

Answer on Question #51725 - Programming | Other

Manufacture is to market a new fertilizer which is to be a mixture of ingredients A and B. The properties of the two ingredients are as give on the table below

	Bone meal	Nitrogen	Lime	Phosphate	Cost per kg
Ingredients A	20%	30%	40%	10%	12
Ingredients B	40%	10%	45%	5%	8

It has been decided that the fertilizer will:

- Be sold in bags containing 100 kilograms
- Be containing at least 15 kilograms of nitrogen
- Must contain at least 8 kilograms of phosphate
- Must contain at least 25 kilograms of bone meal

The manufacturer wants to meet the above requirements at minimum cost possible.

Required Develop a linear program and hence find the optimal solution for the problem.

Solution:

Since the exercise is asking for the number of kilograms of each ingredients required for the mixture, our variables will stand for the number of kilograms of each:

x - kgs of ingredient A, and y - kgs of ingredient B.

The optimization equation will be the cost relation $C = 12 * x + 8 * y$.

Subject to:

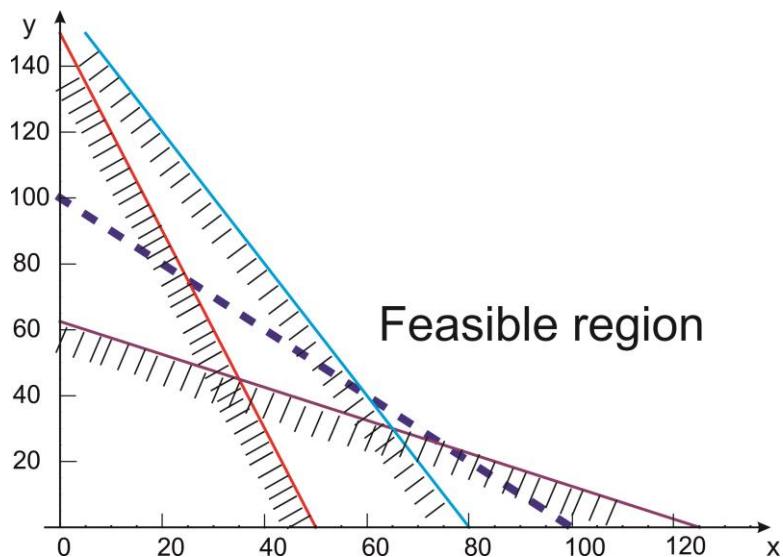
- $x + y = 100$ (Weight Constraint)
- $0.3x + 0.1y \geq 15$ (Nitrogen Constraint)
- $0.1x + 0.05y \geq 8$ (Phosphate Constraint)
- $0.2x + 0.4y \geq 25$ (Bone Meal Constraint)

Since we can't use negative amounts of either fertilizer: $x \geq 0, y \geq 0$.

Remove the inequalities and solve thus:

- $x + y = 100$ If $x = 0$ then $y = 100$ and If $y = 0$ then $x = 100$.
- $0.3x + 0.1y = 15$ If $x = 0$ then $y = \frac{15}{0.1} = 150$ and If $y = 0$ then $x = \frac{15}{0.3} = 50$
- $0.1x + 0.05y = 8$ If $x = 0$ then $y = \frac{8}{0.05} = 160$ and If $y = 0$ then $x = \frac{8}{0.1} = 80$
- $0.2x + 0.4y = 25$ If $x = 0$ then $y = \frac{25}{0.4} = 62.5$ and If $y = 0$ then $x = \frac{25}{0.2} = 125$

The above computations are then graphed as follows:



In this graph we could take points from feasible region that lie on the dotted dark blue line.

Reading from the graph:

Point	Ingredient A (12 per kg)	Ingredient B (8 per kg)	Total Cost (C)
1	60	40	$12 * 60 + 40 * 8 = 1040$
2	65	35	$12 * 65 + 35 * 8 = 1060$
3	70	30	$12 * 70 + 30 * 8 = 1080$

The above implies that the best combination of ingredients that would minimize total cost is 60 kg of A and 40 kg of B.

Answer: 60 kg of A and 40 kg of B.