Pt7

Sets

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

Data

- $Supply_f$ - milk supply from each farm $f \in F$ (L)
- $PMin_p$ - 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 $t \in T$
- $MMax$ - maximum number of minutes a tanker can be used for each day (min)
- $RunP_r$ - origin processing facility for milk run $r \in R$
- $RunF_r$ - farms visited by milk run $r \in R$
- $RunT_r$ - time taken to complete milk run $r \in R$ (min)
- $RunC_r$ - cost of travel for milk run $r \in R$ ($)

Variables

- W_{pt} - binary assignment of tankers $t \in T$ to processing facilities $p \in P$
- X_{prt} - binary assignment of routes $r \in R$ to processing facilities $p \in P$ and tankers $t \in T$

Objective function

$$\min\Big(\sum_{p\in P}\sum_{r\in R}\sum_{t\in T}\big(X_{prt}\times C_r\big)+\sum_{p\in P}\sum_{t\in T}\big(W_{pt}\times Maintenance_t\big)\Big)$$

Constraints

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

$$\sum_{r\in R}\sum_{t\in T}\sum_{f\in F \text{ st. } f\in RunF_r} X_{prt}\times Supply_f \le PMax_p, \quad \forall p \in P$$

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

$$\sum_{r\in R}\sum_{t\in T}\sum_{f\in F \text{ st. } f\in RunF_r} X_{prt}\times Supply_f \ge PMin_p, \quad \forall p \in P$$

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

$$\sum_{r\in R} X_{prt}\times RunT_r \le MMax, \quad \forall p \in P,\ t \in T$$

- If a tanker $t \in T$ is used, the binary tanker variable must be set.

$$X_{prt} = 1 \implies W_{pt} = 1, \quad \forall p \in P,\ t \in T,\ r \in R$$

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

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

- If a milkrun does not originate from processing facility $p \in P$, it cannot be assigned to a tanker at that facility.

$$X_{prt} = 0, \quad \forall p \in P,\ t \in T,\ r \in R \text{ if } RunP_r \ne p$$

- Each farm $f \in F$ must be visited on one of the assigned routes.

$$\sum_{p \in P} \sum_{r \in R} \sum_{t \in T} X_{prt} = 1, \quad \forall f \in F \text{ such that } f \in RunF_r$$