LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc., DEGREE EXAMINATION – STATISTICS

THIRD SEMESTER – NOVEMBER 2013

ST 3505/ST 3504/ST 3502/ST 4500 – SAMPLING THEORY

Date : 06/11/2013   Dept. No.   Max. : 100 Marks
Time : 9:00 - 12:00

PART – A

ANSWER ALL QUESTIONS: (10 x 2 =20)

1. Define the term "Parameter" in the context of Sampling Theory.

2. Distinguish between Variance and Mean Square error of an estimator.

3. Compare SRSWR and SRSWOR.

4. Suggest an unbiased estimator for the population mean under SRSWOR.

5. What do you mean by allocation problems?

6. Define : Neyman allocation

7. List all possible linear systematic samples when N=13 and n=4 and give your comments.

8. Is sample mean unbiased for population mean under stratified sampling? Justify your answer.

9. Is ratio estimator unbiased for the population total/mean? Justify your answer.

10. Define : Regression estimator.

PART – B

ANSWER ANY FIVE QUESTIONS: (5 x 8 =40)

11. Show that when $N = 3, n = 2$ in simple random sampling, the estimator

$$\hat{\bar{Y}}^* = \begin{cases} \dfrac{1}{2}Y_1 + \dfrac{1}{2}Y_2 \text{ if } s = \{1,2\} \\ \dfrac{1}{2}Y_1 + \dfrac{2}{3}Y_3 \text{ if } s = \{1,3\} \\ \dfrac{1}{2}Y_2 + \dfrac{1}{3}Y_3 \text{ if } s = \{2,3\} \end{cases}$$

is unbiased for the population mean and derive the condition under which $V(\hat{\bar{Y}}^*) > V(\hat{\bar{Y}})$.

12. Compare Sampling with Census.

13. Derive the variance of sample mean under SRSWOR.

14. Define proportional allocation. Derive the variance of the usual estimator for the population mean under stratified sampling when proportional allocation is used.

15. Describe Circular Systematic Sampling.

16. Explain the role of auxiliary information with examples in survey sampling.

17. Derive the bias and mean square error of the ratio estimator.

18. Derive the formula for stratum sample size under Neyman allocation.

PART – C

ANSWER ANY TWO QUESTIONS: **(2 x 20 = 40)**

19. (a) Show that the unbiasedness of an estimator depends on the sampling design with an example.
(8)

(b) Is the number of distinct units in a SRSWR sample a random variable? Derive the variance of the mean of distinct units in sample when SRSWR is used assuming the sample size is 3.   (6)

(c) Under the usual notations, show that $E(s^2) = S^2$ in SRSWOR.   (8)

20. (a) A sampler has two strata with relative sizes $W_1 = \dfrac{N_1}{N}$ and $W_2 = \dfrac{N_2}{N}$. He believes that S_1, S_2 can be taken as equal. For a given cost $C = c_1 n_1 + c_2 n_2$, show that (assuming N_h is large)

$$\left[\frac{V_{prop}}{V_{opt}}\right] = \frac{\left[W_1 c_1 + W_2 c_2\right]}{\left[W_1 \sqrt{c_1} + W_2 \sqrt{c_2}\right]^2}.$$
(15)

(b) Compare $V(\bar{y}_{st})$ under proportional and Neyman allocation assuming the strata size are large. (5)

21. Derive the variance of linear regression estimator and compare its performance with ratio estimator.   (5+15)

22. Write short notes on the following :
    (a) Strata formation
    (b) Limitations of systematic sampling methods
    (c) Relationship between bias and mean square error
    (d) Stratified sampling Vs Systematic Sampling.   (4x5 = 20)

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