



فاز دوم پروژه درس تحقیق در عملیات ۲

دکتر مدرس

امیرحسین قناعتیان

۹۷۱۰۴۵۸۳

علی بیک ولی

۹۷۱۰۴۱۴۲

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مدل سازی

متغیر تصمیم

$$Y_{ij}, 1 \leq i \leq 11, 1 \leq j \leq 5$$

اگر پرداخت ایالت i به منطقه j فرستاده شود ۱ خواهد بود و در غیر این صورت صفر.

$$W_{jk}, 1 \leq j \leq 5, 1 \leq k \leq 3$$

اگر $k=1$ باشد یعنی مرکز منطقه i کوچک است،

اگر $k=2$ باشد یعنی مرکز منطقه i متوسط است،

اگر $k=3$ باشد یعنی مرکز منطقه i بزرگ است،

یک بودن این متغیر تصمیم به معنی احداث مرکز و صفر بودن به معنی عدم احداث است.

محدودیت

$$\forall j \sum_{i=1}^{11} Y_{ij} \leq 2W_{j1} + 3W_{j2} + 4W_{j3}$$

دریافتی هر منطقه با توجه به هر حالت کوچک، متوسط و بزرگ احداث شده.

$$\forall i \sum_{j=1}^5 Y_{ij} = 1$$

پرداختی هر ایالت تنها به یک مرکز فرستاده میشود.

$$\forall j \sum_{k=1}^3 W_{jk} \leq 1$$

در هر منطقه حداکثر یکی از سه حالت کوچک، متوسط و بزرگ احداث میشود.

تابع هدف:

$$\text{Min } Z = A + B$$

توضیحات مربوط به A:

هزینه احداث مراکز دریافت در هر ۵ منطقه

$$A = W_{11} * 35 + W_{12} * 35 + W_{13} * 40 + W_{21} * 30 + W_{22} * 45 + W_{23} * 90 + W_{31} * 40 + W_{32} * 45 \\ + W_{33} * 90 + W_{41} * 10 + W_{42} * 30 + W_{43} * 30 + W_{51} * 20 + W_{52} * 35 + W_{53} * 55$$

توضیحات مربوط به B:

سود از دست رفته به ازای تاخیر

$$B =$$

NY

$$6 * Y_{11} * 70 * 0.2 + 6 * Y_{12} * 70 * 0.15 + 5 * Y_{13} * 70 * 0.2 + 6 * Y_{14} * 70 * 0.15 + 6 * Y_{15} * 70 * 0.25 \\ +$$

AZ

$$6 * Y_{21} * 70 * 0.2 + 9 * Y_{22} * 70 * 0.15 + 9 * Y_{23} * 70 * 0.2 + 9 * Y_{24} * 70 * 0.15 + 8 * Y_{25} * 70 * 0.25 \\ +$$

CA

$$5 * Y_{31} * 60 * 0.2 + 5 * Y_{32} * 60 * 0.15 + 7 * Y_{33} * 60 * 0.2 + 5 * Y_{34} * 60 * 0.15 + 6 * Y_{35} * 60 * 0.25 \\ +$$

FL

$$8 * Y_{41} * 50 * 0.2 + 5 * Y_{42} * 50 * 0.15 + 5 * Y_{43} * 50 * 0.2 + 2 * Y_{44} * 50 * 0.15 + 3 * Y_{45} * 50 * 0.25 \\ +$$

GA

$$7 * Y_{51} * 70 * 0.2 + 3 * Y_{52} * 70 * 0.15 + 6 * Y_{53} * 70 * 0.2 + 7 * Y_{54} * 70 * 0.15 + 5 * Y_{55} * 70 * 0.25 \\ +$$

IL

$$4 * Y_{61} * 80 * 0.2 + 3 * Y_{62} * 80 * 0.15 + 8 * Y_{63} * 80 * 0.2 + 8 * Y_{64} * 80 * 0.15 + 3 * Y_{65} * 80 * 0.25 \\ +$$

KY

$$4 * Y_{71} * 20 * 0.2 + 2 * Y_{72} * 20 * 0.15 + 7 * Y_{73} * 20 * 0.2 + 5 * Y_{74} * 20 * 0.15 + 4 * Y_{75} * 20 * 0.25$$

+

MD

$$6 * Y_{81} * 50 * 0.2 + 4 * Y_{82} * 50 * 0.15 + 8 * Y_{83} * 50 * 0.2 + 7 * Y_{84} * 50 * 0.15 + 2 * Y_{85} * 50 * 0.25$$

+

MS

$$9 * Y_{91} * 40 * 0.2 + 6 * Y_{92} * 40 * 0.15 + 3 * Y_{93} * 40 * 0.2 + 7 * Y_{94} * 40 * 0.15 + 5 * Y_{95} * 40 * 0.25$$

+

NV

$$6 * Y_{10,1} * 50 * 0.2 + 9 * Y_{10,2} * 50 * 0.15 + 9 * Y_{10,3} * 50 * 0.2 + 4 * Y_{10,4} * 50 * 0.15 + 8 * Y_{10,5} * 50$$

* 0.25 +

LA

$$9 * Y_{11,1} * 70 * 0.2 + 10 * Y_{11,2} * 70 * 0.15 + 10 * Y_{11,3} * 70 * 0.2 + 9 * Y_{11,4} * 70 * 0.15 + 8 * Y_{11,5}$$

* 70 * 0.25

کد گمز

اسکرین شات کد

```
gamside: C:\Users\user\Documents\gamsdir\projdir\gmsproj.gpr
File Edit Search Windows Utilities Model Libraries Help

output

C:\Users\user\Desktop\New folder (2)\OR2 GAMS project.gms
OR2 GAMS project.gms OR2 GAMS project.lst

sets
i states /NY,AZ,CA,FL,GA,IL,KY,MD,MS,NV,LA/
J regions /region1,region2,region3,region4,region5/
k size of centers in regions /small,medium,large/;
parameters
m(k) maximum meghdar pardakhti ke centers mitavanand az states begirand /small 2, medium 3,large 4/;
parameter Days(i,j) farakhani sheete <days> az file excel;
$call gdxrw.exe C:/Users/user/Documents/gamsdir/projdir/Phase2.xlsx par=Days Rng = Days!A1:F12 rdim=1 odim=1
$gdxin Phase2.gdx
$load Days
$gdxin
;
parameter numberofcredits(i) farakhani sheete <number of credits> az file excel;
$call gdxrw.exe C:/Users/user/Documents/gamsdir/projdir/Phase2.xlsx par=numberofcredits Rng = numberofcredits!A1:B12 rdim=1
$gdxin Phase2.gdx
$load numberofcredits
$gdxin
;
parameter costofbuild(j,k) farakhani sheete <cost of build> az file excel;
$call gdxrw.exe C:/Users/user/Documents/gamsdir/projdir/Phase2.xlsx par=costofbuild Rng = costofbuild!A1:d6 rdim=1 odim=1
$gdxin Phase2.gdx
$load costofbuild
$gdxin
;
parameter interestrate(j) farakhani sheete <interest rate> az file excel;
$call gdxrw.exe C:/Users/user/Documents/gamsdir/projdir/Phase2.xlsx par=interestrate Rng = interestrate!A1:F2 odim=1
$gdxin Phase2.gdx
$load interestrate
$gdxin
;

54: 1 Insert
```

```
gamside: C:\Users\user\Documents\gamsdir\projdir\gmsproj.gpr
File Edit Search Windows Utilities Model Libraries Help

output

C:\Users\user\Desktop\New folder (2)\OR2 GAMS project.gms
OR2 GAMS project.gms OR2 GAMS project.lst

parameter interestrate(j) farakhani sheete <interest rate> az file excel;
$call gdxrw.exe C:/Users/user/Documents/gamsdir/projdir/Phase2.xlsx par=interestrate Rng = interestrate!A1:F2 odim=1
$gdxin Phase2.gdx
$load interestrate
$gdxin

variables
z tabe hadaf;
binary variables
y(i,j) dar soorati ke az state i be region j pardakhti ersal shavad meghdare 1 migirad va dar gheyre in soorat meghdare 0 migirad
w(j,k) dar soorati ke maghdare 1 begirad be in ma'nast ke dar region j andaze center k mibashad ;
equation
lost_profits meghdar soode az dast rafte
states(i) mahdoodiate in ke az har state faghat be 1 region pardakhti ersal mishavad
regions(j) mahdoodiate in ke dar har region maximum 1 center mitavan sakht
centers(k) mahdoodiate in ke small centers va medium centers va large centers be tartib maximum 2 va 3 va 4 meghdar daryafte az states mitavanand dashte bashand ;
lost_profits..z=e=sum((i,j),Days(i,j)*numberofcredits(i)*interestrate(j)*y(i,j))+sum((j,k),costofbuild(j,k)*w(j,k));
states(i)..sum(j,y(i,j))=e=1;
regions(j)..sum(k,w(j,k))=e=1;
centers(k)..sum(i,y(i,j))=e=1;
model main/all/;
solve main using MIP minimizing Z ;
display y.l,y.m,w.l,w.m,z.l;

execute unload"phase2.gdx" z, y, w;
execute 'gdxrw.exe phase2.gdx var=z rng=z!b2'
execute 'gdxrw.exe phase2.gdx var=y rng=y!b2'
execute 'gdxrw.exe phase2.gdx var=w rng=w!b2'

54: 1 Insert
```

sets

i states /NY,AZ,CA,FL,GA,IL,KY,MD,MS,NV,LA/

J regions /region1,region2,region3,region4,region5/

k size of centers in regions /small,medium,large;/

parameters

m(k) maximum meghdar pardakhti ke centers mitavanand az states begirand /small 2, medium 3,large 4;/

parameter Days(i,j) farakhani sheete <days> az file excel;

\$call gdxxrw.exe C:/Users/user/Documents/gamsdir/projdir/Phase2.xlsx par=Days Rng = Days!A1:F12
rdim=1 cdim=1

\$gdxin Phase2.gdx

\$load Days

\$gdxin

;

parameter numberofcredits(i) farakhani sheete <number of credits> az file excel;

\$call gdxxrw.exe C:/Users/user/Documents/gamsdir/projdir/Phase2.xlsx par=numberofcredits Rng
=numberofcredits!A1:B12 rdim=1

\$gdxin Phase2.gdx

\$load numberofcredits

\$gdxin

;

parameter costofbuild(j,k) farakhani sheete <cost of build> az file excel;

\$call gdxxrw.exe C:/Users/user/Documents/gamsdir/projdir/Phase2.xlsx par=costofbuild Rng =
costofbuild!A1:d6 rdim=1 cdim=1

\$gdxin Phase2.gdx

\$load costofbuild

\$gdxin

;

parameter interestrate(j) farakhani sheete <interest rate> az file excel;

\$call gdxrw.exe C:/Users/user/Documents/gamsdir/projdir/Phase2.xlsx par=interestrate Rng = interestrate!A1:F2 cdim=1

\$gdxin Phase2.gdx

\$load interestrate

\$gdxin

variables

z tabe hadaf;

binary variables

$y(i,j)$ dar soorati ke az state i be region j pardakhti ersal shavad meghdare 1 migirad va dar gheyre in soorat meghdare 0 migirad

$w(j,k)$ dar soorati ke maghdare 1 begirad be in ma'nast ke dar region j andaze center k mibashad;

equation

lost_profits meghdar soode az dast rafte

states(i) mahdoodiate in ke az har state faghat be 1 region pardakhti ersal mishavad

regions(j) mahdoodiate in ke dar har region maximum 1 center mitavan sakht

centers(j) mahdoodiat in ke small centers va medium centers va large centers be tartib maximum 2 va 3 va 4 meghdar daryafti az states mitavanand dashte bashand;

lost_profits.. $z=e=\sum((i,j), \text{Days}(i,j) * \text{numberofcredits}(i) * \text{interestrate}(j) * y(i,j)) + \sum((j,k), \text{costofbuild}(j,k) * w(j,k);(($

states(i).. $\sum(j, y(i,j))=e=1;$

regions(j).. $\sum(k, w(j,k))=l=1;$

centers(j).. $\sum(i, y(i,j))=l=\sum(k, m(k) * w(j,k);(($

model main/all; /

solve main using MIP minimizing Z;

display y.l,y.m,w.l,w.m,Z.l;

execute_unload"phase2.gdx" z, y , w;

execute'gdxxrw.exe phase2.gdx var=z rng=z!b2'

execute'gdxxrw.exe phase2.gdx var=y rng=y!b2'

execute'gdxxrw.exe phase2.gdx var=w rng=w!b2'

خروجی کد

خلاصه خروجی

$$Z = 620$$

$$Y_{12} = Y_{21} = Y_{34} = Y_{44} = Y_{52} = Y_{62} = Y_{71} = Y_{85} = Y_{95} = Y_{10,4} = Y_{11,4} = 1$$

$$W_{12} = W_{22} = W_{43} = W_{51} = 1$$

سایر متغیرهایی که نوشته نشده‌اند، مقدار صفر را اتخاذ کرده‌اند.

اسکرین شات خروجی

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General Algebraic Modeling System
Compilation

```

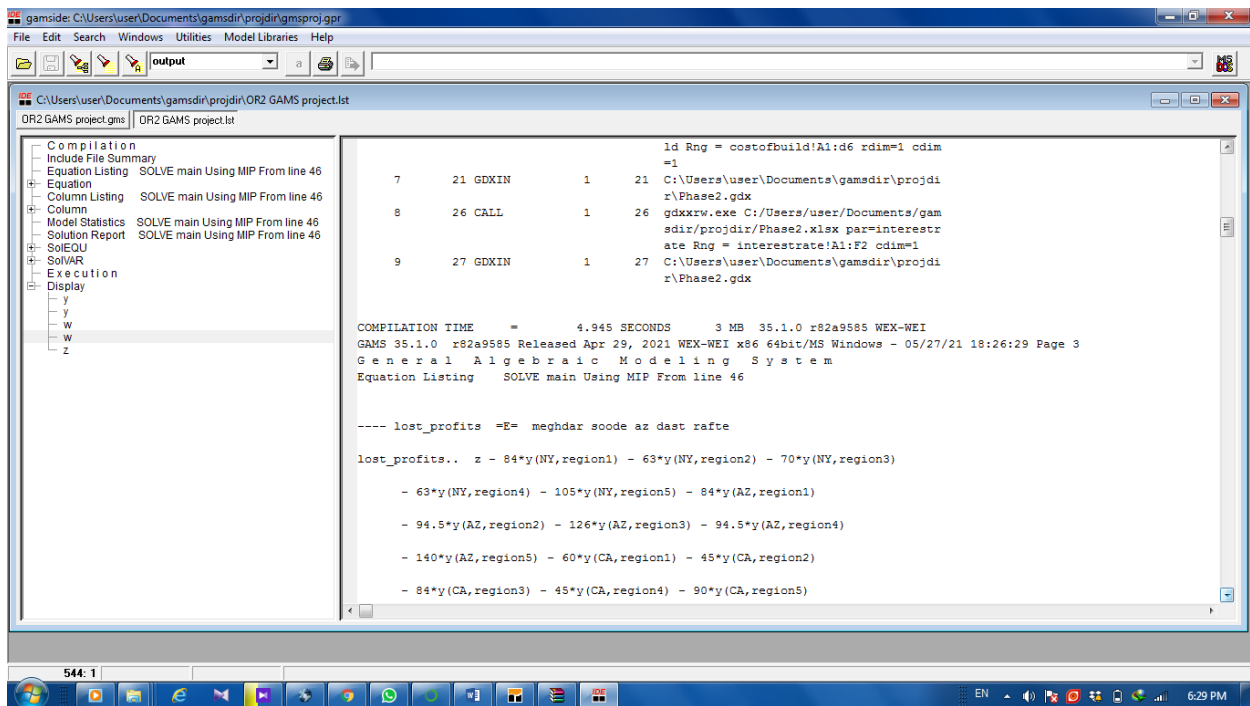
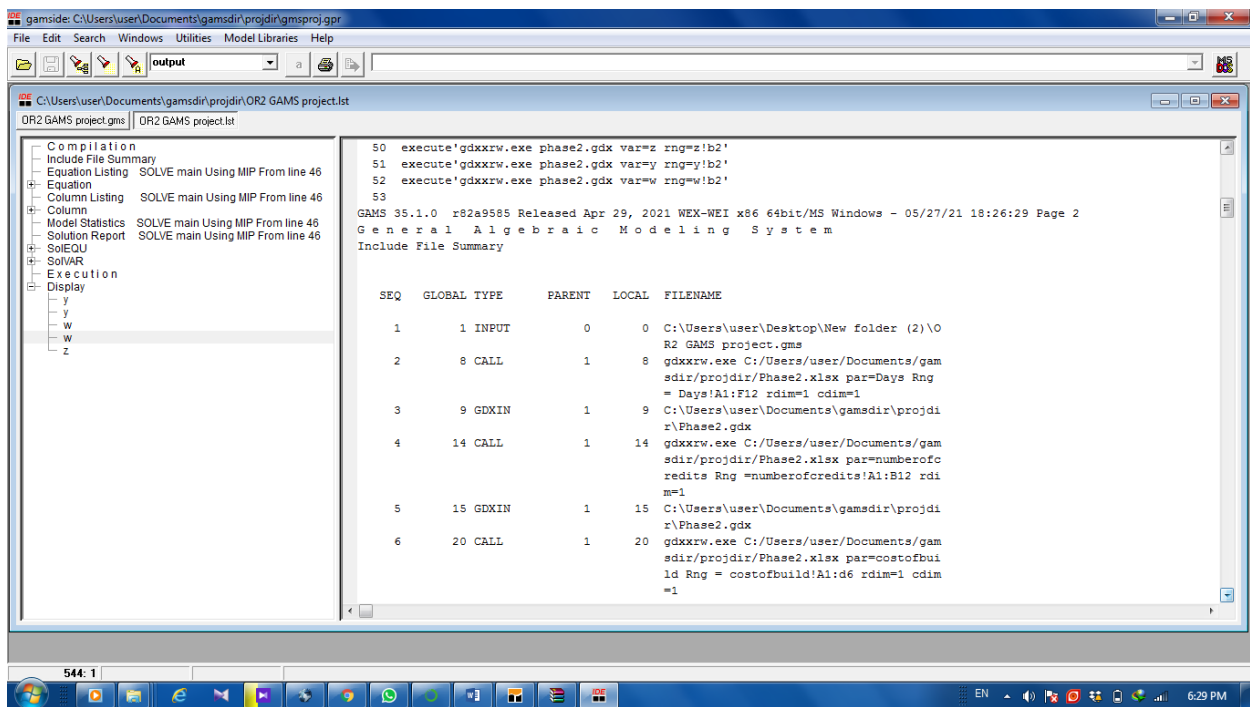
1 sets
2 i states /NY,AZ,CA,FL,GA,IL,KY,MD,MS,NV,LA/
3 j regions /region1,region2,region3,region4,region5/
4 k size of centers in regions /small,medium,large/;
5 parameters
6 m(k) maximum megdhar pardakhti ke centers mitavanand az states begirand /s
  mall 2, medium 3, large 4/;
7 parameter Days(i,j) farakhani sheete <days> az file excel;
GDXIN C:\Users\user\Documents\gamsdir\projdir\Phase2.gdx
--- LOAD Days = 1:Days
12 ;
13 parameter numerofocredits(i) farakhani sheete <number of credits> az file
  excel;
GDXIN C:\Users\user\Documents\gamsdir\projdir\Phase2.gdx
--- LOAD numerofocredits = 1:numerofocredits
18 ;
19 parameter costofbuild(j,k) farakhani sheete <cost of build> az file excel;
GDXIN C:\Users\user\Documents\gamsdir\projdir\Phase2.gdx
--- LOAD costofbuild = 1:costofbuild
24 ;
25 parameter interestrate(j) farakhani sheete <interest rate> az file excel;
GDXIN C:\Users\user\Documents\gamsdir\projdir\Phase2.gdx
--- LOAD interestrate = 1:interestrate

```

```

--- LOAD interestrate = 1:interestrate
30
31 variables
32 z tabe hadaf;
33 binary variables
34 y(i,j) dar soorati ke az state i be region j pardakhti ersal shavad megdha
  re i migirad va dar gheyre in soorat megdhare 0 migirad
35 w(j,k) dar soorati ke maghdare 1 begirad be in ma'nast ke dar region j and
  aze center k mibashad ;
36 equation
37 lost_profits megdhar soode az dast rafte
38 states(i) mahdoodiate in ke az har state faghat be 1 region pardakhti ersa
  l mishavad
39 regions(j) mahdoodiate in ke dar har region maximum 1 center mitavan sakht
40 centers(j) mahdoodiat in ke small centers va medium centers va large cente
  rs be tartib maximum 2 va 3 va 4 megdhar daryafte az states mitavanand das
  hte bashand ;
41 lost_profits..z=e=sum((i,j),Days(i,j)*numerofocredits(i)*interestrate(j)*y
  (i,j))+sum((j,k),costofbuild(j,k)*w(j,k));
42 states(i)..sum(j,y(i,j))=e=1;
43 regions(j)..sum(k,w(j,k))=l=1;
44 centers(j)..sum(i,y(i,j))=l=sum(k,m(k)*w(j,k));
45 model main/all/;
46 solve main using MIP minimizing Z ;
47 display y..l,y..m,w..l,w..m,Z..l;
48
49 execute_unload"phase2.gdx" z, y, w;
50 execute'gdxrw.exe phase2.gdx var=z rng=z!b2'

```



gamside: C:\Users\user\Documents\gamsdir\projdir\gmsproj.gpr

File Edit Search Windows Utilities Model Libraries Help

output

C:\Users\user\Documents\gamsdir\projdir\OR2 GAMS project.lst

OR2 GAMS project.gms | OR2 GAMS project.lst

- Compilation
 - Include File Summary
 - Equation Listing SOLVE main Using MIP From line 46
 - Equation
 - Column Listing SOLVE main Using MIP From line 46
 - Column
 - Model Statistics SOLVE main Using MIP From line 46
 - Solution Report SOLVE main Using MIP From line 46
 - SoIEQU
 - SolVAR
 - Execution
 - Display
 - y
 - w
 - z

```

- 84*y(CA,region3) - 45*y(CA,region4) - 90*y(CA,region5)
- 80*y(FL,region1) - 37.5*y(FL,region2) - 50*y(FL,region3)
- 15*y(FL,region4) - 37.5*y(FL,region5) - 98*y(GA,region1)
- 31.5*y(GA,region2) - 84*y(GA,region3) - 73.5*y(GA,region4)
- 87.5*y(GA,region5) - 64*y(IL,region1) - 36*y(IL,region2)
- 128*y(IL,region3) - 96*y(IL,region4) - 60*y(IL,region5)
- 16*y(KY,region1) - 6*y(KY,region2) - 28*y(KY,region3) - 15*y(KY,region4)
- 20*y(KY,region5) - 60*y(MD,region1) - 30*y(MD,region2)
- 80*y(MD,region3) - 52.5*y(MD,region4) - 25*y(MD,region5)
- 72*y(MS,region1) - 36*y(MS,region2) - 24*y(MS,region3)
- 42*y(MS,region4) - 50*y(MS,region5) - 60*y(NV,region1)
- 67.5*y(NV,region2) - 90*y(NV,region3) - 30*y(NV,region4)
- 100*y(NV,region5) - 126*y(LA,region1) - 105*y(LA,region2)
- 140*y(LA,region3) - 94.5*y(LA,region4) - 140*y(LA,region5)

```

544: 1

EN 6:29 PM

gamside: C:\Users\user\Documents\gamsdir\projdir\gmsproj.gpr

File Edit Search Windows Utilities Model Libraries Help

output

C:\Users\user\Documents\gamsdir\projdir\OR2 GAMS project.lst

OR2 GAMS project.gms | OR2 GAMS project.lst

- Compilation
 - Include File Summary
 - Equation Listing SOLVE main Using MIP From line 46
 - Equation
 - Column Listing SOLVE main Using MIP From line 46
 - Column
 - Model Statistics SOLVE main Using MIP From line 46
 - Solution Report SOLVE main Using MIP From line 46
 - SoIEQU
 - SolVAR
 - Execution
 - Display
 - y
 - w
 - z

```

- 140*y(LA,region3) - 94.5*y(LA,region4) - 140*y(LA,region5)
- 35*w(region1,small) - 35*w(region1,medium) - 40*w(region1,large)
- 30*w(region2,small) - 45*w(region2,medium) - 90*w(region2,large)
- 40*w(region3,small) - 45*w(region3,medium) - 90*w(region3,large)
- 10*w(region4,small) - 30*w(region4,medium) - 30*w(region4,large)
- 20*w(region5,small) - 35*w(region5,medium) - 55*w(region5,large) =E= 0 ;
(LHS = 0)

---- states =E= mahdoodiate in ke az har state faghat be 1 region pardakhti er
sal mishavad

states(NY).. y(NY,region1) + y(NY,region2) + y(NY,region3) + y(NY,region4)
+ y(NY,region5) =E= 1 ; (LHS = 0, INFES = 1 ****)

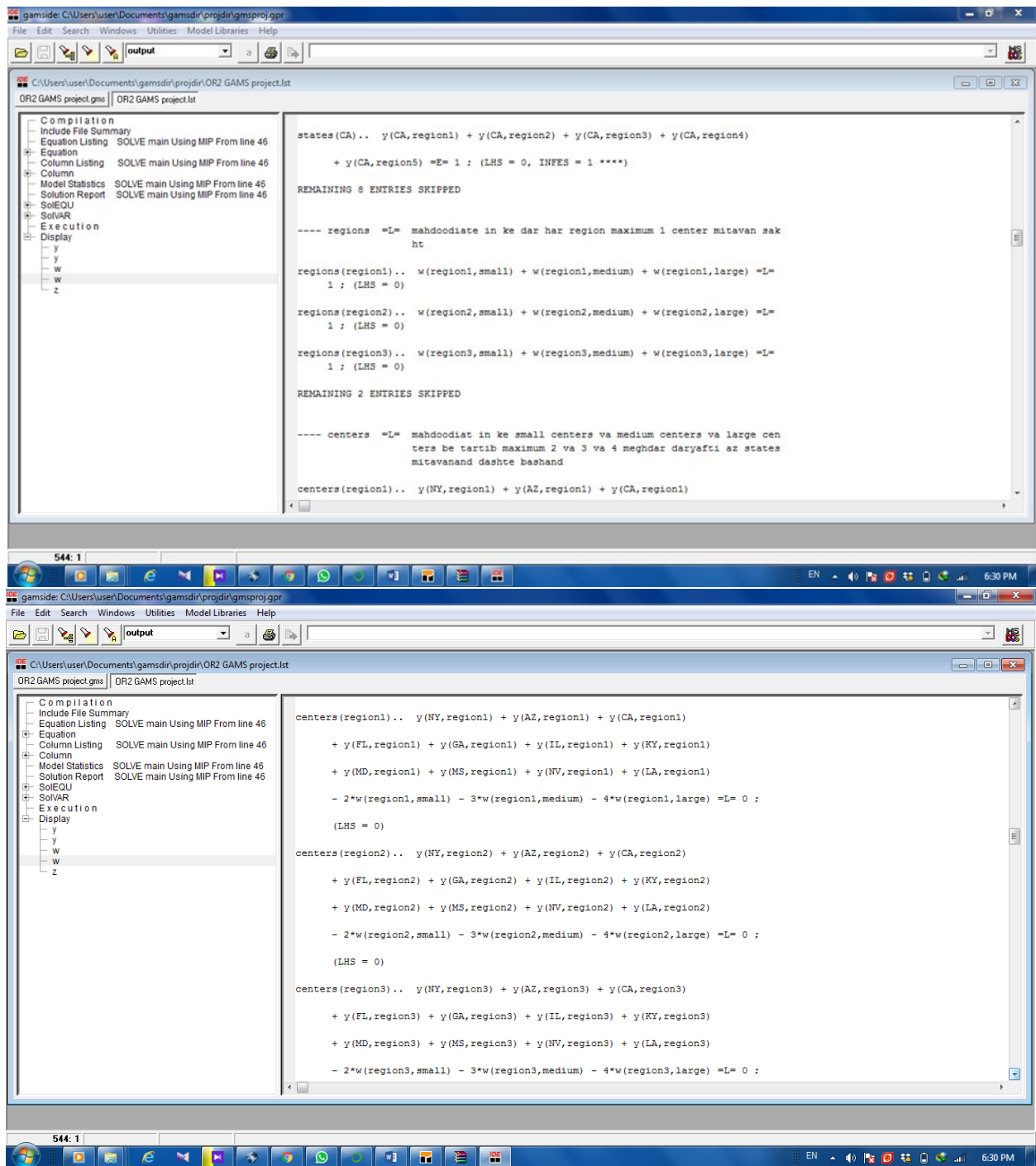
states(AZ).. y(AZ,region1) + y(AZ,region2) + y(AZ,region3) + y(AZ,region4)
+ y(AZ,region5) =E= 1 ; (LHS = 0, INFES = 1 ****)

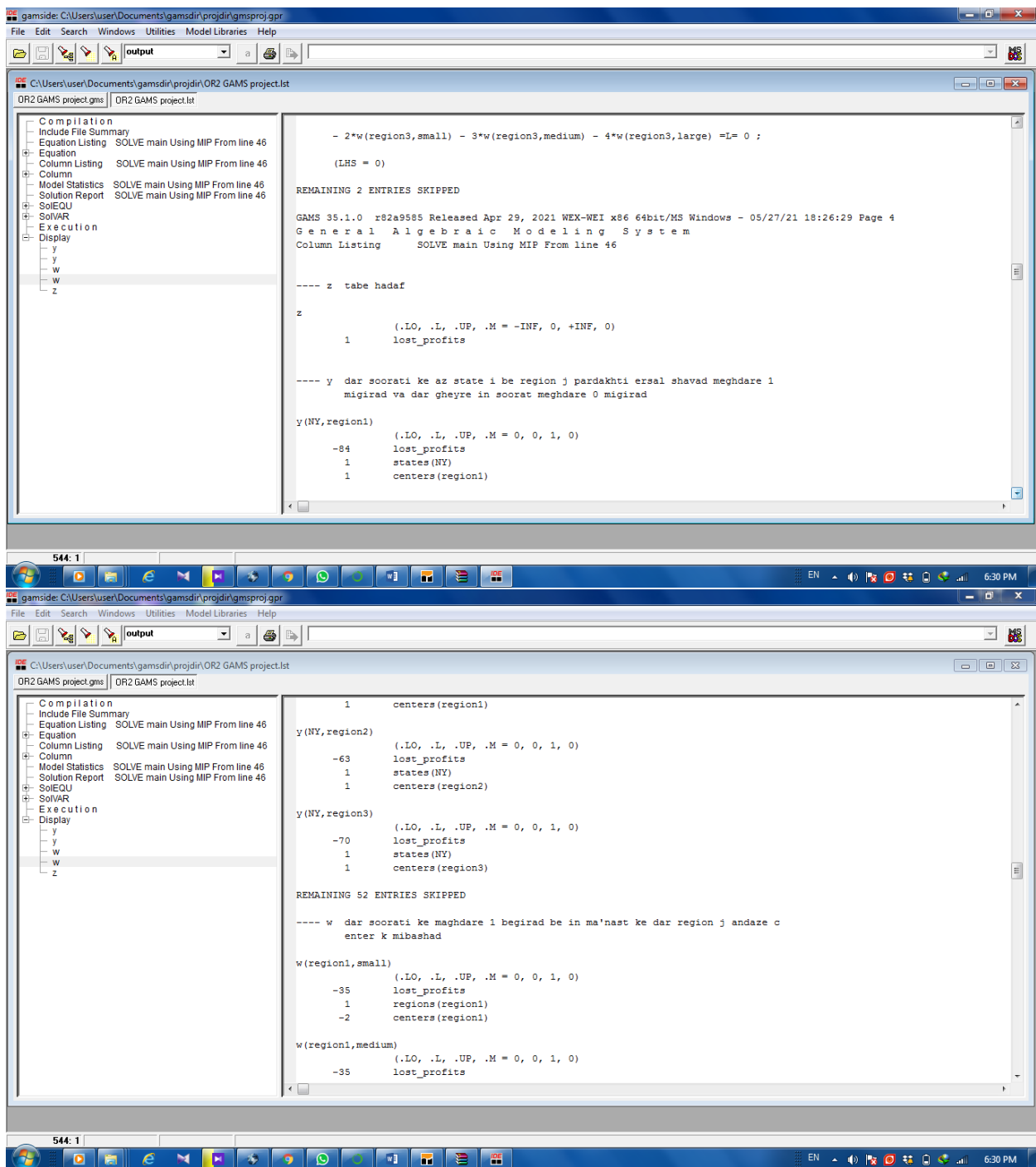
states(CA).. y(CA,region1) + y(CA,region2) + y(CA,region3) + y(CA,region4)

```

544: 1

EN 6:30 PM





gamside: C:\Users\user\Documents\gamsdir\projdir\gmsproj.gpr

File Edit Search Windows Utilities Model Libraries Help

output

C:\Users\user\Documents\gamsdir\projdir\OR2 GAMS project.lst

OR2 GAMS project.gms | OR2 GAMS project.lst

Compilation
Include File Summary
Equation Listing SOLVE main Using MIP From line 46
Equation
Column Listing SOLVE main Using MIP From line 46
Column
Model Statistics SOLVE main Using MIP From line 46
Solution Report SOLVE main Using MIP From line 46
Solve
Solve
Execution
Display
y
y
w
w
z

```

-35      lost_profits
         1      regions(region1)
        -3      centers(region1)

w(region1,large)
      (.LO, .L, .UP, .M = 0, 0, 1, 0)

-40      lost_profits
         1      regions(region1)
        -4      centers(region1)

REMAINING 12 ENTRIES SKIPPED
GAMS 35.1.0 r82a9585 Released Apr 29, 2021 WEX-WEI x86 64bit/MS Windows - 05/27/21 18:26:29 Page 5
General Algebraic Modeling System
Model Statistics SOLVE main Using MIP From line 46

MODEL STATISTICS

BLOCKS OF EQUATIONS      4      SINGLE EQUATIONS      22
BLOCKS OF VARIABLES      3      SINGLE VARIABLES      71
NON ZERO ELEMENTS      211     DISCRETE VARIABLES      70

GENERATION TIME      =      0.032 SECONDS      4 MB  35.1.0 r82a9585 WEX-WEI
GAMS 35.1.0 r82a9585 Released Apr 29, 2021 WEX-WEI x86 64bit/MS Windows - 05/27/21 18:26:29 Page 6
General Algebraic Modeling System
Solution Report SOLVE main Using MIP From line 46

```

544: 1

gamside: C:\Users\user\Documents\gamsdir\projdir\gmsproj.gpr

File Edit Search Windows Utilities Model Libraries Help

output

C:\Users\user\Documents\gamsdir\projdir\OR2 GAMS project.lst

OR2 GAMS project.gms | OR2 GAMS project.lst

Compilation
Include File Summary
Equation Listing SOLVE main Using MIP From line 46
Equation
Column Listing SOLVE main Using MIP From line 46
Column
Model Statistics SOLVE main Using MIP From line 46
Solution Report SOLVE main Using MIP From line 46
Solve
Solve
Execution
Display
y
y
w
w
z

Solution Report SOLVE main Using MIP From line 46

```

S O L V E      S U M M A R Y

MODEL main      OBJECTIVE z
TYPE MIP      DIRECTION MINIMIZE
SOLVER CBC      FROM LINE 46

**** SOLVER STATUS      1 Normal Completion
**** MODEL STATUS      8 Integer Solution
**** OBJECTIVE VALUE      620.0000

RESOURCE USAGE, LIMIT      0.098 10000000000.000
ITERATION COUNT, LIMIT      15 2147483647

COIN-OR CBC      35.1.0 r82a9585 Released Apr 29, 2021 WEI x86 64bit/MS Window

Integer solution of 633 found by feasibility pump after 0 iterations and 0 nodes
(0.03 seconds)
Integer solution of 620 found by DiveCoefficient after 15 iterations and 0 nodes
(0.03 seconds)

6 added rows had average density of 10.666667
At root node, 6 cuts changed objective from 584 to 620 in 3 passes
Cut generator 0 (Probing) - 0 row cuts average 0.0 elements, 0 column cuts (0 ac
tive) in 0.001 seconds - new frequency is -100
Cut generator 1 (Gomory) - 4 row cuts average 16.3 elements, 0 column cuts (0 ac
tive) in 0.001 seconds - new frequency is 1

```

544: 1

gamside: C:\Users\user\Documents\gamsdir\projdir\gmsproj.gpr

File Edit Search Windows Utilities Model Libraries Help

output

CA\Users\user\Documents\gamsdir\projdir\OR2 GAMS project.lst

OR2 GAMS project.gms | OR2 GAMS project.lst

- Compilation
 - Include File Summary
 - Equation Listing SOLVE main Using MIP From line 46
 - Equation
 - Column Listing SOLVE main Using MIP From line 46
 - Column
 - Model Statistics SOLVE main Using MIP From line 46
 - Solution Report SOLVE main Using MIP From line 46
 - SoIEQU
 - SoIAR
 - Execution
 - Display
 - y
 - y
 - w
 - w
 - z

Cut generator 1 (Gomory) - 4 row cuts average 16.3 elements, 0 column cuts (0 active) in 0.001 seconds - new frequency is 1

Cut generator 2 (Knapsack) - 3 row cuts average 4.0 elements, 0 column cuts (0 active) in 0.000 seconds - new frequency is 1

Cut generator 3 (Clique) - 0 row cuts average 0.0 elements, 0 column cuts (0 active) in 0.000 seconds - new frequency is -100

Cut generator 4 (MixedIntegerRounding2) - 4 row cuts average 8.3 elements, 0 column cuts (0 active) in 0.001 seconds - new frequency is 1

Cut generator 5 (FlowCover) - 0 row cuts average 0.0 elements, 0 column cuts (0 active) in 0.000 seconds - new frequency is -100

Cut generator 6 (TwoMirCuts) - 16 row cuts average 23.3 elements, 0 column cuts (0 active) in 0.000 seconds - new frequency is 1

Cut generator 7 (ZeroHalf) - 1 row cuts average 7.0 elements, 0 column cuts (0 active) in 0.000 seconds - new frequency is -100

Search completed - best objective 620, took 15 iterations and 0 nodes (0.09 seconds)

Maximum depth 0, 30 variables fixed on reduced cost

Solved to optimality (within gap tolerances optca and optcr).

MIP solution: 6.200000e+02 (0 nodes, 0.098 seconds)

Best possible: 6.200000e+02

Absolute gap: 0.000000e+00 (absolute tolerance optca: 0)

Relative gap: 0.000000e+00 (relative tolerance optcr: 0.0001)

Optimal - objective value 620

| | LOWER | LEVEL | UPPER | MARGINAL |
|---------------------|-------|-------|-------|----------|
| ---- EQU lost_prof- | . | . | . | 1.000 |

544: 1

gamside: C:\Users\user\Documents\gamsdir\projdir\gmsproj.gpr

File Edit Search Windows Utilities Model Libraries Help

output

CA\Users\user\Documents\gamsdir\projdir\OR2 GAMS project.lst

OR2 GAMS project.gms | OR2 GAMS project.lst

- Compilation
 - Include File Summary
 - Equation Listing SOLVE main Using MIP From line 46
 - Equation
 - Column Listing SOLVE main Using MIP From line 46
 - Column
 - Model Statistics SOLVE main Using MIP From line 46
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 - SoIAR
 - Execution
 - Display
 - y
 - y
 - w
 - w
 - z

| | LOWER | LEVEL | UPPER | MARGINAL |
|---------------------|-------|-------|-------|----------|
| ---- EQU lost_prof- | . | . | . | 1.000 |

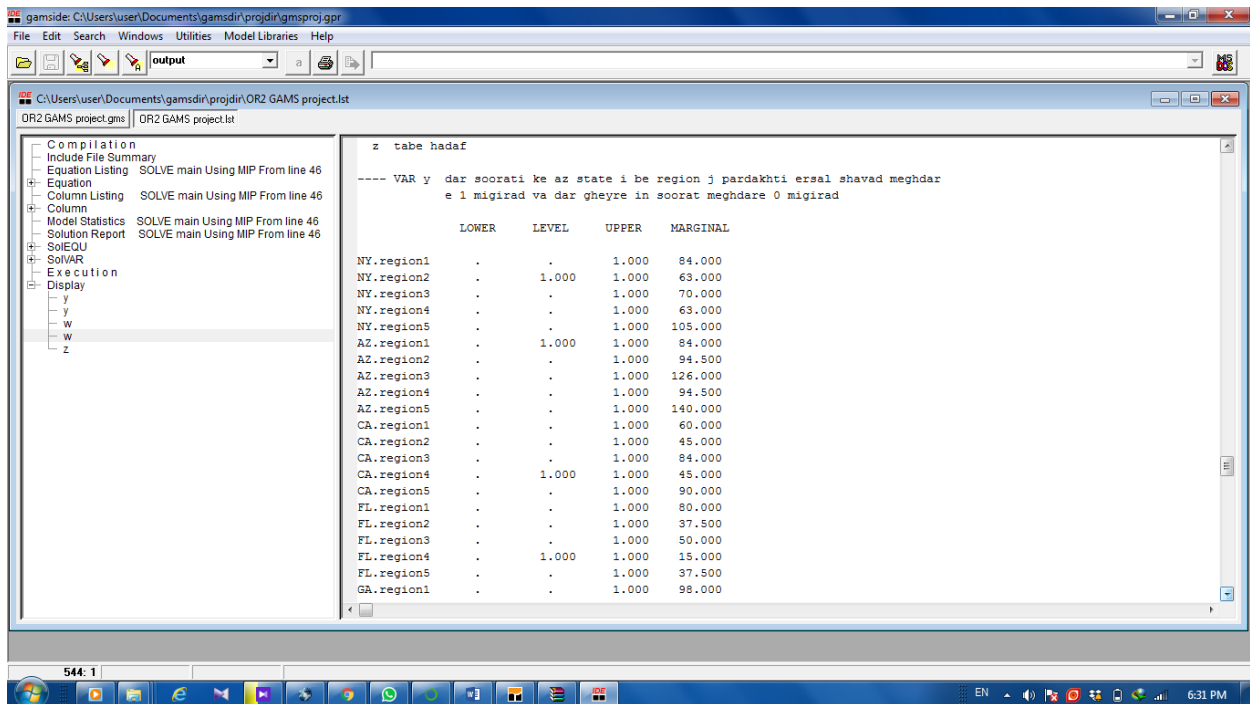
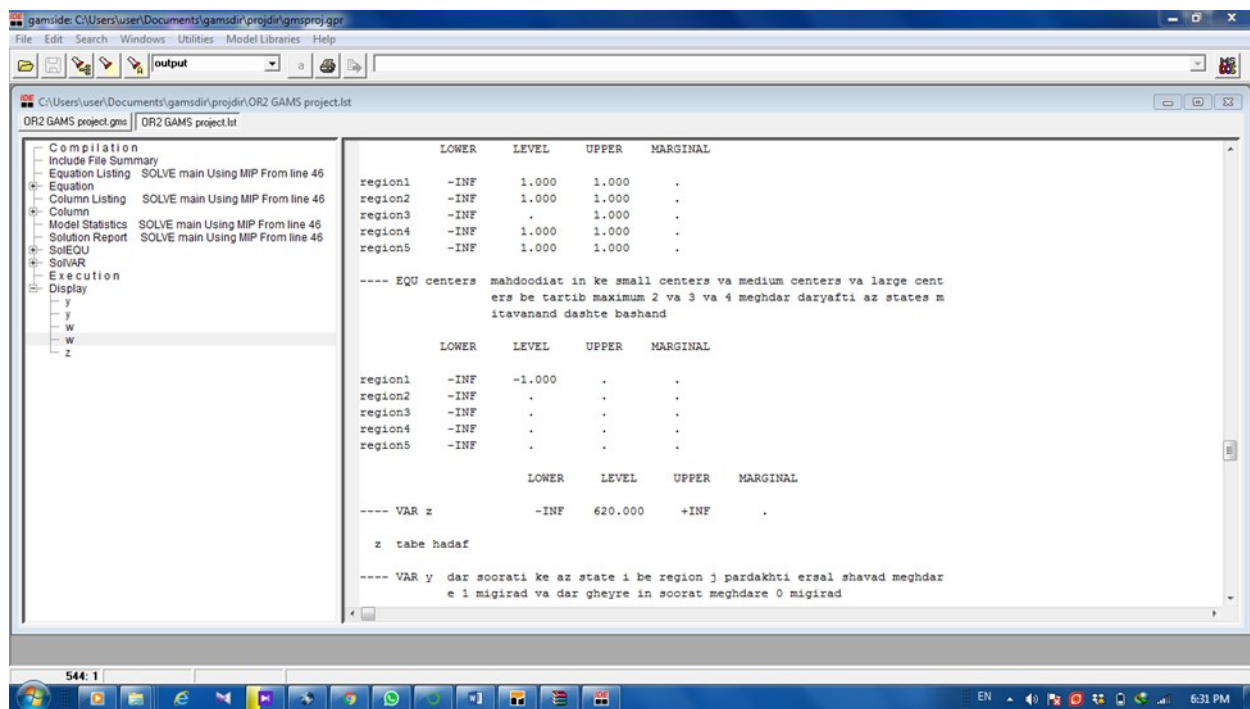
lost_profits meghdar soode az dast rafte

---- EQU states mahdoodiate in ke az har state faghat be 1 region pardakhti ers al mishavad

| | LOWER | LEVEL | UPPER | MARGINAL |
|----|-------|-------|-------|----------|
| NY | 1.000 | 1.000 | 1.000 | . |
| AZ | 1.000 | 1.000 | 1.000 | . |
| CA | 1.000 | 1.000 | 1.000 | . |
| FL | 1.000 | 1.000 | 1.000 | . |
| GA | 1.000 | 1.000 | 1.000 | . |
| IL | 1.000 | 1.000 | 1.000 | . |
| KY | 1.000 | 1.000 | 1.000 | . |
| MD | 1.000 | 1.000 | 1.000 | . |
| MS | 1.000 | 1.000 | 1.000 | . |
| NV | 1.000 | 1.000 | 1.000 | . |
| LA | 1.000 | 1.000 | 1.000 | . |

---- EQU regions mahdoodiate in ke dar har region maximum 1 center mitavan sakh t

| | LOWER | LEVEL | UPPER | MARGINAL |
|--|-------|-------|-------|----------|
|--|-------|-------|-------|----------|



gamside: C:\Users\user\Documents\gamsdir\projdir\gmsproj.gpr

File Edit Search Windows Utilities Model Libraries Help

output

C:\Users\user\Documents\gamsdir\projdir\OR2 GAMS project.lst

OR2 GAMS project.gms | OR2 GAMS project.lst

| Compilation | FL.region5 | . | . | 1.000 | 37.500 |
|--|------------|---|-------|-------|---------|
| Include File Summary | GA.region1 | . | . | 1.000 | 98.000 |
| Equation Listing SOLVE main Using MIP From line 46 | GA.region2 | . | 1.000 | 1.000 | 31.500 |
| Equation | GA.region3 | . | . | 1.000 | 84.000 |
| Column Listing SOLVE main Using MIP From line 46 | GA.region4 | . | . | 1.000 | 73.500 |
| Column | GA.region5 | . | . | 1.000 | 87.500 |
| Model Statistics SOLVE main Using MIP From line 46 | IL.region1 | . | . | 1.000 | 64.000 |
| Solution Report SOLVE main Using MIP From line 46 | IL.region2 | . | 1.000 | 1.000 | 36.000 |
| SOIEQU | IL.region3 | . | . | 1.000 | 128.000 |
| SoIWAR | IL.region4 | . | . | 1.000 | 96.000 |
| Execution | IL.region5 | . | . | 1.000 | 60.000 |
| Display | KY.region1 | . | 1.000 | 1.000 | 16.000 |
| y | KY.region2 | . | . | 1.000 | 6.000 |
| w | KY.region3 | . | . | 1.000 | 28.000 |
| w | KY.region4 | . | . | 1.000 | 15.000 |
| z | KY.region5 | . | . | 1.000 | 20.000 |
| | MD.region1 | . | . | 1.000 | 60.000 |
| | MD.region2 | . | . | 1.000 | 30.000 |
| | MD.region3 | . | . | 1.000 | 80.000 |
| | MD.region4 | . | . | 1.000 | 52.500 |
| | MD.region5 | . | 1.000 | 1.000 | 25.000 |
| | MS.region1 | . | . | 1.000 | 72.000 |
| | MS.region2 | . | . | 1.000 | 36.000 |
| | MS.region3 | . | . | 1.000 | 24.000 |
| | MS.region4 | . | . | 1.000 | 42.000 |
| | MS.region5 | . | 1.000 | 1.000 | 50.000 |
| | NV.region1 | . | . | 1.000 | 60.000 |
| | NV.region2 | . | . | 1.000 | 67.500 |

544: 1

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File Edit Search Windows Utilities Model Libraries Help

output

C:\Users\user\Documents\gamsdir\projdir\OR2 GAMS project.lst

OR2 GAMS project.gms | OR2 GAMS project.lst

| Compilation | NV.region1 | . | . | 1.000 | 60.000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|---|-------|-------|----------|---------|--|-------|-------|-------|----------|---------------|---|---|-------|--------|----------------|---|-------|-------|--------|---------------|---|---|-------|--------|---------------|---|---|-------|--------|----------------|---|-------|-------|--------|---------------|---|---|-------|--------|---------------|---|---|-------|--------|----------------|---|---|-------|--------|---------------|---|---|-------|--------|---------------|---|---|-------|--------|----------------|---|---|-------|--------|---------------|---|-------|-------|--------|
| Include File Summary | NV.region2 | . | . | 1.000 | 67.500 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Equation Listing SOLVE main Using MIP From line 46 | NV.region3 | . | . | 1.000 | 90.000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Equation | NV.region4 | . | 1.000 | 1.000 | 30.000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Column Listing SOLVE main Using MIP From line 46 | NV.region5 | . | . | 1.000 | 100.000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Column | LA.region1 | . | . | 1.000 | 126.000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Model Statistics SOLVE main Using MIP From line 46 | LA.region2 | . | . | 1.000 | 105.000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Solution Report SOLVE main Using MIP From line 46 | LA.region3 | . | . | 1.000 | 140.000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SOIEQU | LA.region4 | . | 1.000 | 1.000 | 94.500 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SoIWAR | LA.region5 | . | . | 1.000 | 140.000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Execution | <p>---- VAR w dar soorati ke maghdare 1 begirad be in ma'nast ke dar region j anda ze center k mibashad</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Display | <table border="1"> <thead> <tr> <th></th> <th>LOWER</th> <th>LEVEL</th> <th>UPPER</th> <th>MARGINAL</th> </tr> </thead> <tbody> <tr> <td>region1.small</td> <td>.</td> <td>.</td> <td>1.000</td> <td>35.000</td> </tr> <tr> <td>region1.medium</td> <td>.</td> <td>1.000</td> <td>1.000</td> <td>35.000</td> </tr> <tr> <td>region1.large</td> <td>.</td> <td>.</td> <td>1.000</td> <td>40.000</td> </tr> <tr> <td>region2.small</td> <td>.</td> <td>.</td> <td>1.000</td> <td>30.000</td> </tr> <tr> <td>region2.medium</td> <td>.</td> <td>1.000</td> <td>1.000</td> <td>45.000</td> </tr> <tr> <td>region2.large</td> <td>.</td> <td>.</td> <td>1.000</td> <td>90.000</td> </tr> <tr> <td>region3.small</td> <td>.</td> <td>.</td> <td>1.000</td> <td>40.000</td> </tr> <tr> <td>region3.medium</td> <td>.</td> <td>.</td> <td>1.000</td> <td>45.000</td> </tr> <tr> <td>region3.large</td> <td>.</td> <td>.</td> <td>1.000</td> <td>90.000</td> </tr> <tr> <td>region4.small</td> <td>.</td> <td>.</td> <td>1.000</td> <td>10.000</td> </tr> <tr> <td>region4.medium</td> <td>.</td> <td>.</td> <td>1.000</td> <td>30.000</td> </tr> <tr> <td>region4.large</td> <td>.</td> <td>1.000</td> <td>1.000</td> <td>30.000</td> </tr> </tbody> </table> | | | | | | LOWER | LEVEL | UPPER | MARGINAL | region1.small | . | . | 1.000 | 35.000 | region1.medium | . | 1.000 | 1.000 | 35.000 | region1.large | . | . | 1.000 | 40.000 | region2.small | . | . | 1.000 | 30.000 | region2.medium | . | 1.000 | 1.000 | 45.000 | region2.large | . | . | 1.000 | 90.000 | region3.small | . | . | 1.000 | 40.000 | region3.medium | . | . | 1.000 | 45.000 | region3.large | . | . | 1.000 | 90.000 | region4.small | . | . | 1.000 | 10.000 | region4.medium | . | . | 1.000 | 30.000 | region4.large | . | 1.000 | 1.000 | 30.000 |
| | LOWER | LEVEL | UPPER | MARGINAL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| region1.small | . | . | 1.000 | 35.000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| region1.medium | . | 1.000 | 1.000 | 35.000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| region1.large | . | . | 1.000 | 40.000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| region2.small | . | . | 1.000 | 30.000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| region2.medium | . | 1.000 | 1.000 | 45.000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| region2.large | . | . | 1.000 | 90.000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| region3.small | . | . | 1.000 | 40.000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| region3.medium | . | . | 1.000 | 45.000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| region3.large | . | . | 1.000 | 90.000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| region4.small | . | . | 1.000 | 10.000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| region4.medium | . | . | 1.000 | 30.000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| region4.large | . | 1.000 | 1.000 | 30.000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| y | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| w | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| w | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| z | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

544: 1

gamside: C:\Users\user\Documents\gamsdir\projdir\gmsproj.gpr

File Edit Search Windows Utilities Model Libraries Help

output

C:\Users\user\Documents\gamsdir\projdir\OR2 GAMS projectList

OR2 GAMS project.gms | OR2 GAMS project.lst

- Compilation
 - Include File Summary
 - Equation Listing SOLVE main Using MIP From line 46
 - Equation
 - Column Listing SOLVE main Using MIP From line 46
 - Column
 - Model Statistics SOLVE main Using MIP From line 46
 - Solution Report SOLVE main Using MIP From line 46
 - SoIEQU
 - SoIAR
 - Execution
 - Display
 - y
 - w
 - w
 - z

```

region3.medium . . 1.000 45.000
region3.large . . 1.000 90.000
region4.small . . 1.000 10.000
region4.medium . . 1.000 30.000
region4.large . 1.000 1.000 30.000
region5.small . 1.000 1.000 20.000
region5.medium . . 1.000 35.000
region5.large . . 1.000 55.000

**** REPORT SUMMARY :      0  NONOPT
                        0  INFEASIBLE
                        0  UNBOUNDED

GAMS 35.1.0 r82a9585 Released Apr 29, 2021 WEX-WEI x86 64bit/MS Windows - 05/27/21 18:26:29 Page 7
General Algebraic Modeling System
Execution

---- 47 VARIABLE y.L dar soorati ke az state i be region j pardakhti ersal
      shavad meghdare 1 migirad va dar gheyre in soorat megh
      dare 0 migirad

      region1    region2    region4    region5

NY
AZ      1.000
CA
FL
      1.000
      1.000

```

544: 1

EN 6:32 PM

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File Edit Search Windows Utilities Model Libraries Help

output

C:\Users\user\Documents\gamsdir\projdir\OR2 GAMS projectList

OR2 GAMS project.gms | OR2 GAMS project.lst

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 - Execution
 - Display
 - y
 - y
 - w
 - w
 - z

```

---- 47 VARIABLE y.L dar soorati ke az state i be region j pardakhti ersal
      shavad meghdare 1 migirad va dar gheyre in soorat megh
      dare 0 migirad

      region1    region2    region4    region5

NY
AZ      1.000
CA
FL
      1.000
      1.000
GA
IL
      1.000
      1.000
KY
MD
      1.000
      1.000
MS
NV
      1.000
LA
      1.000

---- 47 VARIABLE y.M dar soorati ke az state i be region j pardakhti ersal
      shavad meghdare 1 migirad va dar gheyre in soorat megh
      dare 0 migirad

      region1    region2    region3    region4    region5

NY  84.000    63.000    70.000    63.000    105.000
AZ  84.000    94.500    126.000    94.500    140.000

```

544: 1

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File Edit Search Windows Utilities Model Libraries Help

output

C:\Users\user\Documents\gamsdir\projdir\OR2 GAMS project.lst

OR2 GAMS project.gms | OR2 GAMS project.lst

- Compilation
 - Include File Summary
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- Execution
 - Display
 - y
 - w
 - w
 - z

```

----- 47 VARIABLE y.M dar soorati ke az state i be region j pardakhti ersal
shavad meghdare 1 migirad va dar gheyre in soorat megh
dare 0 migirad

      region1      region2      region3      region4      region5
NY      84.000      63.000      70.000      63.000      105.000
AZ      84.000      94.500      126.000      94.500      140.000
CA      60.000      45.000      84.000      45.000      90.000
FL      80.000      37.500      50.000      15.000      37.500
GA      98.000      31.500      84.000      73.500      87.500
IL      64.000      36.000      128.000      96.000      60.000
KY      16.000      6.000      28.000      15.000      20.000
MD      60.000      30.000      80.000      52.500      25.000
MS      72.000      36.000      24.000      42.000      50.000
NV      60.000      67.500      90.000      30.000      100.000
LA      126.000      105.000      140.000      94.500      140.000

----- 47 VARIABLE w.L dar soorati ke maghdare 1 begirad be in ma'nast ke dar
region j andaze center k mibashad

      small      medium      large
region1
region2      1.000
region4      1.000
region5      1.000

```

544: 1

EN 6:32 PM

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File Edit Search Windows Utilities Model Libraries Help

output

C:\Users\user\Documents\gamsdir\projdir\OR2 GAMS project.lst

OR2 GAMS project.gms | OR2 GAMS project.lst

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 - w
 - w
 - z

```

----- 47 VARIABLE w.L dar soorati ke maghdare 1 begirad be in ma'nast ke dar
region j andaze center k mibashad

      small      medium      large
region1
region2      1.000
region4      1.000
region5      1.000

----- 47 VARIABLE w.M dar soorati ke maghdare 1 begirad be in ma'nast ke dar
region j andaze center k mibashad

      small      medium      large
region1      35.000      35.000      40.000
region2      30.000      45.000      90.000
region3      40.000      45.000      90.000
region4      10.000      30.000      30.000
region5      20.000      35.000      55.000

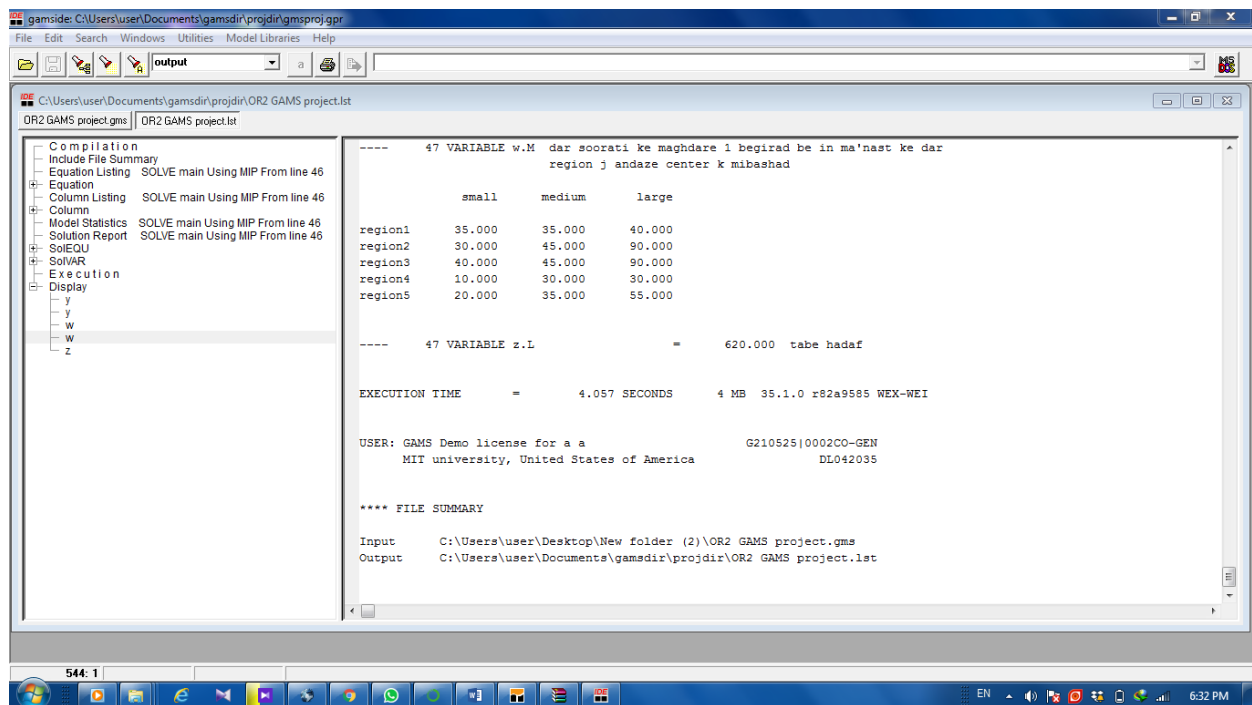
----- 47 VARIABLE z.L = 620.000 tabe hadaf

EXECUTION TIME = 4.057 SECONDS 4 MB 35.1.0 r82a9585 WEX-WEI

```

544: 1

EN 6:32 PM



GAMS 35.1.0 r82a9585 Released Apr 29, 2021 WEX-WEI x86 64bit/MS Windows - 05/27/21 18:26:29
Page 1

General Algebraic Modeling System Compilation

```

1 sets
2 i states /NY,AZ,CA,FL,GA,IL,KY,MD,MS,NV,LA/
3 J regions /region1,region2,region3,region4,region5/
4 k size of centers in regions /small,medium,large/;
5 parameters
6 m(k) maximum meghdar pardakhti ke centers mitavanand az states begirand /s
    mall 2, medium 3,large 4/;
7 parameter Days(i,j) farakhani sheete <days> az file excel;
GDXIN C:\Users\user\Documents\gamssdir\projdir\Phase2.gdx
--- LOAD Days = 1:Days
12 ;
13 parameter numberofcredits(i) farakhani sheete <number of credits> az file
    excel;
GDXIN C:\Users\user\Documents\gamssdir\projdir\Phase2.gdx
--- LOAD numberofcredits = 1:numberofcredits
18 ;
19 parameter costofbuild(j,k) farakhani sheete <cost of build> az file excel;
GDXIN C:\Users\user\Documents\gamssdir\projdir\Phase2.gdx
--- LOAD costofbuild = 1:costofbuild
24 ;
25 parameter interstrate(j) farakhani sheete <interest rate> az file excel;
GDXIN C:\Users\user\Documents\gamssdir\projdir\Phase2.gdx
--- LOAD interstrate = 1:interstrate
30
31 variables

```

32 z tabe hadaf;
 33 binary variables
 34 $y(i,j)$ dar soorati ke az state i be region j pardakhti ersal shavad megghda
 re 1 migirad va dar gheyre in soorat megghdare 0 migirad
 35 $w(j,k)$ dar soorati ke maghdare 1 begirad be in ma'nast ke dar region j and
 aze center k mibashad ;
 36 equation
 37 lost_profits megghdar soode az dast rafte
 38 states(i) mahdoodiate in ke az har state faghat be 1 region pardakhti ersa
 l mishavad
 39 regions(j) mahdoodiate in ke dar har region maximum 1 center mitavan sakht
 40 centers(j) mahdoodiat in ke small centers va medium centers va large cente
 rs be tartib maximum 2 va 3 va 4 megghdar daryafti az states mitavanand das
 hte bashand ;
 41 $\text{lost_profits..}z=e=\text{sum}((i,j),\text{Days}(i,j)*\text{numberofcredits}(i)*\text{interestrates}(j)*y$
 $(i,j))+\text{sum}((j,k),\text{costofbuild}(j,k)*w(j,k));$
 42 $\text{states}(i)..\text{sum}(j,y(i,j))=e=1;$
 43 $\text{regions}(j)..\text{sum}(k,w(j,k))=l=1;$
 44 $\text{centers}(j)..\text{sum}(i,y(i,j))=l=\text{sum}(k,m(k)*w(j,k));$
 45 model main/all/;
 46 solve main using MIP minimizing Z ;
 47 display y.l,y.m,w.l,w.m,Z.l;
 48
 49 execute_unload"phase2.gdx" z, y , w;
 50 execute'gdxxrw.exe phase2.gdx var=z rng=z!b2'
 51 execute'gdxxrw.exe phase2.gdx var=y rng=y!b2'
 52 execute'gdxxrw.exe phase2.gdx var=w rng=w!b2'
 53

General Algebraic Modeling System

Include File Summary

| SEQ | GLOBAL | TYPE | PARENT | LOCAL | FILENAME |
|-----|--------|-------|--------|-------|---|
| 1 | 1 | INPUT | 0 | 0 | C:\Users\user\Desktop\New folder (2)\O R2 GAMS project.gms |
| 2 | 8 | CALL | 1 | 8 | gdxxrw.exe C:/Users/user/Documents/gam sdir/projdir/Phase2.xlsx par=Days Rng = Days!A1:F12 rdim=1 cdim=1 |
| 3 | 9 | GDXIN | 1 | 9 | C:\Users\user\Documents\gamsdir\projdi r\Phase2.gdx |
| 4 | 14 | CALL | 1 | 14 | gdxxrw.exe C:/Users/user/Documents/gam sdir/projdir/Phase2.xlsx par=numberofc redits Rng =numberofcredits!A1:B12 rdi m=1 |
| 5 | 15 | GDXIN | 1 | 15 | C:\Users\user\Documents\gamsdir\projdi r\Phase2.gdx |
| 6 | 20 | CALL | 1 | 20 | gdxxrw.exe C:/Users/user/Documents/gam sdir/projdir/Phase2.xlsx par=costofbui ld Rng = costofbuild!A1:d6 rdim=1 cdim =1 |
| 7 | 21 | GDXIN | 1 | 21 | C:\Users\user\Documents\gamsdir\projdi r\Phase2.gdx |
| 8 | 26 | CALL | 1 | 26 | gdxxrw.exe C:/Users/user/Documents/gam sdir/projdir/Phase2.xlsx par=interestr ate Rng = interestrate!A1:F2 cdim=1 |
| 9 | 27 | GDXIN | 1 | 27 | C:\Users\user\Documents\gamsdir\projdi r\Phase2.gdx |

COMPILATION TIME = 4.945 SECONDS 3 MB 35.1.0 r82a9585 WEX-WEI

General Algebraic Modeling System

Equation Listing SOLVE main Using MIP From line 46

---- lost_profits =E= meghdar soode az dast rafte

lost_profits.. z - 84*y(NY,region1) - 63*y(NY,region2) - 70*y(NY,region3)

- 63*y(NY,region4) - 105*y(NY,region5) - 84*y(AZ,region1)

- 94.5*y(AZ,region2) - 126*y(AZ,region3) - 94.5*y(AZ,region4)

- 140*y(AZ,region5) - 60*y(CA,region1) - 45*y(CA,region2)

- 84*y(CA,region3) - 45*y(CA,region4) - 90*y(CA,region5)

- 80*y(FL,region1) - 37.5*y(FL,region2) - 50*y(FL,region3)

- 15*y(FL,region4) - 37.5*y(FL,region5) - 98*y(GA,region1)

- 31.5*y(GA,region2) - 84*y(GA,region3) - 73.5*y(GA,region4)

- 87.5*y(GA,region5) - 64*y(IL,region1) - 36*y(IL,region2)

- 128*y(IL,region3) - 96*y(IL,region4) - 60*y(IL,region5)

- 16*y(KY,region1) - 6*y(KY,region2) - 28*y(KY,region3) - 15*y(KY,region4)

- 20*y(KY,region5) - 60*y(MD,region1) - 30*y(MD,region2)

$$- 80*y(MD,region3) - 52.5*y(MD,region4) - 25*y(MD,region5)$$

$$- 72*y(MS,region1) - 36*y(MS,region2) - 24*y(MS,region3)$$

$$- 42*y(MS,region4) - 50*y(MS,region5) - 60*y(NV,region1)$$

$$- 67.5*y(NV,region2) - 90*y(NV,region3) - 30*y(NV,region4)$$

$$- 100*y(NV,region5) - 126*y(LA,region1) - 105*y(LA,region2)$$

$$- 140*y(LA,region3) - 94.5*y(LA,region4) - 140*y(LA,region5)$$

$$- 35*w(region1,small) - 35*w(region1,medium) - 40*w(region1,large)$$

$$- 30*w(region2,small) - 45*w(region2,medium) - 90*w(region2,large)$$

$$- 40*w(region3,small) - 45*w(region3,medium) - 90*w(region3,large)$$

$$- 10*w(region4,small) - 30*w(region4,medium) - 30*w(region4,large)$$

$$- 20*w(region5,small) - 35*w(region5,medium) - 55*w(region5,large) = E = 0 ;$$

$$(LHS = 0)$$

---- states =E= mahdoodiate in ke az har state faghat be 1 region pardakhti er
sal mishavad

$$states(NY).. y(NY,region1) + y(NY,region2) + y(NY,region3) + y(NY,region4)$$

$$+ y(NY,region5) = E = 1 ; (LHS = 0, INFES = 1 ****)$$

states(AZ).. $y(AZ,region1) + y(AZ,region2) + y(AZ,region3) + y(AZ,region4)$

+ $y(AZ,region5) = E = 1$; (LHS = 0, INFES = 1 ****)

states(CA).. $y(CA,region1) + y(CA,region2) + y(CA,region3) + y(CA,region4)$

+ $y(CA,region5) = E = 1$; (LHS = 0, INFES = 1 ****)

REMAINING 8 ENTRIES SKIPPED

---- regions =L= mahdoodiate in ke dar har region maximum 1 center mitavan sak
ht

regions(region1).. $w(region1,small) + w(region1,medium) + w(region1,large) = L =$
 1 ; (LHS = 0)

regions(region2).. $w(region2,small) + w(region2,medium) + w(region2,large) = L =$
 1 ; (LHS = 0)

regions(region3).. $w(region3,small) + w(region3,medium) + w(region3,large) = L =$
 1 ; (LHS = 0)

REMAINING 2 ENTRIES SKIPPED

---- centers =L= mahdoodiat in ke small centers va medium centers va large cen
ters be tartib maximum 2 va 3 va 4 meghdar daryafti az states
mitavanand dashte bashand

$$\begin{aligned}
& \text{centers(region1).. } y(\text{NY,region1}) + y(\text{AZ,region1}) + y(\text{CA,region1}) \\
& + y(\text{FL,region1}) + y(\text{GA,region1}) + y(\text{IL,region1}) + y(\text{KY,region1}) \\
& + y(\text{MD,region1}) + y(\text{MS,region1}) + y(\text{NV,region1}) + y(\text{LA,region1}) \\
& - 2*w(\text{region1,small}) - 3*w(\text{region1,medium}) - 4*w(\text{region1,large}) = L = 0 ; \\
& (\text{LHS} = 0)
\end{aligned}$$

$$\begin{aligned}
& \text{centers(region2).. } y(\text{NY,region2}) + y(\text{AZ,region2}) + y(\text{CA,region2}) \\
& + y(\text{FL,region2}) + y(\text{GA,region2}) + y(\text{IL,region2}) + y(\text{KY,region2}) \\
& + y(\text{MD,region2}) + y(\text{MS,region2}) + y(\text{NV,region2}) + y(\text{LA,region2}) \\
& - 2*w(\text{region2,small}) - 3*w(\text{region2,medium}) - 4*w(\text{region2,large}) = L = 0 ; \\
& (\text{LHS} = 0)
\end{aligned}$$

$$\begin{aligned}
& \text{centers(region3).. } y(\text{NY,region3}) + y(\text{AZ,region3}) + y(\text{CA,region3}) \\
& + y(\text{FL,region3}) + y(\text{GA,region3}) + y(\text{IL,region3}) + y(\text{KY,region3}) \\
& + y(\text{MD,region3}) + y(\text{MS,region3}) + y(\text{NV,region3}) + y(\text{LA,region3}) \\
& - 2*w(\text{region3,small}) - 3*w(\text{region3,medium}) - 4*w(\text{region3,large}) = L = 0 ; \\
& (\text{LHS} = 0)
\end{aligned}$$

REMAINING 2 ENTRIES SKIPPED

General Algebraic Modeling System

Column Listing SOLVE main Using MIP From line 46

---- z tabe hadaf

z

(.LO, .L, .UP, .M = -INF, 0, +INF, 0)

1 lost_profits

---- y dar soorati ke az state i be region j pardakhti ersal shavad meghdare 1
 migirad va dar gheyre in soorat meghdare 0 migirad

y(NY,region1)

(.LO, .L, .UP, .M = 0, 0, 1, 0)

-84 lost_profits

1 states(NY)

1 centers(region1)

y(NY,region2)

(.LO, .L, .UP, .M = 0, 0, 1, 0)

-63 lost_profits

1 states(NY)

1 centers(region2)

y(NY,region3)

(.LO, .L, .UP, .M = 0, 0, 1, 0)

-70 lost_profits

1 states(NY)


```
1    centers(region3)
```

REMAINING 52 ENTRIES SKIPPED

---- w dar soorati ke maghdare 1 begirad be in ma'nast ke dar region j andaze c
enter k mibashad

```
w(region1,small)
```

```
(.LO, .L, .UP, .M = 0, 0, 1, 0)
```

```
-35    lost_profits
```

```
1      regions(region1)
```

```
-2      centers(region1)
```

```
w(region1,medium)
```

```
(.LO, .L, .UP, .M = 0, 0, 1, 0)
```

```
-35    lost_profits
```

```
1      regions(region1)
```

```
-3      centers(region1)
```

```
w(region1,large)
```

```
(.LO, .L, .UP, .M = 0, 0, 1, 0)
```

```
-40    lost_profits
```

```
1      regions(region1)
```

```
-4      centers(region1)
```

REMAINING 12 ENTRIES SKIPPED

General Algebraic Modeling System

Model Statistics SOLVE main Using MIP From line 46

MODEL STATISTICS

| | | | |
|---------------------|-----|--------------------|----|
| BLOCKS OF EQUATIONS | 4 | SINGLE EQUATIONS | 22 |
| BLOCKS OF VARIABLES | 3 | SINGLE VARIABLES | 71 |
| NON ZERO ELEMENTS | 211 | DISCRETE VARIABLES | 70 |

GENERATION TIME = 0.032 SECONDS 4 MB 35.1.0 r82a9585 WEX-WEI

General Algebraic Modeling System

Solution Report SOLVE main Using MIP From line 46

SOLVE SUMMARY

| | |
|------------|--------------------|
| MODEL main | OBJECTIVE z |
| TYPE MIP | DIRECTION MINIMIZE |
| SOLVER CBC | FROM LINE 46 |

**** SOLVER STATUS 1 Normal Completion

**** MODEL STATUS 8 Integer Solution

**** OBJECTIVE VALUE 620.0000

RESOURCE USAGE, LIMIT 0.098 10000000000.000

ITERATION COUNT, LIMIT 15 2147483647

COIN-OR CBC 35.1.0 r82a9585 Released Apr 29, 2021 WEI x86 64bit/MS Window

Integer solution of 633 found by feasibility pump after 0 iterations and 0 nodes

(0.03 seconds)

Integer solution of 620 found by DiveCoefficient after 15 iterations and 0 nodes

(0.03 seconds)

6 added rows had average density of 10.666667

At root node, 6 cuts changed objective from 584 to 620 in 3 passes

Cut generator 0 (Probing) - 0 row cuts average 0.0 elements, 0 column cuts (0 active) in 0.001 seconds - new frequency is -100

Cut generator 1 (Gomory) - 4 row cuts average 16.3 elements, 0 column cuts (0 active) in 0.001 seconds - new frequency is 1

Cut generator 2 (Knapsack) - 3 row cuts average 4.0 elements, 0 column cuts (0 active)

ctive) in 0.000 seconds - new frequency is 1

Cut generator 3 (Clique) - 0 row cuts average 0.0 elements, 0 column cuts (0 active) in 0.000 seconds - new frequency is -100

Cut generator 4 (MixedIntegerRounding2) - 4 row cuts average 8.3 elements, 0 column cuts (0 active) in 0.001 seconds - new frequency is 1

Cut generator 5 (FlowCover) - 0 row cuts average 0.0 elements, 0 column cuts (0 active) in 0.000 seconds - new frequency is -100

Cut generator 6 (TwoMirCuts) - 16 row cuts average 23.3 elements, 0 column cuts (0 active) in 0.000 seconds - new frequency is 1

Cut generator 7 (ZeroHalf) - 1 row cuts average 7.0 elements, 0 column cuts (0 active) in 0.000 seconds - new frequency is -100

Search completed - best objective 620, took 15 iterations and 0 nodes (0.09 seconds)

Maximum depth 0, 30 variables fixed on reduced cost

Solved to optimality (within gap tolerances optca and optcr).

MIP solution: 6.200000e+02 (0 nodes, 0.098 seconds)

Best possible: 6.200000e+02

Absolute gap: 0.000000e+00 (absolute tolerance optca: 0)

Relative gap: 0.000000e+00 (relative tolerance optcr: 0.0001)

Optimal - objective value 620

| LOWER | LEVEL | UPPER | MARGINAL |
|-------|-------|-------|----------|
|-------|-------|-------|----------|

| | | | |
|---------------------|---|---|-------|
| ---- EQU lost_prof~ | . | . | 1.000 |
|---------------------|---|---|-------|

lost_profits meghdar soode az dast rafte

---- EQU states mahdoodiate in ke az har state faghat be 1 region pardakhti ers al mishavad

| | LOWER | LEVEL | UPPER | MARGINAL |
|--|-------|-------|-------|----------|
|--|-------|-------|-------|----------|

| | | | | |
|----|-------|-------|-------|---|
| NY | 1.000 | 1.000 | 1.000 | . |
| AZ | 1.000 | 1.000 | 1.000 | . |
| CA | 1.000 | 1.000 | 1.000 | . |
| FL | 1.000 | 1.000 | 1.000 | . |
| GA | 1.000 | 1.000 | 1.000 | . |
| IL | 1.000 | 1.000 | 1.000 | . |
| KY | 1.000 | 1.000 | 1.000 | . |
| MD | 1.000 | 1.000 | 1.000 | . |
| MS | 1.000 | 1.000 | 1.000 | . |
| NV | 1.000 | 1.000 | 1.000 | . |
| LA | 1.000 | 1.000 | 1.000 | . |

---- EQU regions mahdoodiate in ke dar har region maximum 1 center mitavan sakh
t

| | LOWER | LEVEL | UPPER | MARGINAL |
|--|-------|-------|-------|----------|
|--|-------|-------|-------|----------|

| | | | | |
|---------|------|-------|-------|---|
| region1 | -INF | 1.000 | 1.000 | . |
| region2 | -INF | 1.000 | 1.000 | . |
| region3 | -INF | . | 1.000 | . |
| region4 | -INF | 1.000 | 1.000 | . |
| region5 | -INF | 1.000 | 1.000 | . |

---- EQU centers mahdoodiat in ke small centers va medium centers va large cent
ers be tartib maximum 2 va 3 va 4 meghdar daryafte az states m
itavanand dashte bashand

| | LOWER | LEVEL | UPPER | MARGINAL |
|--|-------|-------|-------|----------|
|--|-------|-------|-------|----------|

| | | | | |
|---------|------|--------|---|---|
| region1 | -INF | -1.000 | . | . |
| region2 | -INF | . | . | . |
| region3 | -INF | . | . | . |
| region4 | -INF | . | . | . |
| region5 | -INF | . | . | . |

| | | | |
|-------|-------|-------|----------|
| LOWER | LEVEL | UPPER | MARGINAL |
|-------|-------|-------|----------|

| | | | | | |
|------|-------|------|---------|------|---|
| ---- | VAR z | -INF | 620.000 | +INF | . |
|------|-------|------|---------|------|---|

z tabe hadaf

---- VAR y dar soorati ke az state i be region j pardakhti ersal shavad meghdar
e 1 migirad va dar gheyre in soorat meghdare 0 migirad

| | | | |
|-------|-------|-------|----------|
| LOWER | LEVEL | UPPER | MARGINAL |
|-------|-------|-------|----------|

| | | | | |
|------------|---|-------|-------|---------|
| NY.region1 | . | . | 1.000 | 84.000 |
| NY.region2 | . | 1.000 | 1.000 | 63.000 |
| NY.region3 | . | . | 1.000 | 70.000 |
| NY.region4 | . | . | 1.000 | 63.000 |
| NY.region5 | . | . | 1.000 | 105.000 |
| AZ.region1 | . | 1.000 | 1.000 | 84.000 |
| AZ.region2 | . | . | 1.000 | 94.500 |
| AZ.region3 | . | . | 1.000 | 126.000 |
| AZ.region4 | . | . | 1.000 | 94.500 |
| AZ.region5 | . | . | 1.000 | 140.000 |
| CA.region1 | . | . | 1.000 | 60.000 |
| CA.region2 | . | . | 1.000 | 45.000 |
| CA.region3 | . | . | 1.000 | 84.000 |
| CA.region4 | . | 1.000 | 1.000 | 45.000 |

| | | | | |
|------------|---|-------|-------|---------|
| CA.region5 | . | . | 1.000 | 90.000 |
| FL.region1 | . | . | 1.000 | 80.000 |
| FL.region2 | . | . | 1.000 | 37.500 |
| FL.region3 | . | . | 1.000 | 50.000 |
| FL.region4 | . | 1.000 | 1.000 | 15.000 |
| FL.region5 | . | . | 1.000 | 37.500 |
| GA.region1 | . | . | 1.000 | 98.000 |
| GA.region2 | . | 1.000 | 1.000 | 31.500 |
| GA.region3 | . | . | 1.000 | 84.000 |
| GA.region4 | . | . | 1.000 | 73.500 |
| GA.region5 | . | . | 1.000 | 87.500 |
| IL.region1 | . | . | 1.000 | 64.000 |
| IL.region2 | . | 1.000 | 1.000 | 36.000 |
| IL.region3 | . | . | 1.000 | 128.000 |
| IL.region4 | . | . | 1.000 | 96.000 |
| IL.region5 | . | . | 1.000 | 60.000 |
| KY.region1 | . | 1.000 | 1.000 | 16.000 |
| KY.region2 | . | . | 1.000 | 6.000 |
| KY.region3 | . | . | 1.000 | 28.000 |
| KY.region4 | . | . | 1.000 | 15.000 |
| KY.region5 | . | . | 1.000 | 20.000 |
| MD.region1 | . | . | 1.000 | 60.000 |
| MD.region2 | . | . | 1.000 | 30.000 |
| MD.region3 | . | . | 1.000 | 80.000 |
| MD.region4 | . | . | 1.000 | 52.500 |
| MD.region5 | . | 1.000 | 1.000 | 25.000 |
| MS.region1 | . | . | 1.000 | 72.000 |
| MS.region2 | . | . | 1.000 | 36.000 |
| MS.region3 | . | . | 1.000 | 24.000 |
| MS.region4 | . | . | 1.000 | 42.000 |
| MS.region5 | . | 1.000 | 1.000 | 50.000 |

| | | | | |
|------------|---|-------|-------|---------|
| NV.region1 | . | . | 1.000 | 60.000 |
| NV.region2 | . | . | 1.000 | 67.500 |
| NV.region3 | . | . | 1.000 | 90.000 |
| NV.region4 | . | 1.000 | 1.000 | 30.000 |
| NV.region5 | . | . | 1.000 | 100.000 |
| LA.region1 | . | . | 1.000 | 126.000 |
| LA.region2 | . | . | 1.000 | 105.000 |
| LA.region3 | . | . | 1.000 | 140.000 |
| LA.region4 | . | 1.000 | 1.000 | 94.500 |
| LA.region5 | . | . | 1.000 | 140.000 |

---- VAR w dar soorati ke maghdare 1 begirad be in ma'nast ke dar region j anda
ze center k mibashad

LOWER LEVEL UPPER MARGINAL

| | | | | |
|----------------|---|-------|-------|--------|
| region1.small | . | . | 1.000 | 35.000 |
| region1.medium | . | 1.000 | 1.000 | 35.000 |
| region1.large | . | . | 1.000 | 40.000 |
| region2.small | . | . | 1.000 | 30.000 |
| region2.medium | . | 1.000 | 1.000 | 45.000 |
| region2.large | . | . | 1.000 | 90.000 |
| region3.small | . | . | 1.000 | 40.000 |
| region3.medium | . | . | 1.000 | 45.000 |
| region3.large | . | . | 1.000 | 90.000 |
| region4.small | . | . | 1.000 | 10.000 |
| region4.medium | . | . | 1.000 | 30.000 |
| region4.large | . | 1.000 | 1.000 | 30.000 |
| region5.small | . | 1.000 | 1.000 | 20.000 |
| region5.medium | . | . | 1.000 | 35.000 |
| region5.large | . | . | 1.000 | 55.000 |

**** REPORT SUMMARY : 0 NONOPT

0 INFEASIBLE

0 UNBOUNDED

General Algebraic Modeling System

Execution

---- 47 VARIABLE y.L dar soorati ke az state i be region j pardakhti ersal
shavad meghdare 1 migirad va dar gheyre in soorat megh
dare 0 migirad

| | region1 | region2 | region4 | region5 |
|----|---------|---------|---------|---------|
| NY | | 1.000 | | |
| AZ | 1.000 | | | |
| CA | | | 1.000 | |
| FL | | | 1.000 | |
| GA | | 1.000 | | |
| IL | | 1.000 | | |
| KY | 1.000 | | | |
| MD | | | 1.000 | |
| MS | | | 1.000 | |
| NV | | | 1.000 | |
| LA | | | 1.000 | |

---- 47 VARIABLE y.M dar soorati ke az state i be region j pardakhti ersal
shavad meghdare 1 migirad va dar gheyre in soorat megh
dare 0 migirad

| | region1 | region2 | region3 | region4 | region5 |
|----|---------|---------|---------|---------|---------|
| NY | 84.000 | 63.000 | 70.000 | 63.000 | 105.000 |

| | | | | | |
|----|---------|---------|---------|--------|---------|
| AZ | 84.000 | 94.500 | 126.000 | 94.500 | 140.000 |
| CA | 60.000 | 45.000 | 84.000 | 45.000 | 90.000 |
| FL | 80.000 | 37.500 | 50.000 | 15.000 | 37.500 |
| GA | 98.000 | 31.500 | 84.000 | 73.500 | 87.500 |
| IL | 64.000 | 36.000 | 128.000 | 96.000 | 60.000 |
| KY | 16.000 | 6.000 | 28.000 | 15.000 | 20.000 |
| MD | 60.000 | 30.000 | 80.000 | 52.500 | 25.000 |
| MS | 72.000 | 36.000 | 24.000 | 42.000 | 50.000 |
| NV | 60.000 | 67.500 | 90.000 | 30.000 | 100.000 |
| LA | 126.000 | 105.000 | 140.000 | 94.500 | 140.000 |

---- 47 VARIABLE w.L dar soorati ke maghdare 1 begirad be in ma'nast ke dar
region j andaze center k mibashad

| | small | medium | large |
|---------|-------|--------|-------|
| region1 | | 1.000 | |
| region2 | | 1.000 | |
| region4 | | | 1.000 |
| region5 | 1.000 | | |

---- 47 VARIABLE w.M dar soorati ke maghdare 1 begirad be in ma'nast ke dar
region j andaze center k mibashad

| | small | medium | large |
|---------|--------|--------|--------|
| region1 | 35.000 | 35.000 | 40.000 |
| region2 | 30.000 | 45.000 | 90.000 |
| region3 | 40.000 | 45.000 | 90.000 |

| | | | |
|---------|--------|--------|--------|
| region4 | 10.000 | 30.000 | 30.000 |
| region5 | 20.000 | 35.000 | 55.000 |

---- 47 VARIABLE z.L = 620.000 tabe hadaf

EXECUTION TIME = 4.057 SECONDS 4 MB 35.1.0 r82a9585 WEX-WEI

USER: GAMS Demo license for a a G210525|0002CO-GEN
MIT university, United States of America DL042035

**** FILE SUMMARY

Input C:\Users\user\Desktop\New folder (2)\OR2 GAMS project.gms

Output C:\Users\user\Documents\gamssdir\projdir\OR2 GAMS project.lst