LPDualityTemplate

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```
library(lpSolveAPI)
```

Defining decision variables and objective function

```
lprec <- make.lp(0, 3)
lp.control(lprec, sense = "max")
```

```
## $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] "maximize"
##
## $simplextype
## [1] "dual"   "primal"
##
## $timeout
## [1] 0
##
## $verbose
## [1] "neutral"
```

```
set.objfn(lprec, c(10, 12, 4))
```

Set constraints

```
add.constraint(lprec, c(1, 1, 1), ">=", 75)
add.constraint(lprec, c(3, 4, 5), "<=", 360)
add.constraint(lprec, c(8, 8, 2), "<=", 480)
```

Duality and Optimal Readout

```
write.lp(lprec, filename = "lprec.lp")
x <- read.lp(filename = "lprec.lp")
solve(x)
```

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

```
get.objective(x)        # get objective value
```

```
## [1] 750
```

```
get.variables(x)        # get values of decision variables
```

```
## [1]  0.0 52.5 30.0
```

```
get.constraints(x)      # get constraint RHS values
```

```
## [1]  82.5 360.0 480.0
```

```
get.sensitivity.rhs(x)  # get shadow prices
```

```
## $duals
## [1]  0.000  0.250  1.375 -1.750  0.000  0.000
##
## $dualsfrom
## [1] -1.0e+30  3.2e+02  2.4e+02 -4.0e+01 -1.0e+30 -1.0e+30
##
## $dualstill
## [1] 1.000000e+30 1.200000e+03 7.200000e+02 4.941176e+01 1.000000e+30
## [6] 1.000000e+30
```

```
get.sensitivity.obj(x)  # get reduced cost
```

```
## $objfrom
## [1] -1.000000e+30  1.035294e+01  3.000000e+00
##
## $objtill
## [1] 11.75 16.00 11.00
```

Creating readable chart for Duality of Decision Variables

```
final_value <- data.frame(matrix(get.variables(x), nrow = 3, ncol = 1, byrow = FALSE))      # created "
colnames(final_value) <- c("Final Value") # renamed column, will do this many times and will not commen

reduce_sp <- get.sensitivity.rhs(x)
reduced_cost <- data.frame(matrix(reduce_sp$duals, nrow = 3, ncol = 2)) # get reduced cost and shadow p
```

```
reduced_cost <- data.frame(matrix(reduced_cost$X2, nrow = 3, ncol = 1)) # made "reduced cost" column.
colnames(reduced_cost) <- c("Reduced Cost") # make obj coefficients a df.

obj_coeff <- data.frame(matrix(c(10, 12, 4), nrow = 3, ncol = 1)) # make obj coefficients a df.
colnames(obj_coeff) <- c("Obj Coeff")

var_allowable <- get.sensitivity.obj(x)  # get decision variable allowable increase and decrease.

var_allowable_inc <- data.frame(matrix(var_allowable$objtill, nrow = 3, ncol = 1)) # make allowable inc
colnames(var_allowable_inc) <- c("Obj Coeff + Allow Incr")

var_allowable_decr <- obj_coeff - data.frame(matrix(var_allowable$objfrom, nrow = 3, ncol = 1)) # make
colnames(var_allowable_decr) <- c("Obj Coeff - Allow Decr")

dec_variable_change <- cbind(final_value, reduced_cost, obj_coeff, var_allowable_inc, var_allowable_dec

rownames(dec_variable_change) <- c("X1", "X2", "X3")
```

Create readable chart for Duality in Constraints.

```
opt_constraint <- data.frame(matrix(get.constraints(x),  nrow = 3, ncol = 1, byrow = FALSE))    # get c
colnames(opt_constraint) <- c("Final Value")

shadow_price <- data.frame(matrix(reduce_sp$duals, nrow = 3, ncol = 2)) # get duals so I can separate t

shadow_price <- data.frame(matrix(shadow_price$X1, nrow = 3, ncol = 1))
colnames(shadow_price) <- c("Shadow Price") # make shadow price as a column.

constraint_RHS <- data.frame(matrix(c(75, 360, 480), nrow = 3, ncol = 1))
colnames(constraint_RHS) <- c("Constraint RHS") # created df for the constraints RHS.

constr_allow_incr_decr <- data.frame(matrix(reduce_sp$dualstill, nrow = 3, ncol = 2)) # get duals so I

constr_allow_incr <- data.frame(matrix(constr_allow_incr_decr$X1, nrow = 3, ncol = 1)) - constraint_RHS
colnames(constr_allow_incr) <- c("RHS - Allow Incr")

constr_allow_decr <- data.frame(matrix(constr_allow_incr_decr$X2, nrow = 3, ncol = 1)) + constraint_RHS
colnames(constr_allow_decr) <- c("RHS + Allow Decr")

constr_change <- cbind(opt_constraint, shadow_price, constraint_RHS, constr_allow_incr, constr_allow_de

rownames(constr_change) <- c("Constraint 1", "Constraint 2", "Constraint 3")

dec_variable_change
```

```
##    Final Value Reduced Cost Obj Coeff Obj Coeff + Allow Incr
## X1         0.0        -1.75        10                  11.75
## X2        52.5         0.00        12                  16.00
## X3        30.0         0.00         4                  11.00
##    Obj Coeff - Allow Decr
```

```
## X1           1.000000e+30
## X2           1.647059e+00
## X3           1.000000e+00
```

```
constr_change
```

```
##              Final Value Shadow Price Constraint RHS RHS - Allow Incr
## Constraint 1        82.5        0.000             75          1.0e+30
## Constraint 2       360.0        0.250            360          8.4e+02
## Constraint 3       480.0        1.375            480          2.4e+02
##              RHS + Allow Decr
## Constraint 1     1.244118e+02
## Constraint 2     1.000000e+30
## Constraint 3     1.000000e+30
```