Best Buy Fitbits[1]

During the next four months Best Buy requires, respectively, 500, 650, 1000 and 700 units of Fitbits. No backlogging is allowed (that is, Best Buy's requirements must be met on time). Production costs are $50, $80, $40, and $70 per Fitbit during these months. The storage cost from one month to the next is $20 per unit (assessed on ending inventory). It is estimated that each Fitbit unit on hand at the end of month 4 can be sold for $60. Assume there is no beginning inventory and determine how to minimize the net cost incurred in meeting the demands for the next four months.

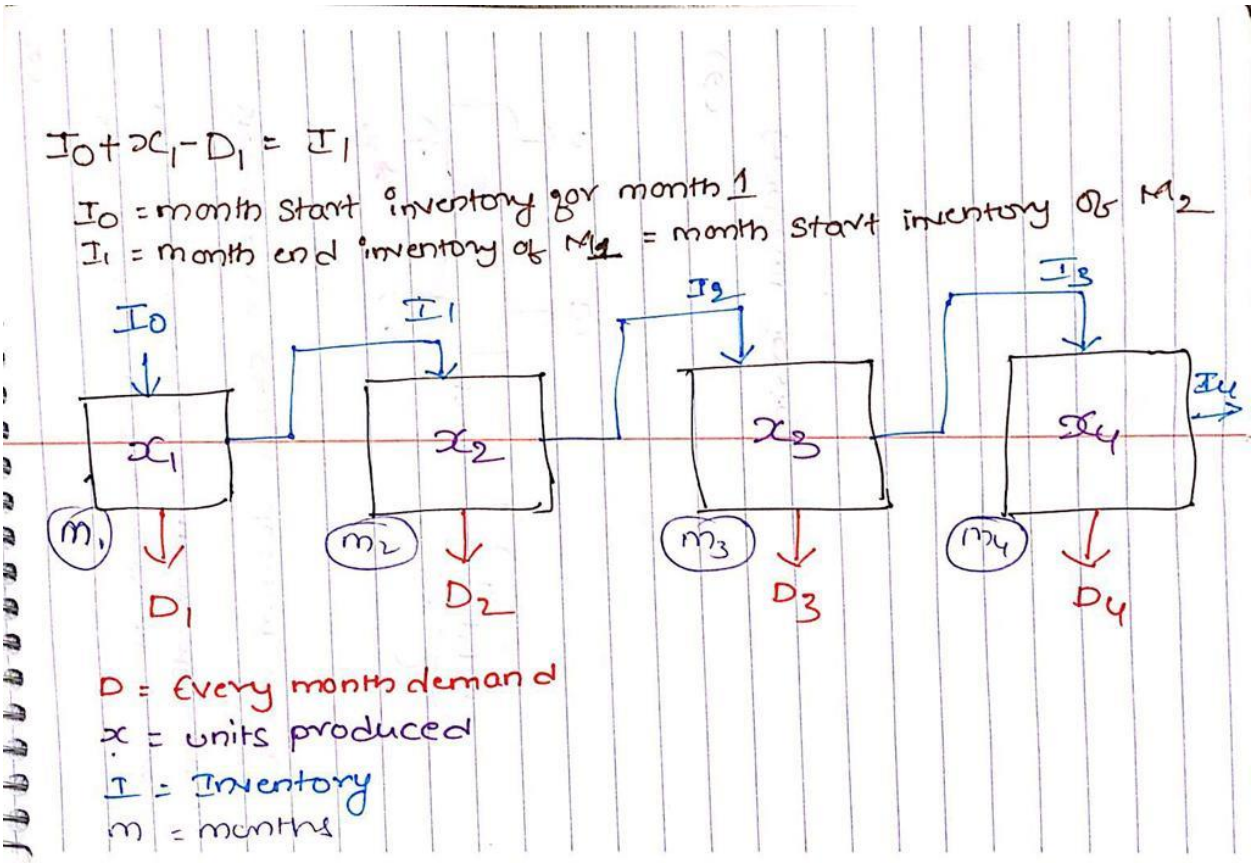
Discussion:

The objective is to design a multi-period production plan in such a way that Fitbit Co. reduces its cost. Fitbit Co. is producing Fitbit's to meet Best Buy's requirements on time. The input values given in this problem are the "demand" received from Best Buy, the "production cost" to produce Fitbit units in that month, and the "storage cost" for any inventory at the end of a month.

On top of these inputs it was mentioned that there is no beginning inventory for month-1, and it was estimated that each Fitbit unit on hand at the end of month-4 can be sold for $60.

Therefore, we must make sure that the summation of a month's beginning inventory and produced units are greater than or equal to the demand for that month. This is the important constraint needed to solve this problem. The screenshot below illustrates how to set up the model to calculate the month-end inventory.

[1] This exercise problem and related solutions were originally developed by Ramesh Alla based on Practical Management Science 5th Edition. This vision is revised by Nowed Patwary.


$I_0 + x_1 - D_1 = I_1$
I_0 = month start inventory for month 1
I_1 = month end inventory of M_1 = month start inventory of M_2
I_0
I_1
I_2
I_3
I_4
x_1
x_2
x_3
x_4
m_1
m_2
m_3
m_4
D_1
D_2
D_3
D_4
D = Every month demand
x = units produced
I = Inventory
m = months

Mathematical Model:

Parameters (Inputs):

$i \in 1,2,3,4\ (Index\ for\ months)$
$D_i : Demand\ in\ month\ i$
$C_i : Production\ cost\ per\ Fitbit\ unit\ in\ month\ i$
$S : Storage\ cost\ per\ Fitbit\ unit$
$P : Selling\ price\ for\ leftover\ Fitbits\ units\ at\ the\ end\ of\ month\ 4$
$I_0 : Beginning\ Inventory\ of\ month\ 1\ , I_o = 0$

Calculated Variables:

$I_i : Month - end\ Inventory\ in\ month\ i;\ I_i = (I_{i-1} + x_i - D_i)$

Decision Variables:

$x_i : Number\ of\ Fitbit\ units\ produced\ in\ each\ month\ i$

Objective:

$$Minimize\ Total\ Cost = \left[\sum_{i=1}^{4}(x_i * C_i) + (I_i * S)\right] - [I_4 * P]$$

Constraints:

$x_i \geq 0;$ $(1) Non\ Negative\ constraint$
$(I_{i-1} + x_i - D_i) \geq 0$ $(2) Demand\ constraint$

Excel Implementation:

Please find the attached spreadsheet for solution.

									Inputs
	Month-1	Month-2	Month-3	Month-4					Decision variables
Demand of Fitbit units	500	650	1000	700					Calculated Variables
Production Cost per unit	$ 50	$ 80	$ 40	$ 70					Constraints
Storage Cost per unit	$ 20								Objective
Selling price per unit	$ 60								
Beginning Inventory	0								
	Month 1	Month 2	Month 3	Month 4					
# of Units produced	1150	0	1700	0					
Month End Inventory	650	0	700	0	>=	0			
Production Cost	$ 57,500	$ -	$ 68,000	$ -					
Storage Cost	$ 13,000	$ -	$ 14,000	$ -					
Total Cost	$ 152,500								

As per the optimization model Fitbit Co. can produce 1150 Fitbit units in month-1 and 1700 units in month-3.

Because the Fitbit unit production cost in month-2 is higher than the summation of month production cost and storage cost, the optimal solution suggests producing 1150 units in month-1,

to account for and manage the month-2 demand as well. Similarly, Solver suggests producing Fitbit units required for month-4 in month-3. If there were any constraints with respect to the production units per month, there would have been a different solution from solver.