Problem Formulation:

1.

Let,

X_{ij} = number of units produced on plant i and shipped to warehouse j, where i = (Plant A, Plant B) & j = (Warehouse 1, Warehouse 2 & Warehouse 3).

Minimize the combined cost of production and shipping.

$Z = 622X_{A1} + 614X_{A2} + 630X_{A3} + 641X_{B1} + 645X_{B2} + 649X_{B3}$

Constraints:

Monthly production capacity per plant:

Plant A = $X_{A1}+X_{A2}+X_{A3} \leq 100$

Plant B = $X_{B1}+X_{B2}+X_{B3} \leq 120$

Monthly demand of units per warehouse:

Warehouse 1 = $X_{A1}+X_{B1} = 80$

Warehouse 2 = $X_{A2}+X_{B2} = 60$

Warehouse 3 = $X_{A3}+X_{B3} = 70$

All values must be greater or equal to zero

$X_{ij} \geq 0$

2.(i)

Let Xia be the flow scheduled from Well i to Pump Station A, i = 1, 2, 3

Let Xib be the flow from Well i to Pump Station B, i = 1, 2, 3
Let Xic be the flow from Well i to Pump Station C, i = 1, 2, 3
Let Xai be the flow from Pump Station A to Refinery i, i = 1, 2, 3, 4, 5, 6
Let Xbi be the flow from Pump Station B to Refinery i, i = 1, 2, 3, 4, 5, 6
Let Xci be the flow from Pump Station C to Refinery i, i = 1, 2, 3, 4, 5, 6

Objective function

$$1.52X1a + 1.60X1b + 1.40X1c + 1.70X2a + 1.63X2b + 1.55X2c + 1.45X3c + 1.57X3b + 1.30X3c + 5.15Xa1 + 5.69Xa2 + 6.13Xa3 + 5.63Xa4 + 5.80Xa5 + 5.12Xb1 + 5.47Xb2 + 6.05Xb3 + 6.12Xb4 + 5.71Xb5 + 5.32Xc1 + 6.16Xc2 + 6.25Xc3 + 6.17Xc4 + 5.87Xc5$$

Constraints:

$$X1a + X1b + X1c = 93$$
$$X2a + X2b + X2c = 88$$
$$X3a + X3b + X3c = 95$$
$$Xa1 + Xb1 + Xc1 = 30$$
$$Xa2 + Xb2 + Xc2 = 57$$
$$Xa3 + Xb3 + Xc3 = 48$$
$$Xa4 + Xb4 + Xc4 = 91$$
$$Xa5 + Xb5 + Xc5 = 48$$
$$Xa6 + Xb6 + Xc6 = 2$$

2.(ii) Network Diagram