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دوره جامع آنلاین بهینه‌سازی استوار و برنامه‌ریزی در شرایط عدم‌قطعیت همراه با کدنویسی در نرم‌افزار(GAMS)

Decision-Making under Uncertainty (Robust Optimization - Stochastic Programming - Fuzzy Programming)

مدرس:

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تخصص شاخص: بهینه‌سازی و تحقیق در عملیات، علم تحلیل داده، تکنیک‌های تجزیه و روش‌های حل دقیق، بهینه‌سازی استوار داده‌محور، هوش محاسباتی و الگوریتم‌های فرابتکاری، نظریه بازی، بهینه‌سازی چندهدفه و تصمیم‌گیری چندمعیاره

Optimization & Operations Research, Data Analytics, Computational Intelligence & Metaheuristics, Decomposition Techniques & Exact Methods, Data-Driven Robust Optimization, Game Theory, Multi Criteria Decision Making

کدهای نرم‌افزاری

SCND_Nominal

SCND_RNSSP

SCND_RASSP

SCND_HybridSSP

SCND_Regret

SCND_RelativeRegret

SCND_Aghezzaf

SCND_DevelopedHybridModel

SCND_Nominal

```
Sets
S       /s1*s10/
D       /d1*d20/
C       /c1*c30/
w       /w1*w5/
;


Parameters
A(s)
f(d)
b(s)
trSD(s,d)
trDC(d,c)
p
dem(c,w)
dem_N(c)
capD(d)
capS(s)
Prob(w)
/
w1      0.2
w2      0.3
w3      0.1
w4      0.2
w5      0.2
/
;
A(s)    = uniform(1000,1500);
```

f(d) = uniform(2000,3000);

b(s) = uniform(5,10);

trSD(s,d)= uniform(1,2);

trDC(d,c)= uniform(0.5,0.7);

p = 15;

capD(d) = uniform(500,1000);

capS(s) = uniform(1000,2000);

dem(c,'w1') = uniform(50,100);

dem(c,'w2') = (1+0.8)*dem(c,'w1') ;

dem(c,'w3') = (1+0.2)*dem(c,'w1') ;

dem(c,'w4') = (1-0.2)*dem(c,'w1') ;

dem(c,'w5') = (1-0.3)*dem(c,'w1') ;

dem_N(c)= sum(w,prob(w)*dem(c,w));

****

Free Variable

Z;

Binary Variables

y(s)

x(d)

;

Positive Variable

```
u(s)
QSD(s,d)
QDC(d,c)
;

Equations
obj
cons1
cons2
cons3
cons4
cons5
;

obj..  z =e= p*sum({d,c},QDC(d,c)) - (sum(d,f(d)*x(d)) + sum(s,A(s)*y(s)) + sum({s,d},trSD(s,d)*QSD(s,d))
                                    + sum({d,c},trDC(d,c)*QDC(d,c)) + sum(s,b(s)*u(s))) ;

cons1(s)..  u(s) =L= capS(s)*y(s);

cons2(d)..  sum(S,QSD(s,d))=L= capD(d)*x(d);

cons3(s)..  u(s) =e= sum(d,QSD(s,d));

cons4(d)..  sum(s,QSD(s,d)) =e= sum(c,QDC(d,c));

cons5(c)..  sum(d,QDC(d,c)) =l= dem_N(c);
```

```
Model SCND
/
obj
cons1
cons2
cons3
cons4
cons5
/
;

Options
mip = CPLEX
reslim =100
optcr = 0
;

Solve SCND us mip max Z;

Display
Z.l
y.l
x.l
QSD.l
QDC.l
;
```

SCND_RNSSP

```
Sets
S       /s1*s10/
D       /d1*d20/
C       /c1*c30/
w       /w1*w5/
;


Parameters
A(s)
f(d)
b(s)
trSD(s,d)
trDC(d,c)
p
dem(c,w)
dem_N(c)
capD(d)
capS(s)
Prob(w)
/
w1      0.2
w2      0.3
w3      0.1
w4      0.2
w5      0.2
/


;
```

```
A(s)     = uniform(1000,1500);
f(d)     = uniform(2000,3000);
b(s)     = uniform(5,10);
trSD(s,d)= uniform(1,2);
trDC(d,c)= uniform(0.5,0.7);
p        = 15;
capD(d)  = uniform(500,1000);
capS(s)  = uniform(1000,2000);



dem(c,'w1')   = uniform(50,100);
dem(c,'w2')   = (1+0.8)*dem(c,'w1') ;
dem(c,'w3')   = (1+0.2)*dem(c,'w1') ;
dem(c,'w4')   = (1-0.2)*dem(c,'w1') ;
dem(c,'w5')   = (1-0.3)*dem(c,'w1') ;


dem_N(c)= sum(w,prob(w)*dem(c,w));



Display
A
f
b
trSD
trDC
p
```

capD

capS

dem

dem_N

;

****

Free Variable

Z(w)

EB

;

Binary Variables

y(s)

x(d)

;

Positive Variable

u(s,w)

QSD(s,d,w)

QDC(d,c,w)

;

Equations

obj_RNSSP

```
obj_Scenario
cons1
cons2
cons3
cons4
cons5
;

obj_RNSSP..      EB =e= sum(w,Prob(w)*Z(w));

obj_Scenario(w) ..      z(w) =e=   p*sum({d,c},QDC(d,c,w)) - (sum(d,f(d)*x(d)) + sum(s,A(s)*y(s)) + sum({s,d},trSD(s,d)*QSD(s,d,w))
                                    + sum({d,c},trDC(d,c)*QDC(d,c,w)) + sum(s,b(s)*u(s,w))) ;

cons1(s,w)..      u(s,w) =L= capS(s)*y(s);

cons2(d,w)..      sum(S,QSD(s,d,w))=L= capD(d)*x(d);

cons3(s,w)..      u(s,w) =e= sum(d,QSD(s,d,w));

cons4(d,w)..      sum(s,QSD(s,d,w)) =e= sum(c,QDC(d,c,w));

cons5(c,w)..      sum(d,QDC(d,c,w)) =l= dem(c,w);

Model SCND
/
obj_RNSSP
```

```
obj_Scenario
cons1
cons2
cons3
cons4

cons5
/
;

Options
mip = CPLEX
reslim =100
optcr = 0
;

Solve SCND us mip max EB;

Display
EB.l
Z.l
y.l
x.l
QSD.l
QDC.l
;
```

SCND_RASSP

```
Sets
S       /s1*s10/
D       /d1*d20/
C       /c1*c30/
w       /w1*w5/
;


Parameters
A(s)
f(d)
b(s)
trSD(s,d)
trDC(d,c)
p
dem(c,w)
dem_N(c)
capD(d)
capS(s)
Prob(w)
/
w1      0.2
w2      0.3
w3      0.1
w4      0.2
w5      0.2
/
;
```

```
A(s)     = uniform(1000,1500);
f(d)     = uniform(2000,3000);
b(s)     = uniform(5,10);
trSD(s,d)= uniform(1,2);
trDC(d,c)= uniform(0.5,0.7);
p        = 15;
capD(d)  = uniform(500,1000);
capS(s)  = uniform(1000,2000);



dem(c,'w1')   = uniform(50,100);
dem(c,'w2')   = (1+0.8)*dem(c,'w1') ;
dem(c,'w3')   = (1+0.2)*dem(c,'w1') ;
dem(c,'w4')   = (1-0.2)*dem(c,'w1') ;
dem(c,'w5')   = (1-0.3)*dem(c,'w1') ;


dem_N(c)= sum(w,prob(w)*dem(c,w));


Display
A
f
b
trSD
trDC
p
capD
capS
dem
dem_N
```

;

****

Free Variable

Z(w)

EB

WB

;

Binary Variables

y(s)

x(d)

;

Positive Variable

u(s,w)

QSD(s,d,w)

QDC(d,c,w)

;

Equations

obj_RNSSP

obj_RASSP

obj_Scenario

cons1

cons2

cons3

cons4

```
cons5

;

obj_RNSSP..        EB =e= sum(w,Prob(w)*Z(w));


obj_RASSP(w)..     WB =l= Z(w);


obj_Scenario(w) ..      z(w) =e=   p*sum({d,c},QDC(d,c,w)) - (sum(d,f(d)*x(d)) + sum(s,A(s)*y(s)) +
sum({s,d},trSD(s,d)*QSD(s,d,w))
                                   + sum({d,c},trDC(d,c)*QDC(d,c,w)) + sum(s,b(s)*u(s,w))) ;


cons1(s,w)..       u(s,w) =L= capS(s)*y(s);


cons2(d,w)..       sum(S,QSD(s,d,w))=L= capD(d)*x(d);


cons3(s,w)..       u(s,w) =e= sum(d,QSD(s,d,w));


cons4(d,w)..       sum(s,QSD(s,d,w)) =e= sum(c,QDC(d,c,w));


cons5(c,w)..       sum(d,QDC(d,c,w)) =l= dem(c,w);


Model SCND

/

obj_RNSSP

obj_RASSP

obj_Scenario

cons1

cons2

cons3
```

```
cons4
cons5
/
;
Options
mip = CPLEX
reslim =100
optcr = 0
;

Solve SCND us mip max WB;

Display
WB.l
EB.l
Z.l
y.l
x.l
QSD.l
QDC.l
;
```

SCND_HybridSSP

```
Sets
S       /s1*s10/
D       /d1*d20/
C       /c1*c30/
w       /w1*w5/
;


Parameters
A(s)
f(d)
b(s)
trSD(s,d)
trDC(d,c)
p
dem(c,w)
dem_N(c)
capD(d)
capS(s)
Prob(w)
/
w1      0.2
w2      0.3
w3      0.1
w4      0.2
w5      0.2
/
;
```

```
A(s)     = uniform(1000,1500);
f(d)     = uniform(2000,3000);
b(s)     = uniform(5,10);
trSD(s,d)= uniform(1,2);
trDC(d,c)= uniform(0.5,0.7);
p        = 15;
capD(d)  = uniform(500,1000);
capS(s)  = uniform(1000,2000);

dem(c,'w1')   = uniform(50,100);
dem(c,'w2')   = (1+0.8)*dem(c,'w1') ;
dem(c,'w3')   = (1+0.2)*dem(c,'w1') ;
dem(c,'w4')   = (1-0.2)*dem(c,'w1') ;
dem(c,'w5')   = (1-0.3)*dem(c,'w1') ;

dem_N(c)= sum(w,prob(w)*dem(c,w));

Display
A
f
b
trSD
trDC
p
capD
capS
dem
dem_N
;
```

****

Free Variable

Z(w)

EB

WB

HO

;

Binary Variables

y(s)

x(d)

;

Positive Variable

u(s,w)

QSD(s,d,w)

QDC(d,c,w)

;

Equations

obj_Hybrid

obj_RNSSP

obj_RASSP

obj_Scenario

cons1

```
cons2
cons3
cons4
cons5
;

Sets
Iter /iter0*iter10/

Parameter
Lamda
L(iter)
*Worst-Case Importancy    (0,1)
;
L(iter)=(ord(iter)-1)/(card(iter)-1);
Display L;
;

obj_Hybrid..        HO =e= Lamda*WB + (1-Lamda)*EB;

obj_RNSSP..         EB =e= sum(w,Prob(w)*Z(w));

obj_RASSP(w)..      WB =l= Z(w);

obj_Scenario(w) ..    z(w) =e=  p*sum({d,c},QDC(d,c,w)) - (sum(d,f(d)*x(d)) + sum(s,A(s)*y(s)) +
sum({s,d},trSD(s,d)*QSD(s,d,w))
                                    + sum({d,c},trDC(d,c)*QDC(d,c,w)) + sum(s,b(s)*u(s,w))) ;

cons1(s,w)..        u(s,w) =L= capS(s)*y(s);
```

```
cons2(d,w)..      sum(S,QSD(s,d,w))=L= capD(d)*x(d);

cons3(s,w)..      u(s,w) =e= sum(d,QSD(s,d,w));

cons4(d,w)..      sum(s,QSD(s,d,w)) =e= sum(c,QDC(d,c,w));

cons5(c,w)..      sum(d,QDC(d,c,w)) =l= dem(c,w);



Model SCND
/
obj_Hybrid
obj_RNSSP
obj_RASSP
obj_Scenario
cons1
cons2
cons3
cons4
cons5
/
;

Options
mip = CPLEX
reslim =100
optcr = 0
;
```

```
Parameters
WorstCaseBenefit(iter)
ExpectefBenefit (iter)
Result(iter,*)
;

Loop(iter,

Lamda=L(iter);

Solve SCND us mip max HO;

WorstCaseBenefit(iter)=WB.l;
ExpectefBenefit (iter)=EB.l;
Result(iter,'Lamda') = Lamda;
Result(iter,'WB') = WB.l;
Result(iter,'EB') = EB.l;

Display
HO.l
WB.l
EB.l
Z.l
y.l
x.l
QSD.l
QDC.l
;
);
```

*end if loop

Display

Result

SCND_Regret

```
Sets
S       /s1*s10/
D       /d1*d20/
C       /c1*c30/
w       /w1*w5/
;


Parameters
A(s)
f(d)
b(s)
trSD(s,d)
trDC(d,c)
p
dem(c,w)
dem_N(c)
dem_w(c)
capD(d)
capS(s)
Prob(w)
/
w1      0.2
w2      0.3
w3      0.1
w4      0.2
w5      0.2
/
;
```

```
A(s)     = uniform(1000,1500);
f(d)     = uniform(2000,3000);
b(s)     = uniform(5,10);
trSD(s,d)= uniform(1,2);
trDC(d,c)= uniform(0.5,0.7);
p        = 15;
capD(d)  = uniform(500,1000);
capS(s)  = uniform(1000,2000);



dem(c,'w1')   = uniform(50,100);
dem(c,'w2')   = (1+0.8)*dem(c,'w1') ;
dem(c,'w3')   = (1+0.2)*dem(c,'w1') ;
dem(c,'w4')   = (1-0.2)*dem(c,'w1') ;
dem(c,'w5')   = (1-0.3)*dem(c,'w1') ;


dem_N(c)= sum(w,prob(w)*dem(c,w));



Display
A
f
b
trSD
trDC
p
```

capD

capS

dem

dem_N

;

****

Free Variable

AR

RR

Z_w

Z(w)

EB

WB

;

Binary Variables

y(s)

x(d)

;

Positive Variable

u(s,w)

QSD(s,d,w)

QDC(d,c,w)

u_w(s)

QSD_w(s,d)

QDC_w(d,c)

;

Equations

obj_AR

obj_RNSSP

obj_RASSP

obj_Scenario

obj_w

cons1

cons2

cons3

cons4

cons5

cons1_w

cons2_w

cons3_w

cons4_w

cons5_w

;

****

obj_w .. Z_w =e= p*sum({d,c},QDC_w(d,c)) - (sum(d,f(d)*x(d)) + sum(s,A(s)*y(s)) + sum({s,d},trSD(s,d)*QSD_w(s,d))

+ sum({d,c},trDC(d,c)*QDC_w(d,c)) + sum(s,b(s)*u_w(s))) ;

```
cons1_w(s)..      u_w(s) =L= capS(s)*y(s);

cons2_w(d)..      sum(S,QSD_w(s,d))=L= capD(d)*x(d);

cons3_w(s)..      u_w(s) =e= sum(d,QSD_w(s,d));

cons4_w(d)..      sum(s,QSD_w(s,d)) =e= sum(c,QDC_w(d,c));

cons5_w(c)..      sum(d,QDC_w(d,c)) =l= dem_w(c);
**************

Model SCND_W
/
obj_w
cons1_w
cons2_w
cons3_w
cons4_w
cons5_w
/
;

Options
Optcr=0;
```

```
Parameters
ZS(w);

Loop(w,

dem_w(c)=dem(c,w) ;
Solve SCND_w us mip max Z_w;

ZS(w)= Z_w.l;

);
*end of loop

Display  ZS;

**********************************************************************************

obj_AR(w)..      AR =g= ZS(w) - Z(w);

obj_RNSSP..      EB =e= sum(w,Prob(w)*Z(w));

obj_RASSP(w)..      WB =l= Z(w);
```

```
obj_Scenario(w) ..    z(w) =e=  p*sum({d,c},QDC(d,c,w)) - (sum(d,f(d)*x(d)) + sum(s,A(s)*y(s)) +
sum({s,d},trSD(s,d)*QSD(s,d,w))

                                    + sum({d,c},trDC(d,c)*QDC(d,c,w)) + sum(s,b(s)*u(s,w))) ;

cons1(s,w)..       u(s,w) =L= capS(s)*y(s);


cons2(d,w)..       sum(S,QSD(s,d,w))=L= capD(d)*x(d);


cons3(s,w)..       u(s,w) =e= sum(d,QSD(s,d,w));


cons4(d,w)..       sum(s,QSD(s,d,w)) =e= sum(c,QDC(d,c,w));


cons5(c,w)..       sum(d,QDC(d,c,w)) =l= dem(c,w);


Model SCND
/
obj_AR
obj_RNSSP
obj_RASSP
obj_Scenario
cons1
cons2
cons3
cons4
cons5
/
;
```

```
Options
mip = CPLEX
reslim =100
optcr = 0
;


Solve SCND us mip min AR;


Display
AR.l
EB.l
WB.l
Z.l
y.l
x.l
QSD.l
QDC.l
;
```

SCND_RelativeRegret

```
Sets
S       /s1*s10/
D       /d1*d20/
C       /c1*c30/
w       /w1*w5/
;


Parameters
A(s)
f(d)
b(s)
trSD(s,d)
trDC(d,c)
p
dem(c,w)
dem_N(c)
dem_w(c)
capD(d)
capS(s)
Prob(w)
/
w1      0.2
w2      0.3
w3      0.1
w4      0.2
w5      0.2
/
;
```

```
A(s)     = uniform(1000,1500);
f(d)     = uniform(2000,3000);
b(s)     = uniform(5,10);
trSD(s,d)= uniform(1,2);
trDC(d,c)= uniform(0.5,0.7);
p        = 15;
capD(d)  = uniform(500,1000);
capS(s)  = uniform(1000,2000);



dem(c,'w1')   = uniform(50,100);
dem(c,'w2')   = (1+0.8)*dem(c,'w1') ;
dem(c,'w3')   = (1+0.2)*dem(c,'w1') ;
dem(c,'w4')   = (1-0.2)*dem(c,'w1') ;
dem(c,'w5')   = (1-0.3)*dem(c,'w1') ;


dem_N(c)= sum(w,prob(w)*dem(c,w));



Display
A
f
b
trSD
trDC
p
```

capD

capS

dem

dem_N

;

****

Free Variable

AR

RR

Z_w

Z(w)

EB

WB

;

Binary Variables

y(s)

x(d)

;

Positive Variable

u(s,w)

QSD(s,d,w)

QDC(d,c,w)

u_w(s)

QSD_w(s,d)

QDC_w(d,c)

;

Equations

obj_RR

obj_AR

obj_RNSSP

obj_RASSP

obj_Scenario

obj_w

cons1

cons2

cons3

cons4

cons5

cons1_w

cons2_w

cons3_w

cons4_w

cons5_w

;

****

obj_w .. Z_w =e= p*sum({d,c},QDC_w(d,c)) - (sum(d,f(d)*x(d)) + sum(s,A(s)*y(s)) + sum({s,d},trSD(s,d)*QSD_w(s,d))

+ sum({d,c},trDC(d,c)*QDC_w(d,c)) + sum(s,b(s)*u_w(s))) ;

cons1_w(s).. u_w(s) =L= capS(s)*y(s);

cons2_w(d).. sum(S,QSD_w(s,d))=L= capD(d)*x(d);

cons3_w(s).. u_w(s) =e= sum(d,QSD_w(s,d));

cons4_w(d).. sum(s,QSD_w(s,d)) =e= sum(c,QDC_w(d,c));

cons5_w(c).. sum(d,QDC_w(d,c)) =l= dem_w(c);

****

Model SCND_W

/

obj_w

cons1_w

cons2_w

cons3_w

cons4_w

cons5_w

/

;

Options

Optcr=0;

```
Parameters
ZS(w);

Loop(w,

dem_w(c)=dem(c,w) ;
Solve SCND_w us mip max Z_w;

ZS(w)= Z_w.l;

);
*end of loop

Display  ZS;

**********************************************************************************

obj_RR(w)..      RR =g= Prob(w)*(ZS(w) - Z(w))/(abs(ZS(w))+0.001);

obj_AR(w)..      AR =g= ZS(w) - Z(w);

obj_RNSSP..      EB =e= sum(w,Prob(w)*Z(w));

obj_RASSP(w)..      WB =l= Z(w);
```

```
obj_Scenario(w) ..      z(w) =e=  p*sum({d,c},QDC(d,c,w)) - (sum(d,f(d)*x(d)) + sum(s,A(s)*y(s)) + sum({s,d},trSD(s,d)*QSD(s,d,w))
                                  + sum({d,c},trDC(d,c)*QDC(d,c,w)) + sum(s,b(s)*u(s,w))) ;

cons1(s,w)..      u(s,w) =L= capS(s)*y(s);


cons2(d,w)..      sum(S,QSD(s,d,w))=L= capD(d)*x(d);


cons3(s,w)..      u(s,w) =e= sum(d,QSD(s,d,w));


cons4(d,w)..      sum(s,QSD(s,d,w)) =e= sum(c,QDC(d,c,w));


cons5(c,w)..      sum(d,QDC(d,c,w)) =l= dem(c,w);


Model SCND
/
obj_RR
obj_AR
obj_RNSSP
obj_RASSP
obj_Scenario
cons1
cons2
cons3
cons4
cons5
/
;
```

```
Options
mip = CPLEX
reslim =100
optcr = 0
;


Solve SCND us mip min RR;


Display
RR.l
AR.l
EB.l
WB.l
Z.l
y.l
x.l
QSD.l
QDC.l
;
```

SCND_Aghezzaf

```
Sets
S       /s1*s10/
D       /d1*d20/
C       /c1*c30/
w       /w1*w5/
;


Parameters
A(s)
f(d)
b(s)
trSD(s,d)
trDC(d,c)
p
dem(c,w)
dem_N(c)
dem_w(c)
capD(d)
capS(s)
Prob(w)
/
w1      0.2
w2      0.3
w3      0.1
w4      0.2
w5      0.2
/
;
```

```
A(s)     = uniform(1000,1500);
f(d)     = uniform(2000,3000);
b(s)     = uniform(5,10);
trSD(s,d)= uniform(1,2);
trDC(d,c)= uniform(0.5,0.7);
p        = 15;
capD(d)  = uniform(500,1000);
capS(s)  = uniform(1000,2000);



dem(c,'w1')   = uniform(50,100);
dem(c,'w2')   = (1+0.8)*dem(c,'w1') ;
dem(c,'w3')   = (1+0.2)*dem(c,'w1') ;
dem(c,'w4')   = (1-0.2)*dem(c,'w1') ;
dem(c,'w5')   = (1-0.3)*dem(c,'w1') ;


dem_N(c)= sum(w,prob(w)*dem(c,w));



Display
A
f
b
trSD
trDC
p
```

capD

capS

dem

dem_N

;

****

Free Variable

AR

RR

Z_w

Z(w)

Z_Agh

EB

WB

;

Binary Variables

y(s)

x(d)

;

Positive Variable

u(s,w)

QSD(s,d,w)

QDC(d,c,w)

u_w(s)

QSD_w(s,d)

QDC_w(d,c)

;

Equations

obj_Agh

obj_RR

obj_AR

obj_RNSSP

obj_RASSP

obj_Scenario

obj_w

cons1

cons2

cons3

cons4

cons5

cons1_w

cons2_w

cons3_w

cons4_w

cons5_w

;

****

obj_w .. Z_w =e= p*sum({d,c},QDC_w(d,c)) - (sum(d,f(d)*x(d)) + sum(s,A(s)*y(s)) + sum({s,d},trSD(s,d)*QSD_w(s,d))

+ sum({d,c},trDC(d,c)*QDC_w(d,c)) + sum(s,b(s)*u_w(s))) ;

cons1_w(s).. u_w(s) =L= capS(s)*y(s);

cons2_w(d).. sum(S,QSD_w(s,d))=L= capD(d)*x(d);

cons3_w(s).. u_w(s) =e= sum(d,QSD_w(s,d));

cons4_w(d).. sum(s,QSD_w(s,d)) =e= sum(c,QDC_w(d,c));

cons5_w(c).. sum(d,QDC_w(d,c)) =l= dem_w(c);

****

Model SCND_W

/

obj_w

cons1_w

cons2_w

cons3_w

cons4_w

cons5_w

/

;

Options

Optcr=0;

```
Parameters
ZS(w);

Loop(w,

dem_w(c)=dem(c,w) ;
Solve SCND_w us mip max Z_w;

ZS(w)= Z_w.l;

);
*end of loop

Display  ZS;

Scalar Lamda /0.3/;

*************************************************************************************

obj_Agh..       Z_Agh=e=  EB/(6763-4444) - Lamda*RR/(0.132-0.118);

obj_RR(w)..     RR =g= Prob(w)*(ZS(w) - Z(w))/(abs(ZS(w))+0.001);

obj_AR(w)..     AR =g= ZS(w) - Z(w);

obj_RNSSP..     EB =e= sum(w,Prob(w)*Z(w));
```

```
obj_RASSP(w)..      WB =l= Z(w);


obj_Scenario(w) ..      z(w) =e=   p*sum({d,c},QDC(d,c,w)) - (sum(d,f(d)*x(d)) + sum(s,A(s)*y(s)) +
sum({s,d},trSD(s,d)*QSD(s,d,w))
                                    + sum({d,c},trDC(d,c)*QDC(d,c,w)) + sum(s,b(s)*u(s,w))) ;
cons1(s,w)..       u(s,w) =L= capS(s)*y(s);


cons2(d,w)..       sum(S,QSD(s,d,w))=L= capD(d)*x(d);


cons3(s,w)..       u(s,w) =e= sum(d,QSD(s,d,w));


cons4(d,w)..       sum(s,QSD(s,d,w)) =e= sum(c,QDC(d,c,w));


cons5(c,w)..       sum(d,QDC(d,c,w)) =l= dem(c,w);



Model SCND
/
obj_Agh
obj_RR
obj_AR
obj_RNSSP
obj_RASSP
obj_Scenario
cons1
```

```
cons2
cons3
cons4
cons5
/
;


Options
mip = CPLEX
reslim =100
optcr = 0
;


Solve SCND us mip max Z_Agh;


Display
RR.l
AR.l
EB.l
WB.l
Z.l
y.l
x.l
QSD.l
QDC.l
;
```

SCND_DevelopedHybridModel

```
Sets
S       /s1*s10/
D       /d1*d20/
C       /c1*c30/
w       /w1*w5/
;


Parameters
A(s)
f(d)
b(s)
trSD(s,d)
trDC(d,c)
p
dem(c,w)
dem_N(c)
dem_w(c)
capD(d)
capS(s)
Prob(w)
/
w1      0.2
w2      0.3
w3      0.1
w4      0.2
w5      0.2
/
;
```

```
A(s)     = uniform(1000,1500);
f(d)     = uniform(2000,3000);
b(s)     = uniform(5,10);
trSD(s,d)= uniform(1,2);
trDC(d,c)= uniform(0.5,0.7);
p        = 15;
capD(d)  = uniform(500,1000);
capS(s)  = uniform(1000,2000);



dem(c,'w1')   = uniform(50,100);
dem(c,'w2')   = (1+0.8)*dem(c,'w1') ;
dem(c,'w3')   = (1+0.2)*dem(c,'w1') ;
dem(c,'w4')   = (1-0.2)*dem(c,'w1') ;
dem(c,'w5')   = (1-0.3)*dem(c,'w1') ;


dem_N(c)= sum(w,prob(w)*dem(c,w));



Display
A
f
b
trSD
trDC
p
```

capD

capS

dem

dem_N

;

****

Free Variable

AR

RR

Z_w

Z(w)

HO

EB

WB

;

Binary Variables

y(s)

x(d)

;

Positive Variable

u(s,w)

QSD(s,d,w)

QDC(d,c,w)

u_w(s)

QSD_w(s,d)

QDC_w(d,c)

;

Equations

obj_Hybrid

RR_Cal

obj_RNSSP

obj_RASSP

obj_Scenario

obj_w

cons1

cons2

cons3

cons4

cons5

cons1_w

cons2_w

cons3_w

cons4_w

cons5_w

;

****

obj_w .. Z_w =e= p*sum({d,c},QDC_w(d,c)) - (sum(d,f(d)*x(d)) + sum(s,A(s)*y(s)) + sum({s,d},trSD(s,d)*QSD_w(s,d))

+ sum({d,c},trDC(d,c)*QDC_w(d,c)) + sum(s,b(s)*u_w(s))) ;

```
cons1_w(s)..      u_w(s) =L= capS(s)*y(s);

cons2_w(d)..      sum(S,QSD_w(s,d))=L= capD(d)*x(d);

cons3_w(s)..      u_w(s) =e= sum(d,QSD_w(s,d));

cons4_w(d)..      sum(s,QSD_w(s,d)) =e= sum(c,QDC_w(d,c));

cons5_w(c)..      sum(d,QDC_w(d,c)) =l= dem_w(c);
**************

Model SCND_W
/
obj_w
cons1_w
cons2_w
cons3_w
cons4_w
cons5_w
/
;

Options
Optcr=0;
```

```
Parameters
ZS(w);

Loop(w,

dem_w(c)=dem(c,w) ;
Solve SCND_w us mip max Z_w;

ZS(w)= Z_w.l;

);
*end of loop

Display  ZS;

Scalar Lamda /0.3/;

*****************************************************************************

obj_Hybrid..        HO =e= Lamda*WB + (1-Lamda)*EB;

RR_Cal(w)..      RR(w) =e= (ZS(w) - Z(w))/(abs(ZS(w)));

RR.up(w)=0.55;
```

```
obj_RNSSP..      EB =e= sum(w,Prob(w)*Z(w));


obj_RASSP(w)..      WB =l= Z(w);



obj_Scenario(w) ..    z(w) =e=  p*sum({d,c},QDC(d,c,w)) - (sum(d,f(d)*x(d)) + sum(s,A(s)*y(s)) +
sum({s,d},trSD(s,d)*QSD(s,d,w))
                                        + sum({d,c},trDC(d,c)*QDC(d,c,w)) + sum(s,b(s)*u(s,w))) ;
cons1(s,w)..       u(s,w) =L= capS(s)*y(s);


cons2(d,w)..       sum(S,QSD(s,d,w))=L= capD(d)*x(d);


cons3(s,w)..       u(s,w) =e= sum(d,QSD(s,d,w));


cons4(d,w)..       sum(s,QSD(s,d,w)) =e= sum(c,QDC(d,c,w));


cons5(c,w)..       sum(d,QDC(d,c,w)) =l= dem(c,w);



Model SCND
/
obj_Hybrid
RR_Cal
obj_RNSSP
obj_RASSP
obj_Scenario
cons1
```

```
cons2
cons3
cons4
cons5
/
;

Options
mip = CPLEX
reslim =100
optcr = 0
;

Solve SCND us mip max HO;

Display
RR.l
EB.l
WB.l
Z.l
y.l
x.l
QSD.l
QDC.l
;
```

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Decision-Making under Uncertainty (Robust Optimization - Stochastic Programming - Fuzzy Programming)

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تخصص شاخص: بهینه‌سازی و تحقیق در عملیات، علم تحلیل داده، تکنیک‌های تجزیه و روش‌های حل دقیق، بهینه‌سازی استوار داده‌محور، هوش محاسباتی و الگوریتم‌های فراابتکاری، نظریه بازی، بهینه‌سازی چندهدفه و تصمیم‌گیری چندمعیاره

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