QMM_Assignment4

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2023-11-10

Problem: AP, a shipping service ensuring overnight package delivery throughout the continental US, manages hubs in key cities and airports nationwide. These hubs receive packages, which are then dispatched either to intermediate hubs or directly to their final destinations. The manager of the Cleveland hub is actively addressing concerns related to labor costs. The objective is to optimize worker scheduling for the hub, which functions every day of the week, adapting to the variable daily package loads.

```
# Read the LP file
df <- read.lp("pro.lp")
print(df)
```

```
## 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
```

```
# Number of workers required each day
Workers_Per_Day <-
matrix(c("Sunday","Monday","Tuesday","Wednesday","Thursday","Friday","Saturda
y",
                           18,27,22,26,25,21,19), ncol=2, byrow=FALSE)
colnames(Workers_Per_Day) <- c("Day_of_the_week", "Workers_Required")
as.table(Workers_Per_Day)
```

```
##   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
```

AP's package handlers enjoy a standard five-day work week with two consecutive days off. Their base wage is set at $750 per week. For those who work on either Saturday or Sunday, there is an additional $25 per day. The available shifts and corresponding salaries for package handlers are as follows:

```
# Possible shifts and wages
Shifts_and_wages <- matrix(c(1,2,3,4,5,6,7,
                             "Sunday and Monday","Monday and
Tuesday","Tuesday and Wednesday",
                             "Wednesday and Thursday","Thursday and Friday",
                             "Friday and Saturday","Saturday and Sunday",
"$775",
                             "$800","$800","$800","$800","$775","$750"),
ncol=3, byrow=FALSE)
colnames(Shifts_and_wages) <- c("Shift", "Days_Off", "Wage")
as.table(Shifts_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

# Solve the lp model
solve(df)

## [1] 0
```

**Acknowledging that a valid model results in obtaining a value of 0.*

```
# Total Cost - Objective Function
total_cost <- get.objective(df)
total_cost

## [1] 25675
```

The total cost amounts to $25,675. This represents the overall cost for the company to ensure an adequate workforce daily while minimizing the total labor expenses.

```
# Number of workers available each day - variable
workers_available <- get.variables(df)
workers_available

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

# Summary of workers available each day
cat("Summary of Workers Available Each Day:\n")

## Summary of Workers Available Each Day:
```

```
cat("Monday =", workers_available[3] + workers_available[4] +
workers_available[5] + workers_available[6] + workers_available[7],
"Workers\n")

## Monday = 27 Workers

cat("Tuesday =", workers_available[4] + workers_available[5] +
workers_available[6] + workers_available[7] + workers_available[1],
"Workers\n")

## Tuesday = 24 Workers

cat("Wednesday =", workers_available[5] + workers_available[6] +
workers_available[7] + workers_available[1] + workers_available[2],
"Workers\n")

## Wednesday = 28 Workers

cat("Thursday =", workers_available[6] + workers_available[7] +
workers_available[1] + workers_available[2] + workers_available[3],
"Workers\n")

## Thursday = 25 Workers

cat("Friday =", workers_available[7] + workers_available[1] +
workers_available[2] + workers_available[3] + workers_available[4],
"Workers\n")

## Friday = 24 Workers

cat("Saturday =", workers_available[1] + workers_available[2] +
workers_available[3] + workers_available[4] + workers_available[5],
"Workers\n")

## Saturday = 19 Workers

cat("Sunday =", workers_available[2] + workers_available[3] +
workers_available[4] + workers_available[5] + workers_available[6],
"Workers\n")

## Sunday = 18 Workers
```