

Unit 1: Theories and Game Theory

Michael Gill
Dept. of Government, Harvard University

Sept 14, 2011

Outline

- 0) Questions/Concerns
- 1) Review of Kinds of Theories
- 2) Review of Game Theory
- 3) Game Theory Extensions

KINDS OF THEORIES

Why (causal) theories?

Why (causal) theories?

In everyday speech, people make causal statements *all the time*...

Why (causal) theories?

In everyday speech, people make causal statements all the time...

- “The poor are responsible for the economic crisis...”

Why (causal) theories?

In everyday speech, people make causal statements all the time...

- “The poor are responsible for the economic crisis...”
- “Wall Street is responsible for the economic crisis...”

Why (causal) theories?

In everyday speech, people make causal statements all the time...

- "The poor are responsible for the economic crisis..."
- "Wall Street is responsible for the economic crisis..."
- "Bush is responsible for the economic crisis..."

Why (causal) theories?

In everyday speech, people make causal statements all the time...

- "The poor are responsible for the economic crisis..."
- "Wall Street is responsible for the economic crisis..."
- "Bush is responsible for the economic crisis..."
- "Obama is responsible for the the economic crisis..."

Why (causal) theories?

In everyday speech, people make causal statements all the time...

- "The poor are responsible for the economic crisis..."
- "Wall Street is responsible for the economic crisis..."
- "Bush is responsible for the economic crisis..."
- "Obama is responsible for the the economic crisis..."
- "(Straw man of choice) is responsible for the economic crisis..."

Why (causal) theories?

In everyday speech, people make causal statements all the time...

- "The poor are responsible for the economic crisis..."
- "Wall Street is responsible for the economic crisis..."
- "Bush is responsible for the economic crisis..."
- "Obama is responsible for the the economic crisis..."
- "(Straw man of choice) is responsible for the economic crisis..."

But people rarely subject these claims to any sort of **test**.

Why (causal) theories?

In everyday speech, people make causal statements all the time...

- "The poor are responsible for the economic crisis..."
- "Wall Street is responsible for the economic crisis..."
- "Bush is responsible for the economic crisis..."
- "Obama is responsible for the the economic crisis..."
- "(Straw man of choice) is responsible for the economic crisis..."

But people rarely subject these claims to any sort of test. Theories allow us to adjudicate between competing explanations.

What is a theory?

What is a theory?

There are at least 2 types:

What is a theory?

There are at least 2 types:



Good:

What is a theory?

There are at least 2 types:



Good:



Bad:

What is a theory?

There are at least 2 types:

Good:

\neq

Bad:

What is a theory?

There are at least 2 types:

Good:

Falsifiable
Practical
"Scientific"

\neq

Bad:

What is a theory?

There are at least 2 types:

Good:

Falsifiable
Practical
"Scientific"

\neq

Bad:

Unfalsifiable
Impractical
"Unscientific"

What is a theory?

There are at least 2 types:

Good:

Falsifiable
Practical
"Scientific"



\neq

Bad:

Unfalsifiable
Impractical
"Unscientific"



Scientific or Unscientific?

*"God speed the plow... By this wonderful provision, which is only man's mastery over nature, the clouds are dispensing copious rains... [the plow] is the instrument which separates civilization from savagery; and converts a desert into a farm or garden... To be more concise, Rain follows the plow."*¹

¹http://en.wikipedia.org/wiki/Rain_follows_the_plow

Good or Bad Theory?

THEORY

GOOD?

Good or Bad Theory?

THEORY

GOOD?

Theory of Gravity

Good or Bad Theory?

THEORY

GOOD?

Theory of Gravity



Good or Bad Theory?

THEORY

GOOD?

Theory of Gravity



"The Earth is flat"

Good or Bad Theory?

THEORY

GOOD?

Theory of Gravity



"The Earth is flat"



Good or Bad Theory?

THEORY

GOOD?

Theory of Gravity



"The Earth is flat"



"The Earth is flat because Zeus made it that way"

Good or Bad Theory?

THEORY

GOOD?

Theory of Gravity



"The Earth is flat"



"The Earth is flat because Zeus made it that way"



Good or Bad Theory?

THEORY

GOOD?

Theory of Gravity



"The Earth is flat"



"The Earth is flat because Zeus made it that way"



Aristotelean Physics

Good or Bad Theory?

THEORY	GOOD?
Theory of Gravity	✓
"The Earth is flat"	✓
"The Earth is flat because Zeus made it that way"	✗
Aristotelean Physics	✓

Good or Bad Theory?

THEORY

GOOD?

Theory of Gravity



"The Earth is flat"



"The Earth is flat because Zeus made it that way"



Aristotelean Physics



"My name is Michael"

Good or Bad Theory?

THEORY	GOOD?
Theory of Gravity	✓
"The Earth is flat"	✓
"The Earth is flat because Zeus made it that way"	✗
Aristotelean Physics	✓
"My name is Michael"	✓

Good or Bad Theory?

THEORY

GOOD?

Theory of Gravity



"The Earth is flat"



"The Earth is flat because Zeus made it that way"



Aristotelean Physics



"My name is Michael"



"The number 19 is uninteresting"

Good or Bad Theory?

THEORY	GOOD?
Theory of Gravity	✓
"The Earth is flat"	✓
"The Earth is flat because Zeus made it that way"	✗
Aristotelean Physics	✓
"My name is Michael"	✓
"The number 19 is uninteresting"	✗

Good or Bad Theory?

THEORY	GOOD?
Theory of Gravity	✓
"The Earth is flat"	✓
"The Earth is flat because Zeus made it that way"	✗
Aristotelean Physics	✓
"My name is Michael"	✓
"The number 19 is uninteresting"	✗
<i>The Secret</i> (book)	

Good or Bad Theory?

THEORY	GOOD?
Theory of Gravity	✓
"The Earth is flat"	✓
"The Earth is flat because Zeus made it that way"	✗
Aristotelean Physics	✓
"My name is Michael"	✓
"The number 19 is uninteresting"	✗
<i>The Secret</i> (book)	✗

Good or Bad Theory?

THEORY	GOOD?
Theory of Gravity	✓
"The Earth is flat"	✓
"The Earth is flat because Zeus made it that way"	✗
Aristotelean Physics	✓
"My name is Michael"	✓
"The number 19 is uninteresting"	✗
<i>The Secret</i> (book)	✗
Miasmatic disease theory	

Good or Bad Theory?

THEORY	GOOD?
Theory of Gravity	✓
"The Earth is flat"	✓
"The Earth is flat because Zeus made it that way"	✗
Aristotelean Physics	✓
"My name is Michael"	✓
"The number 19 is uninteresting"	✗
<i>The Secret</i> (book)	✗
Miasmatic disease theory	✓

Good or Bad Theory?

THEORY

GOOD?

Theory of Gravity



"The Earth is flat"



"The Earth is flat because Zeus made it that way"



Aristotelean Physics



"My name is Michael"



"The number 19 is uninteresting"



The Secret (book)



Miasmatic disease theory



"Gov 50 is my favorite class"

Good or Bad Theory?

THEORY

GOOD?

Theory of Gravity



"The Earth is flat"



"The Earth is flat because Zeus made it that way"



Aristotelean Physics



"My name is Michael"



"The number 19 is uninteresting"



The Secret (book)



Miasmatic disease theory



"Gov 50 is my favorite class"



Good or Bad Theory?

THEORY

GOOD?

Theory of Gravity



"The Earth is flat"



"The Earth is flat because Zeus made it that way"



Aristotelean Physics



"My name is Michael"



"The number 19 is uninteresting"



The Secret (book)



Miasmatic disease theory



"Gov 50 is my favorite class"



Freudian Psychology

Good or Bad Theory?

THEORY

GOOD?

Theory of Gravity



"The Earth is flat"



"The Earth is flat because Zeus made it that way"



Aristotelean Physics



"My name is Michael"



"The number 19 is uninteresting"



The Secret (book)



Miasmatic disease theory



"Gov 50 is my favorite class"



Freudian Psychology



Good or Bad Theory?

THEORY	GOOD?
Theory of Gravity	✓
"The Earth is flat"	✓
"The Earth is flat because Zeus made it that way"	✗
Aristotelean Physics	✓
"My name is Michael"	✓
"The number 19 is uninteresting"	✗
<i>The Secret</i> (book)	✗
Miasmatic disease theory	✓
"Gov 50 is my favorite class"	✓
Freudian Psychology	✗

- **Note:** the fact that a theory is good or "scientific" is not the same as saying it is correct. To establish "correctness" requires a scientific theory, but the existence of a theory does not make it "correct."

GAME THEORY

Review of Prisoner's Dilemma

To solve this game, imagine you are **Player 1**.

		Player 2	
		<i>C</i>	<i>D</i>
Player 1	<i>C</i>	(3, 3)	(-20, 4)
	<i>D</i>	(4, -20)	(2, 2)

Review of Prisoner's Dilemma

To solve this game, imagine you are Player 1. We will find your **best response** to Player 2's actions regardless of what he or she chooses.

		Player 2	
		<i>C</i>	<i>D</i>
Player 1	<i>C</i>	(3, 3)	(-20, 4)
	<i>D</i>	(4, -20)	(2, 2)

Review of Prisoner's Dilemma

To solve this game, imagine you are Player 1. We will find your best response to Player 2's actions regardless of what he or she chooses.

Let's first look at the case where Player 2 always chooses *C*.

		Player 2	
		<i>C</i>	<i>D</i>
Player 1	<i>C</i>	(3, 3)	(-20, 4)
	<i>D</i>	(4, -20)	(2, 2)

Review of Prisoner's Dilemma

To solve this game, imagine you are Player 1. We will find your best response to Player 2's actions regardless of what he or she chooses.

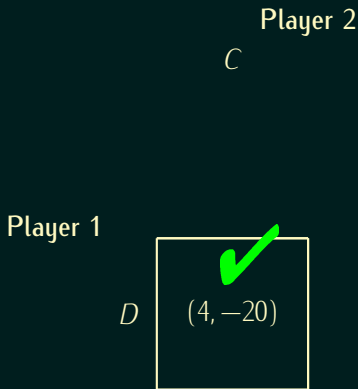
Let's first look at the case where Player 2 always chooses C .

		Player 2	
		C	D
Player 1	C	$(3, 3)$	$(-20, 4)$
	D	$(4, -20)$	$(-20, -20)$

Review of Prisoner's Dilemma

To solve this game, imagine you are Player 1. We will find your best response to Player 2's actions regardless of what he or she chooses.

Let's first look at the case where Player 2 always chooses C .



In this case, you clearly prefer to **defect**, since $4 > 3$.

Review of Prisoner's Dilemma

But what about the case where **Player 2** always chooses *D*?

		Player 2	
		<i>C</i>	<i>D</i>
Player 1	<i>C</i>	(3, 3)	(-20, 4)
	<i>D</i>	(4, -20)	(2, 2)

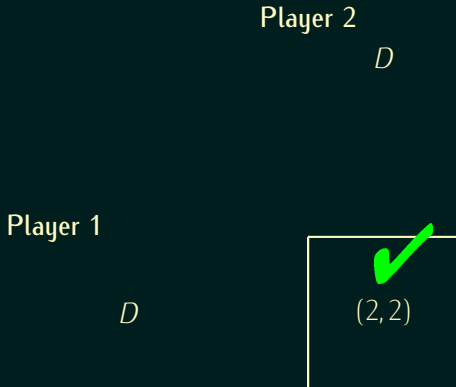
Review of Prisoner's Dilemma

But what about the case where **Player 2** always chooses *D*?

		Player 2	
		<i>C</i>	<i>D</i>
Player 1	<i>C</i>	(-20, 4)	(-10, 0)
	<i>D</i>	(0, 0)	(2, 2)

Review of Prisoner's Dilemma

But what about the case where Player 2 always chooses D ?



In this case, you clearly prefer to **defect**, since $2 > -20$.

Review of Prisoner's Dilemma

So now we know that you (Player 1) want to defect regardless of what Player 2 chooses.

		Player 2	
		<i>C</i>	<i>D</i>
Player 1	<i>D</i>	(4, 1)	(2, 2)

Review of Prisoner's Dilemma

So now we know that you (Player 1) want to defect regardless of what Player 2 chooses. Knowing this, what should Player 2 do?

		Player 2	
		<i>C</i>	<i>D</i>
Player 1	<i>D</i>	(4, 1)	(2, 2)

Review of Prisoner's Dilemma

So now we know that you (Player 1) want to defect regardless of what Player 2 chooses. Knowing this, **what should Player 2 do?**

Let's now look at the game from Player 2's perspective.

		Player 2	
		<i>C</i>	<i>D</i>
Player 1	<i>D</i>	(4, 1)	(2, 2)

Review of Prisoner's Dilemma

So now we know that you (Player 1) want to defect regardless of what Player 2 chooses. Knowing this, *what should Player 2 do?*

Let's now look at the game from Player 2's perspective.



Basic Game Theory

Basic Game Theory

Are these two games the same?

	<i>C</i>	<i>D</i>
<i>C</i>	(5,5)	(0,10)
<i>D</i>	(10,0)	(1,1)

Game 1

	<i>C</i>	<i>D</i>
<i>C</i>	(3,3)	(-5,4)
<i>D</i>	(4,-5)	(0,0)

Game 2

Basic Game Theory


Are these two games the same?

	<i>C</i>	<i>D</i>
<i>C</i>	(5,5)	(0,10)
<i>D</i>	(10,0)	(1,1)

Game 1



	<i>C</i>	<i>D</i>
<i>C</i>	(3,3)	(-5,4)
<i>D</i>	(4,-5)	(0,0)

Game 2

 Nash Equilibrium

Basic Game Theory

Are these two games the same?

	<i>C</i>	<i>D</i>
<i>C</i>	 (5,5)	(0,10)
<i>D</i>	(10,0)	 (1,1)

Game 1

	<i>C</i>	<i>D</i>
<i>C</i>	(3,3)	(-5,4)
<i>D</i>	(4,-5)	(0,0)

Game 2





Nash Equilibrium




Pareto Efficient

Basic Game Theory

Are these two games the same?

	<i>C</i>	<i>D</i>
<i>C</i>	 (5, 5)	(0, 10)
<i>D</i>	(10, 0)	 (1, 1)

Prisoner's Dilemma

	<i>C</i>	<i>D</i>
<i>C</i>	(3, 3)	(-5, 4)
<i>D</i>	(4, -5)	 (0, 0)

Game 2





Nash Equilibrium



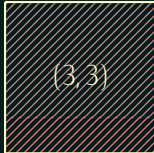
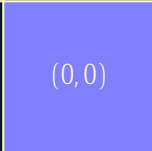
Pareto Efficient

Basic Game Theory

Are these two games the same?

	<i>C</i>	<i>D</i>
<i>C</i>	 (5, 5)	(0, 10)
<i>D</i>	(10, 0)	 (1, 1)

Prisoner's Dilemma

	<i>C</i>	<i>D</i>
<i>C</i>	 (3, 3)	(-5, 4)
<i>D</i>	(4, -5)	 (0, 0)

Game 2





Nash Equilibrium




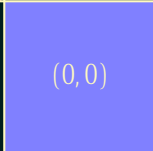
Pareto Efficient

Basic Game Theory

Are these two games the same?

	<i>C</i>	<i>D</i>
<i>C</i>	 (5, 5)	(0, 10)
<i>D</i>	(10, 0)	 (1, 1)

Prisoner's Dilemma

	<i>C</i>	<i>D</i>
<i>C</i>	 (3, 3)	(-5, 4)
<i>D</i>	(4, -5)	 (0, 0)

Prisoner's Dilemma





Nash Equilibrium




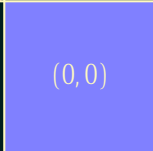
Pareto Efficient

Basic Game Theory

Are these two games the same? **Yes...**

	<i>C</i>	<i>D</i>
<i>C</i>	 (5, 5)	(0, 10)
<i>D</i>	(10, 0)	 (1, 1)

Prisoner's Dilemma

	<i>C</i>	<i>D</i>
<i>C</i>	 (3, 3)	(-5, 4)
<i>D</i>	(4, -5)	 (0, 0)

Prisoner's Dilemma



Nash Equilibrium



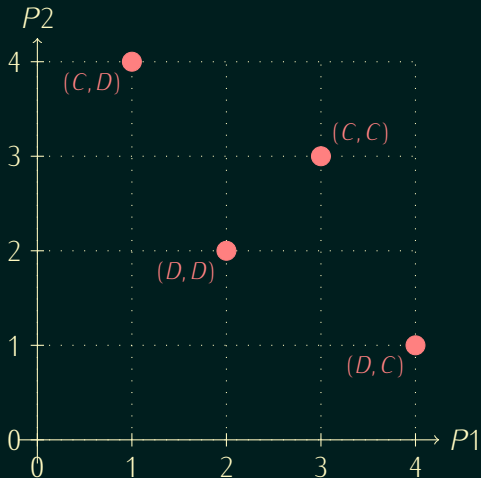
Pareto Efficient

So What is Pareto Efficiency?

What Game is This?

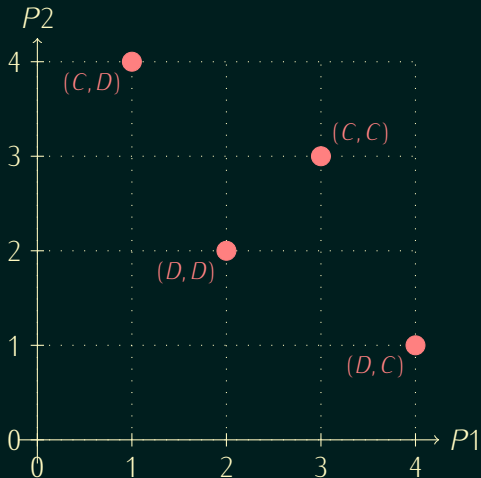
So What is Pareto Efficiency?

What Game is This?

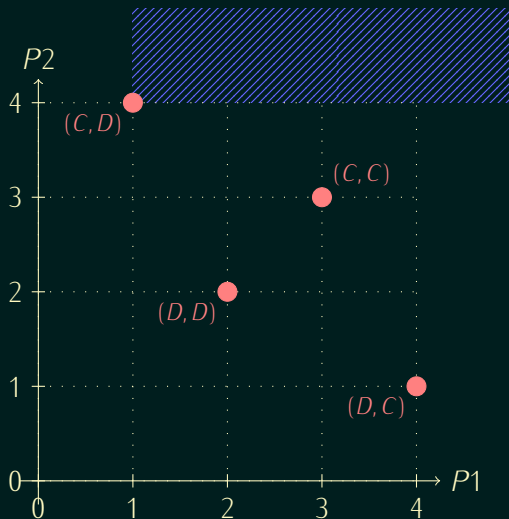


So What is Pareto Efficiency?

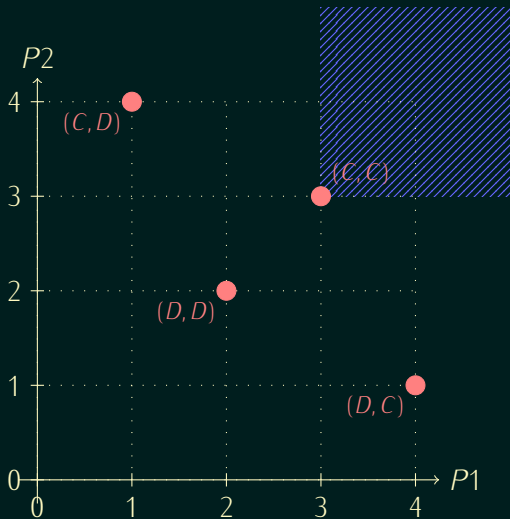
What Game is This? Prisoner's Dilemma



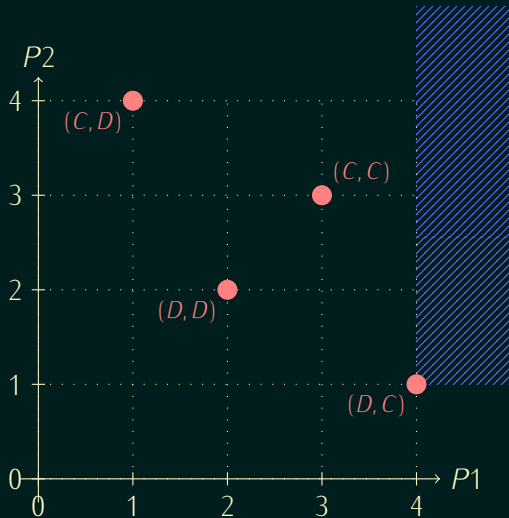
So What is Pareto Efficiency?



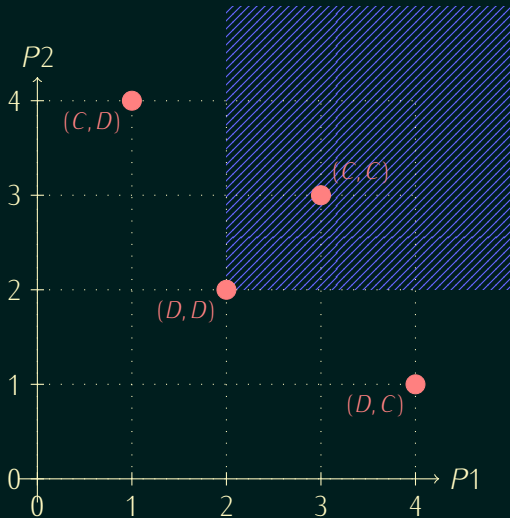
So What is Pareto Efficiency?



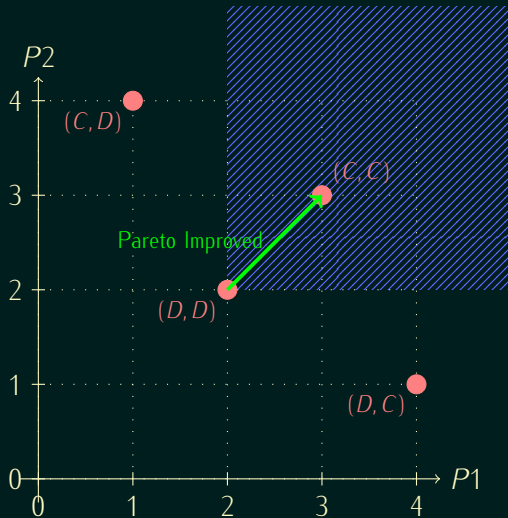
So What is Pareto Efficiency?



So What is Pareto Efficiency?



So What is Pareto Efficiency?



Basic Game Theory (Contd.)

Basic Game Theory (Contd.)

Are these two games the same?

	<i>C</i>	<i>D</i>
<i>C</i>	(0, 0)	(-5, 10)
<i>D</i>	(10, -5)	(-50, -50)

Game 1

	<i>C</i>	<i>D</i>
<i>C</i>	(3, 2)	(1, 1)
<i>D</i>	(1, 1)	(2, 3)

Game 2

Basic Game Theory (Contd.)


Are these two games the same?

	<i>C</i>	<i>D</i>
<i>C</i>	(0,0)	(-5,10)
<i>D</i>	(10,-5)	(-50,-50)

Game 1


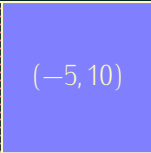
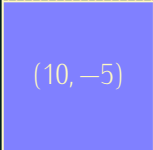
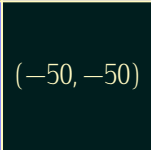
	<i>C</i>	<i>D</i>
<i>C</i>	(3,2)	(1,1)
<i>D</i>	(1,1)	(2,3)

Game 2

 Nash Equilibrium

Basic Game Theory (Contd.)

Are these two games the same?

	<i>C</i>	<i>D</i>
<i>C</i>	 (0, 0)	 (-5, 10)
<i>D</i>	 (10, -5)	 (-50, -50)

Game 1

	<i>C</i>	<i>D</i>
<i>C</i>	(3, 2)	(1, 1)
<i>D</i>	(1, 1)	(2, 3)

Game 2




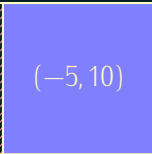
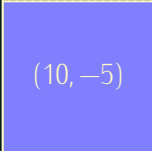
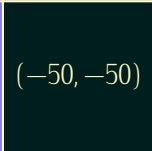
Nash Equilibrium



Pareto Efficient

Basic Game Theory (Contd.)

Are these two games the same?

	<i>C</i>	<i>D</i>
<i>C</i>	 (0, 0)	 (-5, 10)
<i>D</i>	 (10, -5)	 (-50, -50)

Chicken Game

	<i>C</i>	<i>D</i>
<i>C</i>	(3, 2)	(1, 1)
<i>D</i>	(1, 1)	(2, 3)

Game 2




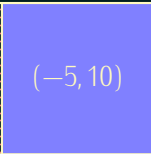
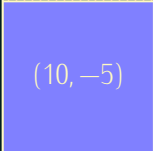
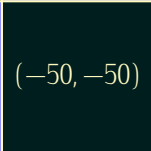
Nash Equilibrium




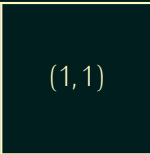


Pareto Efficient

Basic Game Theory (Contd.)

Are these two games the same?

	<i>C</i>	<i>D</i>
<i>C</i>	 (0, 0)	 (-5, 10)
<i>D</i>	 (10, -5)	 (-50, -50)

Chicken Game

	<i>C</i>	<i>D</i>
<i>C</i>	 (3, 2)	 (1, 1)
<i>D</i>	 (1, 1)	 (2, 3)

Game 2




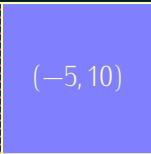
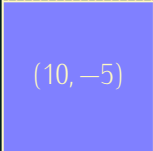
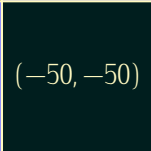
Nash Equilibrium



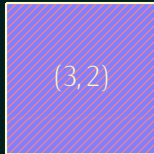
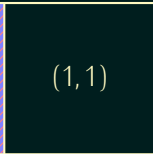
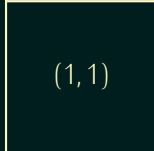
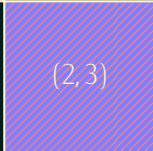
Pareto Efficient

Basic Game Theory (Contd.)



Are these two games the same?

	<i>C</i>	<i>D</i>
<i>C</i>	 $(0, 0)$	 $(-5, 10)$
<i>D</i>	 $(10, -5)$	 $(-50, -50)$

Chicken Game


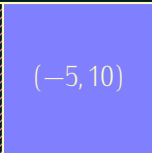
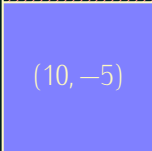
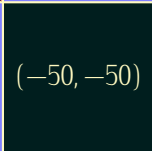
	<i>C</i>	<i>D</i>
<i>C</i>	 $(3, 2)$	 $(1, 1)$
<i>D</i>	 $(1, 1)$	 $(2, 3)$

Game 2

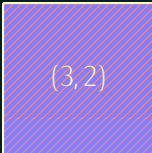
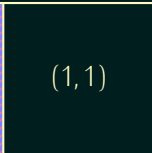
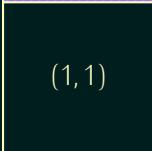
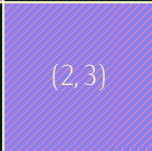
 Nash Equilibrium  Pareto Efficient

Basic Game Theory (Contd.)



Are these two games the same?

	<i>C</i>	<i>D</i>
<i>C</i>	 $(0, 0)$	 $(-5, 10)$
<i>D</i>	 $(10, -5)$	 $(-50, -50)$

Chicken Game


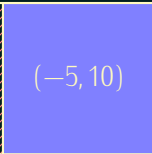
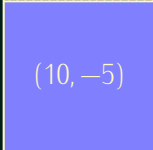
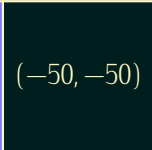
	<i>C</i>	<i>D</i>
<i>C</i>	 $(3, 2)$	 $(1, 1)$
<i>D</i>	 $(1, 1)$	 $(2, 3)$

Battle of the Sexes

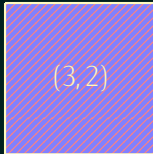
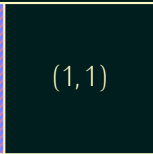
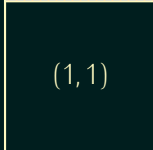
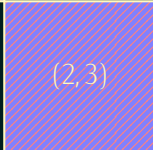
 Nash Equilibrium  Pareto Efficient

Basic Game Theory (Contd.)

Are these two games the same? **No...**

	<i>C</i>	<i>D</i>
<i>C</i>	 (0, 0)	 (-5, 10)
<i>D</i>	 (10, -5)	 (-50, -50)

Chicken Game

	<i>C</i>	<i>D</i>
<i>C</i>	 (3, 2)	 (1, 1)
<i>D</i>	 (1, 1)	 (2, 3)

Battle of the Sexes



Nash Equilibrium



Pareto Efficient