Assignment

```
Module 6 - The Transportation Model
```

Heart Start produces automated external defibrillators (AEDs) in each of two different plants (A and B). The unit production costs and monthly production capacity of the two plants are indicated in the table below. The AEDs are sold through three wholesalers. 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. How many AEDs should be produced in each plant, and how should they be distributed to each of the three wholesaler warehouses so as to minimize the combined cost of production and shipping?

1. Formulate and solve this transportation problem using R
2. Formulate the dual of this transportation problem
3. Make an economic interpretation of the dual

```
tab <- matrix(c(22,14,30,0,16,20,24,0), ncol = 4,byrow = TRUE)
# Set customers and suppliers' names
colnames(tab) <- c("Warehouse 1", "Warehouse 2", "Warehouse 3","Dummy")
rownames(tab) <- c("Plant A", "Plant B")
tab
```

```
##         Warehouse 1 Warehouse 2 Warehouse 3 Dummy
## Plant A          22          14          30     0
## Plant B          16          20          24     0
```

The above transportation problem can be formulated in the LP format as below:

Min TC = 22x11 + 14x12 + 30x13 +16x21 + 20x22 + 24x23

Subject to
Production Capacity
x11 + x12 + x13 ≤ 100 x21 + x22 + x23 ≤ 120

Demand constrain x11 + x21 ≥ 80 x21 + x22 ≥ 60 x21 + x22 ≥ 70

Non-negativity of the variables xij ≥ 0

where i = 1,2,3 and j = 1,2

This transportation problem is unbalanced one (demand is not equal to supply), that is demand is less than supply by 10, so I create a dummy variable in column 4 with transportation cost zero and demand 10

```
library(lpSolve)
```

```
## Warning: package 'lpSolve' was built under R version 4.1.2
```

```
# Set up cost matrix
costs <- matrix(c(22,14,30,0,16,20,24,0), ncol = 4,byrow = TRUE)
# Set customers and suppliers' names
colnames(costs) <- c("Warehouse 1", "Warehouse 2", "Warehouse 3","Dummy")
rownames(costs) <- c("Plant A", "Plant B")
costs
```

```
##         Warehouse 1 Warehouse 2 Warehouse 3 Dummy
## Plant A          22          14          30     0
## Plant B          16          20          24     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)
```

```
# Run
lptrans <- lp.transport(costs, "min", row.signs, row.rhs, col.signs, col.rhs)
#Values of all 9 variables
lptrans$solution
```

```
##      [,1] [,2] [,3] [,4]
## [1,]   30   60    0   10
## [2,]   50    0   70    0
```

```
# Value of the objective function
lptrans$objval
```

```
## [1] 3980
```

When solved the transportation problem, I got the values of the variables as x11 = 30 x12 = 50 x21 = 60 x32 = 70

The minimized value of the transportation cost is 3980