Pranav Murthy || 21BBS0059

OR LA - 1

LA 1

Visualizing the feasible set and solves the following problem:

Maximize the function :2x1+4x2

Subject to the following constraints:

$2x_1 + 2x_2 \le 3$

$2x_1 + x_2 \le 3$

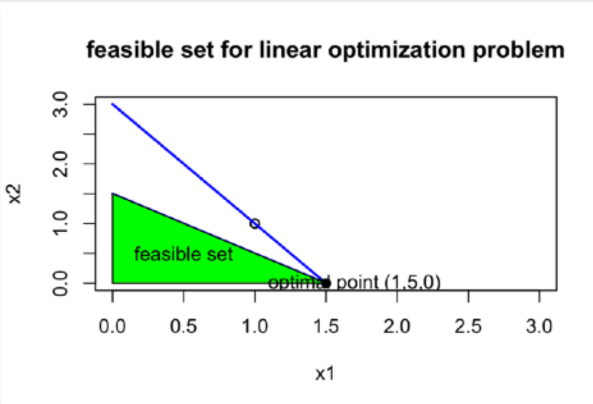
$x_1, x_2 \ge 0$

Code

```
obj.fun=function(x) 2*x[1] + 4*x[2]
x.vert=c(0,1.5,0)
y.vert = c(1.5,0,0)
plot(1,xlim=c(0,3),ylim=c(0,3),xlab="x1",ylab="x2",lty=2,lwd=1.5,main="feasi
ble set for linear optimization problem")
lines(c(1.5,0),c(0,3),lwd=2,col="blue")
lines(c(1.5,0),c(0,1.5),lwd=2,col="blue")
polygon(x.vert,y.vert,col="green")
points(1.5,0,pch=19)
text(1.7,0,"optimal point (1,5,0)")
text(0.5,0.5,"feasible set")
grad=function(x1,x2) c(2,4)
maxim=constrOptim(theta=c(2.5,2.5),f=obj.fun,grad=grad,ui=rbind(c(2,2),c(1,
2)),ci=c(3,3)) maxim$par
maxim$val
```

Output:

```
>
>
>
>
>
>
>
>
>
> obj.fun=function(x) 2*x[1] + 4*x[2]
> x.vert=c(0,1.5,0)
> y.vert = c(1.5,0,0)
> plot(1,xlim=c(0,3),ylim=c(0,3),xlab="x1",ylab="x2",lty=2,lwd=1.5,main="feasible set for linear optimization
problem")
> lines(c(1.5,0),c(0,3),lwd=2,col="blue")
> lines(c(1.5,0),c(0,1.5),lwd=2,col="blue")
> polygon(x.vert,y.vert,col="green")
> points(1.5,0,pch=19)
> text(1.7,0,"optimal point (1,5,0)")
> text(0.5,0.5,"feasible set")
> grad=function(x1,x2) c(2,4)
> maxim=constrOptim(theta=c(2.5,2.5),f=obj.fun,grad=grad,ui=rbind(c(2,2),c(1,2)),ci=c(3,3))
> maxim$par
[1] 1.6005632 0.6997184
>
> maxim$val
[1] 6
>
>
```



OR LA - 5

LA 5

Q. Minimize $8x_1 + 4x_2 + 3x_3$

Subject to $4x_1 + 6x_2 + 2x_3 \geq 13$

$3x_1 + 2x_2 + 5x_3 \geq 15$

$x_1 \geq 0, x_2, x_3 \geq 0$ **and integer**

Code

```
library(lpSolve)
f.obj <- c(8,4,3) f.con=matrix(c(4,6,2,3,2,5,1,0,0),nrow=3,byrow=TRUE) f.dir
<- c(">=",">=",">=")
f.rhs <- c(13,15,0)
lp("max", f.obj, f.con, f.dir, f.rhs, int.vec = 1:3) lp("max", f.obj, f.con, f.dir,
f.rhs, int.vec = 1:3)$solution
lp("max", f.obj, f.con, f.dir, f.rhs, int.vec = 2:3) lp("max", f.obj, f.con, f.dir,
f.rhs, int.vec = 2:3)$solution
lp("max", f.obj, f.con, f.dir, f.rhs, int.vec = 3:3) lp("max", f.obj, f.con, f.dir,
f.rhs, int.vec = 3:3)$solution
```

```
> library(lpSolve)
> f.obj <- c(8,4,3)
> f.con=matrix(c(4,6,2,3,2,5,1,0,0),nrow=3,byrow=
> f.dir <- c(">=",">=",">=")
> f.rhs <- c(13,15,0)
> lp("min", f.obj, f.con, f.dir, f.rhs, int.vec =
Success: the objective function is 16
> lp("min", f.obj, f.con, f.dir, f.rhs, int.vec =
[1] 0 1 4
>
> lp("min", f.obj, f.con, f.dir, f.rhs, int.vec =
Success: the objective function is 15
> lp("min", f.obj, f.con, f.dir, f.rhs, int.vec =
[1] 0.25 1.00 3.00
>
> lp("min", f.obj, f.con, f.dir, f.rhs, int.vec =
Success: the objective function is 13.66667
> lp("min", f.obj, f.con, f.dir, f.rhs, int.vec =
[1] 0.000000 1.166667 3.000000
> |
```

Output:

CONCLUSION

Minimum value of objective function (when x2 and x3 are integers) = 15
X=2 , Y=4

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OR LA - 4

LA 4

Solve the following MIP problem

Maximize $Z = 3x + 2y$

subject to $x + y \leq 6$

$5x + 2y \leq 20$; $x \geq 0, y \geq 0$ **and integer.**

Code

```
library(lpSolve)
f.obj <- c(3,2) f.con=matrix(c(1,1,5,2),nrow=2,byrow=TRUE)
f.dir <- c("<=","<=")
f.rhs <- c(6,20)
lp("max", f.obj, f.con, f.dir, f.rhs, int.vec = 2:2) lp("max", f.obj, f.con, f.dir,
f.rhs, int.vec = 2:2)$solution
lp("max", f.obj, f.con, f.dir, f.rhs, int.vec = 1:1) lp("max", f.obj, f.con, f.dir,
f.rhs, int.vec = 1:1)$solution
lp("max", f.obj, f.con, f.dir, f.rhs, int.vec = 1:2) lp("max", f.obj, f.con, f.dir,
f.rhs, int.vec = 1:2)$solution
```

Output:

```
>
> library(lpSolve)
> f.obj <- c(3,2)
> f.con=matrix(c(1,1,5,2),nrow=2,byrow=TRUE)
> f.dir <- c("<=","<=")
> f.rhs <- c(6,20)
> lp("max", f.obj, f.con, f.dir, f.rhs, int.vec = 2:2)
Success: the objective function is 14
> lp("max", f.obj, f.con, f.dir, f.rhs, int.vec = 2:2)$solution
[1] 2 4
> lp("max", f.obj, f.con, f.dir, f.rhs, int.vec = 1:1)
Success: the objective function is 14
> lp("max", f.obj, f.con, f.dir, f.rhs, int.vec = 1:1)$solution
[1] 3.0 2.5
> lp("max", f.obj, f.con, f.dir, f.rhs, int.vec = 1:2)
Success: the objective function is 14
> lp("max", f.obj, f.con, f.dir, f.rhs, int.vec = 1:2)$solution
[1] 2 4
> 
```

CONCLUSION

Maximum value(x and y are integers) = 14 X=2 , Y=4

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OR LA - 2

LA 3

Find the minimum cost and maximum profit of the problem.

machines

jobs		I	II	III	IV
	A	10	12	19	11
	B	5	10	7	8
	C	12	14	13	11
	D	8	15	11	9

Code

```
library(lpSolve)
cost.mat <- matrix(c(10,12,19,11,5,10,7,8,12,14,13,11,8,15,11,9), nrow = 4,
byrow = TRUE)
lpassign <- lp.assign(cost.mat, direction = "min")
lpassign$solution
lpassign$objval
```

Output:

```
> library(lpSolve)
> cost.mat <- matrix(c(10,12,19,11,5,10,7,8,12,14,13,11,8,15,11,9), nrow = 4, byrow = TRUE)
> lpassign <- lp.assign(cost.mat, direction = "min")
> lpassign$solution
     [,1] [,2] [,3] [,4]
[1,]    0    1    0    0
[2,]    0    0    1    0
[3,]    0    0    0    1
[4,]    1    0    0    0
> lpassign$objval
[1] 38
>
```

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OR LA - 2

LA 2

Find the minimum cost and maximum profit of the problem.

Source	D1	D2	D3	D4	D5	Supply(S_i)
S1	10	2	3	15	9	35
S2	5	10	15	2	4	40
S3	15	5	14	7	15	20
S4	20	15	13	25	8	30
Demand(D_j):	20	20	40	10	35	

Code

```
library(lpSolve)
costs <- matrix(c(10,2,3,15,9,5,10,15,2,4,15,5,14,7,15,20,15,13,25,8), nrow =
4,byrow=TRUE)
row.signs <- rep("<=", 4)
row.rhs <- c(35,40,20,30)
col.signs <- rep(">=", 5)
col.rhs <- c(20,20,40,10,35)
lptrans <- lp.transport(costs, "min", row.signs, row.rhs, col.signs, col.rhs)
lptrans$solution
lptrans$objval
```

Output:

```
> library(lpSolve)
> costs <- matrix(c(10,2,3,15,9,5,10,15,2,4,15,5,14,7,15,20,15,13,25,8), nrow = 4,byrow=TRUE)
> row.signs <- rep("<=", 4)
> row.rhs <- c(35,40,20,30)
> col.signs <- rep(">=", 5)
> col.rhs <- c(20,20,40,10,35)
> lptrans <- lp.transport(costs, "min", row.signs, row.rhs, col.signs, col.rhs)
> lptrans$solution
     [,1] [,2] [,3] [,4] [,5]
[1,]    0    0   35    0    0
[2,]   20    0    0   10   10
[3,]    0   20    0    0    0
[4,]    0    0    5    0   25
> lptrans$objval
[1] 630
> |
```