Introduction to Game Theory

General Principles

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2024

Outline

- Introductions
- What is EC327?
  - Syllabus
  - Schedule & Assignments
  - Office Hours
- What is Game Theory?
  - What are strategic games?
  - How can we classify games?

Introductions

Welcome to the Class!

About Me:

- **Preferred Name**: Dante
- **Preferred Pronouns**: he, him
- 4th year Econ Phd student
- Davis, CA -> Portland, OR -> Eugene, OR

Introduce Yourselves

IntroQuiz

- Your preferred name, pronouns; to help me get t
- Why did you choose this class?
- Song recommendation for class playlist

What is EC327?

Syllabus Document

- Most up to date version on github
- I will also upload to Canvas
- print, sign, and upload as your first assignment

Class Expectations

Prerequisites

- **Courses:** EC201 *or* EC202
- **Knowledge:** This class will require you to use so
  graphing skills. If you felt uncomfortable with th
  EC201, I recommend that you review how to solv
  equations, inequalities, and fractions.
    - There are great free resources out there like K
      always feel free to reach out for help or other

Student Expectations

- **Come to class**
  - Pay attention to lectures, take notes, review to
  - Participate in group work & activities
  - **Ask questions!**
- **Read the textbook**
- **Communicate respectfully**
  - With your classmates
  - With me & grader
- **Have academic integrity** [1]
  - Verify that all submitted work is your own
  - Provide sources for *all* information that you f

1. see UO's Student Conduct Code

Instructor Expectations

- **Provide course material**
  - Slides will be updated on github
  - I will also try to post them on Canvas, but not
  - Assignments posted on Canvas w/ due dates,
- **Face-to-face Interaction**
  - **Classes**
    - Ask me to clarify if something doesn't mak
    - Ask me to slow down if I'm going too fast
  - **Office Hours**
    - Use them!!

Admin Stuff

Problem Sets

You will practice what we learn in class on indepen

Each homework assignment will include a few prob
similar to what you will see on exams.

- Learning something new takes practice, so these
  you keep up with the concepts
- You will be graded not only on whether you got
  also more importantly on *how you communicate*
  - See Canvas rubric for more info

Class Activities

- Sometimes I will ask you to play the types of gar
  lectures
  - Record the strategies you chose and the outc
  - Reflect on how you played the game
  - Relate it to lecture concepts

Exams

You will demonstrate how well you understand co
a **midterm** and a **final** exam

- **Midterm**
  - sometime around week 5 (Oct. 28th or 30th)
  - Will test you on definitions, solution concept
    critical thinking problems
- **Final**
  - finals week of December 9 (check duckweb fo
  - Covers everything we learned in the quarter,
    concepts from the 2nd half

Grading

Problem Sets	30%
In-class Activities	10%
Midterm	30%
Final	30%

Policies

- **No make-up exams!**
  - if you absolutely cannot attend midterm, you
    final exam
- Problem set keys posted automatically after dea
  - -> no late submissions accepted

University Policies

Campus Resources

- **Accessible Education Center**
  - aec.uoregon.edu
- **Support for vicitms of assault, harassment, stal**
  - safe.uoregon.edu
  - 24/7 hotline: (+1) 541-346-SAFE (7244)
- **Health and Wellbeing**
  - University Counseling Services
  - Basic Needs Program
- **Religious Observance Accomadations**
  - Provost website

These resources and others are also included in the course syllabus

Course Pages

https://canvas.uoregon.edu/courses/251353 - subm
check deadlines

github.com/dyasui/EC327 - Find up-to-date version
assignments - *let me know if links are broken*

What is Game Theor

Motivation

What is the goal of **Game Theory**?

> To understand social behavior

Why do economists study Game Theory?

> We are *social* scientists

> To make models, predictions, hypotheses, etc. o
> research

Motivation

Why should **you** study game theory?

> Practice your strategic decision-making in a safe

> Develop your intuition for social interactions in

> Feed your curiosity for economics, social science questions!

What is theory?

What is the point of *theory*?

> **Simplify complex systems** - understanding one
> easier than trying to

> **Generate *falsifiable* hypotheses** - good econom
> good theory

Theory in a data-driven world?

> "The theory of economics does not furnish a bo
> conclusions immediately applicable to policy. It
> than a doctrine, an apparatus of the mind, a tec
> which helps its possessor to draw correct conclu

What are the limits to theory?

- Our models will never be perfect representation
- But we should know how well they *approximate* we want to understand
- Theory is very useful for generating *falsifiable hy* can then use to guide experimental or statistica
- As we play games in class, we will observe the d our theoretical predictions

What is a *game* of strategy?

> Game theory: It's not all fun and games!

Examples of *strategic games*:

Where in the goal should you kick a penaly shot?

Examples of *strategic games*:

Where in the goal should you kick a penaly shot?

- Left, Right, Center? Up or Down?
- Is there one best place to kick?
- What if you always choose top right corner?
- Besides soccer;
  - Which offensive play in football?
  - Where to serve in a tennis court?

Examples of *strategic games*:

If 100% of your grade in this class is decided by a c
should you study?

- If you can all agree to take a chill quarter and no
  get A's
- But what if there's at least one try-hard?
- Now how much should you study, even if you alr
  wouldn't?
- Do you think everyone else will keep their prom

Examples of *strategic games*:

Should you give an engagement ring to the person

- Why buy an expensive trinket when you could sa
  house, etc?
- Does it matter if your recently engaged friends g
  engagement rings?
- Does your paycheck vs. how much your fiancee r

Examples of *strategic games*:

In economics, why do we say there is a ***law of one***

> Imagine I set up a competing Starbucks franchis

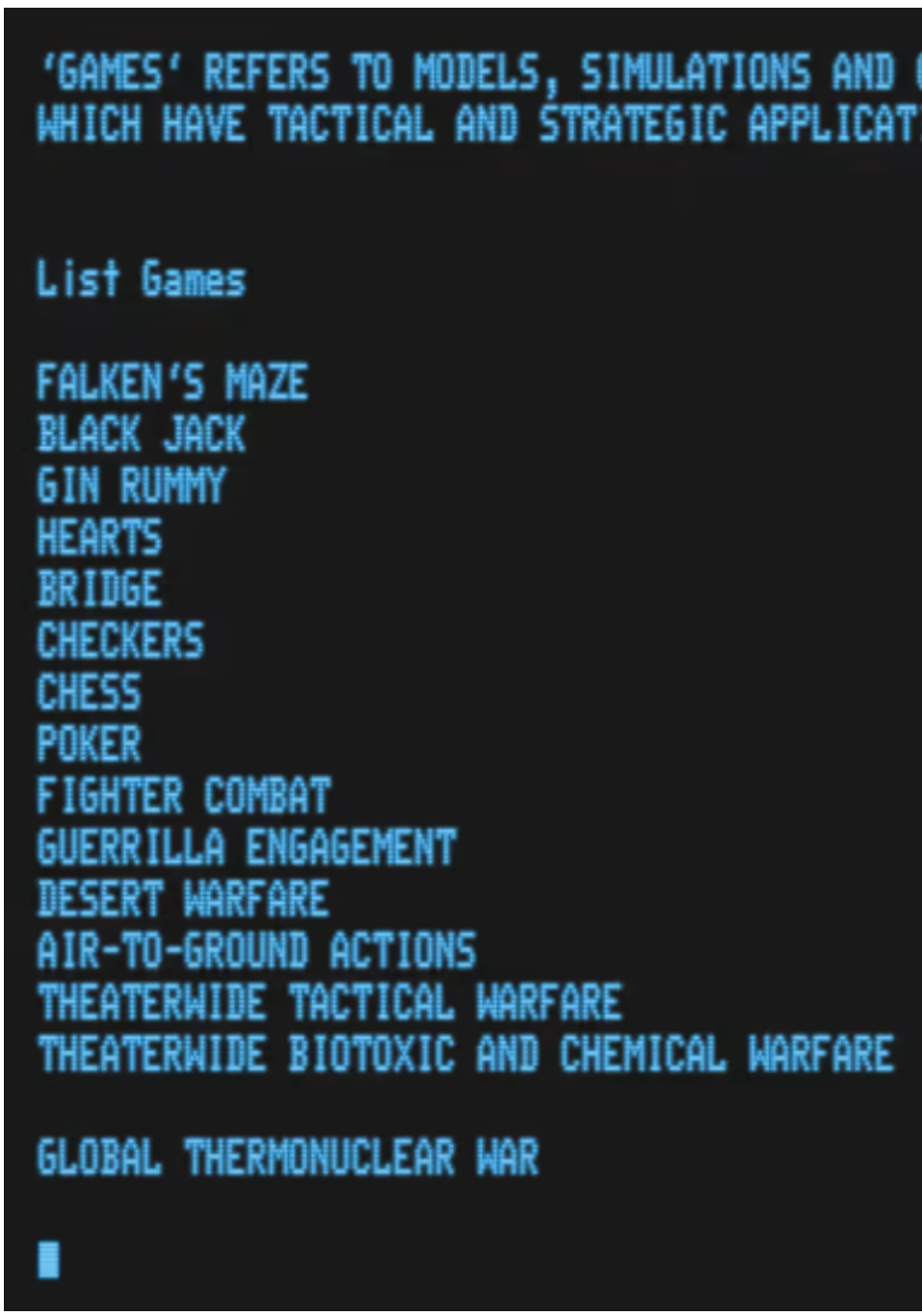
- If they sell PSL for $6.50, what happens if I sell t
- What if I sell for $6.51?

This has been your EC201 review!

Examples of *strategic games*:

Should the US try to defeat its rivals through `glob`
`war`?

- Why did the US and USSR amass massive nuclea
- Why has a nuclear weapon never been used in a
- Are anti-ballistic missiles destabilizing to interna


'GAMES' REFERS TO MODELS, SIMULATIONS AND
WHICH HAVE TACTICAL AND STRATEGIC APPLICAT
List Games
FALKEN'S MAZE
BLACK JACK
GIN RUMMY
HEARTS
BRIDGE
CHECKERS
CHESS
POKER
FIGHTER COMBAT
GUERRILLA ENGAGEMENT
DESERT WARFARE
AIR-TO-GROUND ACTIONS
THEATERWIDE TACTICAL WARFARE
THEATERWIDE BIOTOXIC AND CHEMICAL WARFARE
GLOBAL THERMONUCLEAR WAR

Examples of *strategic games*:

What do these examples have in common?

What is a Game? Def

What do all these questions ha common?

- They all involve people making choices which de of others
- In other words, they are questions of **strategy**:

> **Strategic interdependence** is present in a soc what is best for someone *depends* on what so

1. *Harrington*, pg. 2

A definition of a game [1]

A **Game** consists of:

- a collection of decision-makers, called **players**;
- the set of **information** available to each player;
- the **strategies** available to each player in each i
- a mapping from the intersection strategies of all
- **preferences** of the individual players over all po

1. adapted from Leigh Tesfatsion's slides

Who are the players

What defines a player?

- **Preferences**: Everyone has certain things they *w*

  But you usually can't get everything you want; ec
  constrained choices.

  So its important to have priorities and to unders
  people prefer to others.
- **Information**: Some people might be better infor
- **Beliefs**: What do I think about when I have to ma

Preferences

Preferences describe the subjective ranking that w
alternatives.

For example, on the set of Eugene boba stores, my
goes like this;

1. Day & Night - they have mango sago, cute locati
2. Tea 4 - major chain, good quality and selection
3. Bobahead - no more campus location 😔
4. No boba
5. Rabbit Hole - no hate, just not for me

Rational Preferences

The **rational model** of choice is the foundation of

Its assumptions are that:

- People have **complete preferences**
  - for *every* pair of options, you can either tell m that you are *indifferent*
  - for any pair of deserts, { 🍨, 🍩 }, either (🍨 or (🍨 ∼ 🍩)
- Preferences are **transitive**
  - if (☕ ≻ 🍵) and (🍵 ≻ 🍶), then (☕ ≻ 🍶) ({ ☕, 🍵, 🍶 } ∈ 🫖)

Rational Preferences (cont.)

Another key assumption of rationality is that we ca
preferences by real numbers.

A **utility function** maps a choice to a single numbe

For example, let $u(.)$ be the utility function from e

- I can have $u(🍺) = 5$, $u(🌯) = 10$, $u(🤸) = 25$
- I can also have $u(🍺, 🌯) = 20$, $u(🍺, 🌯, 🤸) =$

Ordinal vs. Cardinal numbers

- **Cardinal:** amounts which can be measured in m
  cardinal numbers
  - examples: $9.99, 80 students, 50:50 odds
- **Ordinal:** all that matters is the *relative ranking*
  - examples: utility; what does 100 utility mean?

Don’t worry!

- For this class, you won’t need to worry about uti
  want to, take EC311).
- I will almost always give you specific values of u
  payoffs.
- The table on the previous page is a good examp

Payoffs

What is a player's goal in a game?

> To maximize their expected **payoff**

- A payoff can represent many things.
- But for simplicity we will abstract them down to value.
- A payoff doesn't need to be abstract; it could be

Payoffs

What is true of payoffs?

> Higher numbers are more preferred

> They are **Ordinal**; i.e., the relative units don't ma

> They capture *everything* in a game that a player

1 except when we talk about *expected* payoffs later

Strategic Choice vs. other types

- Economics is the study of **constrained choice**; in the *utility maximization problem* as the workhor
  - These types of problems usually only involve consumer, who is only constrained by their bu
- We use the term ***strategic games*** to distinguish agent optimization problems
- A ***game*** is a type of problem featuring multiple a in which their optimal choice **depends on the op players**.

State-dependent utility table

- Sometimes my enjoyment of a thing depends on

socially-dependent preferenc

My choice	My friends' choice	M
Duck's game	Duck's game	3
Duck's game	Stay home	2
Stay home	Duck's game	1
Stay home	Stay home	2

- Is this an example of a **strategic** or **non-strategi**

Common Knowledge

Our theories will have to make assumptions about

All of our games will at least assume that **all playe**
rules.

Rules of the Game

We will assume that all players know:

- Who else is playing,
- all of the strategies each player could *potentiall*
- everyone's payoffs for all possible combinations players,
- and that everyone else is maximizing their payo

Taxonomy of Games

General Categorical Terms

- **Sequential** or **Simultaneous**?
- **Zero-sum** or not
- **Perfect** or **Imperfect** information?
  - is info **symmetric** or **asymmetric**?
- **One-shot** or **Repeated**?
- '**Noncooperative**' or '**Cooperative**'?

Sequential vs. Simultaneous

Sequential Games

- players make their moves one after the other
- **Chapter** 3
- **Visual tool**: *game trees*
- **Solution Method**: *backwards induction*

. . .

Simultaneous Games

- players make their moves at the same time
- **Chapter** 4 & 5
- **Visual tool**: *payoff tables*
- **Solution Method**: *best responses*, deletion of *dominated strats*

Sequential Games

In **sequential** games, you have to think about how
affect what your opponent will do in the ***future***.

. . .

> This hierarchy of thinking will make these types
> easier for us to think through, so they will be ou
> games.

. . .

- We'll see that sometimes **moving first** can be ad

. . .

- While other times it's best to **wait and see** what

Simultaneous Games

In **simultaneous** games, you have to figure out wha
thinking about what your opponent is thinking you

. . .

> This circular thinking can get confusing, so we'll
> new methods for organizing these games in cha

Conflicting vs. Common Interes

Many games you are familiar with have distince *wi*

But in other types of games, it's possible for everyo
ahead.

Zero-sum (or constant-sum) Games

When the *total payoffs of all players sum to 0* [1]

- i.e, one player's gain is another player's loss
- Examples: NCAA Football Championship, Scramb
  (technically *constant*-sum)

Not all games are fixed or zero sum;

- Examples: Hiring a tutor (mutual gains), Internat

1 or sum to some constant

Are strategic interactions Repea

A **one-shot** game is played only once by the same

- If you've never played against someone before, y **beliefs** about them
- Secrecy or surprise are potentially good strategi

A game is called **repeated** if the same players play many times.

- If you know your opponent, then your **reputatio** you want to cooperate

Full or Equal Information

How much does each player know when they deci

- **Perfect Information**: when players know all prev external circumstances
  - players may have ***imperfect info***; uncertainty world, previous' moves, or other player's 'type
- **Asymmetric Info**: when one player has access to players do not
  - Examples: hand in poker, used car salesmen
  - Topics: Signaling, Screening

Can agreements be Enforced?

- Self-interest and common good can often confli
- In these situations, players need to form agreem achieve cooperative outcomes.

> But can people actually be held to those agreem

For example:

- Paris Climate accords; who polices nation-state's
- Public goods; why do we need the Internal Reve

Can agreements be Enforced?

Two broad categories of the field are **cooperative** g
noncooperative game theory [1]

> **Cooperative** games are those in which agreemen

> In **Noncooperative** games, no-one can be forced
> own self-interest

1. but if you ask real game theorists, they will probably tell you these na

Tentative Schedule

Week	Chapter(s)	Topic
1	1, 2	Intro & General Principles
2	3	Sequential Move Games
3	4	Simultaneous Move Games
4	6	Combining Sequential and S
5	6	Review & **Midterm**
6	5	Simultaneous Games: Conti Discussion, and Evidence
7	7	Mixed Strategies
8	8	Strategic Moves
9	9	Uncertainty and Informatio

Week	Chapter(s)	Topic
10	10	Repeated Games
Finals	*TBA*	*Exam*