MIS 64018: Assignment_3

Post-optimality and sensitivity analysis for LP problems

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

Loading the lpSolveAPI library

```
library(lpSolveAPI)
```

Reading the lp formulation from weigelt.lp file and assign it to w

```
p <- read.lp("weigelt.lp")
p
```

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

Question 1: Solve the problem using lpsolve library in r.

```
solve(p)    # if output is 0, it means there's a successful solution
```

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

```
# the objective value for this problem is:
get.objective(p)
```

```
## [1] 696000
```

```
# the values of decision variables for the optimal solution are:
get.variables(p)
```

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

Question 2: Identify shadow prices, dual solution, and reduced costs.

```
# the constraint RHS values are as follows:
get.constraints(p)
```

```
##  [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
```

```r
# the shadow prices are the following(the last 9 values are for the non-negativity constraints):
get.sensitivity.rhs(p)
```

```
## $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
```

```r
# the reduced costs are as follows:
get.sensitivity.obj(p)
```

```
## $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
```

Question 3: Further, identify the sensitivity of the above prices and costs.

The range of reduced cost values that maintain the optimal solution are as follows:

Constraints	Range
L1	[360,460]
M1	[345,420]
S1	[-infinity, 324]
L2	[-infinity, 460]
M2	[345,420]
S2	[252,324]
L3	[-infinity, 780]
M3	[-infinity, 480]
S3	[204, +infinity]

The range of shadow prices for constraints(C) 1 to 11, that maintain the optimal solution are as follows:

Constraints	Range
C1	[-infinity, +infinity]
C2	[-infinity, +infinity]
C3	[-infinity, +infinity]
C4	[11222.22, 13888.9]
C5	[11500, 12500]
C6	[4800, 5181.8]
C7	[-infinity, +infinity]
C8	[-infinity, +infinity]
C9	[-infinity, +infinity]
C10	[-25000, 25000]
C11	[-12500, 12500]

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

Reading the lp formulation from weigelt_d.lp file and assign it to w

```r
d <- read.lp("weigelt_d.lp")
d
```

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

Solving the dual problem

```r
solve(p)    # if output is 0, it means there's a successful solution
```

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

```r
# the objective value for this problem is:
get.objective(p)
```

```
## [1] 696000
```

```r
# the values of decision variables for the optimal solution are:
get.variables(p)
```

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

The values I observed from solving the dual does agree with the results of the primal problem. The optimal values of the primal and the dual are both 696000.

Also, the shadow prices of the primal and the decision variables of the dual are the same values too.