Optimization Assignment - 1

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***Problem Statement* - Reshma wishes to mix two types of food P and Q in such a way that the vitamin contents of the mixture contain at least 8 units of vitamin A and 11 units of vitamin B. Food P costs Rs 60/kg and Food Q costs Rs 80/kg. Food P contains 3 units/kg of Vitamin A and 5 units / kg of Vitamin B while food Q contains 4 units/kg of Vitamin A and 2 units/kg of vitamin B. Determine the minimum cost of the mixture.**

Solution

Let the mixture contain x kg of food and y kg of food
Hence $x \geq 0$ and $y \geq 0$
The given information can be compiled in a table as given:

	Vitamin A(units/kg)	Vitamin B(units/kg)	Cost(Rs/kg)
Food P	3	5	60
Food Q	4	2	80
Requirement(units/kg)	8	11	

Table 1: DATA

The mixture must contain at least 8 units of vitamin A and 11 units of vitamin B.

$$P \geq 60x + 80y \tag{1}$$
$$3x + 4y \geq 8 \tag{2}$$
$$5x + 2y \geq 11 \tag{3}$$

which can be expressed in vector form as

$$P = \min_{\mathbf{x}} \begin{pmatrix} 60 & 80 \end{pmatrix} \mathbf{x} \tag{4}$$
$$\begin{pmatrix} 3 & 4 \\ 5 & 2 \end{pmatrix} \mathbf{x} \succeq \begin{pmatrix} 8 \\ 11 \end{pmatrix} \tag{5}$$
$$\mathbf{x} \succeq \mathbf{0} \tag{6}$$

Solving using cvxpy, we get

$$P_{min} = 159.99999999 \tag{7}$$
$$\mathbf{x} = \begin{pmatrix} 2.11436236 \\ 0.41422823 \end{pmatrix} \tag{8}$$