Assignment 1

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1 Introduction

To this problem we were given data from three different seeds which displayed what they can produce as well as their demands. We were also given the contents of the different biofuels and their respective taxes.

Crop	Yield [t/ha]	Water demand [Ml/ha]	Oil content [l/kg]
Soybeans	2.6	5.0	0.178
Sunflower seeds	1.4	4.2	0.216
Cotton seeds	0.9	1.0	0.433

Table 1: Crops data

Product	Biodiesel [%]	Price [€/l]	Tax [%]
B5	5	1.43	20
B30	30	1.29	5
B100	100	1.16	0

Table 2: Products data

2 Model

Notation used in this assignment:

- B_i, $i \in I$ where I is the set of different biofuels (B5, B30, B100).
- X_j, $j \in J$ where J is the set of different seeds (soybeans, sunflower, cotton).
- $P_{i,n}$, $n \in [1, 2, 3]$ which contain the data from the products.
- $C_{j,k}$, $k \in [1, 2, 3]$ which contain the data from the crops
- p, which is the amount of petrol used. The cost for petrol is 1 €/l.

- m, which is the amount of methanol used. The cost for methanol is 1.5 €/l.

The function we wish to maximize is

$$max \quad z = \sum_{i \in I} B_i P_{j,2}(1 - P_{j,3}) \quad - p - 1.5m. \tag{1}$$

The explanation to this model can be given as a simple *revenue − cost* situation. Our revenue is the amount of biofuel we manage to sell, minus the taxes. Our costs are the expenses for creating the biofuel, which is the petrol and methanol. The difference is our profit which is what we want to maximize.

Our model is subjected to:

$$\sum_{j=1}^{3} X_j = 1\,600$$

$$\sum_{j=1}^{3} X_j C_{j,2} \leq 5\,000$$

$$\sum_{i=1}^{3} B_i \geq 280\,000$$

$$B_i,\ X_j \geq 0\ \forall i,\ j$$

$$p = \sum_{i=1}^{3} B_i(1 - P_{i,1})$$

$$\text{Subject to: } p \leq 150\,000$$

$$unrefBiodiesel = \sum_{i=1}^{3} B_i(P_{i,1})$$

$$VegOil = 1\,000 \sum_{j=1}^{3} X_j C_{j,1} C_{j,3}$$

$$\text{Subject to: } VegOil = \frac{4}{3} \cdot \frac{5}{6} unrefBiodiesel$$

$$m = \frac{4}{3} \cdot \frac{1}{6} unrefBiodiesel$$

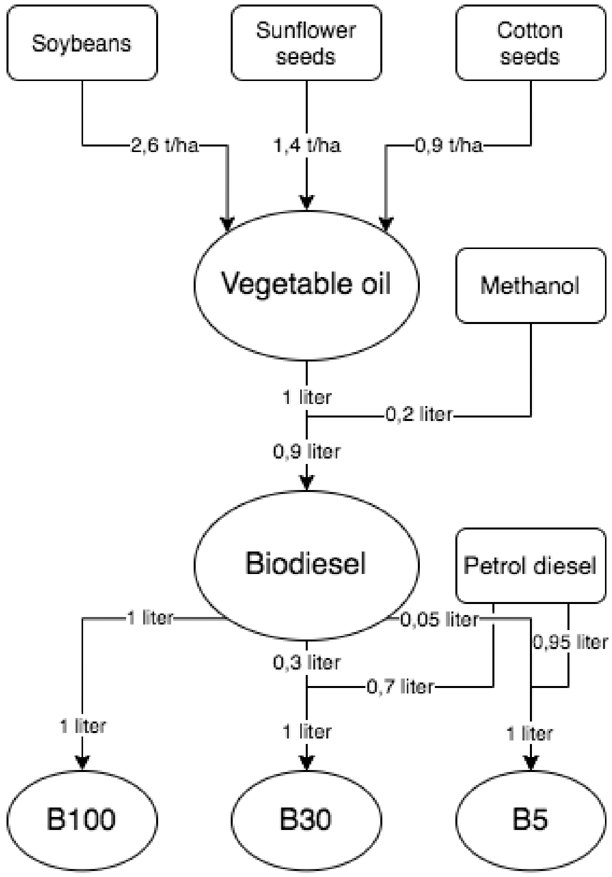

Figure 1: WRITE SOMETHING HERE.

3 Results

The maximization of model 1 gives an optimal solution of $z = 548\ 163$€ when we sold 767 089.5 liter biofuel with a combined value of 903 859€. We where also require to buy methanol and petrol diesel for a combined value of 355 697€. The value of the optimal solution sounds plausible, because the income minus the expenses sums up to 548 162€ with a small rounding error. Not only that, but all the variables and constants where inside the set parameters. Table 3 shows the optimal value for all the variables and constants.

Name of var/cons	Value of var/cons
z ($Objective function$)	548 163 €
B5 (B_1)	0 liters
B30 (B_2)	214 286 liters
B100 (B_3)	552 804 liters
Methanol (m)	137 131 liters
Petrol diesel (p)	150 000 liters
Biodiesel ($--$)	617 090 liters
VegOil ($--$)	685 655 liters
Water in use ($--$)	5 000 liters
Area in use ($--$)	1 600 hectare
Soybeans (X_1)	850 hectare
Sunflower seeds (X_2)	0 hectare
Cotton seeds (X_3)	750 hectare

Table 3: This table shows the value for all the the variables and constants in the optimal solutions to the problem stated above.

4 Sensitivity analysis