MDSC - 201

Sri Sathya Sai Institute of Higher Learning

(Deemed to be University)

DMACS, MDH Campus

Course : **M.Sc Data Science and Computing** Date : **December 19, 2018**

Subject : **Optimization Techniques** Module : **Sensitivity Analysis**

(A) Imagine a furniture company that makes tables and chairs. A table requires 40 board feet of wood and a chair requires 30 board feet of wood. Wood costs $1 per board foot and 40,000 board feet of wood are available. It takes 2 hours of skilled labor to make an unfinished table or an unfinished chair. Three more hours of labor will turn an unfinished table into a finished table; two more hours of skilled labor will turn an unfinished chair into a finished chair. There are 6000 hours of skilled labor available. (Assume that you do not need to pay for this labor.) The prices of output are given in the table below:

Product	Price
unfinished table	$70
finished table	$140
Unfinished chair	$60
finished chair	$110

(1) Formulate an LP that describes the production plans that the firm can use to maximize its profits.
Write
x_1 = number of unfurnished tables
x_2 = number of furnished tables
x_3 = number of unfurnished chairs
x_4 = number of furnished chairs
Maximize $z = 70x_1 + 140x_2 + 60x_3 + 110x_4$
subject to

$$40x_1 + 40x_2 + 30x_3 + 30x_4 \leq 40000.$$

$$2x_1 + 5x_2 + 2x_3 + 4x_4 \leq 6000.$$

(2) What would happen if the price of unfinished chairs went up?
(3) What would happen if the price of unfinished tables went up?
(4) What if the price of finished chairs fell to $100?
(5) How would profit change if lumber supplies changed?
(6) How much would you be willing to pay an additional carpenter?
(7) Suppose that industrial regulations complicate the finishing process, so that it takes one extra hour per chair or table to turn an unfinished product into a finished one. How would this change your plans?
(8) The owner of the firm comes up with a design for a beautiful hand-crafted cabinet. Each cabinet requires 250 hours of labor (this is 6 weeks of full time work) and uses 50 board feet of lumber. Suppose that the company can sell a cabinet for $200, would it be worthwhile?

(B) 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			
	Lawn	chair	Bench Table	Present capacity
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 ?
(2) Solve the problem by SOLVER ?
(3) What is the optimal production mix? What contribution can the firm anticipate by producing this mix?
(4) What is the value of one unit more of tube-bending time? of welding time? of 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?
(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?
(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?
(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?
(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?