Transportation Assignment

2022-10-11

##set transportation matrix

```
library(lpSolve)
library(lpSolveAPI)
cost.1<- matrix(c(22,14,30,600,100,
                  16,20,24,625,120,
                  80,60,70,"-","-"),ncol=5,byrow= TRUE)
colnames(cost.1)<- c("W1","W2","W3","Production.Cost","Production.Capacity")
rownames(cost.1)<-c("A","B"," M.Demand")
cost.1
```

```
##           W1   W2   W3   Production.Cost Production.Capacity
## A         "22" "14" "30" "600"           "100"
## B         "16" "20" "24" "625"           "120"
##  M.Demand "80" "60" "70" "-"             "-"
```

#The Objective function is to Minimize the Transportation Cost(TC) Min TC = 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.

```
transcost.1<- matrix(c(622,614,630,0,
                 641,645,649,0),ncol =4, byrow=TRUE)
transcost.1
```

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

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

```
rowsigns<- rep("<=",2)
rowrhs<- c(100,120)
```

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

```
colsigns<- rep(">=",4)
colrhs<- c(80,60,70,10)
```

##demand function can be greater

```
library(lpSolve)
lptransmodel<-lp.transport(transcost.1,"min",rowsigns,rowrhs,colsigns,colrhs)
lptransmodel$solution
```

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

#80 AEDs in P2 - W1 #60 in P1 - W2 #40 AEDs in P1 - W3 #30 AEDs in P2 - W3

#The total warehouse capacity is 220 which is distributed bewtween 3 warehouses and remaining 10 capacity is stored in a dummy variable. P2 is producing 80 products in W1, p1 is producing 60products in W2. P1 is producing 40 products in W3.

##Value of nvariables

```
lptransmodel$objval
```

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

#Cost of production and shipping for the defibrilators is $132,790

```
lptransmodel$duals
```

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

#2. Formulate the dual of transportation problem - Since the primal was to minimize the transportationcost the dual of it would be to maximize the valueadded(VA). a and b will be the variables for the dual.

```
cost.2<-matrix(c(622,614,630,100,"a1",
                 641,645,649,120,"a2",
                 80,60,70,220,"-","b1","b2","b3","-","-"),ncol = 5,nrow=4,byrow=TRUE)

col.cost.2 <- c("W1", "W2","W3","Production Capacity","Supply(Dual)")
row.cost.2 <- c("A","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: #a1 = 614 a2 = 633 b1 = 8 b3 = 16

#3.Make an economic interpretation of the dual

#Economic Interpretation of the dual is, the minimal Z(Primal) = 132790 and the maximum Z(Dual) = 139120. 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_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(transcost.1,"min",rowsigns,rowrhs,colsigns,colrhs)
```

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

```
lp.transport(transcost.1,"min",row_signs1,row_rhs1,col_signs1,col_rhs1)
```

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

```
lp.transport(transcost.1,"min",row_signs2,row_rhs2,col_signs2,col_rhs2)
```

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

#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", f.obj,f.con, f.dir,f.rhs)$solution
```

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