Combinatorial Problem Solving (CPS)

Laboratory. Linear Programming. Food Manufacture.

A food is manufactured by refining raw oils and blending them together. The raw oils come in two categories:

Vegetable oil:	VEG 1, VEG 2
Non-vegetable oil:	OIL 1, OIL 2, OIL 3

Each oil may be purchased for immediate delivery (January) or bought on the futures market for delivery in a subsequent month. Prices now and in the futures market are given below (in €/ton):

	VEG 1	VEG 2	OIL 1	OIL 2	OIL 3
January	110	120	130	110	115
February	130	130	110	90	115
March	110	140	130	100	95
April	120	110	120	120	125
May	100	120	150	110	105
June	90	100	140	80	135

The final product sells at 150 € per ton.

Vegetable oils and non-vegetable oils require different production lines for refining. In any month it is not possible to refine more than 200 tons of vegetable oils and more than 250 tons of non-vegetable oils. There is no loss of weight in the refining process and the cost of refining may be ignored.

Each month it is possible to store up to 1000 tons of each raw oil for later use. The cost of storage for vegetable and non-vegetable oil is 5 € per ton per month. The final product cannot be stored, nor can refined oils be stored.

There is a technical restriction relating to the hardness of the final product. In the units in which hardness is measured this must lie between 3 and 6. It is assumed that hardness blends linearly and that the hardnesses of the raw oils are:

VEG 1	8.8
VEG 2	6.1
OIL 1	2.0
OIL 2	4.2
OIL 3	5.0

At present there are 500 tons of each type of raw oil in storage. It is required that exactly these stocks will also exist at the end of June.

1. What buying and manufacturing policy should the company pursue in order to maximize profit?

   Note: the maximum profit is ≈ 107843 €.

2. It is wished to impose the following extra conditions on the food manufacture problem:

   - The food may never be made up of more than three oils in any month.
   - If an oil is used in a month at least 20 tons must be used.
   - If either of VEG 1 or VEG 2 is used in a month then OIL 3 must also be used.

   Extend the food manufacture model to encompass these restrictions and find the new optimal solution.

   Note: the maximum profit is ≈ 100279 €.