

QMM Assignment-6

Abhinay Chiranjeeth Marneni

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Loading the packages

```
library(lpSolve)
library(lpSolveAPI)
```

Formulating Lp model problem

#S1 = shift 1 with Sunday #S2 = shift 2 with Monday #S3 = shift 3 with Tuesday #S4 = shift 4 with Wednesday #S5= shift 5 with Thursday #S6 = shift 6 with Friday #S7 = shift 7 with Saturday

Objective function

#Min: $775x_1 + 800x_2 + 800x_3 + 800x_4 + 800x_5 + 775x_6 + 750x_7$; # Constraints $\#0x_1 + 1x_2 + 1x_3 + 1x_4 + 1x_5 + 1x_6 + 0x_7 \geq 18$; $\#0x_2 + 0x_2 + 1x_3 + 1x_4 + 1x_5 + 1x_6 + 1x_7 \geq 27$; $\#1x_3 + 0x_2 + 0x_3 + 1x_4 + 1x_5 + 1x_6 + 1x_7 \geq 22$; $\#1x_4 + 1x_2 + 0x_3 + 0x_4 + 1x_5 + 1x_6 + 1x_7 \geq 26$; $\#1x_5 + 1x_2 + 1x_3 + 0x_4 + 0x_5 + 1x_6 + 1x_7 \geq 25$; $\#1x_6 + 1x_2 + 1x_3 + 1x_4 + 0x_5 + 0x_6 + 1x_7 \geq 21$; $\#1x_7 + 1x_2 + 1x_3 + 1x_4 + 1x_5 + 0x_6 + 0x_7 \geq 19$; $\#S1 > 0$; $\#S2 > 0$; $\#S3 > 0$; $\#S4 > 0$; $\#S5 > 0$; $\#S6 > 0$; $\#S7 > 0$; #int S1, S2, S3, S4, S5, S6, S7;

Create table

```
table <- make.lp(7, 7)
set.objfn(table, c(775, 800, 800, 800, 800, 775, 750))      # Objective function
lp.control(table, sense='min')

## $anti.degen
## [1] "fixedvars" "stalling"
##
## $basis.crash
## [1] "none"
##
## $bb.depthlimit
## [1] -50
##
```

```

## $bb.floorfirst
## [1] "automatic"
##
## $bb.rule
## [1] "pseudononint" "greedy"      "dynamic"      "rcostfixing"
##
## $break.at.first
## [1] FALSE
##
## $break.at.value
## [1] -1e+30
##
## $epsilon
##      epsb      epsd      epsel      epsint  epsperturb  epspivot
##      1e-10      1e-09      1e-12      1e-07      1e-05      2e-07
##
## $improve
## [1] "dualfeas" "thetagap"
##
## $infinite
## [1] 1e+30
##
## $maxpivot
## [1] 250
##
## $mip.gap
## absolute relative
##      1e-11      1e-11
##
## $negrange
## [1] -1e+06
##
## $obj.in.basis
## [1] TRUE
##
## $pivoting
## [1] "devex"      "adaptive"
##
## $presolve
## [1] "none"
##
## $scalelimit
## [1] 5
##
## $scaling
## [1] "geometric"  "equilibrate" "integers"
##
## $sense
## [1] "minimize"
##
## $simplextype
## [1] "dual"      "primal"
##
## $timeout

```

```
## [1] 0
##
## $verbose
## [1] "neutral"

set.row(table, 1, c(0, 1, 1, 1, 1, 1, 0), indices = c(1, 2, 3, 4, 5, 6, 7)) # Set LHS and RHS
set.row(table, 2, c(0, 0, 1, 1, 1, 1, 1), indices = c(1, 2, 3, 4, 5, 6, 7))
set.row(table, 3, c(1, 0, 0, 1, 1, 1, 1), indices = c(1, 2, 3, 4, 5, 6, 7))
set.row(table, 4, c(1, 1, 0, 0, 1, 1, 1), indices = c(1, 2, 3, 4, 5, 6, 7))
set.row(table, 5, c(1, 1, 1, 0, 0, 1, 1), indices = c(1, 2, 3, 4, 5, 6, 7))
set.row(table, 6, c(1, 1, 1, 1, 0, 0, 1), indices = c(1, 2, 3, 4, 5, 6, 7))
set.row(table, 7, c(1, 1, 1, 1, 1, 0, 0), indices = c(1, 2, 3, 4, 5, 6, 7))
rhs <- c(18, 27, 22, 26, 25, 21, 19)
set.rhs(table, rhs)
set.constr.type(table, c(">=", ">=", ">=", ">=", ">=", ">=", ">=")) ## constraint and variables
set.bounds(table, lower = rep(0, 7))
set.type(table, 1:7, "integer")
lp.rownames <- c("Sunday", "Monday", "Tuesday", "Wednesday", "Thursday", "Friday", "Saturday")
lp.colnames <- c("S1", "S2", "S3", "S4", "S5", "S6", "S7")
dimnames(table) <- list(lp.rownames, lp.colnames)
table
```

```
## Model name:
##           S1    S2    S3    S4    S5    S6    S7
## 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
```

#Solving AP-Hub lp model to find optimal variables of workers in factory.

```
solve(table)
```

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

```
# Getting objective, variables
get.objective(table)
```

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

```
get.variables(table)
```

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

##The table shows the available workers, and the total cost is 25675.

#A week's worth of factory worker shifts are considered in order to figure out the best method for reduce total wage costs.

```
shift<- matrix(c(0,4,5,0,8,1,0,0,0,5,0,8,1,13,2,0,0,0,8,1,13,2,4,0,0,8,1,13,2,4,5,0,0,1,13,2,3,4,0,0,0,
row.names(shift) <- c('Sunday', 'Monday', 'Tuesday', 'Wednesday', 'Thursday', 'Friday', 'Saturday')
colnames(shift)<- c('Sun-Mon', 'Mon-Tues', 'Tues-Wed', 'Wed-Thur', 'Thur-Fri', 'Fri-Sat', 'Sat-Sun')
shift
```

##	Sun-Mon	Mon-Tues	Tues-Wed	Wed-Thur	Thur-Fri	Fri-Sat	Sat-Sun
## 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	3	4	0	0	0	13
## Saturday	2	4	5	0	8	0	0

```
rowSums(shift) #To reduce the total cost of labor expenses, the number of workers should be distributed
```

##	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
##	18	27	24	28	25	22	19