Weight Dual HW3

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library(lpSolveAPI)  
lprec<- read.lp("Weight\_ProductionSolution.lp")  
solve(lprec)#Primal

## [1] 0

get.objective(lprec)#getting the optimal objective value Z for the lp problem

## [1] 696000

get.variables(lprec)#Retrieving the variable values of the Primal lp problem

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

get.constraints(lprec)#Retrieving the constraint values for the Primal lp problem

## [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

get.sensitivity.rhs(lprec)#Retrieving the sensitivity and more specifically the shadow price of the constrains.

## $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

get.sensitivity.obj(lprec)#Retrieving the reduced cost of the constrains.

## $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

get.dual.solution(lprec)#Retrieve the values of the dual variables. (This can show the reduced cost)

## [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

In the above output we can see the range for the shadow price by looking at the dualsfrom(lower limits) and dualstill (upper limits) outputs. This shows that the range is from -1e+30 to 1e+30. These values will stay within the optimal solution. The range of each constraint can be seen by looking at the corresponding values in the dualsfrom and dualstill output above.

We can also do the same for the reduced cost by looking at the objfrom (lower limits) and the objtill(upper limits) in a similar fasion as explained above. We see a reduced cost range of

The range for the Shadow Price that will stay within the final solution for the Primal lp is as follows:

|  |  |
| --- | --- |
| Constraints | Range |
| C1 | [-Inf; Inf] |
| C2 | [-Inf; Inf] |
| C3 | [-Inf; Inf] |
| C4 | [11222.22;13888.89] |
| C5 | [11500; 12500] |
| C6 | [4800; 5181.8] |
| C7 | [-Inf; Inf] |
| C8 | [-Inf; Inf] |
| C9 | [-Inf; Inf] |
| C10 | [-25000; 25000] |
| C11 | [-12500; 12500] |

The Range of the reduced cost that stays within the final(optimal) solution for the primal lp is as follows:

|  |  |
| --- | --- |
| Variables | Range |
| L1 | [360; 460] |
| M1 | [245; 420] |
| S1 | [-Inf; 324] |
| L2 | [-Inf; 460] |
| M2 | [345; 420] |
| S2 | [252; 324] |
| L3 | [-Inf; 780] |
| M3 | [-Inf; 480] |
| S3 | [204; Inf] |

Values can change within this range and the Optimal solution will not change. If the values is not within the ranges above the final/optimal solution will change.

**Dual**

Rough work:

A piece of paper with writing

Description automatically generated with medium confidence

**Text

Description automatically generated with medium confidence**The .lp file with the objective function is formulated as follows.

**RMD Code**

library(lpSolveAPI)  
  
x <- read.lp("weightDual.lp")  
  
set.bounds(x,lower = c(-Inf,-Inf),columns=c(10,11))  
  
solve(x) # Dual; ("0" indicates that it was successfully solved)

## [1] 0

get.objective(x)#getting the optimal objective value Z for the lp problem

## [1] 696000

get.variables(x)#Retrieving the variable values of the Primal lp problem

## [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(x)#Retrieving the constraint values for the Primal lp problem

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

get.sensitivity.rhs(x)#Retrieving the sensitivity and more specifically the shadow price of the constrains for the Dual

## $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(x)#Retrieving the reduced cost of the constrains for the Dual

## $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

In the above output we can see the range for the shadow price by looking at the dualsfrom(lower limits) and dualstill (upper limits) outputs. This shows that the range is from 360 to 460 for the 1st constraint. These values will stay within the optimal solution. The range of each constraint can be seen by looking at the corresponding values in the dualsfrom and dualstill output above.

We can also do the same for the reduced cost by looking at the objfrom (lower limits) and the objtill(upper limits) in a similar fashion as explained above. We see a reduced cost range of 694.4444 to infinity for the 1st constraint.

This dual solution agrees with the Primal solution observed above because i) The objective function value $696 000 is the same in both the Primal and the Dual and ii) the decision variables of the Primal is reflected in the values of the shadow prices of the dual. Similarly, the variables of the dual is reflected in the shadow price of the Primal lp.