Integer Programming

2022-11-18

#importing lpsolve library for the current environment

library("lpSolveAPI")

#importing lp for the current integer problem

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

day\_workers <- matrix(c("Sunday","Monday","Tuesday","Wednesday","Thursday","Friday","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","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=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;