

Math 3401 (Ng/Spring 2009)
Handout 5
for class on **March 11, 2009.**

The Classic Stone Cutter Company produces four types of stone sculptures, namely, *figures*, *figurines*, *free forms*, and *statues*, with unit profits of \$280, \$40, \$500, and \$510, respectively. Each product requires certain hours of work for cutting, chiseling, and polishing.

The company's current work force has production capacity to allocate 300 hours to cutting, 180 hours to chiseling, and 300 hours to polishing in any week. Based upon these limitations, it finds its weekly production schedule by solving the following *LP* (where x_1, x_2, x_3, x_4 denote the number of units of figures, figurines, free forms, statues produced weekly, respectively).

$$\begin{array}{rllll}
\text{Maximize } z = & 280x_1 & +40x_2 & +500x_3 & +510x_4 \\
\text{Subject to:} & & & & \\
& 30x_1 & +5x_2 & +45x_3 & +60x_4 \leq 300 \quad (\text{cutting}) \\
& 20x_1 & +8x_2 & +60x_3 & +30x_4 \leq 180 \quad (\text{chiseling}) \\
& & 20x_2 & & +120x_4 \leq 300 \quad (\text{polishing}) \\
& & & & x_j \geq 0 \quad \text{for } j = 1, 2, 3, 4
\end{array}$$

The initial dictionary is:

$$\begin{array}{rllll}
x_5 = & 300 & -30x_1 & -5x_2 & -45x_3 & -60x_4 & (\text{cutting}) \\
x_6 = & 180 & -20x_1 & -8x_2 & -60x_3 & -30x_4 & (\text{chiseling}) \\
x_7 = & 300 & & -20x_2 & & -120x_4 & (\text{polishing}) \\
\hline
z = & & 280x_1 & +40x_2 & +500x_3 & +510x_4 &
\end{array}$$

and the optimal dictionary is :

$$\begin{array}{rllll}
x_1 = & 6 & -1.1x_2 & -7.5x_3 & +0.1x_5 & -0.2x_6 \\
x_7 = & 60 & -76x_2 & -360x_3 & +8x_5 & -12x_6 \\
x_4 = & 2 & +0.47x_2 & +3x_3 & -0.07x_5 & +0.1x_6 \\
\hline
z = & 2700 & -30x_2 & -70x_3 & -6x_5 & -5x_6
\end{array}$$

1. Determine the range on the cutting capacity such that the current dictionary remains optimal.
2. Suppose Cheap Labor Inc. offers to sell five more cutting hours to classic stone company at the cost of \$2.50 per hour. Should classic stone accept Cheap Labor's offer?
3. By how much can the unit profit from figurines increase such that the current dictionary remains optimal. What activities (products produced) will enter the basis at the bounds of this range?
4. *Busts** have the following characteristics, i.e. each bust produced needs the following requirements:
cutting: 15 hrs
chiseling: 10 hrs
polishing: 20 hrs
and the profit per unit is: \$240
Should Classic Stone Cutter maintain its present line or expand its production to include busts?

*The meaning of this term should be taken to be within the context of this problem.