Integer Programming

2022-11-18

#importing lpsolve library for the current environment

```r
library("lpSolveAPI")
```

#importing lp for the current integer problem

```r
setwd("/Users/thupiliabhinav/Desktop/QMM/Integer programming")
int_file <- read.lp("integer_file.lp")
print(int_file)

## Model name:
##                x1    x2    x3    x4    x5    x6    x7
## Minimize      775   800   800   800   800   775   750
## Sunday          0     1     1     1     1     1     0  >=   18
## Monday          0     0     1     1     1     1     1  >=   27
## Tuesday         1     0     0     1     1     1     1  >=   22
## Wednesday       1     1     0     0     1     1     1  >=   26
## Thursday        1     1     1     0     0     1     1  >=   25
## Friday          1     1     1     1     0     0     1  >=   21
## Saturday        1     1     1     1     1     0     0  >=   19
## Kind          Std   Std   Std   Std   Std   Std   Std
## Type          Int   Int   Int   Int   Int   Int   Int
## Upper         Inf   Inf   Inf   Inf   Inf   Inf   Inf
## Lower           0     0     0     0     0     0     0
```

#day workers required under current constraints

```r
day_workers <- matrix(c("Sunday","Monday","Tuesday","Wednesday","Thursday","F
riday","Saturday",
18,27,22,26,25,21,19),ncol=2,byrow = F)

colnames(day_workers) <- c("day_of_the_week", "workers_required")

as.table(day_workers)

##   day_of_the_week workers_required
## A Sunday          18
## B Monday          27
## C Tuesday         22
## D Wednesday       26
## E Thursday        25
## F Friday          21
## G Saturday        19
```

#Package handlers at AP are guaranteed a five-day work week with two consecutive days off. The base wage for the handlers is $750 per week. Workers working on Saturday or Sunday receive an additional $25 per day. The possible shifts and salaries for package handlers are:

```
day_offs_and_wages <- matrix(c(1,2,3,4,5,6,7,
                               "Sunday and Monday","Monday and Tuesday","Tues
day and Wednesday","Wednesday and Thursday","Thursday and Friday","Friday and
Saturday","Saturday and Sunday",
                               "$775","$800","$800","$800","$800","$775","$75
0"),ncol=3,byrow=F)

colnames(day_offs_and_wages) <- c("Shift", "Days_Off", "Wage")

as.table(day_offs_and_wages)

##   Shift Days_Off                Wage
## A 1     Sunday and Monday       $775
## B 2     Monday and Tuesday      $800
## C 3     Tuesday and Wednesday   $800
## D 4     Wednesday and Thursday  $800
## E 5     Thursday and Friday     $800
## F 6     Friday and Saturday     $775
## G 7     Saturday and Sunday     $750
```

#creating lp model.

```
solve(int_file)

## [1] 0
```

#The formulation of lp was successful as the value returned is 0.

#Objective Function.

```
get.objective(int_file)

## [1] 25675
```

#Total wages expenses for our objective function is $25,675 for AP shipping service.

```
get.variables(int_file)

## [1]  2  4  5  0  8  1 13
```

#Interpretation:

#From above we can observe the following:

#Worker Assigned in shift 1 = 2.

#Worker Assigned in shift 2 = 4.

#Worker Assigned in shift 3 = 5.

#Worker Assigned in shift 4 = 0.

#Worker Assigned in shift 5 = 8.

#Worker Assigned in shift 6 = 1.

#Worker Assigned in shift 7 = 13.

#From the above variables we can derive the objective function and constraints for the below model.

#Sunday: x2 + x3 + x4 + x5 + x6 = 18;

#Monday: x3 + x4 + x5 + x6 + x7 = 27;

#Tuesday: x4 + x5 + x6 + x7 + x1 = 22;

#Wednesday: x5 + x6 + x7 + x1 + x2 = 26;

#Thursday: x6 + x7 + x1 + x2 + x3 = 25;

#Friday: x7 + x1 + x2 + x3 + x4 = 21;

#Saturday: x1 + x2 + x3 + x4 + x5 = 19;