Module 11

Hannah Strickling

2022-10-31

Objective Function

775x1 + 800x2 + 800x3 + 800x4 + 800x5 + 775x6 + 750x7 = MINIMIZE

where:

x1 = Workers Shift 1 (off Sunday Monday) x2 = Workers Shift 2 (off Monday Tuesday) x3 = Workers Shift 3 (off Tuesday Wednesday) x4 = Workers Shift 4 (off Wednesday Thursday) x5 = Workers Shift 5 (off Thursday Friday) x6 = Workers Shift 6 (off Friday Saturday) x7 = Workers Shift 7 (off Saturday Sunday)

subject to:

Constraints

```
x2 + x3 + x4 + x5 + x6      >= 18 (Sunday)
     x3 + x4 + x5 + x6 + x7 >= 27 (Monday)
```

x1 + x4 + x5 + x6 + x7 >= 22 (Tuesday) x1 + x2 + x5 + x6 + x7 >= 26 (Wednesday) x1 + x2 + x3 + x6 + x7 >= 25 (Thursday) x1 + x2 + x3 + x4 + x7 >= 21 (Friday) x1 + x2 + x3 + x4 + x5 >= 19 (Saturday)

Formulation

```
library(lpSolveAPI)
lprec <- make.lp(0, 7)
set.objfn(lprec, c(775, 800, 800, 800, 800, 775, 750))
lp.control(lprec, 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"
```

```r
add.constraint(lprec, c(0,1,1,1,1,1,0), ">=", 18)
add.constraint(lprec, c(0,0,1,1,1,1,1), ">=", 27)
add.constraint(lprec, c(1,0,0,1,1,1,1), ">=", 22)
add.constraint(lprec, c(1,1,0,0,1,1,1), ">=", 26)
add.constraint(lprec, c(1,1,1,0,0,1,1), ">=", 25)
add.constraint(lprec, c(1,1,1,1,0,0,1), ">=", 21)
add.constraint(lprec, c(1,1,1,1,1,0,0), ">=", 19)

solve(lprec)
```

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

```r
get.objective(lprec)
```

```
## [1] 25175
```

```r
get.variables(lprec)
```

```
## [1]  1.3333333  4.0000000  6.3333333  0.0000000  7.3333333  0.3333333 13.0000000
```

Interpretation

x1 = 1.33 x2 = 4 x3 = 6.33 x4 = 0 x5 = 7.33 x6 = .33 x7 = 13

Since we are not able to have a fraction of a person, we will round the numbers up: x1 = 2 Workers Shift 1 x2 = 4 Workers Shift 2 x3 = 7 Workers Shift 3 x4 = 0 Workers Shift 4 x5 = 8 Workers Shift 5 x6 = 1 Workers Shift 6 x7 = 13 Workers Shift 7

Feasibility

We will want to employ 35 workers total. As a quick check to above, we can look at shift 7 (employees off Saturday and Sunday). Since we have 13 workers off for shift seven, we are left with 22 to cover. Saturday will include employees who work shifts 1, 2, 3, 4, and 5. This would include 21 employees. We see that Saturday needs a minimum of 19 so we are safe to have 13 on shift 7 and not working on this day. This logic can be applied to the other days and we will find that we have met the minimum staffing needs for each day.

Objective Answer

With the above staffing schedule plan, we will arrive at a minimum cost of $25,175