Transportation Assignment

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##set transportation matrix

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

```
##                 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 "-"
```

The Objective function is to Minimize the TC Min T C = 622x11 + 614x12 + 630x13 + 0x14 + 641x21 + 645x22 + 649x23 + 0x24 Subject to the following constraints : Supply X11 + X12 + X13 + X14 <= 100 X21 + X22 + X23 + X24 <= 120 Subject to the following constraints : 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. We will add a "Dummy" row for Warehouse_4.

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

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

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

```
row.sym<- rep("<=",2)
row.hal<- c(100,120)
```

#Supply function cannot be greater than the specified units ##Demand Side

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

##demand function can be greater

```
library(lpSolve)
lptrans<-lp.transport(trans.costA,"min",row.sym,row.hal,col.sym,col.hal)
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 The above mentioned should be the production in each plant and distribution to the three wholesaler warehouses to minimize the overall cost of production as well as shipping

##Value of nvariables

```
lptrans$objval
```

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

The combined cost of production and shipping for the defibrilators is $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 primal was to minimize the transportationcost the dual of it would be to maximize the valueadded(VA). u and v will be the variables for the dual.

```
costB<-matrix(c(622,614,630,100,"h1",
                641,645,649,120,"h2",
                80,60,70,220,"-","m1","m2","m3","-","-"),ncol = 5,nrow=4,byrow=TRUE)
colnames(costB) <- c("Warehouse_1", "Warehouse_2","Warehouse_3","Production Capacity","Supply(Dual)")
rownames(costB) <- c("Plant_A","Plant_B","Demand","Demand(Dual)")
```

#Objective function

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

#transposed from the constraints matrix in the primal

```
fun.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)
fun.dir <- c("<=",
"<=",
"<=",
"<=",
"<=",
"<=")
fun.rhs <- c(622,614,630,641,645,649)
lp("max",fun.obj,fun.con,fun.dir,fun.rhs)
```

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

Success: the objective function is 139120

```
lp("max",fun.obj,fun.con,fun.dir,fun.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

Economic Interpretation of the dual From the above, the minimal Z(Primal) = 132790 and the maximum Z(Dual) = 139120. We understood that we should not be shipping from Plant(A/B) to all the three Warehouses. We should be shipping from:

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 will Max the profit from each distribution to the respective capacity.

```
row.sym1 <- c(101,120)
row.signs1 <- rep("<=",2)
col.sym1 <- c(80,60,70,10)
col.signs1 <- rep(">=",4)
row.sym2 <- c(100,121)
row.signs2 <- rep("<=",2)
col.sym2 <- c(80,60,70,10)
col.signs2 <- rep(">=",4)
lp.transport(trans.costA,"min",row.sym,row.hal,col.sym,col.hal)
```

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

```
lp.transport(trans.costA,"min",row.signs1,row.sym1,col.signs1,col.sym1)
```

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

```
lp.transport(trans.costA,"min",row.signs2,row.sym2,col.signs2,col.sym2)
```

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

Here we are taking the min of the specific function and observing the number go down by 19 this indicates the shadow price is 19, that was found from the primal and adding 1 to each of the Plants. Plant B does not have a shadow price. From the dual variable v1 where Marginal Revenue <= Marginal Cost. The equation was

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

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

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