

STA 501

Reg. No.

**CREDIT BASED FIFTH SEMESTER B.Sc. DEGREE EXAMINATION
OCTOBER 2012
STATISTICS
SAMPLING THEORY**

Time: 3 Hrs

Max. Marks: 80

PART - A

Answer any TEN of the following:

2X10=20

1. a) Define sampling frame.
- b) What is the need for sampling?
- c) Distinguish between census and sample survey.
- d) Define SRSWOR.
- e) Describe stratified random sampling.
- f) Mention any two merits of stratified sampling.
- g) Explain optimum allocation in case of stratified random sampling.
- h) Give an example for cluster sampling.
- i) What is Judgement sampling?
- j) What do you mean by a Pilot survey?
- k) What is Quota sampling?
- l) Mention any two merits of systematic sampling.

PART - B

Answer any TWO of the following:

10x2=20

2. a) What is a sample survey? In what respect it is superior to a census survey?
- b) Briefly explain the principles of sample survey. **(5+5)**
3. a) Explain the lottery method of drawing a simple random sample.
- b) What are the main steps in a sample survey? Discuss them briefly. **(4+6)**
4. a) What are the different sources of errors in a sample survey? Describe briefly how these errors can be controlled.
- b) State the limitations of sampling. **(6+4)**

Answer any TWO of the following:

10x2=20

5. a) Obtain an expression for $V(\bar{y})$ under SRSWOR. (5+5)
- b) State the merits and demerits of simple random sampling. (5+5)
6. a) Under SRSWOR, show that sample mean square is an unbiased estimator of population mean square. (5+5)
- b) Under SRSWR obtain an expression for the determination of sample size. (5+5)
7. a) Prove that $V(\bar{y}_{st})$ is minimum for fixed total size of the sample (n) if $n_h \propto N_h S_h$. (5+5)
- b) Show that $V(\bar{y})_{opt} \leq V(\bar{y})_{prop}$. (5+5)

Answer any TWO of the following:

10x2=20

8. a) Compare systematic sample with stratified random sample. (4+6)
- b) Show that $V(\bar{y}_{sys}) = \left(\frac{nk-1}{nk}\right) S^2/n \{1 + (n-1)\rho\}$ (4+6)
9. a) Define systematic sampling with an example and with usual notations show that
- $$V(\bar{y}_{sys}) = \frac{N-1}{N} S^2 - \frac{n-1}{n} S^2_{wsy}$$
- b) State the advantages and limitations of systematic sampling. (6+4)
10. a) If the population consists of a linear trend, then prove that
- $$V(\bar{y}_{st}) \leq V(\bar{y}_{sys}) \leq V(\bar{y})_{wor}$$
- b) Write a note on : i) PPS Sampling ii) Multistage sampling (6+4)

CREDIT BASED FIFTH SEMESTER B.Sc. DEGREE EXAMINATION
OCTOBER 2012
STATISTICS
OPERATIONS RESEARCH - I

Time: 3 Hrs

Max. Marks: 80

PART - AAnswer any **TEN** of the following:**2X10=20**

1. a) Give the mathematical formulation of LPP.
- b) Given the simplex tableau, what is the criterion for the existence of alternative optima?
- c) Write down any two properties of LPP.
- d) Max $Z = 3x - y$ subject to $2x + y \leq 10$
 $y \leq 2$
 $x, y \geq 0$,
 suppose $x = 2, y = -1$. Is it a feasible solution to the above LPP?
- e) What is meant by dual of an LPP?
- f) Mention any two advantages of duality in LPP.
- g) Give an example for transportation problem and write down its mathematical model.
- h) What is the necessary and sufficient condition for the existence of a feasible solution in a Transportation problem?
- i) How do you solve a maximizing assignment problem?
- j) What are the situations which make the replacement of items necessary?
- k) Define optimum replacement age.
- l) Define present value and discount rate in replacement theory.

PART - BAnswer any **TWO** of the following:**10x2=20**

2. a) Explain the nature of OR.
- b) Explain any two models used in OR. (5+5)
3. a) Explain the graphical method of solving an LPP.
- b) Point out the criteria for existence of unbounded solution, unique optimal solution and degenerate solution in the simplex table. (5+5)

4. a) Explain Charne's Big M method of solving an LPP.

b) Explain Slack and Surplus variables.

(5+5)

Answer any TWO of the following:

10x2=20

5. a) Write down the dual of the following LPP.

$$\text{Max } Z = 5x_1 + 12x_2 + 4x_3 \text{ subject to}$$

$$x_1 + 2x_2 + x_3 \leq 5$$

$$2x_1 - x_2 + 3x_3 \leq 2$$

$$x_1 \geq 0, x_2 \geq 0 \text{ and } x_3 \text{ is unrestricted in sign}$$

b) State the properties of a dual LPP.

(5+5)

6. a) State the various steps involved in the dual simplex algorithm.

b) Describe the role of duality for sensitivity analysis of LPP.

(6+4)

7. a) What do you understand by Sensitivity Analysis? Explain the effect of the following on optimality or feasibility of current optimal solution:

(i) Change in the constraint coefficients.

(ii) Addition or deletion of a variable.

b) Consider the following LPP:

$$\text{Max } Z = 2x_1 + x_2$$

s.t

$$x_1 + 2x_2 \leq 10$$

$$x_1 + x_2 \leq 6$$

$$x_1 - x_2 \leq 2$$

$$x_1 - 2x_2 \leq 1$$

$$x_1, x_2 \geq 0$$

using Duality, the following optimal simplex table is obtained.

C_B	Basis	Y_1	Y_2	Y_3	Y_4	S_1	S_2	A_1	A_2	b
-2	Y_3	$-\frac{1}{2}$	0	1	$\frac{3}{2}$	$-\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$-\frac{1}{2}$	$\frac{1}{2}$
-6	Y_2	$\frac{3}{2}$	1	0	$-\frac{1}{2}$	$-\frac{1}{2}$	$-\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{3}{2}$
	Δ_j	2	0	0	1	4	2	M-4	M-2	-10

Write the optimal solution to the primal and dual problems.

(5+5)

Answer any TWO of the following:

10x2=20

8. a) Explain an assignment problem and write down its mathematical formulation.
- b) Describe Hungarian method of solving an assignment problem given cost matrix. What changes are necessary when the profit matrix is given? (4+6)
9. a) How do you find an initial basic feasible solution to a transportation problem by North-West Corner rule?
- b) Define basic feasible solution of a transportation problem. When do you say that it is (i) Degenerate (ii) Optimal (5+5)
10. a) Derive the group replacement policy stating the assumption.
- b) Derive the replacement policy for an equipment which deteriorates with usage where the maintenance cost is a discrete function of time with salvage and money value remaining constant. (5+5)

STA 501

Reg. No.

CREDIT BASED FIFTH SEMESTER B.Sc. DEGREE EXAMINATION

OCTOBER 2013

STATISTICS

PAPER V - SAMPLING THEORY

Time: 3 Hrs

Max. Marks: 80

PART - A

Answer any TEN of the following:

2X10=20

1. a) Define a sampling unit. Give an example.
- b) What is the need for sampling surveys?
- c) Define Simple random sampling.
- d) Find the probability of selecting any unit at any stage under SRSWOR.
- e) Define sample variance and sample mean square.
- f) Define parameter and estimator.
- g) What is the need for stratification?
- h) What is quota sampling?
- i) Define finite population correction.
- j) What is meant by PPS sampling?
- k) Define probability sampling.
- l) If $N = 4$ and $n = 2$, how many samples can be drawn under (i) SRSWR (ii) SRSWOR

PART - B

Answer any TWO of the following:

10x2=20

2. a) Distinguish between census and sample survey.
- b) Explain sampling and non sampling errors. (5+5)
3. a) Write a short note on execution of sample surveys.
- b) How do you select a random sample from any contingency table? (4+6)
4. a) Explain the method of selecting a sample from a population using random numbers?
- b) What are the principles of sample surveys? Explain. (6+4)

Answer any TWO of the following:

10x2=20

5. a) Derive an expression for $V(\bar{y})$ under SRSWR.

b) Obtain an expression for the sample size under SRSWOR. (5+5)

6. a) Under SRSWOR with usual notations prove that $V(\bar{y}) = \frac{N-n}{N} \frac{S^2}{n}$

b) Compare SRSWR and SRSWOR. (5+5)

7. a) Derive an expression for the sample size under proportional allocation of Stratified sampling.

b) Under Neyman's allocation prove that $n_p \propto N_h S_h$ for a fixed sample size. (5+5)

Answer any TWO of the following:

10x2=20

8. a) Distinguish between Linear systematic sampling and Circular systematic sampling.

b) Compare SRSWOR and Systematic sampling for a population with a linear trend. (5+5)

9. a) Explain Cluster sampling.

b) With usual notations prove that $V(\bar{y}_{sys}) = \frac{\sigma^2}{N} [1 + (n-1)f_c]$ (4+6)

10. With usual notations prove that $V(\bar{y})_{wor} \geq V(\bar{y})_{prop} \geq V(\bar{y})_{opt}$ (10)

STA 502

Reg. No.

**CREDIT BASED FIFTH SEMESTER B.Sc. DEGREE EXAMINATION
OCTOBER 2013
STATISTICS
OPERATIONS RESEARCH - I**

Time: 3 Hrs

Max. Marks: 80

PART - A

Answer any TEN of the following:

2X10=20

1. a) Give any two applications of OR.
- b) Point out the criteria for the existence of
(i) Multiple solution and ii) Degeneration solution in LPP.
- c) What are slack and surplus variables?
- d) What is meant by dual of an LPP.
- e) With reference to a Transportation problem define
(i) Feasible solution and (ii) Optimum solution
- f) How do you solve a maximization Assignment problem?
- g) Write down the mathematical model of Assignment problem.
- h) Give a real life example for a Transportation problem.
- i) State any two properties of dual LPP.
- j) What do you mean by optimum replacement policy?
- k) Define present value and discount rate in replacement theory.
- l) What do you mean by sensitivity analysis?

PART - B

Answer any TWO of the following:

10x2=20

2. a) Explain the meaning of OR.
- b) Briefly explain the nature of OR. (5+5)
3. a) Describe the simplex algorithm assuming no degeneracy at any state.
- b) Explain the problem created by a degenerate basic feasible solution under simplex method of solving LPP. (6+4)

4. a) Define artificial variables and unrestricted variables.
 b) Explain Big M method of solving LPP. (4+6)
5. a) State various steps involved in the dual simplex algorithm.
 b) Write down the dual of the following LPP.

$$\text{Max } Z = 5x_1 + 12x_2 + 4x_3 \text{ subject to}$$

$$x_1 + 2x_2 + x_3 \leq 5$$

$$2x_1 - x_2 + 3x_3 \leq 2$$

$$x_1 \geq 0, x_2 \geq 0 \text{ and } x_3 \text{ is unrestricted in sign} \quad (5+5)$$
6. a) Describe the role of duality for sensitivity analysis of LPP.
 b) State the advantages of duality in LPP. (5+5)
7. a) State and prove the theorem on the relationship between the feasible solutions of LPP and its dual.
 b) State the general rules for converting any primal LPP into its dual.
8. a) Show that in an Assignment problem, if we subtract a constant from any row (column) of the effective matrix then a solution which minimizes the total effectiveness in the latter matrix minimizes the total effectiveness in the former also.
 b) How do you proceed to convert an unbalanced Assignment problem to balanced Assignment problem? (6+4)
9. a) How do you find an initial basic feasible solution to a transportation problem by Vogel's rule?
 b) Show that transportation problem is a particular case of LPP. (5+5)
10. a) Describe the problem of replacement of items whose maintenance costs increases with time.
 b) Derive the replacement policy for an equipment which deteriorates with usage where the maintenance cost is a discrete function of time with salvage and money value remaining constant. (4+6)

STA 501

Reg. No.

CREDIT BASED FIFTH SEMESTER B.Sc. DEGREE EXAMINATION OCTOBER 2014

STATISTICS

PAPER V - SAMPLING THEORY

Time: 3 Hrs

Max. Marks: 80

PART - A

Answer any TEN of the following:

2X10=20

1. a) Define parameter and statistic.
- b) Distinguish between questionnaire and schedule.
- c) Define efficiency of one design as compared to the other.
- d) What do you mean by pilot survey?
- e) Define SRSWR.
- f) From a population containing 5 units y_1, y_2, y_3, y_4 and y_5 , draw all possible samples of size 2 using SRSWOR.
- g) Give one example for stratified sampling.
- h) Explain proportional allocation in case of stratification.
- i) Define systematic sampling.
- j) Under systematic sampling. Prove that sample mean is an unbiased estimator of the population mean.
- k) Explain multistage sampling.
- l) Briefly explain cluster sampling.

PART - B

Answer any TWO of the following:

10x2=20

2. a) State briefly the advantages of sampling over complete enumeration.
- b) Explain the method of selecting a random sample from a frequency distribution. (5+5)
3. a) Outline the steps in the planning and execution of sample survey.
- b) Explain the method of selecting a random sample from contingency table. (4+6)
4. a) Briefly discuss the different sources of error in sample survey.
- b) What are the limitations of sampling? (6+4)

Answer any TWO of the following:

10x2=20

5. a) Discuss the merits and demerits of SRS.
- b) Prove that under SRSWR the variance of the unbiased estimation of population mean is $\frac{\sigma^2}{n}$. (5+5)
6. a) Under SRSWOR prove with usual notations that $v(\bar{y}) = \frac{N-n}{Nn} \cdot S^2$
- b) What is optimum allocation? Show that under optimum allocation for a fixed cost of survey $C = a + \sum c_i n_i$ variance of the estimated mean \bar{y}_{st} is minimum if $n_h \propto \frac{N_h S_h}{\sqrt{C_h}}$ (5+5)
7. With usual notations under certain conditions show that $V_{ran} \geq V_{prop} \geq V_{opt}$. (10)

Answer any TWO of the following:

10x2=20

8. a) Describe the method of systematic sampling with an example.
- b) Derive the expression for the variance of the unbiased estimate of the population mean under systematic sampling. (5+5)
9. a) State the merit and demerits of systematic sampling.
- b) For a population with linear trend. Prove that $V(\bar{y})_{wor} \geq V(\bar{y})_{sys} \geq V(\bar{y})_{st}$ (4+6)
10. a) Explain circular systematic sampling.
- b) With usual notation show this
- $$V(\bar{y}_{sys}) = \frac{nk-1}{nk} \cdot \frac{s^2}{n} \cdot [1 + (n-1)\rho]$$
- Where ρ is the intraclass correlation coefficient between the units of the same systematic sample. (5+5)

STA 502.1

Reg. No.

CREDIT BASED FIFTH SEMESTER B.Sc. DEGREE EXAMINATION OCTOBER 2014

STATISTICS

OPERATIONS RESEARCH - I

Time: 3 Hrs

Max. Marks: 80

PART - A

Answer any **TEN** of the following:

2X10=20

1. a) Define Operations Research.
- b) Given the simplex tableau, what is the criterion for the existence of unbounded solution?
- c) Define basic feasible solution of a LPP.
- d) Write down the dual form of a general LPP.
- e) Mention any 2 advantages of dualities in LPP.
- f) What is meant by Transportation Problem? Give example.
- g) What is unbalanced Transportation Problems? How do you modify it to find optimal solution?
- h) Mention the modification needed in the assignment algorithm to get maximal assignment.
- i) What is sensitivity analysis?
- j) Mention the two situations which make the replacement of items necessary?
- k) Define 'loop' in a transportation table.
- l) What is the role of artificial variable in solving LPP?

PART - B

Answer any **TWO** of the following:

10x2=20

2. a) What is a model in O.R.?
- b) Explain various models used in O.R. with examples. (2+8)

3. a) With respect to LPP, define
 - i) Feasible solution
 - ii) Degenerate basic Feasible Solution
 - iii) Optimal Solution
- b) Describe the computational procedure of the simplex method for the solution of a LPP. (6+4)

4. a) Explain Two-phase method of solving LPP
 b) Define slack and surplus variable. How these variables utilized in solving LPP. (6+4)

Answer any TWO of the following.

10x2=20

5. a) Write a short note on dualities in linear programming.
 b) Write down the dual of the following LPP.

Max $Z = 2x_1 + 3x_2 + x_4$ subject to

$$x_1 - 2x_2 + x_3 \leq 5$$

$$2x_1 + x_2 + 2x_3 \geq 8$$

$$x_1 - 4x_2 + 3x_3 = 4$$

$$x_1, x_2 \geq 0, x_3 \text{ is unrestricted}$$

(5+5)

6. a) Describe the role of duality for sensitivity analysis of LPP.
 b) Explain the dual simplex algorithm. (4+6)
7. a) Explain with suitable example the basic philosophy, behind sensitivity analysis.
 b) Explain how the change in resource availability affects an optimal solution.

Answer any TWO of the following.

10x2=20

8. a) State and prove the necessary and sufficient condition for the existence of feasible solution to a $m \times n$ transportation problem.
 b) Explain briefly Vogel's approximations method for finding an initial BFS of Transportation problem. (4+6)
9. a) Give the mathematical formulations of Assignment problem.
 b) Explain Hungarian algorithm. (3+7)
10. a) Derive the replacement policy for equipment, whose maintenance costs increases with time and value of money changes with time.
 b) What is 'Group Replacement'? Give an example. (7+3)

STA 501

Reg. No.

CREDIT BASED FIFTH SEMESTER B.Sc. DEGREE EXAMINATION OCTOBER 2015

STATISTICS

PAPER V - SAMPLING THEORY

Time: 3 Hrs

Max. Marks: 80

PART - A

Answer any **TEN** of the following:

2X10=20

1. a) What do you understand by Random sampling?
- b) Define a sampling distribution.
- c) Write a note on a Pilot survey.
- d) Define SRSWOR.
- e) State any two limitations of sampling.
- f) State any two merits of stratified sampling.
- g) Explain proportional allocation in case of stratification.
- h) What do you mean by cluster sampling with equal number of units?
- i) What is PPS sampling?
- j) Distinguish between Linear and Circular systematic sampling.
- k) Under systematic sampling prove that sample mean is an unbiased estimates of the population mean.
- l) What do you mean by Multi-state sampling?

PART - B

Answer any **TWO** of the following:

10x2=20

2. a) What is a sample survey?
- b) Explain the principal steps in a sample survey. **(2+8)**
3. a) Explain the random numbers method of drawing a simple random sample.
- b) Briefly explain the principles of sample survey. **(4+6)**
4. a) State the advantages of sampling over census.
- b) What do you mean by non-sampling errors and what are the causes of these errors? **(6+4)**

(10) 9/10

Answer any TWO of the following:

10x2=20

5. a) Under SRSWOR, prove with usual notations $v(\bar{y}) = \frac{N-n}{N} \frac{S^2}{n}$

b) Prove that $v(\bar{y})_{SRSWR} \geq v(\bar{y})_{SRSWOR}$. (6+4)

6. a) In SRSWR prove that sample mean square is an unbiased estimator of the population variance.

b) Obtain an unbiased estimate of the population total under SRSWOR. (5+5)

7. a) In a stratified random sampling with a given constant function of the form

$$C = C_0 + \sum C_h n_h \text{ show that } n_h \propto \frac{N h S_h}{\sqrt{C_h}}$$

b) Show that $v(\bar{y})_{opt} \leq v(\bar{y})_{prop}$ (5+5)

Answer any TWO of the following:

10x2=20

8. a) Derive an expression for the variance of the variance of sample mean under systematic sampling

b) Show that systematic sampling is more efficient than SRSWOR if $S_{ys}^2 > \xi^2$ (5+5)

9. a) It is proposed to select a systematic sample of size n from the population consisting of $N = nk$ units. Write down all possible systematic samples.

b) Prove that $V(\bar{y}_{ys}) = \frac{k-1}{nk} S_{wst}^2 [1 + (n-1)j_{wst}]$ (4+6)

10. a) If the population consists of a linear trend, then prove that $V(\bar{y}_{st}) \leq V(\bar{y}_{ys}) \leq V(\bar{y}_{SRS})$

(10)

CREDIT BASED FIFTH SEMESTER B.Sc. DEGREE EXAMINATION OCTOBER 2015

STATISTICS
OPERATIONS RESEARCH - I

Time: 3 Hrs

Max. Marks: 80

PART - A

Answer any TEN of the following:

2X10=20

1. a) Mention the phases of OR.
- b) How many basic solutions you can have with the system of linear equations $2x_1 - x_2 + x_3 = 8$ and $4x_1 + 3x_2 + x_4 = 12$?
- c) Define Linear programming problem.
- d) Point out the criteria for the existence of
(i) Multiple solution and (ii) Degenerate solution in LPP
- e) State any two characteristics of the dual of an LPP.
- f) Mention any 2 advantages of dualities in LPP.
- g) Write down the mathematical model of transportation problem.
- h) Show that Assignment problem is a particular case of Transportation problem.
- i) Give a real life example of Assignment problem.
- j) What is the necessary and sufficient condition for the existence of a feasible solution in a Transportation problem?
- k) What are the situations which make the replacement of items necessary?
- l) Define optimum replacement age.

PART - B

Answer any TWO of the following:

10x2=20

2. a) Write down briefly the origin and development of OR.
- b) Describe any two models used in OR. (5+5)
3. a) Explain the graphic method of solving a two decision variable LPP.
- b) Explain the problem created by a degenerate basic feasible solution under simplex method of solving LPP. (5+5)

4. a) Explain Charne's Big M method of solving an LPP.
 b) Explain slack and surplus variables. (6+4)

Answer any TWO of the following. 10x2=20

5. a) Write down the dual of the following LPP.

$$\begin{aligned} \text{Min. } Z &= x_1 - 2x_2 + 4x_3 + 2x_4 \\ \text{subject to } & x_1 + x_2 + x_3 + x_4 = 10 \\ & 2x_1 - x_2 + 5x_3 + 6x_4 \leq 25 \\ & 4x_1 + 3x_2 - 2x_3 - x_4 \geq 15 \\ & x_1, x_2, x_3, x_4 \geq 0 \end{aligned}$$

- b) State the properties of a dual LPP. (5+5)
6. a) Write the dual simplex algorithm.
 b) Describe the role of duality for sensitivity analysis of LPP. (6+4)
7. a) Explain with suitable example the basic philosophy, behind sensitivity analysis.
 b) Prove that dual of the dual of a given primal is the primal. (5+5)
8. a) Show that in a transportation problem with 'm' origins and 'n' destinations there exists redundancy in equations with only (m + n + 1) of the (m + n) equations being independent.
 b) Explain the MODI method of solving a Transportation problem. (5+5)
9. a) Explain an Assignment problem and write down its mathematical formulation.
 b) Explain Hungarian method of solving an Assignment problem. (4+6)
10. a) Derive the group replacement policy by stating the assumptions.
 b) Write a note on Replacement policy of items which deteriorate with time. (5+5)

STA 501

Reg. No.

CREDIT BASED FIFTH SEMESTER B.Sc. DEGREE EXAMINATION OCTOBER 2016

STATISTICS

PAPER V - SAMPLING THEORY

Time: 3 Hrs

Max. Marks: 80

PART - A

Answer any TEN of the following:

2X10=20

1. a) Define a sample survey.
- b) State any two disadvantages of sampling.
- c) Define SRSWR.
- d) What do you mean by a census survey?
- e) From a population consisting of 3 units, draw all possible SRSWOR of size two.
- f) What is a Pilot survey?
- g) What do you mean by Neyman allocation under stratified sampling?
- h) Give an example for cluster sampling.
- i) What is Quota Samplings?
- j) What the formula for $V(\bar{y})$ under SRSWR?
- k) Under SRSWOR show that sample mean is an unbiased estimate of the population mean.
- l) How does sampling WOR differ from sampling WR?

PART - B

Answer any TWO of the following:

10x2=20

2. a) What is sampling error? What are its sources?
- b) Explain the method of selecting a random sample from a frequency distribution. (5+5)
3. a) What are the different steps involved in a sample survey? Discuss them briefly.
- b) Briefly explain the principles of sample survey. (5+5)
4. a) Under SRSWR prove that $E(s^2) = \sigma^2$.
- b) In SRSWOR, find the probability of inclusion of i^{th} unit of the population in the sample. (6+4)

Answer any TWO of the following:

10x2=20

5. a) S.T. the sample mean square is an unbiased estimator of population mean square under SRSWOR.
- b) Obtain an expression for $V(\bar{y})$ under SRSWOR scheme. (5+5)
6. a) Under SRSWOR obtain an expression for the determination of sample size.
- b) Show that $V(\bar{y})_{SRSWOR} < V(\bar{y})_{SRSWR}$. (5+5)
7. a) Show that in a stratified random sampling with a cost function of the type $C = C_0 + \sum c_h n_h$ the variance of the estimated mean \bar{y}_{st} is minimum when $n_h \propto \frac{N_h S_h}{\sqrt{C_h}}$
- b) Derive an expression for the variance of the estimated mean under stratified random sampling. (6+4)

Answer any TWO of the following:

10x2=20

8. a) Explain Systematic sampling. State the merits and demerits of systematic sampling.
- b) With usual notation, show that $V(\bar{y}_{sys}) = \frac{nk-1}{nk} \cdot \frac{s^2}{n} [1 + (n-1)\rho]$ where ρ is the intraclass correlation coefficient between the units of the same systematic sample. (4+6)
9. a) Stating the conditions show that $V(\bar{y}_{st})_{OA} \leq V(\bar{y}_{st})_{PA} \leq V(\bar{y})_{SRSWOR}$ (10)
10. a) Briefly explain Multistage sampling and PPS sampling.
- b) If the population consists of a linear trend $Y_i = i, i = 1, 2, \dots, n$, then show that $V(\bar{y}_{st}) \leq V(\bar{y}_{sy}) \leq V(\bar{y})_{SRSWOR}$ (3+7)

STA 502.1

Reg. No.

CREDIT BASED FIFTH SEMESTER B.Sc. DEGREE EXAMINATION OCTOBER 2016

STATISTICS
OPERATIONS RESEARCH - I

Time: 3 Hrs

Max. Marks: 80

PART - A

Answer any TEN of the following:

2X10=20

1. a) Explain the meaning of an iconic model with an example.
- b) Define a) Basic Solution (ii) Basic feasible solution with reference to LPP.
- c) Write down any two properties of LPP.
- d) What is meant by dual of an LPP?
- e) What are slack and surplus variables?
- f) Mention any two advantages of duality in LPP.
- g) What is transportation problem?
- h) Write down the mathematical model of transportation problem.
- i) Give a real-life example for assignment problem.
- j) Show that AP is, a special case of LPP.
- k) Define optimum replacement age.
- l) Define present value and discount rate in replacement theory.

PART - B

Answer any TWO of the following:

10x2=20

2. a) Explain the nature of OR.
- b) Write down any three definitions of OR. (5+5)
3. a) Describe the graphical method of solving an LPP.
- b) Explain the problem of degenerate basic feasible solution under simplex method of solving LPP. (5+5)
4. a) Discuss Charne's Big M method of solving an LPP.
- b) With reference to an LPP, briefly explain
(i) Basic variables (ii) non-basic variables (6+4)

Answer any TWO of the following.

10x2=20

5. a) Write down the dual of the following LPP.

$$\text{Min. } Z = x_1 - 2x_2 + 4x_3 + 2x_4$$

$$\text{subject to } x_1 + x_2 + x_3 + x_4 = 10$$

$$2x_1 - x_2 + 5x_3 + 6x_4 \leq 25$$

$$4x_1 + 3x_2 - 2x_3 - x_4 \geq 15$$

$$x_1, x_2, x_3, x_4, \geq 0$$

- b) State the properties of a dual LPP. (5+5)
6. a) State the various steps involved in the dual simplex algorithm.
b) Describe the role of duality for sensitivity analysis of LPP. (6+4)
7. a) What do you understand by Sensitivity Analysis? Explain the effect of the following on optimality or feasibility of current optimal solution.
(i) change in the constraint coefficients
(ii) Addition or deletion of a variable
b) Briefly describe Two Phase Method of solving an LPP stating situations of unbounded and infeasible solutions. (5+5)

Answer any TWO of the following.

10x2=20

8. a) Describe Hungarian method of solving an assignment problem.
b) State and prove Reduction theorem of AP. (5+5)
9. a) How do you find an initial basic feasible solution to a transportation problem by Vogel's approximation method.
b) Define basic feasible solution of a transportation problem. When do you say that it is
(i) Degenerate (ii) Optional (5+5)
10. a) Derive the group replacement policy stating the assumption.
b) Derive the replacement for an equipment which deteriorates with usage where the maintenance cost is a discrete function of time with salvage and money value remaining constant. (5+5)
