transportation model

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```
library(lpSolveAPI)
library(lpSolve)
library(tinytex)
library(ggplot2)

price <- matrix(c(22,14,30,600,100,16,20,24,625,120,80,60,70,"-","-"),
ncol=5,byrow=TRUE)

colnames(price) <- c("Warehouse1","Warehouse2","Warehouse3","ProductionCost",
"ProductionCapacity")

rownames(price) <- c("Plant1","Plant2","Demand")

price <- as.table(price)
price

##        Warehouse1 Warehouse2 Warehouse3 ProductionCost ProductionCapacity
## Plant1 22         14         30         600            100
## Plant2 16         20         24         625            120
## Demand 80         60         70         -              -
```

$$Minimize\ the\ transportation\ cost\ is\ the\ objective\ function.$$

X = 622Y11 + 614Y12 + 630Y13 + 0Y14 + 641Y21 + 645Y22 + 649Y23 + 0Y24

$$Subject\ to\ the\ following\ constraints$$

Supply Constraints

Y11 + Y12 + Y13 + Y14 <= 100

Y21 + Y22 + Y23 + Y24 <= 120

Demand Constraints

Y11 + Y21 >= 80

Y12 + Y22 >= 60

Y13 + Y23 >= 70

Y14 + Y24 >= 10

Non – Negativity Constraints

Yij >= 0 Where i = 1,2 and j = 1,2,3,4

```
#cost matrix for given objective function

trans_price = matrix(c(622,614,630,0,641,645,649,0),ncol = 4,byrow = T)
trans_price

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

#define column name and row names
colnames(trans_price)<-c("warehouse1","warehouse2","warehouse3","Dummy")

rownames(trans_price)<-c("plant1","plant2")

trans_price

##        warehouse1 warehouse2 warehouse3 Dummy
## plant1        622        614        630     0
## plant2        641        645        649     0

#setting up constrains
plan.signs<- rep("<=",2)
plant.capacity<-c(100,120)
warehouse.signs<-rep(">=",4)
month.demand<-c(80,60,70,10)

#lp.transport function
lptrans.price<- lp.transport(trans_price,"min",
plan.signs,plant.capacity,warehouse.signs,month.demand)

#getting the objective value
lptrans.price$objval

## [1] 132790

#getting the constraints value
lptrans.price$solution

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

80 AEDs in Plant 2 - Warehouse1

60 AEDs in Plant 1 - Warehouse2

40 AEDs in Plant 1 - Warehouse3

30 AEDs in Plant 2 - Warehouse3 To reduce the total cost of manufacturing and transportation, should be created in each plant and then delivered to each of the three wholesaler warehouses.

$$Create\ the\ dual\ of\ the\ above\ transportation\ issue.$$

Since the primary goal was to reduce transportation costs, the secondary goal would be to increase value added (VA).

Maximize VA = 100P1 + 120P2 – 80W1 – 60W2 – 70W3

Subject to the following constraints

Total Profit Constraints

N1 – R1 >= 622

N2 – R1 >= 614

N3 – R1 >= 630

N1 – R2 >= 641

N2 – R2 >= 645

N3 – R2 >= 649

Where N1 = Warehouse 1

N2 = Warehouse 2

N3 = Warehouse 3

R1 = Plant 1

R2 = Plant 2

Economic Interpretation of the dual

N1 >= R1 + 622

N2 >= R1 + 614

N3 >= R1 + 630

N1 >= R2 + 641

N2 >= R2 + 645

N3 >= R2 + 649

The restrictions listed above, which are based on the economic interpretation of the dual, adhere to the maximizing of profits principle, which states that MR >= MC. where MC stands for marginal cost and MR for marginal cost.

$$Warehouse1 >= Plant1 + 621 \; i.e. MR1 >= MC1$$

The difference between marginal cost (MC), or the income produced for each extra unit sold, and marginal revenue, or The income earned for each extra unit sent to Warehouse 1 should exceed or be equivalent to the change in cost at Plant 1 caused by increasing the supply function.

Businesses can utilize this to balance their production output with expenses in order to increase profits.