QMM Assignment 04

Harish Kunaparaju

2022-09-24

```
install.packages("lpSolve", repos = "https://cran.us.r-project.org")
```

```
##
## The downloaded binary packages are in
##   /var/folders/3f/z3lnbdlx7zqgdtlhcqkyt5fw0000gn/T//RtmpvAYWVc/downloaded_packages
library(lpSolve)
```

Further going down in order to solve the problem we need to define the objective, constraints, direction and constants

Objective Function

The Objective function is to $Max \quad Z = 420(L_1 + L_2 + L_3) + 360(M_1 + M_2 + M_3) + 300(S_1 + S_2 + S_3)$

which can be written as $Z = 420L_1 + 360M_1 + 300S_1 + 420L_2 + 360M_2 + 300S_2 + 420L_3 + 360M_3 + 300S_3$

Subject to the following constraints

$$L_1 + M_1 + S_1 \leq 750$$
$$L_2 + M_2 + S_2 \leq 900$$
$$L_3 + M_3 + S_3 \leq 450$$
$$20L_1 + 15M_1 + 12S_1 \leq 13000$$
$$20L_2 + 15M_2 + 12S_2 \leq 12000$$
$$20L_3 + 15M_3 + 12S_3 \leq 5000$$
$$L_1 + L_2 + L_3 \leq 900$$
$$M_1 + M_2 + M_3 \leq 1200$$
$$S_1 + S_2 + S_3 \leq 750$$

Non Negativity Constraints
$$L_1, L_2, L_3, M_1, M_2, M_3, S_1, S_2, S_3 \geq 0$$

The above constraints can be written as below

$$L_1 + M_1 + S_1 + 0L_2 + 0M_2 + 0S_2 + 0L_3 + 0M_3 + 0S_3 \leq 750$$

$$0L_1 + 0M_1 + 0S_1 + L_2 + M_2 + S_2 + 0L_3 + 0M_3 + 0S_3 \leq 900$$

$$0L_1 + 0M_1 + 0S_1 + 0L_2 + 0M_2 + 0S_2 + L_3 + M_3 + S_3 \leq 450$$

$$20L_1 + 15M_1 + 12S_1 + 0L_2 + 0M_2 + 0S_2 + 0L_3 + 0M_3 + 0S_3 \leq 13000$$

$$0L_1 + 0M_1 + 0S_1 + 20L_2 + 15M_2 + 12S_2 + 0L_3 + 0M_3 + 0S_3 \leq 12000$$

$$0L_1 + 0M_1 + 0S_1 + 0L_2 + 0M_2 + 0S_2 + 20L_3 + 15M_3 + 12S_3 \leq 5000$$

$$L_1 + 0M_1 + 0S_1 + L_2 + 0M_2 + 0S_2 + L_3 + 0M_3 + 0S_3 \leq 900$$

$$0L_1 + M_1 + 0S_1 + 0L_2 + M_2 + 0S_2 + 0L_3 + M_3 + 0S_3 \leq 1200$$

$$0L_1 + 0M_1 + S_1 + 0L_2 + 0M_2 + S_2 + 0L_3 + 0M_3 + S_3 \leq 750$$

Defining the Objective Function - f.obj

```
f.obj <- c(420,360,300,420,360,300,420,360,300)
```

Defining the Constraints - f.con

```
f.con <- matrix(c(1,1,1,0,0,0,0,0,0,
                  0,0,0,1,1,1,0,0,0,
                  0,0,0,0,0,0,1,1,1,
                  20,15,12,0,0,0,0,0,0,
                  0,0,0,20,15,12,0,0,0,
                  0,0,0,0,0,0,20,15,12,
                  1,0,0,1,0,0,1,0,0,
                  0,1,0,0,1,0,0,1,0,
                  0,0,1,0,0,1,0,0,1), nrow = 9, byrow=T)
```

Defining the Direction of the constraints - f.dir

```
f.dir <- c('<=',
           '<=',
           '<=',
           '<=',
           '<=',
           '<=',
           '<=',
           '<=',
           '<=')
```

Defining the constants i.e. the right hand side values - f.rhs

```
f.rhs <- c(750,900,450,13000,12000,5000,900,1200,750)
```

Calling the lp function to solve the problem basing the objective function i.e. to maximize the profits

```
lp('max',f.obj,f.con,f.dir,f.rhs)
```

```
## Success: the objective function is 708000
```

Calling the lp function again to get the values for the variables defined above

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

```
## [1] 350.0000 400.0000   0.0000   0.0000 400.0000 500.0000   0.0000 133.3333
## [9] 250.0000
```