Matching protocols based on payoffs : Experimental evidence of thier performances in games with incomplete information

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Abstract

In standard game theory, some experimental design wildly depends on how the experimenter defines payoffs based on interactions between subjects. In this paper, both matching payoff protocols: Random Pairwise and Mean Matching are compared among the same type of subjects in order to provide experimental evidence on how to set differences between them in terms of speed of convergence and completeness of information. Findings in this paper tries to provide some evidence on how the theoretical predictions could be reached faster by the MM protocol, considering an scenario with complete information.

Introduction

Several research papers in evolutionary game theory have been written based on experimental designs that uses either the Random Pairwise matching protocol (since now RP) or the Mean Matching protocol (since now MM). However, bibliography using or comparing matching protocols is very limited and the purpose is not to compare the behavior of the subjects when they face this type of matchings protocols. On the other hand, experimental research is costly and several sessions, rounds or amount of participants could be reduced by considering the scenario where the specific characteristics of one of this matching protocols could reach better or faster results. Friedman have shown that considering a complete information scenario, the theoretical prediction is reached faster considering the MM protocol, however no evidence has been shown about an scenario with incomplete information

Experimental design

The experiment will be divided into four stages. Considering the type of information and matching protocol. The table is defined as follows:

	Random Pairwise	Mean Matching
Complete	Stage I	Stage II
Incomplete	Stage III	Stage IV

Table 1: Stages using rows for complete or incomplete information and columns for RP and MM protocols

Root of the experiment

The experiment considers a variation of the Hawk-Dove, that can be represented with the following payoff matrix:

$$\begin{pmatrix} x_i & \mu + x_i \\ k - d & k \end{pmatrix} \tag{1}$$

Where $k = 100$, $\mu = 10$ and $d = 95$ are fixed values.

The **first source of variation** depends on x_i:

1. **Incomplete information.**- The value of x_i that each player receives, each round, is drawn from a uniform distribution $F \in [0, k]$
2. **Complete information.**- The value of x_i is fixed and equals to 50 (the expected value from above)

The **second source of variation** depends on the the matching payoff protocol. Suppose that for the session we have a population N of players, then:

1. **Random Pairwise.**- Each round, each player i in the population is randomly matched with a player j of the total population. For the next round the player i is randomly matched with another player k of the same population and so on. The payoff for the player is determined directly from the structure of the matrix in 1
2. **Mean Matching.**- Each round, each player takes a decision based on his own matrix, however, their payoff is not directly obtained from that matrix since her payoff is weighted considering the decision of the entire population with the following rules:
   - **If I play H**
   $$\frac{(N-1-z)}{(N-1)}x_i + \frac{z}{(N-1)}(x_i + 10)$$
   - **If I play D**
   $$\frac{(N-1-z)}{(N-1)}k - d + \frac{z}{(N-1)}k$$

Therefore the players faces a matrix of the form:

$$\begin{pmatrix} A_{11}\ x_i & A_{12}\ (\mu + x_i) \\ A_{21}\ (k-d) & A_{22}\ k \end{pmatrix} \tag{2}$$

Theoretical Predicitions and Hyphoetesis

Incomplete information

To create the scheme of the incomplete information, I ask the participant, with the help of a slider, to select a number between 0 and 100 in such a way that the comparisson between the selcted number and the one obtained from the distribution defines the election of the player in the following way:

Play D	Your choice $\leq x_i$
Play H	Your choice $> x_i$

Given that the player do not know anything about the other player payoff, neither her own, the equilibrium here will be characterized by a cutoff strategy obtained in the following way:

$$x_i^E := k - d + (d - \mu)F(x_i^E)$$

Given that $F(\dot{})$ follows a uniform distribution in the space $[0, k]$, the cutoff point can be rewritten as:

$$x_i^E := \frac{k(\dot{k} - d)}{k - d + \mu} = 33 \tag{3}$$

Complete information

Considering that the values are fixed on the matrix, the equilibrium has two points where the decisions are coordinated. However, the type of player is not defined (given that players will be advertised of this) and thus every outcome from the decision could be obtained from the matrix:

$$\begin{pmatrix} (50, 50) & (60, 5) \\ (5, 60) & (100, 100) \end{pmatrix} \tag{4}$$

Metrics for the error

For all stages, every single round participants will have feedback from the results of the last rounds in terms of amount of H or D played and in terms of the payoff received. Also for both cases, direct comparision between the optimal decision and the decision maked by the player produces an outcome of a binary variable of correct-incorrect. Thus, the first measure of the error is the proportion of correct and incorrect responses. The max number of periods is still to be defined.
Aditionally, for the case of incomplete information another measure is considerated: The distance in terms of integers from the equilibrium condition. When running the correspondent stages, each group will have an account of the total distance that each player differs from the equilibria and this measure tends to the expected value as participants receives feedback. I expect to test two main hypothesis:

1. In a complete information scenario: Is the MM protocol more efficient in terms of speed of convergence?
2. In a incomplete information scenario: Is the MM protocol more efficient in terms of speed of convergence?

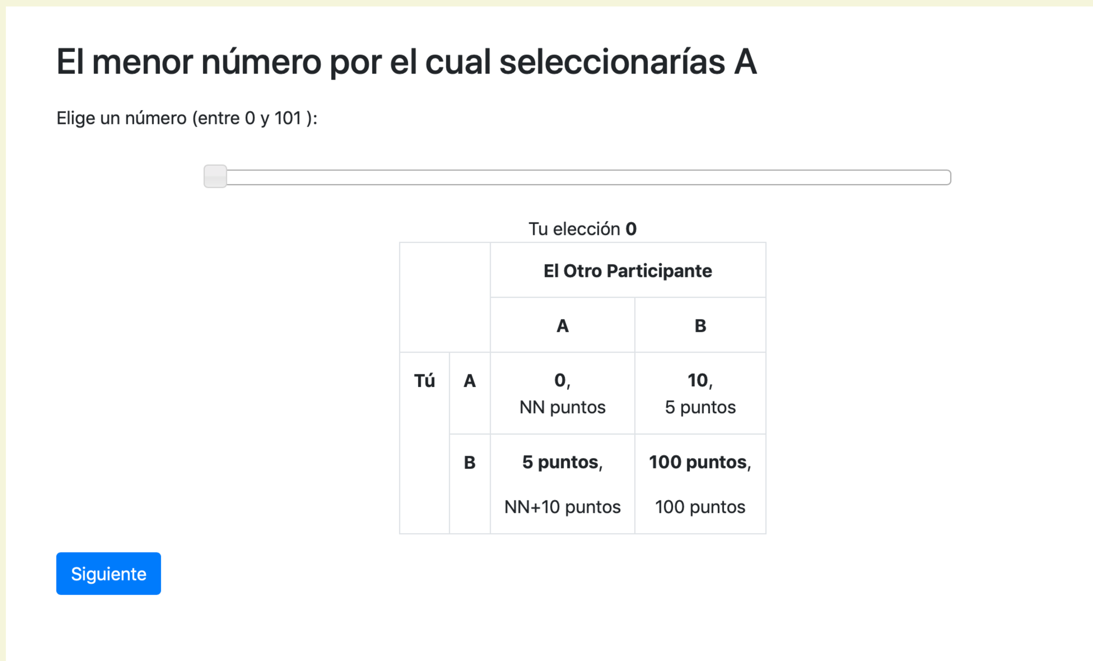
Laboratory details

Power Analysis

Considering each period as unit of calculation. For instance in a session with 10 periods, we got a total of 10 observations I expect to conduct at least 6 sessions of every stage with an average of 10-15 periods to get an total of 60-90 units of observation for the macro analysis and between 900-1350 units of individual behaviour for the micro analysis.

Software

The experiment is already programmed in the software oTree, a display of the image is shown:



Place

This research will be held at ECEL (Experimental and Computational Economics Laboratory) at Universidad San Francisco de Quito, Ecuador.