LECTURE 2.1

SINGLE PERIOD GAMES:

SIMULTANEOUS MOVES

SIMULTANEOUS MOVE, ONE-SHOT GAMES

In simultaneous move, one-shot games, you make decisions without knowing the action of your rival. This can be interpreted as:

- Players make decisions at the same time
- Players make decisions before knowing the decisions of their rivals.

Usually write out in what is called “strategic” or “normal” form:

- Payoffs are represented in a matrix
- Payoffs include all the benefits to a player (monetary, non-monetary)

SIMULTANEOUS MOVE, ONE-SHOT GAMES

Consider the following pricing game for Boeing and Airbus. Numbers represent profits.

The number left number in each cell is the payoff to the left player (Boeing).

Boeing \ Airbus	Low price	High price
Low price	**$500, $500**	**$1000, $0**
High price	**$0, $1000**	**$750, $750**

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SIMULTANEOUS MOVE, ONE-SHOT GAMES

This Airbus-Boeing game is a rebadged Prisoners dilemma in which the (strictly) dominant strategy is to expand.

Notice how this does not maximise surplus from the view of the players. How can firms such as these get to a better outcome?

In this game we assume that players make their decisions simultaneously. Consider what happens when players make decisions sequentially. We'll come to that in another section.

COMPONENTS OF A GAME

- Players: $i = 1,...,n$
- Actions: (e.g. prices or quantities or advertising)
- Strategies: complete contingent plan of action
- Information available to players: we will assume perfect information
- Rules of the game
- Payoffs: a complete summary of the value to each player

DOMINANT STRATEGIES

A strategy is (strictly) **dominant** if it gives a (strictly) higher payoff than every other strategy, for every strategy that your rivals play.

- If you have a strictly dominant strategy, you should play it for sure.
- In a *dominant strategy equilibrium*, all players choose a dominant strategy.

DOMINANT STRATEGIES

Reconsider the pricing game between Boeing and Airbus. Does either player have a dominant strategy?

Boeing \ Airbus	Low price	High price
Low price	$500, $500	$1000, $0
High price	$0, $1000	$750, $750

DOMINANT STRATEGIES

Consider a revised pricing game for Boeing & Airbus where the US Government guarantees Boeing's survival. Can you see any dominant strategies?

Boeing \ Airbus	Low price	High price
Low price	$500, $500	$1000, $0
High price	$600, $1000	$750, $750

EXAMPLE: CIGARETTE ADVERTISING

Consider the problem faced by the major tobacco companies in the 1970s.

- The firms could advertise or not.
- If you don't advertise but your rivals do, their profits increase and yours fall.

		BAT	
		Don't Ad	**Advertise**
Imperial	**Don't advertise**	**$50, $50**	**$20, $60**
	Advertise	**$60, $20**	**$27, $27**

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EXAMPLE: CIGARETTE ADVERTISING

The US government imposed an advertising ban on TV (amongst other health related measures).

Big 4 tobacco companies spent $315m on advertising in 1970, and $252m in 1971. Profits rose by $91m. The dominant strategy equilibrium was removed, benefitting the tobacco firms

Imperial \ BAT	Don't Ad	Advertise
Don't advertise	$50, $50	$20, $60
~~Advertise~~	~~$60, $20~~	~~$27, $27~~

DOMINATED STRATEGIES

A strategy is (strictly) dominated if the player has another strategy that gives a (strictly) higher payoff no matter what her rivals do.

Consider the following game. Does either player have a dominated strategy?

		Toyota		
		Large	**Small**	**Don't build**
Honda	**Large**	0,0	12,8	18,9
	Small	8,12	16,16	20,15
	Don't build	9,18	15,20	18,18

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	Small	8,12	16,16	20,15
	Don't build	9,18	15,20	18,18

BEST RESPONSES

Best response function (reaction function): best choice of strategy for any choice of rival.

A best response is determined by asking:

- “Suppose I know Bob will play ‘Left’. What is my best choice?”
- “Suppose I know Bob will play Right. What is my best response?”

With more players, to determine a best response, you would need to know what every other player would play.

- I’m a member of OPEC. Suppose I know that Kuwait plans to export 20m barrels of oil. Saudi Arabia plans to export 30m barrels, and Nigeria plans to export... How much should I produce?
- Now suppose I know Kuwait plans to export 25m, Saudi Arabia plans to export 32m, and Nigeria plans... How much should I produce now?

NASH EQUILIBRIUM

A set of strategies is a Nash equilibrium if every player is playing a best response to their rivals' strategies. No one has an incentive to change strategy

- A Nash equilibrium is self-enforcing or stable
- Nash equilibrium is a weaker concept than dominant strategy equilibrium

NASH EQUILIBRIUM

Nash equilibrium is a self-fulfilling agreement. If we agree to play a certain way, we'll both go through with it. Unilateral deviations are not worthwhile.

A Nash equilibrium could also be an outcome that we've settled on after repeating a situation many many times, or an outcome we expect given repeated observation of similar situations

What I choose to do depends on what I expect the other player to do – it's an inherently strategic concept.

NASH EQUILIBRIUM

A procedure for finding Nash Equilibrium in two person games in five steps.

- If both players have a dominant strategy – these constitute their Nash equilibrium strategies.
- If one player has a dominant strategy this is their Nash equilibrium strategy, then find the other players best response to identify NE.
- If neither player has a dominant strategy, eliminate dominated strategies.
- Identify best responses for each player.
- Look for an equilibrium in mixed strategies – see later.

NASH EQUILIBRIUM

Recall this example from earlier. Both players have a dominant strategy, which gives the Nash equilibrium.

Boeing \ Airbus	Low price	High price
Low price	$500, $500	$1000, $0
High price	$0, $1000	$750, $750

NASH EQUILIBRIUM

A procedure for finding Nash Equilibrium in two person games in five steps.

- If both players have a dominant strategy – these constitute their Nash equilibrium strategies.
- If one player has a dominant strategy, this is their Nash equilibrium strategy. Then find the other players best response to identify Nash equilibrium.
- If neither player has a dominant strategy, eliminate dominated strategies.
- Identify best responses for each player.
- Look for an equilibrium in mixed strategies – see later.

NASH EQUILIBRIUM

Recall this revised pricing example from earlier. Airbus has a dominant strategy. We can then determine the best response of Boeing to locate the Nash equlilibrium.

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Low price	$500, $500	$1000, $0
High price	$0, $1000	$750, $750

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- If both players have a dominant strategy – these constitute their Nash equilibrium strategies.
- If one player has a dominant strategy this is their Nash equilibrium strategy, then find the other players best response to identify NE.
- If neither player has a dominant strategy, eliminate dominated strategies.
- Identify best responses for each player.
- Look for an equilibrium in mixed strategies – see later.

NASH EQUILIBRIUM

Recall this game from before. We effectively used these steps: eliminated the dominated strategies to identify the Nash equilibrium of Small/Small.

		Toyota		
		Large	**Small**	**Don't build**
Honda	~~**Large**~~	~~0,0~~	~~12,8)~~	~~18,9~~
	Small	8,12	16,16	20,15
	Don't build	9,18	15,20	18,18

COORDINATION GAMES

In a competitive setting coordination can often be very profitable. Consider this game between Boeing & Airbus making a decision about using a common communications technology

Boeing \ Airbus	Alpha	Beta
Alpha	$100, $100	$50, $50
Beta	$50, $50	$100, $100

COORDINATION GAMES

There are two Nash equilibria, and no focal point to help coordinate.

Boeing \ Airbus	Alpha	Beta
Alpha	$100, $100	$50, $50
Beta	$50, $50	$100, $100

COORDINATION GAMES

Consider this revised technology game. Again there are two Nash equilibria.

How could Boeing get its preferred Nash equilibria? Could Boeing pre-commit to one option? If so, pre-commitment must be credible (e.g. public sign agreement with parts supplier).

Boeing \ Airbus	Alpha	Beta
Alpha	$100, $50	$40, $40
Beta	$25, $25	$50, $100