Pt7

Sets

- F : Farms
- P : Facilities
- T : Tankers

Data

- Supply_f - milk supply from each farm $f \in F$ (L)
- Distance_{fp} - distance between farm $f \in F$ and processing facility $p \in P$ (km)
- PMin_p - minimum daily processing at processing facility $p \in P$ (L)
- PMax_p - maximum daily processing at processing facility $p \in P$ (L)
- Maintenance_t - daily cost of maintenance for tanker $t \in T$
- DMax - maximum number of kilometers a tanker can be used for each day (km)
- TRound - cost of round trip travel ($/km)

Variables

$$W_{pt} = \begin{cases} 1 & \text{if tanker } t \in T \text{ from } p \in P \text{ is operational} \\ 0 & \text{otherwise} \end{cases}$$

$$X_{prt} = \begin{cases} 1 & \text{if tanker } t \in T \text{ from } p \in P \text{ performs milk run } r \in R \\ 0 & \text{otherwise} \end{cases}$$

Objective function

$$\min\Big(\sum_{p \in P} \sum_{f \in F} \sum_{t \in T} \big(X_{pft} \times \text{Distance}_{fp} \times \text{TRound}\big) + \sum_{p \in P} \sum_{t \in T} \big(W_{pt} \times \text{Maintenance}_t\big) \Big)$$

Constraints

- Total milk processed at processing facility $p \in P$ cannnot exceed the daily processing capacity.

$$\sum_{f \in F} \sum_{t \in T} X_{pft} \times \text{Supply}_f \leq \text{PMax}_p, \quad \forall p \in P$$

- Total milk processed at processing facility $p \in P$ must meet the minimal daily operational requirement.

$$\sum_{f \in F} \sum_{t \in T} X_{pft} \times \text{Supply}_f \geq \text{PMin}_p, \quad \forall p \in P$$

- Each tanker $t \in T$ for processing facility $p \in P$ cannot be operational for more than 10 hours (600km).

$$\sum_{f \in F} X_{pft} \times \text{Distance}_{fp} \times 2 \leq \text{DMax}, \quad \forall p \in P,\ t \in T$$

- If a tanker $t \in T$ is operation, set the binary variable to indicate this.

$$W_{pt} \geq X_{prt}, \quad \forall p \in P,\ t \in T,\ r \in R$$

- Tankers must be used in order, i.e., tanker 1 and then tanker 2 etc.,

$$W_{pt} \leq W_{p(t-1)}, \quad \forall p \in P,\ t \in T,\ t > 0$$

- Each farm $f \in F$ must be assigned to exactly one processing facility and one tanker.

$$\sum_{p \in P} \sum_{t \in T} X_{pft} = 1, \quad \forall f \in F$$