

Seat No. : _____

N15-101
November-2014
B.Sc., Sem.-V
Statistics
STA-303 : Sampling Techniques

Time : 3 Hours]

[Max. Marks : 70

- Instructions :** (1) Each question carry equal marks.
(2) **All** questions are compulsory.
(3) Scientific calculator is allowed.

1. (a) Explain stratified random sampling for attributes for proportion case in detail by giving all its notations and derive the formula for mean and variance of it. 7

OR

For optimum allocation when sample size n is fixed, derive the formula for variance for proportion case in stratified sampling.

- (b) If $V_1 = V(Y_{st})$ and $V_2 = V_{opt}(Y_{st})$ denotes the variances given by $n_1 = n_2$ and Neyman allocation respectively then show that :

$$\frac{V_1 - V_2}{V_2} = \left(\frac{r - 1}{r + 1} \right)^2, \text{ where } r = \frac{n_1}{n_2} \text{ given by Neyman allocation, f.p.c. may ignored.}$$
7

OR

Explain the method of drawing a sample in Stratified sampling and derive the expression for unbiased estimator of the population mean and also find the variance of this estimator.

2. (a) Explain in detail the procedure of drawing a random sample by simple random sampling technique. Also give properties for both the methods SRSWR and SRSWOR. 7

OR

For simple random sampling without replacement show that :

- (i) \bar{y} is an unbiased estimate of Y

(ii) $V(\bar{y}) = \frac{N - n}{N} \cdot \frac{S^2}{n}$

- (b) In a population of size $N = 5$ the values of y_i are 2, 4, 6, 8, 10. Select samples of sizes $n = 3$ and Show that $V(y)$ from sampling without replacement is less than that of obtained from sampling with replacement. 7

OR

Show that in simple random sampling without replacement, the variance of y is less than the variance in case of sampling with replacement.

3. (a) Explain the procedure of systematic sampling in detail and state its merits and demerits. Obtain the formula for variance of mean of systematic sampling. Define demand and supply law. 7

OR

“Positive correlation between the units in the same sample inflates the variance of the sample mean in systematic sampling.” Obtain a formula justifying this statement. Also compare it with S.R.S.

- (b) Compute S_{wsy} and S_{wst} for the following data : 7

Stratum	Systematic sampling		
1	9	12	3
2	5	2	7

OR

- (i) If $N = nk$, show that Y_{sy} is an unbiased estimate of the population mean.
- (ii) If $N = 1000$, $n = 12$, $S^2 = 50$ and $\rho = \frac{1}{11}$ then obtain the efficiency of systematic random sampling with respect to sample random sampling.

4. (a) For two stage sampling for units of equal sizes prove that 7

$$V(y) = \left(\frac{N-n}{N} \right) \cdot \frac{S_1^2}{n} + \left(\frac{M-m}{M} \right) \cdot \frac{S_2^2}{mn}$$

OR

Explain the procedure for finding mean and variance in two stage sampling. Also derive $V(\hat{\theta}) = V_1 [E_2(\hat{\theta})] + E_1(V_2(\hat{\theta}))$

- (b) Explain the procedure of two stage sampling. Give illustration where it can be used. 7

OR

In usual notations prove that an unbiased estimate of $V(y)$ is

$$V(y) = \frac{1-f_1}{n} S_1^2 + \frac{f_1(1-f_2)}{mn} S_2^2$$

$$\text{Where, } S_1^2 = \frac{1}{n-1} \sum_{i=1}^n (y_i - \bar{y})^2 \text{ and } S_2^2 = \frac{1}{n(m-1)} \sum_{i=1}^n \sum_{j=1}^m (y_{ij} - \bar{y})^2$$

5. Write answer in short :

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- (1) Give the formula for the efficiency of systematic sampling with respect to simple random sampling.
 - (2) Who was the founder of two stage sampling ?
 - (3) Give reason why systematic sampling is called a particular case of cluster sampling.
 - (4) Define f.p.c and sampling fraction.
 - (5) Give the formula for variance of p_{st} in the case of proportional allocation.
 - (6) Give two merits and demerits of systematic sampling.
 - (7) Why sub-sampling is known as incomplete stratification ?
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