Assignment 4

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PART 1

```
/* Objective Fuction */
min: 22xa1 + 14xa2 + 30xa3 + 16xb1 + 20xb2 + 24xb3 + 600xa1 + 600xa2 + 600xa3 + 625xb1 + 625xb2 + 625xb3 +
0xa4 + 0xb4 ;

/* Constraints */
Dem1: xa1 + xb1 >= 80;
Dem2: xa2 + xb2 >= 60;
Dem3: xa3 + xb3 >= 70;
Dum1: xa4 + xb4 >= 10;

Capac1: xa1 + xa2 + xa3 + xa4 <= 100;
capac2: xb1 + xb2 + xb3 + xb4 <= 120;

/* End */
```

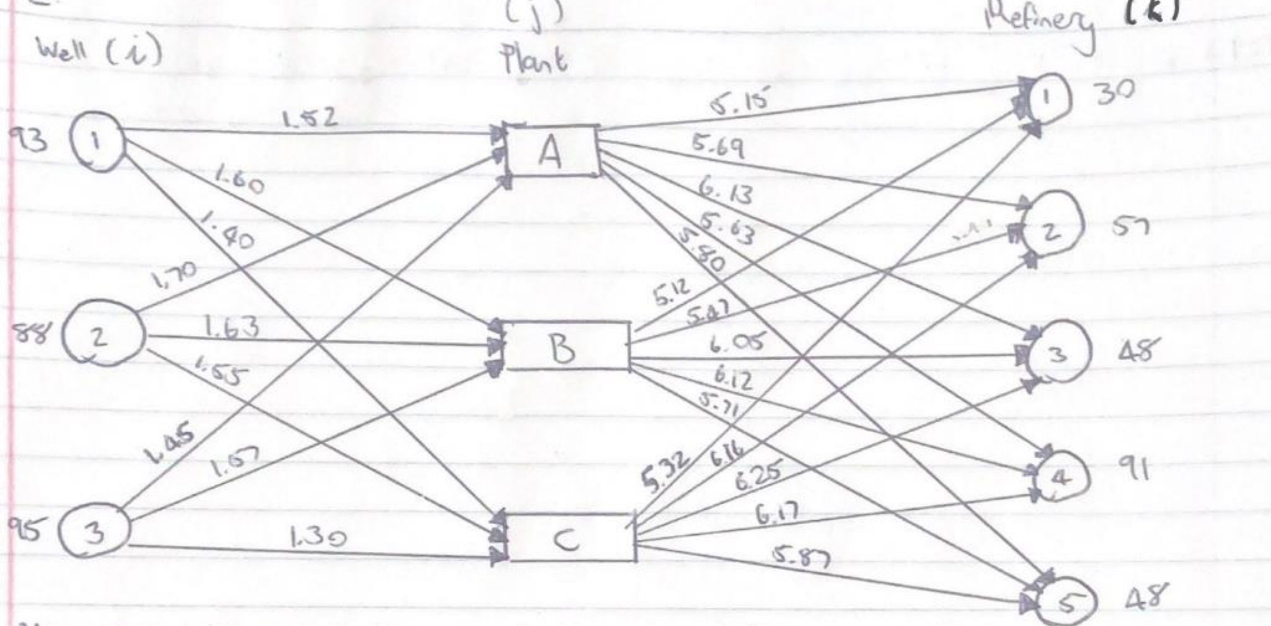
```
#Importing libraries to be able to run the lp models
library(lpSolve)
library(lpSolveAPI)
#Reading the .lp file which contains the formulation of the HeartStart problem
x <- read.lp("HeartStart.lp")
x

## Model name:
##             xa1   xa2   xa3   xb1   xb2   xb3   xa4   xb4
## Minimize    622   614   630   641   645   649     0     0
## Dem1          1     0     0     1     0     0     0     0  >=   80
## Dem2          0     1     0     0     1     0     0     0  >=   60
## Dem3          0     0     1     0     0     1     0     0  >=   70
## Dum1          0     0     0     0     0     0     1     1  >=   10
## Capac1        1     1     1     0     0     0     1     0  <=  100
## capac2        0     0     0     1     1     1     0     1  <=  120
## Kind        Std   Std   Std   Std   Std   Std   Std   Std
## Type       Real  Real  Real  Real  Real  Real  Real  Real
## Upper       Inf   Inf   Inf   Inf   Inf   Inf   Inf   Inf
## Lower         0     0     0     0     0     0     0     0

solve(x) #Solving the lp formulation. Since an output of [0] is produced we know it was s
olved successfully

## [1] 0

get.objective(x) # Getting the value of Z (objective function)

## [1] 132790

get.variables(x) # Output of the variables indicate how many AED's should be produced for
the optimal solution.

## [1]  0 60 40 80  0 30  0 10
```

```
#get.constraints(x)
```

We can see that the optimal solution for the AED production & shipping is:
0 units (of xa1) in Plant A and warehouse 1
60 units (of xa2) in Plant A and warehouse 2
40 units (of xa3) in Plant A and warehouse 3
0 units (of xa4) in Plant A and warehouse 4
80 units (of xb1) in Plant B and warehouse 1
0 units (of xb2) in Plant B and warehouse 2
30 units (of xb3) in Plant B and warehouse 3
10 units (of xb4) in Plant B and warehouse 4
These combinations will minimize the cost of production and shipping.

PART 2

2.



$$\text{Min } Z = 1.52x_{1A} + 1.60x_{1B} + 1.40x_{1C} + 1.70x_{2A} + 1.63x_{2B} + 1.55x_{2C}$$
$$+ 1.45x_{3A} + 1.57x_{3B} + 1.30x_{3C} + 5.15x_{A1} + 5.69x_{A2} +$$
$$6.13x_{A3} + 5.63x_{A4} + 5.80x_{A5} + 6.12x_{B1} + 5.47x_{B2} +$$
$$6.05_{B3} + 6.12x_{B4} + 5.71x_{B5} + 5.32x_{C1} + 6.16x_{C2} +$$
$$6.25x_{C3} + 6.17x_{C4} + 5.87x_{C5}$$

Supply

$$\text{ST.} \quad x_{1A} + x_{1B} + x_{1C} \leq 93$$
$$x_{2A} + x_{2B} + x_{2C} \leq 88$$
$$x_{3A} + x_{3B} + x_{3C} \leq 95$$

Inflow/outflow

$$-x_{1A} - x_{2A} - x_{3A} + x_{A1} + x_{A2} + x_{A3} + x_{A4} + x_{A5} = 0$$
$$-x_{1B} - x_{2B} - x_{3B} + x_{B1} + x_{B2} + x_{B3} + x_{B4} + x_{B5} = 0$$
$$-x_{1C} - x_{2C} - x_{3C} + x_{C1} + x_{C2} + x_{C3} + x_{C4} + x_{C5} = 0$$

Demand

$$x_{A1} + x_{B1} + x_{C1} \geq 30 \qquad \text{where } x_{ij} \text{ \& } x_{jk} \geq 0$$
$$x_{A2} + x_{B2} + x_{C2} \geq 57$$
$$x_{A3} + x_{B3} + x_{C3} \geq 48$$
$$x_{A4} + x_{B4} + x_{C4} \geq 91$$
$$x_{A5} + x_{B5} + x_{C5} \geq 48$$

Wells 1 & 3 are used to capacity.

```
/* Objective Fuction */

min: 1.52x1a + 1.60x1b + 1.40x1c + 1.7x2a + 1.63x2b + 1.55x2c + 1.45x3a + 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 */
Supp1: x1a + x1b + x1c <= 93;
Supp2: x2a + x2b + x2c <= 88;
Supp3: x3a + x3b + x3c <= 95;

Tnode1: -x1a - x2a - x3a + xa1 + xa2 + xa3 + xa4 + xa5 = 0;
Tnode2: -x1b - x2b - x3b + xb1 + xb2 + xb3 + xb4 + xb5 = 0;
Tnode3: -x1c - x2c - x3c + xc1 + xc2 + xc3 + xc4 + xc5 = 0;

Dem1: xa1 + xb1 + xc1 >= 30;
Dem2: xa2 + xb2 + xc2 >= 57;
Dem3: xa3 + xb3 + xc3 >= 48;
Dem4: xa4 + xb4 + xc4 >= 91;
Dem5: xa5 + xb5 + xc5 >= 48;
```

```
#Reading the .lp file which contains the formulation of the Oil Distribution problem
y <- read.lp("OilDistribution.lp")
solve(y) #Solving the lp formulation. Since an output of [0] is produced we know it was s
olved successfully

## [1] 0

get.objective(y) # Getting the value of Z (objective function)

## [1] 1963.82

get.variables(y)

##  [1] 93  0  0  0 86  0 28  0 67 30  0  0 91  0  0 57 29  0  0  0  0 19  0 48

get.constraints(y)

##  [1] 93 86 95  0  0  0 30 57 48 91 48
```