QMM Assignment 2

SAI SREE PULIMAMIDI

2022-10-18

R Markdown

```
tbl <- matrix(c(22,14,30,600,100 ,
16,20,24,625,120,
80,60,70,"-","-" ), ncol=5, byrow=TRUE)
colnames(tbl) <- c("Warehouse 1", "Warehouse 2", "Warehouse 3","Production
cost","Production Capacity")
rownames(tbl) <- c("Plant A", "Plant B","Monthly Demand")
tbl <- as.table(tbl)
tbl
```

```
##                Warehouse 1 Warehouse 2 Warehouse 3 Production cost
## Plant A        22          14          30          600
## Plant B        16          20          24          625
## Monthly Demand 80          60          70          -
##                Production Capacity
## Plant A        100
## Plant B        120
## Monthly Demand -
```

LP format of transporation problem are

$$ \text{Min} \hspace{.2cm} TC = 22 x_{11} +14 x_{12} +30 x_{13}$$

$$+16x_{21} + 20x_{22} + 24x_{23}$$

$$+80x_{31} + 60x_{32} + 70x_{33}$$

The Supply constraints are :

$$x_{11} + x_{12} + x_{13} \leq 100$$

$$x_{21} + x_{22} + x_{23} \leq 120$$

$$\text The Demand Constraints are :$$

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

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

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

$$Non - Negativity\ constraints$$

$$x_{ij} \geq 0$$

$$i = 1,2,3$$

$$j = 1,2,3$$

```
library(lpSolve)

# Set up cost matrix

cost_tbl <- matrix(c(622,614,630,0,
641,645,649,0), ncol = 4,byrow = TRUE)

# Set Plant names

colnames(cost_tbl ) <- c("Warehouse 1", "Warehouse 2","Warehouse 3","Dummy")
rownames(cost_tbl ) <- c("Plant A", "Plant B")
cost_tbl

##          Warehouse 1 Warehouse 2 Warehouse 3 Dummy
## Plant A         622         614         630     0
## Plant B         641         645         649     0
```

#Set up constraint signs and right-hand sides (supply side)

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

#Demand (sinks) side constraints

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

#Running the

```
lptrans_tbl <- lp.transport(cost_tbl, "min", row.signs, row.rhs, col.signs,
col.rhs)
```

#Values of all 8 variables

```
lptrans_tbl$solution

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

#Value of the objective function

```
lptrans_tbl$objval

## [1] 132790
```

#Getting the constraints value

```
lptrans_tbl$solution
```

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

2) Dual Problem:

Formulating the dual constraints and variables

$$ \text{The objective function is }Max\hspace{.3cm} VA= 80w_{1}+60w_{2}+70w_{3}-100p_{1}-120p_{2} $$

$$ \text{Where,}\hspace{.3cm}w_{1}\text{= Price received at the Warehouse 1} $$

w_2= Price, received at the Warehouse 2

w_3= Price, received at the Warehouse 3

p_1= Price, purchased at the Plant A

p_2= Price, purchased at the Plant B

Subject to:

$$w_1 - p_1 \geq 622$$

$$w_2 - p_1 \geq 614$$

$$w_3 - p_1 \geq 630$$

$$w_1 - p_2 \geq 641$$

$$w_2 - p_2 \geq 645$$

$$w_3 - p_2 \geq 649$$

3) Economic Interpretation of dual:

The goal of AED's business is to reduce the total cost of production and shipment.

To achieve this, the corporation needs hire a logistic company to handle the transportation, which will include purchasing the AEDs and transporting them to various warehouses in an effort to reduce the overall cost of production and shipping.

The constraints in the dual can be modified as

$$w_1 \geq 622 + p_1$$

$$w_2 \geq 614 + p_1$$

$$w_3 \geq 630 + p_1$$

$$w_1 \geq 641 + p_2$$

$$w_2 \geq 645 + p_2$$

$$w_3 \geq 649 + p_2$$

$$ \text{From the above we get to see that}\hspace{.3cm} w_{1}−p_{1}\ge 622$$

$$ \text{That can be exponented as}\hspace{.3cm} w_{1} \ge 622+p_{1}$$

$$ \text{Here}\hspace{.3cm} w_{1}\hspace{.3cm}\text{is considered as the price payments being received at the origin which is nothing else,but the revenue,whereas}\hspace{.3cm} p_{1}+622\hspace{.3cm}\text{is the money paid at the origin at PlantA} $$

$$\text{This can be formulated as below}\\ MR \ge MC $$

If MR < MC, in order to meet the Marginal Revenue (MR), we need to decrease the costs at the plants.

If MR > MC, in order to meet the Marginal Revenue (MR), we need to increase the production supply.

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

Therefore, MR=MC

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