1. Transportation Problem

**Decision Variables:**

Xij = Number of units shipped from i plant to j warehouse

XA1= Number of units shipped from A plant to warehouse 1

XA2= Number of units shipped from A plant to warehouse 2

XA3= Number of units shipped from A plant to warehouse 3

XB1= Number of units shipped from B plant to warehouse 1

XB2= Number of units shipped from B plant to warehouse 2

XB3= Number of units shipped from B plant to warehouse 3

**Objective Function:**

Min = 22 XA1+14 XA2 + 30 XA3 + 16 XB1+ 20XB2+ 24XB3 + 600 XA1 +600 XA2 +600 XA3 + 625XB1 + 625 XB2 + 625 XB3

= 622 XA1 + 614 XA2 + 630 XA3 + 641 XB1 + 645 XB2 + 649 XB3

**Constraints:**

Subject to

Supply

Plant A: XA1 + ZA2 + XA3 <= 100

Plant B: XB1 + XB2 + XB3 <= 120

Warehouse1 : XA1 + XB1 = 80

Warehouse 2: XA2 + XB2 = 60

Warehouse 3: Xa3 + XB3 = 70

All Xij>=0

2a)

X1A = Number of units of barrels moved from Well 1 to Pump Station A in thousand barrels per day (TBD)

X1B = Number of units of barrels moved from Well 1 to Pump Station B in TBD

X1C= Number of units of barrels moved from Well 1 to Pump Station C in TBD

X2A= Number of units of barrels moved from Well 2 to Pump Station A in TBD

X2B= Number of units of barrels moved from Well 2 to Pump Station B in TBD

X2C= Number of units of barrels moved from Well 2 to Pump Station C in TBD

X3A= Number of units of barrels moved from Well 3 to Pump Station A in TBD

X3B= Number of units of barrels moved from Well 3 to Pump Station B in TBD

X3C= Number of units of barrels moved from Well 3 to Pump Station C in TBD

XAR1=Number of units of barrels moved from Pump Station A to Refinery 1 in thousand barrels per day (TBD)

XAR2= Number of units of barrels moved from Pump Station A to Refinery 2 in TBD

XAR3= Number of units of barrels moved from Pump Station A to Refinery 3 in TBD

XAR4= Number of units of barrels moved from Pump Station A to Refinery 4 in TBD

XAR5= Number of units of barrels moved from Pump Station A to Refinery 5 in TBD

XBR1= Number of units of barrels moved from Pump Station B to Refinery 1 in TBD

XBR2= Number of units of barrels moved from Pump Station B to Refinery 2 in TBD

XBR3= Number of units of barrels moved from Pump Station B to Refinery 3 in TBD

XBR4= Number of units of barrels moved from Pump Station B to Refinery 4 in TBD

XBR5= Number of units of barrels moved from Pump Station B to Refinery 5 in TBD

XCR1= Number of units of barrels moved from Pump Station C to Refinery 1 in TBD

XCR2= Number of units of barrels moved from Pump Station C to Refinery 2 in TBD

XCR3= Number of units of barrels moved from Pump Station C to Refinery 3 in TBD

XCR4= Number of units of barrels moved from Pump Station C to Refinery 4 in TBD

XCR5= Number of units of barrels moved from Pump Station C to Refinery 5 in TBD

**Objective Function:**

Min C: 1.52X1A + 1.60X1B + 1.40X1C + 1.70X2A + 1.63X2B + 1.55X2C + 1.45X3A + 1.57 X3B + 1.30X3C + 5.15XAR1 + 5.69XAR2+ 6.13XAR3 + 5.63XAR4 + 5.80XAR5 + 5.12XBR1 + 5.47XBR2 + 6.05XBR3 + 6.12XBR4 + 5.71XBR5 + 5.32XCR1 + 6.16XCR2 + 6.25XCR3 + 6.17XCR4 + 5.87XCR5;

**Constraints:**

Subject to

**Supply Constraints:**

X1A+ X1B+X1C<=93;

X2A+X2B+X2C<=88;

X3A+X3B+X3C<=95;

**Transshipment:**

X1A+ X2A+X3A=XAR1+XAR2+XAR3+XAR4+XAR5;

X1B+X2B+X3B=XBR1+XBR2+XBR3+XBR4+XBR5;

X1C+X2C+X3C=XCR1+XCR2+XCR3+XCR4+XCR5;

**Demand Constraints:**

XAR1+XBR1+XCR1=30;

XAR2+XBR2+XCR2=57;

XAR3+XBR3+XCR3=48;

XAR4+XBR4+XCR4=91;

XAR5+XBR5+XCR5=48;

All Xij>=0

2b)

Pumps

Refinery

93

88

95

30

57

48

91

48

1.52

1.60

1.40

1.70

1.63

1.55

1.45

1.57

1.30

5.15

5.69

6.13

5.8

5.63

5.12

5.477

6.05

6.12

5.71

5.87

6.17

6.25

6.16

5.32