Intro to Economic Analysis: Microeconomics
EC 201 - Day 20 Slides

Connor Wiegand

Department of Economics - University of Oregon

1 December 2021

Logistics

▶ Homework 8 due <u>this</u> Monday (Monday of finals week, Dec 6th at 11:59pm)

▶ Comprehensive final exam on <u>December 9th</u> at 2:45pm – the exam will last for 2 hours

Dictator Game

▶ Pair up: Youngest is dictator, eldest is acceptor

Dictator Game

- ▶ Pair up: Youngest is dictator, eldest is acceptor
- ▶ The dictator has \$100, and can choose an offer amount \$$x$, that the other player receives out of their \$100

Dictator Game

▶ Pair up: Youngest is dictator, eldest is acceptor

▶ The dictator has $100, and can choose an offer amount x, that the other player receives out of their $100

▶ The acceptor is allowed to reply to the offer with "yes" or "no"

Dictator Game

▶ Pair up: Youngest is dictator, eldest is acceptor

▶ The dictator has \$100, and can choose an offer amount \$$x$, that the other player receives out of their \$100

▶ The acceptor is allowed to reply to the offer with "yes" or "no"
  • If yes, both players keep their money

Dictator Game

▶ Pair up: Youngest is dictator, eldest is acceptor

▶ The dictator has \$100, and can choose an offer amount \$$x$, that the other player receives out of their \$100

▶ The acceptor is allowed to reply to the offer with "yes" or "no"

  • If yes, both players keep their money
  • If no, both players get nothing

Dictator Game

▶ Pair up: Youngest is dictator, eldest is acceptor

▶ The dictator has $100, and can choose an offer amount x, that the other player receives out of their $100

▶ The acceptor is allowed to reply to the offer with "yes" or "no"
  • If yes, both players keep their money
  • If no, both players get nothing

▶ Play

Dictator Game

▶ Pair up: Youngest is dictator, eldest is acceptor

▶ The dictator has $100, and can choose an offer amount x, that the other player receives out of their $100

▶ The acceptor is allowed to reply to the offer with "yes" or "no"

    • If yes, both players keep their money
    • If no, both players get nothing

▶ Play

▶ Switch

Dictator Game

▶ Pair up: Youngest is dictator, eldest is acceptor

▶ The dictator has \$100, and can choose an offer amount \$$x$, that the other player receives out of their \$100

▶ The acceptor is allowed to reply to the offer with "yes" or "no"

  • If yes, both players keep their money
  • If no, both players get nothing

▶ Play

▶ Switch

▶ What should you do?

Dictator Game

▶ Pair up: Youngest is dictator, eldest is acceptor

▶ The dictator has \$100, and can choose an offer amount \$$x$, that the other player receives out of their \$100

▶ The acceptor is allowed to reply to the offer with "yes" or "no"
  - If yes, both players keep their money
  - If no, both players get nothing

▶ Play

▶ Switch

▶ What should you do?
  - If you are just playing once and you value money, offer \$0/ always accept (unless maybe the offer is literally \$0, in which case it doesn't matter)

Dictator Game

▶ Pair up: Youngest is dictator, eldest is acceptor

▶ The dictator has \$100, and can choose an offer amount \$x, that the other player receives out of their \$100

▶ The acceptor is allowed to reply to the offer with "yes" or "no"
  • If yes, both players keep their money
  • If no, both players get nothing

▶ Play

▶ Switch

▶ What should you do?
  • If you are just playing once and you value money, offer \$0/ always accept (unless maybe the offer is literally \$0, in which case it doesn't matter)
  • What actually happens? Do people care about spite? How does this change if people are expecting another round?

What is a Game?

▶ Loose definition: a game consists of (i) players, (ii) strategies (also called *moves*, or *actions*), and (iii) payoffs

What is a Game?

▶ Loose definition: a game consists of (i) players, (ii) strategies (also called *moves*, or *actions*), and (iii) payoffs

▶ This is a very broad definition, and allows for a lot of different things to count as games

What is a Game?

▶ Loose definition: a game consists of (i) players, (ii) strategies (also called *moves*, or *actions*), and (iii) payoffs

▶ This is a very broad definition, and allows for a lot of different things to count as games

• It is also one of the test questions I can ask you

What is a Game?

▶ Loose definition: a game consists of (i) players, (ii) strategies (also called *moves*, or *actions*), and (iii) payoffs

▶ This is a very broad definition, and allows for a lot of different things to count as games

    • It is also one of the test questions I can ask you

▶ Strategery is important, because interactive elements are what make games interesting

What is a Game?

▶ Loose definition: a game consists of (i) players, (ii) strategies (also called *moves*, or *actions*), and (iii) payoffs

▶ This is a very broad definition, and allows for a lot of different things to count as games

    • It is also one of the test questions I can ask you

▶ Strategery is important, because interactive elements are what make games interesting

    • For instance, a bunch of people separately making decisions is more accurately described as *decision theory*

What is a Game?

▶ Loose definition: a game consists of (i) players, (ii) strategies (also called *moves*, or *actions*), and (iii) payoffs

▶ This is a very broad definition, and allows for a lot of different things to count as games

  • It is also one of the test questions I can ask you

▶ Strategery is important, because interactive elements are what make games interesting

  • For instance, a bunch of people separately making decisions is more accurately described as *decision theory*

▶ What are some games that you have heard of, or can think of?

What is a Game?

▶ Loose definition: a game consists of (i) players, (ii) strategies (also called *moves*, or *actions*), and (iii) payoffs

▶ This is a very broad definition, and allows for a lot of different things to count as games

- It is also one of the test questions I can ask you

▶ Strategery is important, because interactive elements are what make games interesting

- For instance, a bunch of people separately making decisions is more accurately described as *decision theory*

▶ What are some games that you have heard of, or can think of?

- Duopoly – two firms picking prices or quantities

What is a Game?

▶ Loose definition: a game consists of (i) players, (ii) strategies (also called *moves*, or *actions*), and (iii) payoffs

▶ This is a very broad definition, and allows for a lot of different things to count as games
  • It is also one of the test questions I can ask you

▶ Strategery is important, because interactive elements are what make games interesting
  • For instance, a bunch of people separately making decisions is more accurately described as *decision theory*

▶ What are some games that you have heard of, or can think of?
  • Duopoly – two firms picking prices or quantities
  • Prisoner's Dilemma

What is a Game?

▶ Loose definition: a game consists of (i) players, (ii) strategies (also called *moves*, or *actions*), and (iii) payoffs

▶ This is a very broad definition, and allows for a lot of different things to count as games

  • It is also one of the test questions I can ask you

▶ Strategery is important, because interactive elements are what make games interesting

  • For instance, a bunch of people separately making decisions is more accurately described as *decision theory*

▶ What are some games that you have heard of, or can think of?

  • Duopoly – two firms picking prices or quantities
  • Prisoner's Dilemma
  • Matching Pennies

What is a Game?

▶ Loose definition: a game consists of (i) players, (ii) strategies (also called *moves*, or *actions*), and (iii) payoffs

▶ This is a very broad definition, and allows for a lot of different things to count as games

  • It is also one of the test questions I can ask you

▶ Strategery is important, because interactive elements are what make games interesting

  • For instance, a bunch of people separately making decisions is more accurately described as *decision theory*

▶ What are some games that you have heard of, or can think of?

  • Duopoly – two firms picking prices or quantities
  • Prisoner's Dilemma
  • Matching Pennies
  • Battle of the Sexes

What is a Game?

▶ Loose definition: a game consists of (i) players, (ii) strategies (also called *moves*, or *actions*), and (iii) payoffs

▶ This is a very broad definition, and allows for a lot of different things to count as games

  • It is also one of the test questions I can ask you

▶ Strategery is important, because interactive elements are what make games interesting

  • For instance, a bunch of people separately making decisions is more accurately described as *decision theory*

▶ What are some games that you have heard of, or can think of?

  • Duopoly – two firms picking prices or quantities
  • Prisoner's Dilemma
  • Matching Pennies
  • Battle of the Sexes
  • Quiche/Beer

What is a Game?

▶ Loose definition: a game consists of (i) players, (ii) strategies (also called *moves*, or *actions*), and (iii) payoffs

▶ This is a very broad definition, and allows for a lot of different things to count as games
   - It is also one of the test questions I can ask you

▶ Strategery is important, because interactive elements are what make games interesting
   - For instance, a bunch of people separately making decisions is more accurately described as *decision theory*

▶ What are some games that you have heard of, or can think of?

   - Duopoly – two firms picking prices or quantities
   - Prisoner's Dilemma
   - Matching Pennies
   - Battle of the Sexes
   - Quiche/Beer

   - Dictator game

What is a Game?

▶ Loose definition: a game consists of (i) players, (ii) strategies (also called *moves*, or *actions*), and (iii) payoffs

▶ This is a very broad definition, and allows for a lot of different things to count as games

  • It is also one of the test questions I can ask you

▶ Strategery is important, because interactive elements are what make games interesting

  • For instance, a bunch of people separately making decisions is more accurately described as *decision theory*

▶ What are some games that you have heard of, or can think of?

  • Duopoly – two firms picking prices or quantities
  • Prisoner's Dilemma
  • Matching Pennies
  • Battle of the Sexes
  • Quiche/Beer

  • Dictator game
  • 2/3 of average

What is a Game?

▶ Loose definition: a game consists of (i) players, (ii) strategies (also called *moves*, or *actions*), and (iii) payoffs

▶ This is a very broad definition, and allows for a lot of different things to count as games

  • It is also one of the test questions I can ask you

▶ Strategery is important, because interactive elements are what make games interesting

  • For instance, a bunch of people separately making decisions is more accurately described as *decision theory*

▶ What are some games that you have heard of, or can think of?

  • Duopoly – two firms picking prices or quantities
  • Prisoner's Dilemma
  • Matching Pennies
  • Battle of the Sexes
  • Quiche/Beer

  • Dictator game
  • 2/3 of average
  • Centipede Game

What is a Game?

▶ Loose definition: a game consists of (i) players, (ii) strategies (also called *moves*, or *actions*), and (iii) payoffs

▶ This is a very broad definition, and allows for a lot of different things to count as games
  • It is also one of the test questions I can ask you

▶ Strategery is important, because interactive elements are what make games interesting
  • For instance, a bunch of people separately making decisions is more accurately described as *decision theory*

▶ What are some games that you have heard of, or can think of?

  • Duopoly – two firms picking prices or quantities
  • Prisoner's Dilemma
  • Matching Pennies
  • Battle of the Sexes
  • Quiche/Beer

  • Dictator game
  • 2/3 of average
  • Centipede Game
  • Chicken

What is a Game?

▶ Loose definition: a game consists of (i) players, (ii) strategies (also called *moves*, or *actions*), and (iii) payoffs

▶ This is a very broad definition, and allows for a lot of different things to count as games

- It is also one of the test questions I can ask you

▶ Strategery is important, because interactive elements are what make games interesting

- For instance, a bunch of people separately making decisions is more accurately described as *decision theory*

▶ What are some games that you have heard of, or can think of?

- Duopoly – two firms picking prices or quantities
- Prisoner's Dilemma
- Matching Pennies
- Battle of the Sexes
- Quiche/Beer

- Dictator game
- 2/3 of average
- Centipede Game
- Chicken
- Rock, Paper, Scissors

What is a Game?

▶ Loose definition: a game consists of (i) players, (ii) strategies (also called *moves*, or *actions*), and (iii) payoffs

▶ This is a very broad definition, and allows for a lot of different things to count as games

  • It is also one of the test questions I can ask you

▶ Strategery is important, because interactive elements are what make games interesting

  • For instance, a bunch of people separately making decisions is more accurately described as *decision theory*

▶ What are some games that you have heard of, or can think of?

  • Duopoly – two firms picking prices or quantities
  • Prisoner's Dilemma
  • Matching Pennies
  • Battle of the Sexes
  • Quiche/Beer

  • Dictator game
  • 2/3 of average
  • Centipede Game
  • Chicken
  • Rock, Paper, Scissors
  • Signaling Game

Who Cares about Game Theory?

▶ There are other games, too: Chess, League of Legends, Poker, etc.

---

[1] "The only winning move is not to play." - *WarGames* (1983)

Who Cares about Game Theory?

▶ There are other games, too: Chess, League of Legends, Poker, etc.
▶ Game theory is the careful analysis of interactive games, and what makes these game interesting is their true complexity

---

[1] "The only winning move is not to play." - *WarGames* (1983)

Who Cares about Game Theory?

▶ There are other games, too: Chess, League of Legends, Poker, etc.

▶ Game theory is the careful analysis of interactive games, and what makes these game interesting is their true complexity

▶ Game theory cannot make you win a League match[1], but it *can* help you analyze specific decisions that come in such complex games

---

[1] "The only winning move is not to play."- *WarGames* (1983)

Who Cares about Game Theory?

▶ There are other games, too: Chess, League of Legends, Poker, etc.

▶ Game theory is the careful analysis of interactive games, and what makes these game interesting is their true complexity

▶ Game theory cannot make you win a League match[1], but it *can* help you analyze specific decisions that come in such complex games

▶ Who cares about game theory?

---

[1] "The only winning move is not to play."- *WarGames* (1983)

Who Cares about Game Theory?

- ▶ There are other games, too: Chess, League of Legends, Poker, etc.
- ▶ Game theory is the careful analysis of interactive games, and what makes these game interesting is their true complexity
- ▶ Game theory cannot make you win a League match[1], but it *can* help you analyze specific decisions that come in such complex games
- ▶ Who cares about game theory?
  - Coke/Pepsi (or other duopolies)

---

[1] "The only winning move is not to play."- *WarGames* (1983)

Who Cares about Game Theory?

► There are other games, too: Chess, League of Legends, Poker, etc.

► Game theory is the careful analysis of interactive games, and what makes these game interesting is their true complexity

► Game theory cannot make you win a League match[1], but it *can* help you analyze specific decisions that come in such complex games

► Who cares about game theory?

  • Coke/Pepsi (or other duopolies)
  • Amazon

---

[1] "The only winning move is not to play." - *WarGames* (1983)

Who Cares about Game Theory?

▶ There are other games, too: Chess, League of Legends, Poker, etc.

▶ Game theory is the careful analysis of interactive games, and what makes these game interesting is their true complexity

▶ Game theory cannot make you win a League match[1], but it *can* help you analyze specific decisions that come in such complex games

▶ Who cares about game theory?
  • Coke/Pepsi (or other duopolies)
  • Amazon
  • Verizon

---

[1] "The only winning move is not to play."- *WarGames* (1983)

Who Cares about Game Theory?

▶ There are other games, too: Chess, League of Legends, Poker, etc.

▶ Game theory is the careful analysis of interactive games, and what makes these game interesting is their true complexity

▶ Game theory cannot make you win a League match[1], but it *can* help you analyze specific decisions that come in such complex games

▶ Who cares about game theory?

     • Coke/Pepsi (or other duopolies)
     • Amazon
     • Verizon
     • Game Studios?

---

[1] "The only winning move is not to play."- *WarGames* (1983)

Everyday Uses

▶ Much like intuition in this class helps you understand why things happen in the real world, game theory can also help with understanding the optimal/best ways to make interactive decisions:

---

[2]If anyone is reading this, this isn't my example

Everyday Uses

▶ Much like intuition in this class helps you understand why things happen in the real world, game theory can also help with understanding the optimal/best ways to make interactive decisions:

- When should I email my professor to ask for a favor?

---
[2]If anyone is reading this, this isn't my example

Everyday Uses

- ▶ Much like intuition in this class helps you understand why things happen in the real world, game theory can also help with understanding the optimal/best ways to make interactive decisions:

  - When should I email my professor to ask for a favor?
  - When and how should I reveal my valuation when buying a car?

---

[2] If anyone is reading this, this isn't my example

Everyday Uses

▶ Much like intuition in this class helps you understand why things happen in the real world, game theory can also help with understanding the optimal/best ways to make interactive decisions:

- When should I email my professor to ask for a favor?
- When and how should I reveal my valuation when buying a car?
- When my annoying family member says something during th holidays, should I provide a legitimate counterargument, or just gaslight them?

---

[2]If anyone is reading this, this isn't my example

Everyday Uses

▶ Much like intuition in this class helps you understand why things happen in the real world, game theory can also help with understanding the optimal/best ways to make interactive decisions:

- When should I email my professor to ask for a favor?
- When and how should I reveal my valuation when buying a car?
- When my annoying family member says something during th holidays, should I provide a legitimate counterargument, or just gaslight them?

- How should I interact with this business on a regular basis in order to minimize costs, and keep me from getting screwed over?

---

[2] If anyone is reading this, this isn't my example

Everyday Uses

▶ Much like intuition in this class helps you understand why things happen
in the real world, game theory can also help with understanding the
optimal/best ways to make interactive decisions:

- When should I email my
professor to ask for a favor?
- When and how should I reveal
my valuation when buying a car?
- When my annoying family
member says something during
th holidays, should I provide a
legitimate counterargument, or
just gaslight them?

- How should I interact with this
business on a regular basis in
order to minimize costs, and keep
me from getting screwed over?
- Should I buy my my girlfriend
new boobs?[2]

---

[2]If anyone is reading this, this isn't my example

Everyday Uses

▶ Much like intuition in this class helps you understand why things happen in the real world, game theory can also help with understanding the optimal/best ways to make interactive decisions:

- When should I email my professor to ask for a favor?
- When and how should I reveal my valuation when buying a car?
- When my annoying family member says something during th holidays, should I provide a legitimate counterargument, or just gaslight them?

- How should I interact with this business on a regular basis in order to minimize costs, and keep me from getting screwed over?
- Should I buy my my girlfriend new boobs?[2]
- What happens if your wife gets kidnapped? (Don't use game theory)

---

[2]If anyone is reading this, this isn't my example

EC 201

Connor Wiegand

2/3 Average

▶ Everyone write down a number between 0 and 100, inclusive ([0, 100]).
You win if you correctly guess 2/3 of the average of everyone's score (we
will call $\frac{2}{3}$ of the average the "target score").

2/3 Average

- Everyone write down a number between 0 and 100, inclusive ($[0, 100]$). You win if you correctly guess 2/3 of the average of everyone's score (we will call $\frac{2}{3}$ of the average the "target score").

- What's your guess?

2/3 Average

▶ Everyone write down a number between 0 and 100, inclusive ($[0, 100]$).
You win if you correctly guess 2/3 of the average of everyone's score (we
will call $\frac{2}{3}$ of the average the "target score").

▶ What's your guess?

▶ What's the best strategy?

2/3 Average Solution

▶ Note: the maximum that anyone can say is 100. If everyone said 100, the average would be 100, so 2/3 of the average would be 66.$\bar{6}$, so this is the largest target score

2/3 Average Solution

▶ Note: the maximum that anyone can say is 100. If everyone said 100, the average would be 100, so 2/3 of the average would be $66.\bar{6}$, so this is the largest target score

- Thus, it is extremely unlikely that anyone would play 66.6-100, so we can effectively eliminate those strategies when trying to guess the average

2/3 Average Solution

- ▶ Note: the maximum that anyone can say is 100. If everyone said 100, the average would be 100, so 2/3 of the average would be 66.$\bar{6}$, so this is the largest target score
  - • Thus, it is extremely unlikely that anyone would play 66.6-100, so we can effectively eliminate those strategies when trying to guess the average
  - • If the only reasonable guess is less than or equal to 66.6, then the maximum reasonable average is 66.6

2/3 Average Solution

▶ Note: the maximum that anyone can say is 100. If everyone said 100, the average would be 100, so 2/3 of the average would be $66.\bar{6}$, so this is the largest target score

- Thus, it is extremely unlikely that anyone would play 66.6-100, so we can effectively eliminate those strategies when trying to guess the average
- If the only reasonable guess is less than or equal to 66.6, then the maximum reasonable average is 66.6
  - This makes the largest reasonable target score $\frac{2}{3}(66.6) = 44.4$

2/3 Average Solution

▶ Note: the maximum that anyone can say is 100. If everyone said 100, the average would be 100, so $2/3$ of the average would be $66.\bar{6}$, so this is the largest target score

- Thus, it is extremely unlikely that anyone would play 66.6-100, so we can effectively eliminate those strategies when trying to guess the average
- If the only reasonable guess is less than or equal to 66.6, then the maximum reasonable average is 66.6
  - This makes the largest reasonable target score $\frac{2}{3}(66.6) = 44.4$
  - So now, the largest reasonable guess is 44.4

2/3 Average Solution

▶ Note: the maximum that anyone can say is 100. If everyone said 100, the average would be 100, so 2/3 of the average would be $66.\bar{6}$, so this is the largest target score

- Thus, it is extremely unlikely that anyone would play 66.6-100, so we can effectively eliminate those strategies when trying to guess the average
- If the only reasonable guess is less than or equal to 66.6, then the maximum reasonable average is 66.6
    - This makes the largest reasonable target score $\frac{2}{3}(66.6) = 44.4$
    - So now, the largest reasonable guess is 44.4
    - But this will make the largest reasonable target score 29.629

2/3 Average Solution

▶ Note: the maximum that anyone can say is 100. If everyone said 100, the average would be 100, so 2/3 of the average would be $66.\bar{6}$, so this is the largest target score

- Thus, it is extremely unlikely that anyone would play 66.6-100, so we can effectively eliminate those strategies when trying to guess the average
- If the only reasonable guess is less than or equal to 66.6, then the maximum reasonable average is 66.6
  - This makes the largest reasonable target score $\frac{2}{3}(66.6) = 44.4$
  - So now, the largest reasonable guess is 44.4
  - But this will make the largest reasonable target score 29.629

▶ As we keep repeating this thinking, what happens?

2/3 Average Solution

▶ Note: the maximum that anyone can say is 100. If everyone said 100, the average would be 100, so $2/3$ of the average would be $66.\bar{6}$, so this is the largest target score

- Thus, it is extremely unlikely that anyone would play 66.6-100, so we can effectively eliminate those strategies when trying to guess the average
- If the only reasonable guess is less than or equal to 66.6, then the maximum reasonable average is 66.6
  - This makes the largest reasonable target score $\frac{2}{3}(66.6) = 44.4$
  - So now, the largest reasonable guess is 44.4
  - But this will make the largest reasonable target score 29.629

▶ As we keep repeating this thinking, what happens?

▶ The only guess that is left is _zero_

2/3 Average Solution

▶ Note: the maximum that anyone can say is 100. If everyone said 100, the average would be 100, so $2/3$ of the average would be $66.\bar{6}$, so this is the largest target score

- Thus, it is extremely unlikely that anyone would play 66.6-100, so we can effectively eliminate those strategies when trying to guess the average
- If the only reasonable guess is less than or equal to 66.6, then the maximum reasonable average is 66.6
  - This makes the largest reasonable target score $\frac{2}{3}(66.6) = 44.4$
  - So now, the largest reasonable guess is 44.4
  - But this will make the largest reasonable target score 29.629

▶ As we keep repeating this thinking, what happens?

▶ The only guess that is left is _zero_

▶ Is this what we see?

2/3 Average Solution

▶ Note: the maximum that anyone can say is 100. If everyone said 100, the average would be 100, so $2/3$ of the average would be $66.\bar{6}$, so this is the largest target score

- Thus, it is extremely unlikely that anyone would play 66.6-100, so we can effectively eliminate those strategies when trying to guess the average
- If the only reasonable guess is less than or equal to 66.6, then the maximum reasonable average is 66.6
    - This makes the largest reasonable target score $\frac{2}{3}(66.6) = 44.4$
    - So now, the largest reasonable guess is 44.4
    - But this will make the largest reasonable target score 29.629

▶ As we keep repeating this thinking, what happens?

▶ The only guess that is left is *zero*

▶ Is this what we see?

- A Danish newspaper tried this with about 19,000 respondents, and the target number was found to be 21.6

2/3 Average Solution

▶ Note: the maximum that anyone can say is 100. If everyone said 100, the average would be 100, so 2/3 of the average would be $66.\bar{6}$, so this is the largest target score

- Thus, it is extremely unlikely that anyone would play 66.6-100, so we can effectively eliminate those strategies when trying to guess the average
- If the only reasonable guess is less than or equal to 66.6, then the maximum reasonable average is 66.6
  - This makes the largest reasonable target score $\frac{2}{3}(66.6) = 44.4$
  - So now, the largest reasonable guess is 44.4
  - But this will make the largest reasonable target score 29.629

▶ As we keep repeating this thinking, what happens?

▶ The only guess that is left is *zero*

▶ Is this what we see?

- A Danish newspaper tried this with about 19,000 respondents, and the target number was found to be 21.6
- Even among economists, no

The Rules of the Game

▶ Today, we will mostly talk about games with 2 players and 2 strategies

The Rules of the Game

- ▶ Today, we will mostly talk about games with 2 players and 2 strategies
- ▶ Players only play once, and they do not communicate before or during the game

The Rules of the Game

▶ Today, we will mostly talk about games with 2 players and 2 strategies

▶ Players only play once, and they do not communicate before or during the game

▶ If our players are named A and B, the following is true:

The Rules of the Game

▶ Today, we will mostly talk about games with 2 players and 2 strategies

▶ Players only play once, and they do not communicate before or during the game

▶ If our players are named A and B, the following is true:

    • A knows how to play the game, and B knows how to play the game

The Rules of the Game

▶ Today, we will mostly talk about games with 2 players and 2 strategies

▶ Players only play once, and they do not communicate before or during the game

▶ If our players are named A and B, the following is true:

- A knows how to play the game, and B knows how to play the game
- A knows that B knows how to play the game, and B knows that A knows how to play the game

The Rules of the Game

▶ Today, we will mostly talk about games with 2 players and 2 strategies

▶ Players only play once, and they do not communicate before or during the game

▶ If our players are named A and B, the following is true:

- A knows how to play the game, and B knows how to play the game
- A knows that B knows how to play the game, and B knows that A knows how to play the game
- A knows that B knows that A knows how to play the game, and B knows that A knows that B knows how to play the game

The Rules of the Game

▶ Today, we will mostly talk about games with 2 players and 2 strategies

▶ Players only play once, and they do not communicate before or during the game

▶ If our players are named A and B, the following is true:

- A knows how to play the game, and B knows how to play the game
- A knows that B knows how to play the game, and B knows that A knows how to play the game
- A knows that B knows that A knows how to play the game, and B knows that A knows that B knows how to play the game
- …So on and so forth

The Rules of the Game

▶ Today, we will mostly talk about games with 2 players and 2 strategies

▶ Players only play once, and they do not communicate before or during the game

▶ If our players are named A and B, the following is true:

    • A knows how to play the game, and B knows how to play the game
    • A knows that B knows how to play the game, and B knows that A knows how to play the game
    • A knows that B knows that A knows how to play the game, and B knows that A knows that B knows how to play the game
    • ...So on and so forth
    • This seems silly, but game theorists have spent a great deal of time analyzing what happens when the nth iteration of this thinking fails

The Rules of the Game

▶ Today, we will mostly talk about games with 2 players and 2 strategies

▶ Players only play once, and they do not communicate before or during the game

▶ If our players are named A and B, the following is true:
  - A knows how to play the game, and B knows how to play the game
  - A knows that B knows how to play the game, and B knows that A knows how to play the game
  - A knows that B knows that A knows how to play the game, and B knows that A knows that B knows how to play the game
  - ...So on and so forth
  - This seems silly, but game theorists have spent a great deal of time analyzing what happens when the nth iteration of this thinking fails
    - Here is an interesting application of this principle Green-Eyed Islander Puzzle

9/33

Normal Form Games

▶ If these (and some other, subtler principles) are satisfied, we may write down what's called a <u>Normal Form Game</u>[3]

$$
\begin{array}{cc}
& P_B \\
& \begin{array}{cc} L & R \end{array} \\
P_A \begin{array}{c} U \\ D \end{array} & \begin{array}{|c|c|} \hline a,b & c,d \\ \hline e,f & g,h \\ \hline \end{array}
\end{array}
\qquad \text{or} \qquad
\begin{array}{cc}
& P_B \\
& \begin{array}{cc} L & R \end{array} \\
P_A \begin{array}{c} U \\ D \end{array} & \begin{array}{|c|c|} \hline \pi_{11}^A,\pi_{11}^B & \pi_{12}^A,\pi_{12}^B \\ \hline \pi_{21}^A,\pi_{21}^B & \pi_{22}^A,\pi_{22}^B \\ \hline \end{array}
\end{array}
$$

---

[3]Note: this isn't the only way to represent a game

Normal Form Games

▶ If these (and some other, subtler principles) are satisfied, we may write down what's called a <u>Normal Form Game</u>[3]

$$
\begin{array}{cc}
 & P_B \\
 & \begin{array}{cc} L & R \end{array} \\
P_A \begin{array}{c} U \\ D \end{array} & \begin{array}{|c|c|} \hline a,b & c,d \\ \hline e,f & g,h \\ \hline \end{array}
\end{array}
\qquad \text{or} \qquad
\begin{array}{cc}
 & P_B \\
 & \begin{array}{cc} L & R \end{array} \\
P_A \begin{array}{c} U \\ D \end{array} & \begin{array}{|c|c|} \hline \pi_{11}^A, \pi_{11}^B & \pi_{12}^A, \pi_{12}^B \\ \hline \pi_{21}^A, \pi_{21}^B & \pi_{22}^A, \pi_{22}^B \\ \hline \end{array}
\end{array}
$$

▶ Player A (P_A) can play Top or Bottom, while player B can play Left or Right

---

[3] Note: this isn't the only way to represent a game

Normal Form Games

▶ If these (and some other, subtler principles) are satisfied, we may write
down what's called a <u>Normal Form Game</u>[3]

$$
\begin{array}{cc}
 & P_B \\
 & \begin{array}{cc} L & R \end{array} \\
P_A \begin{array}{c} U \\ D \end{array} & \begin{array}{|c|c|} \hline a,b & c,d \\ \hline e,f & g,h \\ \hline \end{array}
\end{array}
\qquad \text{or} \qquad
\begin{array}{cc}
 & P_B \\
 & \begin{array}{cc} L & R \end{array} \\
P_A \begin{array}{c} U \\ D \end{array} & \begin{array}{|c|c|} \hline \pi_{11}^A, \pi_{11}^B & \pi_{12}^A, \pi_{12}^B \\ \hline \pi_{21}^A, \pi_{21}^B & \pi_{22}^A, \pi_{22}^B \\ \hline \end{array}
\end{array}
$$

▶ Player A (P_A) can play Top or Bottom, while player B can play Left or
Right

▶ The first entry in each cell denotes player A's payoff if each player plays
the corresponding move, while the second entry represents B's payoff

---

[3] Note: this isn't the only way to represent a game

Normal Form Games

▶ If these (and some other, subtler principles) are satisfied, we may write down what's called a <u>Normal Form Game</u>[3]

$$
P_A \quad
\begin{array}{c}
 & & P_B \\
 & L & R \\
U & \boxed{a, b} & \boxed{c, d} \\
D & \boxed{e, f} & \boxed{g, h}
\end{array}
\quad \text{or} \quad
P_A \quad
\begin{array}{c}
 & & P_B \\
 & L & R \\
U & \boxed{\pi^A_{11}, \pi^B_{11}} & \boxed{\pi^A_{12}, \pi^B_{12}} \\
D & \boxed{\pi^A_{21}, \pi^B_{21}} & \boxed{\pi^A_{22}, \pi^B_{22}}
\end{array}
$$

▶ Player A (P_A) can play Top or Bottom, while player B can play Left or Right

▶ The first entry in each cell denotes player A's payoff if each player plays the corresponding move, while the second entry represents B's payoff

   • For instance, if A plays Top and B plays Left, then player A receives a (or π^A_{11}), while B receives b (or π^B_{11})

---

[3]Note: this isn't the only way to represent a game

Normal Form Games

▶ If these (and some other, subtler principles) are satisfied, we may write down what's called a <u>Normal Form Game</u>[3]

$$
\begin{array}{cc}
 & P_B \\
 & \begin{array}{c|c|c}
 & L & R \\
\hline
\end{array} \\
P_A \begin{array}{c} U \\ D \end{array} & \begin{array}{|c|c|}
\hline a, b & c, d \\
\hline e, f & g, h \\
\hline
\end{array}
\end{array}
\qquad \text{or} \qquad
\begin{array}{cc}
 & P_B \\
 & \begin{array}{c|c|c}
 & L & R \\
\hline
\end{array} \\
P_A \begin{array}{c} U \\ D \end{array} & \begin{array}{|c|c|}
\hline \pi_{11}^A, \pi_{11}^B & \pi_{12}^A, \pi_{12}^B \\
\hline \pi_{21}^A, \pi_{21}^B & \pi_{22}^A, \pi_{22}^B \\
\hline
\end{array}
\end{array}
$$

▶ Player A (P_A) can play Top or Bottom, while player B can play Left or Right

▶ The first entry in each cell denotes player A's payoff if each player plays the corresponding move, while the second entry represents B's payoff

• For instance, if A plays Top and B plays Left, then player A receives a (or π_{11}^A), while B receives b (or π_{11}^B)

▶ Players are trying to maximize their utility

---

[3]Note: this isn't the only way to represent a game

The Most Famous Game

▶ In game theory, the most popular (and probably mostly richly studied) is the prisoners dilemma

The Most Famous Game

- In game theory, the most popular (and probably mostly richly studied) is the prisoners dilemma
- Story: Ariana and Byron get caught trying to steal cars at a car wash

The Most Famous Game

▶ In game theory, the most popular (and probably mostly richly studied) is the prisoners dilemma

▶ Story: Ariana and Byron get caught trying to steal cars at a car wash

▶ Ariana and Byron both are being separately interrogated by the police

The Most Famous Game

► In game theory, the most popular (and probably mostly richly studied) is the prisoners dilemma

► Story: Ariana and Byron get caught trying to steal cars at a car wash

► Ariana and Byron both are being separately interrogated by the police

• If neither snitches, they both go to jail for 5 years, because the police can't prove anything

The Most Famous Game

▶ In game theory, the most popular (and probably mostly richly studied) is the prisoners dilemma

▶ Story: Ariana and Byron get caught trying to steal cars at a car wash

▶ Ariana and Byron both are being separately interrogated by the police

- If neither snitches, they both go to jail for 5 years, because the police can't prove anything
- If Araiana snitches on Byron, but Byron keeps quiet, then Ariana gets off scot-free, but Byron goes away for 20 years (and vice versa)

The Most Famous Game

▶ In game theory, the most popular (and probably mostly richly studied) is the prisoners dilemma

▶ Story: Ariana and Byron get caught trying to steal cars at a car wash

▶ Ariana and Byron both are being separately interrogated by the police

- If neither snitches, they both go to jail for 5 years, because the police can't prove anything
- If Araiana snitches on Byron, but Byron keeps quiet, then Ariana gets off scot-free, but Byron goes away for 20 years (and vice versa)
- If both players snitch, then both go away for 10 years

The Most Famous Game

- ▶ In game theory, the most popular (and probably mostly richly studied) is the prisoners dilemma

- ▶ Story: Ariana and Byron get caught trying to steal cars at a car wash

- ▶ Ariana and Byron both are being separately interrogated by the police
  - If neither snitches, they both go to jail for 5 years, because the police can't prove anything
  - If Araiana snitches on Byron, but Byron keeps quiet, then Ariana gets off scot-free, but Byron goes away for 20 years (and vice versa)
  - If both players snitch, then both go away for 10 years

- ▶ Here is the game in Normal Form:

$$
\begin{array}{c c}
 & B \\
 & \begin{array}{cc} Q & S \end{array}
\end{array}
$$

		Q	S
A	Q	$-5, -5$	$-20, 0$
	S	$0, -20$	$-10, -10$

Example Prisoner's Dilemma

▶ Again, here is the game we are considering:

$$B$$

		Q	S
A	Q	$-5, -5$	$-20, 0$
	S	$0, -20$	$-10, -10$

Example Prisoner's Dilemma

▶ Again, here is the game we are considering:

		B	
		Q	S
A	Q	$-5, -5$	$-20, 0$
	S	$0, -20$	$-10, -10$

▶ What do you think happens?

Example Prisoner's Dilemma

▶ Again, here is the game we are considering:

$$
\begin{array}{cc}
 & B \\
 & \begin{array}{cc}
Q & S
\end{array}
\end{array}
$$

		Q	S
A	Q	$-5, -5$	$-20, 0$
	S	$0, -20$	$-10, -10$

▶ What do you think happens?

- In theory and <u>very</u> often in practice, both players snitch

Example Prisoner's Dilemma

▶ Again, here is the game we are considering:

$$B$$

		Q	S
A	Q	$-5, -5$	$-20, 0$
	S	$0, -20$	$-10, -10$

▶ What do you think happens?

- In theory and <u>very</u> often in practice, both players snitch

▶ Okay, but how do talk about this economically?

Example Prisoner's Dilemma

▶ Again, here is the game we are considering:

$$
\begin{array}{c}
 & & B \\
 & & Q & S \\
A & Q & -5, -5 & -20, 0 \\
 & S & 0, -20 & -10, -10
\end{array}
$$

▶ What do you think happens?

- In theory and <u>very</u> often in practice, both players snitch

▶ Okay, but how do talk about this economically?

▶ Much like the 2/3 average game, we do so by iteratively thinking about what a *rational* person would do

EC 201
Connor Wiegand

Example Prisoner's Dilemma

► Again, here is the game we are considering:

$$B$$

		Q	S
A	Q	$-5, -5$	$-20, 0$
	S	$0, -20$	$-10, -10$

► What do you think happens?

- In theory and <u>very</u> often in practice, both players snitch

► Okay, but how do talk about this economically?

► Much like the 2/3 average game, we do so by iteratively thinking about what a *rational* person would do

- Much of game theory is about assuming the other player is rational, narrowing down their rational decisions, and then seeing what another player would do, given what is rational for the first player

Analyzing Prisoner's Dilemma

▶ Remember, the players cannot talk before or while the game

$$
\begin{array}{c c}
 & B \\
 & \begin{array}{c c}
 Q & S
 \end{array}
\end{array}
$$

		Q	S
A	Q	$-5, -5$	$-20, 0$
	S	$0, -20$	$-10, -10$

---

[4] They are only playing once. By "switch", I mean that we are thinking hypothetically. One might also say "she might instead play"

Analyzing Prisoner's Dilemma

▶ Remember, the players cannot talk before or while the game

$$B$$

		Q	S
A	Q	−5, −5	−20, 0
	S	0, −20	−10, −10

▶ Let's suppose we thought both players could keep quiet

---

[4] They are only playing once. By "switch", I mean that we are thinking hypothetically. One might also say "she might instead play"

Analyzing Prisoner's Dilemma

▶ Remember, the players cannot talk before or while the game

$$B$$

		Q	S
A	Q	−5, −5	−20, 0
	S	0, −20	−10, −10

▶ Let's suppose we thought both players could keep quiet

- Consider Ariana: she cannot control what Byron does, but she can control what she does

---

[4] They are only playing once. By "switch", I mean that we are thinking hypothetically. One might also say "she might instead play"

Analyzing Prisoner's Dilemma

▶ Remember, the players cannot talk before or while the game

$$
\begin{array}{c c}
 & B \\
 & \begin{array}{cc} Q & S \end{array}
\end{array}
$$

$$
A\ \begin{array}{c} Q \\ S \end{array}
\begin{array}{|c|c|}
\hline
-5,-5 & -20,0 \\
\hline
0,-20 & -10,-10 \\
\hline
\end{array}
$$

▶ Let's suppose we thought both players could keep quiet

- Consider Ariana: she cannot control what Byron does, but she can control what she does
- If she were to "switch" strategies[4], she would change her payoff from -5 to 0, an improvement

---

[4] They are only playing once. By "switch", I mean that we are thinking hypothetically. One might also say "she might instead play"

13/33

Analyzing Prisoner's Dilemma

▶ Remember, the players cannot talk before or while the game

$$B$$

		Q	S
A	Q	$-5, -5$	$-20, 0$
	S	$0, -20$	$-10, -10$

▶ Let's suppose we thought both players could keep quiet

- Consider Ariana: she cannot control what Byron does, but she can control what she does
- If she were to "switch" strategies[4], she would change her payoff from -5 to 0, an improvement

▶ So now let's consider (S, Q) (Ariana plays S, Byron plays Q)

---

[4] They are only playing once. By "switch", I mean that we are thinking hypothetically. One might also say "she might instead play"   13/33

Analyzing Prisoner's Dilemma

▶ Remember, the players cannot talk before or while the game

$$
\begin{array}{c c}
 & B \\
 & \begin{array}{c c}
Q & S
\end{array}
\end{array}
$$

		Q	S
A	Q	−5, −5	−20, 0
	S	0, −20	−10, −10

▶ Let's suppose we thought both players could keep quiet

- Consider Ariana: she cannot control what Byron does, but she can control what she does
- If she were to "switch" strategies[4], she would change her payoff from −5 to 0, an improvement

▶ So now let's consider (S, Q) (Ariana plays S, Byron plays Q)

- Ariana now does not want to deviate from this strategy, so let's consider Byron

---

[4] They are only playing once. By "switch", I mean that we are thinking hypothetically. One might also say "she might instead play"

Analyzing Prisoner's Dilemma

▶ Remember, the players cannot talk before or while the game

$$
\begin{array}{c c}
 & B \\
 & \begin{array}{c c}
 Q & S
\end{array}
\end{array}
$$

		Q	S
A	Q	−5, −5	−20, 0
	S	0, −20	−10, −10

▶ Let's suppose we thought both players could keep quiet

- Consider Ariana: she cannot control what Byron does, but she can control what she does
- If she were to "switch" strategies[4], she would change her payoff from −5 to 0, an improvement

▶ So now let's consider (S, Q) (Ariana plays S, Byron plays Q)

- Ariana now does not want to deviate from this strategy, so let's consider Byron
- Given that Byron is "currently" playing Q, switching to S will have a better payoff (-10 vs -20) for him

---

[4] They are only playing once. By "switch", I mean that we are thinking hypothetically. One might also say "she might instead play"

13/33

Intro to Game Theory
000000000

Analyzing Games
0000000

Other Games
00000000

Review
00000000

Analyzing Prisoner's Dilemma

▶ Remember, the players cannot talk before or while the game

$$
\begin{array}{cc}
 & B \\
 & \begin{array}{cc}
Q & S
\end{array}
\end{array}
$$

	Q	S
A Q	−5, −5	−20, 0
S	0, −20	−10, −10

▶ Let's suppose we thought both players could keep quiet

- Consider Ariana: she cannot control what Byron does, but she can control what she does
- If she were to "switch" strategies[4], she would change her payoff from −5 to 0, an improvement

▶ So now let's consider (S, Q) (Ariana plays S, Byron plays Q)

- Ariana now does not want to deviate from this strategy, so let's consider Byron
- Given that Byron is "currently" playing Q, switching to S will have a better payoff (-10 vs -20) for him
  - That is, given that he knows (...) that playing Q will mean Araiana plays S, he should play S

[4] They are only playing once. By "switch", I mean that we are thinking hypothetically. One might also say "she might instead play"

13/33

Analyzing Prisoner's Dilemma, (cont.)

▶ We could repeat that whole analysis starting with Byron instead of Ariana

$$B$$

		Q	S
A	Q	−5, −5	−20, 0
	S	0, −20	−10, −10

Analyzing Prisoner's Dilemma, (cont.)

▶ We could repeat that whole analysis starting with Byron instead of Ariana

$$
\begin{array}{c c}
& B \\
& \begin{array}{c c}
 & Q \qquad\qquad S
\end{array}
\end{array}
$$

		Q	S
A	Q	$-5, -5$	$-20, 0$
	S	$0, -20$	$-10, -10$

▶ Also note that starting at (Q, S) or (S, Q) resumes the above argument in the middle, and still leads us to (S, S)

Analyzing Prisoner's Dilemma, (cont.)

▶ We could repeat that whole analysis starting with Byron instead of Ariana

$$
\begin{array}{c}
 & & B \\
 & & Q & S \\
A & Q & \boxed{-5, -5 \quad | \quad -20, 0} \\
 & S & \boxed{0, -20 \quad | \quad -10, -10}
\end{array}
$$

▶ Also note that starting at (Q, S) or (S, Q) resumes the above argument in the middle, and still leads us to (S, S)

▶ What happens when we consider (S, S) as a possible outcome?

Analyzing Prisoner's Dilemma, (cont.)

▶ We could repeat that whole analysis starting with Byron instead of Ariana

$$B$$

		Q	S
A	Q	$-5, -5$	$-20, 0$
	S	$0, -20$	$-10, -10$

▶ Also note that starting at (Q, S) or (S, Q) resumes the above argument in the middle, and still leads us to (S, S)

▶ What happens when we consider (S, S) as a possible outcome?

  • Remember, players can't explicitly coordinate

Analyzing Prisoner's Dilemma, (cont.)

▶ We could repeat that whole analysis starting with Byron instead of Ariana

$$
\begin{array}{c c}
 & B \\
 & \begin{array}{c c}
 Q & S
\end{array}
\end{array}
$$

		Q	S
A	Q	−5, −5	−20, 0
	S	0, −20	−10, −10

▶ Also note that starting at (Q, S) or (S, Q) resumes the above argument in the middle, and still leads us to (S, S)

▶ What happens when we consider (S, S) as a possible outcome?

  • Remember, players can't explicitly coordinate
  • Does any of them have any incentive to individually deviate from this spot?

Analyzing Prisoner's Dilemma, (cont.)

▶ We could repeat that whole analysis starting with Byron instead of Ariana

$$
\begin{array}{c c}
 & B \\
 & \begin{array}{c c}
 Q & S
\end{array}
\end{array}
$$

		Q	S
A	Q	$-5, -5$	$-20, 0$
	S	$0, -20$	$-10, -10$

▶ Also note that starting at (Q, S) or (S, Q) resumes the above argument in the middle, and still leads us to (S, S)

▶ What happens when we consider (S, S) as a possible outcome?

- Remember, players can't explicitly coordinate
- Does any of them have any incentive to <u>individually</u> deviate from this spot?
  - *No.*

Analyzing Prisoner's Dilemma, (cont.)

▶ We could repeat that whole analysis starting with Byron instead of Ariana

$$B$$

		Q	S
A	Q	−5, −5	−20, 0
	S	0, −20	−10, −10

▶ Also note that starting at (Q, S) or (S, Q) resumes the above argument in the middle, and still leads us to (S, S)

▶ What happens when we consider (S, S) as a possible outcome?

  • Remember, players can't explicitly coordinate
  • Does any of them have any incentive to individually deviate from this spot?
    ◦ No.

▶ This last point is important to defining why (S, S) is something worth calling an "equilibrium", and summing up this whole argument

Analyzing Prisoner's Dilemma, (cont.)

▶ We could repeat that whole analysis starting with Byron instead of Ariana

$$B$$

		Q	S
A	Q	−5, −5	−20, 0
	S	0, −20	−10, −10

▶ Also note that starting at (Q, S) or (S, Q) resumes the above argument in the middle, and still leads us to (S, S)

▶ What happens when we consider (S, S) as a possible outcome?

  • Remember, players can't explicitly coordinate
  • Does any of them have any incentive to <u>individually</u> deviate from this spot?

    ○ *No.*

▶ This last point is important to defining why (S, S) is something worth calling an "equilibrium", and summing up this whole argument

▶ For the test, I want to be able to give you a prisoner's dilemma (with possibly varied notation), and show that you know that both players snitching is the solution

Nash Equilibrium (NE)

▶ In game theory, the thing we call a "solution" or "equilibrium" to a game
is called a _Nash Equilibrium_

Nash Equilibrium (NE)

▶ In game theory, the thing we call a "solution" or "equilibrium" to a game is called a *Nash Equilibrium*

▶ To define it formally, we need the notion of a *best response*

Nash Equilibrium (NE)

▶ In game theory, the thing we call a "solution" or "equilibrium" to a game is called a *Nash Equilibrium*

▶ To define it formally, we need the notion of a *best response*

▶ A **Best Response** is the strategy (or strategies) which produces the most favorable outcome for a player, taking other players' strategies as given

Nash Equilibrium (NE)

▶ In game theory, the thing we call a "solution" or "equilibrium" to a game is called a *Nash Equilibrium*

▶ To define it formally, we need the notion of a *best response*

▶ A **Best Response** is the strategy (or strategies) which produces the most favorable outcome for a player, taking other players' strategies as given

  • Symbolically, given other players' strategies S as given, my payoff of playing s is better than (or at least as good as) any other strategy s', given S:

$$\pi^i \left(s | S \right) \geq \pi^i \left(s' | S \right)$$

Nash Equilibrium (NE)

▶ In game theory, the thing we call a "solution" or "equilibrium" to a game is called a *Nash Equilibrium*

▶ To define it formally, we need the notion of a *best response*

▶ A **Best Response** is the strategy (or strategies) which produces the most favorable outcome for a player, taking other players' strategies as given

  • Symbolically, given other players' strategies S as given, my payoff of playing s is better than (or at least as good as) any other strategy s', given S:

$$\pi^i (s|S) \geq \pi^i (s'|S)$$

▶ Definition: A **Nash Equilibrium** is a set of mutually best responses

Nash Equilibrium (NE)

▶ In game theory, the thing we call a "solution" or "equilibrium" to a game is called a *Nash Equilibrium*

▶ To define it formally, we need the notion of a *best response*

▶ A **Best Response** is the strategy (or strategies) which produces the most favorable outcome for a player, taking other players' strategies as given

- Symbolically, given other players' strategies S as given, my payoff of playing s is better than (or at least as good as) any other strategy s', given S:

$$\pi^i \left(s | S \right) \geq \pi^i \left(s' | S \right)$$

▶ Definition: A **Nash Equilibrium** is a set of mutually best responses

- In short, a Nash Equilibrium is "a set of strategies such that no player has the incentive to unilaterally (individually) deviate from their chosen strategy"

Nash Equilibrium (NE)

▶ In game theory, the thing we call a "solution" or "equilibrium" to a game is called a *Nash Equilibrium*

▶ To define it formally, we need the notion of a *best response*

▶ A **Best Response** is the strategy (or strategies) which produces the most favorable outcome for a player, taking other players' strategies as given

- Symbolically, given other players' strategies S as given, my payoff of playing s is better than (or at least as good as) any other strategy s', given S:

$$\pi^i (s|S) \geq \pi^i (s'|S)$$

▶ Definition: A **Nash Equilibrium** is a set of mutually best responses

- In short, a Nash Equilibrium is "a set of strategies such that no player has the incentive to unilaterally (individually) deviate from their chosen strategy"
- For the test, I want you to know what a Nash Equilibirum is

How Do We Find Nash Equilibria?

▶ This just describes the algorithm that we did to find the NE of Prisoner's Dilemma:

How Do We Find Nash Equilibria?

▶ This just describes the algorithm that we did to find the NE of Prisoner's Dilemma:

1. Given a normal-form game, start at a cell

How Do We Find Nash Equilibria?

▶ This just describes the algorithm that we did to find the NE of Prisoner's Dilemma:
  1. Given a normal-form game, start at a cell
  2. For each player, underline the best response

How Do We Find Nash Equilibria?

▶ This just describes the algorithm that we did to find the NE of Prisoner's Dilemma:

1. Given a normal-form game, start at a cell
2. For each player, underline the best response
3. Move to the next cell

Intro to Game Theory
000000000

Analyzing Games
0000000●0

Other Games
00000000

Review
00000000

How Do We Find Nash Equilibria?

▶ This just describes the algorithm that we did to find the NE of Prisoner's Dilemma:
  1. Given a normal-form game, start at a cell
  2. For each player, underline the best response
  3. Move to the next cell
  4. Repeat until done

How Do We Find Nash Equilibria?

► This just describes the algorithm that we did to find the NE of Prisoner's Dilemma:

1. Given a normal-form game, start at a cell
2. For each player, underline the best response
3. Move to the next cell
4. Repeat until done

► Here it is with PD:

$$B$$

		Q	S
A	Q	$-5, -5$	$-20, 0$
	S	$0, -20$	$-10, -10$

How Do We Find Nash Equilibria?

▶ This just describes the algorithm that we did to find the NE of Prisoner's Dilemma:

    1. Given a normal-form game, start at a cell
    2. For each player, underline the best response
    3. Move to the next cell
    4. Repeat until done

▶ Here it is with PD:

$$
\begin{array}{cc}
 & B \\
 & \begin{array}{cc} Q & S \end{array} \\
A \begin{array}{c} Q \\ S \end{array} &
\begin{array}{|c|c|}
\hline
-5, -5 & -20, \underline{0} \\
\hline
\underline{0}, -20 & -\underline{10}, -\underline{10} \\
\hline
\end{array}
\end{array}
$$

A Bigger Prisoner's Dilemma

▶ Recognize the following? It's just a prisoner's dilemma

Air To A Fortune, Mario Party Franchise

Chicken

▶ Yes, that chicken: car who can stay or dodge, driving at a person who can stay or dodge

Pedestrian

		D	S
Car	D	$-25, -25$	$-10, 40$
	S	$20, -5$	$-100, -\infty$

Chicken

▶ Yes, that chicken: car who can stay or dodge, driving at a person who can stay or dodge

Pedestrian

		D	S
Car	D	$-25, -25$	$-10, 40$
	S	$20, -5$	$-100, -\infty$

▶ We see two NE here: (S, D) and (D, S)

Chicken

▶ Yes, that chicken: car who can stay or dodge, driving at a person who can stay or dodge

Pedestrian

		D	S
Car	D	$-25, -25$	$-10, 40$
	S	$20, -5$	$-100, -\infty$

▶ We see two NE here: (S, D) and (D, S)

• Either player wants to individually deviate from (D, D), likewise with (S, S)

Chicken

▶ Yes, that chicken: car who can stay or dodge, driving at a person who can stay or dodge

Pedestrian

		D	S
Car	D	$-25, -25$	$-10, 40$
	S	$20, -5$	$-100, -\infty$

▶ We see two NE here: (S, D) and (D, S)

- Either player wants to individually deviate from (D, D), likewise with (S, S)

▶ Some questions to think about:

Chicken

▶ Yes, that chicken: car who can stay or dodge, driving at a person who can stay or dodge

Pedestrian

		D	S
Car	D	$-25, -25$	$-10, 40$
	S	$20, -5$	$-100, -\infty$

▶ We see two NE here: (S, D) and (D, S)

   • Either player wants to individually deviate from (D, D), likewise with (S, S)

▶ Some questions to think about:

   • How do we determine which is better?

Chicken

▶ Yes, that chicken: car who can stay or dodge, driving at a person who can stay or dodge

Pedestrian

		D	S
Car	D	$-25, -25$	$-10, 40$
	S	$20, -5$	$-100, -\infty$

▶ We see two NE here: (S, D) and (D, S)

- Either player wants to individually deviate from (D, D), likewise with (S, S)

▶ Some questions to think about:

- How do we determine which is better?
- Do we think one will happen more often than the other?

Chicken

▶ Yes, that chicken: car who can stay or dodge, driving at a person who can stay or dodge

Pedestrian

		D	S
Car	D	$-25, -25$	$-10, 40$
	S	$20, -5$	$-100, -\infty$

▶ We see two NE here: (S, D) and (D, S)

  • Either player wants to individually deviate from (D, D), likewise with (S, S)

▶ Some questions to think about:

  • How do we determine which is better?
  • Do we think one will happen more often than the other?
  • What happens if the car randomly plays S half the time, and the pedestrian randomly plays S one third of the time? What happens if we play with these probabilities?

BoS

▶ I want to go to the Bread Bank for dinner, but my girlfriend wants to eat at the Krusty Krab.

BoS

- ▶ I want to go to the Bread Bank for dinner, but my girlfriend wants to eat at the Krusty Krab.
- ▶ Our phones died, so we just have to go to the restaurant individually and hope the other person is there

BoS

▶ I want to go to the Bread Bank for dinner, but my girlfriend wants to eat at the Krusty Krab.

▶ Our phones died, so we just have to go to the restaurant individually and hope the other person is there

▶ We both value getting the food we want, as well as eating with the other person:

<table>
<tr><td></td><td></td><td colspan="2">Gf</td></tr>
<tr><td></td><td></td><td>KK</td><td>BB</td></tr>
<tr><td rowspan="2">Me</td><td>KK</td><td>1, 2</td><td>0, 0</td></tr>
<tr><td>BB</td><td>0, 0</td><td>2, 1</td></tr>
</table>

BoS

▶ I want to go to the Bread Bank for dinner, but my girlfriend wants to eat at the Krusty Krab.

▶ Our phones died, so we just have to go to the restaurant individually and hope the other person is there

▶ We both value getting the food we want, as well as eating with the other person:

$$
\begin{array}{c c}
 & \text{Gf} \\
 & \begin{array}{c c}
 \text{KK} & \text{BB}
 \end{array} \\
\text{Me} \begin{array}{c}
\text{KK} \\
\text{BB}
\end{array} &
\begin{array}{|c|c|}
\hline
1,2 & 0,0 \\
\hline
0,0 & 2,1 \\
\hline
\end{array}
\end{array}
$$

▶ Again, we see two NE here, where we are both eating at the same restaurant

Intro to Game Theory
000000000

Analyzing Games
0000000

Other Games
0●000000

Review
00000000

BoS

- ▶ I want to go to the Bread Bank for dinner, but my girlfriend wants to eat at the Krusty Krab.
- ▶ Our phones died, so we just have to go to the restaurant individually and hope the other person is there
- ▶ We both value getting the food we want, as well as eating with the other person:

$$
\begin{array}{c c}
& \text{Gf} \\
& \begin{array}{cc}
\text{KK} & \text{BB}
\end{array} \\
\text{Me} \begin{array}{c} \text{KK} \\ \text{BB} \end{array} &
\begin{array}{|c|c|}
\hline
1,2 & 0,0 \\
\hline
0,0 & 2,1 \\
\hline
\end{array}
\end{array}
$$

- ▶ Again, we see two NE here, where we are both eating at the same restaurant
- ▶ What happens if each person plays KK with probability 2/3?

BoS

▶ I want to go to the Bread Bank for dinner, but my girlfriend wants to eat at the Krusty Krab.

▶ Our phones died, so we just have to go to the restaurant individually and hope the other person is there

▶ We both value getting the food we want, as well as eating with the other person:

$$
\begin{array}{c}
& \text{Gf} \\
& \begin{array}{cc} \text{KK} & \text{BB} \end{array} \\
\text{Me} \begin{array}{c} \text{KK} \\ \text{BB} \end{array} &
\begin{array}{|c|c|}
\hline
1,2 & 0,0 \\
\hline
0,0 & 2,1 \\
\hline
\end{array}
\end{array}
$$

▶ Again, we see two NE here, where we are both eating at the same restaurant

▶ What happens if each person plays KK with probability 2/3?

▶ Suppose I have the option that morning to burn a dollar in front of my girlfriend, changing my payoffs by a dollar if I did. How would this change the outcome of the game?

19/33

Matching Pennies

- If the pennies match, I keep them. If not, you keep them:

		You	
		H	T
Me	H	$1, -1$	$-1, 1$
	T	$-1, 1$	$1, -1$

Matching Pennies

▶ If the pennies match, I keep them. If not, you keep them:

You

	H	T
Me H	$1, -1$	$-1, 1$
T	$-1, 1$	$1, -1$

▶ This game has no NE that we can see

Matching Pennies

▶ If the pennies match, I keep them. If not, you keep them:

You

		H	T
Me	H	$1, -1$	$-1, 1$
	T	$-1, 1$	$1, -1$

▶ This game has no NE that we can see

▶ The only solution is to randomize

Matching Pennies

▶ If the pennies match, I keep them. If not, you keep them:

$$
\begin{array}{c}
 & & \text{You} \\
 & & \text{H} \qquad \text{T} \\
\text{Me} \begin{array}{c} \text{H} \\ \text{T} \end{array} &
\begin{array}{|c|c|}
\hline
1, -1 & -1, 1 \\
\hline
-1, 1 & 1, -1 \\
\hline
\end{array}
\end{array}
$$

▶ This game has no NE that we can see
▶ The only solution is to randomize
  • Fact: Every game with finite players and finite strategies has a solution

Pascal's Wager

▶ Pascal: don't use this to believe in God, but if you are truly on the fence completely, here is a nifty argument:

<div align="center">

		Nature	
		God Exists	God DNE
You	Believe in God	∞, —	finite loss, —
	Don't Believe in God	$-\infty$, —	finite win, —

</div>

Pascal's Wager

▶ Pascal: don't use this to believe in God, but if you are truly on the fence completely, here is a nifty argument:

		Nature	
		God Exists	God DNE
You	Believe in God	∞, —	finite loss, —
	Don't Believe in God	−∞, —	finite win, —

▶ Solution: believe in God

Pascal's Wager

▶ Pascal: don't use this to believe in God, but if you are truly on the fence completely, here is a nifty argument:

<table>
<tr><td></td><td></td><td colspan="2" align="center"><u>Nature</u></td></tr>
<tr><td></td><td></td><td align="center">God Exists</td><td align="center">God DNE</td></tr>
<tr><td rowspan="2">You</td><td align="right">Believe in God</td><td align="center">∞, —</td><td align="center">finite loss, —</td></tr>
<tr><td align="right">Don't Believe in God</td><td align="center">−∞, —</td><td align="center">finite win, —</td></tr>
</table>

▶ Solution: believe in God

  • Once again, even Pascal was not a huge fan of this as an argument

Pascal's Wager

▶ Pascal: don't use this to believe in God, but if you are truly on the fence completely, here is a nifty argument:

		Nature	
		God Exists	God DNE
You	Believe in God	∞, —	finite loss, —
	Don't Believe in God	$-\infty$, —	finite win, —

▶ Solution: believe in God

  • Once again, even Pascal was not a huge fan of this as an argument

▶ This isn't really a game, it's more of a decision

Pascal's Wager

▶ Pascal: don't use this to believe in God, but if you are truly on the fence completely, here is a nifty argument:

		Nature	
		God Exists	God DNE
You	Believe in God	∞, —	finite loss, —
	Don't Believe in God	$-\infty$, —	finite win, —

▶ Solution: believe in God

- Once again, even Pascal was not a huge fan of this as an argument

▶ This isn't really a game, it's more of a decision

- Hopefully you can see that decisions can still be structured as games, they can still be interesting, but they lose their quintessential interactive flavor

Repeated Games

▶ What happens if you play games more than once?

Repeated Games

▶ What happens if you play games more than once?

  • Let's suppose that we know we will play PD infinitely many times

Repeated Games

▶ What happens if you play games more than once?

- Let's suppose that we know we will play PD infinitely many times
- Idea [Grim Trigger]: Start by cooperating; if you snitch once, I will play snitch every game thereafter for the rest of time

Repeated Games

▶ What happens if you play games more than once?

- Let's suppose that we know we will play PD infinitely many times
- Idea [Grim Trigger]: Start by cooperating; if you snitch once, I will play snitch every game thereafter for the rest of time
- Result: It's enough to incentivize cooperation forever

Repeated Games

▶ What happens if you play games more than once?

- Let's suppose that we know we will play PD infinitely many times
- Idea [Grim Trigger]: Start by cooperating; if you snitch once, I will play snitch every game thereafter for the rest of time
- Result: It's enough to incentivize cooperation forever
- Idea [Tit-for-Tat]: Copy your previous move

Repeated Games

▶ What happens if you play games more than once?

- Let's suppose that we know we will play PD infinitely many times
- Idea [Grim Trigger]: Start by cooperating; if you snitch once, I will play snitch every game thereafter for the rest of time
- Result: It's enough to incentivize cooperation forever
- Idea [Tit-for-Tat]: Copy your previous move
- Result: We will often either cooperate forever or swap forever

Repeated Games

▶ What happens if you play games more than once?

- Let's suppose that we know we will play PD infinitely many times
- Idea [Grim Trigger]: Start by cooperating; if you snitch once, I will play snitch every game thereafter for the rest of time
- Result: It's enough to incentivize cooperation forever
- Idea [Tit-for-Tat]: Copy your previous move
- Result: We will often either cooperate forever or swap forever
- There are variations of each of these

Repeated Games

▶ What happens if you play games more than once?

  • Let's suppose that we know we will play PD infinitely many times
  • Idea [Grim Trigger]: Start by cooperating; if you snitch once, I will play snitch every game thereafter for the rest of time
  • Result: It's enough to incentivize cooperation forever
  • Idea [Tit-for-Tat]: Copy your previous move
  • Result: We will often either cooperate forever or swap forever
  • There are variations of each of these

▶ Can we commit to these things?

Repeated Games

▶ What happens if you play games more than once?

- Let's suppose that we know we will play PD infinitely many times
- Idea [Grim Trigger]: Start by cooperating; if you snitch once, I will play snitch every game thereafter for the rest of time
- Result: It's enough to incentivize cooperation forever
- Idea [Tit-for-Tat]: Copy your previous move
- Result: We will often either cooperate forever or swap forever
- There are variations of each of these

▶ Can we commit to these things?

- What happens when you actually get down to having to punish the other player by snitching?

Repeated Games

▶ What happens if you play games more than once?

- Let's suppose that we know we will play PD infinitely many times
- Idea [Grim Trigger]: Start by cooperating; if you snitch once, I will play snitch every game thereafter for the rest of time
- Result: It's enough to incentivize cooperation forever
- Idea [Tit-for-Tat]: Copy your previous move
- Result: We will often either cooperate forever or swap forever
- There are variations of each of these

▶ Can we commit to these things?

- What happens when you actually get down to having to punish the other player by snitching?
- What happens if you up-talk yourself before chicken?

Repeated Games

▶ What happens if you play games more than once?

- Let's suppose that we know we will play PD infinitely many times
- Idea [Grim Trigger]: Start by cooperating; if you snitch once, I will play snitch every game thereafter for the rest of time
- Result: It's enough to incentivize cooperation forever
- Idea [Tit-for-Tat]: Copy your previous move
- Result: We will often either cooperate forever or swap forever
- There are variations of each of these

▶ Can we commit to these things?

- What happens when you actually get down to having to punish the other player by snitching?
- What happens if you up-talk yourself before chicken?
- What happens if the other prisoner knows you will shoot them when you get out?

Threats

▶ A threat may allow you to take a strategic move. But is it credible?

---

[5] And should you really be threatening that?

Threats

▶ A threat may allow you to take a strategic move. But is it credible?

▶ You can say you absolutely won't dodge in chicken, but is it believable? Will you really die when it comes down to it?

---

[5]And should you really be threatening that?

Threats

▶ A threat may allow you to take a strategic move. But is it credible?

▶ You can say you absolutely won't dodge in chicken, but is it believable? Will you really die when it comes down to it?

▶ When analyzing games that have many steps, we often start from the end, and ask if people can make threats, and if those threats are credible enough to be taken seriously

---

[5] And should you really be threatening that?

Threats

► A threat may allow you to take a strategic move. But is it credible?

► You can say you absolutely won't dodge in chicken, but is it believable? Will you really die when it comes down to it?

► When analyzing games that have many steps, we often start from the end, and ask if people can make threats, and if those threats are credible enough to be taken seriously

  • A credible threat is one that is costly, but not costly enough that you won't do it

---

[5] And should you really be threatening that?

Threats

- ▶ A threat may allow you to take a strategic move. But is it credible?

- ▶ You can say you absolutely won't dodge in chicken, but is it believable? Will you really die when it comes down to it?

- ▶ When analyzing games that have many steps, we often start from the end, and ask if people can make threats, and if those threats are credible enough to be taken seriously

  - A credible threat is one that is costly, but not costly enough that you won't do it

- ▶ JFK can threaten nuclear war in order to get missiles out of Cuba, but is that threat believable?[5]

---

[5]And should you really be threatening that?

Tying Oneself to the Mast

▶ An interesting part of game theory is that restricting your choices can actually *improve* your outcomes

Tying Oneself to the Mast

▶ An interesting part of game theory is that restricting your choices can actually *improve* your outcomes

- Ex: consider the game of chicken again. Suppose that I visibly step in a layer of quick dry cement. What will happen?

Pedestrian

		D	S
Car	D	$-25, -25$	$-10, 40$
	S	$20, -5$	$-100, -\infty$

Tying Oneself to the Mast

▶ An interesting part of game theory is that restricting your choices can actually *improve* your outcomes

- Ex: consider the game of chicken again. Suppose that I visibly step in a layer of quick dry cement. What will happen?

Pedestrian

		D	S
Car	D	$-25, -25$	$-10, 40$
	S	$20, -5$	$-100, -\infty$

- The driver will see that I cannot play D, so they are forced to choose between killing me and dodging, they will dodge

Tying Oneself to the Mast

▶ An interesting part of game theory is that restricting your choices can actually *improve* your outcomes

- Ex: consider the game of chicken again. Suppose that I visibly step in a layer of quick dry cement. What will happen?

Pedestrian

		D	S
Car	D	$-25, -25$	$-10, 40$
	S	$20, -5$	$-100, -\infty$

- The driver will see that I cannot play D, so they are forced to choose between killing me and dodging, they will dodge

▶ Ulysses/Odysseus: tie me to the mast (and you all put wax in your ears), so that I can hear the song of the Sirens without jumping into the sea

Tying Oneself to the Mast

▶ An interesting part of game theory is that restricting your choices can actually *improve* your outcomes

- Ex: consider the game of chicken again. Suppose that I visibly step in a layer of quick dry cement. What will happen?

  Pedestrian

		D	S
Car	D	$-25, -25$	$-10, 40$
	S	$20, -5$	$-100, -\infty$

- The driver will see that I cannot play D, so they are forced to choose between killing me and dodging, they will dodge

▶ Ulysses/Odysseus: tie me to the mast (and you all put wax in your ears), so that I can hear the song of the Sirens without jumping into the sea

▶ You may have done this when you *asked* your mom to say no to your friend staying the night

Summary

▶ Game theory is a whole discipline. It is hard to get through it all in one undergrad class, let alone a lecture. Hopefully I provided some thought-provoking intuition

Summary

- ▶ Game theory is a whole discipline. It is hard to get through it all in one undergrad class, let alone a lecture. Hopefully I provided some thought-provoking intuition
- ▶ To summarize:

Summary

▶ Game theory is a whole discipline. It is hard to get through it all in one undergrad class, let alone a lecture. Hopefully I provided some thought-provoking intuition

▶ To summarize:

- A game consists of (i) players, (ii) strategies/actions/moves, and (iii) payoffs

Summary

▶ Game theory is a whole discipline. It is hard to get through it all in one undergrad class, let alone a lecture. Hopefully I provided some thought-provoking intuition

▶ To summarize:
  • A game consists of (i) players, (ii) strategies/actions/moves, and (iii) payoffs
  • Much of game theory is about assuming the other player is rational, narrowing down their rational decisions, and then seeing what another player would do, given what is rational for the first player

Summary

▶ Game theory is a whole discipline. It is hard to get through it all in one undergrad class, let alone a lecture. Hopefully I provided some thought-provoking intuition

▶ To summarize:

- A game consists of (i) players, (ii) strategies/actions/moves, and (iii) payoffs
- Much of game theory is about assuming the other player is rational, narrowing down their rational decisions, and then seeing what another player would do, given what is rational for the first player
- You can't do everything you want with game theory, but it is still very powerful

Summary

▶ Game theory is a whole discipline. It is hard to get through it all in one undergrad class, let alone a lecture. Hopefully I provided some thought-provoking intuition

▶ To summarize:

- A game consists of (i) players, (ii) strategies/actions/moves, and (iii) payoffs
- Much of game theory is about assuming the other player is rational, narrowing down their rational decisions, and then seeing what another player would do, given what is rational for the first player
- You can't do everything you want with game theory, but it is still very powerful
- A Nash Equilibrium is a set of mutual best responses, where no player will unilaterally deviate

Summary

- ▶ Game theory is a whole discipline. It is hard to get through it all in one undergrad class, let alone a lecture. Hopefully I provided some thought-provoking intuition
- ▶ To summarize:
  - A game consists of (i) players, (ii) strategies/actions/moves, and (iii) payoffs
  - Much of game theory is about assuming the other player is rational, narrowing down their rational decisions, and then seeing what another player would do, given what is rational for the first player
  - You can't do everything you want with game theory, but it is still very powerful
  - A Nash Equilibrium is a set of mutual best responses, where no player will unilaterally deviate
  - In a Prisoner's dilemma, both players will snitch in equilibrium

▶

Basic Overview of Topics (Pre-Midterm)

▶ The following list is a brief overview, and is by no means extensive

Basic Overview of Topics (Pre-Midterm)

▶ The following list is a brief overview, and is by no means extensive

▶ PPF and OC (ch 1-3)

Basic Overview of Topics (Pre-Midterm)

▶ The following list is a brief overview, and is by no means extensive
▶ PPF and OC (ch 1-3)
  • Draw a PPF given production table, understand it's regions

Basic Overview of Topics (Pre-Midterm)

▶ The following list is a brief overview, and is by no means extensive

▶ PPF and OC (ch 1-3)

- Draw a PPF given production table, understand it's regions
- Shifting a PPF

Basic Overview of Topics (Pre-Midterm)

▶ The following list is a brief overview, and is by no means extensive

▶ PPF and OC (ch 1-3)

- Draw a PPF given production table, understand it's regions
- Shifting a PPF
- Compute OC from production table

Basic Overview of Topics (Pre-Midterm)

▶ The following list is a brief overview, and is by no means extensive

▶ PPF and OC (ch 1-3)

- Draw a PPF given production table, understand it's regions
- Shifting a PPF
- Compute OC from production table
- Combine two PPFs from trade

Basic Overview of Topics (Pre-Midterm)

▶ The following list is a brief overview, and is by no means extensive

▶ PPF and OC (ch 1-3)

  • Draw a PPF given production table, understand it's regions
  • Shifting a PPF
  • Compute OC from production table
  • Combine two PPFs from trade

▶ Demand (/Supply) Curve (ch 4)

Basic Overview of Topics (Pre-Midterm)

▶ The following list is a brief overview, and is by no means extensive

▶ PPF and OC (ch 1-3)

- Draw a PPF given production table, understand it's regions
- Shifting a PPF
- Compute OC from production table
- Combine two PPFs from trade

▶ Demand (/Supply) Curve (ch 4)

- How to draw one from data

Basic Overview of Topics (Pre-Midterm)

▶ The following list is a brief overview, and is by no means extensive

▶ PPF and OC (ch 1-3)

  • Draw a PPF given production table, understand it's regions
  • Shifting a PPF
  • Compute OC from production table
  • Combine two PPFs from trade

▶ Demand (/Supply) Curve (ch 4)

  • How to draw one from data
  • Individual curves → market curve

Basic Overview of Topics (Pre-Midterm)

▶ The following list is a brief overview, and is by no means extensive

▶ PPF and OC (ch 1-3)

- Draw a PPF given production table, understand it's regions
- Shifting a PPF
- Compute OC from production table
- Combine two PPFs from trade

▶ Demand (/Supply) Curve (ch 4)

- How to draw one from data
- Individual curves → market curve
- What causes movement along, what shifts

Basic Overview of Topics (Pre-Midterm)

▶ The following list is a brief overview, and is by no means extensive

▶ PPF and OC (ch 1-3)

- Draw a PPF given production table, understand it's regions
- Shifting a PPF
- Compute OC from production table
- Combine two PPFs from trade

▶ Demand (/Supply) Curve (ch 4)

- How to draw one from data
- Individual curves → market curve
- What causes movement along, what shifts
- Law of demand (supply)

Basic Overview of Topics (Pre-Midterm)

▶ The following list is a brief overview, and is by no means extensive

▶ PPF and OC (ch 1-3)

- Draw a PPF given production table, understand it's regions
- Shifting a PPF
- Compute OC from production table
- Combine two PPFs from trade

▶ Demand (/Supply) Curve (ch 4)

- How to draw one from data
- Individual curves $\rightarrow$ market curve
- What causes movement along, what shifts
- Law of demand (supply)
- Graphing with equations

Basic Overview of Topics (Pre-Midterm)

▶ The following list is a brief overview, and is by no means extensive

▶ PPF and OC (ch 1-3)

- Draw a PPF given production table, understand it's regions
- Shifting a PPF
- Compute OC from production table
- Combine two PPFs from trade

▶ Demand (/Supply) Curve (ch 4)

- How to draw one from data
- Individual curves $\rightarrow$ market curve
- What causes movement along, what shifts
- Law of demand (supply)
- Graphing with equations

▶ Equilibrium (ch 4)

Basic Overview of Topics (Pre-Midterm)

▶ The following list is a brief overview, and is by no means extensive

▶ PPF and OC (ch 1-3)

- Draw a PPF given production table, understand it's regions
- Shifting a PPF
- Compute OC from production table
- Combine two PPFs from trade

▶ Demand (/Supply) Curve (ch 4)

- How to draw one from data
- Individual curves → market curve
- What causes movement along, what shifts
- Law of demand (supply)
- Graphing with equations

▶ Equilibrium (ch 4)

- Identifying, intuition behind markets

Basic Overview of Topics (Pre-Midterm)

▶ The following list is a brief overview, and is by no means extensive

▶ PPF and OC (ch 1-3)

- Draw a PPF given production table, understand it's regions
- Shifting a PPF
- Compute OC from production table
- Combine two PPFs from trade

▶ Demand (/Supply) Curve (ch 4)

- How to draw one from data
- Individual curves → market curve
- What causes movement along, what shifts
- Law of demand (supply)
- Graphing with equations

▶ Equilibrium (ch 4)

- Identifying, intuition behind markets
- Shifting both supply and demand, and seeing the impact on equilibrium P and Q

Basic Overview of Topics (Pre-Midterm)

▶ The following list is a brief overview, and is by no means extensive

▶ PPF and OC (ch 1-3)

- Draw a PPF given production table, understand it's regions
- Shifting a PPF
- Compute OC from production table
- Combine two PPFs from trade

▶ Demand (/Supply) Curve (ch 4)

- How to draw one from data
- Individual curves → market curve
- What causes movement along, what shifts
- Law of demand (supply)
- Graphing with equations

▶ Equilibrium (ch 4)

- Identifying, intuition behind markets
- Shifting both supply and demand, and seeing the impact on equilibrium P and Q
- Graphing

Basic Overview of Topics (Pre-Midterm)

- ▶ Elasticity (ch 5)

Basic Overview of Topics (Pre-Midterm)

▶ Elasticity (ch 5)

  • PED, Income elasticity of demand, CPED, Price elasticity of supply

Basic Overview of Topics (Pre-Midterm)

▶ Elasticity (ch 5)

- PED, Income elasticity of demand, CPED, Price elasticity of supply
- How to compute given data/points on graph

Basic Overview of Topics (Pre-Midterm)

▶ Elasticity (ch 5)

- PED, Income elasticity of demand, CPED, Price elasticity of supply
- How to compute given data/points on graph
- **How to interpret**

Basic Overview of Topics (Pre-Midterm)

▶ Elasticity (ch 5)

  • PED, Income elasticity of demand, CPED, Price elasticity of supply
  • How to compute given data/points on graph
  • **How to interpret**
  • Steep curve usually implies relatively inelastic

Basic Overview of Topics (Pre-Midterm)

▶ Elasticity (ch 5)

- PED, Income elasticity of demand, CPED, Price elasticity of supply
- How to compute given data/points on graph
- **How to interpret**
- Steep curve usually implies relatively inelastic
- Can vary along linear demand curve

28/33

Basic Overview of Topics (Pre-Midterm)

▶ Elasticity (ch 5)

- PED, Income elasticity of demand, CPED, Price elasticity of supply
- How to compute given data/points on graph
- **How to interpret**
- Steep curve usually implies relatively inelastic
- Can vary along linear demand curve
- Ceteris Paribus

Basic Overview of Topics (Pre-Midterm)

- ▶ Elasticity (ch 5)
  - PED, Income elasticity of demand, CPED, Price elasticity of supply
  - How to compute given data/points on graph
  - **How to interpret**
  - Steep curve usually implies relatively inelastic
  - Can vary along linear demand curve
  - Ceteris Paribus
- ▶ CS/PS (ch 7)

Basic Overview of Topics (Pre-Midterm)

- ▶ Elasticity (ch 5)
    - PED, Income elasticity of demand, CPED, Price elasticity of supply
    - How to compute given data/points on graph
    - **How to interpret**
    - Steep curve usually implies relatively inelastic
    - Can vary along linear demand curve
    - Ceteris Paribus
- ▶ CS/PS (ch 7)
    - Identification

Basic Overview of Topics (Pre-Midterm)

▶ Elasticity (ch 5)

- PED, Income elasticity of demand, CPED, Price elasticity of supply
- How to compute given data/points on graph
- **How to interpret**
- Steep curve usually implies relatively inelastic
- Can vary along linear demand curve
- Ceteris Paribus

▶ CS/PS (ch 7)

- Identification
- Interpretation

28/33

Basic Overview of Topics (Pre-Midterm)

▶ Elasticity (ch 5)

- PED, Income elasticity of demand, CPED, Price elasticity of supply
- How to compute given data/points on graph
- **How to interpret**
- Steep curve usually implies relatively inelastic
- Can vary along linear demand curve
- Ceteris Paribus

▶ CS/PS (ch 7)

- Identification
- Interpretation
- How to calculate it

Basic Overview of Topics (Pre-Midterm)

▶ Elasticity (ch 5)

- PED, Income elasticity of demand, CPED, Price elasticity of supply
- How to compute given data/points on graph
- **How to interpret**
- Steep curve usually implies relatively inelastic
- Can vary along linear demand curve
- Ceteris Paribus

▶ CS/PS (ch 7)

- Identification
- Interpretation
- How to calculate it
- How they are influenced by relative elasticity

Basic Overview of Topics (Pre-Midterm)

▶ Elasticity (ch 5)

- PED, Income elasticity of demand, CPED, Price elasticity of supply
- How to compute given data/points on graph
- **How to interpret**
- Steep curve usually implies relatively inelastic
- Can vary along linear demand curve
- Ceteris Paribus

▶ CS/PS (ch 7)

- Identification
- Interpretation
- How to calculate it
- How they are influenced by relative elasticity
- TWTP and MWTP tables, diminishing marginal returns

Basic Overview of Topics (Pre-Midterm)

▶ Elasticity (ch 5)

- PED, Income elasticity of demand, CPED, Price elasticity of supply
- How to compute given data/points on graph
- **How to interpret**
- Steep curve usually implies relatively inelastic
- Can vary along linear demand curve
- Ceteris Paribus

▶ CS/PS (ch 7)

- Identification
- Interpretation
- How to calculate it
- How they are influenced by relative elasticity
- TWTP and MWTP tables, diminishing marginal returns

▶ Price Ceilings/Floors (ch 6.1, 7)

Basic Overview of Topics (Pre-Midterm)

▶ Elasticity (ch 5)

- PED, Income elasticity of demand, CPED, Price elasticity of supply
- How to compute given data/points on graph
- **How to interpret**
- Steep curve usually implies relatively inelastic
- Can vary along linear demand curve
- Ceteris Paribus

▶ CS/PS (ch 7)

- Identification
- Interpretation
- How to calculate it
- How they are influenced by relative elasticity
- TWTP and MWTP tables, diminishing marginal returns

▶ Price Ceilings/Floors (ch 6.1, 7)

- Identification, including effective/ineffective

Basic Overview of Topics (Pre-Midterm)

▶ Elasticity (ch 5)

- PED, Income elasticity of demand, CPED, Price elasticity of supply
- How to compute given data/points on graph
- **How to interpret**
- Steep curve usually implies relatively inelastic
- Can vary along linear demand curve
- Ceteris Paribus

▶ CS/PS (ch 7)

- Identification
- Interpretation
- How to calculate it
- How they are influenced by relative elasticity
- TWTP and MWTP tables, diminishing marginal returns

▶ Price Ceilings/Floors (ch 6.1, 7)

- Identification, including effective/ineffective
- Effect on market, including new price, Q_D, Q_s, and quantity traded

Basic Overview of Topics (Pre-Midterm)

▶ Elasticity (ch 5)

- PED, Income elasticity of demand, CPED, Price elasticity of supply
- How to compute given data/points on graph
- **How to interpret**
- Steep curve usually implies relatively inelastic
- Can vary along linear demand curve
- Ceteris Paribus

▶ CS/PS (ch 7)

- Identification
- Interpretation
- How to calculate it
- How they are influenced by relative elasticity
- TWTP and MWTP tables, diminishing marginal returns

▶ Price Ceilings/Floors (ch 6.1, 7)

- Identification, including effective/ineffective
- Effect on market, including new price, Q_D, Q_s, and quantity traded
- Shortages and surpluses, including how to calculate them

Basic Overview of Topics (Pre-Midterm)

▶ Elasticity (ch 5)

- PED, Income elasticity of demand, CPED, Price elasticity of supply
- How to compute given data/points on graph
- **How to interpret**
- Steep curve usually implies relatively inelastic
- Can vary along linear demand curve
- Ceteris Paribus

▶ CS/PS (ch 7)

- Identification
- Interpretation
- How to calculate it
- How they are influenced by relative elasticity
- TWTP and MWTP tables, diminishing marginal returns

▶ Price Ceilings/Floors (ch 6.1, 7)

- Identification, including effective/ineffective
- Effect on market, including new price, Q_D, Q_s, and quantity traded
- Shortages and surpluses, including how to calculate them
- Effect on market

Basic Overview of Topics (Post-Midterm)

▶ Taxes/subsidies (ch 6.2, 7, 8)

Basic Overview of Topics (Post-Midterm)

▶ Taxes/subsidies (ch 6.2, 7, 8)
  • Different kinds + what we analyze in this class

Basic Overview of Topics (Post-Midterm)

▶ Taxes/subsidies (ch 6.2, 7, 8)
  • Different kinds + what we analyze in this class
  • How they change equations, how they shift curves

EC 201
Connor Wiegand

Basic Overview of Topics (Post-Midterm)

▶ Taxes/subsidies (ch 6.2, 7, 8)
  - Different kinds + what we analyze in this class
  - How they change equations, how they shift curves
  - Why we use taxes/subs at the basic level (slides 11) vs in theory/in this class (i.e. externalities)

Basic Overview of Topics (Post-Midterm)

▶ Taxes/subsidies (ch 6.2, 7, 8)

- Different kinds + what we analyze in this class
- How they change equations, how they shift curves
- Why we use taxes/subs at the basic level (slides 11) vs in theory/in this class (i.e. externalities)
- Price paid vs Price received

Basic Overview of Topics (Post-Midterm)

▶ Taxes/subsidies (ch 6.2, 7, 8)

- Different kinds + what we analyze in this class
- How they change equations, how they shift curves
- Why we use taxes/subs at the basic level (slides 11) vs in theory/in this class (i.e. externalities)
- Price paid vs Price received
- Who bears the tax burden/subsidy incidence

Basic Overview of Topics (Post-Midterm)

▶ Taxes/subsidies (ch 6.2, 7, 8)

- Different kinds + what we analyze in this class
- How they change equations, how they shift curves
- Why we use taxes/subs at the basic level (slides 11) vs in theory/in this class (i.e. externalities)
- Price paid vs Price received
- Who bears the tax burden/subsidy incidence
- Welfare impacts (CS, PS, GR, GE, DWL)

Basic Overview of Topics (Post-Midterm)

▶ Taxes/subsidies (ch 6.2, 7, 8)
  • Different kinds + what we analyze in this class
  • How they change equations, how they shift curves
  • Why we use taxes/subs at the basic level (slides 11) vs in theory/in this class (i.e. externalities)
  • Price paid vs Price received
  • Who bears the tax burden/subsidy incidence
  • Welfare impacts (CS, PS, GR, GE, DWL)
  • Original demand (supply, resp.) is still the reflection of WTP (WTA)

Basic Overview of Topics (Post-Midterm)

- ▶ Taxes/subsidies (ch 6.2, 7, 8)
  - Different kinds + what we analyze in this class
  - How they change equations, how they shift curves
  - Why we use taxes/subs at the basic level (slides 11) vs in theory/in this class (i.e. externalities)
  - Price paid vs Price received
  - Who bears the tax burden/subsidy incidence
  - Welfare impacts (CS, PS, GR, GE, DWL)
  - Original demand (supply, resp.) is still the reflection of WTP (WTA)
  - How elasticity effects tax burdens (on your own)

Basic Overview of Topics (Post-Midterm)

▶ Taxes/subsidies (ch 6.2, 7, 8)
  - Different kinds + what we analyze in this class
  - How they change equations, how they shift curves
  - Why we use taxes/subs at the basic level (slides 11) vs in theory/in this class (i.e. externalities)
  - Price paid vs Price received
  - Who bears the tax burden/subsidy incidence
  - Welfare impacts (CS, PS, GR, GE, DWL)
  - Original demand (supply, resp.) is still the reflection of WTP (WTA)
  - How elasticity effects tax burdens (on your own)

▶ Externalities (ch 10, mainly 10.1)

Basic Overview of Topics (Post-Midterm)

▶ Taxes/subsidies (ch 6.2, 7, 8)

- Different kinds + what we analyze in this class
- How they change equations, how they shift curves
- Why we use taxes/subs at the basic level (slides 11) vs in theory/in this class (i.e. externalities)
- Price paid vs Price received
- Who bears the tax burden/subsidy incidence
- Welfare impacts (CS, PS, GR, GE, DWL)
- Original demand (supply, resp.) is still the reflection of WTP (WTA)
- How elasticity effects tax burdens (on your own)

▶ Externalities (ch 10, mainly 10.1)

- What they mean, what kinds there are

Basic Overview of Topics (Post-Midterm)

▶ Taxes/subsidies (ch 6.2, 7, 8)
  - Different kinds + what we analyze in this class
  - How they change equations, how they shift curves
  - Why we use taxes/subs at the basic level (slides 11) vs in theory/in this class (i.e. externalities)
  - Price paid vs Price received
  - Who bears the tax burden/subsidy incidence
  - Welfare impacts (CS, PS, GR, GE, DWL)
  - Original demand (supply, resp.) is still the reflection of WTP (WTA)
  - How elasticity effects tax burdens (on your own)

▶ Externalities (ch 10, mainly 10.1)
  - What they mean, what kinds there are
  - MEB and MEC, and how they influence private/social demand and supply

Basic Overview of Topics (Post-Midterm)

▶ Taxes/subsidies (ch 6.2, 7, 8)

- Different kinds + what we analyze in this class
- How they change equations, how they shift curves
- Why we use taxes/subs at the basic level (slides 11) vs in theory/in this class (i.e. externalities)
- Price paid vs Price received
- Who bears the tax burden/subsidy incidence
- Welfare impacts (CS, PS, GR, GE, DWL)
- Original demand (supply, resp.) is still the reflection of WTP (WTA)
- How elasticity effects tax burdens (on your own)

▶ Externalities (ch 10, mainly 10.1)

- What they mean, what kinds there are
- MEB and MEC, and how they influence private/social demand and supply
- Private vs social equilibrium

Basic Overview of Topics (Post-Midterm)

▶ Taxes/subsidies (ch 6.2, 7, 8)

- Different kinds + what we analyze in this class
- How they change equations, how they shift curves
- Why we use taxes/subs at the basic level (slides 11) vs in theory/in this class (i.e. externalities)
- Price paid vs Price received
- Who bears the tax burden/subsidy incidence
- Welfare impacts (CS, PS, GR, GE, DWL)
- Original demand (supply, resp.) is still the reflection of WTP (WTA)
- How elasticity effects tax burdens (on your own)

▶ Externalities (ch 10, mainly 10.1)

- What they mean, what kinds there are
- MEB and MEC, and how they influence private/social demand and supply
- Private vs social equilibrium
- EC and EB, how to calculate TS in this case

Basic Overview of Topics (Post-Midterm)

▶ Taxes/subsidies (ch 6.2, 7, 8)

- Different kinds + what we analyze in this class
- How they change equations, how they shift curves
- Why we use taxes/subs at the basic level (slides 11) vs in theory/in this class (i.e. externalities)
- Price paid vs Price received
- Who bears the tax burden/subsidy incidence
- Welfare impacts (CS, PS, GR, GE, DWL)
- Original demand (supply, resp.) is still the reflection of WTP (WTA)
- How elasticity effects tax burdens (on your own)

▶ Externalities (ch 10, mainly 10.1)

- What they mean, what kinds there are
- MEB and MEC, and how they influence private/social demand and supply
- Private vs social equilibrium
- EC and EB, how to calculate TS in this case
- Drawing all of these things, with correct regions

Basic Overview of Topics (Post-Midterm)

▶ Taxes/subsidies (ch 6.2, 7, 8)

- Different kinds + what we analyze in this class
- How they change equations, how they shift curves
- Why we use taxes/subs at the basic level (slides 11) vs in theory/in this class (i.e. externalities)
- Price paid vs Price received
- Who bears the tax burden/subsidy incidence
- Welfare impacts (CS, PS, GR, GE, DWL)
- Original demand (supply, resp.) is still the reflection of WTP (WTA)
- How elasticity effects tax burdens (on your own)

▶ Externalities (ch 10, mainly 10.1)

- What they mean, what kinds there are
- MEB and MEC, and how they influence private/social demand and supply
- Private vs social equilibrium
- EC and EB, how to calculate TS in this case
- Drawing all of these things, with correct regions
- Calculating them

Basic Overview of Topics (Post-Midterm)

▶ Taxes/subsidies (ch 6.2, 7, 8)

- Different kinds + what we analyze in this class
- How they change equations, how they shift curves
- Why we use taxes/subs at the basic level (slides 11) vs in theory/in this class (i.e. externalities)
- Price paid vs Price received
- Who bears the tax burden/subsidy incidence
- Welfare impacts (CS, PS, GR, GE, DWL)
- Original demand (supply, resp.) is still the reflection of WTP (WTA)
- How elasticity effects tax burdens (on your own)

▶ Externalities (ch 10, mainly 10.1)

- What they mean, what kinds there are
- MEB and MEC, and how they influence private/social demand and supply
- Private vs social equilibrium
- EC and EB, how to calculate TS in this case
- Drawing all of these things, with correct regions
- Calculating them
- How to correct for an externality (internalize through a tax/sub)

Basic Overview of Topics (Post-Midterm)

▶ Theory of the Firm (Costs, Ch 13)

Basic Overview of Topics (Post-Midterm)

▶ Theory of the Firm (Costs, Ch 13)

    • Explicit/Implicit Costs, Accounting profit vs Economic Profit

Basic Overview of Topics (Post-Midterm)

▶ Theory of the Firm (Costs, Ch 13)
  • Explicit/Implicit Costs, Accounting profit vs Economic Profit
  • Production table and production function

Basic Overview of Topics (Post-Midterm)

▶ Theory of the Firm (Costs, Ch 13)
  - Explicit/Implicit Costs, Accounting profit vs Economic Profit
  - Production table and production function
  - Marginal product of labor and marginal thinking

Basic Overview of Topics (Post-Midterm)

▶ Theory of the Firm (Costs, Ch 13)
  • Explicit/Implicit Costs, Accounting profit vs Economic Profit
  • Production table and production function
  • Marginal product of labor and marginal thinking
  • Diminishing marginal returns in production function leads to exponential total cost function

Basic Overview of Topics (Post-Midterm)

▶ Theory of the Firm (Costs, Ch 13)
- Explicit/Implicit Costs, Accounting profit vs Economic Profit
- Production table and production function
- Marginal product of labor and marginal thinking
- Diminishing marginal returns in production function leads to exponential total cost function
- Fixed Costs vs Variable Costs

Basic Overview of Topics (Post-Midterm)

▶ Theory of the Firm (Costs, Ch 13)

- Explicit/Implicit Costs, Accounting profit vs Economic Profit
- Production table and production function
- Marginal product of labor and marginal thinking
- Diminishing marginal returns in production function leads to exponential total cost function
- Fixed Costs vs Variable Costs
- TC, FC, VC, ATC, AFC, AVC, MC

Basic Overview of Topics (Post-Midterm)

▶ Theory of the Firm (Costs, Ch 13)
- Explicit/Implicit Costs, Accounting profit vs Economic Profit
- Production table and production function
- Marginal product of labor and marginal thinking
- Diminishing marginal returns in production function leads to exponential total cost function
- Fixed Costs vs Variable Costs
- TC, FC, VC, ATC, AFC, AVC, MC
  - How to calculate

Basic Overview of Topics (Post-Midterm)

▶ Theory of the Firm (Costs, Ch 13)

- Explicit/Implicit Costs, Accounting profit vs Economic Profit
- Production table and production function
- Marginal product of labor and marginal thinking
- Diminishing marginal returns in production function leads to exponential total cost function
- Fixed Costs vs Variable Costs
- TC, FC, VC, ATC, AFC, AVC, MC
  - How to calculate
  - How to fill in tables

Basic Overview of Topics (Post-Midterm)

▶ Theory of the Firm (Costs, Ch 13)

- Explicit/Implicit Costs, Accounting profit vs Economic Profit
- Production table and production function
- Marginal product of labor and marginal thinking
- Diminishing marginal returns in production function leads to exponential total cost function
- Fixed Costs vs Variable Costs
- TC, FC, VC, ATC, AFC, AVC, MC
  - How to calculate
  - How to fill in tables
  - How to draw: knowing the height between AVC and ATC is AFC, MC intersects ATC at it's minimum, etc.

Basic Overview of Topics (Post-Midterm)

▶ Theory of the Firm (Costs, Ch 13)
  • Explicit/Implicit Costs, Accounting profit vs Economic Profit
  • Production table and production function
  • Marginal product of labor and marginal thinking
  • Diminishing marginal returns in production function leads to exponential total cost function
  • Fixed Costs vs Variable Costs
  • TC, FC, VC, ATC, AFC, AVC, MC
    ○ How to calculate
    ○ How to fill in tables
    ○ How to draw: knowing the height between AVC and ATC is AFC, MC intersects ATC at it's minimum, etc.
  • Short run vs long run: definition, deriving LRATC

Basic Overview of Topics (Post-Midterm)

▶ Theory of the Firm (Costs, Ch 13)
  • Explicit/Implicit Costs, Accounting profit vs Economic Profit
  • Production table and production function
  • Marginal product of labor and marginal thinking
  • Diminishing marginal returns in production function leads to exponential total cost function
  • Fixed Costs vs Variable Costs
  • TC, FC, VC, ATC, AFC, AVC, MC
    ○ How to calculate
    ○ How to fill in tables
    ○ How to draw: knowing the height between AVC and ATC is AFC, MC intersects ATC at it's minimum, etc.
  • Short run vs long run: definition, deriving LRATC
  • Returns to scale

Basic Overview of Topics (Post-Midterm)

▶ Theory of the Firm (Costs, Ch 13)

- Explicit/Implicit Costs, Accounting profit vs Economic Profit
- Production table and production function
- Marginal product of labor and marginal thinking
- Diminishing marginal returns in production function leads to exponential total cost function
- Fixed Costs vs Variable Costs
- TC, FC, VC, ATC, AFC, AVC, MC
  - How to calculate
  - How to fill in tables
  - How to draw: knowing the height between AVC and ATC is AFC, MC intersects ATC at it's minimum, etc.
- Short run vs long run: definition, deriving LRATC
- Returns to scale
- Types of Firms spectrum

Basic Overview of Topics (Post-Midterm)

▶ PC Markets (Ch 14, skip 14-2d)

Basic Overview of Topics (Post-Midterm)

▶ PC Markets (Ch 14, skip 14-2d)
  • What it means, key elements

Basic Overview of Topics (Post-Midterm)

▶ PC Markets (Ch 14, skip 14-2d)
  • What it means, key elements
  • MR=MC, MR=P, so P=MC

Basic Overview of Topics (Post-Midterm)

▶ PC Markets (Ch 14, skip 14-2d)

- What it means, key elements
- MR=MC, MR=P, so P=MC
- Filling out tables, selecting optimal production

Basic Overview of Topics (Post-Midterm)

▶ PC Markets (Ch 14, skip 14-2d)
  - What it means, key elements
  - MR=MC, MR=P, so P=MC
  - Filling out tables, selecting optimal production
  - Marginal revenue

Basic Overview of Topics (Post-Midterm)

▶ PC Markets (Ch 14, skip 14-2d)

- What it means, key elements
- MR=MC, MR=P, so P=MC
- Filling out tables, selecting optimal production
- Marginal revenue
- Profit box/equation, what happens when firms make profit in SR, what their profit is in long run

Basic Overview of Topics (Post-Midterm)

▶ PC Markets (Ch 14, skip 14-2d)

- What it means, key elements
- MR=MC, MR=P, so P=MC
- Filling out tables, selecting optimal production
- Marginal revenue
- Profit box/equation, what happens when firms make profit in SR, what their profit is in long run
- Shutting down in short vs long run

Basic Overview of Topics (Post-Midterm)

▶ PC Markets (Ch 14, skip 14-2d)

- What it means, key elements
- MR=MC, MR=P, so P=MC
- Filling out tables, selecting optimal production
- Marginal revenue
- Profit box/equation, what happens when firms make profit in SR, what their profit is in long run
- Shutting down in short vs long run
- MC + shutdown condition makes up supply

Intro to Game Theory
000000000

Analyzing Games
0000000

Other Games
00000000

Review
00000●00

Basic Overview of Topics (Post-Midterm)

▶ PC Markets (Ch 14, skip 14-2d)

- What it means, key elements
- MR=MC, MR=P, so P=MC
- Filling out tables, selecting optimal production
- Marginal revenue
- Profit box/equation, what happens when firms make profit in SR, what their profit is in long run
- Shutting down in short vs long run
- MC + shutdown condition makes up supply
  ◦ Linear Curves induce no practical shutdown condition

Basic Overview of Topics (Post-Midterm)

▶ PC Markets (Ch 14, skip 14-2d)

- What it means, key elements
- MR=MC, MR=P, so P=MC
- Filling out tables, selecting optimal production
- Marginal revenue
- Profit box/equation, what happens when firms make profit in SR, what their profit is in long run
- Shutting down in short vs long run
- MC + shutdown condition makes up supply
  - Linear Curves induce no practical shutdown condition
- Long run supply is horizontal

Basic Overview of Topics (Post-Midterm)

▶ PC Markets (Ch 14, skip 14-2d)

- What it means, key elements
- MR=MC, MR=P, so P=MC
- Filling out tables, selecting optimal production
- Marginal revenue
- Profit box/equation, what happens when firms make profit in SR, what their profit is in long run
- Shutting down in short vs long run
- MC + shutdown condition makes up supply
    ○ Linear Curves induce no practical shutdown condition
- Long run supply is horizontal
- Drawing typical pictures that we discussed, for both the firm and the market

Basic Overview of Topics (Post-Midterm)

► PC Markets (Ch 14, skip 14-2d)

- What it means, key elements
- MR=MC, MR=P, so P=MC
- Filling out tables, selecting optimal production
- Marginal revenue
- Profit box/equation, what happens when firms make profit in SR, what their profit is in long run
- Shutting down in short vs long run
- MC + shutdown condition makes up supply
  - Linear Curves induce no practical shutdown condition
- Long run supply is horizontal
- Drawing typical pictures that we discussed, for both the firm and the market
  - How demand intersecting short run supply gives us a flat MR=P line, how moving curves changes the equilibrium, etc.

Basic Overview of Topics (Post-Midterm)

▶ PC Markets (Ch 14, skip 14-2d)

- What it means, key elements
- MR=MC, MR=P, so P=MC
- Filling out tables, selecting optimal production
- Marginal revenue
- Profit box/equation, what happens when firms make profit in SR, what their profit is in long run
- Shutting down in short vs long run
- MC + shutdown condition makes up supply
    ○ Linear Curves induce no practical shutdown condition
- Long run supply is horizontal
- Drawing typical pictures that we discussed, for both the firm and the market
    ○ How demand intersecting short run supply gives us a flat MR=P line, how moving curves changes the equilibrium, etc.
    ○ How to find # of firms from total vs individual production, or how to find individual production from total and # of firms, etc.

Basic Overview of Topics (Post-Midterm)

▶ Monopoly (Ch 15)

Basic Overview of Topics (Post-Midterm)

▶ Monopoly (Ch 15)
  - What it means, key elements

Basic Overview of Topics (Post-Midterm)

▶ Monopoly (Ch 15)

- What it means, key elements
- Why they arise, natural monopolies

Basic Overview of Topics (Post-Midterm)

▶ Monopoly (Ch 15)

- What it means, key elements
- Why they arise, natural monopolies
- $MR = MC$ for production, but MR$\neq$ P

Basic Overview of Topics (Post-Midterm)

▶ Monopoly (Ch 15)

- What it means, key elements
- Why they arise, natural monopolies
- $MR = MC$ for production, but MR$\neq$ P
- How the monopolist sets their price

Basic Overview of Topics (Post-Midterm)

▶ Monopoly (Ch 15)

- What it means, key elements
- Why they arise, natural monopolies
- $MR = MC$ for production, but MR$\neq$ P
- How the monopolist sets their price
- Demand in monopoly vs PC

Basic Overview of Topics (Post-Midterm)

▶ Monopoly (Ch 15)

- What it means, key elements
- Why they arise, natural monopolies
- $MR = MC$ for production, but MR$\neq$ P
- How the monopolist sets their price
- Demand in monopoly vs PC
- How to draw the market/firm for the monopolist, including production decision, price, and profit box

Basic Overview of Topics (Post-Midterm)

▶ Monopoly (Ch 15)

- What it means, key elements
- Why they arise, natural monopolies
- $MR = MC$ for production, but MR$\neq$ P
- How the monopolist sets their price
- Demand in monopoly vs PC
- How to draw the market/firm for the monopolist, including production decision, price, and profit box
- Comparing PC to monopoly:

Basic Overview of Topics (Post-Midterm)

▶ Monopoly (Ch 15)

- What it means, key elements
- Why they arise, natural monopolies
- $MR = MC$ for production, but MR$\neq$ P
- How the monopolist sets their price
- Demand in monopoly vs PC
- How to draw the market/firm for the monopolist, including production decision, price, and profit box
- Comparing PC to monopoly:
  - Equilibrium analysis

Basic Overview of Topics (Post-Midterm)

▶ Monopoly (Ch 15)

- What it means, key elements
- Why they arise, natural monopolies
- $MR = MC$ for production, but MR$\neq$ P
- How the monopolist sets their price
- Demand in monopoly vs PC
- How to draw the market/firm for the monopolist, including production decision, price, and profit box
- Comparing PC to monopoly:
  - Equilibrium analysis
  - MR differences

Basic Overview of Topics (Post-Midterm)

▶ Monopoly (Ch 15)

- What it means, key elements
- Why they arise, natural monopolies
- $MR = MC$ for production, but MR$\neq$ P
- How the monopolist sets their price
- Demand in monopoly vs PC
- How to draw the market/firm for the monopolist, including production decision, price, and profit box
- Comparing PC to monopoly:
  - Equilibrium analysis
  - MR differences
  - Welfare analysis, including DWL (and how to correct it)

Basic Overview of Topics (Post-Midterm)

▶ Monopoly (Ch 15)

- What it means, key elements
- Why they arise, natural monopolies
- $MR = MC$ for production, but MR$\neq$ P
- How the monopolist sets their price
- Demand in monopoly vs PC
- How to draw the market/firm for the monopolist, including production decision, price, and profit box
- Comparing PC to monopoly:
    - Equilibrium analysis
    - MR differences
    - Welfare analysis, including DWL (and how to correct it)

▶ In general: anything else from the homework, or a reading that I told you to do in the slides

Basic Overview of Topics (Post-Midterm)

▶ Monopoly (Ch 15)

- What it means, key elements
- Why they arise, natural monopolies
- $MR = MC$ for production, but MR$\neq$ P
- How the monopolist sets their price
- Demand in monopoly vs PC
- How to draw the market/firm for the monopolist, including production decision, price, and profit box
- Comparing PC to monopoly:
  ○ Equilibrium analysis
  ○ MR differences
  ○ Welfare analysis, including DWL (and how to correct it)

▶ In general: anything else from the homework, or a reading that I told you to do in the slides

▶ Ask questions if something is fair game or not for the exam

Final Exam

▶ 2 hours, comprehensive

Final Exam

▶ 2 hours, comprehensive
▶ 40-50 MC, 4-5 FA

EC 201
Connor Wiegand

Final Exam

- ▶ 2 hours, comprehensive
- ▶ 40-50 MC, 4-5 FA
  - Even at 50 and 5, this gives you more time per question than last time

Final Exam

▶ 2 hours, comprehensive
▶ 40-50 MC, 4-5 FA
  • Even at 50 and 5, this gives you more time per question than last time
▶ Don't leave questions blank!

Final Exam

▶ 2 hours, comprehensive

▶ 40-50 MC, 4-5 FA

 • Even at 50 and 5, this gives you more time per question than last time

▶ Don't leave questions blank!

▶ Different seating chart

Final Exam

▶ 2 hours, comprehensive
▶ 40-50 MC, 4-5 FA
  • Even at 50 and 5, this gives you more time per question than last time
▶ Don't leave questions blank!
▶ Different seating chart
▶ The class is curved, don't fret