Assignment 3

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$$\text{The objective function is } Min \;\; Tc = 622x_{11} + 614x_{12} + 630x_{13} + 641x_{21} + 645x_{22} + 649x_{23}$$

Supply Costraints:

$$x_{11} + x_{12} + x_{13} \leq 100$$
$$x_{21} + x_{22} + x_{23} \leq 120$$

Demand Constraint:

$$x_{11} + x_{21} \geq 80$$
$$x_{12} + x_{22} \geq 60$$
$$x_{13} + x_{23} \geq 70$$

Non-Negative:

$$x_{i,j} \geq 0$$

```
library(lpSolve)
```

```
Problem <- matrix(c(22,14,30,600,100,
                16,20,24,625,120,
                80,60,70,"-","-"),ncol = 5,byrow = TRUE)
colnames(Problem)<- c("Warehouse1","Warehouse2","Warehouse3","Production Cost","Production Capacity")
rownames(Problem)<-c("Plant A","Plant B","Monthly Demand")
Problem <-as.table(Problem)
Problem
```

```
##                Warehouse1 Warehouse2 Warehouse3 Production Cost
## Plant A        22         14         30         600
## Plant B        16         20         24         625
## Monthly Demand 80         60         70         -
##                Production Capacity
## Plant A        100
## Plant B        120
## Monthly Demand -
```

```
# Since production and demand is unbalanced, Dummy column is created

# Name of the column and rows:
costs <- matrix(c(622,614,630,0,
                  641,645,649,0),ncol = 4,byrow = TRUE)
colnames(costs)<- c("Warehouse1","Warehouse2","Warehouse3","Dummy")
rownames(costs)<-c("Plant A","Plant B")
costs <-as.table(costs)
costs
```

```
##         Warehouse1 Warehouse2 Warehouse3 Dummy
## Plant A        622        614        630     0
## Plant B        641        645        649     0
```

```
# Setting up the row signs and production capacity values
row.signs <- rep("<=",2)
row.rhs<- c(100,120)

# Setting up the column sign and demand values
col.signs <- rep(">=",4)
col.rhs <- c(80,60,70,10)
```

```
# Running lptrans to find minimum cost

lptrans <- lp.transport(costs,"min",row.signs,row.rhs,col.signs,col.rhs)

# Values of all variables
lptrans$solution
```

```
##      [,1] [,2] [,3] [,4]
## [1,]    0   60   40    0
## [2,]   80    0   30   10
```

```
# Objective function
lptrans$objval
```

```
## [1] 132790
```

Therefore

x12 = 60

x13 = 40

x21 = 80

x23 = 30

Objective function is 132790.

2. Dual Problem:

Formulating the dual constraints and variables

$$\text{The objective function is } Max \quad VA = 80w_1 + 60w_2 + 70w_3 - 100p_1 - 120p_2$$

$$\text{Where, } \quad w_1 = \text{Price received at the Warehouse 1}$$

$$w_2 = \text{Price, received at the Warehouse 2}$$

$$w_3 = \text{Price, received at the Warehouse 3}$$

$$p_1 = \text{Price, purchased at the Plant A}$$

$$p_2 = \text{Price, purchased at the Plant B}$$

Subject to:

$$w_1 - p_1 \geq 622$$

$$w_2 - p_1 \geq 614$$

$$w_3 - p_1 \geq 630$$

$$w_1 - p_2 \geq 641$$

$$w_2 - p_2 \geq 645$$

$$w_3 - p_2 \geq 649$$

3) Economic Interpretation of dual:

The goal of AED's business is to reduce the total cost of production and shipment.

To achieve this, the corporation needs hire a logistic company to handle the transportation, which will include purchasing the AEDs and transporting them to various warehouses in an effort to reduce the overall cost of production and shipping.

$$\text{The constraints in the dual can be modified as}$$

$$w_1 \geq 622 + p_1$$

$$w_2 \geq 614 + p_1$$

$$w_3 \geq 630 + p_1$$

$$w_1 \geq 641 + p_2$$

$$w_2 \geq 645 + p_2$$

$$w_3 \geq 649 + p_2$$

$$\text{From the above we get to see that } \quad w_1 - p_1 \geq 622$$

$$\text{That can be exponented as } \quad w_1 \geq 622 + p_1$$

Here w_1 is considered as the price payments being received at the origin which is nothing else,but the revenue,whereas $p_1 + 622$ is the mc

This can be formulated as below

$$MR \geq MC$$

If MR < MC, in order to meet the Marginal Revenue (MR), we need to decrease the costs at the plants.

If MR > MC, in order to meet the Marginal Revenue (MR), we need to increase the production supply.

For a profit maximization, The Marginal Revenue(MR) should be equal to MarginalCosts(MC)

Therefore, MR=MC

Based on above interpretation, we can conclude that,profit maximization takes place if MC is equal to MR.