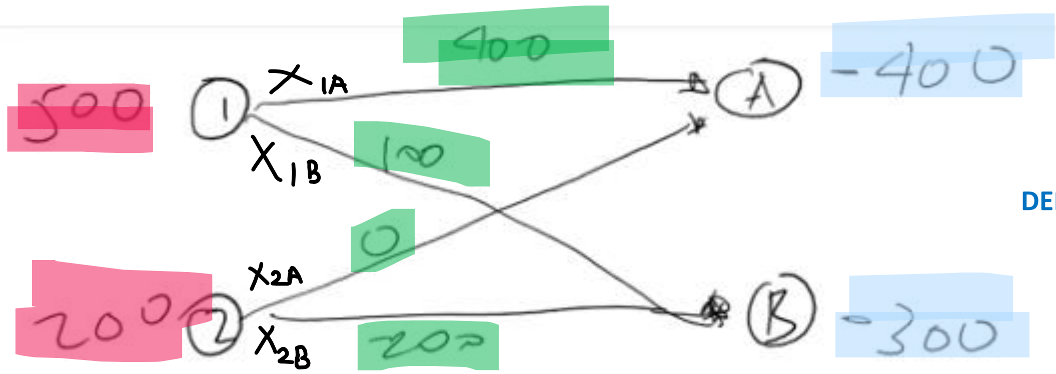
SETUP FOR TRANSPORTATION PROBLEM



SUPPLY

DEMAND

FLOW OF GOODS

Sets (OF NODES) →

$S: \{1, 2\}$

$D: \{A, B\}$

Parameters →

CAPACITY CONSTRANT (U)

$$\left.\begin{aligned} u_{1A} &= 300 \\ u_{1B} &= 300 \\ u_{2A} &= 400 \\ u_{2B} &= 400 \end{aligned}\right\} \text{capacity of each arc}$$

COST (C)

$$\left.\begin{aligned} c_{1A} &= 10 \\ c_{1B} &= 2 \\ c_{2A} &= 1 \\ c_{2B} &= 5 \end{aligned}\right\} \text{unit flow cost of each arc}$$

(Parameters Continued)

DEMAND / SUPPLY of each node

$$\left.\begin{aligned} b_1 &= 500 \\ b_2 &= 200 \\ b_A &= -400 \\ b_B &= -300 \end{aligned}\right\} \text{Demand/supply of each node}$$

VARIABLES

Variables

$$\left.\begin{aligned} &X_{1A} \\ &X_{1B} \\ &X_{2A} \\ &X_{2B} \end{aligned}\right\} \text{Flows for each arc}$$

OBJECTIVE FUNCTION

Goal: minimize the cost of each arc

obj. function

COST (C) FLOW OF ARC

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

CONSTRAINTS

$$\left.\begin{aligned} x_{1A} + x_{1B} &\leq b_1 \\ x_{2A} + x_{2B} &\leq b_2 \end{aligned}\right\}$$ Supply capacity for each supply node

$$\left.\begin{aligned} x_{1A} + x_{2A} &\geq (-b_A) \\ x_{1B} + x_{2B} &\geq (-b_B) \end{aligned}\right\}$$ Demand satisfaction for each demand node

$$\left.\begin{aligned} x_{1A} &\leq u_{1A} \\ x_{2A} &\leq u_{2A} \\ x_{1B} &\leq u_{1B} \\ x_{2B} &\leq u_{2B} \end{aligned}\right\}$$ Capacity constraint for each arc

$$x_{1A}, x_{2A}, x_{1B}, x_{2B} \geq 0$$

SETUP FOR >> *GENERAL* << TRANSPORTATION PROBLEM

Sets → S : supply nodes

D : demand nodes

Parameters u_{ij} : flow capacity of arc from node $i \in S$ to node $j \in D$

c_{ij} : unit flow cost arc from node $i \in S$ to node $j \in D$

a_i : supply of supply node $i \in S$

b_j : demand of demand node $j \in D$

variables:

x_{ij} : flow through arc from node $i \in S$ to node $j \in D$

obj. function

COST (C) FLOW OF ARC

$$\min \ z = \sum_{i \in S} \sum_{j \in D} c_{ij} x_{ij}$$

constraints

$$\sum_{j \in D} x_{ij} \le a_i \quad , \forall i \in S$$

$$\sum_{i \in S} x_{ij} \ge b_j \quad , \forall j \in D$$

This is not part of the basic transportation problem

$$\boxed{x_{ij} \le u_{ij} \quad , \forall i \in S, \forall j \in D}$$

$$x_{ij} \ge 0 \quad , \forall i \in S \ , \forall j \in D$$

SET MAX CAPACITY OF NODE

$b_w = 0$ ✓

Transshipment node = 0

$R_w \rightarrow$ Max cap of the ware house

$$\sum_{i:(i,w)\in A} X_{iw} \leq R_w$$

The number of units must be less than the capacity

Changing units in network problem

Simply multiply the conversion unit by the number of units within $\boldsymbol{X_{i,j}}$

Unmet Demand (Supply < Demand)

- Add a slack variable (- for too little supply), (+ for too much supply)

General setup for unmet demand or supply

$$\boxed{\left(\sum_{j:(i,j)\in A} X_{ij} - \sum_{k:(k,i)\in A} X_{ki}\right) = b_i + S_i^- - S_i^+}$$

$$(75+75) - (0) = 200 + 0 - 50$$

$$(0) - (75) = -100 + 25 + 0$$

$$(0) - (75) = -100 + 25 + 0$$

$$\boxed{\text{Min} \sum_{(i,j)\in A} C_{ij} X_{ij} + M \sum S_i}$$

Changes to the Objective (+ M ∑[S_i]