INTERGER PROGRAMMING

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```r
# Required package for optimization
require(lpSolve)
```

```
## Loading required package: lpSolve
```

```r
# Define the number of workers needed from Sunday to Saturday
daily_worker_requirements <- c(18, 27, 22, 26, 25, 21, 19)
standard_weekly_salary <- 750
additional_salary_for_weekends <- 25
day_labels <- c("Sun", "Mon", "Tue", "Wed", "Thurs", "Fri", "Sat")

# Determining salaries for different shift patterns
# Shifts: Sun-Thu, Mon-Fri, ..., Wed-Sun
salary_for_shifts <- rep(standard_weekly_salary, 7) + c(2, 1, 0, 0, 0, 0, 1) * additional_salary_for_we

# The aim is to minimize the total salary cost
# Constraint: Meeting the daily workforce requirements

# The number of shift types
number_of_shifts <- length(salary_for_shifts)

# Creating the objective function for the optimization
objective_function <- salary_for_shifts

# Formulating the constraints matrix
# Each row signifies a day and columns signify shifts
day_shift_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)

# Types of constraints: ensuring enough workers each day
types_of_constraints <- rep(">=", 7)

# Right-hand side values of the constraints
rhs_values <- daily_worker_requirements
```

```r
# Executing the integer linear programming model
optimization_result <- lp("min", objective_function, day_shift_matrix, types_of_constraints, rhs_values

# Displaying the results
if(optimization_result$status == 0) {
  cat("Optimal solution successfully determined.\n")
  cat("Total Salary Cost: $", sum(optimization_result$solution * salary_for_shifts), "\n")
  cat("Daily Worker Allocation:\n")

  # Displaying the number of workers allocated for each day
  for(i in seq_along(day_labels)) {
    workers_today <- sum(day_shift_matrix[i, ] * optimization_result$solution)
    cat(day_labels[i], ": ", workers_today, "\n")
  }
} else {
  cat("Failed to find an optimal solution.")
}
```

```
## Optimal solution successfully determined.
## Total Salary Cost: $ 25100
## Daily Worker Allocation:
## Sun :  23
## Mon :  29
## Tue :  22
## Wed :  26
## Thurs :  25
## Fri :  21
## Sat :  19
```