Game Output

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15 Simulations of the Game

```
#### run all
game_simulations(15, best_resp="Yes")
## Game of 2 firms:
     Scenario Si Sj_left Sj_right Si_Payoff Sj_Payoff_left Sj_Payoff_right
                             2
                                     0.0
                                                    0.0
## 1 Sum_Si<K 0
                    0
                                                    0.0
## 2 Sum_Si<K 1
                      0
                             1
                                      0.5
                                                                   0.5
## 3 Sum_Si<K 2
                      0
                             0
                                                    0.0
                                     1.5
                                                                   0.0
                           2
                      2
## 4 Sum_Si=>K 1
                                     0.0
                                                    0.5
                                                                   0.5
## 5 Sum_Si=>K 2
                      2
                             2
                                    0.5
                                                    0.5
                                                                   0.5
## 6 Sum_Si=>K 0
                              2
                                     0.0
                                                    0.5
                                                                   0.5
##
## ---- Pareto Equilibrium ---
## Pareto Optimality is reached when: Si = 2 with vi(Si, S_i) = 1.5, if Sum_Si < k & Sj = 0, wi
##
## That is:
## 1 firms choose \, 0 units, with a payoff of \, 0 \,.
## 1 firm chooses 2 units, with a payoff of 1.5.
##
## ---- Nash Equilibrium ---
## There
         are 2 Nash Equilibriums
##
    ( 1 ) Nash Equilibrium 1 , for Sum_Si<K :
##
     3 firms choose 1 units, each with a payoff of 0.5 .
    ( 2 ) Nash Equilibrium 2 , for Sum_Si=>K :
     3 firms choose 2 units, each with a payoff of 0.1666667.
##
##
##
##
## Game of 3 firms:
     Scenario Si Sj_left Sj_right Si_Payoff Sj_Payoff_left Sj_Payoff_right
                             2 0.0000000
## 1 Sum_Si<K 0
                    0
                                               0.0000000
                                                              1.5000000
## 2 Sum_Si<K 1
                      0
                              2 0.5000000
                                               0.0000000
                                                              1.5000000
## 3 Sum_Si<K 2
                    0
                             1 1.5000000
                                               0.0000000
                                                              0.5000000
## 4 Sum_Si=>K 1
                     1
                             2 -0.1666667
                                              -0.1666667
                                                              0.1666667
```

-0.1666667

0.1666667

2 0.1666667

1

5 Sum_Si=>K 2

```
## 6 Sum_Si=>K 0 1 2 0.0000000 -0.1666667 0.1666667
##
## ---- Pareto Equilibrium ---
## Pareto Optimality is reached when: Si = 2 with vi(Si, S_i) = 1.5, if Sum_Si < K & Sj = [0],
## That is:
## 1 firms choose 0 units, with a payoff of 0.
## 1 firm chooses 2 units, with a payoff of 1.5.
\#\# 1 firms choose 1 units, with a payoff of 0.5 .
## ---- Nash Equilibrium ---
## There are 2 Nash Equilibriums .
    (1) Nash Equilibrium 1, for Sum_Si<K:
##
##
    3 firms choose 1 units, each with a payoff of 0.5.
##
    ( 2 ) Nash Equilibrium 2 , for Sum_Si=>K :
     3 firms choose 2 units, each with a payoff of 0.1666667 .
##
##
## -----
##
##
## Game of 4 firms:
     Scenario Si Sj_left Sj_right Si_Payoff Sj_Payoff_left Sj_Payoff_right
## 1 Sum_Si<K 0 0 2 0.0 0
                   0 2 0.5
0 2 1.5
1 2 0.0
1 2 0.5
## 2 Sum_Si<K 1
                                   0.5
                                                  0
                                                               1.5
## 3 Sum_Si<K 2
                                                  0
                                                               1.5
## 5 Sum_Si=>K 2
## 6 Sum_Si=> X 2
                                                  0
                                                                0.5
                                                  0
                                                                0.5
                   1
## 6 Sum_Si=>K 0
                            2
                                  0.0
                                                   0
                                                                0.5
## ---- Pareto Equilibrium ---
## Pareto Optimality is reached when: Si = 2 with vi(Si, S_i) = 1.5, if Sum_Si < K & Sj = [0, 1]
## That is:
## 2 \text{ firms choose } 0 \text{ units, with a payoff of } 0.
## 0 firms choose 1 units, with a payoff of 0.
## 2 \text{ firms choose } 2 \text{ units, with a payoff of } 1.5.
## ---- Nash Equilibrium ---
## There are 2 Nash Equilibriums .
##
   ( 1 ) Nash Equilibrium 1 , for Sum_Si<K :
     3 firms choose 1 units, each with a payoff of 0.5.
    ( 2 ) Nash Equilibrium 2 , for Sum_Si=>K :
     3 firms choose 2 units, each with a payoff of 0.1666667.
##
##
##
##
## Game of 5 firms:
## Scenario Si Sj_left Sj_right Si_Payoff Sj_Payoff_left Sj_Payoff_right
                                         0.0
## 1 Sum_Si<K 0 0 2 0.0
```

```
## 2 Sum_Si<K 1 0 2 0.5
## 3 Sum_Si<K 2 0 2 1.5
## 4 Sum_Si=>K 1 1 2 -0.1
## 5 Sum_Si=>K 2 1 2 0.3
                                                  0.0
                                                                  1.5
                                                   0.0
                                                                  1.5
                                                  -0.1
                                                                 0.3
                                                  -0.1
                                                                  0.3
## 6 Sum_Si=>K 0
                     1
                             2
                                     0.0
                                                   -0.1
                                                                  0.3
##
## ---- Pareto Equilibrium ---
## Pareto Optimality is reached when: Si = 2 with vi(Si, S_i) = 1.5, if Sum_Si < k & Sj = [0, 1]
##
## That is:
## 2 firms choose \, 0 units, with a payoff of \, 0 \, .
## 1 firms choose 1 units, with a payoff of 0.
\#\# 2 firms choose 2 units, with a payoff of 1.5 .
## ---- Nash Equilibrium ---
## There are 2 Nash Equilibriums .
##
##
    (1) Nash Equilibrium 1, for Sum_Si<K:
     3 firms choose 1 units, each with a payoff of 0.5.
    ( 2 ) Nash Equilibrium 2 , for Sum_Si=>K :
##
     3 firms choose 2 units, each with a payoff of 0.1666667.
##
## Game of 6 firms:
     Scenario Si Sj_left Sj_right Si_Payoff Sj_Payoff_left Sj_Payoff_right
## 1 Sum_Si<K 0 0 2 0.0
                                                   0
## 2 Sum_Si<K 1
                    0
                             2
                                    0.5
                                                     0
                                                                  1.5
                           2
2
2
## 3 Sum_Si<K 2
                                    1.5
                    0
                                                     0
                                                                  1.5
                                                    0
## 4 Sum_Si=>K 1
                    1
                                    0.0
                                                                  0.5
## 5 Sum_Si=>K 2
                    1
                                    0.5
                                                    0
                                                                  0.5
## 6 Sum_Si=>K 0
                             2
                                    0.0
                                                     0
                                                                  0.5
                    1
## ---- Pareto Equilibrium ---
## Pareto Optimality is reached when: Si = 2 with vi(Si, S_i) = 1.5, if Sum_Si < k & Sj = [0, 1]
##
## That is:
## 3 firms choose 0 units, with a payoff of 0.
## 0 firms choose 1 units, with a payoff of 0.
## 3 \text{ firms choose } 2 \text{ units, with a payoff of } 1.5.
## ---- Nash Equilibrium ---
## There are 2 Nash Equilibriums .
##
##
    (1) Nash Equilibrium 1, for Sum_Si<K:
     3 firms choose 1 units, each with a payoff of 0.5.
##
    ( 2 ) Nash Equilibrium 2 , for Sum_Si=>K :
     3 firms choose 2 units, each with a payoff of 0.1666667 .
##
##
##
## -----
##
```

```
##
## Game of 7 firms:
      Scenario Si Sj_left Sj_right Si_Payoff_Sj_Payoff_left Sj_Payoff_right
## 1 Sum_Si<K 0 0 2 0.00000000 0.00000000 1.5000000    ## 2 Sum_Si<K 1 0 2 0.5000000 0.00000000 1.5000000    ## 3 Sum_Si<K 2 0 2 1.5000000 0.00000000 1.5000000    ## 4 Sum_Si=>K 1 1 2 -0.07142857 -0.07142857 0.3571429
## 5 Sum_Si=>K 2
                      1
                               2 0.35714286 -0.07142857
                                                                  0.3571429
## 6 Sum Si=>K 0
                      1
                            2 0.00000000
                                               -0.07142857
                                                                   0.3571429
## ---- Pareto Equilibrium ---
## Pareto Optimality is reached when: Si = 2 with vi(Si, S_i) = 1.5, if Sum_Si<K & Sj = [0, \cdot]
## That is:
## 3 firms choose 0 units, with a payoff of 0 .
## 1 firms choose 1 units, with a payoff of 0.
## 3 \text{ firms choose } 2 \text{ units, with a payoff of } 1.5.
##
## ---- Nash Equilibrium ---
## There are 2 Nash Equilibriums .
##
   (1) Nash Equilibrium 1, for Sum_Si<K:
     3 firms choose 1 units, each with a payoff of 0.5.
##
     ( 2 ) Nash Equilibrium 2 , for Sum_Si=>K :
     3 firms choose 2 units, each with a payoff of 0.1666667.
##
##
##
##
## Game of 8 firms:
      Scenario Si Sj_left Sj_right Si_Payoff Sj_Payoff_left Sj_Payoff_right
## 1 Sum_Si<K 0 0 2 0.0
## 2 Sum_Si<K 1
                      0
                               2
                                       0.5
                                                         0
                                                                        1.5
                     0 2 0.0
0 2 1.5
1 2 0.0
1 2 0.5
## 3 Sum_Si<K 2
                                                         0
                                                                        1.5
                                                        0
## 4 Sum_Si=>K 1
                                                                        0.5
## 5 Sum Si=>K 2
                                                         0
                                                                        0.5
                                     0.0
## 6 Sum_Si=>K 0
                      1
                               2
                                                          0
                                                                        0.5
##
## ---- Pareto Equilibrium ---
## Pareto Optimality is reached when: Si = 2 with vi(Si, S_i) = 1.5, if Sum_Si < k & Sj = [0, 1]
##
## That is:
\#\# 4 firms choose 0 units, with a payoff of 0.
## 0 firms choose 1 units, with a payoff of 0.
## 4 firms choose 2 units, with a payoff of 1.5.
## ---- Nash Equilibrium ---
## There are 2 Nash Equilibriums .
##
##
   (1) Nash Equilibrium 1, for Sum_Si<K:
##
    3 firms choose 1 units, each with a payoff of 0.5.
##
     ( 2 ) Nash Equilibrium 2 , for Sum_Si=>K :
     3 firms choose 2 units, each with a payoff of 0.1666667.
```

```
##
## -----
##
## Game of 9 firms:
## Scenario Si Sj_left Sj_right Si_Payoff Sj_Payoff_left Sj_Payoff_right
1.5000000
                                                           1.5000000
                   0 2 1.50000000 0.00000000

1 2 -0.05555556 -0.05555556

1 2 0.38888889 -0.05555556

1 2 0.00000000 -0.05555556
## 3 Sum_Si<K 2 0
                                                           1.5000000
## 4 Sum_Si=>K 1
                                                           0.3888889
## 5 Sum_Si=>K 2
                                                            0.3888889
## 6 Sum_Si=>K 0
                                                            0.3888889
## ---- Pareto Equilibrium ---
## Pareto Optimality is reached when: Si = 2 with vi(Si, S_i) = 1.5, if Sum_Si < K & Sj = [0, 1]
##
## That is:
## 4 firms choose 0 units, with a payoff of 0.
## 1 firms choose 1 units, with a payoff of 0.
## 4 \text{ firms choose } 2 \text{ units, with a payoff of } 1.5.
## ---- Nash Equilibrium ---
## There are 2 Nash Equilibriums .
##
    ( 1 ) Nash Equilibrium 1 , for Sum_Si<K :
##
    3 firms choose 1 units, each with a payoff of 0.5.
    ( 2 ) Nash Equilibrium 2 , for Sum_Si=>K :
     3 firms choose 2 units, each with a payoff of 0.1666667.
##
##
##
##
## Game of 10 firms:
## Scenario Si Sj_left Sj_right Si_Payoff Sj_Payoff_left Sj_Payoff_right
## 1 Sum_Si<K 0 0 2 0.0 0
                          2
2
2
## 2 Sum_Si<K 1
                   0
                                   0.5
                                                  0
                                                               1.5
## 3 Sum_Si<K 2
                                  1.5
                   0
                                                  0
                                                               1.5
## 4 Sum_Si=>K 1
                   1
                                  0.0
                                                  0
                                                               0.5
## 5 Sum Si=>K 2
                   1
                           2
                                  0.5
                                                  0
                                                               0.5
## 6 Sum_Si=>K 0
                   1
                            2
                                   0.0
                                                   0
                                                               0.5
## ---- Pareto Equilibrium ---
## Pareto Optimality is reached when: Si = 2 with vi(Si, S_i) = 1.5, if Sum_Si < K & Sj = [0, 1]
##
## That is:
## 5 firms choose 0 units, with a payoff of 0.
## 0 firms choose 1 units, with a payoff of 0.
\#\# 5 firms choose 2 units, with a payoff of 1.5 .
##
## ---- Nash Equilibrium ---
## There are 2 Nash Equilibriums .
```

##

```
##
     ( 1 ) Nash Equilibrium 1 , for Sum_Si<K :
##
     3 firms choose 1 units, each with a payoff of 0.5.
     ( 2 ) Nash Equilibrium 2 , for Sum_Si=>K :
##
     3 firms choose 2 units, each with a payoff of 0.1666667.
##
##
## -----
##
##
## Game of 11 firms:
     Scenario Si Sj_left Sj_right Si_Payoff_Sj_Payoff_left Sj_Payoff_right
                  0 2 0.00000000 0.00000000
## 1 Sum_Si<K 0
                                                                  1.5000000
## 2 Sum_Si<K 1 0 2 0.50000000 0.000000000 ## 3 Sum_Si<K 2 0 2 1.50000000 0.00000000 ## 4 Sum_Si=>K 1 1 2 -0.04545455 -0.04545455 ## 5 Sum_Si=>K 2 1 2 0.40909091 -0.04545455 ## 6 Sum_Si=>K 0 1 2 0.00000000 -0.04545455
                                                                  1.5000000
                                                                 1.5000000
                                                                 0.4090909
                                                                 0.4090909
                                                                 0.4090909
##
## ---- Pareto Equilibrium ---
## Pareto Optimality is reached when: Si = 2 with vi(Si, S_i) = 1.5 , if Sum_Si < k & Sj = [0 ,
##
## 5 firms choose 0 units, with a payoff of 0.
## 1 firms choose 1 units, with a payoff of 0.
## 5 firms choose 2 units, with a payoff of 1.5 .
## ---- Nash Equilibrium ---
## There are 2 Nash Equilibriums .
##
     (1) Nash Equilibrium 1, for Sum_Si<K:
##
     3 firms choose 1 units, each with a payoff of 0.5.
##
     ( 2 ) Nash Equilibrium 2 , for Sum_Si=>K :
##
     3 firms choose 2 units, each with a payoff of 0.1666667.
##
##
##
## Game of 12 firms:
     Scenario Si Sj_left Sj_right Si_Payoff_Sj_Payoff_left Sj_Payoff_right
                  0 2
## 1 Sum Si<K 0
                                      0.0
                     0 2
0 2
1 2
1 2
## 2 Sum_Si<K 1
                                      0.5
                                                        0
                                                                      1.5
## 3 Sum_Si<K 2
                                      1.5
                                                        0
                                                                      1.5
## 4 Sum_Si=>K 1
                                      0.0
                                                       0
                                                                      0.5
## 5 Sum_Si=>K 2
                                      0.5
                                                       0
                                                                      0.5
                                   0.0
                     1 2
## 6 Sum_Si=>K 0
                                                                      0.5
                                                        0
## ---- Pareto Equilibrium ---
## Pareto Optimality is reached when: Si = 2 with vi(Si, S_i) = 1.5, if Sum_Si < k & Sj = [0, k]
## That is:
## 6 firms choose 0 units, with a payoff of 0.
## 0 firms choose 1 units, with a payoff of 0.
## 6 firms choose 2 units, with a payoff of 1.5.
```

```
##
## ---- Nash Equilibrium ---
## There are 2 Nash Equilibriums .
##
    (1) Nash Equilibrium 1, for Sum_Si<K:
    3 firms choose 1 units, each with a payoff of 0.5.
##
    ( 2 ) Nash Equilibrium 2 , for Sum_Si=>K :
     3 firms choose 2 units, each with a payoff of 0.1666667.
##
##
##
##
##
## Game of 13 firms:
     Scenario Si Sj_left Sj_right Si_Payoff Sj_Payoff_left Sj_Payoff_right
## 1 Sum_Si<K 0 0 2 0.0000000 0.00000000
## 2 Sum_Si<K 1 0 2 0.5000000 0.00000000
## 3 Sum_Si<K 2 0 2 1.5000000 0.00000000
                                                                1.5000000
                                                                1.5000000
                                                               1.5000000
                    1 2 -0.03846154 -0.03846154
1 2 0.42307692 -0.03846154
1 2 0.00000000 -0.03846154
## 4 Sum_Si=>K 1
                                                              0.4230769
## 5 Sum_Si=>K 2
                                                                0.4230769
## 6 Sum_Si=>K 0
                                                                0.4230769
## ---- Pareto Equilibrium ---
## Pareto Optimality is reached when: Si = 2 with vi(Si, S_i) = 1.5 , if Sum_Si < k & Sj = [0 ,
##
## That is:
## 6 firms choose 0 units, with a payoff of 0.
## 1 firms choose 1 units, with a payoff of 0.
## 6 firms choose 2 units, with a payoff of 1.5.
## ---- Nash Equilibrium ---
## There are 2 Nash Equilibriums .
##
##
    (1) Nash Equilibrium 1, for Sum_Si<K:
     3 firms choose 1 units, each with a payoff of 0.5.
    ( 2 ) Nash Equilibrium 2 , for Sum_Si=>K :
##
     3 firms choose 2 units, each with a payoff of 0.1666667.
##
## -----
##
##
## Game of 14 firms:
     Scenario Si Sj_left Sj_right Si_Payoff Sj_Payoff_left Sj_Payoff_right
## 1 Sum_Si<K 0
                 0 2 0.0
## 2 Sum_Si<K 1
                             2
                      0
                                     0.5
                                                       0
                                                                    1.5
                             2
## 3 Sum_Si<K 2
                    0
                                     1.5
                                                      0
                                                                    1.5
## 4 Sum_Si=>K 1
                                                     0
                     1
                                     0.0
                                                                    0.5
                             2
## 5 Sum_Si=>K 2
                     1
                                     0.5
                                                     0
                                                                    0.5
## 6 Sum_Si=>K 0
                               2
                                     0.0
                                                       0
                                                                    0.5
## ---- Pareto Equilibrium ---
## Pareto Optimality is reached when: Si = 2 with vi(Si, S_i) = 1.5, if Sum_Si < k & Sj = [0, k]
##
```

```
## That is:
## 7 firms choose 0 units, with a payoff of 0.
## 0 firms choose 1 units, with a payoff of 0.
## 7 firms choose 2 units, with a payoff of 1.5 .
## ---- Nash Equilibrium ---
## There are 2 Nash Equilibriums .
##
##
    ( 1 ) Nash Equilibrium 1 , for Sum_Si<K :
##
     3 firms choose 1 units, each with a payoff of 0.5.
    ( 2 ) Nash Equilibrium 2 , for Sum_Si=>K :
     3 firms choose 2 units, each with a payoff of 0.1666667 .
##
##
##
## -----
##
##
## Game of 15 firms:
     Scenario Si Sj_left Sj_right Si_Payoff Sj_Payoff_left Sj_Payoff_right
## 1 Sum_Si<K 0 0 2 0.00000000 0.00000000 1.5000000
## 2 Sum_Si<K 1 0 2 0.5000000 0.00000000 1.5000000
## 3 Sum_Si<K 2 0 2 1.50000000 0.00000000 1.5000000
## 4 Sum_Si=>K 1
                            2 -0.03333333 -0.03333333
                                                             0.4333333
                    1
                            2 0.43333333 -0.033333333
                    1
## 5 Sum Si=>K 2
                                                              0.4333333
## 6 Sum_Si=>K 0
                    1
                             2 0.00000000 -0.03333333
                                                              0.4333333
## ---- Pareto Equilibrium ---
## Pareto Optimality is reached when: Si = 2 with vi(Si, S_i) = 1.5, if Sum_Si<K & Sj = [0, \cdot]
## That is:
## 7 firms choose 0 units, with a payoff of 0.
## 1 firms choose 1 units, with a payoff of 0.
\#\# 7 firms choose 2 units, with a payoff of 1.5 .
## ---- Nash Equilibrium ---
## There are 2 Nash Equilibriums .
##
##
    ( 1 ) Nash Equilibrium 1 , for Sum_Si<K :
     3 firms choose 1 units, each with a payoff of 0.5.
    ( 2 ) Nash Equilibrium 2 , for Sum_Si=>K :
##
     3 firms choose 2 units, each with a payoff of 0.1666667.
##
## -----
```