IDO TAREA

DIMAS RAMIREZ LUIS DANIEL/MOJICA SANDOVAL ERICK ISAAC

8/1/2021

Obtenga el dual de los siguientes programas lineales y resuelva tanto el programa lineal "primal" como el "dual". Encuentre los precios sombra de cada caso. Puede usar algún software para apoyarse en la solución.

Ejercicio 3

Primal

$$Max\ z = x_1 + x_2 + 3x_3 + 2x_4$$

- Restricciones

$$x_1 + 2x_2 - 3x_3 + 5x_4 \leq 4$$
$$5x_1 - 2x_2 + 0x_3 + 6x_4 \leq 8$$
$$2x_1 + 3x_2 - 2x_3 + 3x_4 \leq 3$$
$$-x_1 + 0x_2 + x_3 + 2x_4 \leq 0$$
$$x_{1,2,3,4} \geq 0$$

Dual

$$Min\ w = 4y_1 + 8y_2 + 3y_3 + 0y_4$$

- Restricciones

$$y_1 + 5y_2 + 2y_3 - y_4 \geq 1$$
$$2y_1 - 2y_2 + 3y_3 + 0y_4 \geq 1$$
$$-3y_1 + 0y_2 - 2y_3 + y_4 \geq 3$$
$$5y_1 1 + 6y_2 + 3y_3 + 2y_4 \geq 2$$
$$y_{1,2,3,4} \geq 0$$

Resolviendo el modelo primal

```r
library(lpSolve)


fobj1 <- c(1,1,3,2)

a <- c(1,2,-3,5)
b <- c(5,-2,0,6)
c <- c(2,3,-2,3)
d <- c(-1,0,1,2)
e <- c(1,1,1,1)

m1 <- matrix(rbind(a,b,c,d,e), nrow = 5)
colnames(m1) <- c("X1","x2","X3","X4")
rownames(m1) <- c("R1","R2","R3","R4","R5")
m1
```

```
##    X1 x2 X3 X4
## R1  1  2 -3  5
## R2  5 -2  0  6
## R3  2  3 -2  3
## R4 -1  0  1  2
## R5  1  1  1  1
```

```r
direction1 <- c(rep("<=", 4),">=")

rhs1 <- c(4,8,3,0,0)

solve1 <- lp(direction = "max", fobj1, m1, direction1, rhs1, all.int = TRUE)
solve1
```

```
## Success: the objective function is 9
```

```r
solve1$solution
```

```
## [1] 2 1 2 0
```

```r
solve1$duals[1:4]
```

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

- El resultado de maximizar la función del modelo primal objetivo es 9 , con los coeficientes:

$$x_1 = 2, x_2 = 1, x_3 = 2, x_4 = 0$$

- Para este caso no hay presencia de precios sombra.

Resolviendo el modelo dual

```r
fobj2 <- c(4,8,3,0)

f <- c(1,5,2,-1)
g <- c(2,-2,3,0)
h <- c(-3,0,-2,1)
i <- c(5,6,3,2)
j <- c(1,1,1,1)

m2 <- matrix(rbind(f,g,h,i,j), nrow = 5)
colnames(m2) <- c("X1","x2","X3","X4")
rownames(m2) <- c("R1","R2","R3","R4","R5")
m2
```

```
##    X1 x2 X3 X4
## R1  1  5  2 -1
## R2  2 -2  3  0
## R3 -3  0 -2  1
## R4  5  6  3  2
## R5  1  1  1  1
```

```r
direction2 <- c(rep(">=", 5))

rhs2 <- c(1,1,3,2,0)

solve2 <- lp(direction = "min", fobj2, m2, direction2, rhs2, all.int = TRUE)
solve2
```

```
## Success: the objective function is 11
```

```r
solve2$solution
```

```
## [1] 0 1 1 6
```

```r
solve2$duals[1:4]
```

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

- El resultado de minimizar la función objetivo del modelo dual es 11 , con los coeficientes:

$$y_1 = 0, y_2 = 1, y_3 = 1, y_4 = 6$$

- Para este ejercicio no hay presencia de precios sombra

Ejercicio 4

Primal

$$Max\ z = 2x_1 - 4x_2 + 3x_3$$

- Restricciones

$$5x_1 - 6x_2 + 2x_3 \geq 5$$

$$-x_1 + 3x_2 + 5x_3 \geq 8$$

$$2x_1 + 5x_2 - 4x_3 \geq 4$$

$$x_{1,2,3} \geq 0$$

Dual

$$Min\ w = 5y_1 + 8y_2 + 4y_3$$

- Restricciones

$$5y_1 - 1y_2 + 2y_3 \leq 2$$

$$-6y_1 + 3y_2 + 5y_3 \leq -4$$

$$2y_1 + 5y_2 - 4y_3 \leq 3$$

$$y_{1,2,3} \geq 0$$

Resolviendo el modelo primal

```r
fobj3 <- c(2,-4,3)

k <- c(5,-6,2)
l <- c(-1,3,5)
m <- c(2,5,-4)
n <- c(1,1,1)


m3 <- matrix(rbind(k,l,m,n), nrow = 4)
colnames(m3) <- c("X1","x2","X3")
rownames(m3) <- c("R1","R2","R3","R4")
m3
```

```
##    X1 x2 X3
## R1  5 -6  2
## R2 -1  3  5
## R3  2  5 -4
## R4  1  1  1
```

```r
direction3 <- c(rep(">=", 4))

rhs3 <- c(5,8,4,0)

solve3 <- lp(direction = "min", fobj3, m3, direction3, rhs3, all.int = TRUE)
solve3
```

```
## Error: status 3
```

```r
solve3$solution
```

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

```r
solve3
```

```
## Error: status 3
```

```r
solve3$duals[1:4]
```

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

- No hay solución factible para este modelo dual

Resolviendo el modelo dual

```r
fobj4 <- c(5,8,4)

o <- c(5,-1,2)
p <- c(-6,3,5)
q <- c(2,5,-4)
r <- c(1,1,1)


m4 <- matrix(rbind(o,p,q,r), nrow = 4)
colnames(m4) <- c("X1","x2","X3")
rownames(m4) <- c("R1","R2","R3","R4")
m4
```

```
##    X1 x2 X3
## R1  5 -1  2
## R2 -6  3  5
## R3  2  5 -4
## R4  1  1  1
```

```r
direction4 <- c(rep("<=", 3),">=")

rhs4 <- c(2,-4,3,0)

solve4 <- lp(direction = "max", fobj4, m4, direction4, rhs4, all.int = TRUE)
solve4
```

```
## Error: no feasible solution found
```

```r
solve4$solution
```

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

```r
solve4$duals[1:4]
```

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

- El resultado al maximizar la función objetivo del modelo primal no esta acotado, por lo que no tiene solución óptima.

Ejercicio 5

Primal

$$Max\ z = 2x_1 + x_2 + 2x_3$$

- Restricciones

$$4x_1 + 3x_2 + 8x_3 \leq 12$$
$$4x_1 + x_2 + 12x_3 \leq 8$$
$$4x_1 - x_2 + -3x_3 \leq 4$$
$$x_{1,2,3} \geq 0$$

Dual

$$Min\ w = 12y_1 + 8y_2 + 4y_3$$

- Restricciones

$$4y_1 + 4y_2 + 4y_3 \geq 2$$
$$3y_1 + 2y_2 - y_3 \geq 1$$
$$8y_1 + 12y_2 - 3y_3 \geq 2$$
$$y_{1,2,3} \geq 0$$

Resolviendo el modelo primal

```r
fobj5 <- c(2,1,2)

s <- c(4,3,8)
t <- c(4,1,12)
u <- c(4,-1,-3)
v <- c(1,1,1)


m5 <- matrix(rbind(s,t,u,v), nrow = 4)
colnames(m5) <- c("X1","x2","X3")
rownames(m5) <- c("R1","R2","R3","R4")
m5
```

```
##    X1 x2 X3
## R1  4  3  8
## R2  4  1 12
## R3  4 -1 -3
## R4  1  1  1
```

```r
direction5 <- c(rep("<=", 3),">=")

rhs5 <- c(12,8,4,0)

solve5 <- lp(direction = "max", fobj5, m5, direction5, rhs5, all.int = TRUE)
solve5
```

```
## Success: the objective function is 4
```

```r
solve5$solution
```

```
## [1] 0 4 0
```

```r
solve5$duals[1:4]
```

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

- El resultado de maximizar la función del modelo primal objetivo es 4 , con los coeficientes:

$$x_1 = 0, x_2 = 4, x_3 = 0$$

- Para este caso no hay presencia de precios sombra.

Resolviendo el modelo dual

```r
fobj6 <- c(12,8,4)

w <- c(4,4,4)
x <- c(3,2,-1)
y <- c(8,12,-3)
```

```r
z <- c(1,1,1)

m6 <- matrix(rbind(w,x,y,z), nrow = 4)
colnames(m6) <- c("X1","x2","X3")
rownames(m6) <- c("R1","R2","R3","R4")
m6
```

```
##    X1 x2 X3
## R1  4  4  4
## R2  3  2 -1
## R3  8 12 -3
## R4  1  1  1
```

```r
direction6 <- c(rep(">=", 4))

rhs6 <- c(2,1,2,0)

solve6 <- lp(direction = "min", fobj6, m6, direction6,rhs6, all.int = TRUE)
solve6
```

```
## Success: the objective function is 8
```

```r
solve6$solution
```

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

```r
solve6$duals[1:4]
```

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

- El resultado de minimizar la función objetivo del modelo dual es 8 , con los coeficientes:

$$y_1 = 0, y_2 = 1, y_3 = 0$$

- Para este ejercicio no hay presencia de precios sombra

Ejercicio 6

Primal

$$Max\ z = 6x_1 - 2x_2 + 3x_3$$

- Restricciones

$$2x_1 - x_2 + 2x_3 \leq 2$$
$$x_1 + 0x_2 + 4x_3 \leq 4$$
$$x_{1,2,3} \geq 0$$

Dual

$$Min\ z = 2y_1 + 4y_2$$

- Restricciones

$$2y_1 + y_2 \geq 6$$
$$-y_1 + 0y_2 \geq -2$$
$$2y_1 + 4y_2 \geq 3$$
$$y_{1,2} \geq 0$$

Resolviendo el problema primal

```
fobj7 <- c(6,-2,3)

a1 <- c(2,-1,2)
b1 <- c(1,0,4)
c1 <- c(1,1,1)

m7 <- matrix(rbind(a1,b1,c1), nrow = 3)
m7
```

```
##      [,1] [,2] [,3]
## [1,]    2   -1    2
## [2,]    1    0    4
## [3,]    1    1    1
```

```
direction7 <- c(rep("<=", 2),">=")

rhs7 <- c(2,4,0)

solve7 <- lp(direction = "max", fobj7, m7, direction7,rhs7, all.int = TRUE)
solve7
```

```
## Success: the objective function is 12
```

```
solve7$solution
```

```
## [1] 4 6 0
```

```
solve7$duals[1:4]
```

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

- El resultado de maximizar la función del modelo primal objetivo es 12 , con los coeficientes:

$$x_1 = 4, x_2 = 6, x_3 = 0$$

- Para este caso no hay presencia de precios sombra.

Resolviendo el modelo dual

```
fobj8 <- c(2,4)

d1 <- c(2,1)
f1 <- c(-1,0)
g1 <- c(2,4)
h1 <- c(1,1)

m8 <- matrix(rbind(d1,f1,g1,h1), nrow = 4)
m8
```

```
##      [,1] [,2]
## [1,]    2    1
## [2,]   -1    0
## [3,]    2    4
## [4,]    1    1
```

```
direction8 <- c(rep(">=", 4))

rhs8 <- c(6,-2,3,0)

solve8 <- lp(direction = "min", fobj8, m8, direction8,rhs8, all.int = TRUE)
solve8
```

```
## Success: the objective function is 12
```

```
solve8$solution
```

```
## [1] 2 2
```

```
solve8$duals[1:4]
```

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

- El resultado de minimizar la función objetivo del modelo dual es 12 , con los coeficientes:

$$y_1 = 2, y_2 = 2$$

- Para este ejercicio no hay presencia de precios sombra