

Assignment 3

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1)

```
library("lpSolveAPI")
library("lpSolve")
library("tinytex")
```

Formulating Transportation using R

This data has to be transformed into a table format

```
tab <- matrix(c(22,14,30,600,100,
                16,20,24,625,120,
                80,60,70,"-", "-"), ncol=5,byrow=T)
colnames(tab) <- c("Warehouse1", "Warehouse2", "Warehouse3", "ProductionCost", "ProductionCapacity")
rownames(tab) <- c("PlantA", "PlantB", "Demand")
tab <- as.table(tab)
tab
```

##		Warehouse1	Warehouse2	Warehouse3	ProductionCost	ProductionCapacity
##	PlantA	22	14	30	600	100
##	PlantB	16	20	24	625	120
##	Demand	80	60	70	-	-

The Objective Function is to Minimize the Transportation cost

$$Z = 622X_{11} + 614X_{12} + 630X_{13} + 0X_{14} + 641X_{21} + 645X_{22} + 649X_{23} + 0X_{24}$$

Subject to the following constraints

Supply Constraints

$$X_{11} + X_{12} + X_{13} + X_{14} \leq 100$$

$$X_{21} + X_{22} + X_{23} + X_{24} \leq 120$$

Demand Constraints

$$X_{11} + X_{21} \geq 80$$

$$X_{12} + X_{22} \geq 60$$

$$X_{13} + X_{23} \geq 70$$

$$X_{14} + X_{24} \geq 10$$

Non – Negativity Constraints

$$X_{ij} \geq 0 \quad \text{Where } i = 1,2 \text{ and } j = 1,2,3,4$$

#Since demand is not equal to supply creating dummy variables

#Creating a matrix for the given objective function

```
trans1 <- matrix(c(622,614,630,0,
                   641,645,649,0), ncol=4, byrow=T)
```

```
trans1
```

```
##      [,1] [,2] [,3] [,4]
## [1,]  622  614  630    0
## [2,]  641  645  649    0
```

#Defining the column names and row names

```
colnames(trans1) <- c("Warehouse1", "Warehouse2", "Warehouse3", "Dummy")
```

```
rownames(trans1) <- c("PlantA", "PlantB")
```

```
trans1
```

```
##      Warehouse1 Warehouse2 Warehouse3 Dummy
## PlantA         622         614         630    0
## PlantB         641         645         649    0
```

#Defining the row signs and row values

```
row.signs <- rep("<=",2)
```

```
row.rhs <- c(100,120)
```

#Since it's supply function it cannot be greater than the specified units.

#Defining the column signs and column values

```
col.signs <- rep(">=",4)
```

```
col.rhs <- c(80,60,70,10)
```

#Since it's demand function it can be greater than the specified units.

#Running the lp.transport function

```
lptrans1 <- lp.transport(trans1,"min", row.signs,row.rhs,col.signs,col.rhs)
```

#Getting the objective value

```
lptrans1$objval
```

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

The minimization value so obtained is **\$132,790** which is the minimal combined cost thereby attained from the combined cost of production and shipping the defibrilators.

#Getting the constraints value

```
lptrans1$solution
```

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

80 AEDs in Plant B - Warehouse1

60 AEDs in Plant A - Warehouse2

40 AEDs in Plant A - Warehouse3

30 AEDs in Plant B - Warehouse3 should be created in each facility, supplied to each of the three warehouses of the wholesalers, and then packaged to reduce the overall cost of manufacturing and shipment..

2. Formulate the dual of this transportation problem

Since the primary goal was to reduce transportation costs, the secondary goal would be to increase value added (VA).

$$\text{Maximize } VA = 80WH_1 + 60WH_2 + 70WH_3 - 100P_A - 120P_B$$

Subject to the following constraints

Total Payments Constraints

$$WH_1 - P_A \geq 622$$

$$WH_2 - P_A \geq 614$$

$$WH_3 - P_A \geq 630$$

$$WH_1 - P_B \geq 641$$

$$WH_2 - P_B \geq 645$$

$$WH_3 - P_B \geq 649$$

Where WH_1 = Warehouse 1

WH_2 = Warehouse 2

WH_3 = Warehouse 3

P_A = Plant 1

P_B = Plant 2

3. Make an economic interpretation of the dual

$$WH_1 \leq 622 + P_A$$

$$WH_2 \leq 614 + P_A$$

$$WH_3 \leq 630 + P_A$$

$$WH_1 \leq 641 + P_B$$

$$WH_2 \leq 645 + P_B$$

$$WH_3 \leq 649 + P_B$$

From the above we get to see that $WH_1 - P_A \geq 622$

that can be exponented as $WH_1 \leq 622 + P_A$

Here WH_1 is considered as the price payments being received at the origin which is nothing else, but the revenue, whereas $P_A + 622$ is the money paid at the origin at $Plant_A$

Therefore the equation turns, out to be $MR_1 \geq MC_1$.

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

$$\text{Therefore, } MR_1 = MC_1$$

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

If $MR < MC$, We must lower plant costs in order to reach the Marginal Revenue (MR).

If $MR > MC$, We must boost manufacturing supply if we are to reach the Marginal Revenue (MR).