MDSC – 103

Problem on Sensitivity Analysis

(1) Formulate LP model for this problem?

Let x1 = no. of lawn chairs
x2 = no. of benches
x3 = no. of tables

Maximize Z = 3x1 + 3x2 + 5x3

Subject to:

C1: 1.2x1 + 1.7x2 + 1.2x3 <= 1000
C2: 0.8x1 + 0x2 + 2.3x3 <= 1200
C3: 2x1 + 3x2 + 4.5x3 <= 2000

x1, x2, x3 >=0

(2) Solve the problem by SOLVER?

		x1	x2	x3			
		700	0	133.3333333			
Z	:	3	3	5		=	2766.666667
c1	:	1.2	1.7	1.2	1000	<=	1000
c2	:	0.8	0	2.3	866.6666667	<=	1200
c3	:	2	3	4.5	2000	<=	2000

Variable Cells

Cell	Name	Final Value	Reduced Cost	Objective Coefficient	Allowable Increase	Allowable Decrease
G7	x1	700	0	3	2	0.777777778
H7	x2	0	-1.383333333	3	1.383333333	1E+30
I7	x3	133.3333333	0	5	1.75	2

Constraints

Cell	Name	Final Value	Shadow Price	Constraint R.H. Side	Allowable Increase	Allowable Decrease
J11	:	1000	1.166666667	1000	200	466.6666667
J12	:	866.6666667	0	1200	1E+30	333.3333333
J13	:	2000	0.8	2000	555.5555556	333.3333333

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

Optimal production mix = 2766.67
X1 = 2100, x2 = 0, x3 = 666.65

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

Tube-bending time = 1.167

Welding time = 0

Metal tubing = 0.8

(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?

Yes, the firm can buy the metal tubing for $0.6/lb.

If they do so, their investment = 0.6*500 = $300

Shadow price of metal tubing = 0.8 and allowable increase is 555.55

Therefore, the firm can invest and its total contribution will get increased by:

500*0.8 = $400

Implies, profit will be 400-300 = $100.

(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?

From the sensitivity report, the allowable range for benches is (-infinity,1.383], therefore if the firm produces more benches than within this range, the optimal solution will decrease since its reduced cost is -1.383.

(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?

Reduced cost of bench = -1.383

Shadow prices of tube-bending = 1.167, welding = 0, metal-tubing = 0.8 and the given requirements are within the increasing range.

Implies, change/unit production of bench

= 1.1*1.167 + 0*2.2 + 0.8*2 = 2.8837

Implies, overall effect = 2.8837-1.383 = 1.5007/unit contribution of production of bench

(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 his new product have to make it attractive to produce this season?

Since all the resources are within the allowable increasing range,

Contribution of patio = 1.8*1.167 + 0*0.5 + 0.8*1.3 = 3.1406

Therefore, the new product will contribute 3.1406/unit

(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?

Since selling of 200 hours is within increasable range,

Total earnings = 1.5*200 = 300

Then, only 800 hours are used for contribution, since initially 1000 hours were being used and 200 of them are sold now.

Then, contribution of 800 hours = 800*1.167

Therefore, final impact on the contribution

= (1.167*200 + 300) – (1000*1.167) = -233.4

The firm has to incur a loss of $233.4

(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?

Decreased amount = $3 - $2.50 = $0.5

Since the decreased amount is < 0.778, this will not have any effect on the total contribution