Experiment 2: Rock, Paper, Scissors

Objective of the experiment: study the performance of mixed strategies NE.

+ Experiment 2A: "Rock, Paper, Scissors".

+ Payoffs can be modeled as:

		player 2		
		R	P	S
player 1	R	$0, 0$	$-1, 1$	$1, -1$
	P	$1, -1$	$0, 0$	$-1, 1$
	S	$-1, 1$	$1, -1$	$0, 0$

Experiment: Equilibrium

		player 2		
		R	P	S
player 1	R	$0, 0$	$-1, 1$	$1, -1$
	P	$1, -1$	$0, 0$	$-1, 1$
	S	$-1, 1$	$1, -1$	$0, 0$

$+$ $\alpha_1 = \left(\frac{1}{3}, \frac{1}{3}, \frac{1}{3}\right)$ and $\alpha_2 = \left(\frac{1}{3}, \frac{1}{3}, \frac{1}{3}\right)$.

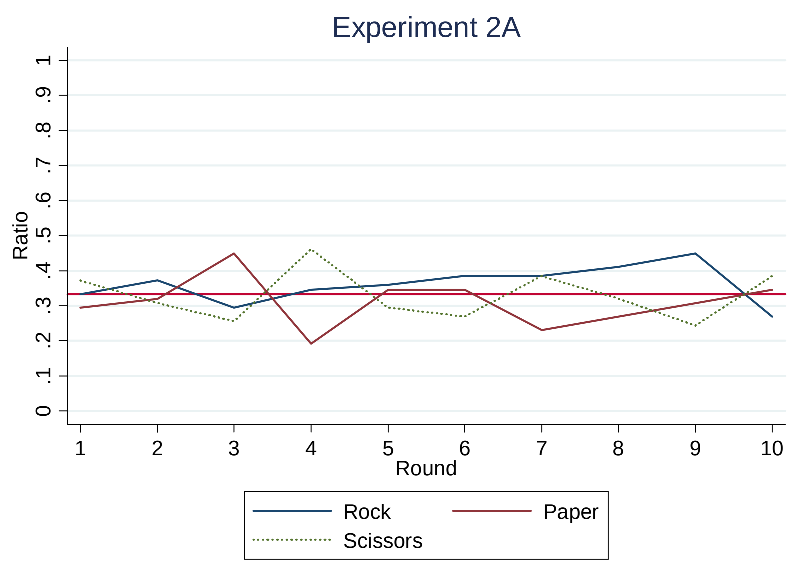
$+$Zero utility in expected value.

Experiment: Results

+ 110 subjects, 20 actions each.

+ Distributions of actions:

	NE	Actual
R	$\frac{1}{3}$	0.36
P	$\frac{1}{3}$	0.31
S	$\frac{1}{3}$	0.33



+ Distribution of actions is similar to predicted one.

+ Not significantly different.

+ Expected payoffs are 0.046, 0.116 and -0.160.

Experiment: Results

+ But not only proportions matter.

+ RPSRPSRPS.... is a bad idea.

+ Actions should not depend on past actions.

+Actions display negative autocorrelation!

  - Subjects tend not to play RR, PP, SS.

  - R reduces probability of R in next round by 0.12.

Experiment: Results

$+$ Alternative strategy.

$+$ Other likely to best respond to my past action, then best respond to that.

$+$ $a_{it} = BR(BR(a_{it-1}))$.

Simulated payoffs from this strategy (leaving the behavior of others constant) is -0.051.

Experiment 2B

+ "Rock, Paper, Scissors" with super actions.

+ Payoffs can be modeled as:

		player 2		
		R	P	SS
player 1	SR	$1, -1$	$-1, 1$	$1, -1$
	P	$1, -1$	$0, 0$	$-1, 1$
	S	$-1, 1$	$1, -1$	$-1, 1$

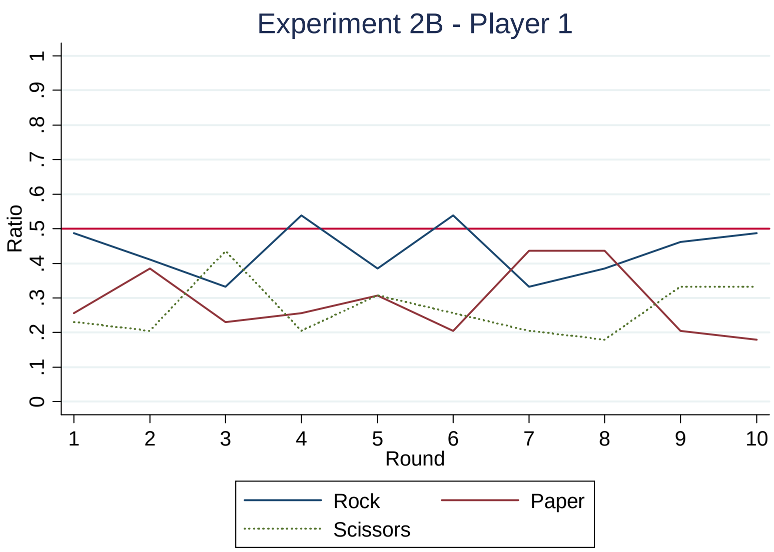
+NE equilibrium $\alpha_1 = \left(\frac{1}{2}, 0, \frac{1}{2}\right)$ and $\alpha_2 = \left(0, \frac{1}{2}, \frac{1}{2}\right)$.

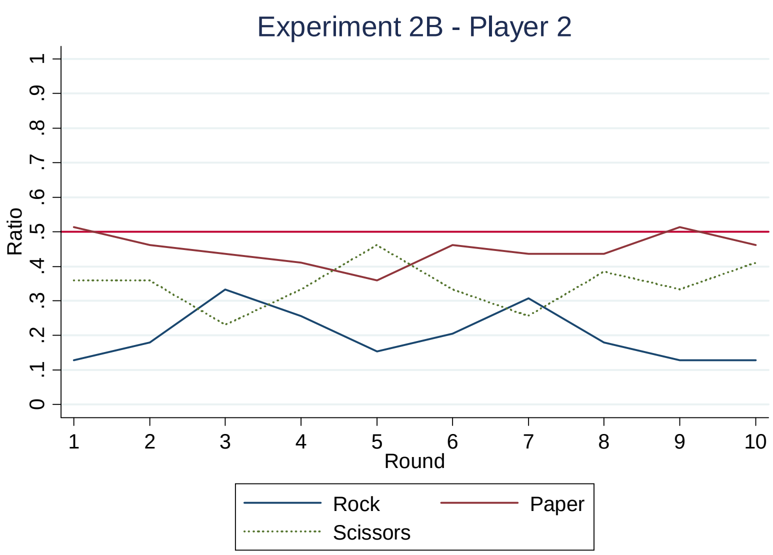
+Zero utility in expected value.

Experiment: Results

Player 1	NE	Actual	Player 2	NE	Actual
SR	$\frac{1}{2}$	0.438	R	0	0.201
P	0	0.291	P	$\frac{1}{2}$	0.451
S	$\frac{1}{2}$	0.271	SS	$\frac{1}{2}$	0.348

+ Proportions are significantly different from the predicted ones.


Experiment 2B - Player 1
Ratio
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1
2
3
4
5
6
7
8
9
10
Round
Rock
Paper
Scissors


Experiment 2B - Player 2
Ratio
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1
1
2
3
4
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6
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9
10
Round
Rock
Paper
Scissors

Main Results:

+ While NE may not explain the exact proportions of randomizations, it provides a good prediction.

Professionals Play Minimax

by Ignacio Palacios-Huerta, RES 2003.

Analyses data from 1417 football-soccer penalty shots.

Studies the performance of mixed strategy Nash equilibrium in predicting behavior.

The game:

+ One shot zero-sum game with simultaneous moves.

+ Payoffs correspond to the probabilities of scoring:

		goalie	
		NN	N
kicker	NN	58.30	94.97
	N	92.91	69.92

The Equilibrium:

+Kicker wants to maximize the probability of scoring.

+Goalie wants to minimize the probability of scoring.

		goalie	
		NN	N
kicker	NN	58.30	94.97
	N	92.91	69.92

In equilibrium both players must be randomizing, thus both must be indifferent between their two actions.

Define k as the probability of the kicker playing NN.

Define g as the probability of the goalie playing NN.

$58.3g + 94.97(1 - g) = 92.91g + 69.92(1 - g)$, Solution is: 0.419 88

$58.3k + 92.91(1 - k) = 94.97k + 69.92(1 - k)$, Solution is: 0.385 35

Equilibrium Performance:

	Nash	Real
k	38.54	39.98
g	41.99	42.31

Main Result: as predicted by NE winning probabilities are identical across actions.

Can humans randomize?:

The mixed strategy Nash Equilibrium implies that randomizations must be serially independent.

There is experimental evidence that shows that subjects have problems generating random series.

But professional soccer players can randomize!