QMM Assignment4

**Question 1)**

**Decision Variables:**

The minimized cost of production and shipping together can be formulated as below:

Objective Function is given by

To equalize demand and supply we need 2 dummy variables and 6 decision variables,

**Constraints**:

**Demands in 3 warehouses:**

W11 + W21 = 80

W12 + W22 = 60

W13 + W23 = 70

W14 + W24 = 10

**Monthly production in 3 warehouses**

W11 + W12 + W13 + W14 = 100

W21 + W22 + W23 + W24 = 120

Where, Wij>0 for i =1,2 and j = 1,2,3,4 where I represents the plant A or B and j represents the warehouse.

The objective function is defined by minimizing the total cost:

Zmin = 622 W11 + 614 W12 + 630 W13 + 0 W14 + 641 W21 + 645 W22 + 649 W23 + 0 W24

This is the total cost function that is to be minimized.

**Question 2)**

**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.**

In the given problem, supply of oil is 93+88+95 276 thousand barrels, and the demand is 30+57+48+91+58 = 284 thousand barrels. That means with current wells the demand is not equal to supply.

As given in the problem, the minimum objective function is formulated below:

Zmin = 1.52 W1A + 1.60 W1B + 1.40 W1C + 1.70 W2A + 1.63 W2B + 1.55 W2C + 1.45 W3A +

1.57 W3B + 1.30 W3C + 5.15 WA1 + 5.12 WB1 + 5.32 WC1 + 5.69 WA2 + 5.47 WB2 + 6.16 WC2 +6.13 WA3 + 6.05 WB3 + 6.25 WC3 + 5.63 WA4 + 6.12 WB4 + 6.17 WC4 + 5.80 WA5 + 5.71 WB5 +5.87 WC5

**Constraints:**

Supply Constraints

W1A +W1B + W1C <= 93

W2A + W2B + W2C <= 88

W3A + W3B + W3C <= 95

Constraints from pumps to refinery

W1A + W2A + W3A = WA1 + WA2 + WA3 + WA4 + WA5

W1B + W2B + W3B = WB1 + WB2 + WB3 + WB4 + WB5

W1C + W2C + W3C = WC1 + WC2 + WC3+ WC4 + WC5

Demand Constraints

WA1 + WB1 + WC1 = 30

WA2 + WB2 + WC2 = 57

WA3 + WB3 + WC3 = 48

WA4 + WB4 + WC4 = 91

WA5 + WB5 + WC5 = 48

Where, Wij >= 0: where i = A, B, C for pumps, j= 1,2,3 for wells, and 1:5 are refineries

Using Ipsolve the optimal solution is 1953.68.(Minimizing the total cost)

Well 3 has been used totally.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Well 1 | Well 2 | Well 3 | Ref 1 | Ref 2 | Ref 3 | Ref 4 | Ref 5 |
| Pump A | 1.52 | 1.7 | 1.45 | 5.15 | 5.69 | 6.13 | 5.63 | 5.8 |
| Pump B | 1.6 | 1.63 | 1.57 | 5.12 | 5.47 | 6.05 | 6.12 | 5.71 |
| Pump C | 1.4 | 1.55 | 1.3 | 5.32 | 6.16 | 6.25 | 6.17 | 5.87 |
|  | 93 | 88 | 95 | 30 | 57 | 48 | 91 | 58 |
|  |  | Supply |  |  |  | Demand |  |  |
|  |  |  |  |  |  |  |  |  |
|  | Well 1 | Well 2 | Well 3 | Ref 1 | Ref 2 | Ref 3 | Ref 4 | Ref 5 |
| Pump A | 93 | 0 | 28 | 30 | 0 | 0 | 91 | 0 |
| Pump B | 0 | 88 | 0 | 0 | 57 | 31 | 0 | 0 |
| Pump C | 0 | 0 | 67 | 0 | 9 | 9 | 0 | 58 |

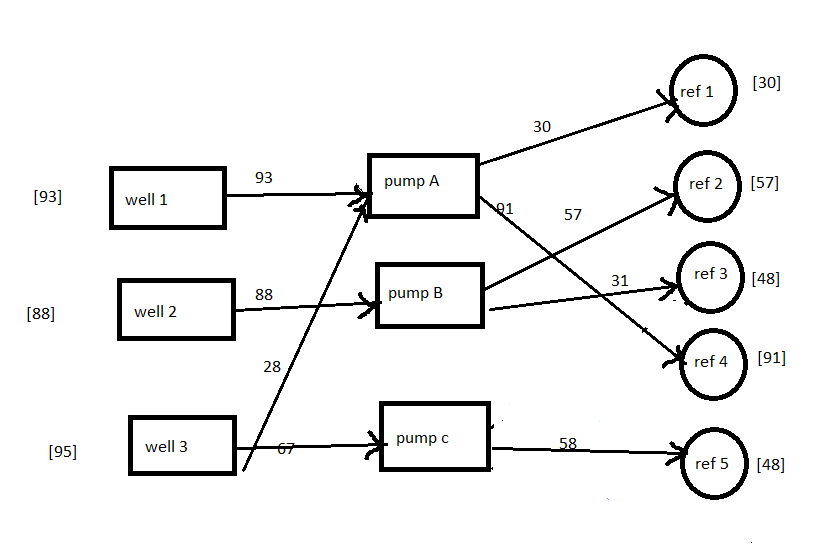
**2) Show the network diagram corresponding to the solution in (a). That is, label each of the arcs in the solution and verify that the flows are consistent with the given information.**

Network diagram for optimal solution

Wells: 1,2,3

Pumps: A, B, C

Refineries: 1,2,3,4,5

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