

### Communication 3

#### Sets

- $Farms$
- $S$  : Supply
- $F$  : Fat

#### Data

- $O_f$  - Farm being organic (binary)
- $O_w$  - Price of organic whole milk (\$/L)
- $O_l$  - Price of organic low fat milk (\$/L)
- $C_w$  - price of whole milk (\$/L)
- $C_l$  - price of low fat milk (\$/L)
- $F_w$  - fat of whole milk (%)
- $F_l$  - fat of low fat milk (%)
- $S_f$  - supply from each farm (L)
- $F_f$  - fat from each farm (%)

#### Variables

- $P_{wf}$  - Production of normal whole milk from each farm (L)
- $P_{owf}$  - Production of organic whole milk from each farm (L)
- $P_{olf}$  - Production of organic low fat milk from each farm (L)

#### Objective function

The goal is to maximise the sum of products of the production of each type of milk and the corresponding unit price.

$$\max(\sum_{f \in Farms} C_w \times P_{wf} + C_l \times (S_f - P_{wf} - P_{olf} - P_{owf}) + O_w \times P_{owf} + O_l \times P_{olf})$$

#### Constraints

- The supplied milk is processed into whole milk and low fat milk so that the total milk fat content of production at most the total milk fat of supply - excess milk fat can be potentially used for other causes.

$$\sum_{f \in Farms} F_w \times (P_{wf} + P_{owf}) + F_l \times (S_f - P_{wf} - P_{owf}) \leq \sum_{f \in Farms} S_f \times F_f$$

- A fat cap on organic milk, as organic products must use only organic supply

$$\sum_{f \in Farms} F_w \times P_{owf} + F_l \times P_{olf} \leq \sum_{f \in O_f} S_f \times F_f$$

- The production of organic whole milk from a farm should be at most its supply minus its production of organic low fat milk, if it's an organic farm.

$$\forall f \in F, 0 \leq P_{owf} \leq S_f \times O_f - P_{olf}$$

- The production of normal whole milk from a farm should be at most its supply minus its production of organic milk - both whole & low fat.

$$\forall f \in F, 0 \leq P_{wf} \leq S_f - P_{owf} - P_{olf}$$

- The low fat milk can make up at most 25% of the total of low fat and whole milk, for each of organic and normal products.

$$\sum_{f \in F} P_{owf} \geq 3 \times \sum_{f \in F} P_{olf}$$

$$\sum_{f \in F} P_{wf} \geq 3 \times \sum_{f \in F} (S_f - P_{wf} - P_{owf} - P_{olf})$$

- Organic products can make up at most 15% of all milk sold.

$$\sum_{f \in F} (P_{owf} + P_{olf}) \leq 0.15 \times \sum_{f \in F} S_f$$