and C, the replication number being 6, 5 and 10.

(ii) An RBD with 5 treatments in four blocks.

(iii) A 6 x 6 Latin Square Design. (9,9)

6. (a) Show that in a Latin Square Design, the mean sum of squares due to error is always an unbiased estimator of the error variance while mean sum of squares due to treatments is biased estimates of the error variance. Under what condition does it become unbiased for error variance?

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2. Name and Number of experimental units

3. Number of replications

4. The principles of design used in this experiment

5. The design being used

(c) Calculate the minimum number of replications required so that an observed difference of 10% of the mean $\bar{p}$ will be regarded as significant at 5% level of significance, given that the coefficient of variation of plot value is 12%.

(d) Describe briefly the advantages of carrying out a sample survey in preference to a complete enumeration survey. Under what circumstances can complete enumeration be recommended in preference to a sample survey?

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(e) Describe the rule for determining the sample sizes to be allocated different strata if Neyman's optimum allocation.

(f) Define (a) Sampling unit, (b) Sampling frame, (c) Finite population correction factor, and (d) Non-sampling error. (3×6)

SECTION-A

2. Define S.R.S. (i) with replacement, (ii) without replacement from a finite population. Derive the unbiased estimates of the population mean and its variance based on the above two methods. Compare the efficiencies of the estimates of the population mean. (18)

3. Explain the purpose of stratification in sample surveys. Obtain the estimate of the population mean and determine its variance under proportional allocation. Additionally, compare its efficiency with simple random sampling. (18)
4. Show that in SRSWOR, the probability of selecting a specified unit of the population at any given draw is equal to the probability of selecting it at the first draw. Prove that in SRSWOR, the variance of the sample mean is given by

$$Var(\bar{y}_n) = \left(\frac{N-n}{nN} \right) S^2. \quad (18)$$

SECTION-B

5. (a) Write the mathematical model, the hypothesis to be tested, and the underlying assumptions for one-way classified data under fixed effects model. Also find the variance of estimates of μ and $\hat{\alpha}_i$.