



# Equilibrium.

---

- Sometimes a game can be solved simply by finding the dominant and dominated strategies (e.g., the example above).
- However, there are many games for which this does not work.

In a *Nash Equilibrium* no player wants to change his/her strategy unilaterally, given what the other players have chosen.

- Games can have no *pure strategy* equilibria, or
- Multiple equilibria.



# The prisoner's dilemma.

---

		Prisoner 1	
		Lie	Confess
Prisoner 2	Lie	10, 10	20, -5
	Confess	20, -5	0, 0

The table illustrates the prisoner's dilemma with the following payoffs (Prisoner 2, Prisoner 1):

- (Lie, Lie): 10, 10
- (Lie, Confess): 20, -5
- (Confess, Lie): 20, -5
- (Confess, Confess): 0, 0

Arrows in the original image point from the top-right cell (20, -5) to the bottom-right cell (0, 0) and from the bottom-left cell (20, -5) to the bottom-right cell (0, 0), indicating that confessing is a dominant strategy for both prisoners.

# Cournot Oligopoly w/ 2 firms

---

## *Assumptions:*

- 2 firms choose output independently but aware of each other's decisions (market only exists for one period)
- consumers are price takers : Demand  $Q=1000-1000p$
- no entry
- Homogeneous products  $Q=q_1+q_2$
- firms collectively have market power (can set  $p > mc$  cost=28 cents)

## *What strategy should firm 1 use to choose its output level?*

- If firm 1 believes that firm 2 will sell  $q_2$  it can determine the  $q_1$  that maximize its profits facing the residual demand  $q_1=Q(p)-q_2$

# Cournot Oligopoly – 2 firms contin.

---

- The profit maximizing  $q_1$  given the beliefs about  $q_2$  is the **best response function**  $q_1=R_1(q_2)$ . This relationship comes from equating the marginal revenue function (from residual demand) with marginal costs:

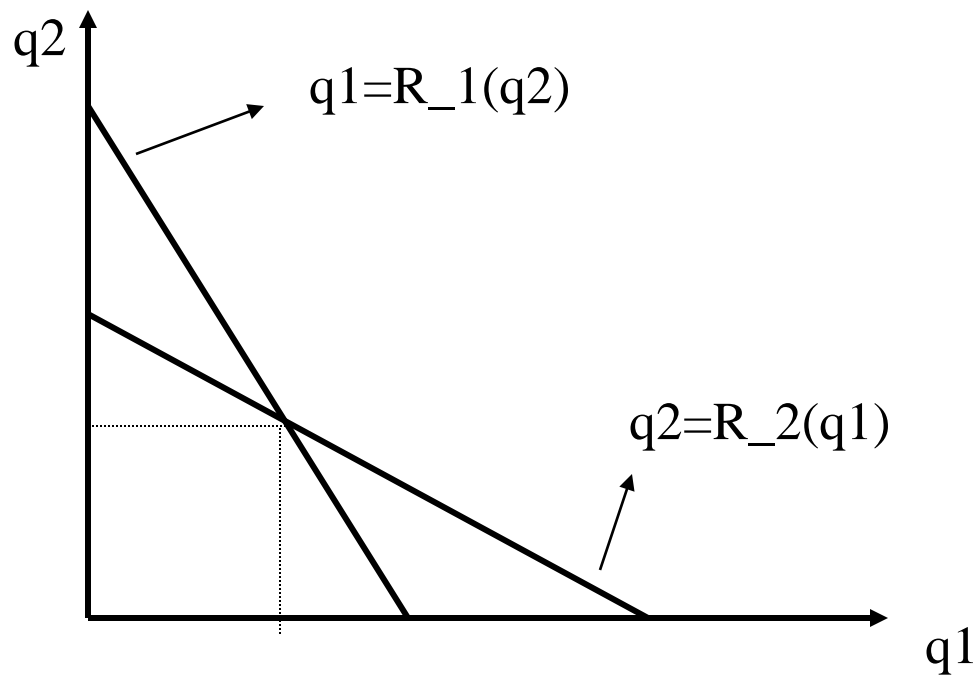
$$q_1 = R_1(q_2) = 360 - q_2/2.$$

- Firm's 2 best response is derived in similar way  $q_2=R_2(q_1)=360-q_1/2$ .
- The point of intersection of the two best response function is the Cournot-Nash Equilibrium: each firm sells the quantity that maximizes its profits given the correct beliefs about the other firm's choice of output:  
 $q_1=q_2=240$ .
- No firm wants to change its output choice given that other firms produce at equilibrium levels: Cournot-Nash equilibrium

# Cournot Oligopoly

---

- 2 firms



# Cournot Oligopoly – N firms

---

- N firms, identical
- Firm one's best response  $q_1 = R_1(q_2, \dots, q_n)$
- Equilibrium
- As n increases the lower each firm's production, the lower p
- Do firms make their decisions simultaneously ?
- Do firms choose output or price?
- What about capacity constraints?

# Next Lecture

---

- Cartel and Cournot Equilibria
- Stackelberg Model
- Bertrand Model
- Differentiated products