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

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

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:

$$\sum_{j=1}^{3} X_j = 1600$$

$$\sum_{j=1}^{3} X_j C_{j,2} \leq 5000$$

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

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

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

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

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

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

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

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

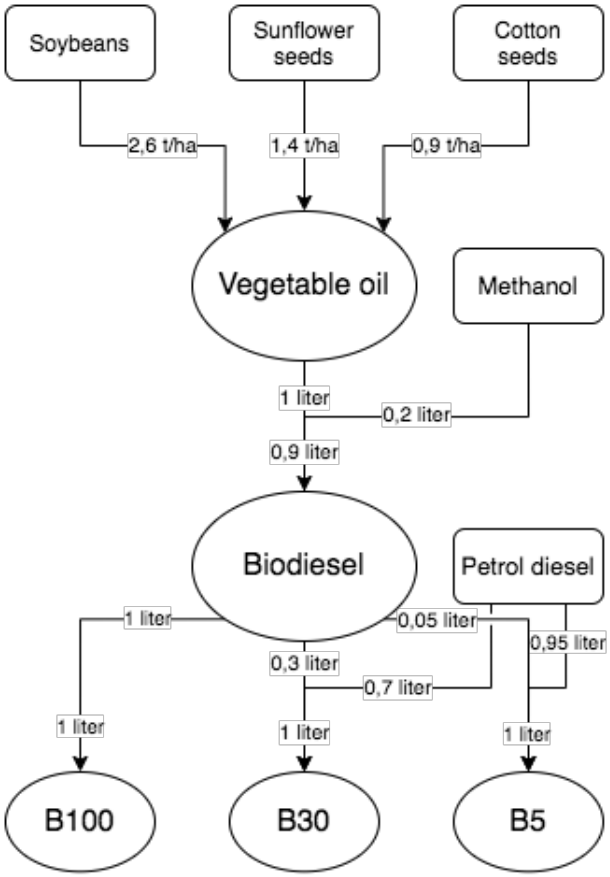

Figure 1: WRITE SOMETHING HERE.

3 Results

The maximization of model 1 gives an optimal solution of $z = 548\,163$€ when we sold 767089.5 liter biofuel with a combined value of 903859€. We where also require to buy methanol and petrol diesel for a combined value of 355697€. 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 inside the set parameters. Table 3 shows the optimal value for all the variables and constants.

4 Sensitivity analysis

Name of var/cons	Value of var/cons
z	548 163 €

Table 3: Caption