2017

(October)

STATISTICS

(Elective/Honours)

(Categorical Data, Survey Sampling and Design of Experiments)

[STEH-3 (TH)]

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 mean by independence of attributes? Show that if the attributes A and B are independent, then the proportion of AB's in the population is equal to the product of the proportions of A's and B's in the population. 1+5=6

(b) Show that for n attributes

$$A_1, A_2, A_3, \cdots, A_n \; (A_1 A_2 A_3 \cdots A_n) \geq (A_1) + (A_2) + (A_3) + \cdots + (A_n) - (n-1)N$$

where N is the total number of observations. 6

2. (a) What is association of attributes? Does association between two attributes imply a causal relationship? Explain. 2+4=6

(b) Show that

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

and hence that Q is greater in absolute value than Y, except when both are zero or ± 1 (notations have their usual meanings). 4+2=6

UNIT—II

3. (a) What is a sample survey? In what respects is it superior to a census survey? 2+4=6

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

(c) How does sampling with replacement differ from that of without replacement? 2

(Continued)

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

(b) Explain how systematic sampling is carried out. Obtain the variance of the estimate of the population mean under the systematic method of sampling. 2+3=5

UNIT—III

5. (a) Explain the purpose of stratification in sample surveys. Describe the advantages of stratified sampling with illustrations. 2+4=6

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

6. (a) With a cost function

$$c = a + \sum_{i=1}^{k} c_i n_i$$

prove that the variance of the estimate of the population mean $\bar{y}_{st}$ is minimum when

$$n_i \propto \frac{N_i S_i}{\sqrt{c_i}}$$ 6

(Turn Over)

(b) Show that

$$V(\bar{y}_{sys}) = \frac{k-1}{nk} S^2_{wst} [1+(n-1)\rho_{wst}]$$

(Notations have their usual meanings.) 5

UNIT—IV

7. (a) What is analysis of variance? Discuss the analysis of variance of a one-way classified data with one observation per cell. 1+5=6

(b) 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, randomisation and local control in experimental designs 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

(Continued)

UNIT—V

9. (a) What is meant by randomised block design? Discuss the layout and analysis of a randomised block design. 2+4=6

(b) Write the mathematical model for Latin Square Design and explain the ANOVA table for such design. 5

10. (a) What is the use of 'missing plot technique'? Show that in a randomised block design with r blocks and t plots, by substituting the value

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

for the missing yield, the treatment sum of squares is overestimated by

$$[B-(t-1)y]^2 / t(t-1)$$

where B = the actual total 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

(b) What is a factorial experiment? In what respects is it different from a single-factor experiment? Define the terms main effects and interaction effects in relation to a 2^2-experiment. 1+2+3=6

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