2022

(November)

STATISTICS

(Elective/Honours)

[STEH-3 (TH)]

(Categorical Data, Survey Sampling and Design of Experiments)

Marks : 56

Time : 3 hours

The figures in the margin indicate full marks for the questions

Answer **five** questions, taking **one** from each Unit

UNIT—I

1. *(a)* What do you understand by consistency of data? State the conditions for consistency of data. 4

   (b) What do you mean by independence of attributes? Give criteria of independence for two attributes. 3

   (c) What do you mean by coefficient of contingency? Describe how to use the same for a 2×2 contingency table. 5

2. *(a)* When are two attributes said to be—

(i) positively associated;

(ii) negatively associated? 2

(b) Define Yule's coefficient of association and coefficient of colligation. Establish the following relation between coefficient of association Q and coefficient of colligation Y: 1+1+4=6

$$Q = \frac{2Y}{1+Y^2}$$

(c) Show that if $\frac{(A)}{N} = x$, $\frac{(B)}{N} = 2x$, $\frac{(C)}{N} = 3x$ and $\frac{(AB)}{N} = \frac{(BC)}{N} = \frac{(CA)}{N} = y$, then the value of neither x nor y can exceed $\frac{1}{4}$. 4

UNIT—II

3. *(a)* What do you mean by sample survey? Give examples. 3

(b) Discuss briefly the principle of a sample survey. 3

(c) Show that, in SRSWOR, the sample mean square is an unbiased estimate of the population mean square i.e., $E(s^2) = S^2$. 5

4. *(a)* Obtain the expression for the variance of the estimate of population mean for simple random sampling without replacement. 6

(b) Define systematic sampling. Discuss its advantages and disadvantages. 3

(c) Explain how a systematic sample is to be drawn. 2

UNIT—III

5. *(a)* Obtain the estimate of the population mean by the method of stratified simple random sampling and also obtain the variance of the estimate. 5

(b) In stratified random sampling, show that $\text{var}(\bar{y}_{st})$ is minimum for fixed total size of the sample n if $n_i \propto N_i S_i$ where N_i is the number of sampling units in the ith stratum $(i = 1, 2, \cdots, k)$, n_i is the number of sampling units selected with SRSWOR from the ith stratum and S_i^2 is the population mean square of the ith stratum. 6

6. Obtain the variance of the estimates of the population mean under stratified random sampling with proportional and optimum allocation respectively and show that under certain conditions to be stated $\text{var(opt)} \leq \text{var(prop)}$. 11

UNIT—IV

7. *(a)* What is analysis of variance? State the basic assumptions in the analysis of variance. 1+1=2

(b) Discuss the analysis of variance of a one-way classified data with one observation per cell. 4

(c) State the mathematical model used in analysis of variance in a two-way classification. Explain the hypothesis to be used. Discuss the advantages of this method over one-way classification. 1+2+2=5

8. *(a)* Explain the principles of replication, randomization and local control in experimental design pointing out the role each one plays in the valid and accurate interpretation of the data. 6

(b) Define 'experimental error'. What are its main sources? What methods are adopted to increase the accuracy of an experiment? 1+2+2=5

UNIT—V

9. *(a)* Give the layout of a completely randomized block design and explain the situations when it is used. 4+2=6

(Continued)

(b) What is the use of 'missing plot technique'? Show that in a randomized block design with r blocks and t plots, the analysis can be carried out by substituting the value

$$y = \frac{rB + rT - G}{(r-1)(t-1)}$$

for the missing yield, B = the actual of the block with the missing unit, T = the total of yields of the treatment with the missing unit and G = the grand total. 2+3=5

10. *(a)* What is a factorial experiment? Define the terms 'main effects' and 'interaction effects' in relation to a 2^3-experiment. 5

(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. 1+1+4=6

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