QMM Assign3

Prerak Patel

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Question

The Weigelt Corporation has three branch plants with excess production capacity. Fortunately, the corporation has a new product ready to begin production, and all three plants have this capability, so some of the excess capacity can be used in this way. This product can be made in three sizes–large, medium, and small–that yield a net unit profit of $420, $360, and $300, respectively. Sizes [large, medium, small] = [420, 360, 300] $ Plant [P1, P2, P3] = [750, 900, 450] units per day of this product,
Amount of available in-process storage space also imposes a limitation on the production rates of the new product. Storage [s1, s2, s3] = [13,000, 12,000, 5,000] square feet Each unit of the [large, medium, small] sizes produced per day requires [20, 15, 12] square feet

Sales forecasts [large, medium, and small] = [900, 1,200, 750] units of the sizes, would be sold per day.

At each plant, some employees will need to be laid off unless most of the plant's excess production capacity can be used to produce the new product. To avoid layoffs if possible, management has decided that the plants should use the same percentage of their excess capacity to produce the new product.

Management wishes to know how much of each of the sizes should be produced by each of the plants to maximize profit.

1.Solve the problem using lpsolve, or any other equivalent library in R.

2.Identify the shadow prices, dual solution, and reduced costs

3.Further, identify the sensitivity of the above prices and costs. That is, specify the range of shadow prices and reduced cost within which the optimal solution will not change.

4.Formulate the dual of the above problem and solve it. Does the solution agree with what you observed for the primal problem?

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1. Solve the problem using lpsolve, or any other equivalent library in R.

```
## Model name:
##   a linear program with 9 decision variables and 11 constraints

## [1] 0
```

```
## [1] 696000

## [1] 516.6667 177.7778   0.0000   0.0000 666.6667 166.6667   0.0000
0.0000
## [9] 416.6667

##  [1]  6.944444e+02  8.333333e+02  4.166667e+02  1.300000e+04  1.200000e+04
##  [6]  5.000000e+03  5.166667e+02  8.444444e+02  5.833333e+02 -2.037268e-10
## [11]  0.000000e+00
```

2.Identify the shadow prices, dual solution, and reduced costs

```
## $duals
##  [1]    0.00    0.00    0.00   12.00   20.00   60.00    0.00    0.00
0.00
## [10]   -0.08    0.56    0.00    0.00  -24.00  -40.00    0.00    0.00 -
360.00
## [19] -120.00    0.00
##
## $dualsfrom
##  [1] -1.000000e+30 -1.000000e+30 -1.000000e+30  1.122222e+04  1.150000e+04
##  [6]  4.800000e+03 -1.000000e+30 -1.000000e+30 -1.000000e+30 -2.500000e+04
## [11] -1.250000e+04 -1.000000e+30 -1.000000e+30 -2.222222e+02 -1.000000e+02
## [16] -1.000000e+30 -1.000000e+30 -2.000000e+01 -4.444444e+01 -1.000000e+30
##
## $dualstill
##  [1] 1.000000e+30 1.000000e+30 1.000000e+30 1.388889e+04 1.250000e+04
##  [6] 5.181818e+03 1.000000e+30 1.000000e+30 1.000000e+30 2.500000e+04
## [11] 1.250000e+04 1.000000e+30 1.000000e+30 1.111111e+02 1.000000e+02
## [16] 1.000000e+30 1.000000e+30 2.500000e+01 6.666667e+01 1.000000e+30

## $objfrom
## [1]  3.60e+02  3.45e+02 -1.00e+30 -1.00e+30  3.45e+02  2.52e+02 -1.00e+30
## [8] -1.00e+30  2.04e+02
##
## $objtill
## [1] 4.60e+02 4.20e+02 3.24e+02 4.60e+02 4.20e+02 3.24e+02 7.80e+02
4.80e+02
## [9] 1.00e+30

##  [1]    1.00    0.00    0.00    0.00   12.00   20.00   60.00    0.00
0.00
## [10]    0.00   -0.08    0.56    0.00    0.00  -24.00  -40.00    0.00
0.00
## [19] -360.00 -120.00    0.00
```

4. Formulate the dual of the above problem and solve it. Does the solution agree with what you observed for the primal problem?

```
## $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"

# Adding constraints

add.constraint(lprec1,c(1, 0, 0, 20, 0, 0, 1, 0, 0, 900, 450), '>=',420 )
add.constraint(lprec1,c(1, 0, 0, 15, 0, 0, 0, 1, 0, 900, 450), '>=',360 )
add.constraint(lprec1,c(1, 0, 0, 12, 0, 0, 0, 0, 1, 900, 450), '>=',300 )

add.constraint(lprec1,c(0, 1, 0, 0, 20, 0, 1, 0, 0, -750, 0), '>=',420 )
add.constraint(lprec1,c(0, 1, 0, 0, 15, 0, 0, 1, 0, -750, 0), '>=',360 )
add.constraint(lprec1,c(0, 1, 0, 0, 12, 0, 0, 0, 1, -750, 0), '>=',300 )

add.constraint(lprec1,c(0, 0, 1, 0, 0, 20, 1, 0, 0, 0, -750), '>=',420 )
add.constraint(lprec1,c(0, 0, 1, 0, 0, 15, 0, 1, 0, 0, -750), '>=',360 )
add.constraint(lprec1,c(0, 0, 1, 0, 0, 12, 0, 0, 1, 0, -750), '>=',300 )

set.bounds(lprec1, lower=c(-Inf, -Inf), columns= 10:11)

# write.lp(lprec1,'duality.lp',type="lp" )

solve(lprec1)

## [1] 0

get.objective(lprec1)

## [1] 696000

get.variables(lprec1)

##  [1]  0.00  0.00  0.00 12.00 20.00 60.00  0.00  0.00  0.00 -0.08  0.56

get.constraints(lprec1)

## [1] 420 360 324 460 360 300 780 480 300

get.sensitivity.rhs(lprec1)

## $duals
##  [1] 516.66667 177.77778   0.00000   0.00000 666.66667 166.66667   0.00000
```

```
##  [8]   0.00000 416.66667  55.55556  66.66667  33.33333   0.00000   0.00000
## [15]   0.00000 383.33333 355.55556 166.66667   0.00000   0.00000
##
## $dualsfrom
##  [1]  3.600000e+02  3.450000e+02 -1.000000e+30 -1.000000e+30  3.450000e+02
##  [6]  2.880000e+02 -1.000000e+30 -1.000000e+30  2.040000e+02 -1.000000e+30
## [11] -2.605325e+13 -1.000000e+30 -1.000000e+30 -1.000000e+30 -1.000000e+30
## [16] -4.000000e+01 -1.500000e+01 -2.400000e+01 -1.000000e+30 -1.000000e+30
##
## $dualstill
##  [1] 4.60e+02 4.20e+02 1.00e+30 1.00e+30 3.75e+02 3.24e+02 1.00e+30
1.00e+30
##  [9] 1.00e+30 2.52e+02 6.00e+01 4.80e+02 1.00e+30 1.00e+30 1.00e+30
6.00e+01
## [17] 1.50e+01 1.20e+01 1.00e+30 1.00e+30
```

```
get.sensitivity.obj(lprec1)
```

```
## $objfrom
##  [1]    694.4444    833.3333    416.6667  11222.2222  11500.0000
4800.0000
##  [7]    516.6667    844.4444    583.3333 -25000.0000 -12500.0000
##
## $objtill
##  [1] 1.000000e+30 1.000000e+30 1.000000e+30 1.388889e+04 1.250000e+04
##  [6] 5.181818e+03 1.000000e+30 1.000000e+30 1.000000e+30 1.000000e+30
## [11] 1.250000e+04
```