Transportation model

Pratheek sreerangam

2022-10-17

##set transportation matrix

library(lpSolve)  
library(lpSolveAPI)  
c1<- matrix(c(22,14,30,600,100,  
 16,20,24,625,120,  
 80,60,70,"-","-"),ncol=5,byrow= TRUE)  
colnames(c1)<- c("Warehouse1","Warehouse 2","Warehouse 3","Production cost","Production Capacity")  
rownames(c1)<-c("PlantA","Plant B"," Monthly Demand")  
c1

## 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 "-"

Minimizing the TC is the goal function. Min T C = 622x11 + 614x12 + 630x13 + 0x14 + 641x21 + 645x22 + 649x23 + 0x24 subject to the aforementioned limitations Supply X11 + X12 + X13 + X14 <= 100 X21 + X22 + X23 + X24 <= 120 subject to the limitations listed : 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. A “Dummy” row will be added for Warehouse\_4 ..

trans.c1<- matrix(c(622,614,630,0,  
 641,645,649,0),ncol =4, byrow=TRUE)  
trans.c1

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

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

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

#Supply function is not permitted to exceed the units demanded side.

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

##demand function can be greater

library(lpSolve)  
lptrans<-lp.transport(trans.c1,"min",row.signs,row.rhs,col.signs,col.rhs)  
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 To reduce the overall cost of manufacturing and delivery, the aforementioned should be produced in each factory and distributed to the three wholesaler warehouses.

##Value of nvariables

lptrans$objval

## [1] 132790

The defibrilators’ total manufacturing and delivery expenses are $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 primary goal was to reduce transportation costs, the secondary goal would be to increase value added (VA). The dual’s variables are going to be u and v.

c2<-matrix(c(622,614,630,100,"u1",  
 641,645,649,120,"u2",  
 80,60,70,220,"-","v1","v2","v3","-","-"),ncol = 5,nrow=4,byrow=TRUE)  
colnames(c2) <- c("Warehouse\_1", "Warehouse\_2","Warehouse\_3","Production Capacity","Supply(Dual)")  
rownames(c2) <- c("Plant\_A","Plant\_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

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lp("max",f.obj,f.con,f.dir,f.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

Financial Analysis of the Dual Given the foregoing, the minimum Z(Primal) = 132790 and the maximum Z(Dual) = 139120. We realized that we shouldn’t be shipping to all three Warehouses from Plants (A/B). From where we should be shipping:

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’ll maximize the earnings from each distribution to the extent of the available resources.

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(trans.c1,"min",row.signs,row.rhs,col.signs,col.rhs)

## Success: the objective function is 132790

lp.transport(trans.c1,"min",row.signs1,row.rhs1,col.signs1,col.rhs1)

## Success: the objective function is 132771

lp.transport(trans.c1,"min",row.signs2,row.rhs2,col.signs2,col.rhs2)

## Success: the objective function is 132790

Here, we are watching the number decrease by 19 by taking the minimum of the particular function. This shows that the shadow price is 19, which was calculated by adding 1 to each of the plants and the primordial. There isn’t a shadow price for Plant B. v1 is a dual variable with the condition that Marginal Revenue Equals Marginal Cost. The formula was

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

## [1] 614 633 8 0 16

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