ZZCA6510 3: Quantitative Decision Analysis

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1 Linear Programming

Peanut for Life, a food manufacturer, seeks to produce a chanachur snack product comprising three mixtures: puffed rice, nuts and cereal. Each ingredient mixture has a different cost per kilogram (see Table 1); therefore, Peanut for Life is aiming to minimise the total cost of each package of chanachur by formulating a linear programming model.

	Cost ($/kg)
Puffed rice mix	0.35
Nut mix	0.50
Cereal mix	0.20

Table 1: Cost of each ingredient

If x_1, x_2 and x_3 represent the weight (in kilograms) of puffed rice, nuts and cereal respectively, then the total cost of one package of chanachur would be:

$$0.35x_1 + 0.5x_2 + 0.2x_3$$

However, there is not just the cost to consider. Peanut for Life must also ensure the product is commercially viable; it can do this by composing the product in such a way that it is both nutritionally balanced and attractive to consumers. To this end, the following constraints on the final composition are given:

- The chanachur package must hold between 3 and 4 cups of product.

- One package cannot contain more than 1000 calories in food energy.

- One package cannot contain more than 25 grams of fat.

- At least 20% of the product volume must comprise puffed rice mixture.

- No more than 15% of the product weight may comprise nuts.

These constraints may be modelled mathematically as the following inequalities:

$$-0.25x_1 - 0.375x_2 - x_3 <= -3$$
$$0.25x_1 + 0.375x_2 + 1x_3 <= 4$$
$$150x_1 + 400x_2 + 50x_3 <= 1000$$
$$10x_2 + 1x_3 <= 25$$
$$-0.2x_1 + 0.075x_2 + 0.2x_3 <= 0$$
$$-0.15x_1 + 0.85x_2 - 0.15x_3 <= 0$$