RAMANASRI
IAS/IFoS Institute

Linear Programming

IFoS (IFS) Previous Year Questions (PYQ) from 2020 to 2009

Ramana sri Sir

IAS, UPSC, IFS, IFoS, CIVIL SERVICE MAINS EXAMS MATHS OPTIONAL STUDY MATERIALS

WEBSITE: MATHEMATICSOPTIONAL.COM
CONTACT: 8750706262 | 8750706363

Ramanasri IAS/IFoS(IFS) Maths Optional Linear Programming PYQ 2020 to 2009

2020

1. Solve graphically the following LPP:

$$\text{Max } z = 5x_1 - 3x_2$$

subject to

$$3x_1 + 2x_2 \le 12$$
$$-x_1 + x_2 \ge 1$$
$$-x_1 + x_2 \le 2$$
$$x_1, x_2 \le 0$$

If the objective function z is changed to $\text{Max } z = 6x_1 + 4x_2$, while the constraints remain the same, then comment on the number of solutions. Will $(4,0)$ be also a solution? **[8 Marks]**

2. Solve the following LPP by simplex method:

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

subject to

$$2x_1 - 2x_2 \le 1$$
$$2x_1 - 4x_2 \le 3$$
$$2x_1 + x_2 \le 2$$
$$x_1, x_2 \ge 0$$

Does there exist an alternate optional solution? If yes, give one and hence find all the optional solutions. **[15 Marks]**

3. Find the minimum transportation cost using Vogel's approximation method for the following transportation problem:

		Destinations				
		D_1	D_2	D_3	D_4	Availability
Sources	S_1	9	16	15	9	15
	S_2	2	1	3	5	25
	S_3	6	4	7	3	20
Demand		10	15	25	10	

[15 Marks]

2019

4. A salesman wants to visit cities C_1, C_2, C_3 and C_4. He does not want to visit any city twice before completing the tour of all the cities and wishes to return to his home city, the starting station. Cost of going from one city to another in rupees is given below in the table. Find the least cost route.

		To city			
		C_1	C_2	C_3	C_4
From city	C_1	0	30	80	50
	C_2	40	0	140	30
	C_3	40	50	0	20
	C_4	70	80	130	0

[15 Marks]

5. Use simplex method to solve the following problem:

Maximize $z = 2x_1 + 5x_2$

Subject to $x_1 + 4x_2 \le 24$
$3x_1 + x_2 \le 21$
$x_1 + x_2 \le 9$
$x_1, x_2 \ge 0$ **[15 Marks]**

6. A firm manufactures two products A and B on which he profits earned per unit ₹ 3 and ₹ 4 respectively. Each product is processed on two machines $M1$ and $M2$. Product A requires one minute of processing time on $M1$ and two minutes on $M2$, while B requires one minute on $M1$ and one minute on $M2$. Machine $M1$ is available for not more than 7 hours 30 minutes, while machine $M2$ is available for 10 hours during any working day. Find the number of units of products A and B to be manufactured to get maximum profit, using graphical method. **[8 Marks]**

2018

7. The capacities of three production facilities S_1, S_2 and S_3 and the requirements of four destinations D_1, D_2, D_3 and D_4 and transportation costs in rupees are given in the following table:

	D_1	D_2	D_3	D_4	*Capacity*
S_1	19	30	50	10	7
S_2	70	30	40	60	9
S_3	40	8	70	20	18
Demand	5	8	7	14	34

Find the minimum transportation cost using Vogel's Approximation Method (VAM). **[12 Marks]**

8. Solve by simplex method the following Linear Programming Problem :

Maximize $Z = 3x_1 + 2x_2 + 5x_3$

Subject to the constraints

$x_1 + 2x_2 + x_3 \le 430$
$3x_1 + 2x_3 \le 460$
$x_1 + 4x_2 \le 420$
$x_1, x_2, x_3 \ge 0$ **[12 Marks]**

2017

9. Solve by simplex method the following LLP

Minimize $Z = x_1 - 3x_2 + 2x_3$

Subject to the constraints

$3x_1 - x_2 + 2x_3 \le 7$
$-2x_1 + 4x_2 \le 12$
$-4x_1 + 3x_2 + 8x_3 \le 0$
and $x_1, x_2, x_3 \ge 0$ **[14 Marks]**

10. A Computer centre has four expert programmers. The centre needs four application programs to be developed the head of the centre after studying carefully the programs to be developed, estimates the computer times in hours required by the experts to the application programs as follows:

		Programs			
		A	B	C	D
Programmers	P_1	5	3	2	8
	P_2	7	9	2	6
	P_3	6	4	5	7
	P_4	5	7	7	8

Assign the programs to the programmers in such a way that total computer time is least. **[12 Marks]**

2016

11. A company manufacturing air-coolers has two plants located at Bangalore and Mumbai with a weekly capacity of 200 units 100 units respectively. The company supplies air-coolers to its 4 showrooms situated at situated at Mangalore, Bangalore, Delhi and Goa which have a demand of 75, 100, 100 and 25 units respectively. Due to the differences in local taxes, showroom charges, transportation cost and others, the profits differ. The profits (in RS.) are shown in the following table:

From	**To**			
	Mangalore	Bangalore	Delhi	Goa
Bangalore	90	90	100	100
Mumbai	5	70	130	85

Plane the production program so as to maximize the profit. The Company may have its production capacity at both plants partially or wholly unused. **[12 Marks]**

12. Prove that the set of all feasible solution of a linear programming problem is a convex set. **[8 Marks]**

2015

13. Solve the following transportation problem: **[10 Marks]**

	D_1	D_2	D_3	Supply
O_1	5	3	6	20
O_2	4	7	9	40
Demand	15	22	23	60

14. A manufacturer wants to maximize his daily output of bulbs which are made by two processes P_1 and P_2, . If x_1 is the output by process P_1 and If x_2 is the output by process P_2, then the total labour hours is given by $2x_1 + 3x_2$ and this cannot exceed 130, the total machine time is given by $3x_1 + 8x_2$

which cannot exceed 300 and the total raw material is given by $4x_1 + 2x_2$ and this cannot exceed 140. What should x_1 and x_2 be so that the total output $x_1 + x_2$ is maximum? Solve by the Simplex method only. **[14 Marks]**

15. Solve graphically:

Maximize $z = 7x + 4y$

Subject to $2x + y \le 2,\ x + 10y \le 10$ and $x \le 8$. (Draw your own graph without graph paper)

[10 Marks]

2014

16. Solve that following LPP graphically:

Maximize $Z = 3x_1 + 4x_2$

Subject to $x_1 + x_2 \le 6$

$$x_1 - x_2 \le 2$$
$$x_2 \le 4$$
$$x_1, x_2 \ge 0$$

Write the dual problem of the above and obtain the optimal value of the objective function of the duel without actually solving it **[15 Marks]**

17. Obtain the initial basic feasible solution for the transportation problem by North-west corner rule:

		Retail shop					
		R_1	R_2	R_3	R_4	R_5	*Supply*
Factory	F_1	1	9	13	36	51	50
	F_2	25	12	16	20	1	100
	F_3	14	35	1	23	26	150
		100	70	50	40	40	

8 Marks]

2013

18. Find the optimal assignment cost from the following cost matrix:

	A	B	C	D
I	4	5	4	3
II	3	2	2	6
III	4	5	3	5
IV	2	4	2	6

[10 Marks]

19. Solve the following salesman problem:

	A	B	C	D
A	∞	12	10	15
B	16	∞	11	13
C	17	18	∞	20
D	13	13	18	∞

[14 Marks]

20. $x_1 = 4, x_2 = 1, x_3 = 3$ is a feasible solution of the system of equations

$2x_1 - 3x_2 + 3x_3 = 8$

$x_1 + 2x_2 + 3x_3 = 15$

Reduce the feasible solution to the different basic feasible solution **[14 Marks]**

2012

21. Solve the following problem by simplex method how does the optimal table indicate that the optimal solution obtained is not unique?

Maximize $z = 8x_1 + 7x_2 - 2x_3$

Subject to the constraints

$x_1 + 2x_2 + 2x_3 \le 12$

$2x_1 + x_2 - 2x_3 \le 12$ **[14 Marks]**

$x_1, x_2, x_3 \ge 0$

22. Find the initial basic feasible solution of the following minimum cost transportation problem by least cost (matrix minima) method and using it find the optimal transportation cost: -

		Destinations				
		D_1	D_2	D_3	D_4	Supply
Sources	S_1	5	11	12	13	10
	S_2	8	12	7	8	30
	S_3	12	7	15	6	35
Requirement		15	15	20	25	

[14 Marks]

2011

23. Reduce the feasible solution $x_1 = 2, x_2 = 1, x_3 = 1$ for the linear programming problem Maximize

$Z = x_1 + 2x_2 + 3x_3$

Subject to

$x_1 - x_2 + 3x_3 = 4$

$2x_1 + x_2 + x_3 = 6$

$x_1, x_2, x_3 \ge 0$

to a basic feasible solution **[14 Marks]**

24. A steel company has three open-hearth furnaces and four rolling mills. Transportation costs (rupees per quintal) for shipping steel from furnaces to rolling mills are given in the following table:

	M_1	M_2	M_3	M_4	Supply (quintals)
F_1	29	40	60	20	7
F_2	80	40	50	70	10
F_3	50	18	80	30	18
Demand (quintals)	4	8	8	15	

Find the optimal shipping schedule. **[14 Marks]**

25. Write the dual of the linear programming problem (LPP)

Minimize $Z = 18x_1 + 9x_2 + 10x_3$

Subject to

$x_1 + x_2 + 2x_3 \geq 30$

$2x_1 + x_2 \geq 15$

$x_1, x_2, x_3 \geq 0$

Solve the graphically. Hence obtain the minimum objective function value of the above LPP.

[10 Marks]

2010

26. ABC Electricals manufactures and sells two models of lamps L_1 and $L2$ the profit per unit being Rs 50 and Rs 30, respectively. The process involves two workers W_1 and W_2 who are available for 40 hours and 30 hours per week respectively. W_1 assembles each unit of L_1 in 30 minutes and that of $L2$ in 40 minutes. W_2 paints each unit of L_1 in 30 minutes and that of $L2$ in 15 minutes .Assuming that all lamps made can be sold, determine the weekly production figures that maximize the profit **[14 Marks]**

27. Solve the following linear programming problem by the Simplex method:

Maximize $Z = 3x_1 + 4x_2 + x_3$

Subject to

$x_1 + 2x_2 + 7x_3 \leq 8$

$x_1 + x_2 - 2x_3 \leq 6$ **[14 Marks]**

$x_1, x_2, x_3 \geq 0$

2009

28. Write the dual of the following LPP and hence, solve it by graphical method:

Minimize $Z = 6x_1 + 4x_2$

Constraints

$2x_1 + x_2 \geq 1$

$3x_1 + 4x_2 \geq 1.5$ **[14 Marks]**

$x_1, x_2 \geq 0$

29. Solve by simplex method the following LPP

Maximize $Z = 5x_1 + 3x_2$

Constraints

$3x_1 + 5x_2 \leq 15$

$5x_1 + 2x_2 \leq 10$ **[14 Marks]**

$x_1, x_2 \geq 0$