# Transportation

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```r
library(lpSolve)
```

```r
# Solve the transportation Problem in R and formulate it.
# use Dataframe
transport = matrix(c(22,14,30,600,100,
               16,20,24,625,120,
               80,60,70,"-","-"),ncol=5,byrow=TRUE)
colnames(transport)=c("Warehouse-1","Warehouse-2","Warehouse-3","Production cost","Production capacity")
rownames(transport)=c("Plant-A","Plant-B","Demand")
transport
```

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

```r
# THE Transportation model and the Objective Function solved below
# Minimization:: The combined cost of a production and shipping
# Min TM = 22x11 + 14x12 + 30x13+ 16x21 + 20x22+ 24x23
#  which is Subjected to supply constraints:
# x11 + x12 + x13 <= 100 (Plant-A)
# x21 + x22 + x23 >= 120 (Plant-B)
# Demand Constraints
# x11 + x21 >= 80 (Warehouse-1)
# x12 + x22 >= 60 (Warehouse-2)
# x13 + x23 >= 70 (Warehouse-3)
# Seems to be the transportation problem is unbalanced because demand < supply by 10.
# Use dummy variable method column 4 with the transportation cost = 0 and demand = 10.

# Transportation problem in R

tp <- matrix(c(622,614,630,0,
                  641,645,649,0), ncol = 4, byrow = TRUE)
# Column names, row names
colnames(tp) <- c("Warehouse-1", "Warehouse-2", "Warehouse-3", "Dummy")
row.names(tp) <- c("Plant-A", "PLant-B")
tp <- as.table(tp)
tp
```

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

```
# Production Capacity set row :
# supply end
rowsign <- rep("<=", 2)
rowrhs <- c(100,120)

# demand end
colsign <- rep(">=", 4)
colrhs <- c(80,60,70,10)

# LP Transport to find min.cost
lpt <- lp.transport(tp, "min", rowsign, rowrhs, colsign, colrhs)

# solution
lpt$solution
```

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

```
# objective function
lpt$objval
```

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

```
# Objective function is 132790
# Plant A they should ship 40 to Warehouse 1 and 60 units to Warehouse 2,from Plant B they should ship 

# The dual
lpt$duals
```

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

```
# Dual is the shadow prices of primal.



# 3. Make an economic interpretation of the dual
# Warehouse-1 <= 622 + Plant-A
# Warehouse-2 <= 614 + Plant-A
# Warehouse-3 <= 630 + Plant-A
# Warehouse-1 <= 641 + PlantB
# Warehouse-2 <= 645 + PlantB
# Warehouse-3 <= 649 + PlantB

#We conclude that Warehouse-1 - Plant-A >= 622$$ that can be exponented as arehouse-1 <= 622 + Plant-A
# Warehouse-1 is considered as the price payments being  received  at  the  origin  which  is  nothing
# Therefore  the  equation  turns,  out to be  MarketRevenue >= MarginalCost_1

# For  a  profit  maximization,  The  Marginal  Revenue (MR) should be equal to Marginal Costs MR_1 = M
```

```
#Based  on above interpretation, we can conclude that, Profit maximization takes place  if MC is equal

# If MR < MC, We must lower plant costs in order to reach the Marginal Revenue (MR)

#If MR > MC, We must boost manufacturing supply if we are to reach the Marginal Revenue (MR)

 4.# Conclusion from the primal
```

```
## [1] 4
```

```
# 60x12 which is 60 Units from Plant A to Warehouse 2.
# 40x13 which is 40 Units from Plant A to Warehouse 3.
# 80x21 which is 60 Units from Plant B to Warehouse 1.
# 30x23 which is 60 Units from Plant B to Warehouse 3.
# from the dual
# So, MR=MC. Five of the six MR<=MC. The only equation that does not satisfy this requirement is Plant 
# Warehouse 2.
#The primal that we will not be shipping any AED device there
```