Assignment No. 4

Question 1

Solution:

Decision Variables:

Let,

A1 = cost of plant A for the Warehouse 1
A2 = cost of plant A for the Warehouse 2
A3 = cost of plant A for the Warehouse 3
B1 = cost of plant B for the Warehouse 1
B2 = cost of plant B for the Warehouse 2
B3 = cost of plant B for the Warehouse 3
A4 & B4 = Dummy Variables

Objective Function:

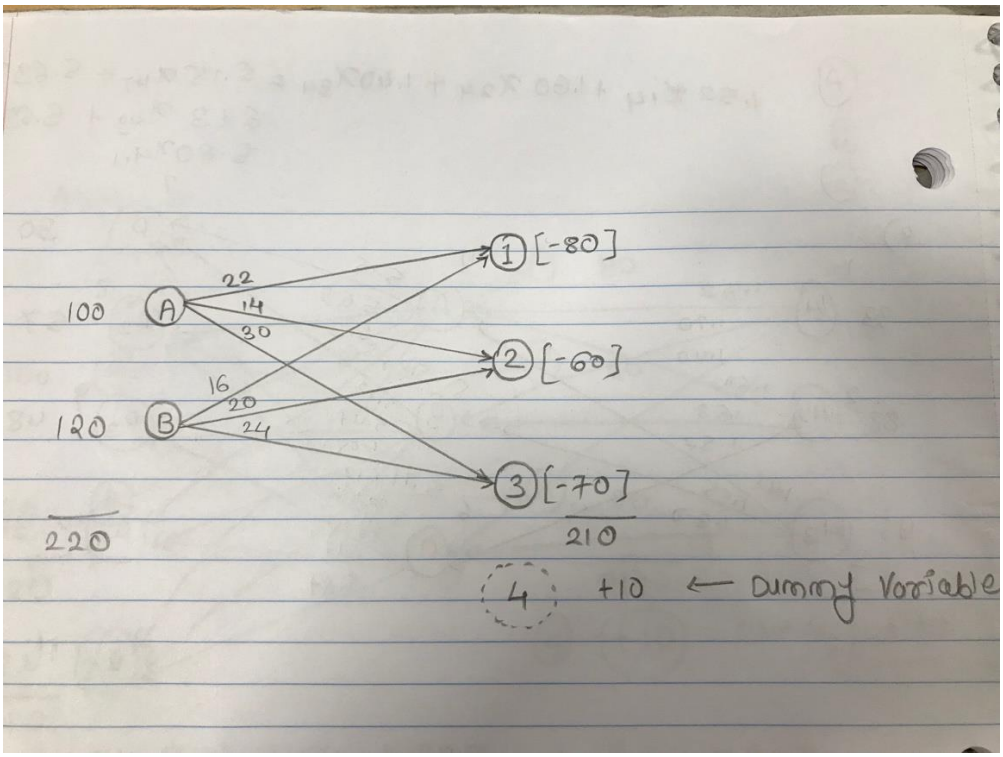
Min Z = (600 + 22) X_{A1} + (600 + 14) X_{A2} + (600 + 30) X_{A3} +(625+16) X_{B1} + (625 + 20) X_{B2} + (625 + 24) X_{B3} + 0 X_{A4} + 0 X_{B4}
Min Z = 622 X_{A1} + 614 X_{A2} + 630 X_{A3} + 641 X_{B1} + 645 X_{B2} + 649 X_{B3} + 0 X_{A4} + 0 X_{B4}

Constraints:
Monthly Production Capacity:
$X_{A1} + X_{A2} + X_{A3} + X_{A4} = 100$
$X_{B1} + X_{B2} + X_{B3} + X_{B4} = 120$

Monthly Demand:
$X_{A1} + X_{B1} = 80$
$X_{A2} + X_{B2} = 60$
$X_{A3} + X_{B3} = 70$
$X_{A4} + X_{B4} = 10$ …… (Dummy Variables)

Mathematical Formulation:
$X_{A1} + X_{A2} + X_{A3} + X_{A4} = 100$
$X_{B1} + X_{B2} + X_{B3} + X_{B4} = 120$
$X_{A1} + X_{B1} = 80$
$X_{A2} + X_{B2} = 60$
$X_{A3} + X_{B3} = 70$
$X_{A4} + X_{B4} = 10$ …… (Dummy Variables)
$X_{A1}, X_{A2}, X_{A3}, X_{A4}, X_{B1}, X_{B2}, X_{B3}, X_{B4}, X_{A4}, X_{B4} >= 0$

Network Diagram:



Question 2

Solution:

Decision Variables:

Let,
X_{14} = The daily cost requires form Well 1 to Pump A
X_{15} = The daily cost requires form Well 1 to Pump B
X_{16}= The daily cost requires form Well 1 to Pump C
X_{24} = The daily cost requires form Well 2 to Pump A
X_{25} = The daily cost requires form Well 2 to Pump B
X_{26}= The daily cost requires form Well 2 to Pump C
X_{34} = The daily cost requires form Well 3 to Pump A
X_{35} = The daily cost requires form Well 3 to Pump B
X_{36}= The daily cost requires form Well 3 to Pump C
X_{47}= The daily cost requires form Pump A to Refineries 1
X_{48}= The daily cost requires form Pump A to Refineries 2
X_{49}= The daily cost requires form Pump A to Refineries 3
X_{410}= The daily cost requires form Pump A to Refineries 4
X_{411}= The daily cost requires form Pump A to Refineries 5
X_{57}= The daily cost requires form Pump B to Refineries 1
X_{58}= The daily cost requires form Pump B to Refineries 2
X_{59}= The daily cost requires form Pump B to Refineries 3
X_{510}= The daily cost requires form Pump B to Refineries 4
X_{511}= The daily cost requires form Pump B to Refineries 5
X_{67}= The daily cost requires form Pump C to Refineries 1
X_{68}= The daily cost requires form Pump C to Refineries 2
X_{69}= The daily cost requires form Pump C to Refineries 3
X_{610}= The daily cost requires form Pump C to Refineries 4
X_{611}= The daily cost requires form Pump C to Refineries 5

X_{412}, X_{512}, X_{612} = Dummy Variables

Objective Function:

Min Z = $1.52 X_{14} + 1.60 X_{15} + 1.40 X_{16} + 1.70 X_{24} + 1.63 X_{25} + 1.55 X_{26} + 1.45 X_{34} + 1.57 X_{35} + 1.30 X_{36} + 5.15 X_{47} + 5.12 X_{57} + 5.32 X_{67} + 5.69 X_{48} + 5.47 X_{58} + 6.16 X_{68} + 6.13 X_{49} + 6.05 X_{59} + 6.25 X_{69} + 5.63 X_{410} + 6.12 X_{510} + 6.17 X_{610} + 5.80 X_{411} + 5.71 X_{511} + 5.87 X_{611}$

Constraints:

Supply Constraints

$X_{14} + X_{15} + X_{16} = 93$

$X_{24} + X_{25} + X_{26} = 88$

$X_{34} + X_{35} + X_{36} = 95$

Demand Constraints:

$X_{47} + X_{57} + X_{67} = 30$

$X_{48} + X_{58} + X_{68} = 57$

$X_{49} + X_{59} + X_{69} = 48$

$X_{410} + X_{510} + X_{610} = 91$

$X_{411} + X_{511} + X_{611} = 48$

$X_{412} + X_{512} + X_{612} = 2$ …… (Dummy Variables)

Constraints from Pump to Refinery:

$X_{14} + X_{24} + X_{34} = X_{47} + X_{48} + X_{49} + X_{410} + X_{411}$

$X_{15} + X_{25} + X_{35} = X_{57} + X_{58} + X_{59} + X_{510} + X_{511}$

$X_{16} + X_{26} + X_{36} = X_{67} + X_{68} + X_{59} + X_{610} + X_{611}$

Mathematical Formulation:

$X_{14} + X_{24} + X_{34} = 93$

$X_{15} + X_{25} + X_{35} = 88$

$X_{16} + X_{26} + X_{36} = 95$

$X_{47} + X_{57} + X_{67} = 30$

$X_{48} + X_{58} + X_{68} = 57$

$X_{49} + X_{59} + X_{69} = 48$

$X_{410} + X_{510} + X_{610} = 91$

$X_{411} + X_{511} + X_{611} = 48$

$X_{412} + X_{512} + X_{612} = 2$ …… (Dummy Variables)

$1.52X_{14} + 1.70X_{24} + 1.45X_{34} = 5.15X_{47} + 5.69X_{48} + 6.13X_{49} + 5.63X_{410} + 5.80X_{411}$

$1.60X_{15} + 1.63X_{25} + 1.57X_{35} = 5.12X_{57} + 5.47X_{58} + 6.05X_{59} + 6.12X_{510} + 5.71X_{511}$

$1.40X_{16} + 1.55X_{26} + 1.30X_{36} = 5.32X_{67} + 6.16X_{68} + 6.25X_{59} + 6.17X_{610} + 5.87X_{611}$

$X_{14}, X_{24}, X_{34}, X_{15}, X_{25}, X_{35}, X_{16}, X_{26}, X_{36}, X_{47}, X_{57}, X_{67}, X_{48}, X_{58}, X_{68}, X_{49}, X_{59}, X_{69}, X_{410}, X_{510}, X_{610}, X_{411}, X_{511}, X_{611}, X_{412}, X_{512}, X_{612} >= 0$

Q2 Part 1) Solution:

Using IpSolve the optimal solution is 1966.68.
Well 3 Has used to the capacity in the optimal schedule.

Part 2) Solution:

Network Diagram: