QMM ASSIGMENT 3

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Loading packages

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

1.Formulate and solve the Transportation Problem with R *Make a table by using information provided.*

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

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

Primal Model The Objective Function of Minimize the Transportation cost

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

\

The Constraints for Primal model Subject to

$$\begin{gathered} Supply\ \ Constraints \\ C_{11} + C_{12} + C_{13} + C_{14} \leq 100 \\ C_{21} + C_{22} + C_{23} + C_{24} \leq 120 \\ Demand\ \ Constraints \\ C_{11} + C_{21} \geq 80 \\ C_{12} + C_{22} \geq 60 \\ C_{13} + C_{23} \geq 70 \end{gathered}$$

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

$$\text{Non} - Negativity\ \ Constraints$$

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

demand Constraints is not equal to supply variables # To solve Primal with R

```
# Matrix for the given objective function
trans.cost <- matrix(c(622,614,630,0,
                  641,645,649,0), ncol=4, byrow=T) # Matrix for the given objective function
trans.cost
```

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

```
colnames(trans.cost) <- c("Warehouse1", "Warehouse2", "Warehouse3", "Dummy")
rownames(trans.cost) <- c("PlantA", "PlantB")
trans.cost
```

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

```
#Identify the row signs, row right hand side values, column sign and column right hand side values
row.signs <- rep("<=",2)
row.rhs <- c(100,120)
col.signs <- rep(">=",4)
col.rhs <- c(80,60,70,10)
lptrans.cost <- lp.transport(trans.cost,"min", row.signs,row.rhs,col.signs,col.rhs) #the linear problem
```

```
# the objective value for linear problem transport function
  lptrans.cost$objval # the solution of primal
```

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

$$\text{Where}\ \ WH_1 = Warehouse\ \ 1$$

$$WH_2 = Warehouse\ \ 2$$

$$WH_3 = Warehouse\ \ 3$$

$$\text{Where}\ \ PL_1 = PlantA$$

$$PL_2 = plantB$$

```
#To Get the constraints value
lptrans.cost$solution
```

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

##The shipping cost from each plant to the warehouse of each wholesaler along with the monthly demand from each wholesaler are also indicated in the table

2. Formulate the dual model of the above transportation problem

##the primal model to minimize the transportation cost the dual model of maximize the value added(Z)

$$Maximize \quad Z = \quad 80WH_1 + 60WH_2 + 70WH_3 - 100PL_1 - 120PL_2$$

Subject to the payment constraints

$$Total \;\; Payments \;\; Constraints$$

$$WH_1 - PL_1 \geq 622$$

$$WH_2 - PL_1 \geq 614$$

$$WH_3 - PL_1 \geq 630$$

$$WH_1 - PL_2 \geq 641$$

$$WH_2 - PL_2 \geq 645$$

$$WH_3 - PL_2 \geq 649$$

$$WH_i > 0, PL_j > 0$$

3.Economic Interpretation for above Constraints we can written as

$$WH_1 \leq 622 + PL_1$$

$$WH_2 \leq 614 + PL_1$$

$$WH_3 \leq 630 + PL_1$$

$$WH_1 \leq 641 + PL_2$$

$$WH_2 \leq 645 + PL_2$$

$$WH_3 \leq 649 + PL_2$$

Here Warehouse 1 recieved payment , which consider as marginal revenue

To Maximization the Profit MR has to equal to MC , MR = MC

We must lower plant expenses in order to get to the Marginal Revenue (MR)

MR < MC

We must expend more supply production in order to get to the Marginal Revenue (MR)

MR > MC