Data Science Programming: Ice Cream shop

The question asked me about "How can I maximize the profit of an ice cream shop" and provided me a useful detail that is

1) Vanilla ice cream is cost 0.5 fresh milk and worth $2
2) Strawberry ice cream is cost 0.2 fresh milk and worth $3
3) I have 10 fresh milk per day
4) I also have dolls for promoting my shop

1st Answer: I would sell only Strawberry ice cream that spends less cost but gain higher benefit. Hence, if I have 10 liters of fresh milk, I will make 50 cups of Strawberry ice cream and received $150 per day without caring about those 20 customers who didn't get a doll from my shop. Even though I have to give that tiny little doll to all of my customers, I could sell 30 cups of Strawberry ice cream, gain $90 each day and still have 4 liters of milk left for my family. Problem solved.

2nd Answer: However, vanilla is given in the question which means I must sell Vanilla ice cream too and every customer of mine must receive the doll. OK. Let say I have 10 liters of milk that must use for producing those types of ice cream. I can write the equation like.

$$0.5x_1 + 0.2x_2 \leq 10 \quad (1)$$

Where x_1 is the number of vanilla ice cream produced per day.

x_2 is the number of strawberry ice cream produced per day.

0.5 is the amount of fresh milk for producing one vanilla ice cream.

0.2 is the amount of fresh milk for producing one strawberry ice cream.

Then, I write the equation for my tiny doll, like

$$x_1 + x_2 \leq 30 \quad (2)$$

Where 30 is the number of tiny dolls I have to give to my customer per day.

Also, I have to write an equation for the maximum profit.

$$2x_1 + 3x_2 = Maximum\ Profit \quad (3)$$

Where 2 is the profit from selling one cup of vanilla ice cream.

3 is the profit from selling one cup of strawberry ice cream.

To calculate the maximum profit, I take all Constance from equations (1) and (2) and put it into matrix A and its result into matrix B where the first raw of these matrixes came from (1) and the second row came from (2).

$$A = \begin{bmatrix} 0.5 & 0.2 \\ 1 & 1 \end{bmatrix}, B = \begin{bmatrix} 10 \\ 30 \end{bmatrix}$$

Then, I use **solve** from python library "**scipy.linalg"** to find the result of matrix $X = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$.

The result displays an amount of vanilla ice cream and strawberry ice cream that should be sold per day to get maximum profit which is 13.33 and 16.66 (figure1). However, the result is not an integer, therefore, I round the number 13.33 of vanilla ice cream down to 13 and 16.66 of strawberry ice cream up to 17.

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In [1]: import numpy as np
   ...: from scipy.linalg import solve
   ...: a = [[0.5,0.2],[1,1]]
   ...: b = [[10],[30]]
   ...: x = solve(a,b)
   ...: x
   ...:
Out[1]:
array([[13.33333333],
       [16.66666667]])
```

Figure 1: result of maximum profit of ice cream sold per day calculated from solve in scipy.linalg python library

When I replace the number of vanilla ice cream and strawberry ice cream to the equation (1), (2), and (3), the first equation will be

$$\begin{aligned} 0.5(13) + 0.2(17) &\leq 10 \\ 6.5 + 3.4 &\leq 10 \\ 9.9 &\leq 10 \end{aligned} \qquad (1)$$

The second equation will be

$$\begin{aligned} 13 + 17 &\leq 30 \\ 30 &\leq 30 \end{aligned} \qquad (2)$$

The third equation will be

$$\begin{aligned} Maximum\ Profit &= 2x_1 + 3x_2 \\ Maximum\ Profit &= 2(13) + 3(17) \\ Maximum\ Profit &= 26 + 51 \\ Maximum\ Profit &= 77 \end{aligned} \qquad (3)$$

The result of replacement shows that the number of vanilla ice cream per day and the number of strawberry ice cream per day if valid for these equations and we can conclude that the maximum profit of selling ice cream is **$77** when the number of vanilla ice cream sold per day is 13 and the number of strawberry ice cream sold per day is 17 in the condition that most of the fresh milk must be used and the doll must be given to every customer who bought my ice cream.

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