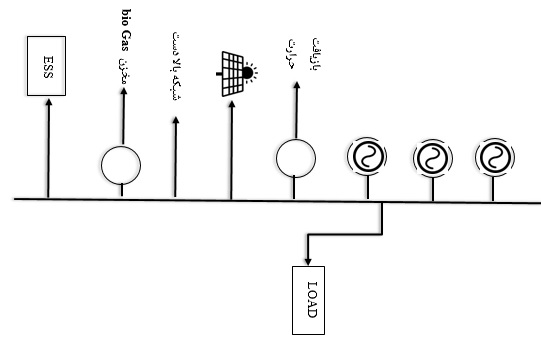
محمد عباسی 402449120 تاریخ: 04/03/1403

دانشجوی کارشناسی ارشد مجازی مهندسی سیستم های قدرت

درس بهره برداری از سیستم های قدرت دکتر محمد صادق قاضی زاده

پروژه برنامه نویسی گمز مجموعه صنعتی و تولیدی در قالب ویلای صنعتی

ترم بهمن 1402-1403



فرمولاسیون معادلات بهینه سازی مجموعه تولیدی و بهره برداری متصل به شبکه

1. پیش بینی بار 24 ساعته از این مجموعه موجود می باشد.
2. شاخص که معرف در سرویس بودن و خارج از سرویس بودن هر کدام از منابع تولیدی و شبکه موجود می باشد.
3. تعداد سه نیروگاه گازی با معادلات هزینه ای و محدودیتی به فرمت زیر موجود است.
4. ارتباط با شبکه سراسری و دریافت برق بر اساس قرارداد دیماندی با در نظر گرفتن محدودیت توان دریافتی بر اساس ظرفیت خط و پست انتقال

با این شرط که مجموعه تنها مجاز به دریافت توان از شبکه می باشد و شبکه را بر اساس قرارداد دیماندی به عنوان پشتیبان در نظر می گیریم.

لازم به توضیح است که هزینه برق دریافتی از شبکه تابعی از توان دریافتی می باشد که خود این ضریب می تواند بر اساس ساعت ، هفته و فصول سال تغییر کند.

1. این مجموعه شامل یک *Solar System* می باشد که براساس پیش بینی تابش خورشید، توان تولیدی ساعتی این مجموعه موجود می باشد.
2. این واحد شامل یک مولد *CHP* می باشد که بخار خروجی جهت مصارف مشخصی استفاده می شود. از آنجایی که سطح مشخصی از بخار برای تولید لازم می باشد. پس این واحد همواره در سرویس می باشد و حداقل توان تولیدی از این واحد استحصال می گردد.
3. ذخیره ساز این مجموعه توانایی ذخیره و تحویل توان در این 24 ساعت را دارد. این ذخیره ساز بصورت یک باتری با محدودیت توان مدل شده است که در دو مدل کاری شارژ و دشارژ اقدام به ذخیره توان در ساعات بی باری و تحویل آن در ساعات نیاز مجموعه جهت به حداقل رساندن هزینه های تولید می باشد.
4. مولد زیست توده که خوراک خود را از مخزن گاز دریافت می کند و گاز این مخزن بصورت ساعتی از دامداری استحصال می گردد. حجم گاز استحصالی در شبانه روز ثابت و بصورت ساعتی تصادفی است.

دبی ورودی به مخزن و دبی خروجی به مخزن و سطح مقطع خط لوله می باشد.

کد برنامه نویسی شده در برنامه گمز

sets

i /i1\*i3/

t /t1\*t24/;

table gdata(i,\*)

af bf cf Pmax Pmin

\* MBtu/MW2h MBtu/MWh MBtu/h MW MW

i1 0.0004 13.51 176.95 220 100

i2 0.001 32.63 129.97 100 10

i3 0.005 17.7 137.41 20 10

;

parameter load(t)

/

t1 227.747

t2 214.695

t3 206.271

t4 201.149

t5 201.578

t6 208.624

t7 225.407

t8 247.52

t9 267.228

t10 282.36

t11 297.193

t12 306.93

t13 314.834

t14 316.68

t15 323.518

t16 332.527

t17 332.8

t18 320.762

t19 332.8

t20 323.505

t21 313.456

t22 304.564

t23 308.399

t24 295.802

/;

parameter Psolar(t)

/

t1 0

t2 0

t3 0

t4 0

t5 8

t6 10

t7 12

t8 14

t9 15

t10 16

t11 18

t12 20

t13 25

t14 27

t15 27

t16 25

t17 20

t18 18

t19 10

t20 0

t21 0

t22 0

t23 0

t24 0

/;

parameter Qinlet(t)

/

t1 120

t2 21

t3 22

t4 23

t5 24

t6 25

t7 26

t8 27

t9 28

t10 29

t11 30

t12 31

t13 32

t14 33

t15 34

t16 35

t17 36

t18 37

t19 38

t20 39

t21 150

t22 41

t23 42

t24 43

/;

parameter Qoutlet(t)

/

t1 15

t2 16

t3 17

t4 18

t5 19

t6 20

t7 21

t8 22

t9 23

t10 24

t11 25

t12 26

t13 27

t14 28

t15 29

t16 30

t17 31

t18 32

t19 33

t20 34

t21 35

t22 36

t23 37

t24 38

/;

scalar

Price /50/

Ebini /10/

Gasprice /8/;

variable

Obj;

positive variables

P(i,t)

Pslr(t)

Pgrid(t)

Pch(t)

Pdch(t)

Eb(t)

Pchp(t)

Pbio(t)

Gbio(t);

binary variables

x(i,t);

equations eq1,eq2,eq3,eq4,eq5,eq6,eq7,eq8,eq9,eq10,eq11,eq12,eq13,eq14,eq15,eq16,eq17;

eq1..Obj=e=sum((t,i),gdata(i,'af')\*power(P(i,t),2)+gdata(i,'bf')\*P(i,t)+gdata(i,'cf')\*x(i,t))+

sum(t,Price\*Pgrid(t))+

sum(t,0.001\*power(Pchp(t),2)+32.63\*Pchp(t)+129.97)+

sum(t,0.003\*power(Pbio(t),2)+24.7\*Pbio(t)+107.7);

eq2(t)..sum(i,P(i,t))+Pgrid(t)+Pslr(t)+Pchp(t)+Pbio(t)+Pdch(t)-Pch(t)=e=load(t);

eq3(i,t)..P(i,t)=l=gdata(i,'Pmax')\*x(i,t);

eq4(i,t)..P(i,t)=g=gdata(i,'Pmin')\*x(i,t);

eq5(t)..Pchp(t)=l=100;

eq6(t)..Pchp(t)=g=10;

eq7(t)..Pch(t)=l=15;

eq8(t)..Pch(t)=g=0;

eq9(t)..Pdch(t)=l=15;

eq10(t)..Pdch(t)=g=0;

eq11(t)..Eb(t)=l=50;

eq12(t)..Eb(t)=g=10;

eq13..Eb('t1')=e=Ebini+0.9\*Pch('t1')-(Pdch('t1')/0.9);

eq14(t)$(ord(t)>1)..Eb(t)=e=Eb(t-1)+0.9\*Pch(t)-(Pdch(t)/0.9);

eq15(t)..Gbio(t)=e=1.25\*(Qinlet(t)-Qoutlet(t));

eq16(t)..Pbio(t)=e=0.6\*Gbio(t);

eq17(t)..Pslr(t)=l=Psolar(t);

model MG /all/;

option MINLP=baron,optcr=0,optca=0;

solve MG using minlp minimizing Obj;

display Obj.l,Pslr.l,Pchp.l,Pbio.l,Pgrid.l,p.l,x.l,Pch.l,Pdch.l,Eb.l;

خروجی برنامه نویسی در برنامه گمز

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G e n e r a l A l g e b r a i c M o d e l i n g S y s t e m

C o m p i l a t i o n

1 sets

2 i /i1\*i3/

3 t /t1\*t24/;

4

5 table gdata(i,\*)

6 af bf cf Pmax Pmin

7 \* MBtu/MW2h MBtu/MWh MBtu/h MW MW

8 i1 0.0004 13.51 176.95 220 100

9 i2 0.001 32.63 129.97 100 10

10 i3 0.005 17.7 137.41 20 10

11 ;

12 parameter load(t)

13 /

14 t1 227.747

15 t2 214.695

16 t3 206.271

17 t4 201.149

18 t5 201.578

19 t6 208.624

20 t7 225.407

21 t8 247.52

22 t9 267.228

23 t10 282.36

24 t11 297.193

25 t12 306.93

26 t13 314.834

27 t14 316.68

28 t15 323.518

29 t16 332.527

30 t17 332.8

31 t18 320.762

32 t19 332.8

33 t20 323.505

34 t21 313.456

35 t22 304.564

36 t23 308.399

37 t24 295.802

38 /;

39 parameter Psolar(t)

40 /

41 t1 0

42 t2 0

43 t3 0

44 t4 0

45 t5 8

46 t6 10

47 t7 12

48 t8 14

49 t9 15

50 t10 16

51 t11 18

52 t12 20

53 t13 25

54 t14 27

55 t15 27

56 t16 25

57 t17 20

58 t18 18

59 t19 10

60 t20 0

61 t21 0

62 t22 0

63 t23 0

64 t24 0

65 /;

66 parameter Qinlet(t)

67 /

68 t1 20

69 t2 21

70 t3 22

71 t4 23

72 t5 24

73 t6 25

74 t7 26

75 t8 27

76 t9 28

77 t10 29

78 t11 30

79 t12 31

80 t13 32

81 t14 33

82 t15 34

83 t16 35

84 t17 36

85 t18 37

86 t19 38

87 t20 39

88 t21 40

89 t22 41

90 t23 42

91 t24 43

92 /;

93 parameter Qoutlet(t)

94 /

95 t1 15

96 t2 16

97 t3 17

98 t4 18

99 t5 19

100 t6 20

101 t7 21

102 t8 22

103 t9 23

104 t10 24

105 t11 25

106 t12 26

107 t13 27

108 t14 28

109 t15 29

110 t16 30

111 t17 31

112 t18 32

113 t19 33

114 t20 34

115 t21 35

116 t22 36

117 t23 37

118 t24 38

119 /;

120 scalar

121 Price /50/

122 Ebini /10/

123 Gasprice /8/;

124

125 variable

126 Obj;

127 positive variables

128 P(i,t)

129 Pslr(t)

130 Pgrid(t)

131 Pch(t)

132 Pdch(t)

133 Eb(t)

134 Pchp(t)

135 Pbio(t)

136 Gbio(t);

137 binary variables

138 x(i,t);

139 equations eq1,eq2,eq3,eq4,eq5,eq6,eq7,eq8,eq9,eq10,eq11,eq12,eq13,eq14,eq1

5,eq16,eq17;

140 eq1..Obj=e=sum((t,i),gdata(i,'af')\*power(P(i,t),2)+gdata(i,'bf')\*P(i,t)+gd

ata(i,'cf')\*x(i,t))+

141 sum(t,Price\*Pgrid(t))+

142 sum(t,0.001\*power(Pchp(t),2)+32.63\*Pchp(t)+129.97)+

143 sum(t,0.003\*power(Pbio(t),2)+24.7\*Pbio(t)+107.7);

144 eq2(t)..sum(i,P(i,t))+Pgrid(t)+Pslr(t)+Pchp(t)+Pbio(t)+Pdch(t)-Pch(t)=e=lo

ad(t);

145 eq3(i,t)..P(i,t)=l=gdata(i,'Pmax')\*x(i,t);

146 eq4(i,t)..P(i,t)=g=gdata(i,'Pmin')\*x(i,t);

147 eq5(t)..Pchp(t)=l=100;

148 eq6(t)..Pchp(t)=g=10;

149 eq7(t)..Pch(t)=l=15;

150 eq8(t)..Pch(t)=g=0;

151 eq9(t)..Pdch(t)=l=15;

152 eq10(t)..Pdch(t)=g=0;

153 eq11(t)..Eb(t)=l=50;

154 eq12(t)..Eb(t)=g=10;

155 eq13..Eb('t1')=e=Ebini+0.9\*Pch('t1')-(Pdch('t1')/0.9);

156 eq14(t)$(ord(t)>1)..Eb(t)=e=Eb(t-1)+0.9\*Pch(t)-(Pdch(t)/0.9);

157 eq15(t)..Gbio(t)=e=1.25\*(Qinlet(t)-Qoutlet(t));

158 eq16(t)..Pbio(t)=e=0.6\*Gbio(t);

159 eq17(t)..Pslr(t)=l=Psolar(t);

160 model MG /all/;

161 option MINLP=baron,optcr=0,optca=0;

162 solve MG using minlp minimizing Obj;

163 display Obj.l,Pslr.l,Pchp.l,Pbio.l,Pgrid.l,p.l,x.l,Pch.l,Pdch.l,Eb.l;

164

165

166

167

COMPILATION TIME = 0.000 SECONDS 3 MB 25.1.2 r67455 WEX-VS8

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G e n e r a l A l g e b r a i c M o d e l i n g S y s t e m

Equation Listing SOLVE MG Using MINLP From line 162

---- eq1 =E=

eq1.. Obj - (13.51)\*P(i1,t1) - (13.51)\*P(i1,t2) - (13.51)\*P(i1,t3)

- (13.51)\*P(i1,t4) - (13.51)\*P(i1,t5) - (13.51)\*P(i1,t6)

- (13.51)\*P(i1,t7) - (13.51)\*P(i1,t8) - (13.51)\*P(i1,t9)

- (13.51)\*P(i1,t10) - (13.51)\*P(i1,t11) - (13.51)\*P(i1,t12)

- (13.51)\*P(i1,t13) - (13.51)\*P(i1,t14) - (13.51)\*P(i1,t15)

- (13.51)\*P(i1,t16) - (13.51)\*P(i1,t17) - (13.51)\*P(i1,t18)

- (13.51)\*P(i1,t19) - (13.51)\*P(i1,t20) - (13.51)\*P(i1,t21)

- (13.51)\*P(i1,t22) - (13.51)\*P(i1,t23) - (13.51)\*P(i1,t24)

- (32.63)\*P(i2,t1) - (32.63)\*P(i2,t2) - (32.63)\*P(i2,t3)

- (32.63)\*P(i2,t4) - (32.63)\*P(i2,t5) - (32.63)\*P(i2,t6)

- (32.63)\*P(i2,t7) - (32.63)\*P(i2,t8) - (32.63)\*P(i2,t9)

- (32.63)\*P(i2,t10) - (32.63)\*P(i2,t11) - (32.63)\*P(i2,t12)

- (32.63)\*P(i2,t13) - (32.63)\*P(i2,t14) - (32.63)\*P(i2,t15)

- (32.63)\*P(i2,t16) - (32.63)\*P(i2,t17) - (32.63)\*P(i2,t18)

- (32.63)\*P(i2,t19) - (32.63)\*P(i2,t20) - (32.63)\*P(i2,t21)

- (32.63)\*P(i2,t22) - (32.63)\*P(i2,t23) - (32.63)\*P(i2,t24)

- (17.7)\*P(i3,t1) - (17.7)\*P(i3,t2) - (17.7)\*P(i3,t3) - (17.7)\*P(i3,t4)

- (17.7)\*P(i3,t5) - (17.7)\*P(i3,t6) - (17.7)\*P(i3,t7) - (17.7)\*P(i3,t8)

- (17.7)\*P(i3,t9) - (17.7)\*P(i3,t10) - (17.7)\*P(i3,t11) - (17.7)\*P(i3,t12)

- (17.7)\*P(i3,t13) - (17.7)\*P(i3,t14) - (17.7)\*P(i3,t15)

- (17.7)\*P(i3,t16) - (17.7)\*P(i3,t17) - (17.7)\*P(i3,t18)

- (17.7)\*P(i3,t19) - (17.7)\*P(i3,t20) - (17.7)\*P(i3,t21)

- (17.7)\*P(i3,t22) - (17.7)\*P(i3,t23) - (17.7)\*P(i3,t24) - 50\*Pgrid(t1)

- 50\*Pgrid(t2) - 50\*Pgrid(t3) - 50\*Pgrid(t4) - 50\*Pgrid(t5) - 50\*Pgrid(t6)

- 50\*Pgrid(t7) - 50\*Pgrid(t8) - 50\*Pgrid(t9) - 50\*Pgrid(t10)

- 50\*Pgrid(t11) - 50\*Pgrid(t12) - 50\*Pgrid(t13) - 50\*Pgrid(t14)

- 50\*Pgrid(t15) - 50\*Pgrid(t16) - 50\*Pgrid(t17) - 50\*Pgrid(t18)

- 50\*Pgrid(t19) - 50\*Pgrid(t20) - 50\*Pgrid(t21) - 50\*Pgrid(t22)

- 50\*Pgrid(t23) - 50\*Pgrid(t24) - (32.63)\*Pchp(t1) - (32.63)\*Pchp(t2)

- (32.63)\*Pchp(t3) - (32.63)\*Pchp(t4) - (32.63)\*Pchp(t5)

- (32.63)\*Pchp(t6) - (32.63)\*Pchp(t7) - (32.63)\*Pchp(t8)

- (32.63)\*Pchp(t9) - (32.63)\*Pchp(t10) - (32.63)\*Pchp(t11)

- (32.63)\*Pchp(t12) - (32.63)\*Pchp(t13) - (32.63)\*Pchp(t14)

- (32.63)\*Pchp(t15) - (32.63)\*Pchp(t16) - (32.63)\*Pchp(t17)

- (32.63)\*Pchp(t18) - (32.63)\*Pchp(t19) - (32.63)\*Pchp(t20)

- (32.63)\*Pchp(t21) - (32.63)\*Pchp(t22) - (32.63)\*Pchp(t23)

- (32.63)\*Pchp(t24) - (24.7)\*Pbio(t1) - (24.7)\*Pbio(t2) - (24.7)\*Pbio(t3)

- (24.7)\*Pbio(t4) - (24.7)\*Pbio(t5) - (24.7)\*Pbio(t6) - (24.7)\*Pbio(t7)

- (24.7)\*Pbio(t8) - (24.7)\*Pbio(t9) - (24.7)\*Pbio(t10) - (24.7)\*Pbio(t11)

- (24.7)\*Pbio(t12) - (24.7)\*Pbio(t13) - (24.7)\*Pbio(t14)

- (24.7)\*Pbio(t15) - (24.7)\*Pbio(t16) - (24.7)\*Pbio(t17)

- (24.7)\*Pbio(t18) - (24.7)\*Pbio(t19) - (24.7)\*Pbio(t20)

- (24.7)\*Pbio(t21) - (24.7)\*Pbio(t22) - (24.7)\*Pbio(t23)

- (24.7)\*Pbio(t24) - 176.95\*x(i1,t1) - 176.95\*x(i1,t2) - 176.95\*x(i1,t3)

- 176.95\*x(i1,t4) - 176.95\*x(i1,t5) - 176.95\*x(i1,t6) - 176.95\*x(i1,t7)

- 176.95\*x(i1,t8) - 176.95\*x(i1,t9) - 176.95\*x(i1,t10) - 176.95\*x(i1,t11)

- 176.95\*x(i1,t12) - 176.95\*x(i1,t13) - 176.95\*x(i1,t14)

- 176.95\*x(i1,t15) - 176.95\*x(i1,t16) - 176.95\*x(i1,t17)

- 176.95\*x(i1,t18) - 176.95\*x(i1,t19) - 176.95\*x(i1,t20)

- 176.95\*x(i1,t21) - 176.95\*x(i1,t22) - 176.95\*x(i1,t23)

- 176.95\*x(i1,t24) - 129.97\*x(i2,t1) - 129.97\*x(i2,t2) - 129.97\*x(i2,t3)

- 129.97\*x(i2,t4) - 129.97\*x(i2,t5) - 129.97\*x(i2,t6) - 129.97\*x(i2,t7)

- 129.97\*x(i2,t8) - 129.97\*x(i2,t9) - 129.97\*x(i2,t10) - 129.97\*x(i2,t11)

- 129.97\*x(i2,t12) - 129.97\*x(i2,t13) - 129.97\*x(i2,t14)

- 129.97\*x(i2,t15) - 129.97\*x(i2,t16) - 129.97\*x(i2,t17)

- 129.97\*x(i2,t18) - 129.97\*x(i2,t19) - 129.97\*x(i2,t20)

- 129.97\*x(i2,t21) - 129.97\*x(i2,t22) - 129.97\*x(i2,t23)

- 129.97\*x(i2,t24) - 137.41\*x(i3,t1) - 137.41\*x(i3,t2) - 137.41\*x(i3,t3)

- 137.41\*x(i3,t4) - 137.41\*x(i3,t5) - 137.41\*x(i3,t6) - 137.41\*x(i3,t7)

- 137.41\*x(i3,t8) - 137.41\*x(i3,t9) - 137.41\*x(i3,t10) - 137.41\*x(i3,t11)

- 137.41\*x(i3,t12) - 137.41\*x(i3,t13) - 137.41\*x(i3,t14)

- 137.41\*x(i3,t15) - 137.41\*x(i3,t16) - 137.41\*x(i3,t17)

- 137.41\*x(i3,t18) - 137.41\*x(i3,t19) - 137.41\*x(i3,t20)

- 137.41\*x(i3,t21) - 137.41\*x(i3,t22) - 137.41\*x(i3,t23)

- 137.41\*x(i3,t24) =E= 5704.08 ; (LHS = 0, INFES = 5704.08 \*\*\*\*)

---- eq2 =E=

eq2(t1).. P(i1,t1) + P(i2,t1) + P(i3,t1) + Pslr(t1) + Pgrid(t1) - Pch(t1)

+ Pdch(t1) + Pchp(t1) + Pbio(t1) =E= 227.747 ;

(LHS = 0, INFES = 227.747 \*\*\*\*)

eq2(t2).. P(i1,t2) + P(i2,t2) + P(i3,t2) + Pslr(t2) + Pgrid(t2) - Pch(t2)

+ Pdch(t2) + Pchp(t2) + Pbio(t2) =E= 214.695 ;

(LHS = 0, INFES = 214.695 \*\*\*\*)

eq2(t3).. P(i1,t3) + P(i2,t3) + P(i3,t3) + Pslr(t3) + Pgrid(t3) - Pch(t3)

+ Pdch(t3) + Pchp(t3) + Pbio(t3) =E= 206.271 ;

(LHS = 0, INFES = 206.271 \*\*\*\*)

REMAINING 21 ENTRIES SKIPPED

---- eq3 =L=

eq3(i1,t1).. P(i1,t1) - 220\*x(i1,t1) =L= 0 ; (LHS = 0)

eq3(i1,t2).. P(i1,t2) - 220\*x(i1,t2) =L= 0 ; (LHS = 0)

eq3(i1,t3).. P(i1,t3) - 220\*x(i1,t3) =L= 0 ; (LHS = 0)

REMAINING 69 ENTRIES SKIPPED

---- eq4 =G=

eq4(i1,t1).. P(i1,t1) - 100\*x(i1,t1) =G= 0 ; (LHS = 0)

eq4(i1,t2).. P(i1,t2) - 100\*x(i1,t2) =G= 0 ; (LHS = 0)

eq4(i1,t3).. P(i1,t3) - 100\*x(i1,t3) =G= 0 ; (LHS = 0)

REMAINING 69 ENTRIES SKIPPED

---- eq5 =L=

eq5(t1).. Pchp(t1) =L= 100 ; (LHS = 0)

eq5(t2).. Pchp(t2) =L= 100 ; (LHS = 0)

eq5(t3).. Pchp(t3) =L= 100 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq6 =G=

eq6(t1).. Pchp(t1) =G= 10 ; (LHS = 0, INFES = 10 \*\*\*\*)

eq6(t2).. Pchp(t2) =G= 10 ; (LHS = 0, INFES = 10 \*\*\*\*)

eq6(t3).. Pchp(t3) =G= 10 ; (LHS = 0, INFES = 10 \*\*\*\*)

REMAINING 21 ENTRIES SKIPPED

---- eq7 =L=

eq7(t1).. Pch(t1) =L= 15 ; (LHS = 0)

eq7(t2).. Pch(t2) =L= 15 ; (LHS = 0)

eq7(t3).. Pch(t3) =L= 15 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq8 =G=

eq8(t1).. Pch(t1) =G= 0 ; (LHS = 0)

eq8(t2).. Pch(t2) =G= 0 ; (LHS = 0)

eq8(t3).. Pch(t3) =G= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq9 =L=

eq9(t1).. Pdch(t1) =L= 15 ; (LHS = 0)

eq9(t2).. Pdch(t2) =L= 15 ; (LHS = 0)

eq9(t3).. Pdch(t3) =L= 15 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq10 =G=

eq10(t1).. Pdch(t1) =G= 0 ; (LHS = 0)

eq10(t2).. Pdch(t2) =G= 0 ; (LHS = 0)

eq10(t3).. Pdch(t3) =G= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq11 =L=

eq11(t1).. Eb(t1) =L= 50 ; (LHS = 0)

eq11(t2).. Eb(t2) =L= 50 ; (LHS = 0)

eq11(t3).. Eb(t3) =L= 50 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq12 =G=

eq12(t1).. Eb(t1) =G= 10 ; (LHS = 0, INFES = 10 \*\*\*\*)

eq12(t2).. Eb(t2) =G= 10 ; (LHS = 0, INFES = 10 \*\*\*\*)

eq12(t3).. Eb(t3) =G= 10 ; (LHS = 0, INFES = 10 \*\*\*\*)

REMAINING 21 ENTRIES SKIPPED

---- eq13 =E=

eq13.. - 0.9\*Pch(t1) + 1.11111111111111\*Pdch(t1) + Eb(t1) =E= 10 ;

(LHS = 0, INFES = 10 \*\*\*\*)

---- eq14 =E=

eq14(t2).. - 0.9\*Pch(t2) + 1.11111111111111\*Pdch(t2) - Eb(t1) + Eb(t2) =E= 0 ;

(LHS = 0)

eq14(t3).. - 0.9\*Pch(t3) + 1.11111111111111\*Pdch(t3) - Eb(t2) + Eb(t3) =E= 0 ;

(LHS = 0)

eq14(t4).. - 0.9\*Pch(t4) + 1.11111111111111\*Pdch(t4) - Eb(t3) + Eb(t4) =E= 0 ;

(LHS = 0)

REMAINING 20 ENTRIES SKIPPED

---- eq15 =E=

eq15(t1).. Gbio(t1) =E= 6.25 ; (LHS = 0, INFES = 6.25 \*\*\*\*)

eq15(t2).. Gbio(t2) =E= 6.25 ; (LHS = 0, INFES = 6.25 \*\*\*\*)

eq15(t3).. Gbio(t3) =E= 6.25 ; (LHS = 0, INFES = 6.25 \*\*\*\*)

REMAINING 21 ENTRIES SKIPPED

---- eq16 =E=

eq16(t1).. Pbio(t1) - 0.6\*Gbio(t1) =E= 0 ; (LHS = 0)

eq16(t2).. Pbio(t2) - 0.6\*Gbio(t2) =E= 0 ; (LHS = 0)

eq16(t3).. Pbio(t3) - 0.6\*Gbio(t3) =E= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

---- eq17 =L=

eq17(t1).. Pslr(t1) =L= 0 ; (LHS = 0)

eq17(t2).. Pslr(t2) =L= 0 ; (LHS = 0)

eq17(t3).. Pslr(t3) =L= 0 ; (LHS = 0)

REMAINING 21 ENTRIES SKIPPED

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G e n e r a l A l g e b r a i c M o d e l i n g S y s t e m

Column Listing SOLVE MG Using MINLP From line 162

---- Obj

Obj

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

1 eq1

---- P

P(i1,t1)

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

(-13.51) eq1

1 eq2(t1)

1 eq3(i1,t1)

1 eq4(i1,t1)

P(i1,t2)

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

(-13.51) eq1

1 eq2(t2)

1 eq3(i1,t2)

1 eq4(i1,t2)

P(i1,t3)

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

(-13.51) eq1

1 eq2(t3)

1 eq3(i1,t3)

1 eq4(i1,t3)

REMAINING 69 ENTRIES SKIPPED

---- Pslr

Pslr(t1)

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

1 eq2(t1)

1 eq17(t1)

Pslr(t2)

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

1 eq2(t2)

1 eq17(t2)

Pslr(t3)

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

1 eq2(t3)

1 eq17(t3)

REMAINING 21 ENTRIES SKIPPED

---- Pgrid

Pgrid(t1)

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

-50 eq1

1 eq2(t1)

Pgrid(t2)

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

-50 eq1

1 eq2(t2)

Pgrid(t3)

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

-50 eq1

1 eq2(t3)

REMAINING 21 ENTRIES SKIPPED

---- Pch

Pch(t1)

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

-1 eq2(t1)

1 eq7(t1)

1 eq8(t1)

-0.9 eq13

Pch(t2)

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

-1 eq2(t2)

1 eq7(t2)

1 eq8(t2)

-0.9 eq14(t2)

Pch(t3)

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

-1 eq2(t3)

1 eq7(t3)

1 eq8(t3)

-0.9 eq14(t3)

REMAINING 21 ENTRIES SKIPPED

---- Pdch

Pdch(t1)

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

1 eq2(t1)

1 eq9(t1)

1 eq10(t1)

1.1111 eq13

Pdch(t2)

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

1 eq2(t2)

1 eq9(t2)

1 eq10(t2)

1.1111 eq14(t2)

Pdch(t3)

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

1 eq2(t3)

1 eq9(t3)

1 eq10(t3)

1.1111 eq14(t3)

REMAINING 21 ENTRIES SKIPPED

---- Eb

Eb(t1)

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

1 eq11(t1)

1 eq12(t1)

1 eq13

-1 eq14(t2)

Eb(t2)

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

1 eq11(t2)

1 eq12(t2)

1 eq14(t2)

-1 eq14(t3)

Eb(t3)

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

1 eq11(t3)

1 eq12(t3)

1 eq14(t3)

-1 eq14(t4)

REMAINING 21 ENTRIES SKIPPED

---- Pchp

Pchp(t1)

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

(-32.63) eq1

1 eq2(t1)

1 eq5(t1)

1 eq6(t1)

Pchp(t2)

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

(-32.63) eq1

1 eq2(t2)

1 eq5(t2)

1 eq6(t2)

Pchp(t3)

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

(-32.63) eq1

1 eq2(t3)

1 eq5(t3)

1 eq6(t3)

REMAINING 21 ENTRIES SKIPPED

---- Pbio

Pbio(t1)

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

(-24.7) eq1

1 eq2(t1)

1 eq16(t1)

Pbio(t2)

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

(-24.7) eq1

1 eq2(t2)

1 eq16(t2)

Pbio(t3)

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

(-24.7) eq1

1 eq2(t3)

1 eq16(t3)

REMAINING 21 ENTRIES SKIPPED

---- Gbio

Gbio(t1)

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

1 eq15(t1)

-0.6 eq16(t1)

Gbio(t2)

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

1 eq15(t2)

-0.6 eq16(t2)

Gbio(t3)

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

1 eq15(t3)

-0.6 eq16(t3)

REMAINING 21 ENTRIES SKIPPED

---- x

x(i1,t1)

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

-176.95 eq1

-220 eq3(i1,t1)

-100 eq4(i1,t1)

x(i1,t2)

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

-176.95 eq1

-220 eq3(i1,t2)

-100 eq4(i1,t2)

x(i1,t3)

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

-176.95 eq1

-220 eq3(i1,t3)

-100 eq4(i1,t3)

REMAINING 69 ENTRIES SKIPPED

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G e n e r a l A l g e b r a i c M o d e l i n g S y s t e m

Model Statistics SOLVE MG Using MINLP From line 162

MODEL STATISTICS

BLOCKS OF EQUATIONS 17 SINGLE EQUATIONS 457

BLOCKS OF VARIABLES 11 SINGLE VARIABLES 337

NON ZERO ELEMENTS 1,104 NON LINEAR N-Z 120

DERIVATIVE POOL 20 CONSTANT POOL 24

CODE LENGTH 722 DISCRETE VARIABLES 72

GENERATION TIME = 0.297 SECONDS 4 MB 25.1.2 r67455 WEX-VS8

EXECUTION TIME = 0.297 SECONDS 4 MB 25.1.2 r67455 WEX-VS8

GAMS 25.1.2 r67455 Released Aug 1, 2018 WEX-VS8 x86 32bit/MS Windows 06/19/10 00:31:28 Page 5

G e n e r a l A l g e b r a i c M o d e l i n g S y s t e m

Solution Report SOLVE MG Using MINLP From line 162

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

MODEL MG OBJECTIVE Obj

TYPE MINLP DIRECTION MINIMIZE

SOLVER BARON FROM LINE 162

\*\*\*\* SOLVER STATUS 1 Normal Completion

\*\*\*\* MODEL STATUS 1 Optimal

\*\*\*\* OBJECTIVE VALUE 119316.4078

RESOURCE USAGE, LIMIT 0.930 1000.000

ITERATION COUNT, LIMIT 0 2000000000

EVALUATION ERRORS 0 0

GAMS/BARON 25.1.2 r67455 Released Aug 1, 2018 VS8 x86 32bit/MS Windows

BARON is a product of The Optimization Firm, LLC. http://www.minlp.com/

Parts of the BARON software were created at the

University of Illinois at Urbana-Champaign.

===========================================================================

BARON version 18.5.8. Built: WIN-32 Tue May 8 15:30:52 EDT 2018

BARON is a product of The Optimization Firm, LLC. http://www.minlp.com/

If you use this software, please cite publications from

http://www.minlp.com/about-baron, such as:

Kilinc, M. and N. V. Sahinidis, Exploiting integrality in the global

optimization of mixed-integer nonlinear programming problems in BARON,

Optimization Methods and Software, 33, 540-562, 2018.

===========================================================================

This BARON run may utilize the following subsolver(s)

For LP/MIP: ILOG CPLEX

For NLP: MINOS, SNOPT, GAMS external NLP, IPOPT, FILTERSD, FILTERSQP

===========================================================================

Solution = 119316.407845795 found at node 1

Best possible = 119316.407726

Absolute gap = 0.000119795091450214 optca = 1E-9

Relative gap = 1.00401188414118E-9 optcr = 1E-9

(Note that BARON uses a different formula to compute the relative gap as

was used for the above reported value.)

LOWER LEVEL UPPER MARGINAL

---- EQU eq1 5704.080 5704.080 5704.080 1.000

---- EQU eq2

LOWER LEVEL UPPER MARGINAL

t1 227.747 227.747 227.747 13.681

t2 214.695 214.695 214.695 13.671

t3 206.271 206.271 206.271 13.668

t4 201.149 201.149 201.149 13.668

t5 201.578 201.578 201.578 13.666

t6 208.624 208.624 208.624 13.668

t7 225.407 225.407 225.407 13.670

t8 247.520 247.520 247.520 13.686

t9 267.228 267.228 267.228 17.885

t10 282.360 282.360 282.360 32.675

t11 297.193 297.193 297.193 32.701

t12 306.930 306.930 306.930 32.716

t13 314.834 314.834 314.834 32.722

t14 316.680 316.680 316.680 32.722

t15 323.518 323.518 323.518 32.736

t16 332.527 332.527 332.527 32.758

t17 332.800 332.800 332.800 32.761

t18 320.762 320.762 320.762 32.748

t19 332.800 332.800 332.800 32.761

t20 323.505 323.505 323.505 32.761

t21 313.456 313.456 313.456 32.761

t22 304.564 304.564 304.564 32.752

t23 308.399 308.399 308.399 32.759

t24 295.802 295.802 295.802 32.734

---- EQU eq3

LOWER LEVEL UPPER MARGINAL

i1.t1 -INF -6.003 . .

i1.t2 -INF -19.055 . .

i1.t3 -INF -21.921 . .

i1.t4 -INF -21.921 . .

i1.t5 -INF -25.172 . .

i1.t6 -INF -21.921 . .

i1.t7 -INF -20.343 . .

i1.t8 -INF -0.230 . .

i1.t9 -INF . . -4.199

i1.t10 -INF . . -18.989

i1.t11 -INF . . -19.015

i1.t12 -INF . . -19.030

i1.t13 -INF . . -19.036

i1.t14 -INF . . -19.036

i1.t15 -INF . . -19.050

i1.t16 -INF . . -19.072

i1.t17 -INF . . -19.075

i1.t18 -INF . . -19.062

i1.t19 -INF . . -19.075

i1.t20 -INF . . -19.075

i1.t21 -INF . . -19.075

i1.t22 -INF . . -19.066

i1.t23 -INF . . -19.073

i1.t24 -INF . . -19.048

i2.t1 -INF . . .

i2.t2 -INF . . .

i2.t3 -INF . . .

i2.t4 -INF . . .

i2.t5 -INF . . .

i2.t6 -INF . . .

i2.t7 -INF . . .

i2.t8 -INF . . .

i2.t9 -INF . . .

i2.t10 -INF . . -0.045

i2.t11 -INF . . -0.071

i2.t12 -INF . . -0.086

i2.t13 -INF . . -0.092

i2.t14 -INF . . -0.092

i2.t15 -INF . . -0.106

i2.t16 -INF . . -0.128

i2.t17 -INF . . -0.131

i2.t18 -INF . . -0.118

i2.t19 -INF . . -0.131

i2.t20 -INF . . -0.131

i2.t21 -INF . . -0.131

i2.t22 -INF . . -0.122

i2.t23 -INF . . -0.129

i2.t24 -INF . . -0.104

i3.t1 -INF . . .

i3.t2 -INF . . .

i3.t3 -INF . . .

i3.t4 -INF . . .

i3.t5 -INF . . .

i3.t6 -INF . . .

i3.t7 -INF . . .

i3.t8 -INF . . .

i3.t9 -INF -1.522 . .

i3.t10 -INF . . -14.775

i3.t11 -INF . . -14.801

i3.t12 -INF . . -14.816

i3.t13 -INF . . -14.822

i3.t14 -INF . . -14.822

i3.t15 -INF . . -14.836

i3.t16 -INF . . -14.858

i3.t17 -INF . . -14.861

i3.t18 -INF . . -14.848

i3.t19 -INF . . -14.861

i3.t20 -INF . . -14.861

i3.t21 -INF . . -14.861

i3.t22 -INF . . -14.852

i3.t23 -INF . . -14.859

i3.t24 -INF . . -14.834

---- EQU eq4

LOWER LEVEL UPPER MARGINAL

i1.t1 . 113.997 +INF .

i1.t2 . 100.945 +INF .

i1.t3 . 98.079 +INF .

i1.t4 . 98.079 +INF .

i1.t5 . 94.828 +INF .

i1.t6 . 98.079 +INF .

i1.t7 . 99.657 +INF .

i1.t8 . 119.770 +INF .

i1.t9 . 120.000 +INF .

i1.t10 . 120.000 +INF .

i1.t11 . 120.000 +INF .

i1.t12 . 120.000 +INF .

i1.t13 . 120.000 +INF .

i1.t14 . 120.000 +INF .

i1.t15 . 120.000 +INF .

i1.t16 . 120.000 +INF .

i1.t17 . 120.000 +INF .

i1.t18 . 120.000 +INF .

i1.t19 . 120.000 +INF .

i1.t20 . 120.000 +INF .

i1.t21 . 120.000 +INF .

i1.t22 . 120.000 +INF .

i1.t23 . 120.000 +INF .

i1.t24 . 120.000 +INF .

i2.t1 . . +INF .

i2.t2 . . +INF .

i2.t3 . . +INF .

i2.t4 . . +INF .

i2.t5 . . +INF .

i2.t6 . . +INF .

i2.t7 . . +INF .

i2.t8 . . +INF .

i2.t9 . . +INF .

i2.t10 . . +INF .

i2.t11 . . +INF .

i2.t12 . . +INF .

i2.t13 . . +INF .

i2.t14 . . +INF .

i2.t15 . . +INF .

i2.t16 . . +INF .

i2.t17 . . +INF .

i2.t18 . . +INF .

i2.t19 . . +INF .

i2.t20 . . +INF .

i2.t21 . . +INF .

i2.t22 . . +INF .

i2.t23 . . +INF .

i2.t24 . . +INF .

i3.t1 . . +INF .

i3.t2 . . +INF .

i3.t3 . . +INF .

i3.t4 . . +INF .

i3.t5 . . +INF .

i3.t6 . . +INF .

i3.t7 . . +INF .

i3.t8 . . +INF .

i3.t9 . 8.478 +INF .

i3.t10 . 10.000 +INF .

i3.t11 . 10.000 +INF .

i3.t12 . 10.000 +INF .

i3.t13 . 10.000 +INF .

i3.t14 . 10.000 +INF .

i3.t15 . 10.000 +INF .

i3.t16 . 10.000 +INF .

i3.t17 . 10.000 +INF .

i3.t18 . 10.000 +INF .

i3.t19 . 10.000 +INF .

i3.t20 . 10.000 +INF .

i3.t21 . 10.000 +INF .

i3.t22 . 10.000 +INF .

i3.t23 . 10.000 +INF .

i3.t24 . 10.000 +INF .

---- EQU eq5

LOWER LEVEL UPPER MARGINAL

t1 -INF 10.000 100.000 .

t2 -INF 10.000 100.000 .

t3 -INF 10.000 100.000 .

t4 -INF 10.000 100.000 .

t5 -INF 10.000 100.000 .

t6 -INF 10.000 100.000 .

t7 -INF 10.000 100.000 .

t8 -INF 10.000 100.000 .

t9 -INF 10.000 100.000 .

t10 -INF 22.610 100.000 .

t11 -INF 35.443 100.000 .

t12 -INF 43.180 100.000 .

t13 -INF 46.084 100.000 .

t14 -INF 45.930 100.000 .

t15 -INF 52.768 100.000 .

t16 -INF 63.777 100.000 .

t17 -INF 65.390 100.000 .

t18 -INF 59.012 100.000 .

t19 -INF 65.390 100.000 .

t20 -INF 65.390 100.000 .

t21 -INF 65.390 100.000 .

t22 -INF 60.814 100.000 .

t23 -INF 64.649 100.000 .

t24 -INF 52.052 100.000 .

---- EQU eq6

LOWER LEVEL UPPER MARGINAL

t1 10.000 10.000 +INF 18.969

t2 10.000 10.000 +INF 18.979

t3 10.000 10.000 +INF 18.982

t4 10.000 10.000 +INF 18.982

t5 10.000 10.000 +INF 18.984

t6 10.000 10.000 +INF 18.982

t7 10.000 10.000 +INF 18.980

t8 10.000 10.000 +INF 18.964

t9 10.000 10.000 +INF 14.765

t10 10.000 22.610 +INF .

t11 10.000 35.443 +INF .

t12 10.000 43.180 +INF .

t13 10.000 46.084 +INF .

t14 10.000 45.930 +INF .

t15 10.000 52.768 +INF .

t16 10.000 63.777 +INF .

t17 10.000 65.390 +INF .

t18 10.000 59.012 +INF .

t19 10.000 65.390 +INF .

t20 10.000 65.390 +INF .

t21 10.000 65.390 +INF .

t22 10.000 60.814 +INF .

t23 10.000 64.649 +INF .

t24 10.000 52.052 +INF .

---- EQU eq7

LOWER LEVEL UPPER MARGINAL

t1 -INF . 15.000 .

t2 -INF . 15.000 .

t3 -INF 5.558 15.000 .

t4 -INF 10.680 15.000 .

t5 -INF 15.000 15.000 -0.003

t6 -INF 13.205 15.000 .

t7 -INF . 15.000 .

t8 -INF . 15.000 .

t9 -INF . 15.000 .

t10 -INF . 15.000 .

t11 -INF . 15.000 .

t12 -INF . 15.000 .

t13 -INF . 15.000 .

t14 -INF . 15.000 .

t15 -INF . 15.000 .

t16 -INF . 15.000 .

t17 -INF . 15.000 .

t18 -INF . 15.000 .

t19 -INF . 15.000 .

t20 -INF . 15.000 .

t21 -INF . 15.000 .

t22 -INF . 15.000 .

t23 -INF . 15.000 .

t24 -INF . 15.000 .

---- EQU eq8

LOWER LEVEL UPPER MARGINAL

t1 . . +INF .

t2 . . +INF .

t3 . 5.558 +INF .

t4 . 10.680 +INF .

t5 . 15.000 +INF .

t6 . 13.205 +INF .

t7 . . +INF 0.001

t8 . . +INF 0.017

t9 . . +INF .

t10 . . +INF 6.208

t11 . . +INF 6.213

t12 . . +INF 6.216

t13 . . +INF 6.186

t14 . . +INF 6.186

t15 . . +INF 6.199

t16 . . +INF 6.221

t17 . . +INF 6.225

t18 . . +INF 6.212

t19 . . +INF 6.225

t20 . . +INF 6.225

t21 . . +INF 6.225

t22 . . +INF 6.215

t23 . . +INF 6.224

t24 . . +INF 6.219

---- EQU eq9

LOWER LEVEL UPPER MARGINAL

t1 -INF . 15.000 .

t2 -INF . 15.000 .

t3 -INF . 15.000 .

t4 -INF . 15.000 .

t5 -INF . 15.000 .

t6 -INF . 15.000 .

t7 -INF . 15.000 .

t8 -INF . 15.000 .

t9 -INF . 15.000 .

t10 -INF . 15.000 .

t11 -INF . 15.000 .

t12 -INF . 15.000 .

t13 -INF . 15.000 .

t14 -INF . 15.000 .

t15 -INF . 15.000 .

t16 -INF . 15.000 .

t17 -INF 3.660 15.000 .

t18 -INF . 15.000 .

t19 -INF 13.660 15.000 .

t20 -INF 14.365 15.000 .

t21 -INF 4.316 15.000 .

t22 -INF . 15.000 .

t23 -INF . 15.000 .

t24 -INF . 15.000 .

---- EQU eq10

LOWER LEVEL UPPER MARGINAL

t1 . . +INF 3.209

t2 . . +INF 3.207

t3 . . +INF 3.206

t4 . . +INF 3.206

t5 . . +INF 3.209

t6 . . +INF 3.206

t7 . . +INF 3.205

t8 . . +INF 3.189

t9 . . +INF 4.195

t10 . . +INF .

t11 . . +INF .

t12 . . +INF .

t13 . . +INF 0.039

t14 . . +INF 0.039

t15 . . +INF 0.025

t16 . . +INF 0.003

t17 . 3.660 +INF .

t18 . . +INF 0.013

t19 . 13.660 +INF .

t20 . 14.365 +INF .

t21 . 4.316 +INF .

t22 . . +INF 0.009

t23 . . +INF .

t24 . . +INF .

---- EQU eq11

LOWER LEVEL UPPER MARGINAL

t1 -INF 10.000 50.000 .

t2 -INF 10.000 50.000 .

t3 -INF 15.003 50.000 .

t4 -INF 24.615 50.000 .

t5 -INF 38.115 50.000 .

t6 -INF 50.000 50.000 .

t7 -INF 50.000 50.000 .

t8 -INF 50.000 50.000 -4.685

t9 -INF 50.000 50.000 -9.536

t10 -INF 50.000 50.000 -0.023

t11 -INF 50.000 50.000 -0.014

t12 -INF 50.000 50.000 -0.040

t13 -INF 50.000 50.000 .

t14 -INF 50.000 50.000 .

t15 -INF 50.000 50.000 .

t16 -INF 50.000 50.000 .

t17 -INF 45.934 50.000 .

t18 -INF 45.934 50.000 .

t19 -INF 30.756 50.000 .

t20 -INF 14.795 50.000 .

t21 -INF 10.000 50.000 .

t22 -INF 10.000 50.000 .

t23 -INF 10.000 50.000 .

t24 -INF 10.000 50.000 .

---- EQU eq12

LOWER LEVEL UPPER MARGINAL

t1 10.000 10.000 +INF 0.012

t2 10.000 10.000 +INF 0.003

t3 10.000 15.003 +INF .

t4 10.000 24.615 +INF .

t5 10.000 38.115 +INF .

t6 10.000 50.000 +INF .

t7 10.000 50.000 +INF .

t8 10.000 50.000 +INF .

t9 10.000 50.000 +INF .

t10 10.000 50.000 +INF .

t11 10.000 50.000 +INF .

t12 10.000 50.000 +INF .

t13 10.000 50.000 +INF .

t14 10.000 50.000 +INF .

t15 10.000 50.000 +INF .

t16 10.000 50.000 +INF .

t17 10.000 45.934 +INF .

t18 10.000 45.934 +INF .

t19 10.000 30.756 +INF .

t20 10.000 14.795 +INF .

t21 10.000 10.000 +INF .

t22 10.000 10.000 +INF 0.001

t23 10.000 10.000 +INF 0.023

t24 10.000 10.000 +INF 29.461

LOWER LEVEL UPPER MARGINAL

---- EQU eq13 10.000 10.000 10.000 -15.201

---- EQU eq14

LOWER LEVEL UPPER MARGINAL

t2 . . . -15.190

t3 . . . -15.187

t4 . . . -15.187

t5 . . . -15.187

t6 . . . -15.187

t7 . . . -15.187

t8 . . . -15.187

t9 . . . -19.872

t10 . . . -29.408

t11 . . . -29.431

t12 . . . -29.445

t13 . . . -29.485

t14 . . . -29.485

t15 . . . -29.485

t16 . . . -29.485

t17 . . . -29.485

t18 . . . -29.485

t19 . . . -29.485

t20 . . . -29.485

t21 . . . -29.485

t22 . . . -29.485

t23 . . . -29.483

t24 . . . -29.461

---- EQU eq15

LOWER LEVEL UPPER MARGINAL

t1 6.250 6.250 6.250 6.625

t2 6.250 6.250 6.250 6.631

t3 6.250 6.250 6.250 6.632

t4 6.250 6.250 6.250 6.632

t5 6.250 6.250 6.250 6.634

t6 6.250 6.250 6.250 6.632

t7 6.250 6.250 6.250 6.632

t8 6.250 6.250 6.250 6.622

t9 6.250 6.250 6.250 4.103

t10 6.250 6.250 6.250 -4.772

t11 6.250 6.250 6.250 -4.787

t12 6.250 6.250 6.250 -4.796

t13 6.250 6.250 6.250 -4.800

t14 6.250 6.250 6.250 -4.800

t15 6.250 6.250 6.250 -4.808

t16 6.250 6.250 6.250 -4.821

t17 6.250 6.250 6.250 -4.823

t18 6.250 6.250 6.250 -4.815

t19 6.250 6.250 6.250 -4.823

t20 6.250 6.250 6.250 -4.823

t21 6.250 6.250 6.250 -4.823

t22 6.250 6.250 6.250 -4.817

t23 6.250 6.250 6.250 -4.822

t24 6.250 6.250 6.250 -4.807

---- EQU eq16

LOWER LEVEL UPPER MARGINAL

t1 . . . 11.041

t2 . . . 11.052

t3 . . . 11.054

t4 . . . 11.054

t5 . . . 11.057

t6 . . . 11.054

t7 . . . 11.053

t8 . . . 11.037

t9 . . . 6.838

t10 . . . -7.953

t11 . . . -7.978

t12 . . . -7.994

t13 . . . -8.000

t14 . . . -7.999

t15 . . . -8.013

t16 . . . -8.035

t17 . . . -8.038

t18 . . . -8.026

t19 . . . -8.038

t20 . . . -8.038

t21 . . . -8.038

t22 . . . -8.029

t23 . . . -8.037

t24 . . . -8.012

---- EQU eq17

LOWER LEVEL UPPER MARGINAL

t1 -INF . . -13.681

t2 -INF . . -13.671

t3 -INF . . -13.668

t4 -INF . . -13.668

t5 -INF 8.000 8.000 -13.666

t6 -INF 10.000 10.000 -13.668

t7 -INF 12.000 12.000 -13.670

t8 -INF 14.000 14.000 -13.686

t9 -INF 15.000 15.000 -17.885

t10 -INF 16.000 16.000 -32.675

t11 -INF 18.000 18.000 -32.701

t12 -INF 20.000 20.000 -32.716

t13 -INF 25.000 25.000 -32.722

t14 -INF 27.000 27.000 -32.722

t15 -INF 27.000 27.000 -32.736

t16 -INF 25.000 25.000 -32.758

t17 -INF 20.000 20.000 -32.761

t18 -INF 18.000 18.000 -32.748

t19 -INF 10.000 10.000 -32.761

t20 -INF . . -32.761

t21 -INF . . -32.761

t22 -INF . . -32.752

t23 -INF . . -32.759

t24 -INF . . -32.734

LOWER LEVEL UPPER MARGINAL

---- VAR Obj -INF 1.1932E+5 +INF .

---- VAR P

LOWER LEVEL UPPER MARGINAL

i1.t1 . 213.997 +INF .

i1.t2 . 200.945 +INF .

i1.t3 . 198.079 +INF .

i1.t4 . 198.079 +INF .

i1.t5 . 194.828 +INF .

i1.t6 . 198.079 +INF .

i1.t7 . 199.657 +INF .

i1.t8 . 219.770 +INF .

i1.t9 . 220.000 +INF .

i1.t10 . 220.000 +INF .

i1.t11 . 220.000 +INF .

i1.t12 . 220.000 +INF .

i1.t13 . 220.000 +INF .

i1.t14 . 220.000 +INF .

i1.t15 . 220.000 +INF .

i1.t16 . 220.000 +INF .

i1.t17 . 220.000 +INF .

i1.t18 . 220.000 +INF .

i1.t19 . 220.000 +INF .

i1.t20 . 220.000 +INF .

i1.t21 . 220.000 +INF .

i1.t22 . 220.000 +INF .

i1.t23 . 220.000 +INF .

i1.t24 . 220.000 +INF .

i2.t1 . . +INF 18.949

i2.t2 . . +INF 18.959

i2.t3 . . +INF 18.962

i2.t4 . . +INF 18.962

i2.t5 . . +INF 18.964

i2.t6 . . +INF 18.962

i2.t7 . . +INF 18.960

i2.t8 . . +INF 18.944

i2.t9 . . +INF 14.745

i2.t10 . . +INF .

i2.t11 . . +INF .

i2.t12 . . +INF .

i2.t13 . . +INF .

i2.t14 . . +INF .

i2.t15 . . +INF .

i2.t16 . . +INF .

i2.t17 . . +INF .

i2.t18 . . +INF .

i2.t19 . . +INF .

i2.t20 . . +INF .

i2.t21 . . +INF .

i2.t22 . . +INF .

i2.t23 . . +INF .

i2.t24 . . +INF .

i3.t1 . . +INF 4.019

i3.t2 . . +INF 4.029

i3.t3 . . +INF 4.032

i3.t4 . . +INF 4.032

i3.t5 . . +INF 4.034

i3.t6 . . +INF 4.032

i3.t7 . . +INF 4.030

i3.t8 . . +INF 4.014

i3.t9 . 18.478 +INF .

i3.t10 . 20.000 +INF .

i3.t11 . 20.000 +INF .

i3.t12 . 20.000 +INF .

i3.t13 . 20.000 +INF .

i3.t14 . 20.000 +INF .

i3.t15 . 20.000 +INF .

i3.t16 . 20.000 +INF .

i3.t17 . 20.000 +INF .

i3.t18 . 20.000 +INF .

i3.t19 . 20.000 +INF .

i3.t20 . 20.000 +INF .

i3.t21 . 20.000 +INF .

i3.t22 . 20.000 +INF .

i3.t23 . 20.000 +INF .

i3.t24 . 20.000 +INF .

---- VAR Pslr

LOWER LEVEL UPPER MARGINAL

t1 . . +INF .

t2 . . +INF .

t3 . . +INF .

t4 . . +INF .

t5 . 8.000 +INF .

t6 . 10.000 +INF .

t7 . 12.000 +INF .

t8 . 14.000 +INF .

t9 . 15.000 +INF .

t10 . 16.000 +INF .

t11 . 18.000 +INF .

t12 . 20.000 +INF .

t13 . 25.000 +INF .

t14 . 27.000 +INF .

t15 . 27.000 +INF .

t16 . 25.000 +INF .

t17 . 20.000 +INF .

t18 . 18.000 +INF .

t19 . 10.000 +INF .

t20 . . +INF .

t21 . . +INF .

t22 . . +INF .

t23 . . +INF .

t24 . . +INF .

---- VAR Pgrid

LOWER LEVEL UPPER MARGINAL

t1 . . +INF 36.319

t2 . . +INF 36.329

t3 . . +INF 36.332

t4 . . +INF 36.332

t5 . . +INF 36.334

t6 . . +INF 36.332

t7 . . +INF 36.330

t8 . . +INF 36.314

t9 . . +INF 32.115

t10 . . +INF 17.325

t11 . . +INF 17.299

t12 . . +INF 17.284

t13 . . +INF 17.278

t14 . . +INF 17.278

t15 . . +INF 17.264

t16 . . +INF 17.242

t17 . . +INF 17.239

t18 . . +INF 17.252

t19 . . +INF 17.239

t20 . . +INF 17.239

t21 . . +INF 17.239

t22 . . +INF 17.248

t23 . . +INF 17.241

t24 . . +INF 17.266

---- VAR Pch

LOWER LEVEL UPPER MARGINAL

t1 . . +INF .

t2 . . +INF .

t3 . 5.558 +INF .

t4 . 10.680 +INF .

t5 . 15.000 +INF .

t6 . 13.205 +INF .

t7 . . +INF .

t8 . . +INF .

t9 . . +INF .

t10 . . +INF .

t11 . . +INF .

t12 . . +INF .

t13 . . +INF .

t14 . . +INF .

t15 . . +INF .

t16 . . +INF .

t17 . . +INF .

t18 . . +INF .

t19 . . +INF .

t20 . . +INF .

t21 . . +INF .

t22 . . +INF .

t23 . . +INF .

t24 . . +INF .

---- VAR Pdch

LOWER LEVEL UPPER MARGINAL

t1 . . +INF .

t2 . . +INF .

t3 . . +INF .

t4 . . +INF .

t5 . . +INF .

t6 . . +INF .

t7 . . +INF .

t8 . . +INF .

t9 . . +INF .

t10 . . +INF .

t11 . . +INF .

t12 . . +INF .

t13 . . +INF .

t14 . . +INF .

t15 . . +INF .

t16 . . +INF .

t17 . 3.660 +INF .

t18 . . +INF .

t19 . 13.660 +INF .

t20 . 14.365 +INF .

t21 . 4.316 +INF .

t22 . . +INF .

t23 . . +INF .

t24 . . +INF .

---- VAR Eb

LOWER LEVEL UPPER MARGINAL

t1 . 10.000 +INF .

t2 . 10.000 +INF .

t3 . 15.003 +INF .

t4 . 24.615 +INF .

t5 . 38.115 +INF .

t6 . 50.000 +INF .

t7 . 50.000 +INF .

t8 . 50.000 +INF .

t9 . 50.000 +INF .

t10 . 50.000 +INF .

t11 . 50.000 +INF .

t12 . 50.000 +INF .

t13 . 50.000 +INF .

t14 . 50.000 +INF .

t15 . 50.000 +INF .

t16 . 50.000 +INF .

t17 . 45.934 +INF .

t18 . 45.934 +INF .

t19 . 30.756 +INF .

t20 . 14.795 +INF .

t21 . 10.000 +INF .

t22 . 10.000 +INF .

t23 . 10.000 +INF .

t24 . 10.000 +INF .

---- VAR Pchp

LOWER LEVEL UPPER MARGINAL

t1 . 10.000 +INF .

t2 . 10.000 +INF .

t3 . 10.000 +INF .

t4 . 10.000 +INF .

t5 . 10.000 +INF .

t6 . 10.000 +INF .

t7 . 10.000 +INF .

t8 . 10.000 +INF .

t9 . 10.000 +INF .

t10 . 22.610 +INF .

t11 . 35.443 +INF .

t12 . 43.180 +INF .

t13 . 46.084 +INF .

t14 . 45.930 +INF .

t15 . 52.768 +INF .

t16 . 63.777 +INF .

t17 . 65.390 +INF .

t18 . 59.012 +INF .

t19 . 65.390 +INF .

t20 . 65.390 +INF .

t21 . 65.390 +INF .

t22 . 60.814 +INF .

t23 . 64.649 +INF .

t24 . 52.052 +INF .

---- VAR Pbio

LOWER LEVEL UPPER MARGINAL

t1 . 3.750 +INF .

t2 . 3.750 +INF .

t3 . 3.750 +INF .

t4 . 3.750 +INF .

t5 . 3.750 +INF .

t6 . 3.750 +INF .

t7 . 3.750 +INF .

t8 . 3.750 +INF .

t9 . 3.750 +INF .

t10 . 3.750 +INF .

t11 . 3.750 +INF .

t12 . 3.750 +INF .

t13 . 3.750 +INF .

t14 . 3.750 +INF .

t15 . 3.750 +INF .

t16 . 3.750 +INF .

t17 . 3.750 +INF .

t18 . 3.750 +INF .

t19 . 3.750 +INF .

t20 . 3.750 +INF .

t21 . 3.750 +INF .

t22 . 3.750 +INF .

t23 . 3.750 +INF .

t24 . 3.750 +INF .

---- VAR Gbio

LOWER LEVEL UPPER MARGINAL

t1 . 6.250 +INF .

t2 . 6.250 +INF .

t3 . 6.250 +INF .

t4 . 6.250 +INF .

t5 . 6.250 +INF .

t6 . 6.250 +INF .

t7 . 6.250 +INF .

t8 . 6.250 +INF .

t9 . 6.250 +INF .

t10 . 6.250 +INF .

t11 . 6.250 +INF .

t12 . 6.250 +INF .

t13 . 6.250 +INF .

t14 . 6.250 +INF .

t15 . 6.250 +INF .

t16 . 6.250 +INF .

t17 . 6.250 +INF .

t18 . 6.250 +INF .

t19 . 6.250 +INF .

t20 . 6.250 +INF .

t21 . 6.250 +INF .

t22 . 6.250 +INF .

t23 . 6.250 +INF .

t24 . 6.250 +INF .

---- VAR x

LOWER LEVEL UPPER MARGINAL

i1.t1 . 1.000 1.000 176.950

i1.t2 . 1.000 1.000 176.950

i1.t3 . 1.000 1.000 176.950

i1.t4 . 1.000 1.000 176.950

i1.t5 . 1.000 1.000 176.950

i1.t6 . 1.000 1.000 176.950

i1.t7 . 1.000 1.000 176.950

i1.t8 . 1.000 1.000 176.950

i1.t9 . 1.000 1.000 -746.782

i1.t10 . 1.000 1.000 -4000.678

i1.t11 . 1.000 1.000 -4006.325

i1.t12 . 1.000 1.000 -4009.729

i1.t13 . 1.000 1.000 -4011.007

i1.t14 . 1.000 1.000 -4010.939

i1.t15 . 1.000 1.000 -4013.948

i1.t16 . 1.000 1.000 -4018.792

i1.t17 . 1.000 1.000 -4019.502

i1.t18 . 1.000 1.000 -4016.695

i1.t19 . 1.000 1.000 -4019.502

i1.t20 . 1.000 1.000 -4019.502

i1.t21 . 1.000 1.000 -4019.502

i1.t22 . 1.000 1.000 -4017.488

i1.t23 . 1.000 1.000 -4019.176

i1.t24 . 1.000 1.000 -4013.633

i2.t1 . . 1.000 129.970

i2.t2 . . 1.000 129.970

i2.t3 . . 1.000 129.970

i2.t4 . . 1.000 129.970

i2.t5 . . 1.000 129.970

i2.t6 . . 1.000 129.970

i2.t7 . . 1.000 129.970

i2.t8 . . 1.000 129.970

i2.t9 . . 1.000 129.970

i2.t10 . . 1.000 125.448

i2.t11 . . 1.000 122.881

i2.t12 . . 1.000 121.334

i2.t13 . . 1.000 120.753

i2.t14 . . 1.000 120.784

i2.t15 . . 1.000 119.416

i2.t16 . . 1.000 117.215

i2.t17 . . 1.000 116.892

i2.t18 . . 1.000 118.168

i2.t19 . . 1.000 116.892

i2.t20 . . 1.000 116.892

i2.t21 . . 1.000 116.892

i2.t22 . . 1.000 117.807

i2.t23 . . 1.000 117.040

i2.t24 . . 1.000 119.560

i3.t1 . . 1.000 137.410

i3.t2 . . 1.000 137.410

i3.t3 . . 1.000 137.410

i3.t4 . . 1.000 137.410

i3.t5 . . 1.000 137.410

i3.t6 . . 1.000 137.410

i3.t7 . . 1.000 137.410

i3.t8 . . 1.000 137.410

i3.t9 . 1.000 1.000 137.410

i3.t10 . 1.000 1.000 -158.094

i3.t11 . 1.000 1.000 -158.608

i3.t12 . 1.000 1.000 -158.917

i3.t13 . 1.000 1.000 -159.033

i3.t14 . 1.000 1.000 -159.027

i3.t15 . 1.000 1.000 -159.301

i3.t16 . 1.000 1.000 -159.741

i3.t17 . 1.000 1.000 -159.806

i3.t18 . 1.000 1.000 -159.550

i3.t19 . 1.000 1.000 -159.806

i3.t20 . 1.000 1.000 -159.806

i3.t21 . 1.000 1.000 -159.806

i3.t22 . 1.000 1.000 -159.623

i3.t23 . 1.000 1.000 -159.776

i3.t24 . 1.000 1.000 -159.272

\*\*\*\* REPORT SUMMARY : 0 NONOPT

0 INFEASIBLE

0 UNBOUNDED

0 ERRORS

39 PROJECTED

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G e n e r a l A l g e b r a i c M o d e l i n g S y s t e m

E x e c u t i o n

---- 163 VARIABLE Obj.L = 119316.408

---- 163 VARIABLE Pslr.L

t5 8.000, t6 10.000, t7 12.000, t8 14.000, t9 15.000

t10 16.000, t11 18.000, t12 20.000, t13 25.000, t14 27.000

t15 27.000, t16 25.000, t17 20.000, t18 18.000, t19 10.000

---- 163 VARIABLE Pchp.L

t1 10.000, t2 10.000, t3 10.000, t4 10.000, t5 10.000

t6 10.000, t7 10.000, t8 10.000, t9 10.000, t10 22.610

t11 35.443, t12 43.180, t13 46.084, t14 45.930, t15 52.768

t16 63.777, t17 65.390, t18 59.012, t19 65.390, t20 65.390

t21 65.390, t22 60.814, t23 64.649, t24 52.052

---- 163 VARIABLE Pbio.L

t1 3.750, t2 3.750, t3 3.750, t4 3.750, t5 3.750, t6 3.750

t7 3.750, t8 3.750, t9 3.750, t10 3.750, t11 3.750, t12 3.750

t13 3.750, t14 3.750, t15 3.750, t16 3.750, t17 3.750, t18 3.750

t19 3.750, t20 3.750, t21 3.750, t22 3.750, t23 3.750, t24 3.750

---- 163 VARIABLE Pgrid.L

( ALL 0.000 )

---- 163 VARIABLE P.L

t1 t2 t3 t4 t5 t6

i1 213.997 200.945 198.079 198.079 194.828 198.079

+ t7 t8 t9 t10 t11 t12

i1 199.657 219.770 220.000 220.000 220.000 220.000

i3 18.478 20.000 20.000 20.000

+ t13 t14 t15 t16 t17 t18

i1 220.000 220.000 220.000 220.000 220.000 220.000

i3 20.000 20.000 20.000 20.000 20.000 20.000

+ t19 t20 t21 t22 t23 t24

i1 220.000 220.000 220.000 220.000 220.000 220.000

i3 20.000 20.000 20.000 20.000 20.000 20.000

---- 163 VARIABLE x.L

t1 t2 t3 t4 t5 t6

i1 1.000 1.000 1.000 1.000 1.000 1.000

+ t7 t8 t9 t10 t11 t12

i1 1.000 1.000 1.000 1.000 1.000 1.000

i3 1.000 1.000 1.000 1.000

+ t13 t14 t15 t16 t17 t18

i1 1.000 1.000 1.000 1.000 1.000 1.000

i3 1.000 1.000 1.000 1.000 1.000 1.000

+ t19 t20 t21 t22 t23 t24

i1 1.000 1.000 1.000 1.000 1.000 1.000

i3 1.000 1.000 1.000 1.000 1.000 1.000

---- 163 VARIABLE Pch.L

t3 5.558, t4 10.680, t5 15.000, t6 13.205

---- 163 VARIABLE Pdch.L

t17 3.660, t19 13.660, t20 14.365, t21 4.316

---- 163 VARIABLE Eb.L

t1 10.000, t2 10.000, t3 15.003, t4 24.615, t5 38.115

t6 50.000, t7 50.000, t8 50.000, t9 50.000, t10 50.000

t11 50.000, t12 50.000, t13 50.000, t14 50.000, t15 50.000

t16 50.000, t17 45.934, t18 45.934, t19 30.756, t20 14.795

t21 10.000, t22 10.000, t23 10.000, t24 10.000

EXECUTION TIME = 0.016 SECONDS 3 MB 25.1.2 r67455 WEX-VS8

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