A Mediterranean diet

Difficulty level: advanced

Keywords

- Diet
- Mixed Integer Linear Programming
- Excel Solver

Problem description

According to a nutritionist who supports the Mediterranean diet, the minimum amounts of nutrients that must be taken every day are 1700 kilocalories, 200 g of carbohydrates, 70 g of proteins, 60 g of fats, and 0.7 g of calcium. Generally, the nutritionist prescribes a diet composed of eight foods: bread, pasta, milk, eggs, chicken, tuna, chocolate, and vegetables. Table 1 shows how much energy (in kcal), how many carbohydrates, proteins, fats (in grams), and calcium (in mg) a serving of each food provides.

	Bread	**Pasta**	**Milk**	**Eggs**	**Chicken**	**Tuna**	**Chocolate**	**Vegetables**
Energy (kcal)	150	390	70	70	150	150	112	45
Carbohydrates (g)	30	75	5	0	2	0	7	8
Proteins (g)	5	11	5	6	36	25	2	3
Fats (g)	2	3	3	6	5	15	10	2
Calcium (mg)	52	5	150	50	22	4	11	50

Table 1: Amount of energy (in kcal), carbohydrates, proteins, fats (in g), and calcium (in mg)
provided by a serving of each food in the diet.

The nutritionist also recommends at least two servings of vegetables per day. Instead, the maximum number of servings for each food is shown in Table 2.

	Bread	**Pasta**	**Milk**	**Eggs**	**Chicken**	**Tuna**	**Chocolate**	**Vegetables**
Maximum nb of servings	2	2	2	1	1	2	2	6

Table 2: Maximum number of servings for each food in the diet.

The number of servings of bread and pasta cannot be greater than 3, whereas that of servings of milk, chicken, and tuna must be at least 4. Moreover, the nutritionist says that there must be exactly seven of the eight foods in the diet. The cost (in €) of a serving of each food is indicated in Table 3.

Determine which foods are going to be inserted in the daily diet and how many servings of each of them, to comply with all dietary prescriptions indicated by the nutritionist, while minimizing the total cost.

	Bread	**Pasta**	**Milk**	**Eggs**	**Chicken**	**Tuna**	**Chocolate**	**Vegetables**
Cost (€)	0.50	3.50	1.00	1.50	4.50	2.00	1.50	4.00

Table 3: Cost (in €) for a serving of each food in the diet.

Tasks

1. Formulate the problem by applying Linear, Integer, or Mixed Integer Linear Programming.

2. Solve the problem by using Excel Solver.