rm(list = ls())

library(lpSolve)

#(i)

u <- c(36, 40, 32, 43, 29,

28, 27, 29, 40, 38,

34, 35, 41, 29, 55,

41, 42, 35, 27, 36,

25, 28, 40, 34, 38,

31, 30, 43, 40, 38)

b <- c(72, 115, 82, 28, 91, 63, 19, 61, 82, 18, 20)

A <- rbind(c(rep(1,5),rep(0,25)),

c(rep(0,5),rep(1,5),rep(0,20)),

c(rep(0,10),rep(1,5),rep(0,15)),

c(rep(0,15),rep(1,5),rep(0,10)),

c(rep(0,20),rep(1,5),rep(0,5)),

c(rep(0,25),rep(1,5)),

rep(c(1,0,0,0,0),6),

rep(c(0,1,0,0,0),6),

rep(c(0,0,1,0,0),6),

rep(c(0,0,0,1,0),6),

rep(c(0,0,0,0,1),6))

dir <- c(rep("<=",6),rep(">=",5))

o=lp(direction = "min",objective.in = u,const.mat = A,const.dir = dir,const.rhs = b)

o$status

o$objval

o$solution

#solve with lp.transport

bs=c(72, 115, 82, 28, 91, 63); bd=c(19, 61, 82, 18, 20)

o=lp.transport(cost.mat = matrix(u,nrow = 6,byrow = T),direction = "min",row.signs = rep("<=",6),row.rhs = bs,col.signs = rep(">=",5),col.rhs = bd,integers = F)

colnames(o$solution)=c("A","B","C","D","E"); rownames(o$solution)=c("1|","2|","3|","4|","5|","6|")

o$status

o$solution

o$objval

#(ii)

x=matrix(u,nrow=6,byrow=T)

colnames(x)=c("A","B","C","D","E"); rownames(x)=c("1|","2|","3|","4|","5|","6|")

print(x)

xx=matrix(b,nrow=1,byrow=T)

print(xx)

#A-coefficients for Retail Outlets and Supplier Depot

xy=matrix(A,nrow=11,byrow=T)

print(xy)

#

# now Solve as an Lp Problem

#

dir <- c(rep("<=",6),rep(">=",5))

o=lp("min", u, A, dir, b); soln=o$solution; print(o$objval)

x=matrix(soln,nrow=6,byrow=T)

colnames(x)=c("A","B","C","D","E"); rownames(x)=c("1|","2|","3|","4|","5|","6|")

print(x) #best solution

#worst allocation

o=lp("max", u, A, dir, b); soln=o$solution ; print(o$bjval)

x = matrix(soln,nrow=6,byrow=T)

colnames(x)=c("A","B","C","D","E"); rownames(x)=c("1|","2|","3|","4|","5|","6|")

print(x) #(worst solution)

(iii)

u <- c(36, 40, 32, 43, 29,

28, 27, 29, 40, 38,

34, 35, 41, 29, 55,

41, 42, 35, 27, 36,

25, 28, 40, 34, 38,

31, 30, 43, 40, 38)

b <- c(72, 115, 82, 28, 91, 63, 19, 61, 82, 18, 20)

A <- rbind(c(rep(1,5),rep(0,25)),

c(rep(0,5),rep(1,5),rep(0,20)),

c(rep(0,10),rep(1,5),rep(0,15)),

c(rep(0,15),rep(1,5),rep(0,10)),

c(rep(0,20),rep(1,5),rep(0,5)),

c(rep(0,25),rep(1,5)),

rep(c(1,0,0,0,0),6),

rep(c(0,1,0,0,0),6),

rep(c(0,0,1,0,0),6),

rep(c(0,0,0,1,0),6),

rep(c(0,0,0,0,1),6))

dir <- c(rep("<=",6),rep(">=",5))

o=lp( "max", u, A, dir, b, compute.sens=1); soln=o$solution

o$solution

ds=seq(-20,20,length=200); fs=NULL

for(k in 1:30) { ffs=NULL;for(d in ds) { un=u ; un[k]=u[k]+d; o=lp("max", un, A, dir, b); solnn=o$solution

ffs=c(ffs,100\*sum(sum(solnn\*un-soln\*un)/sum(solnn\*un))) }

fs=cbind(fs,ffs) }

matplot(ds,fs,type="l",lty=c(1),main="Sensitivity of Lp Solution to cost changes (one-at-a-time)",

ylab="% Deviation from Prmal Optimal",xlab="cn\_j= c\_j", lwd=1.5)

legend(legend=as.character(c(1:30)),col=c(1:30),pch=16); abline(h=0,lty=c(2))

(iv)

u <- c(72, 115, 82, 28, 91, 63, -19, -61, -82, -18, -20)

b <- c(-36, -40, -32, -43, -29,

-28, -27, -29, -40, -38,

-34, -35, -41, -29, -55,

-41, -42, -35, -27, -36,

-25, -28, -40, -34, -38,

-31, -30, -43, -40, -38)

A <- rbind(c(1,0,0,0,0,0,1,0,0,0,0),c(1,0,0,0,0,0,0,1,0,0,0),

c(1,0,0,0,0,0,0,0,1,0,0),c(1,0,0,0,0,0,0,0,0,1,0),

c(1,0,0,0,0,0,0,0,0,0,1),c(0,1,0,0,0,0,1,0,0,0,0),

c(0,1,0,0,0,0,0,1,0,0,0),c(0,1,0,0,0,0,0,0,1,0,0),

c(0,1,0,0,0,0,0,0,0,1,0),c(0,1,0,0,0,0,0,0,0,0,1),

c(0,0,1,0,0,0,1,0,0,0,0),c(0,0,1,0,0,0,0,1,0,0,0),

c(0,0,1,0,0,0,0,0,1,0,0),c(0,0,1,0,0,0,0,0,0,1,0),

c(0,0,1,0,0,0,0,0,0,0,1),c(0,0,0,1,0,0,1,0,0,0,0),

c(0,0,0,1,0,0,0,1,0,0,0),c(0,0,0,1,0,0,0,0,1,0,0),

c(0,0,0,1,0,0,0,0,0,1,0),c(0,0,0,1,0,0,0,0,0,0,1),

c(0,0,0,0,1,0,1,0,0,0,0),c(0,0,0,0,1,0,0,1,0,0,0),

c(0,0,0,0,1,0,0,0,1,0,0),c(0,0,0,0,1,0,0,0,0,1,0),

c(0,0,0,0,1,0,0,0,0,0,1),c(0,0,0,0,0,1,1,0,0,0,0),

c(0,0,0,0,0,1,0,1,0,0,0),c(0,0,0,0,0,1,0,0,1,0,0),

c(0,0,0,0,0,1,0,0,0,1,0),c(0,0,0,0,0,1,0,0,0,0,1))

dir <- rep(">=",11)

o=lp( "max", u, A, dir, b, compute.sens=1); soln=o$solution

o$solution

ds=seq(-20,20,length=200); fs=NULL

for(k in 1:11) { ffs=NULL;for(d in ds) { bn=b ; bn[k]=b[k]+d; o=lp("max", bn, A, dir, u); solnn=o$solution

ffs=c(ffs,100\*sum(sum(solnn\*bn-soln\*bn)/sum(solnn\*bn))) }

fs=cbind(fs,ffs) }

matplot(ds,fs,type="l",lty=c(1),main="Sensitivity of Lp Solution to cost changes (one-at-a-time)",

ylab="% Deviation from Prmal Optimal",xlab="cn\_j= c\_j", lwd=1.5)

legend(legend=as.character(c(1:11)),col=c(1:11),pch=16); abline(h=0,lty=c(2))

u <- c(72, 115, 82, 28, 91, 63, -19, -61, -82, -18, -20)

b <- c(-36, -40, -32, -43, -29,

-28, -27, -29, -40, -38,

-34, -35, -41, -29, -55,

-41, -42, -35, -27, -36,

-25, -28, -40, -34, -38,

-31, -30, -43, -40, -38)

A <- rbind(c(1,0,0,0,0,0,1,0,0,0,0),c(1,0,0,0,0,0,0,1,0,0,0),

c(1,0,0,0,0,0,0,0,1,0,0),c(1,0,0,0,0,0,0,0,0,1,0),

c(1,0,0,0,0,0,0,0,0,0,1),c(0,1,0,0,0,0,1,0,0,0,0),

c(0,1,0,0,0,0,0,1,0,0,0),c(0,1,0,0,0,0,0,0,1,0,0),

c(0,1,0,0,0,0,0,0,0,1,0),c(0,1,0,0,0,0,0,0,0,0,1),

c(0,0,1,0,0,0,1,0,0,0,0),c(0,0,1,0,0,0,0,1,0,0,0),

c(0,0,1,0,0,0,0,0,1,0,0),c(0,0,1,0,0,0,0,0,0,1,0),

c(0,0,1,0,0,0,0,0,0,0,1),c(0,0,0,1,0,0,1,0,0,0,0),

c(0,0,0,1,0,0,0,1,0,0,0),c(0,0,0,1,0,0,0,0,1,0,0),

c(0,0,0,1,0,0,0,0,0,1,0),c(0,0,0,1,0,0,0,0,0,0,1),

c(0,0,0,0,1,0,1,0,0,0,0),c(0,0,0,0,1,0,0,1,0,0,0),

c(0,0,0,0,1,0,0,0,1,0,0),c(0,0,0,0,1,0,0,0,0,1,0),

c(0,0,0,0,1,0,0,0,0,0,1),c(0,0,0,0,0,1,1,0,0,0,0),

c(0,0,0,0,0,1,0,1,0,0,0),c(0,0,0,0,0,1,0,0,1,0,0),

c(0,0,0,0,0,1,0,0,0,1,0),c(0,0,0,0,0,1,0,0,0,0,1))

dir <- rep(">=",11)

o=lp( "max", u, A, dir, b, compute.sens=1); soln=o$solution

o$solution