1. Formulate and solve this transportation problem using lpsolve, or any other equivalent library in R.

Sol : Objective is to minimize the cost of production and shipping. The supply and demand are not equal. We create dummies to equal them to 220.

Z_{min} = 622 X_{11} + 614 X_{12} + 630 X_{13} + 641 X_{21} + 645 X_{22} + 649 X_{23} + 0X_{14} + 0X_{24}

X_{ij} where i stands for plant =1,2 and j standards for warehouses = 1,2,3, 4.

Constraints:

Supply Constraints

X_{11} + X_{12} + X_{13} + X_{14}= 100

X_{21} + X_{22} + X_{23} + X_{24}= 120

We can see the supply total is 220.

Demand Constraints

X_{11} + X_{21} = 80

X_{12} + X_{22} = 60

X_{13} + X_{23} = 70

X_{14} + X_{24} = 10

We created dummies for warehouse 4 and included the necessary demand of 10. Now the demand is equal to supply.

X_{ij} >=0

1) What is the minimum cost of providing oil to the refineries? Which wells are used to capacity in the optimal schedule? Formulation of the problem is enough.

Sol: Supply and Demand are off by two. We create dummy on the demand side such that demand is equal to supply

The Objective function is:

$Z_{min} = 1.52X_{1A} + 1.60X_{1B} + 1.40X_{1C} + 1.70X_{2A} + 1.63X_{2B} + 1.55X_{2C} + 1.45X_{3A} + 1.57X_{3B} + 1.30X_{3C} + 5.15X_{A1} + 5.12X_{B1} + 5.32X_{C1} + 5.69X_{A2} + 5.47X_{B2} + 6.16X_{C2} + 6.13X_{A3} + 6.05X_{B3} + 6.25X_{C3} + 5.63X_{A4} + 6.12X_{B4} + 6.17X_{C4} + 5.80X_{A5} + 5.71X_{B5} + 5.87X_{C5} + 0X_{A6} + 0X_{B6} + 0X_{C6}$

X_{ij} where i represents wells 1,2,3 and j represent pumps A, B, C. Later changed to i as pumps A, B, C, and j as refineries 1,2,3,4,5,6.

Constraints:

Supply Constraints: Wells to Pumps

$X_{1A} + X_{1B} + X_{1C} = 93$

$X_{2A} + X_{2B} + X_{2C} = 88$

$X_{3A} + X_{3B} + X_{3C} = 95$

Demand Constraints

$X_{A1} + X_{B1} + X_{C1} = 30$

$X_{A2} + X_{B2} + X_{C2} = 57$

$X_{A3} + X_{B3} + X_{C3} = 48$

$X_{A4} + X_{B4} + X_{C4} = 91$

$X_{A5} + X_{B5} + X_{C5} = 48$

$X_{A6} + X_{B6} + X_{C6} = 2$

Constraints from pumps to refinery

$X_{1A} + X_{2A} + X_{3A} = X_{A1} + X_{A2} + X_{A3} + X_{A4} + X_{A5} + X_{A6}$

$X_{1B} + X_{2B} + X_{3B} = X_{B1} + X_{B2} + X_{B3} + X_{B4} + X_{B5} + X_{B6}$

$X_{1C} + X_{2C} + X_{3C} = X_{C1} + X_{C2} + X_{C3} + X_{C4} + X_{C5} + X_{C6}$

$X_{ij} >= 0$

the optimal solution obtained from ipsolve is 1966.68. Well 3 has optimal usage capacity.

2. Show the network diagram corresponding to the solution in (a). That is, label each of the arcs in the solution and verify that the flows are consistent with the given information.

Sol: