Assignment_6

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11/15/2022

##Integer Programming

AP is a shipping service that guarantees overnight delivery of packages in the continental US. The company has various hubs at major cities and airports across the country. Packages are received at hubs, and then shipped to intermediate hubs or to their final destination. The manager of the AP hub in Cleveland is concerned about labor costs, and is interested in determining the most effective way to schedule workers. The hub operates seven days a week, and the number of packages it handles varies from one day to another.

Setting default values to get a clean output

```
#Loading the .lp file
getwd()

## [1] "C:/Users/mercy/OneDrive/Desktop/QMM/Assignment_6"

setwd("C:/Users/mercy/OneDrive/Desktop/QMM/Assignment_6")

#Loading the lpSolveAPI Package
library("lpSolveAPI")

## Warning: package 'lpSolveAPI' was built under R version 4.1.3

#Loading the lp file
AP_HUB <- read.lp("IntegerProgramming.lp")
print(AP_HUB)

## 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
```

```
#We are estimating the number of workers required for every day for week in t
he table below
Required_Workers_Daywise<- matrix(c("Sunday","Monday","Tuesday","Wednesday","
Thursday","Friday","Saturday",
18,27,22,26,25,21,19),ncol=2,byrow = F)
colnames(Required_Workers_Daywise) <- c("No_of_Days_per_week", "No_of_Workers
_Required")
as.table(Required_Workers_Daywise)
```

```
##   No_of_Days_per_week No_of_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

```
No_of_Day_offs_and_wages <- matrix(c(1,2,3,4,5,6,7, "Sunday and Monday","Mond
ay and Tuesday","Tuesday and Wednesday","Wednesday and Thursday","Thursday an
d Friday","Friday and Saturday","Saturday and Sunday","$775","$800","$800","$
800","$800","$775","$750"),ncol=3,byrow=F)
colnames(No_of_Day_offs_and_wages) <- c("Shifts", "Day_Offs", "Wages")
as.table(No_of_Day_offs_and_wages)
```

```
##   Shifts Day_Offs               Wages
## 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
```

```
#Now Running the lp model
solve(AP_HUB)
```

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

By getting 0 as the value we get to know that there exists a model.

```
#Objective Function
get.objective(AP_HUB)
```

```
## [1] 25675
```

The overall cost to the company to ensure that total pay expenses are as little as feasible and that there are enough workers available each day to work is “25,675$”.

```
#The number of workers whom is available to work each day
get.variables(AP_HUB)

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

The variables have values from x1, x2…….x7 where,

x1 = Number of workers assigned to shift 1 = 2

x2 = Number of workers assigned to shift 2 = 4

x3 = Number of workers assigned to shift 3 = 5

x4 = Number of workers assigned to shift 4 = 0

x5 = Number of workers assigned to shift 5 = 8

x6 = Number of workers assigned to shift 6 = 1

x7 = Number of workers assigned to shift 7 = 13

With respect to the objective function as well as the limits set by the business, we may determine how many workers are available to work each day by the variable values obtained.

Sunday = x2 + x3 + x4 + x5 + x6 = 18 Workers

Monday = x3 + x4 + x5 + x6 + x7 = 27 Workers

Tuesday = x4 + x5 + x6 + x7 + x1 = 24 Workers

Wednesday = x5 + x6 + x7 + x1 + x2 = 28 Workers

Thursday = x6 + x7 + x1 + x2 + x3 = 25 Workers

Friday = x7 + x1 + x2 + x3 + x4 = 24 Workers

Saturday = x1 + x2 + x3 + x4 + x5 = 19 Workers