TOPIC 34: GAME THEORY I

I.   Between Two Extremes
   a. An oligopoly is a market dominated by a small number of firms.
       i. On one hand competition is competition. Perhaps an oligopoly industry operates just like our competitive model.
       ii. On the other hand this competition is easy to dislodge. With so few firms, it's relatively easy for the companies to conspire together, constrain production, and act like a monopoly. Remember: monopoly profits are very tempting!
   b. Both play a role here, but we have to understand how powerful point (i) is before we can see how point (ii) comes about.

II.   Basics of Game Theory
   a. To better understand point (i), we turn to an approach originally from mathematics (and now found in many other disciplines) called *game theory*: the study of strategic decision-making.
   b. In game theory, each player has no control over what the other player(s) does. This exists despite the fact that each player's actions influence other players' costs and benefits.
       i. For example, you don't control Andy the Arsonist but his actions affect you if he decides to burn down your store.
       ii. We will simplify our analysis by focusing on an oligopoly of two firms called a *duopoly*.
   c. To determine what each player will do, we consider the options each player has (usually two each) and their payoff in various combinations of actions.
       i. *Payoff* is a general term for the result to that player. It can be positive (e.g. dollars awarded) or negative (e.g. years in jail).
       ii. For simplicity and clarity, payoffs combine costs and benefits. Each payoff is represented as a single number.

III.   Nash Equilbrium
   a. To determine what happens in a game, we find a point of equilibrium.
   b. This equilibrium point is called *Nash Equilibrium (NE)*—when no player wants to change their strategy holding the strategy of the other player constant. It's named after the creator of game theory, John Nash.

c. An example of Nash Equilibrium sitting in class. Suppose someone is sitting in a seat you'd like to sit in more. Remember, you can't make them sit elsewhere so you sit where you're happiest given the choices. Note that people are not constantly changing their seats minute-to-minute (or even class to class). We've reached NE.

d. If someone changes her seat then that person could take an independent action to become better off. Thus we are not in NE.

IV. Basic Structure

a. When both players move at the same time, the game resembles a table of outcomes.

    i. Player 1 is indicated as Alfred. His payoff is first.

    ii. Player 2 is indicated as Batman. His payoff is second.

    iii. In this game there are two strategies: Strategy 1 and Strategy 2.

    iv. The payoffs are A1, A2, B1, etc.

		Batman	
		Strategy 1	*Strategy 2*
Alfred	*Strategy 1*	A1, B1	A3, B2
	Strategy 2	A2, B3	A4, B4

b. Because I have no values in for the payoffs, we cannot play the game. This is just to remind you which payoff goes with which player.

    i. For example, if Alfred plays 2 and Batman plays 1, then Alfred gets A2 and Batman gets B3.

V. Types of strategies

a. When finding Nash equilibrium, it's often helpful to find strategies a player would definitely do or would never do.

    i. The first is called the *dominate strategy*. Selecting this option means the player will always prefer this strategy regardless of what the other player does.

    ii. The second is called the *dominated strategy*. The player will never prefer this strategy, regardless of what the other player chooses.

b. <u>Example</u>. Creating a bill that the House and the Senate will agree on.

		House of Representatives	
		Low Spending	*High Spending*
Senate	*Low Spending*	6, 0	0, 3
	High Spending	4, 2	1, 5

i. In this example, the House will *never* choose Low Spending because its payoff will always be lower, regardless of what the Senate does. Low Spending is a dominated strategy.
ii. At the same time, High Spending is the House's dominate strategy; it always will produce a preferred strategy.
iii. Since the House will definitely choose High Spending, it's clear the Senate will also prefer High Spending (1>0).

c. <u>Example</u>.

		Blue Team			
		A	*B*	*C*	*D*
	X	0, 0	4, 4	-4, 6	1, 1
Red Team	*Y*	-1, 8	3, 2	1, 8	2, 6
	Z	-2, -3	1, 3	3, 2	-1, -5

i. While this game seems intimidating, eliminating the dominated strategies makes it a lot easier! For example, Blue will never prefer D so you can cross out that whole column.
ii. Since anything in D will never be an option, Red will never prefer Y so that whole row can be crossed out.
iii. If Y will never be an option, Blue will never choose A; A can be crossed out.
iv. With only four cells left, it's clear this game as no Nash equilibrium.