

PG4S-039-B-23

M.A./M.Sc. IV Semester (CBCS) Degree Examination

STATISTICS

Operations Research in Industries

Paper : SCT-4.1(a)

Time : 3 Hours

Maximum Marks :80

Instructions:

Answer any six questions from Part-A and five questions from Part-B.

PART-A

(6×5=30)

1. Define the following terms:
 - a) Initial basic feasible solution.
 - b) Degenerate solution
 - c) Unbounded Solution.
2. State the standard form of linear programming problem (Lpp). Write the following Lpp in Standard form.
Min $Z = 4x_1 + 3x_2$
Subject to $x_1 + x_2 \leq 20$
 $-2x_1 + 3x_2 \leq -5$
 $7x_1 + 4x_2 \leq 160$
and $x_1, x_2 \geq 0$
3. Explain simplex method of solving Lpp.
4. Discuss Lagrange's method of solving non-Linear programming problem (NLPP).
5. Explain total float, free float and independent float.
6. Discuss maximal flow method of solving network problem.
7. Explain various costs involved in an inventory problem.
8. Discuss (t_p, s) system of inventory problem.

PART-B

(5×10=50)

9. Define operations research (OR). Enlist any two models used in OR. Discuss in brief the role of OR model in decision making.
10. Solve the following Lpp by using Big-M method
Max $Z = 4x_1 + 5x_2$
Subject to $3x_1 + 4x_2 \leq 200$
 $3x_1 + 6x_2 = 180$
 $8x_1 + 5x_2 \geq 160$
and $x_1, x_2 \geq 0$

11. Solve the following N Lpp.

$$\text{Optimize } Z = 2x_1^2 + x_2^2 + 3x_3^2 + 10x_1 + 8x_2 + 6x_3 - 100$$

$$\text{Subject to } x_1 + x_2 + x_3 = 20$$

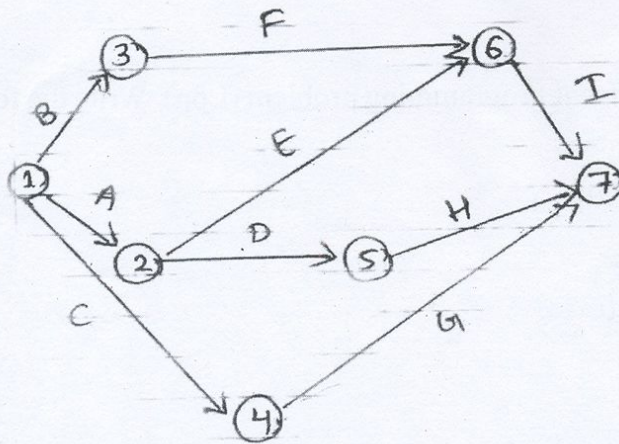
$$x_1, x_2, x_3 \geq 0.$$

12. Explain Beale's method for solving quadratic programming problem.

13. State the integer programming problem (Ipp). Explain Gomorian cutting plane method of solving Ipp.

14. A project is represented by the network diagram as below and has the following data.

Task	A	B	C	D	E	F	G	H	I
Latest time	5	18	26	16	15	6	7	7	3
Greatest time	10	22	40	20	25	12	12	9	5
Most likely time	8	20	33	18	20	9	10	8	4



Determine the following:

- Expected task times and their variance
- The earliest and latest expected time to reach each node.
- The initial path.

15. Outline the critical path method of solving network problem.

16. Write short notes on any two of the following:

- Phases of OR.
- Two phase simplex method of solving Lpp.
- Inventory model with probabilistic demand
- Pure and mixed integer programming problem.

PG4S-037-B-23

M.A./M.Sc IV Semester (CBCS) Degree Examination

STATISTICS

Sampling Theory

Paper : HCT-4.1

Time : 3 Hours

Maximum Marks :80

Instructions to Candidates:

Answer any six questions from Part-A and five questions from Part-B.

PART-A

(6×5=30)

1. Explain Sen-Midzuno scheme. Obtain π_i and π_j under this scheme.
2. Derive Hansen-Hurwitz estimator of the population total under PPSWR.
3. Define intra-class correlation coefficient. Obtain the bounds for it in case of equal clusters.
4. With usual notations, prove that the efficiency of CSRSWOR over SRSWOR is $\{1+(m-1)\rho_c\}^{-1}$ when K is large.
5. Explain two situations where two stage sampling is useful.
6. What is two phase sampling. When it is used? Give an example.
7. Compare ratio and regression estimators under SRS.
8. Prove that ratio estimator is better than the regression estimator for estimating population mean under SRSWOR scheme.

PART-B

(5×10=50)

9. Obtain the Horvitz-Thompson estimator of the population total under PPSWOR sampling. With usual notations prove that

$$V(\hat{Y}_{HT}) = \sum_{i=1}^N \frac{(1-\pi_i)}{\pi_i} Y_i^2 + \sum_{\substack{i=1 \\ i \neq j}}^N \sum_{j=1}^N \frac{(\pi_{ij} - \pi_i \pi_j)}{\pi_i \pi_j} Y_i Y_j$$

10. a) Obtain Lahiri's unbiased ratio estimator of the population total under Midzuno sampling scheme.
- b) Outline the merits and demerits of cluster sampling. (5+5)

11. Under CSRSWR, obtain an unbiased estimator of the population mean. Also find its sampling variance.
 12. In two stage sampling, obtain an unbiased estimator of the population total when SRSWOR is used at both the stages, clearly stating results that are used Also discuss optimum allocation when precision is fixed.
 13. a) Obtain an estimator of the bias of the ratio estimator of the population ratio and mean.
b) Write a note on almost unbiased ratio estimator. (5+5)
 14. Explain briefly sources and types of non-sampling errors.
 15. Giving examples for sensitive issues, explain the randomized response techniques. Discuss the Warner's model for estimating a proportion.
 16. **Write Short notes on any two of the following:** (5+5)
 - i) Cumulative total method of selecting a PPS sample.
 - ii) Probability proportional to total size sampling.(PPTS)
 - iii) Design of field surveys
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PG4S-041-B-23

M.A/M.Sc IV Semester Degree Examination

STATISTICS

Based on HCT 4.2

Paper : HCP 4.2

Time : 2 Hours

Maximum Marks :30

Instruction to Candidates:

1. Answer any Two questions.
2. All questions carry Equal Marks.

1. Thickness of cork boring in North (X_N), East (X_E), and South (X_S) directions are given below for 10 cork trees. Assuming a trivariate distribution for (X_N, X_E, X_S) , obtain the maximum likelihood estimators of mean vector and dispersion matrix.

Trees:	1	2	3	4	5	6	7	8	9	10
X_N	72	60	56	41	32	30	30	39	42	33
X_E	66	53	57	29	32	35	39	39	43	29
X_S	76	66	64	36	35	34	31	31	31	27

2. Perspiration from 20 healthy female rats were analysed for 3 components X_1 = sweat rate, X_2 =sodium content and X_3 = potassium content. The results regarding the sample mean vector and sample variance co-variance matrix are as follows:

$$\bar{x} = (4.64 \quad 45.4 \quad 9.965)^1 \text{ and } S = \begin{pmatrix} 2.879 & 10.002 & -1.810 \\ & 119.798 & -5.627 \\ & & 3.628 \end{pmatrix}$$

Test the hypothesis $H_0: \mu = \mu_0$ where $\mu_0 = (4 \quad 50 \quad 10)'$ at 1% level of significance. Obtain 99% confidence interval for the mean vector μ .

3. The following table gives data on the values of the trace elements: X_1 , Vanadium, X_2 , Iron and X_3 , Beryllium, all in percent ash of chemically analysed Crude-Oil samples from two zones of sand stone:

Zone	X_1 :	4.9	3.7	1.8	3.1	3.5	3.9	3.7
1	X_2 :	41	39	36	45	36	43	38
	X_3 :	0.2	0.7	0.3	0.8	0.1	0.09	0.06

Zone	X_1 :	6.0	4.4	2.2	7.4	6.5	5.2	3.9	4.9
2	X_2 :	57	42	22	17	36	35	41	26
	X_3 :	0.4	0.2	0.6	0.08	0.5	0.5	0.4	0.7

4. From data on open and closed book examinations, marks on different topics namely Statistics (0), Mathematics(c), Physics (0), and Chemistry (0), where 'c' is for closed book examinations and 'o' is for open book examinations. The following matrix of correlation Co-efficient was obtained.

$$R = \begin{pmatrix} 302.3 & 125.8 & 106.1 & 116.1 \\ 125.8 & 170.9 & 93.6 & 97.9 \\ 106.1 & 93.6 & 217.9 & 153.8 \\ 116.1 & 97.9 & 153.8 & 294.4 \end{pmatrix}$$

How highly a student's ability on closed book examination is correlated with his ability on open book examination? Also obtain the first canonical vector.

PG4S-040-B-23

M.A/M.Sc IV Semester (CBCS) Degree Examination

STATISTICS

Practical Based on HCT 4.1

Paper : HCP 4.1

Time : 2 Hours

Maximum Marks :30

Instructions to Candidates:

1. Answer any Two questions.
 2. All questions carry Equal Marks.
1. From a list of 54 districts of the UP State, 7 districts were chosen one by one with replacement in such a way that the probability of selecting any district in a particular draw was proportional to the area of the district. The total area of all the districts in UP is 1,13,453 square miles. Estimate the total population in the state and also estimate the standard error of the estimate.

Sl. No.	Population in lakhs (y)	Area in Sq. Miles (x)
01	17.28	1543
02	10.86	3888
03	16.16	2236
04	18.6	1227
05	23.72	2084
06	14.98	2620
07	17.36	1887

2. A pilot sample survey for the cultivation practices and yield of guava was conducted. Out of 412 bearing trees, 5 clusters of 4 trees each were selected using SRSWOR and yield in Kg were recorded as follows.

Cluster Number	Trees			
	1	2	3	4
1	5.53	4.84	0.69	15.79
2	11.08	10.93	19.08	11.18
3	12.06	0.65	4.21	7.56
4	0.87	32.56	16.92	37.02
5	6.4	3.56	4.81	57.54

Estimate the gain in efficiency of CSRSOR over SRSWOR. Also estimate ρ_c .

3. A survey on pepper was conducted to estimate the number of pepper standard and production of pepper in Kerala state. For this 3-clusters from 95 were selected by SRSWOR. The information on the number of pepper standards record is given below.

Cluster Number	Cluster Size	Number of Pepper Standards
01	11	41,16,19,15,144,454, 212, 57, 28, 76, 199.
02	12	39,70,38,37,161,38,27, 219,46,128,30,02.
03	13	115,59,120.

Estimate the total number of pepper standards along with standard error.

4. For studying milk yield, feeding and management practices of milk animals in the year 1977-78 of Haryana state, 5 villages were selected with SRSWR. The total numbers of milk animals in 1977-78 along with their livestock census data in 1976 are given below.

Sl.No	01	02	03	04	05
No. of Milk animals in survey (Y)	1129	1144	1125	1138	1137
No. of Milk animals in census(X)	1141	1144	1127	1153	1117

Estimate the total number of milk animals in 117 villages of Haryana by

- i) Ratio method
- ii) Regression method

Given that the total number of milk animals in the census was 143968. Compare the two estimators by computing their standard errors.