Integer Programming

Namrah

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```
library("lpSolveAPI")
# Loading the LP file
data <- read.lp("lin.lp")
print(data)
```

```
## 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
```

```
# Defining the required workforce for each day
workersNeededPerDay <-
matrix(c("Sunday","Monday","Tuesday","Wednesday","Thursday","Friday","Saturda
y",
                            18,27,22,26,25,21,19), ncol=2, byrow=FALSE)
colnames(workersNeededPerDay) <- c("Day", "RequiredWorkers")
as.table(workersNeededPerDay)
```

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

AP's package handling team operates on a five-day work schedule with two consecutive days off. Their base salary stands at $750 per week. Those working on either Saturday or Sunday receive an additional $25 per day. The available shifts and respective compensations for package handlers are:

```
# Available shifts and corresponding salaries
shiftsAndCompensation <- 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(shiftsAndCompensation) <- c("Shift", "DaysOff", "Wage")
as.table(shiftsAndCompensation)
```

```
##   Shift DaysOff                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
```

```
# Solving the LP model
solve(data)
```

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

Valid models yield an outcome of 0.

```
# Objective Function - Total Cost
totalCost <- get.objective(data)
totalCost
```

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

The total cost is $25,675, representing the overall expenses incurred by the company to ensure adequate staffing daily while minimizing labor expenses.

```
# Workforce availability per day - variable
availableWorkers <- get.variables(data)
availableWorkers
```

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

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

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

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

```
## Monday = 27 Workers
```

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

## Tuesday = 24 Workers

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

## Wednesday = 28 Workers

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

## Thursday = 25 Workers

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

## Friday = 24 Workers

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

## Saturday = 19 Workers

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

## Sunday = 18 Workers
```