

THE PRISONER'S DILEMMA TOURNAMENT WEBSITE

Teaching Note

Synopsis

The prisoner's dilemma tournament website (the website) provides instructors the capability to conduct real time prisoner's dilemma tournaments using the WWW. To participate in the tournament students need only a browser and Internet access. A tournament can be set up in a matter of seconds, and conducted in a matter of minutes. Tournament results are available instantaneously for review and discussion among the instructor and participants.

While the emphasis in this note is on prisoner's dilemma tournaments, Version 1.0 of the website affords the flexibility to conduct tournaments using any 2x2, symmetric, non-zero-sum game. While not as popular as prisoner's dilemma, the website can incorporate games such as chicken, battle of the sexes, and stag hunt.

Purpose

Prisoner's dilemma is taught in a wide variety of courses and educational settings. Here at the Darden Business School, for example, it gets attention in at least four required courses: Strategy, Quantitative Analysis, Marketing, and Ethics. Although the topic arises in a variety of ways, the teaching of it is fairly standard. The story of the two prisoners is told, a 2x2 payoff matrix is presented, and two students are selected to play. The game gets played a couple of times (sometimes allowing prior communication), and the class observes the behavior of the two participants. The ensuing discussion and lecture help develop in students an appreciation for this important dilemma. To read more about prisoner's dilemma, see the list of references at the end of this note.

While the standard approach to teaching prisoner's dilemma provides a good start, only a small number of students get to experience the game. And that experience is often limited to a couple of rounds. This limited experience leads to a limited appreciation of the dilemma. "I'm always better off if I defect, but if we both defect we are both worse off than if we had both cooperated." Most students quickly see and understand the dilemma at this first level. While they see why it is a dilemma, there is much more richness to be discovered. There is more to be learned by actually experiencing the dilemma. There is more to be learned by actually playing the game repeatedly versus a variety of opponents.

The purpose of the website is to provide that experience as quickly and efficiently as possible. With a minimum of prior setup the instructor can turn to the students and say: “Let’s get a better appreciation for this important dilemma. Open your computers, go to the URL you have been provided with, pick an alias for yourself, and sign in. In a few seconds, you’ll be competing in an iterative prisoner’s dilemma tournament.” During the tournament, students are busy entering their selections and reacting to their results. An instructor screen displays the total number of rounds played and average score. Students moan, groan and smile as their results come in. Time flies by as students become engrossed in the tournament. The website accepts decisions as quickly as the students want to enter them. In a matter of minutes, thousands of rounds and hundreds of matches are completed. When the instructor chooses, she stops the tournament. Within seconds, the instructor screen displays a list of participant aliases ranked by their average scores per round. The ensuing discussion is lively, and the students’ appreciation for prisoner’s dilemma should be deeper.

A secondary purpose of the website is to build a database of results for research purposes. Version 1.0 affords the option of surveying participants both before and after the tournament. All data (at the individual round level) from the tournaments are stored for later analysis.

Setting Up a Tournament. Version 1.0

Contact the Darden School at dardencases@virginia.edu to receive a course ID. Go to URL that you will be provided, select “SET UP” to set up a new tournament, enter the course ID, and select the tournament you want to run using the drop down menus. Exhibit 1 shows the opening screen.

Depending on the kind of tournament selected, you will be given another page of control options. Exhibit 2 shows the control options for the Prisoner’s Dilemma with simple (0,1,3,5) payoffs. Exhibit 3 shows the control options required for the general symmetric 2-person non-zero-sum game.

Instructors set a maximum time limit (in minutes) for the tournament. This limit applies only if the instructor does not manually stop the tournament before the time limit is reached. The instructor also selects the time (in seconds) in which a player must respond, the default response if the player is timed out, and the lower and upper bound on the number of rounds per match (the actual number of rounds played in a match is selected randomly and uniformly between these two bounds). Instructors are also invited to enter a text description for the tournament. This description will be used to identify the particular tournament. Instructors are encouraged to enter their name and affiliation.

Playing in a Tournament. Version 1.0

The demo option on the opening instructor screen is a good way to get acquainted with the procedures for playing in the tournament. Exhibit 3 shows the player screen. Each round, the player must select either the “cooperate” button or the “defect” button. If the player takes too long to select, a warning appears in the upper right corner. After each selection, the results are displayed in the upper left corner. Running totals for the player appear in the lower left corner. At the end of each match, a message alerts the player to wait to be paired with another prisoner for the next match.

Conducting a Tournament. Version 1.0

After explaining the tournament and using the demo option to show player what they will be asked to do, hit the “START/STOP” button on the control screen. The instructor screen displays the address students should go to. After answering any last minute questions, hit the “START” button to open up registrations and launch the tournament. The instructor screen keeps track of the number of players registered, number of rounds played, number of matches played, and the overall average score per round. See Exhibit 4 for an example of this screen. Hitting the “STOP” button ends the tournament. After a short time for processing, the “RESULTS” button will display a options for viewing the tournament results (see Exhibit 5 for an example).

If you want to repeat the tournament, simply hit the “START/STOP” and then the “START” button. Students will be asked to register again—giving them the chance to change their aliases.

Future Enhancements

A top priority for future versions of the website is to include the option to enter popular strategies into the tournament. The most popular is TIT for TAT, a simple strategy that does remarkable well (see the Axelrod reference). In TIT for TAT you cooperate in the first round and copy the other players moves in all subsequent rounds. If the other player cooperates, so do you. If the other player defects, you do too. In future versions, the instructor will have the option to “enter” TIT for TAT into the tournament. A second strategy to include is called PAVLOV. In TIT for TAT you react to the other players last action. In PAVLOV, you react to your last payoff. If your last payoff was one of the two highest you repeat your last action. If your last payoff was one of the two lowest, you do the opposite of what you did last time. See the Nowak, May, and Sigmund article for a more detailed description of the PAVLOV strategy.

A second enhancement will be to allow asymmetric 2x2 games. It should be an easy matter to ask for and accept eight numerical payoffs. It will take a little more effort to program the website to accommodate two different roles. Upon registering, students will be assigned (or allowed to chose) one of two roles. Matches will be a little more difficult to form, and two sets of results must

be displayed—one for each role.

A third enhancement would be to allow for other probability distributions for the number of rounds per match. For example, I think the Poisson and geometric distributions would be attractive because they make it more difficult for players to predict the length of a match. Players will change tactics if they believe they are close to the end game.

We welcome your reactions and suggestions for additional enhancements to improving the website. You can contact me at PFEIFERP@VIRGINIA.EDU.

References

Bodily, S.E., Carraway, R.L., Frey, S.C. Jr., And Pfeifer, P.E., *Quantitative Business Analysis Text and Cases*, Chicago: Richard D. Irwin, 1998.

Bodily, S.E., Carraway, R.L., Frey, S.C. Jr., And Pfeifer, P.E., *Instructor's Manual to accompany Quantitative Business Analysis Casebook*, Irwin, Chicago, 566 pages, 1996.

Chapter 10 of the text and cases book deals with competitive analysis. A discussion of prisoner's dilemma starts on page 142. Case 32: Lesser Antilles Lines: The Island of San Huberto (UVA-QA-0355) and Case 35: Maxco, Inc., and the Gambit Company both afford the opportunity to talk about prisoner's dilemma. See the instructor's manual for more details.

Poundstone, William. *Prisoner's Dilemma*. Doubleday. New York. 1992

This is a very readable paperback serving as both a biography of John von Neumann and a lucid explanation of game theory. On page 217 he describes prisoner's dilemma as the most important of four social dilemmas: deadlock, prisoner's dilemma, chicken, and stag hunt.

Axelrod, Robert. *The Evolution of Cooperation*. Basic Books. 1984.

This book describes the first iterative prisoner's dilemma computer tournaments conducted by Axelrod in the 1970s and the emergence of TIT for TAT as a winning strategy. He goes on to explore questions about the evolution of cooperation in biological and social settings.

Nowak, Martin A., May, Robert M., and Sigmund, Karl. The Arithmetics of Mutual Help. *Scientific American*. June 1995.

The article provides a comparison of the TIT FOR TAT and PAVLOV strategies for competing in an iterative prisoner's dilemma tournament.

Blass, Thomas A. Forgiveness Math. *Discover* (May, 1993).

This is a very readable introduction to prisoner's dilemma and the work of Axelrod, Sigmund, and Nowak.

Exhibit 1

THE PRISONER'S DILEMMA TOURNAMENT WEBSITE

Opening Set Up Screen

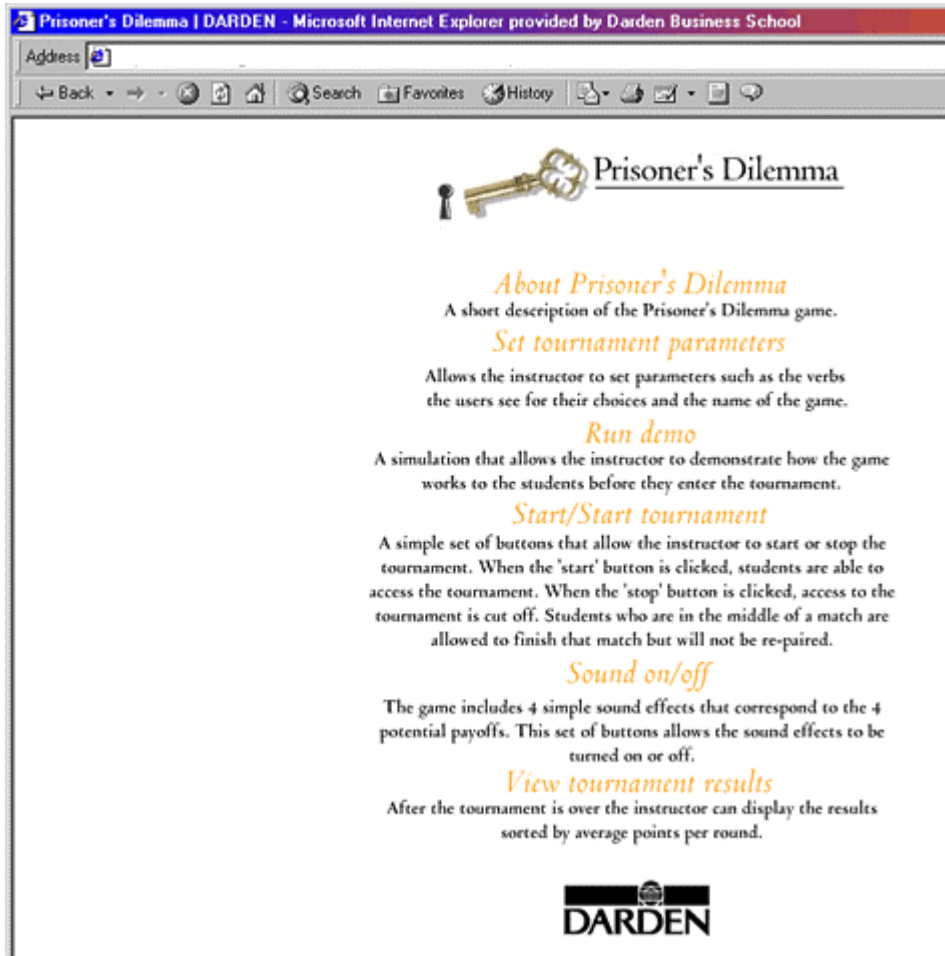


Exhibit 2

THE PRISONER'S DILEMMA TOURNAMENT WEBSITE

Set Up Screen for Prisoner's Dilemma with Simple (0,1,3,5) Payoffs

CURRENT TOURNAMENT PARAMETERS	CHANGE TO
Tournament title: Prisoner's Dilemma	<input type="text"/>
Tournament verbs	
Cooperate verb: Cooperate	<input type="text"/>
Defect verb: Defect	<input type="text"/>
Tournament point values	
Both players cooperate: 3	<input type="text"/>
I cooperate, you defect: 0	<input type="text"/>
I defect, you cooperate: 5	<input type="text"/>
Both players defect: 1	<input type="text"/>
Number of rounds per match	
Minimum number of rounds per match: 3	<input type="text"/>
Maximum number of rounds per match: 6	<input type="text"/>

Exhibit 3

THE PRISONER'S DILEMMA TOURNAMENT WEBSITE

Player Screen

Prisoner's Dilemma

TheKing		Killer	
Choice	Points	Choice	Points
Cooperate	0	Defect	5
Defect	1	Defect	1

Your Opponent: Killer

Cooperate Defect

3	5
5	1

Click on one of these buttons to play.

TheKing

Cooperate

Defect

Rounds played: 2
Average points/round: 0.5
Total matches played: 000

ATTENTION!
The guard above is counting down the time you have left before a choice is made for you.

Make your Pick.

3

Exhibit 4



THE PRISONER'S DILEMMA TOURNAMENT WEBSITE

Example Instructor Screen During Running of the Tournament

ResultsAll - Microsoft Internet Explorer provided by Darden Business School

Address

Back Forward Stop Home Search Favorites History Print Mail News RSS

 Prisoner's Dilemma 

About
Set Up
Demo
Start/Stop
Sound
Results

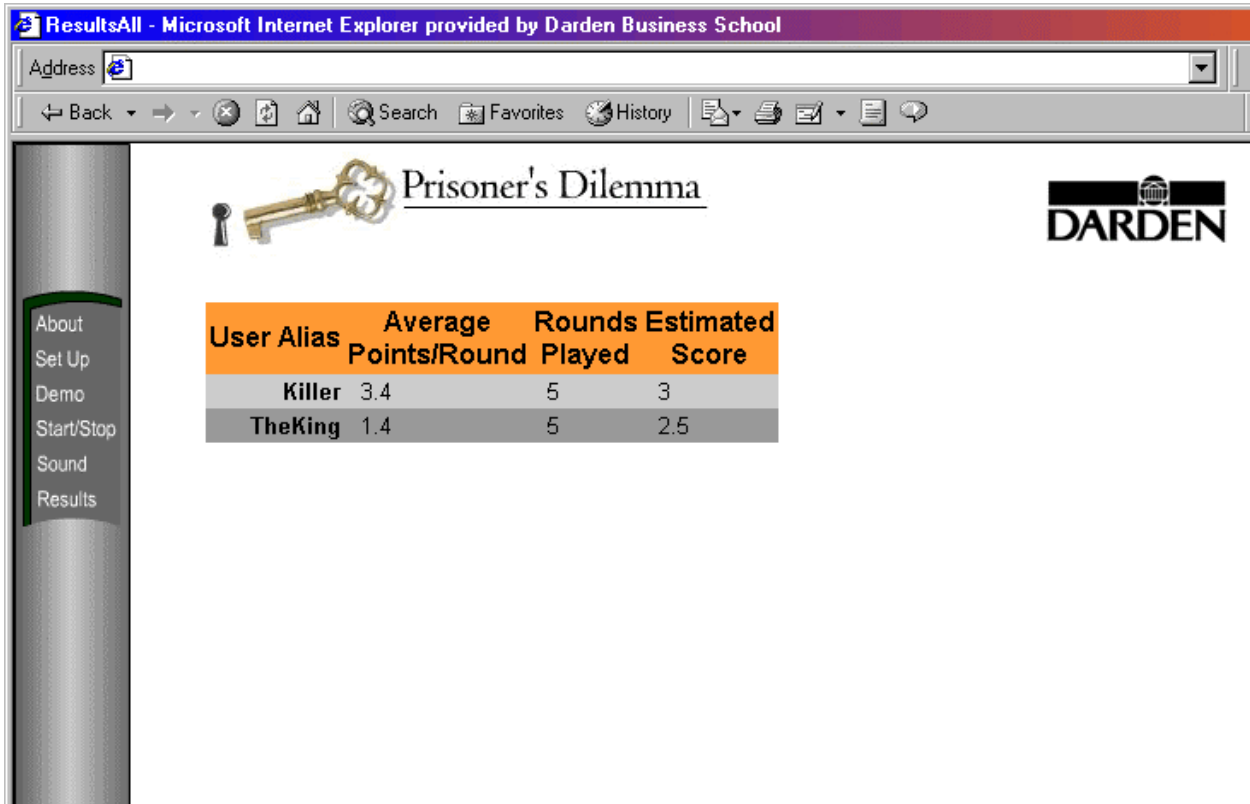
**TOTAL AVERAGE
SCORE PER ROUND:**
2.40000

TOTAL ROUNDS PLAYED:
10

Exhibit 5

THE PRISONER'S DILEMMA TOURNAMENT WEBSITE



Example Results Screen



ResultsAll - Microsoft Internet Explorer provided by Darden Business School

Address

Back Forward Stop Home Search Favorites History

 Prisoner's Dilemma 

About
Set Up
Demo
Start/Stop
Sound
Results

User Alias	Average Points/Round	Rounds Played	Estimated Score
Killer	3.4	5	3
TheKing	1.4	5	2.5