

TOYCO uses three operations to assemble three types of toys—trains, trucks, and cars. The daily available times for the three operations are 430, 460, and 420 mins, respectively, and the revenues per unit of toy train, truck, and car are \$3, \$2, and \$5, respectively. The assembly times per train at the three operations are 1, 3, and 1 mins, respectively. The corresponding times per train and per car are (2, 0, 4) and (1, 2, 0) mins (a zero time indicates that the operation is not used).

Letting  $x_1$ ,  $x_2$ , and  $x_3$  represent the daily number of units assembled of trains, trucks, and cars, respectively, the associated LP model is given as:

$$\text{Maximize } z = 3x_1 + 2x_2 + 5x_3$$

subject to

$$x_1 + 2x_2 + x_3 \leq 430 \text{ (Operation 1)}$$

$$3x_1 + 2x_3 \leq 460 \text{ (Operation 2)}$$

$$x_1 + 4x_2 \leq 420 \text{ (Operation 3)}$$

$$x_1, x_2, x_3 \geq 0$$

Using  $x_4$ ,  $x_5$ , and  $x_6$  as the slack variables for the constraints of operations 1, 2, and 3, respectively, the optimum tableau is

Basic	$x_1$	$x_2$	$x_3$	$x_4$	$x_5$	$x_6$	Solution
$z$	4	0	0	1	2	0	1350
$x_2$	$-\frac{1}{4}$	1	0	$\frac{1}{2}$	$-\frac{1}{4}$	0	100
$x_3$	$\frac{3}{2}$	0	1	0	$\frac{1}{2}$	0	230
$x_6$	2	0	0	-2	1	1	20

The solution recommends manufacturing 100 trucks and 230 cars but no trains. The associated revenue is \$1350.

\*3-69. Consider the TOYCO model.

- (a) Suppose that any additional time for operation 1 beyond its current capacity of 430 mins per day must be done on an overtime basis at \$50 an hour. The hourly cost includes both labor and the operation of the machine. Is it economically advantageous to use overtime with operation 1?
- (b) Suppose that the operator of operation 2 has agreed to work 2 hrs of overtime daily at \$45 an hour. Additionally, the cost of the operation itself is \$10 an hour. What is the net effect of this activity on the daily revenue?
- (c) Is overtime needed for operation 3?
- (d) Suppose that the daily availability of operation 1 is increased to 440 mins. Any overtime used beyond the current maximum capacity will cost \$40 an hour. Determine the new optimum solution, including the associated net revenue.
- (e) Suppose that the availability of operation 2 is decreased by 15 mins a day and that the hourly cost of the operation during regular time is \$30. Is it advantageous to decrease the availability of operation 2?