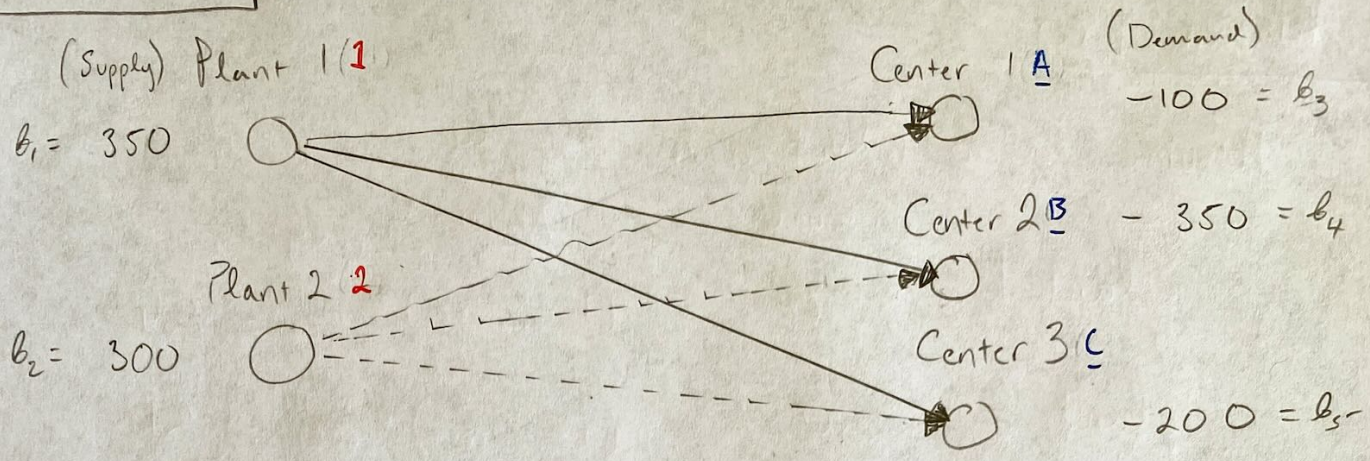
PROBLEM 1



SETUP

Sets: $S : \{1, 2\}$

$D : \{A, B, C\}$

Parameters

COST

$C_{1A} = 25$	$C_{2A} = 50$
$C_{1B} = 85$	$C_{2B} = 35$
$C_{1C} = 25$	$C_{2C} = 95$

Demand / Supply of nodes

$a_1 = 350$
$a_2 = 300$
$b_1 = -100$
$b_2 = -350$
$b_3 = -200$

Variables

X_{1A}	X_{2A}
X_{1B}	X_{2B}
X_{1C}	X_{2C}

a) **Objective Function:**

$$\text{Min} \quad C_{1A}X_{1A} + C_{2A}X_{2A} + C_{1B}X_{1A} + C_{2B}X_{2A} + C_{1C}X_{1C} + C_{2C}X_{2B}$$

Constraints

(1) $\sum_{j \in D} X_j \leq a_i, \quad \forall_i \in S$

(2) $\sum_{j \in S} X_j \geq b_j, \quad \forall_j \in D$

(3) $X_{ij} \geq 0 \quad \forall_i \in S, \forall_j \in D$

Problem 1 (c)

Assume 30% reduction in supply

	Original	New Supply
plant 1	350	$(1 - 0.30) * 350 = 245$
plant 2	800	$(1 - 0.30) * 800 = 210$

Therefore $a_1 = 245$

$a_2 = 210$

Problem 2 (Part 1)

Sets

Plants = {Plant 1, Plant 2}

Warehouses = {Warehouse A, Warehouse B, Warehouse C}

Retailers = {Retailer 1, Retailer 2, Retailer 3, Retailer 4, Retailer 5}

all = Plants ∪ Warehouses ∪ Retailers

Parameters

$c_{i,j}$: Cost of shipping from i to j

s_p : Max supply from plant $p \in$ Plants or warehouses $p \in$ Warehouses

d_r : Demand of product A at retailer for $r \in$ Retailers

Decision Variables

$x_{i,j}$: number of product A sent from i to j

Objective Function

$$\text{Min} \sum_{i,j \in all \cdot all} c_{i,j} \cdot x_{i,j}$$

Constraints

(1) $\sum_{j \in all} x_{p,t} \leq s_p \quad , \forall p \in$ Plants

(2) $\sum_{i \in all} x_{i,r} \geq d_r \quad , \forall r \in$ Retailers

(3) $\sum_{i \in all} x_{i,j} = \sum_{k:(k,i) \in All} x_{k,i} \leq w b_i \quad , \forall i \in N$

(4) $\sum_{i \in all} x_{w,t} \quad , \forall w \in$ Warehouses

Part 2

Sets

Commodities = {Product A, Product B}

* other sets same as part 1

Parameters

V_{ij} upper bound

C_{ij} cost of shipping from node i to j

S_p max supply from plant to warehouse

d_r Demand of products

Decision

X_{ijk} num products from i to j over k

Constraints

Upper

$$\sum_{k \in \text{Commodities}} X_{ijk} \leq V_{ij} \quad \forall\, i, j \in \text{Nodes}$$

Lower

Flow balance Constraint