ASSIGNMENT 4

19-11-2023

```r
# 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)
```

```r
# 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
```

```r
  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", "Sh


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
```

```r
rowSums (constraint_matrix)
```

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