Assignment 4

1. . Heart Start produces automated external defibrillators (AEDs) in each of two different plants (A and B). The unit production costs and monthly production capacity of the two plants are indicated in the table below. The AEDs are sold through three wholesalers. The shipping cost from each plant to the warehouse of each wholesaler along with the monthly demand from each wholesaler are also indicated in the table. How many AEDs should be produced in each plant, and how should they be distributed to each of the three wholesaler warehouses so as to minimize the combined cost of production and shipping?

Solution: For this problem we have to combine unit shipping cost and unit production cost so that we can get minimum objective function.

So here we will create a dummy variable in demand of 10 so that we can make supply and demand equal to 220.

Hence, we get 2 new dummy variables.

Objective Function:

Zmin = 622 X11 + 614 X12 + 630 X13 + 0 X14 + 641 X21 + 645 X22 + 649 X23 + 0 X24;

In this objective function, we have 6 decision variables and 2 dummy variables named X14 and X24.

Constraints:

Supply Constraints

X11 + X12 + X13 + X14 = 100

X21 + X22 + X23 + X24 = 120

Demand Constraints

X11 + X21 = 80

X12 + X22 = 60

X13 + X23 = 70

$X14 + X24 = 0$

Where X_{pq} >= 0 (p = 1,2 and q = 1,2,3,4 and p means plant and q means warehouse)

2. Oil Distribution Texxon Oil Distributors, Inc., has three active oil wells in a west Texas oil field. Well 1 has a capacity of 93 thousand barrels per day (TBD), Well 2 can produce 88 TBD, and Well 3 can produce 95 TBD. The company has five refineries along the Gulf Coast, all of which have been operating at stable demand levels. In addition, three pump stations have been built to move the oil along the pipelines from the wells to the refineries. Oil can flow from any one of the wells to any of the pump stations, and from any one of the pump stations to any of the refineries, and Texxon is looking for a minimum cost schedule.

Solution: In the above problem the supply is 276 TBD and demand is 274 TBD as demand is not equal to supply, we create a dummy variable in demand side of 2 TBD to make sure that the demand is equal to the supply.

(a) Objective Function:

$Zmin = 1.52\ X_{AP} + 1.60\ X_{AQ} + 1.40\ X_{AR} + 1.770\ X_{BP} + 1.63\ X_{BQ} + 1.55\ X_{BR} + 1.45\ X_{CP} + 1.57\ X_{CQ} + 1.30\ X_{CR} + 5.15\ X_{P1} + 5.69\ X_{P2} + 6.13\ X_{P3} + 5.63\ X_{P4} + 5.80\ X_{P5} + 0\ X_{P6} + 5.12\ X_{Q1} + 5.47\ X_{Q2} + 6.05\ X_{Q3} + 6.12\ X_{Q4} + 5.71\ X_{Q5} + 0\ X_{Q6} + 5.32\ X_{R1} + 6.16\ X_{R2} + 6.25\ X_{R3} + 6.17\ X_{R4} + 5.87\ X_{R5} + 0\ X_{R6};$

Constraints:

Supply Constraints:

$X_{AP} + X_{AQ} + X_{AR} = 93$

$X_{BP} + X_{BQ} + X_{BR} = 88$

$X_{CP} + X_{CQ} + X_{CR} = 95$

Demand Constraints:

$X_{P1} + X_{Q1} + X_{R1} = 30$

$X_{P2} + X_{Q2} + X_{R2} = 57$

$X_{P3} + X_{Q3} + X_{R3} = 48$

$$\mathbf{X_{P4} + X_{Q4} + X_{R4} = 91}$$

$$\mathbf{X_{P5} + X_{Q5} + X_{R5} = 48}$$

$$\mathbf{X_{P6} + X_{Q6} + X_{R6} = 2}$$

Constraints from pumps to the refineries:

$$\mathbf{X_{AP} + X_{BP} + X_{CP} = X_{P1} + X_{P2} + X_{P3} + X_{P4} + X_{P5} + X_{P6}}$$

$$\mathbf{X_{AQ} + X_{BQ} + X_{CQ} = X_{Q1} + X_{Q2} + X_{Q3} + X_{Q4} + X_{Q5} + X_{Q6}}$$

$$\mathbf{X_{AR} + X_{BR} + X_{CR} = X_{R1} + X_{R2} + X_{R3} + X_{R4} + X_{R5} + X_{R6}}$$

Where $X_{ij} >= 0$; (wells = A,B,C and pumps = P, Q, R and refineries = 1,2,3,4,5,6).

The optimal solution for the above formulation is 1966.68.

Also **Well 3** is used to the capacity in the optimal schedule.

2(b)

Network diagram for the above problem:

Here Wells are A, B, C

Pumps are P, Q, R

Refineries are 1,2,3,4,5