Homework - 7

Q1 Reddy Mikks problem:

Example 2.1-1 (The Reddy Mikks Company)

Reddy Mikks produces both interior and exterior paints from two raw materials, *M1* and *M2*. The following table provides the basic data of the problem:

	Tons of raw material per ton of		Maximum daily availability (tons)
	Exterior paint	*Interior paint*	
Raw material, *M1*	6	4	24
Raw material, *M2*	1	2	6
Profit per ton ($1000)	5	4	

A market survey indicates that the daily demand for interior paint cannot exceed that for exterior paint by more than 1 ton. Also, the maximum daily demand for interior paint is 2 tons.

Reddy Mikks wants to determine the optimum (best) product mix of interior and exterior paints that maximizes the total daily profit.

i) Use TORA or a simple graph paper to plot the feasible region.

ii) If the maximum daily availability of M1 is changed from 24 to 25, find the change in profit. This is called the shadow price for M1. In a similar way, find the shadow price of M2.

iii) If the profits are changed from $5000 and $4000 per liter of exterior paint and interior paint to $c1 and $c2 respectively, find the range for the ration $c1/c2$, keeping the same optimal value of x_1 and x_2.

iv Try to add a constraint that would change / would not change the present optimal solution.

Solution:

$$\text{Maximize } z = 5x_1 + 4x_2$$

subject to

$$6x_1 + 4x_2 \le 24 \quad (1)$$

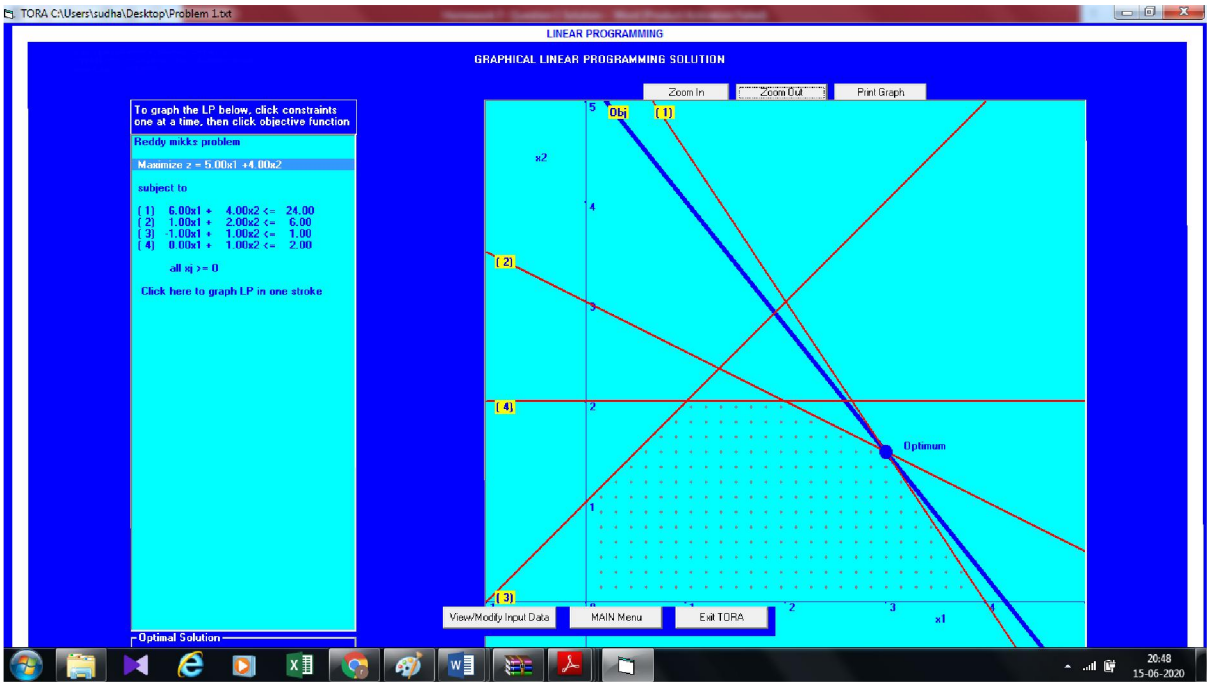
$$x_1 + 2x_2 \le 6 \quad (2)$$

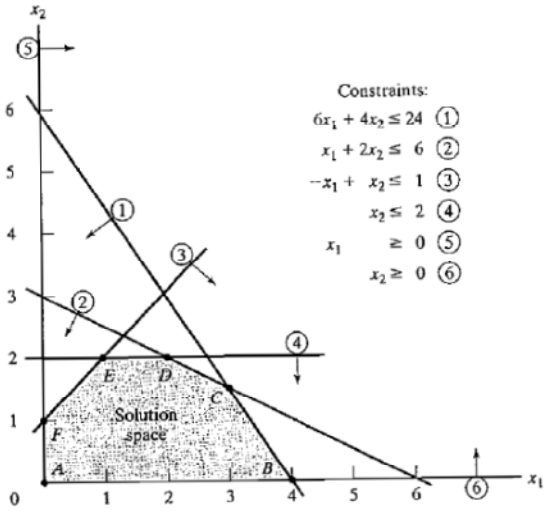
$$-x_1 + x_2 \le 1 \quad (3)$$

$$x_2 \le 2 \quad (4)$$

$$x_1, x_2 \ge 0 \quad (5)$$

(i) Feasible Region By TORA:





Corner point	(x_1, x_2)	z
A	(0, 0)	0
B	(4, 0)	20
C	(3, 1.5)	21 (OPTIMUM)
D	(2, 2)	18
E	(1, 2)	13
F	(0, 1)	4

Maximum Z = $21,000 occurs at x_1 = 3 tons and x_2 = 1.5 tons

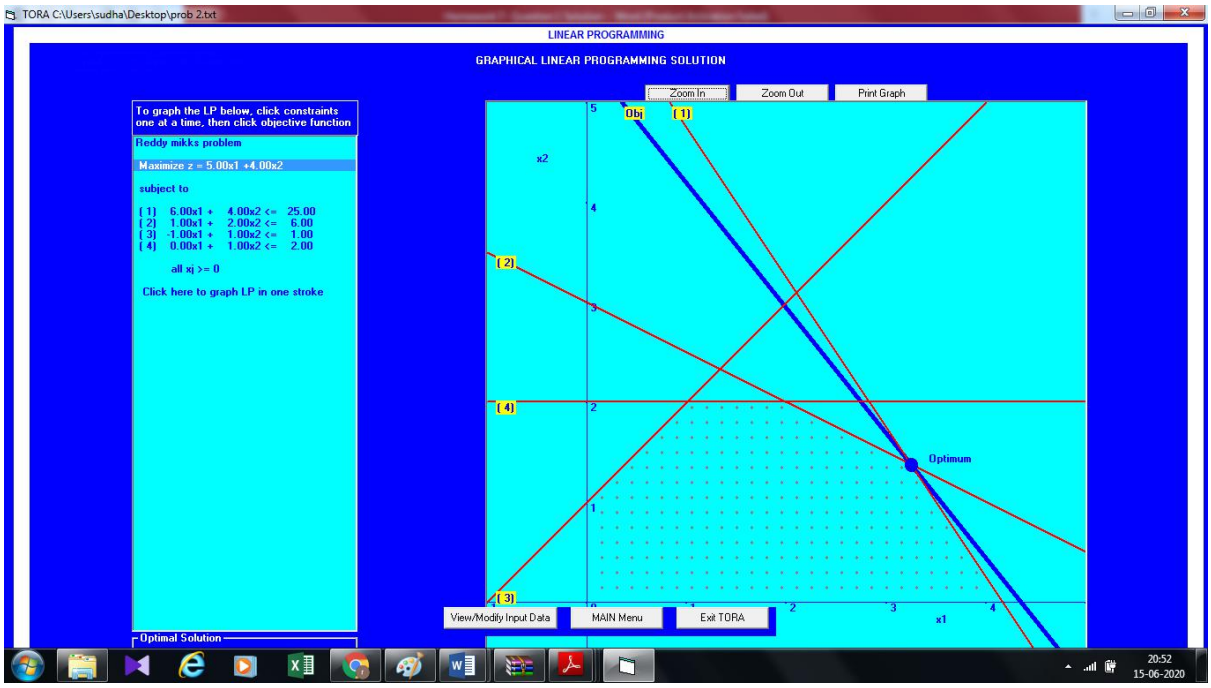
(ii) If the maximum daily availability of M1 is changed from 24 to 25, find the change in profit. This is called the shadow price for M1. In a similar way, find the shadow price of M2.

To Find the maximum value of the function
$Z = 5\,x_1 + 4\,x_2$

subject to the constraints:

$$\begin{cases} 6\,x_1 + 4\,x_2 \le 25 \\ x_1 + 2\,x_2 \le 6 \\ -\,x_1 + x_2 \le 1 \\ x_2 \le 2 \end{cases}$$

$x_1 \ge 0 \quad x_2 \ge 0$



Maximum z = \$21,750, $x_1 = 3.25$, $x_2 = 1.375$

Shadow Price = (21750-21000)/(25-24)=\$750

(iii) If the profits are changed from \$5000 and \$4000 per litre of exterior paint and interior paint to \$c1 and \$c2 respectively, find the range for the ratio c1/ c2, keeping the same optimal value of x1 and x2.

The optimal table of the problem by simplex is

		5	4	0	0	0	0	
CB	Basis	x1	x2	s1	s2	s3	s4	Constants
5	x1	1	0	1/4	- 1/2	0	0	3
4	x2	0	1	- 1/8	3/4	0	0	1 1/2
0	s3	0	0	3/8	-1 1/4	1	0	2 1/2
0	s4	0	0	1/8	- 3/4	0	1	1/2
	cj - zj	0	0	- 3/4	- 1/2	0	0	**21**

If the profits are changed from \$5000 and \$4000 per litre of exterior paint and interior paint to \$c1 and \$c2 respectively

Optimal table:

		C_1	C_2	0	0	0	0	
CB	Basis	x1	x2	s1	s2	s3	s4	Constants
C_1	x1	1	0	1/4	- 1/2	0	0	3
C_2	x2	0	1	- 1/8	3/4	0	0	1 1/2
0	s3	0	0	3/8	-1 1/4	1	0	2 1/2
0	s4	0	0	1/8	- 3/4	0	1	1/2
	cj - zj	0	0	c1/4-c2/8	c1/2+3c2/4	0	0	**21**

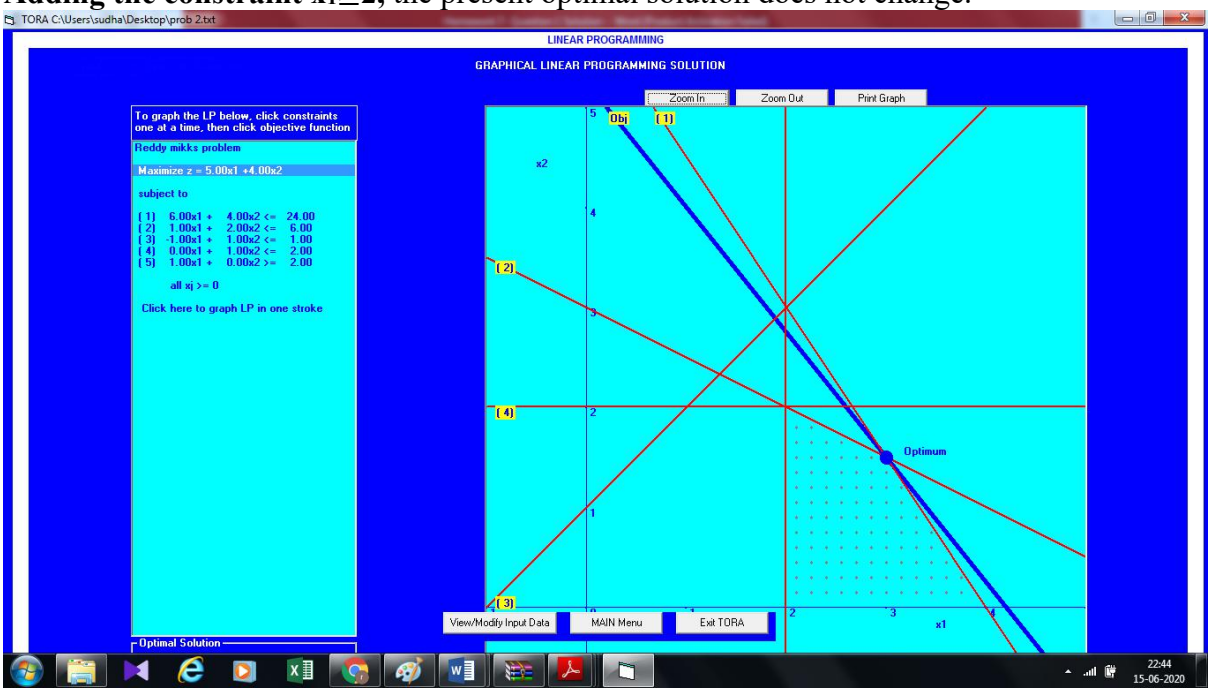
The same optimal retained when $c1/4-c2/8 \leq 0$ and $c1/2+3c2/4 \leq 0$

we get ratio $C_1/C_2 \leq ½$ and $C_1/C_2 \leq -3$

The required ratio is $C_1/C_2 \leq -3$

(iv) Try to add a constraint that would change / would not change the present optimal solution.

- **Adding the constraint $x_1 \geq 2$,** the present optimal solution does not change.



Maximum Z = \$21,000 occurs at $x_1 = 3$ tons and $x_2 = 1.5$ tons

- **Adding the constraint $x_1 \leq 2$,** the present optimal solution will change.

Maximum Z = \$18,000 occurs at $x_1 = 2$ tons and $x_2 = 2$ ton

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Q.2 For the Urban planning problem,

I. Write the complete set of constraints and convert the problem in the standard form.
II. Would the optimal value change if the maximum number of houses we could demolish is changed to 400?
III. Observe the decimal nature of the solution (given in the book) and understand the rounding.

Answer:

I.

Objective function Z= $1000x_1 + 1900x_2 + 2700x_3 + 3400x_4$

Subject to,

$$0.18x_1 + 0.28x_2 + 0.4x_3 + 0.5x_4 - 0.2125x_5 \leq 0$$

$$x_5 \leq 300$$
$$-0.8x_1 + 0.2x_2 + 0.2x_3 + 0.2x_4 \leq 0$$
$$0.1x_1 - 0.9x_2 - 0.1x_3 + 0.1x_4 \leq 0$$
$$0.25x_1 + 0.25x_2 - 0.75x_3 - 0.75x_4 \leq 0$$
$$50x_1 + 70x_2 + 130x_3 + 160x_4 + 2x_5 \leq 0$$
$$x_1, x_2, x_3, x_4, x_5 \geq 0$$

Standard form,

Objective function,

Z= $1000x_1 + 1900x_2 + 2700x_3 + 3400x_4 + S_1 + S_2 + S_3 + S_4 + S_5 + S_6$

Subject to,

$$0.18x_1 + 0.28x_2 + 0.4x_3 + 0.5x_4 - 0.2125x_5 + S_1 = 0$$

$$x_5 + S_2 = 300$$
$$-0.8x_1 + 0.2x_2 + 0.2x_3 + 0.2x_4 + S_3 = 0$$
$$0.1x_1 - 0.9x_2 - 0.1x_3 + 0.1x_4 + S_4 = 0$$
$$0.25x_1 + 0.25x_2 - 0.75x_3 - 0.75x_4 + S_5 \leq 0$$
$$50x_1 + 70x_2 + 130x_3 + 160x_4 + 2x_5 + S_6 \leq 0$$
$$x_1, x_2, x_3, x_4, x_5, S_1, S_2, S_3, S_4, S_5, S_6 \geq 0$$

II.

Solution for original problem by TORA

Iteration 1	Single	Double	Triple	Quadraple	Demolish							
Basic	x1	x2	x3	x4	x5	sx6	sx7	sx8	sx9	sx10	sx11	Solution
z (max)	-1000.00	-1900.00	-2700.00	-3400.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sx6	0.18	0.28	0.40	0.50	-0.21	1.00	0.00	0.00	0.00	0.00	0.00	0.00
sx7	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	300.00
sx8	-0.80	0.20	0.20	0.20	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
sx9	0.10	-0.90	-0.10	0.10	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
sx10	0.25	0.25	-0.75	-0.75	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
sx11	50.00	70.00	130.00	160.00	2.00	0.00	0.00	0.00	0.00	0.00	1.00	15000.00
Lower Bound	0.00	0.00	0.00	0.00	0.00							
Upper Bound	infinity	infinity	infinity	infinity	infinity							
Unrestr'd (y/n)?	n	n	n	n	n							

Iteration 2	Single	Double	Triple	Quadraple	Demolish							
Basic	x1	x2	x3	x4	x5	sx6	sx7	sx8	sx9	sx10	sx11	Solution
z (max)	224.00	4.00	20.00	0.00	-1428.00	6800.00	0.00	0.00	0.00	0.00	0.00	0.00
x4	0.36	0.56	0.80	1.00	-0.42	2.00	0.00	0.00	0.00	0.00	0.00	0.00
sx7	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	300.00
sx8	-0.87	0.09	0.04	0.00	0.08	-0.40	0.00	1.00	0.00	0.00	0.00	0.00
sx9	0.06	-0.96	-0.18	0.00	0.04	-0.20	0.00	0.00	1.00	0.00	0.00	0.00
sx10	0.52	0.67	-0.15	0.00	-0.32	1.50	0.00	0.00	0.00	1.00	0.00	0.00
sx11	-7.60	-19.60	2.00	0.00	69.20	-320.00	0.00	0.00	0.00	0.00	1.00	15000.00
Lower Bound	0.00	0.00	0.00	0.00	0.00							
Upper Bound	infinity	infinity	infinity	infinity	infinity							
Unrestr'd (y/n)?	n	n	n	n	n							

Iteration 3	Single	Double	Triple	Quadraple	Demolish							
Basic	x1	x2	x3	x4	x5	sx6	sx7	sx8	sx9	sx10	sx11	Solution
z (max)	-14600.00	1500.00	700.00	0.00	0.00	0.00	0.00	17000.00	0.00	0.00	0.00	0.00
x4	-4.00	1.00	1.00	1.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00
sx7	10.38	-1.05	-0.48	0.00	0.00	4.76	1.00	-11.90	0.00	0.00	0.00	300.00
x5	-10.38	1.05	0.48	0.00	1.00	-4.76	0.00	11.90	0.00	0.00	0.00	0.00
sx9	0.50	-1.00	-0.20	0.00	0.00	0.00	0.00	-0.50	1.00	0.00	0.00	0.00
sx10	-2.75	1.00	0.00	0.00	0.00	0.00	0.00	3.75	0.00	1.00	0.00	0.00
sx11	710.76	-92.10	-30.95	0.00	0.00	9.52	0.00	-823.81	0.00	0.00	1.00	15000.00
Lower Bound	0.00	0.00	0.00	0.00	0.00							
Upper Bound	infinity	infinity	infinity	infinity	infinity							
Unrestr'd (y/n)?	n	n	n	n	n							

Iteration 4	Single	Double	Triple	Quadraple	Demolish							
Basic	x1	x2	x3	x4	x5	sx6	sx7	sx8	sx9	sx10	sx11	Solution
z (max)	0.00	-27700.00	-5140.00	0.00	0.00	0.00	0.00	2400.00	29200.00	0.00	0.00	0.00
x4	0.00	-7.00	-0.60	1.00	0.00	0.00	0.00	1.00	8.00	0.00	0.00	0.00
sx7	0.00	19.71	3.68	0.00	0.00	4.76	1.00	-1.52	-20.76	0.00	0.00	300.00
x5	0.00	-19.71	-3.68	0.00	1.00	-4.76	0.00	1.52	20.76	0.00	0.00	0.00
x1	1.00	-2.00	-0.40	0.00	0.00	0.00	0.00	-1.00	2.00	0.00	0.00	0.00
sx10	0.00	-4.50	-1.10	0.00	0.00	0.00	0.00	1.00	5.50	1.00	0.00	0.00
sx11	0.00	1329.43	253.35	0.00	0.00	9.52	0.00	-113.05	-1421.52	0.00	1.00	15000.00
Lower Bound	0.00	0.00	0.00	0.00	0.00							
Upper Bound	infinity	infinity	infinity	infinity	infinity							
Unrestr'd (y/n)?	n	n	n	n	n							

Iteration 5	Single	Double	Triple	Quadraple	Demolish							
Basic	x1	x2	x3	x4	x5	sx6	sx7	sx8	sx9	sx10	sx11	Solution
z (max)	0.00	0.00	138.86	0.00	0.00	198.44	0.00	44.54	-418.90	0.00	20.84	312540.30
x4	0.00	0.00	0.73	1.00	0.00	0.05	0.00	0.40	0.52	0.00	0.01	78.98
sx7	0.00	0.00	-0.08	0.00	0.00	4.62	1.00	0.15	0.32	0.00	-0.01	77.56
x5	0.00	0.00	0.08	0.00	1.00	-4.62	0.00	-0.15	-0.32	0.00	0.01	222.44
x1	1.00	0.00	-0.02	0.00	0.00	0.01	0.00	-1.17	-0.14	0.00	0.00	22.57
sx10	0.00	0.00	-0.24	0.00	0.00	0.03	0.00	0.62	0.69	1.00	0.00	50.77
x2	0.00	1.00	0.19	0.00	0.00	0.01	0.00	-0.09	-1.07	0.00	0.00	11.28
Lower Bound	0.00	0.00	0.00	0.00	0.00							
Upper Bound	infinity	infinity	infinity	infinity	infinity							
Unrestr'd (y/n)?	n	n	n	n	n							

Iteration 6	Single	Double	Triple	Quadraple	Demolish							
Basic	x1	x2	x3	x4	x5	sx6	sx7	sx8	sx9	sx10	sx11	Solution
z (max)	0.00	0.00	-8.69	0.00	0.00	218.06	0.00	420.27	0.00	608.63	22.90	343442.62
x4	0.00	0.00	0.92	1.00	0.00	0.03	0.00	-0.06	0.00	-0.75	0.00	40.98
sx7	0.00	0.00	0.03	0.00	0.00	4.61	1.00	-0.13	0.00	-0.46	-0.02	54.10
x5	0.00	0.00	-0.03	0.00	1.00	-4.61	0.00	0.13	0.00	0.46	0.02	245.90
x1	1.00	0.00	-0.07	0.00	0.00	0.02	0.00	-1.05	0.00	0.20	0.00	32.79
sx9	0.00	0.00	-0.35	0.00	0.00	0.05	0.00	0.90	1.00	1.45	0.00	73.77
x2	0.00	1.00	-0.19	0.00	0.00	0.06	0.00	0.87	0.00	1.55	0.01	90.16
Lower Bound	0.00	0.00	0.00	0.00	0.00							
Upper Bound	infinity	infinity	infinity	infinity	infinity							
Unrestr'd (y/n)?	n	n	n	n	n							

Optimum solution (iteration 7)

Iteration 7	Single	Double	Triple	Quadraple	Demolish							
Basic	x1	x2	x3	x4	x5	sx6	sx7	sx8	sx9	sx10	sx11	Solution
z (max)	0.00	0.00	0.00	9.49	0.00	218.31	0.00	419.73	0.00	601.52	22.92	343831.72
x3	0.00	0.00	1.00	1.09	0.00	0.03	0.00	-0.06	0.00	-0.82	0.00	44.77
sx7	0.00	0.00	0.00	-0.03	0.00	4.60	1.00	-0.13	0.00	-0.44	-0.02	52.70
x5	0.00	0.00	0.00	0.03	1.00	-4.60	0.00	0.13	0.00	0.44	0.02	247.30
x1	1.00	0.00	0.00	0.07	0.00	0.02	0.00	-1.05	0.00	0.15	0.00	35.82
sx9	0.00	0.00	0.00	0.38	0.00	0.06	0.00	0.87	1.00	1.16	0.01	89.54
x2	0.00	1.00	0.00	0.20	0.00	0.06	0.00	0.86	0.00	1.40	0.01	98.49
Lower Bound	0.00	0.00	0.00	0.00	0.00							
Upper Bound	infinity	infinity	infinity	infinity	infinity							
Unrestr'd (y/n)?	n	n	n	n	n							

- Would the optimal value change if the maximum number of houses we could demolish is changed to 400?

No, It doesn't change the optimal value.

Iteration 1	Single	Double	Triple	Quadraple	Demolish							
Basic	x1	x2	x3	x4	x5	sx6	sx7	sx8	sx9	sx10	sx11	Solution
z (max)	-1000.00	-1900.00	-2700.00	-3400.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sx6	0.18	0.28	0.40	0.50	-0.21	1.00	0.00	0.00	0.00	0.00	0.00	0.00
sx7	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	400.00
sx8	-0.80	0.20	0.20	0.20	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
sx9	0.10	-0.90	-0.10	0.10	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00
sx10	0.25	0.25	-0.75	-0.75	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
sx11	50.00	70.00	130.00	160.00	2.00	0.00	0.00	0.00	0.00	0.00	1.00	15000.00
Lower Bound	0.00	0.00	0.00	0.00	0.00							
Upper Bound	infinity	infinity	infinity	infinity	infinity							
Unrestr'd (y/n)?	n	n	n	n	n							

Iteration 2	Single	Double	Triple	Quadraple	Demolish							
Basic	x1	x2	x3	x4	x5	sx6	sx7	sx8	sx9	sx10	sx11	Solution
z (max)	224.00	4.00	20.00	0.00	-1428.00	6800.00	0.00	0.00	0.00	0.00	0.00	0.00
x4	0.36	0.56	0.80	1.00	-0.42	2.00	0.00	0.00	0.00	0.00	0.00	0.00
sx7	0.00	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	400.00
sx8	-0.87	0.09	0.04	0.00	0.08	-0.40	0.00	1.00	0.00	0.00	0.00	0.00
sx9	0.06	-0.96	-0.18	0.00	0.04	-0.20	0.00	0.00	1.00	0.00	0.00	0.00
sx10	0.52	0.67	-0.15	0.00	-0.32	1.50	0.00	0.00	0.00	1.00	0.00	0.00
sx11	-7.60	-19.60	2.00	0.00	69.20	-320.00	0.00	0.00	0.00	0.00	1.00	15000.00
Lower Bound	0.00	0.00	0.00	0.00	0.00							
Upper Bound	infinity	infinity	infinity	infinity	infinity							
Unrestr'd (y/n)?	n	n	n	n	n							

Iteration 3	Single	Double	Triple	Quadraple	Demolish							
Basic	x1	x2	x3	x4	x5	sx6	sx7	sx8	sx9	sx10	sx11	Solution
z (max)	-14600.00	1500.00	700.00	0.00	0.00	0.00	0.00	17000.00	0.00	0.00	0.00	0.00
x4	-4.00	1.00	1.00	1.00	0.00	0.00	0.00	5.00	0.00	0.00	0.00	0.00
sx7	10.38	-1.05	-0.48	0.00	0.00	4.76	1.00	-11.90	0.00	0.00	0.00	400.00
x5	-10.38	1.05	0.48	0.00	1.00	-4.76	0.00	11.90	0.00	0.00	0.00	0.00
sx9	0.50	-1.00	-0.20	0.00	0.00	0.00	0.00	-0.50	1.00	0.00	0.00	0.00
sx10	-2.75	1.00	0.00	0.00	0.00	0.00	0.00	3.75	0.00	1.00	0.00	0.00
sx11	710.76	-92.10	-30.95	0.00	0.00	9.52	0.00	-823.81	0.00	0.00	1.00	15000.00
Lower Bound	0.00	0.00	0.00	0.00	0.00							
Upper Bound	infinity	infinity	infinity	infinity	infinity							
Unrestr'd (y/n)?	n	n	n	n	n							

Iteration 4	Single	Double	Triple	Quadraple	Demolish							
Basic	x1	x2	x3	x4	x5	sx6	sx7	sx8	sx9	sx10	sx11	Solution
z (max)	0.00	-27700.00	-5140.00	0.00	0.00	0.00	0.00	2400.00	29200.00	0.00	0.00	0.00
x4	0.00	-7.00	-0.60	1.00	0.00	0.00	0.00	1.00	8.00	0.00	0.00	0.00
sx7	0.00	19.71	3.68	0.00	0.00	4.76	1.00	-1.52	-20.76	0.00	0.00	400.00
x5	0.00	-19.71	-3.68	0.00	1.00	-4.76	0.00	1.52	20.76	0.00	0.00	0.00
x1	1.00	-2.00	-0.40	0.00	0.00	0.00	0.00	-1.00	2.00	0.00	0.00	0.00
sx10	0.00	-4.50	-1.10	0.00	0.00	0.00	0.00	1.00	5.50	1.00	0.00	0.00
sx11	0.00	1329.43	253.35	0.00	0.00	9.52	0.00	-113.05	-1421.52	0.00	1.00	15000.00
Lower Bound	0.00	0.00	0.00	0.00	0.00							
Upper Bound	infinity	infinity	infinity	infinity	infinity							
Unrestr'd (y/n)?	n	n	n	n	n							

Iteration 5	Single	Double	Triple	Quadraple	Demolish							
Basic	x1	x2	x3	x4	x5	sx6	sx7	sx8	sx9	sx10	sx11	Solution
z (max)	0.00	0.00	138.86	0.00	0.00	198.44	0.00	44.54	-418.90	0.00	20.84	312540.30
x4	0.00	0.00	0.73	1.00	0.00	0.05	0.00	0.40	0.52	0.00	0.01	78.98
sx7	0.00	0.00	-0.08	0.00	0.00	4.62	1.00	0.15	0.32	0.00	-0.01	177.56
x5	0.00	0.00	0.08	0.00	1.00	-4.62	0.00	-0.15	-0.32	0.00	0.01	222.44
x1	1.00	0.00	-0.02	0.00	0.00	0.01	0.00	-1.17	-0.14	0.00	0.00	22.57
sx10	0.00	0.00	-0.24	0.00	0.00	0.03	0.00	0.62	0.69	1.00	0.00	50.77
x2	0.00	1.00	0.19	0.00	0.00	0.01	0.00	-0.09	-1.07	0.00	0.00	11.28
Lower Bound	0.00	0.00	0.00	0.00	0.00							
Upper Bound	infinity	infinity	infinity	infinity	infinity							
Unrestr'd (y/n)?	n	n	n	n	n							

Iteration 6	Single	Double	Triple	Quadraple	Demolish							
Basic	x1	x2	x3	x4	x5	sx6	sx7	sx8	sx9	sx10	sx11	Solution
z (max)	0.00	0.00	-8.69	0.00	0.00	218.06	0.00	420.27	0.00	608.63	22.90	343442.62
x4	0.00	0.00	0.92	1.00	0.00	0.03	0.00	-0.06	0.00	-0.75	0.00	40.98
sx7	0.00	0.00	0.03	0.00	0.00	4.61	1.00	-0.13	0.00	-0.46	-0.02	154.10
x5	0.00	0.00	-0.03	0.00	1.00	-4.61	0.00	0.13	0.00	0.46	0.02	245.90
x1	1.00	0.00	-0.07	0.00	0.00	0.02	0.00	-1.05	0.00	0.20	0.00	32.79
sx9	0.00	0.00	-0.35	0.00	0.00	0.05	0.00	0.90	1.00	1.45	0.00	73.77
x2	0.00	1.00	-0.19	0.00	0.00	0.06	0.00	0.87	0.00	1.55	0.01	90.16
Lower Bound	0.00	0.00	0.00	0.00	0.00							
Upper Bound	infinity	infinity	infinity	infinity	infinity							
Unrestr'd (y/n)?	n	n	n	n	n							

Iteration 7	Single	Double	Triple	Quadraple	Demolish							
Basic	x1	x2	x3	x4	x5	sx6	sx7	sx8	sx9	sx10	sx11	Solution
z (max)	0.00	0.00	0.00	9.49	0.00	218.31	0.00	419.73	0.00	601.52	22.92	343831.72
x3	0.00	0.00	1.00	1.09	0.00	0.03	0.00	-0.06	0.00	-0.82	0.00	44.77
sx7	0.00	0.00	0.00	-0.03	0.00	4.60	1.00	-0.13	0.00	-0.44	-0.02	152.70
x5	0.00	0.00	0.00	0.03	1.00	-4.60	0.00	0.13	0.00	0.44	0.02	247.30
x1	1.00	0.00	0.00	0.07	0.00	0.02	0.00	-1.05	0.00	0.15	0.00	35.82
sx9	0.00	0.00	0.00	0.38	0.00	0.06	0.00	0.87	1.00	1.16	0.01	89.54
x2	0.00	1.00	0.00	0.20	0.00	0.06	0.00	0.86	0.00	1.40	0.01	98.49
Lower Bound	0.00	0.00	0.00	0.00	0.00							
Upper Bound	infinity	infinity	infinity	infinity	infinity							
Unrestr'd (y/n)?	n	n	n	n	n							

- Observe the decimal nature of the solution (given in the book) and understand the rounding.

Answer: refer textbook : Introduction to operation research by Hamdy Taha

Page no. 30 remarks .