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Réseaux et transbordement (2 novembre 2018)

Question 1:

Consider three factories which produce honey in Boston, New York and Los Angeles, whose production are 200 units, 250 units and 300 units per day respectively. Customers have a demand of 250 units per day in each city. The costs for transporting one unit are the following :

- from Los Angeles to Boston is 1. \$.
- from Los Angeles to New-York is 0.5 \$.
- from New-York to Boston is 0.8 \$.

The transport from one city to another is limited to 40 units per day.

1. Write a transshipment problem that minimizes the total cost while respecting the problem constraints.
2. Transform it into a linear problem in standard form using a network transformation.
3. Write the incidence matrix. What is its rank and what can be inferred from it?

Question 2:

Which of the following matrices are totally unimodular? Explain.

$$A = \begin{pmatrix} 2 & 1 \\ 1 & 4 \\ 1 & 1 \end{pmatrix}$$

$$B = \begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 1 \end{pmatrix}$$

$$C = \begin{pmatrix} 1 & -1 & 1 \\ 1 & 1 & 0 \end{pmatrix}$$

$$D = \begin{pmatrix} 1 & 1 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ -1 & 0 & 1 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & -1 & 0 & 1 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & -1 & -1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -1 & -1 & -1 \end{pmatrix}$$

Question 3:

Une entreprise de produits forestiers fabrique du contreplaqué dans trois usines et le livre à quatre entrepôts, où il est vendu aux détaillants. Chaque usine a une capacité de production par mois. Chaque entrepôt dessert son propre marché, qui a une certaine demande par mois. Ces demandes doivent être satisfaites exactement. Les coûts de transport ainsi que la production pour chaque usine et la demande pour chaque entrepôt sont spécifiés dans le tableau ci-dessous. Le coût de production du contreplaqué a été omis car il est le même dans chaque usine. L'objectif est de trouver le plan de transport qui minimise le coût total.

	Entrepôt 1	Entrepôt 2	Entrepôt 3	Entrepôt 4	Capacité
Usine 1	4	7	3	5	2500
Usine 2	10	9	3	6	4000
Usine 3	3	6	4	4	3500
Demande	2000	3000	2500	1500	

Modélisez ce problème sous la forme d'un problème de transbordement.

Question 4:

During a wedding dinner gathering p families, the guests are invited to sit at q tables. Denote by a_i the number of members of family i , and by b_j the number of seats at table j . Note that there is the same number of persons and of seats. In order to encourage social exchanges, two members of the same family cannot sit at the same table. Moreover, the first and second family do not talk to each other anymore, and do not want to be seated at the same table.

1. Formulate a network model that helps to seat all the guests and respect the above mentioned conditions.
2. Mention two necessary conditions for the existence of a solution.
3. Write the problem as a transshipment problem.