Logistics examples

1) Nurse Rostering

- W : set of workers
- T : available weekly shifts
- m_j : minimum number of workers required on day j, $j = 1, \dots 7$

m_1	m_2	m_3	m_4	m_5	m_6	m_7
18	27	22	26	25	21	19

- w_i : wage (per worker) related to shift i, $i = 1, \dots 7$

w_1	w_2	w_3	w_4	w_5	w_6	w_7
680	705	705	705	705	680	655

The problem : to schedule workers for each available shift (nurse rostering) so as to satisfy the minimum worker requirement per day at a minimum cost

I. L. P. model

$x_i \geq 0$, integer : workers scheduled for shift i, $i = 1, .. 7$

$$\text{Min} \sum_{i=1}^{7} w_i \cdot x_i$$

$$\sum_{i=1}^{7} a_{ij}\, x_i \geq m_j \qquad j = 1, .. 7$$

$$x_i \geq 0, \text{ integer} \qquad i = 1, .. 7$$

where coefficients a_{ij} give day on / day off information for each shift:

$$a_{ij} = \begin{cases} 1 & \text{if a worker works on day } j \text{ according to shift } i \\ 0 & \text{otherwise} \end{cases}$$

$i = 1, .. 7$ (shifts)

$j = 1, .. 7$ (days)

The optimal solution:

$x_1^* = 4 \quad x_2^* = 0 \quad x_3^* = 7 \quad x_4^* = 0 \quad x_5^* = 8 \quad x_6^* = 3$

$x_7^* = 11$

< Excel file available >

2) Goulte Location problem

- French company manufacturing and distributing soft drinks
- Unexpected increase of its sales: new plants (design of logistics system from scratch)
- Supply costs: negligible (water and sugar extracts)
- Transportation costs: product independent, and calculated as

$$\boxed{\alpha \cdot h_i \cdot d_{ij}} \quad \forall i, j$$

$\alpha = 0{,}67$

h_i: annual demand of i

d_{ij}: distance (in Km) between i and j (given)

Obs: it is the annual transportation cost for satisfying the entire demand