

## Non-zero-Sum 2x2 Game (2022)

Prepared by:

Joseph Malkevitch  
Department of Mathematics  
York College (CUNY)  
Jamaica, New York 11451

email:

[malkevitch@york.cuny.edu](mailto:malkevitch@york.cuny.edu)

web page:

<http://york.cuny.edu/~malk/>

The 2x2 game between two players, Row and Column (Figure 1), seems typical of such two-player matrix games. The entry  $(-3, 2)$  refers to the fact that if Row plays Row 2 and Column plays Column I, then Row loses 3 and Column gains 2. Since  $(-3) + 2$  is not zero this means that this game is not a zero-sum game.

	Column I	Column II
Row 1	(4, -1)	(-2, 2)
Row 2	(-3, 2)	(3, -1)

Figure 1 (A non-zero sum game)

Every time the game is played Row can have one of 4 possible outcomes as a payoff (4, -2, -3 or 3) while Column can have one of two possible outcomes as a payoff (-1 or 2)

Questions:

1. What advice would you give to the players of this game about how to play "optimally?" Who do you think is at an advantage in this game?

Comment: You might want to compute all the Nash equilibria for this game to answer this question.

2. Do any aspects of this game come as a surprise?

3. Though it is time consuming it might be of interest to compare what happens by playing a Nash equilibrium strategy, a prudential strategy, or a counter-prudential strategy for each of Row and Column.

4. One can experiment on games with asymmetrical payoffs for the players by interchanging the "columns" and "rows" of Row's payoffs and the "columns" and "rows" of Column's payoffs and compute the Nash equilibria of these variant games to see if you can understand intuitively the way that the values the players "earn" at the Nash Equilibria (which can be pure or mixed strategy equilibria) in 2x2 non-zero-sum games vary with their "positions."