ASSIGNMENT 4

19-11-2023

# Load the lpSolve package  
library(lpSolve)  
  
# Define the data  
required\_workers <- c(18, 27, 22, 26, 25, 21, 19) # Number of workers needed from Sunday to Saturday  
  
# Wages for each shift as per the problem statement  
shift\_wages <- c(775, 800, 800, 800, 800, 775, 750) # Wages for shifts 1 to 7  
  
# Set up the integer programming model  
# Objective: Minimize total wage cost  
# Constraints: Number of workers per day  
  
# Number of variables (one for each shift)  
num\_vars <- length(shift\_wages)  
  
# Coefficients of the objective function  
objective <- shift\_wages  
  
# Matrix for constraints  
# Each row corresponds to a day, and each column corresponds to a shift  
constraint\_matrix <- matrix(c(  
 0, 1, 1, 1, 1, 1, 0, # Sunday  
 0, 0, 1, 1, 1, 1, 1, # Monday  
 1, 0, 0, 1, 1, 1, 1, # Tuesday  
 1, 1, 0, 0, 1, 1, 1, # Wednesday  
 1, 1, 1, 0, 0, 1, 1, # Thursday  
 1, 1, 1, 1, 0, 0, 1, # Friday  
 1, 1, 1, 1, 1, 0, 0 # Saturday  
), nrow = 7, byrow = TRUE)  
  
# Direction of the constraints (greater than or equal to the required workers)  
constraint\_dir <- rep(">=", 7)  
  
# Right-hand side of the constraints (required workers each day)  
constraint\_rhs <- required\_workers  
  
# Define the variables as integer  
variable\_types <- rep("integer", num\_vars)  
  
# Solve the model  
solution <- lp("min", objective, constraint\_matrix, constraint\_dir, constraint\_rhs,   
 all.int = TRUE, int.vec = 1:num\_vars)  
  
# Display results  
if(solution$status == 0) {  
 cat("Optimal solution found.\n")  
 cat("Total cost: $", sum(solution$solution \* shift\_wages), "\n")  
 cat("Number of workers scheduled for each shift:\n")  
 for(i in 1:num\_vars) {  
 cat("Shift ", i, ": ", solution$solution[i], "\n")  
 }  
} else {  
 cat("No optimal solution found.")  
}

## Optimal solution found.  
## Total cost: $ 25675   
## Number of workers scheduled for each shift:  
## Shift 1 : 2   
## Shift 2 : 4   
## Shift 3 : 5   
## Shift 4 : 0   
## Shift 5 : 8   
## Shift 6 : 1   
## Shift 7 : 13

constraint\_matrix <-matrix(c(  
   
 0, 4, 5, 0, 8, 1, 0, # Sunday  
 0, 0, 5, 0, 8, 1, 13, # Monday  
 2, 0, 0, 0, 8, 1, 13, # Tuesday  
 2, 4, 0, 0, 8, 1, 13, # Wednesday  
 2, 4, 5, 0, 0, 1, 13, # Thursday  
 2, 4, 5, 0, 0, 0, 13, # Friday  
 2, 4, 5, 0, 8, 0, 0 # Saturday  
), nrow = 7, byrow = TRUE)  
  
row.names(constraint\_matrix) <- c("sunday","monday","tuesday", "wednesday",  
 "thursday", "friday", "saturday" )  
colnames(constraint\_matrix) <- c("Shift 1", "Shift 2", "Shift 3", "Shift 4", "Shift 5", "Shift 6", "Shift 7")  
  
   
print(constraint\_matrix)

## Shift 1 Shift 2 Shift 3 Shift 4 Shift 5 Shift 6 Shift 7  
## sunday 0 4 5 0 8 1 0  
## monday 0 0 5 0 8 1 13  
## tuesday 2 0 0 0 8 1 13  
## wednesday 2 4 0 0 8 1 13  
## thursday 2 4 5 0 0 1 13  
## friday 2 4 5 0 0 0 13  
## saturday 2 4 5 0 8 0 0

rowSums (constraint\_matrix)

## sunday monday tuesday wednesday thursday friday saturday   
## 18 27 24 28 25 24 19