Assignment 1 - Linear Programming - Section A

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Sets

C	Set of cities
Q	Set of quarters

Data

i_c	Current number of barrels in city $c \in C$ [1]
d_{cq}	Predicted demand of barrels in $c \in C$ for quarter $q \in Q$
c_q	Predicted cost of dollars per barrel for quarter $q \in Q$
m_c	Maximum storage capacity of barrels in $c \in C$ [2]

Variables

x_{cq}	Number of barrels to deliver to city $c \in C$ in quarter $q \in Q$
s_{cq}	Number of barrels to store in city $c \in C$ at the end of quarter $q \in Q$

Objective

$$\min \sum_{c \in C} \sum_{q \in Q} 25 s_{cq} + c_q x_{cq}$$

Constraints

$$x_{cq} \geq 0 \qquad \forall c \in C,\ \forall q \in Q \tag{1}$$

$$s_{cq} \geq 0 \qquad \forall c \in C,\ \forall q \in Q \tag{2}$$

$$\sum_{c \in C} x_{cq} \leq 10000 \qquad \forall q \in Q \tag{3}$$

$$i_c + x_{cf} - d_{cf} = s_{cf} \qquad \forall c \in C \tag{4}$$

$$s_{c(q-1)} + x_{cq} - d_{cq} = s_{cq} \qquad \forall c \in C,\ \forall q \in Q \setminus \{f\} \tag{5}$$

$$s_{cl} \geq 3000 \qquad \forall c \in C \tag{6}$$

$$s_{cq} \leq m_c \qquad \forall c \in C,\ \forall q \in Q \tag{7}$$

where f is the first quarter, and l is the last quarter, where $f, l \in Q$.

Constraints (1) and (2) are basic non-negativity constraints on our variables. Constraints (3) ensures that the amount shipped per quarter does not exceed the ships capacity. Constraints (4) and (5) describe a recursive relationship between initial supplies, new deliveries, demand, and the amount stored at the end of each quarter. Constarint (6) ensures that there at least 3000 barrels in storage in each port by the end of the last quarter. Constarint (7) ensures that we do not exceed the capacities of our facilities in each port.