AMS 540 / MBA 540 (Fall, 2011) Estie Arkin

Linear Programming

Homework Set # 7

Due in class on Tuesday, November 15, 2011.

2). A company produces and sells wooden soldiers and wooden trains. Each soldier requires 3 board feet of lumber and 2 hours of labor. Each train requires 5 board feet of lumber and 4 hours of labor. A total of 145 board feet of lumber and 90 hours of labor are availble. Upto 50 soldiers and 50 trains can be sold. Trains sell for \$55, and soldiers for \$32. In addition to producing trains and soldiers itself, the company can buy (from an outside supplier) extra soldiers at \$27 each and extra trains at \$50 each. Let SM, TM be the number of soldiers and trains made by the company, and SB, TB the number of soldiers and trains bought from the supplier. Use the Lindo output on the next page to answer each of the following parts.
(a). If the company can purchase trains for \$48, what would be the new optimal profit?
(b). What is the most that the company should be willing to pay to for another board foot of lumber?
(c). If only 40 trains could be sold, what would be the new optimal solution (the z)?
(d). If only 40 trains could be sold, and 91 hours of labor are available, what would be the new optimal solution (the z)?
(e). The company is considering producing sets of wooden blocks. Demand for blocks is unlimited. Each set of wooden blocks requires 10 board feet of lumber and 1 hour of labor, and sells for \$20. Should the company produce any blocks?

$$
\begin{array}{lcr}
\text{max} & 32SM + 55TM + 5SB + 5TB & \\
\text{s.t. } 2) & 3SM + 5TM & \leq 145 \\
3) & 2SM + 4TM & \leq 90 \\
4) & SM + SB & \leq 50 \\
5) & TM + TB & \leq 50
\end{array}
$$

objective function value 1715.00000

variable	value	reduced cost
SM	45.000000	.000000
TM	.000000	4.000000
SB	5.000000	.000000
TB	50.000000	.000000

row	slack or surplus	dual prices
2)	10.000000	0.000000
3)	.000000	13.500000
4)	.000000	5.000000
5)	.000000	5.000000

Range in which basis remains unchanged :

OBJ coefficient ranges

variable	current coef	allowable increase	allowable decrease
SM	32.000000	infinity	2.00000
TM	55.000000	4.00000	infinity
SB	5.00000	2.00000	5.00000
TB	5.00000	infinity	4.00000

righthand side ranges

row	current RHS	allowable increase	allowable decrease
2	145.00000	infinity	10.000000
3	90.00000	6.66667	90.00000
4	50.00000	infinity	5.00000
5	50.00000	infinity	50.00000

3). Consider the following problem and the accompanying optimal tableau (x_4, x_5 are the respective slack variables):

$$
\begin{array}{ll}
\text{max} & z = 2x_1 + x_2 - x_3 \\
\text{s.t.} & x_1 + 2x_2 + x_3 \leq 8
\end{array}
$$

$$
\begin{aligned}
-x_1 + x_2 - 2x_3 &\leq 4 \\
x_1, x_2, x_3 &\geq 0
\end{aligned}
$$

	z	x_1	x_2	x_3	x_4	x_5	RHS
z	1	0	3	3	2	0	16
x_1	0	1	2	1	1	0	8
x_5	0	0	3	-1	1	1	12

(a). Suppose the coefficient of x_2 in the objective function is changed from 1 to 3.5. Use sensitivity analysis to find the new optimal solution.
(b). Suppose that constraint $x_2 + x_3 = 3$ is added to the problem. Use sensitivity analysis to find the new optimal solution.
(c). Suppose that a new activity, x_6, is proposed with unit return $c_6 = 4$ and consumption vector $a_6 = (1, 2)^t$. Use sensitivity analysis to find the new optimal solution.