

\$TITLE: M4-2.GMS: Find all pure-strategy Nash equilibrium
 * *with discrete strategy sets*

\$ONTEXT

*two firms, one in country h and one in country f
 each firm chooses one of three strategies:*

don't enter: strategy 0

enter with a single plant and export to the other country: strategy 1

*enter with plants in both countries (horizontal multinational)
 strategy 2*

\$OFFTEXT

SETS R strategies for firm h /SH0, SH1, SH2/
 C strategies for firm f /SF0, SF1, SF2/;

ALIAS(R,RR)

ALIAS(C,CC);

PARAMETERS

ROWMAX(R,C) maximum value over the rows for a given column C

COLMAX(R,C) maximum value over the columns for a given row R

NASHEQ(R,C) matrix of 0-1 where 1 is a Nash equilibrium

PROFHNE(R,C) profit of firm h in Nash equilibrium

PROFFNE(R,C) profit of firm f in Nash equilibrium;

* *small maintenance costs -0.1 when not entering, not needed*

```

TABLE PAYOFFFH( *, * )
      SF0   SF1   SF2
SH0   -.1   -.1   -.1
SH1    10    6    3
SH2    12    5    2 ;

```

```

TABLE PAYOFFFF( *, * )
      SF0   SF1   SF2
SH0   -.1   10   12
SH1   -.1    6    5
SH2   -.1    3    2 ;

```

```

DISPLAY PAYOFFFH, PAYOFFFF;

```

```

ROWMAX(R,C) = 1$(PAYOFFFH(R,C) EQ SMAX(RR, PAYOFFFH(RR,C)));

```

```

COLMAX(R,C) = 1$(PAYOFFFF(R,C) EQ SMAX(CC, PAYOFFFF(R,CC)));

```

```

DISPLAY ROWMAX, COLMAX;

```

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NASHEQ(R,C) = ROWMAX(R,C)*COLMAX(R,C);

```

```

DISPLAY NASHEQ;

```

```

PROFHNE(R,C) = PAYOFFFH(R,C)$NASHEQ(R,C);

```

```
PROFFNE(R,C) = PAYOFFF(R,C)$NASHEQ(R,C);
```

```
DISPLAY PROFHNE, PROFFNE;
```

```
*CASE 2: MARKETS TOO SMALL FOR A FIRM TO ENTER AGAINST A TWO-PLANT RIVAL  
*subtract 4 from each payoff strategies 1 and 2
```

```
TABLE PAYOFFH2(*,*)  
      SF0   SF1   SF2  
SH0   -.1   -.1   -.1  
SH1    6    2    -1  
SH2    8    1    -2 ;
```

```
TABLE PAYOFFF2(*,*)  
      SF0   SF1   SF2  
SH0   -.1    6    8  
SH1   -.1    2    1  
SH2   -.1   -1   -2 ;
```

```
ROWMAX(R,C) = 1$(PAYOFFH2(R,C) EQ SMAX(RR, PAYOFFH2(RR,C)) );
```

```
COLMAX(R,C) = 1$(PAYOFFF2(R,C) EQ SMAX(CC, PAYOFFF2(R,CC)) );
```

```
NASHEQ(R,C) = ROWMAX(R,C)*COLMAX(R,C);
```

```
DISPLAY NASHEQ;
```

PROFHNE(R,C) = PAYOFFH2(R,C)\$NASHEQ(R,C);

PROFFNE(R,C) = PAYOFFF2(R,C)\$NASHEQ(R,C);

DISPLAY PROFHNE, PROFFNE;

**CASE 3: LOWER FIRM FIXED COSTS, RAISE PLANT FIXED COSTS*

**makes two-plant production more profitable*

**add 2 when playing strategy 2*

TABLE PAYOFFH3(*,*)

	SF0	SF1	SF2
SH0	-.1	-.1	-.1
SH1	10	6	3
SH2	14	7	4 ;

TABLE PAYOFFF3(*,*)

	SF0	SF1	SF2
SH0	-.1	10	14
SH1	-.1	6	7
SH2	-.1	3	4 ;

ROWMAX(R,C) = 1\$(PAYOFFH3(R,C) EQ **SMAX**(RR, PAYOFFH3(RR,C)));

COLMAX(R,C) = 1\$(PAYOFFF3(R,C) EQ **SMAX**(CC, PAYOFFF3(R,CC)));

```
NASHEQ(R,C) = ROWMAX(R,C)*COLMAX(R,C);
```

```
DISPLAY NASHEQ;
```

```
PROFHNE(R,C) = PAYOFFH3(R,C)$NASHEQ(R,C);
```

```
PROFFNE(R,C) = PAYOFFF3(R,C)$NASHEQ(R,C);
```

```
DISPLAY PROFHNE, PROFFNE;
```