

MDSC 103 ASSIGNMENT

Outdoors, Inc. has, as one of its product lines, lawn furniture. They currently have three items in that line: a lawn chair, a standard bench, and a table. These products are produced in a two-step manufacturing process involving the tube-bending department and the welding department. The time required by each item in each department is as follows

	Product			Present capacity
	Lawn	chair	Bench Table	
Tube bending	1.2	1.7	1.2	1000
Welding	0.8	0	2.3	1200

The contribution that Outdoors, Inc. receives from the manufacture and sale of one unit of each product is \$3 for a chair, \$3 for a bench, and \$5 for a table. The company is trying to plan its production mix for the current selling season. It feels that it can sell any number it produces, but unfortunately production is further limited by available material, because of a prolonged strike. The company currently has on hand 2000 lbs. of tubing. The three products require the following amounts of this tubing: 2 lbs. per chair, 3 lbs. per bench, and 4.5 lbs. per table.

(1) Formulate LP model for this problem ?

Decision variables:

Number of lawn chairs = x_1

Number of benches = x_2

Number of tables = x_3

Objective function: Maximise $z = 3x_1 + 3x_2 + 5x_3$

Constraints:

Tube bending: $1.2x_1 + 1.7x_2 + 1.2x_3 \leq 1000$

Welding: $0.8x_1 + 2.3x_3 \leq 1200$

Tubing: $2x_1 + 3x_2 + 4.5x_3 \leq 2000$

(2) Solve the problem by SOLVER ?

	A	B	C	D	E	F	G	H
1								
2	OBJECTIVE	X1	X2	X3		Z		
3	COEFF	3	3	5				
4	SOLUTION	700	0	133.3333		2766.667		
5								
6	C1	1.2	1.7	1.2	1000	<=	1000	
7	C2	0.8	0	2.3	866.6667	<=	1200	
8	C3	2	3	4.5	2000	<=	2000	
9								
10								
11								

- (3) What is the optimal production mix? What contribution can the firm anticipate by producing this mix?

The optimal production mix is considering 700 Chairs and 133.33(approx. 133) Tables with a total of \$2766.66.

- (4) What is the value of one unit more of tube-bending time? of welding time? of metal tubing?

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
\$E\$6	C1	1000	1.166666667	1000	200	466.6666667
\$E\$7	C2	866.6666667	0	1200	1E+30	333.3333333
\$E\$8	C3	2000	0.8	2000	555.5555556	333.3333333

Once we observe the Sensitive analysis Report we come to an understanding that we increase one unit we have \$1.66 on one unit of tube bending 0 on welding and 0.8 on metal tubing.

- (5) A local distributor has offered to sell Outdoors, Inc. some additional metal tubing for \$0.60/lb. Should Outdoors buy it? If yes, how much would the firm's contribution increase if they bought 500 lbs. and used it in an optimal fashion?

For metal tubing we already have \$0.8/lb getting it for just \$0.60/lb is profitable. Yes Outdoors should buy. The contribution of the firm would therefore revenue increase by $0.8 \cdot 550 = \$440$ by buying 550 lbs. of tubing and with a cost of \$0.6/lb, the impact on profit is $0.2 \cdot 550 = \$110$.

- (6) If Outdoors, Inc. feels that it must produce at least 100 benches to round out its product line, what effect will that have on its contribution?

The reduced cost for Bench is -1.38333 Hence, if the firm produces at least 100 benches it can expect a modification of the objective function value of $-1.38333 \cdot 100$. So the contribution will decrease by \$138.333.

- (7) The R&D department has been redesigning the bench to make it more profitable. The new design will require 1.1 hours of tube-bending time, 2.0 hours of welding time, and 2.0 lbs. of metal tubing. If it can sell one unit of this bench with a unit contribution of \$3, what effect will it have on overall contribution?

OBJECTIVE	X1	X2	X3		Z	
COEFF	3	3	5			
SOLUTION	0	200	600		3600	
C1	1.2	1.7	1.1	1000 <=		1000
C2	0.8	0	2	1200 <=		1200
C3	2	3	2	1800 <=		2000

We observe that there is an increase in profit.

- (8) Marketing has suggested a new patio awning that would require 1.8 hours of tube-bending time, 0.5 hours of welding time, and 1.3 lbs. of metal tubing. What contribution must this new product have to make it attractive to produce this season?

- 9) Outdoors, Inc. has a chance to sell some of its capacity in tube bending at cost + \$1.50/hour. If it sells 200 hours at that price, how will this affect contribution?

The shadow price of the bending constraint is \$1.166667, and that this value will not change if the RHS it is decreased to 466.6667. Hence, decreasing the it by 200 hours will decrease contribution by $1.166667 \cdot 200 = \$233.3334$.

- 10) If the contribution on chairs were to decrease to \$2.50, what would be the optimal production mix and what contribution would this production plan give?

The current contribution of chairs is \$3 and we are asked a decrease of \$0.5. The sensitivity report tells us that the allowable decrease for the objective function coefficient of Chair is 0.777778. Therefore, decreasing the contribution of chairs by \$0.5 will not change the optimal production mix. The total contribution $2766.66 - 0.5 \cdot 700 = \$2,416.66$