

**2021
(JUNE)
STATISTICS
HONOURS
STA-309
NINTH PAPER**

THEORY

Full Marks: 50

The figures in the margin indicates full marks for the questions

Answer all the questions

1. a) Solve by Simplex method the following linear programming problem:
- Maximise $z = x_1 - 3x_2 + 2x_3$
 Subject to $3x_1 - x_2 + 2x_3 \leq 7$
 $-2x_1 + 4x_2 \leq 12$
 $-4x_1 + 3x_2 + 8x_3 \leq 10$ and
 $x_1, x_2, x_3 \geq 0.$ 6
- b) Write the dual of the following Linear Programming Problem:
- Maximise $Z = x_1 - x_2 + 3x_3$
 Subject to $x_1 + x_2 + x_3 \leq 10$
 $2x_1 - x_3 = 2$
 $2x_1 - 2x_2 + 3x_3 \leq 6$ and
 $x_1, x_2, x_3 \geq 0.$ 3
- c) A resourceful home decorator manufactures two types of lamps, say, A and B. Both lamps go through two technicians first a cutter, second a finisher. Lamp A requires 2 hours of the cutter's time and 1 hour of the finisher's time. Lamp B requires 1 hour of cutter's and 2 hours of finisher's time. The cutter has 104 hours and finisher 76 hours of available time each month. Profit on one lamp A is Rs.6.00 and on one B lamp is Rs.11.00 Formulate the above problem as a linear programming problem. 3
- Or**
- a) Solve the linear programming problem by using Simplex method:
- Maximize $z = 2x_1 + 4x_2$
 Subject to $2x_1 + 3x_2 \leq 48$
 $x_1 + 3x_2 \leq 42$
 $x_1 + x_2 \leq 21$ and
 $x_1, x_2 \geq 0.$ 6
- b) Write the dual of the following linear programming problem:
- Maximize $z = 2x_1 + 3x_2 + x_3$
 Subject to $4x_1 + 5x_2 + 7x_3 \leq 15$
 $3x_1 - 2x_2 + x_3 \leq 7$
 $2x_1 + x_2 - 8x_3 \leq 10$ and
 $x_1, x_2, \geq 0, x_3$ unrestricted in sign. 3
- c) A manufacturer of a line of patent medicines is preparing a production plan on medicines A and B. There are sufficient ingredients available to make 20000 bottles of A and 40000 bottles of B, but there are only 45000 bottles into which either of the medicines can be put. Furthermore it takes 3 hours to prepare enough material to fill 1000 bottles of A, it takes one hour to prepare enough material to fill 1000 bottles of B and there are 66 hours available for this operation. The profit is Rs.8.00 per bottle of A and Rs.7.00 for bottle of B. Formulate this problem as a linear programming problem. 3

2. a) In which year Directorate of Industrial Statistics was transfer to Industrial Statistical Wing of the Central Statistical Organisation? 1
- b) Write a short note on Army Statistical Organisation. 3
- c) Explain the organisation of Industrial Statistics with respect to Organised and Unorganised sectors. 6

Or

- a) Write a short note on Indian Statistical System. 3
- b) Who is responsible for primary collection of agricultural statistics in India? 1
- c) Describe briefly the methods and nature of information collected in the Indian Population Census, 2011. 6
3. a) What are σ -score and standard scores? In a distribution with mean 86 and standard deviation 15. Gopal's score is 91 and Rita's score is 83. Express these scores in standard scores in a distribution with mean 500 and standard deviation 100. 2+2=4
- b) Test X has a validity coefficient of 0.65 and reliability 0.75 whereas the validity of test Y is 0.67 and its reliability is 0.95. Each of these tests is a 50-item test. Which one of them would show greater validity when the test length is increased 4 times? 4

Or

- a) The frequency distribution of scores for two tests are given:

Score	Frequency	
	Test A	Test B
0	5	2
1	7	4
2	8	9
3	5	8
4	3	5
5	2	2

- Compare a score of 4 in test A with a score of 4 in test B by z-scaling. 4
- b) Explain, in brief, Spearman's two factor theory. 3
- c) The reliability coefficient of the original test is 0.75. By what amount should the length of the original test be increased so as to get a reliability of 0.95? 1
4. a) Use Gauss's forward Central difference formula to find y for $x = 31$ given that 4

x	21	25	29	33	37
y	18.47	17.81	17.11	16.34	15.52

- b) Write a brief note on interpolation with two independent variables. 2
- c) Evaluate $\int_0^6 e^x dx$ by Weddle's rule using the data
 $e = 2.72, e^2 = 7.39, e^3 = 20.09, e^4 = 54.60, e^5 = 148.41, e^6 = 403.43$
 and compare it with the actual value. 4

Or

- a) The population of a town in the years 1931 to 1971 are given as follows:

Year	1931	1941	1951	1961	1971
Population (in thousand)	15	20	27	39	52

Find the population of the town in 1956 by Gauss's backward central difference formula. 4

- b) The following values of $f(x)$ are given:

x	10	15	20
$f(x)$	1754	2648	3564

Find the value of x for $f(x) = 1850$ by the method of reversion of series. 4

- c) Write a comparative note on Stirling's central difference formula and Bessel's Central difference formula. 2
5. a) Evaluate the Cote's number C_3^4 . 2
- b) Use Euler-Maclaurin's summation formula to find the sum of the fifth powers of first n natural numbers. 4
- c) Solve the difference equation $y_{x+2} + y_{x+1} + y_x = x \cdot 2^x$. 4

Or

- a) Solve the difference equation $y_{x+2} - 3y_{x+1} + 2y_x = 2^x$. 4
- b) Show that $\sum_{k=0}^4 C_k^4 = 1$, where C_k^4 are Cote's numbers. 4
- c) Under what conditions Laplace-Everett's formula is conveniently used? 1
- d) What is the order of the difference equation $f(x+3) + f(x+2) - 8f(x+1) = 2x^2 + 5$. 1
