ECONOMICS 412 Professor: Ronald A. Heiner
Spring Term

GAME THEORY & THE PRISONERS' DILEMMA

1. Text: The following text is optional (not required): *Games & Information*, by Eric Rassmussen
A few Study Guides will be sent your GMU email, to help supplement some of the topics shown on the 2nd page. So be sure your GMU email address is linked to this class.

2. Readings: Additional readings will also be used, and will be emailed to you later in the term.

3. Office Hours: Tuesday, NOON - 1 pm, at Carow Hall. Other times by appointment (just ask before or after class). If possible, I will answer questions just after class when that is more convenient for students (avoiding the extra time to meet at my office in Carow Hall). Carow Hall is located off of Shenandoah River Lane across form Presidents Park dorms.

4. Goals & Requirements: This course will give an introduction to game theory concepts, and then focus on the prototypical case of "cooperation versus conflict", called the Prisoners' Dilemma. Both traditional and new approaches to this prototypical case will be discussed. Lectures on traditional approaches will use certain chapters from Rassmussen's text. Lectures on newer approaches will use the set of readings mentioned in topic 2 above. Problem sets will be given to provide practice on key concepts and feedback on students' understanding. A midterm will be given, and a comprehensive final exam will also be given. Students also need to have background in econometrics and/or probability & statistics classes, because most topics will use probability concepts extensively.

5. Content & Instruction Methods: Most classes will be a mixture of lecture and discussion. Student comments and questions are encouraged and recommended for everyone's benefit (for more enjoyable and better understood ideas).

6. Tests & Evaluation Methods: No numerical scores are given for problem sets, only a check mark for turning in on time. So you cannot loose points on the problem sets. They are only to help you prepare and do well on the midterm and final exam.

   The midterm and final exams are worth 40% and 50% respectively. However, if your final exam score exceeds your midterm score by more than 10%, then the final exam will be weighted 70% of the total grade. Problem sets are worth 10% of the final grade. To receive the 10%, you must complete all the problem sets, with no more than 2 late. Problem sets are due the next class period after they are passed out.

   Also, if you are a student with a disability and you need academic accommodations, please see me and contact the disability Resource Center (DRC) at 703-993-2474. All academic accommodations must be arranged through that office.

7. Getting Started: We will begin by introducing the basic idea of strategic behavior in games, in contrast with "price taking" behavior in perfectly competitive economic systems. Next we will discuss key game theory concepts like: actions versus strategies, players, payoff functions, strategic form payoff matrices, extensive form game trees, Nash equilibrium, dominant strategies, mixed strategies, behavioral strategies, perfect versus imperfect information, sequential versus simultaneous games, and so on. We will illustrate these concepts with a number of simple games, including key representative games about "cooperation" versus "conflict" situations, including the prisoner's dilemma, and other games such as: pure coordination, chicken, battle of the sexes, etc.

8. Disability & Honor Code If you are a student with a disability and you need academic accommodations, contact Disability Services at 703.993.2474 or ods.gmu.edu. Academic accommodations need to be arranged through this office.
Familiarize yourself with the Honor Code, http://www.gmu.edu/catalog/apolicies/.
Suspected cases of academic dishonesty including plagiarism will be sent immediately to the Honor Committee.

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Outline of Weekly Topics

WEEK	*Problem Set*	*Topics*
1 - 3		Introduction to game theory definitions and concepts Players, feasible actions, strategies (mapping from potential situations into feasible actions), payoff matrices, Nash equilibrium, dominant strategies
	1	Intro to the One–shot prisoners' dilemma (PD) Mutual defection is the dominant strategy equilibrium (even when randomized strategies are permitted)
	2	Game trees & information sets
3 - 4	3	Randomized Nash equilibria for the matching pennies game
	4	Causal trees and forecasting weather from joint causation, calculating signal correlations from causal probabilities, forecasting a player's decisions from a jointly caused signal;
5 - 6		Freedom of will, and forecasting rational decisions Application to Newcomb's Problem:
	5	first with perfect detection
	6	Second with imperfect detection
7		Evolutionary game theory and evolutionarily stable strategies (ESS) One-Shot PD with contingent cooperators and perfect detection
8		Spring Break, no classes
9		**Review and Midterm [Thursday]**
9 – 11	7	Signal Detection Principles and ROC Curves External verus internal signals, and overlapping density functions Raising internal signal reliability through cautious detection
	8	Applying signal detection to the one–shot PD Green beards, secret handshakes, and mimicry Thwarting mimicry by defecting when signals more typical among DD players are detected
12 - 14	9	Analyzing evolutionary competition between CD versus non–CD behavior Robust dynamics toward CD behavior
15	10	Predicting the equilibrium probability of cooperation Effects of fear, greed, and cooperation payoff differences Effects of face–to–face communication

ADDITIONAL READINGS (electronic reserve in Johnson Center, password "france")

1. Robert Nozick, "Newcomb's Problem and Two Principles of Choice," in *Essays in Honor of Carl Hempel*, 1969

2. David Heeger, "Notes on Signal Detection Theory," New York University; at the following web site.

   http://www.cns.nyu.edu/~david/sdt/sdt.html

   Plus see the following related web site. It has interactive graphics that you can control with your mouse:

   [NOTE Go to: wise.cgu.edu/portfolio to check on whether signal detection demo will work]

   http://wise.cgu.edu/sdtmod/overview.asp [has several parts obtained by clicking "begin the tutorial" and then "next" at the bottom of each page]

   Note: If you have trouble with these web addresses, just type "signal detection tutorial" in the search window of your internet browser, and the above web sites will come up among the first several sites listed by your browser.

3. Ron Heiner, "Robust Stability & Dynamics Toward Cooperation in Pure One-Shot Prisoners' Dilemmas", under review by the *American Economic Review*.

Economics 412 Professor Ron Heiner
Fall 2004

ADDITIONAL READINGS (electronic reserve in Johnson Center, password "france")

1. Robert Nozick, "Newcomb's Problem and Two Principles of Choice," in *Essays in Honor of Carl Hempel*, 1969

2. David Heeger, "Notes on Signal Detection Theory," Stanford University; at the following web site.

   http://sucia.stanford.edu/~lera/psych115s/notes/signal/

   Plus see the following related web sites. They both have interactive graphics that you can control with your mouse:

   http://wise.cgu.edu/sdt/sdt.html [single page with interactive graphics]

   http://wise.cgu.edu/sdt/overview.html [has several parts obtained by clicking "begin the tutorial" and then "next" at the bottom of each page]

3. Ron Heiner, "Robust Stability & Dynamics Toward Cooperation in Pure One-Shot Prisoners' Dilemmas", under review by, *American Economic Review*, 2003.

4. Ahn, Ostrom, et. al. "Cooperation In PD Games: Fear, Greed, and History of Play", *Public Choice*, 2001, pages 137 – 155.

5. Ostrom "Collective Action and the Evolution of Social Norms", *Journal of Economic Perspectives*, summer 2000, pages 137 – 158.

6. R. Sethi & E. Somanathan, "Understanding Reciprocity", *Journal of Economic Behavior & Organization*, 50, 2003, pp. 1 - 27.

RELATED BACKGROUND READINGS

On Two Hour Reserve:

Max Albert & Ron Heiner, "An Indirect Evolution Approach to Newcomb's Problem," *Homoeconocus*, 19, 2003.

Vanberg & Congleton "Rationality, Morality, & Exit", *American Political Science Review*, 1992, pages 418 – 431.

Also available from the library :

1. Evolutionary Game Theory, by Weibull: MIT Press, 1997, chapters 1 - 2.

2. Evolution of Cooperation, by Axelrod, Basic Books, 1984, chapters 1 - 3.

3. Signal Detection Theory & Psychophysics, by Green & Swets, Wiley, 1966, pages 53 – 115.