Economics 1470: Bargaining Theory and Applications

Fall 2019

Professor: Jack Fanning (jack_fanning@brown.edu)

Classes: Tues, Thurs, 1 pm - 2.20 pm at Friedman Hall 108

Office Hours: Fr. 3-4pm in Robinson Hall 303C

TAs: Marcel Peruffo (marcel_peruffo@brown.edu) and Ricardo Fonseca (ricardo_fonseca@brown.edu

TA Sections: TBC

TA Office Hours: TBC

Course website: Canvas

Homeworks due: Monday 5pm at Robinson Hall Basement

Description of the course:

Bargaining involves two or more people who have an opportunity to create economic value and also divide that value between then. How much value will be created and how will it be divided? To answer such questions this course will first take a step backwards and develop a rigorous theory of how people interact in strategic settings. Strategic settings are those in which people must consider how others will behave, before deciding how to behave themselves. This theory of interaction is called (non-cooperative) Game Theory. Having developed your understanding of Game Theory we will use it to study bargaining. In order to develop your understanding of strategic interaction you will be interacting a lot yourselves, with other students, through in class experiments using iclickers. Towards the end of the course we will also introduce an alternative (non-strategic) theory of bargaining which uses axioms to predict the outcomes of group agreements; these axioms are intuitive properties which we might reasonably expect any group agreement to respect.

Primary course goals

If you complete this course you should be able to:

- Analyze strategic interaction formally using Game Theory.
- Appreciate how good models (whether game theoretic or axiomatic) can deliver many insights about the world, and in particular about bargaining. I hope it will also help you to make good decisions in real life, although teaching you how to bargain is *NOT* a goal of the class.

Specific course goals

If you complete this course you should be able to:

- Formally model a wide range of strategic interactions as a game.
- Apply the main solution concepts of Game Theory to different games. Solution concepts are theories economists use to explain why people may behave in a particular ways.
- Understand the rationale for different solution concepts, why they may apply more or less well in different settings, and the tensions in strategic decision making which they highlight.
- Understand how an axiomatic approach provides an alternative way to model group decision making, and be able to apply its solution concepts. You should also understand the potential for game theory and the axiomatic approach to interact.

- Use both Game Theory and axiomatic modelling to help understand bargaining. In particular you should understand how these models can explain why different features of bargaining (such as the ability to make proposals, impatience, aversion to risk and differences in information) may affect its outcome (such as the terms of trade and the likelihood of delay/disagreement).

Prerequisites

Intermediate Microeconomics 1110 or 1130. A good math background will also help.

Breakdown of course grade

The final grade will depend on class experiments (5%), weekly homework (15%), a midterm (30%) and a final exam (50%). Scores in each part will be added up in a simple fashion. The passing grade for the class is 50%. I expect the top 40-45% of students who pass to get an A, the next 40-45% to get a B, with the remainder getting a C. If you are taking the class S/NC and get an A, I will give you S with distinction.

Class experiments

Class experiments typically involve you making a decision in a strategic setting, in which your payoff in experimental points may be affected by what another person does. In each such experiment you will be randomly paired with another student from the class. This introduces an element of chance into your payoff (and hence grade) as it depends on the other person's action. Unfortunately, that's life: it is inherent to strategic decision making, which is the main focus of this class. Five points will also be awarded for each class's experiment in which you take part (it is partly a score for attendance). Your final grade score for experiments will be as a percentage of the student with the maximum point score (he/she will get 100%).

Class experiments require you to have an *iclicker*. I will hand these out in class on Tues Sept 17 when I will also finalize class participation. You will then register your i-clicker on Canvas (go to Quizzes¿I-clicker registration). If you do lose your clicker you will have to visit me office hours to get a new one (and I may not be happy). At the end of the semester, after the final experiment, you will hand back your clicker. You will not get an experiments grade until you do...

If you forget to bring your iclicker to class, the iclicker is not working, or you are unable to attend class, you will obtain no points from an experiment. There will be no make-up experiments. Again, this may introduce a small element of chance into your grade (the dog ate my iclicker), unfortunately again, that's life, however, your lowest two experimental scores in the semester will be dropped. This policy provides incentives to attend class with working equipment. It is your responsibility to replace the battery if it gets low. The only exception to this rule is if you are unable to attend an class because of a sports commitment (see *Accommodations and sports* below) or have note from the Dean's office or a medical professional justifying your absence, in which case I will give you the average number of experimental points of those who did participate.

Homework

The homework will be primarily problem based (not essay based) and will test your progress towards the course goals outlined above. I will post homeworks on Tuesday each week. Homework must be handed on the following Monday by 5pm in the basement of Robinson Hall. Late solutions will not be accepted, however, your lowest grade of the semester will be dropped. You may work with other students on the homeworks, but must submit answers separately. Sometimes we may not have covered material in class

addressed in the homework when that homework is posted. We will have covered the material before the homework is due, however. Some of the problems may be hard. They require thought, rather than simply reproducing class notes (this will help deepen your understanding). Do not worry if you cannot always solve them! If you engage purposefully with a problem but are unable to fully understand it until seeing the solutions/TA section, I will be happy. The TA section will go over the solutions to the homeworks, and solutions will be posted online. Homeworks are out of 10 points. The grading rubric for them is:

- 10 - the student has mastered the key concepts/material addressed (she may certainly, nonetheless have got some questions wrong, e.g through calculation errors/small misunderstandings). Excellent.
- 7 - the student has understood most of the key concepts/material addressed but also demonstrates gaps in her understanding. Satisfactory but room for improvement.
- 4 - the student has demonstrated a very limited understanding of the key concepts/material addressed. Need for significant improvement.
- 0 - the student has not demonstrated no effort to properly answer the questions or has not handed the homework in.

Exams

The exams will also be problem based. If you are unable to attend an exam, a note from the Dean's office or a medical professional is required. I may increase all students exam scores by a constant if the exam is too difficult to satisfy the 50% cutoff for a *C*. The aim of the final grade cutoffs is to match the following rubric:

- A - the student has mastered nearly all of the key concepts/material.
- B - the student has understood most of the key concepts/material addressed, but also demonstrates clear gaps in her understanding.
- C - the student has demonstrated a limited understanding of the key concepts/material, major gaps in her understanding.
- NC - the student has almost no understanding of the key concepts/material

The date for the midterm (which may change) is Tues Oct 22. The date for the final is Dec 14 at 2pm

Cheating

In taking this class, you must agree to follow Brown's Academic Code:

http : \\www.brown.edu\academics\college\degree\sites\brown.edu.academics.college.degree\files\uploads\Academic – Code.pdf

In particular, be aware that cheating on exams will be severely sanctioned.

Accommodations and sports

If you have an accommodation from the SEAS office, you must discuss it with me during the first two weeks of the semester. If you are on a sports team, you must give me a letter during the first two weeks of the semester from your coach or the Dean's office telling me what dates you are going to miss.

Textbooks

Required: *Strategy: An Introduction to Game Theory* by Joel Watson (3rd edition). This covers much of the material in the course, but lectures will sometimes go beyond it. It is available in the bookstore and two copies are on reserve at the Rockefeller library. I will assign readings from this each week depending on our progress in class. Earlier editions of this book can be purchased more cheaply on the internet, covering much of the same material (if you balk at the cost of the 3rd edition, you should be able to manage fairly well using earlier editions and the 3rd edition copies in the library).

Optional: *An Introduction to Game Theory* by Martin Osborne (covering both Game Theory and the axiomatic approach at a similar level to this course), *Games of Strategy* by Dixit, Skeath and Reiley (a more basic introduction to Game Theory), *A course in Game Theory* by Osbourne and Rubinstein (a graduate level text), *Bargaining Theory with Applications* by Abhinay Muthoo (a graduate level text specific to bargaining).

Approximate timings

You should expect to spend approximately 187 hours of time over the 13 weeks of this class. This time can be broken down as follows:

- Class time, including section (3.5 hours per week, 47 hours total)
- Reading course material, homework, studying for midterm exam (8.5 hours per week, 120 hours total)
- Final (3 hours), preparation for final (17 hours)

Expectations

If you take this class you should:

- Come to class and engage with the material: ask questions and take notes
- Actively reread your class notes and readings every week.
- Engage with TA's in recitation sessions.
- Come to office hours with questions and comments.
- Keep a critical mind while studying.
- Watch the videos at this link about how to study effectively (if you have not seen them before), take notes, and apply the recommendations to this course: $http:\backslash\backslash samford.edu\backslash how-to-study$.
- Not use a computer or cell phone in the class (unless authorized by me)

Course Structure

Part 1: Building Game Theoretic foundations
In this part of the course you will learn how to formally describe a strategic interaction as a game. This is the most fundamental skill of a Game Theorist.

1. *An introduction to Game Theory* (Watson Chapter 1)
   Why study Game Theory? A way to model and then understand strategic interaction.

2. *Representing strategic situations as a game: Extensive form* (Watson Chapter 2, 3 up to heading "The Normal Form")
   Explains how to display the order in which players take actions, their information, and their preferences over outcomes. Introduces the concept of a *strategy*.

3. *Representing strategic situations as a game: Normal form* (Watson Chapter 3)
   Explains how a normal form representation takes strategies and payoff functions as primitives. Illustrates relationship between normal and extensive form, static and dynamic games.

4. *Beliefs, mixed strategies and expected payoffs* (Watson Chapter 4)
   Extends your toolkit for describing a game. Introduces *Beliefs* (how to model thinking about opponents' strategies) *Mixed strategies* (randomly choosing strategies) and *Expected payoff* (evaluate payoffs when beliefs are uncertain)

5. *General Assumptions and Methodology* (Watson Chapter 5)
   Introduces the key ideas of *rationality*, *common knowledge* and a *solution concept*

Part 2: Analyzing behavior in strategic settings
This part of the course introduces the most basic solution concepts for Normal form games. You will learn the rationale for these solutions, how to apply them, and begin to develop an appreciation for how Game Theory can generate insights into the real world.

1. *Dominance and best response* (Watson Chapter 6)
   Introduces *dominated* strategies and *best responses*, explains their relationship both with each of other and rationality. Highlights the first strategic tension: clash between individual and group interests

2. *Rationalizability and iterated dominance* (Watson Chapter 7, 8)
   What beliefs are reasonable, can be rationalized? Introduces *common knowledge of rationality*, *iteratively deletion of dominated strategies*, *congruous sets* (end of Watson Chapter 9) and their relationship to the solution concept of *rationalizability*. Highlights the second strategic tension: strategic uncertainty and its implications for efficient coordination. Applications include the Nash demand game (a basic model of bargaining).

3. *Nash equilibrium* (Watson Chapter 9, 10, 11)
   Introduces the *Nash equilibrium* solution concept of mutual best response, both in pure and mixed strategies. Widespread applications include simple bargaining games. Discusses multiple equilibria and *focal points*. Highlights the third strategic tension: inefficient coordination.

Part 3: Analyzing behavior in dynamic settings
This part of the course introduces solution concepts for extensive form games which take advantage of the dynamic nature of decision making. You will learn the rationale for these solutions, how to apply them, and extend your appreciation for Game Theory's explanatory power.

1. *Details of the extensive form* (Watson Chapter 14)
   Adds more details about how to represent a game in extensive form (building on Part 1 of the Course)

2. *Sequential rationality and subgame perfection* (Watson Chapter 15, 16, 17)
   Introduces the idea of *sequential rationality* and its relation to the solution concepts of *subgame perfection* and *iterated conditional dominance* and the solution methods of *backward induction* and *forward induction*.

3. *Applications to bargaining* (Watson Chapter 18, Chapter 19)
   Applies sequential rationality to alternating offer bargaining games to generate insights about: the role of making offers, impatience, outside options. Another application relates bargaining to the hold-up problem.

4. *Repeated games* (Watson Chapter 22, 23)
   Introduces finitely and infinitely repeated games. Applies sequential rationality to understand incentives for non-myopic play due to reputational concerns. This analysis can be applied to repeated bargaining.

Part 4: Information
This part of the course introduces solution concepts for games in which players have *asymmetric (private) information*. You will learn the rationale for these solutions, how to apply them, and further extend your appreciation for Game Theory's explanatory power.

1. *Random events and incomplete information* (Watson Chapter 24)
   Adds more details about how to represent information in extensive form games (building on Part 1 of the Course)

2. *Risk and Incentives in Contracting* (Watson Chapter 25)
   Introduces the concept of risk aversion. Applications include highlighting the role of risk aversion in explaining bargaining outcomes.

3. *Bayesian Nash Equilibrium and Bayesian Rationalizability* (Watson Chapter 26, 27)
   Adapts the solution concepts for static games (Part 2 of the course) to incorporate private information to give *Bayesian Nash Equilibrium and Bayesian Rationalizability*. Introduces the idea of *Bayesian updating* of beliefs. Applications include the *market for lemons*, *auctions*, and the *no trade theorem* which have implications for the role of information on bargaining.

4. *Perfect Bayesian Equilibrium* (Watson Chapter 28, 29)
   Adapts the solution concepts for dynamic games (Part 3 of the course) to incorporate private information to give *Perfect Bayesian Equilibrium*. This requires introducing the concept of *consistent* beliefs. Applications to bargaining highlight how asymmetric information might result in delayed agreement and the incentives to develop a tough reputation.

Part 5: The Axiomatic Approach
This part of the course introduces an alternative way to consider group decision problems, based on axioms.

1. *Nash bargaining* (Watson Appendix D)
   Proves that the *Nash bargaining solution* is the unique solution satisfying three reasonable axioms. Illustrates how this solution also explain the importance of risk aversion in bargaining. Highlights the potential for links between the Game Theoretic and axiomatic approach.