SARDAR PATEL UNIVERSITY
M.Sc.(II Semester) Examination
2019
Tuesday, 26th March
10:0 a.m. to 1:00 p.m.
Course No. PS02CSTA24/04
(Theory of Sample Surveys)
Note: Figures to the right indicate marks. (Total marks: 70)

1 Write the correct answer (each question carries one mark).   08
  (a) Under PPSWOR, Murthy's estimator is
       (A) an unordered estimator   (B) more efficient than Des Raj estimator
       (C) useful only for $n = 2$ (D) (A) and (B) but not (C)
  (b) At least one unbiased estimator of the variance of the Horvitz-Thompson is available if
       (A) $\pi_i > 0, \pi_{ij} > 0 \ \forall \ i \neq j \in U$ (B) design is πps design
       (C) design is fixed-size design   (D) design is varying probability
  (c) To the second order of approximation, the bias of $\widehat{\overline{Y}}_R$ is zero provided
       (A) $\rho = CV(\overline{x})/CV(\overline{y})$ (B) $R = \beta$
       (C) relation between y and x is linear passing through zero (D) all of the above
  (d) Cluster sampling is less precise than SRSWOR if
       (A) $\rho_c > 0$ (B) $\rho_c < 0$
       (C) $\rho_c = 0$ (D) clusters are homogeneous

  (e) We use _____ sampling when there is a considerable variation between groups but the within groups are essentially similar to each other.
       (A) Systematic sampling   (B) Stratified sampling
       (C) Cluster sampling   (D) none.
  (f) In large samples, the product estimator of the population mean is more efficient than the simple mean if
       (A) $\rho > cv(x)/2cv(y)$ (B) $\rho < - cv(x)/2cv(y)$
       (C) $- cv(x)/2cv(y) < \rho < cv(x)/2cv(y)$ (D) none
  (g) Two-stage sampling is appropriate when
       (A) clusters are homogeneous   (B) cluster are heterogeneous
       (C) clusters are of large size   (D) (A) and (C) but not (B)
  (h) Non-sampling errors are
       (A) errors due incomplete or overlap sampling frame
       (B) measurement errors
       (C) errors due to item non-response or total non-response
       (D) all errors except sampling error

2 Answer any SEVEN of the following (each question carries two marks)   14
  (a) State and prove the relations among inclusion probabilities.
  (b) Obtain the alternative expression for the variance of PPS estimator.
  (c) Define PPS systematic sampling. State its merits and demerits.
  (d) Specifying a super-population show that ratio estimator is optimal.

(e) Obtain Hartley-Ross estimator for the population mean. Also, obtain its approximate variance.

(f) Show that s_b^2 is unbiased for S_b^2.

(g) Discuss cluster sampling for proportion.

(h) Let V_{ran}, V_t and V_{cl} be the variance expressions under SRSWR, two-stage sampling (SRSWR at both stages) and cluster sampling with SRSWR. Show that $V_{ran} \leq V_t \leq V_{cl}$.

(i) What is the rationally behind the use of two-phase sampling? Define independent double sampling.

3 (a) Define PPSWR sampling and PPS sample selection procedures.　　　　　06
State and prove three fundamental results of PPSWR sampling.

(b) Define Rao-Hartley- Cochran strategy and obtain its variance and variance estimator.

OR

(b) For varying probability and without replacement sampling scheme obtain unbiased linear estimator of the population total. Also, obtain its variance and variance estimator.

4 (a) Define regression estimator of population mean under SRSWOR. Derive its bias　06
and variance to the first order of approximation. Compare this estimator with mean per element and the ratio estimator.

(b) Write a detail note on the ordinary ratio estimator of the population mean.　　　06

OR

(b) Write a detail note on the product estimator of the population mean.

5 (a) Define cluster sampling State and prove its fundamental results. Further show that the　06
relative efficiency of cluster sampling as compared to SRSWOR will be large if clusters are so formed that the variation between the cluster means is as small as possible while variation within the clusters is as large as possible.

(b) Suppose that the finite population consists of N FSUs and each FSU contains M SSUs.　06
Suppose that SRSWOR is used at both the stages. Obtain unbiased estimator of $\bar{Y}_{..}$ and also obtain its variance.

OR

(b) Obtain unbiased Estimator of the variance of two-stage estimator when clusters are of equal size and SRSWOR is used at both the stages.

6 (a) Write a note on non-sampling errors.　　　　　06

(b) How will you use PPS sampling if $\bar{X}$ is not known. Obtain an unbiased estimator of　06
$\bar{Y}$ and its variance.

OR

(b) Discuss double sampling for Ratio estimation.

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