(Pages : 2) **W – 5617**

Reg. No. :

Name :

First Semester M.Sc. Degree Examination, January 2026

Statistics

ST 514 — SAMPLING TECHNIQUES

(2021 Admission Onwards)

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer any **four** questions. Each question carries **3** mark.

1. How do sampling errors occur? What are the sources of it?
2. How can you determine the sample size in SRSWOR?
3. What do you mean by post stratification? Will it increase the precision of the estimate? Establish your claim.
4. What is balanced Systematic sample?
5. Discuss Midzuno-Sen scheme of sampling in PPSWOR.
6. Explain Murthy's unordered estimator.
7. Derive Hartley-Ross unbiased ratio type estimator.
8. Distinguish between multistage sampling and multiphase sampling.

(4 × 3 = 12 Marks)

SECTION – B

Answer any **three** questions. Each question carries **8** marks.

9. Show that the sample mean $\bar{y}$ is an unbiased and consistent estimate of the population mean in SRS and show that $V_{SRSWOR}(\bar{y}) = \frac{N-n}{N-1} V_{SRSWR}(\bar{y})$.

10. Prove that the sample proportion is an unbiased and consistent estimate of the population proportion in SRSWOR, Hence establish a $100(1-\alpha)\%$ confidence interval for the population proportion.

T.O.

11 Explain a method of fixing the sample size of a SRSWR with a marginal error of ε and a confidence coefficient of $1-\alpha$.

12 For populations with a linear trend, prove with usual notations

$$V(\bar{y}_{sy}) : V(\bar{y}_{sy}) : V(\bar{y}_{ran}) = \frac{1}{n} : 1 : n .$$

13 Under Systematic Sampling show that the estimate of the population mean is more precise than that of SRS if and only if $S_w^2 > s^2$, where S_w^2 is average of the within sample mean square and S^2 is the population mean square.

14 Discuss how stratification is effective in random sampling. Estimate the population mean and its variance under proportional allocation and optimum allocation.

(3 × 8 = 24 Marks)

SECTION – C

Answer any **three** questions. Each question carries **8** marks.

15 Distinguish between ordered and unordered estimators in *ppswor.* Define Desraj's ordered estimator for the population total using a sample of size 2 and show that it is unbiased. Obtain an estimate of its variance.

16 Derive the expression for the population total by the Horwitz-Thomson and the Yates-Grundy estimates of its variance.

17. Obtain a necessary and sufficient condition for PPSWOR to be better than the PPSWR.

18. Define ratio estimators. With usual notations show that ratio estimator is better than the SRSWOR when $\rho > (1/2)\left(C_x / C_y\right)$.

19. Establish the optimum property of the regression estimator of the population mean stating the regularity conditions.

20. What is cluster sampling? Given a sample of n clusters of M units each selected by SRSWOR, explain how will you estimate the efficiency of cluster sampling as compared to SRSWOR of nM units.

(3 × 8 = 24 Marks)

(Pages : 3) **U – 6596**

Reg. No. : .

Name :

First Semester M.Sc. Degree Examination, February 2025

Statistics

ST 514 — SAMPLING TECHNIQUES

(2021 Admission Onwards)

Time : 3 Hours Max. Marks : 60

PART – A

(Answer **any four** questions. Each question carries **3** marks)

1. Explain the following terms :
   (a) Sampling unit;
   (b) The sampling frame and
   (c) Sampling design
2. How can you determine the sample size in SRSWOR?
3. Obtain the expression for the sample size n_i for the i^{th} stratum under optimum allocation in stratified random sampling assuming a suitable cost function.
4. What is balanced Systematic sample?
5. Describe the Lahiri's method of selection under *PPS* sampling.
6. Explain Murthy's unordered estimator.
7. Show that the ratio estimators are biased.
8. In what situations do you prefer cluster sampling?

($4 \times 3 = 12$ Marks)

P.T.O.

PART – B

(Answer **any three** questions. Each question carries **8** marks)

9. Show that the sample mean $\bar{y}$ is an unbiased and consistent estimate of the population mean in SRS and show that $V_{SRSWOR}(\bar{y}) = \frac{N-n}{N-1} V_{SRSWR}(\bar{y})$.

10. Show that the probability of selecting a specified unit in any draw is the same as the probability of selecting that unit in the first draw in a *SRSWOR.* Also show that the sample mean is the *BLUE* of the population mean in a *SRSWOR* procedure.

11. Show that in *SRSWR,* the sample mean square error is an unbiased estimator of the population variance. Also show that an estimate based on '*d*' distinct units is superior to the one based on '*n*' units $(d < n)$.

12. Discuss how stratification is effective in random sampling. Estimate the population mean and its variance under proportional allocation and optimum allocation.

13. Explain linear Systematic Sampling. Show that systematic sampling is more precise than SRS if and only if $S^2_{wsy} > S^2$, where S^2_{wsy} is the within sample mean square and S^2 is the population mean square.

14. For populations with a linear trend, prove with usual notations $V(\bar{y}_{st}) : V(\bar{y}_{sy}) : V(\bar{y}_{ran}) = \frac{1}{n} : 1 : n$.

(3 × 8 = 24 Marks)

PART – C

(Answer **any three** questions. Each question carries **8** marks)

15. Discuss PPSWR and any method to select a sample using PPSWR. Estimate the population mean and establish the expression for its variance.

16. Explain the Midzuno scheme of sampling in PPSWOR. Show that under this scheme the Yates-Grundy estimate of the variance of the Horwitz-Thomson estimate of the population mean is more efficient than the population mean with PPSWR.

17. Distinguish between ordered and unordered estimators in PPSWOR. Define Desraj's ordered estimator for the population total using a sample of size 2 and show that it is unbiased. Obtain an estimate of its variance.

18. What do you mean by ratio estimators? Prove with usual notations that ratio estimator is more efficient than the SRSWOR when $\rho > \left(\frac{1}{2}\right)\left(\frac{C_x}{C_y}\right)$.

19. Discuss the regression estimates in stratified sampling. Also compare the variances of these estimates with the optimum choices.

20. Explain single stage cluster sampling with unequal cluster sizes. Compare the variances of the estimates of the population total in single stage cluster sampling with unequal cluster sizes by any two familiar methods.

($3 \times 8 = 24$ Marks)

(Pages : 3) **S – 6274**

Reg. No. :

Name :

First Semester M.Sc. Degree Examination, April 2024

Statistics

ST 514 : SAMPLING TECHNIQUES

(2021 Admission Onwards)

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer any **four** questions. Each question carries **3** marks.

1. Distinguish between sampling errors and non-sampling errors. What are the sources of them?

2. Explain probability sampling and non-probability sampling. Also mention the sampling designs under this.

3. What do you mean by post stratification? Will it increase the precision of the estimate? Establish your claim.

4. What is meant by circular systematic sampling?

5. Describe Zen-Midzuno scheme of sampling.

6. What is meant by difference estimator?

7. What are the conditions under which a ratio estimator is a BLUE?

8. Compare cluster sampling and two stage sampling?

(4 × 3 = 12 Marks)

P.T.O.

SECTION – B

Answer any **three** questions. Each question carries **8** marks.

9. Prove that sample mean square is an unbiased estimate of the population mean square in SRSWR. Also compute the estimate of its variance.

10. Show that the sample proportion is an unbiased and consistent estimate of the population proportion in SRSWOR. Hence establish a $100(1-\alpha)\%$ confidence interval for the population proportion.

11. Discuss a method of fixing the sample size of a SRSWR with a marginal error of ε and a confidence coefficient of $1-\alpha$.

12. Establish an unbiased estimate of the population proportion and its unbiased estimated variance when random sampling is with stratification.

13. Describe how stratum sample sizes are determined for optimum allocation in stratified sampling. With usual notations, show that $V_{opt} \leq V_{prop} \leq V_{srs}$.

14. Compare the efficiency of Systematic Sample with SRSWOR in terms of the intra class correlation coefficient.

($3 \times 8 = 24$ Marks)

SECTION – C

Answer any **three** questions. Each question carries **8** marks.

15. Prove that a necessary and sufficient condition for PPSWOR to be better than the PPSWR is that $\pi_{ij} \leq 2\left(\frac{n-1}{n}\right)\pi_i\pi_j$, where π_i, π_j and π_{ij} are the inclusion probabilities of first and second order respectively.

16. Establish the expression for the population total by the Horwitz–Thomson and the Yates–Grundy estimates of its variance?

17. Discuss Basu–Murthy's unordered estimator as a weighted average of the Des Raj's ordered estimator for a sample of size two. Derive its estimated variance also.

18. Describe the Hartley and Ross estimator under SRSWOR and derive its bias. Also find the estimate of the population total corrected for the bias.

19. What is meant by linear regression estimator for the population mean? Compare the efficiency of the regression estimator with those based on mean per unit and ratio estimation procedure.

20. Give an unbiased estimate of the population mean in two stage sampling with first stage units are chosen according to PPSWR and second stage units according to SRSWOR. Also derive an unbiased estimate of its variance.

($3 \times 8 = 24$ Marks)

(Pages : 3) **R – 6199**

Reg. No. : .....

Name : .....

First Semester M.Sc. Degree Examination, May 2023

Statistics

ST 514 : SAMPLING TECHNIQUES

(2021 Admission Onwards)

Time : 3 Hours Max. Marks : 60

PART – A

Answer any **four** questions. Each question carries **3** marks.

1. What are the sources of sampling errors?

2. Explain the following terms: (a) Sampling unit; (b) the sampling frame and (c) sampling design.

3. Discuss the advantages of stratified random sampling.

4. Define circular systematic sampling.

5. Discuss the use of auxiliary information in sampling.

6. Explain Midzuno-Sen scheme of sampling in PPS sampling.

7. Discuss Murthy's unordered estimate.

8. Discuss double sampling in brief.

($4 \times 3 = 12$ Marks)

P.T.O.

PART – B

Answer any **three** questions. Each question carries **8** marks.

9. Show that the probability of selecting a specified unit in any draw is the same as the probability of selecting that unit in the first draw in a *SRSWOR*. Show that the sample mean is the *BLUE* of the population mean in a *SRSWOR* procedure.

10. Prove that the sample mean $\bar{y}$ is an unbiased and consistent estimator of the population mean in SRS and also that $V_{SRSWOR}(\bar{y}) = \frac{N-n}{N-1} V_{SRSWR}(\bar{y})$.

11. How do you determine the sample size in SRSWR. Give a 95% confidence interval for the population proportion in SRSWR.

12. Obtain the expression for the sample size n_i for the ith stratum under optimum allocation in stratified random sampling assuming a suitable cost function.

13. Explain linear systematic sampling. Show that systematic sampling is more precise than SRS if and only if $S^2_{wsy} > S^2$, where S^2_{wsy} is the within sample mean square and S^2 is the population mean square.

14. Discuss how stratification is effective in random sampling. Estimate the population mean and its variance under proportional allocation and optimum allocation.

($3 \times 8 = 24$ Marks)

PART – C

Answer any **three** questions. Each question carries **8** marks.

15. Define Horwitz — Thompson estimator under PPSWOR scheme for the population total. Is it unbiased? Obtain an expression for its variance.

16. Distinguish between ordered and unordered estimators in *ppswor*. Define Desraj's ordered estimator for the population total using a sample of size 2 and show that it is unbiased. Obtain an estimate of its variance.

17. Obtain a necessary and sufficient condition for PPSWOR to be better than the PPSWR in terms of the inclusion probabilities.

18. Define ratio estimators. With usual notations show that ratio estimator is better than the SRSWOR when $\rho > (1/2)(C_x / C_y)$.

19. Suggest a linear regression estimator for the population mean. Is it unbiased? Obtain the expression for the variance of the estimator.

20. What is cluster sampling? Given a sample of n clusters of M units each selected by SRSWOR, interpret how will you estimate the efficiency of cluster sampling as compared to SRSWOR of nM units.

($3 \times 8 = 24$ Marks)

(Pages : 3) **N – 5389**

Reg. No. : .....

Name : .....

First Semester M.Sc. Degree Examination, May 2022

Statistics

ST 514 – SAMPLING TECHNIQUES

(2021 Admission)

Time : 3 Hours Max. Marks : 60

PART – A

Answer **any four** questions. **Each** question carries **3** marks.

1. Show that in SRS, $P_{ir} = \frac{1}{N}$, where P_{ir} denotes the probability of selecting the i^{th} unit in the r^{th} draw in a population of size N.
2. Discuss the problem of non-response in a Sample Survey.
3. What is balanced Systematic sample?
4. Find out the similarities and dissimilarities between Stratified sampling and Custer sampling.
5. Explain Lahiri's method under PPS Sampling method.
6. Describe the procedure of drawing samples using Cumulative Total method.
7. Show that the ratio estimators are biased.
8. Distinguish between multistage and multiphase sampling.

($4 \times 3 = 12$ Marks)

P.T.O.

PART – B

Answer **any three** questions. **Each** question carries **8** marks.

9. Show that in *SRSWR*, the sample mean square error is an unbiased estimator of the population variance. Also show that an estimate based on *d* distinct units is superior to the one based on *n* units ($d < n$).

10. Explain a method of fixing the sample size of a SRSWR with a marginal error of a ε and a confidence coefficient of $1-\alpha$.

11. Show that the sample proportion is a consistent estimate of the population proportion in SRSWOR. Hence establish a 100 $(1-\alpha)$% confidence interval for the population proportion.

12. Give an unbiased estimate of the population proportion and its unbiased estimated variance when random sampling is with stratification. Compare it with SRSWR.

13. Explain how stratum sample sizes are determined in optimum allocation in stratified sampling. With usual notations, show that $V(\bar{y}_{st}) : V(\bar{y}_{sy}) : V(\bar{y}_{ran}) = \frac{1}{n} : 1 : n$.

14. Explain linear systematic sampling. Compare the efficiency of Systematic Sample with SRSWOR in terms of the intra class correlation coefficient.

($3 \times 8 = 24$ Marks)

PART – C

Answer **any three** questions. **Each** question carries **8** marks.

15. Show that a necessary and sufficient condition for PPSWOR to be better than the PPSWR is that $\pi_{ij} \leq 2\left(\frac{n-1}{n}\right)\pi_i \pi_j$ where π_i, π_j and π_{ij} are the inclusion probabilities of first and second order respectively.

16. Explain the Midzuno-Zen scheme of sampling. Show that under this scheme the Yates-Grundy estimate of the variance of the Horwitz-Thomson estimate of the population mean is more efficient than the population mean with PPSWR.

17. Define Basu-Murthy's unordered estimator as a weighted average of the Des Raj's ordered estimator for a sample of size two. Derive its estimated variance also.

18. What is meant by linear regression estimator for the population mean? Establish the optimum property of the regression estimator of the population mean stating the regularity conditions.

19. What are the two types of ratio estimates in Stratified sampling? Compare the two methods in terms of their variances.

20. Give an unbiased estimate of the population mean in two stage sampling with first stage units are chosen according to PPSWR and second stage units according to SRSWOR. Also derive an unbiased estimate of its variance.

($3 \times 8 = 24$ Marks)

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