Transportation model

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##set transportation matrix

```r
library(lpSolve)
library(lpSolveAPI)
c1<- matrix(c(22,14,30,600,100,
                    16,20,24,625,120,
                    80,60,70,"-","-"),ncol=5,byrow= TRUE)
colnames(c1)<- c("Warehouse1","Warehouse 2","Warehouse 3","Production cost","Production Capacity")
rownames(c1)<-c("PlantA","Plant B"," Monthly Demand")
c1
```

```
##                 Warehouse1 Warehouse 2 Warehouse 3 Production cost
## PlantA          "22"       "14"        "30"        "600"
## Plant B         "16"       "20"        "24"        "625"
##  Monthly Demand "80"       "60"        "70"        "-"
##                 Production Capacity
## PlantA          "100"
## Plant B         "120"
##  Monthly Demand "-"
```

Minimizing the TC is the goal function. Min T C = 622x11 + 614x12 + 630x13 + 0x14 + 641x21 + 645x22 + 649x23 + 0x24 subject to the aforementioned limitations Supply X11 + X12 + X13 + X14 <= 100 X21 + X22 + X23 + X24 <= 120 subject to the limitations listed : Demand X11 + X21 >= 80 X12 + X22 >= 60 X13 + X23 >= 70 X14 + X24 >= 10 Non-Negativity Constraints Xij >= 0 Where i = 1,2 and j= 1,2,3,4 #The capacity = 220 and Demand = 210. A "Dummy" row will be added for Warehouse_4 ..

```r
trans.c1<- matrix(c(622,614,630,0,
                 641,645,649,0),ncol =4, byrow=TRUE)
trans.c1
```

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

##Set up constraints r.h.s(supply side)

```r
row.signs<- rep("<=",2)
row.rhs<- c(100,120)
```

#Supply function is not permitted to exceed the units demanded side.

```
col.signs<- rep(">=",4)
col.rhs<- c(80,60,70,10)
```

##demand function can be greater

```
library(lpSolve)
lptrans<-lp.transport(trans.c1,"min",row.signs,row.rhs,col.signs,col.rhs)
lptrans$solution
```

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

80 AEDs in Plant 2 - Warehouse 1 60 in Plant 1 - Warehouse 2 40 AEDs in Plant 1 - Warehouse 3 30 AEDs in Plant 2 - Warehouse 3 To reduce the overall cost of manufacturing and delivery, the aforementioned should be produced in each factory and distributed to the three wholesaler warehouses.

##Value of nvariables

```
lptrans$objval
```

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

The defibrilators' total manufacturing and delivery expenses are $132,790

```
lptrans$duals
```

```
##      [,1] [,2] [,3] [,4]
## [1,]    0    0    0    0
## [2,]    0    0    0    0
```

#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). The dual's variables are going to be u and v.

```
c2<-matrix(c(622,614,630,100,"u1",
                 641,645,649,120,"u2",
                 80,60,70,220,"-","v1","v2","v3","-","-"),ncol = 5,nrow=4,byrow=TRUE)
colnames(c2) <- c("Warehouse_1", "Warehouse_2","Warehouse_3","Production Capacity","Supply(Dual)")
rownames(c2) <- c("Plant_A","Plant_B","Demand","Demand(Dual)")
```

#Objective function

```
f.obj <- c(100,120,80,60,70)
```

#transposed from the constraints matrix in the primal

```
f.con <- matrix(c(1,0,1,0,0,
1,0,0,1,0,
1,0,0,0,1,
0,1,1,0,0,
0,1,0,1,0,
0,1,0,0,1), nrow = 6, byrow = TRUE)
f.dir <- c("<=",
"<=",
"<=",
"<=",
"<=",
"<=")
f.rhs <- c(622,614,630,641,645,649)
lp("max",f.obj,f.con,f.dir,f.rhs)
```

```
## Success: the objective function is 139120
```

Success: the objective function is 139120

```
lp("max",f.obj,f.con,f.dir,f.rhs)$solution
```

```
## [1] 614 633   8   0  16
```

Z=139,120 and variables are: u1 = 614 u2 = 633 v1 = 8 v3 = 16

#3.Make an economic interpretation of the dual

Financial Analysis of the Dual Given the foregoing, the minimum Z(Primal) = 132790 and the maximum Z(Dual) = 139120. We realized that we shouldn't be shipping to all three Warehouses from Plants (A/B). From where we should be shipping:

60X12 which is 60 Units from Plant A to Warehouse 2. 40X13 which is 40 Units from Plant A to Warehouse 3. 80X13 which is 60 Units from Plant B to Warehouse 1. 30X13 which is 60 Units from Plant B to Warehouse 3. We'll maximize the earnings from each distribution to the extent of the available resources.

```
row.rhs1 <- c(101,120)
row.signs1 <- rep("<=",2)
col.rhs1 <- c(80,60,70,10)
col.signs1 <- rep(">=",4)
row.rhs2 <- c(100,121)
row.signs2 <- rep("<=",2)
col.rhs2 <- c(80,60,70,10)
col.signs2 <- rep(">=",4)
lp.transport(trans.c1,"min",row.signs,row.rhs,col.signs,col.rhs)
```

```
## Success: the objective function is 132790
```

```
lp.transport(trans.c1,"min",row.signs1,row.rhs1,col.signs1,col.rhs1)
```

```
## Success: the objective function is 132771
```

```r
lp.transport(trans.c1,"min",row.signs2,row.rhs2,col.signs2,col.rhs2)
```

```
## Success: the objective function is 132790
```

Here, we are watching the number decrease by 19 by taking the minimum of the particular function. This shows that the shadow price is 19, which was calculated by adding 1 to each of the plants and the primordial. There isn't a shadow price for Plant B. v1 is a dual variable with the condition that Marginal Revenue Equals Marginal Cost. The formula was

```r
lp("max", f.obj,f.con, f.dir,f.rhs)$solution
```

```
## [1] 614 633   8   0  16
```

Warehouse1= Plant1 + 621 i.e. MR1 >= MC1 Marginal Revenue i.e. The revenue generated for each