Assignment 3

Ryan McGuinness

10/15/2021

Problem description

We need to minimize total cost of producing AEDs in two plants and of shipping from those plants to three warehouses. The table summarizing the costs is shown below.

Unit Shipping Costs	Warehouse 1	Warehouse 2	Warehouse 3	Unit Production Cost	Monthly Capacity
Plant A	\$22	\$14	\$30	\$600	100
Plant B	\$16	\$20	\$24	\$625	120
Monthly Demand	80	60	70		

First, we notice that total supply is not equal to total demand. A dummy warehouse with a demand of 10 units monthly is needed to correct this to equality.

Unit Shipping Costs	Warehouse 1	Warehouse 2	Warehouse 3	Warehouse 4(D)	Unit Production Cost	Monthly Capacity
Plant A	\$22	\$14	\$30	\$0	\$600	100
Plant B	\$16	\$20	\$24	\$0	\$625	120
Monthly Demand	80	60	70	10		

This can be represented by the following linear program:
MIN $Z = 622x_{A1} + 614x_{A2} + 630x_{A3} + 641x_{B1} + 645x_{B2} + 649x_{B3}$ subject to
$x_{A1} + x_{A2} + x_{A3} = 100$,
$x_{B1} + x_{B2} + x_{B3} = 120$,
$x_{A1} + x_{B1} = 80$,
$x_{A2} + x_{B2} = 60$,
$x_{A3} + x_{B3} = 70$,
$x_{A4} + x_{B4} = 10$, and
$x_{i,j} \geq 0$.

The formulation is included in the written up in the AED.lp file.

```
library(lpSolveAPI)
AED <- read.lp("AED.lp")
AED
```

```
## Model name:
##             xa1   xa2   xa3   xb1   xb2   xb3   xa4   xb4
## Minimize    622   614   630   641   645   649     0     0
## R1            1     1     1     0     0     0     1     0  =  100
## R2            0     0     0     1     1     1     0     1  =  120
## R3            1     0     0     1     0     0     0     0  =   80
## R4            0     1     0     0     1     0     0     0  =   60
## R5            0     0     1     0     0     1     0     0  =   70
## R6            0     0     0     0     0     0     1     1  =   10
## Kind        Std   Std   Std   Std   Std   Std   Std   Std
## Type       Real  Real  Real  Real  Real  Real  Real  Real
## Upper       Inf   Inf   Inf   Inf   Inf   Inf   Inf   Inf
## Lower         0     0     0     0     0     0     0     0
```

Now we solve the problem.

```
solve(AED)
```

```
## [1] 0
```

```
get.objective(AED)
```

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

```
get.variables(AED)
```

```
## [1]  0 60 40 80  0 30  0 10
```

The last two values given are for the dummy variables x_{A4} and x_{B4}. Our model tells us that out of the 100 units we can produce at Plant A, 60 should be set to warehouse 2 and 40 to warehouse 3, and out of the 120 units we can produce at Plant B, we only produce 110, send 80 to warehouse 1 and 30 to warehouse 3.