Chapter 8

Chapter 8: Uncertainty and Information

Adverse Selection, Signaling, and Screening

- Adverse selection-sellers have information that buyers do not, or vice versa, about some aspect of product quality
- This term originated within the insurance industry.
- Only those with dangerous jobs will seek life insurance. Thus, this group is a bad customer for insurance companies.
- These customers are more likely to die.

The Market for Lemons

- A "lemon" is a used car that does not work well.
- Suppose two types of used cars are for sale: lemons and oranges (fully functioning cars)
- The price for lemons is $16,000 and $6,000 if the types can be distinguished.

The Market for Lemons

- Used car sellers know the type of the car, buyers do not know.
- Since the cars cannot be distinguished, there is only one price: p
- The fraction of lemons in the market is 1-f. The fraction of oranges in the market is f
- The expected value of the car is $16,000 * f + 6,000 * (1 - f) = 6,000 + 10,000 * f$
- You should buy the car iff $6,000 + 10,000 * f > p$

The Market for Lemons

- The owner of a lemon is willing to sell if $p > 3,000$.
- The owner of a orange is willing to sell if $p > 12,500$.
- Thus, $6,000 + 10,000 * f > p > 12,500$.
- So, $f > 0.65$ creates a possible situation where both lemons and oranges are sold on the market.
- If $f < 0.65$ then only lemons would be sold on the market.
- Signaling could help buyers distinguish the types. In many situations, the signal would not work if sellers of both type are able to signal in the same way.

Signaling in the Labor Market

- On the labor market, you know your own quality of skill much better than potential employers.
- Regardless of what skill level you are, you want to signal that you are of a higher skill. Employers want to screen and determine who is actually a high skilled worker.
- Successful screening policies must satisfy two conditions: incentive compatibility, participation
- incentive compatibility conditions-applicants have the incentive to make the choice that the firm wants
- participation conditions-applicants want to participate in screening system

Incentive Compatibility

- Incentive compatibility constraints align the job applicant's incentive with the employer's desire.
- Employers then find it optimal to reveal type truthfully.
- Separation of types- when constraints work and the types are fully separated
- self selection- employees choose to separate into correct types
- Example: requiring applicants to take tough courses to get the higher salary for being a high-skilled employee. Low-skilled employees have a larger psychic cost for taking the courses.

Incentive Compatibility

- The number of courses is n.
- Type A (oh high-skilled workers) have a cost of 3,000 per each class, while Type C (or low-skilled workers) have a higher psychic cost of 15,000.
- So, an incentive compatible policy for the C types: $60,000 \geq 160,000 - 15,000n$ or $n \geq 6.67$.
- Type A's want to take the courses if: $160,000 - 3,000n \geq 60,000$ or $n \leq 33.33$.

Participation

- For the types to be willing to make the correct choices and exposing their true type, the participation conditions must be satisfied as well:
- $160,000 - 3,000n \geq 125,000$ and $60,0000 \geq 30,000$
- Type C will always participate. Type A will participate if the amount of courses is 11 or less.
- Note that the participation constraint implies that their incentive compatibility constraint is satisfied as well. The full set of conditions that are required for $7 \leq n \leq 11$.

Pooling of Types

- pooling of types (or pooling)- treating every applicant as a random draw from the population.
- In this situation, the firm would have to pay the same salary to everyone and not differentiate between types at all.

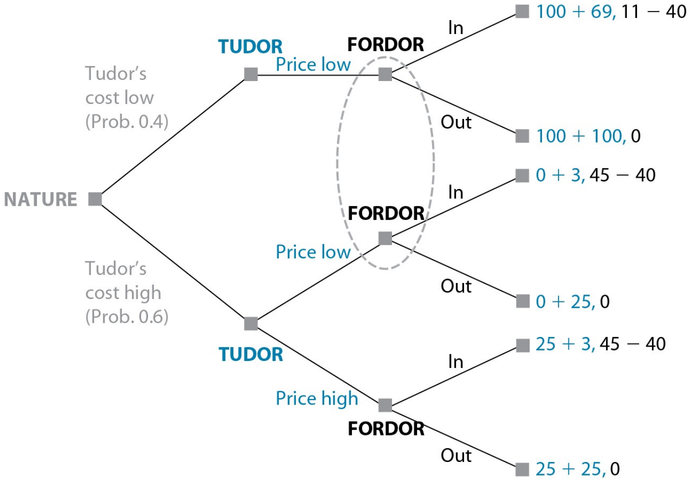
Equilibria in Two-player Signaling Games

- partially revealing or semiseparating equilibrium-separating or pooling type of equilibrium
- These equilibrium come about when two players with asymmetric information face off.

Basic Model and Payoff Structure

- Two auto manufactures, Tudor and Fordor, interact in a sequential game.
- In the first stage, Tudor sets a price (high or low) knowing that it is the only manufacture in the market.
- In the next stage, Fordor makes its entry decision.
- Tudor prefers for Fordor to not exit. It may then use the price at the first stage to signal its costs. A high-cost firm would have to charge a high price.
- Assume the Todor low cost is 5, high cost is 15. Low cost types price at 15 and high cost types price at 20. Fordor's cost of entry is 40.
- Demand is given by $P = 25 - Q^D$.

Basic Model and Payoff Structure



Separating Equilibrium

- We can rule out the bottom node using rollback analysis. Fordor chooses "In" when Tudor sets the price at high.
- Each player then has two strategies. Tudor can bluff or be honest (LL, LH). Fordor can enter irrespective of Tudor's previous period-1 price (Regardless or II or In-In) or enter only if Tudor's period-1 price is high (Conditional or OI or Out-In).
- We can then show the strategic form of the entry game.

Separating Equilibrium

		FORDOR	
		Regardless (II)	Conditional (OI)
TUDOR	Bluff (LL)	$169 \times 0.4 + 3 \times 0.6 = 69.4$, $-29 \times 0.4 + 5 \times 0.6 = -8.6$	$200 \times 0.4 + 25 \times 0.6 = 95$, 0
	Honest (LH)	$169 \times 0.4 + 28 \times 0.6 = 84.4$, $-29 \times 0.4 + 5 \times 0.6 = -8.6$	$200 \times 0.4 + 28 \times 0.6 = 96.8$, $5 \times 0.6 = 3$

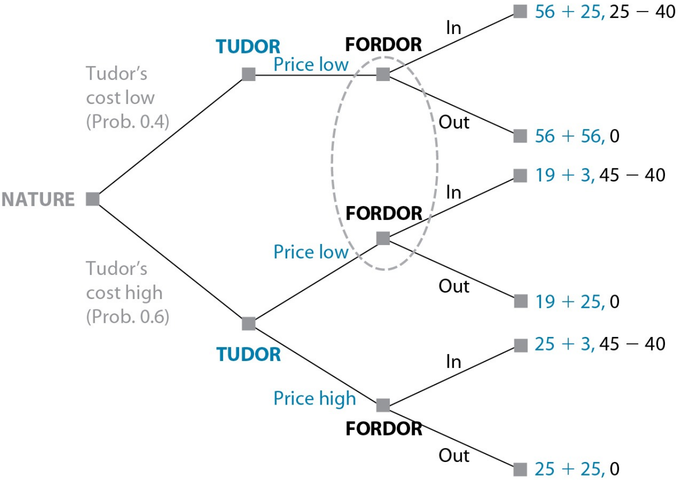
Separating Equilibrium

- Nash equilibrium is Honest, Conditional.
- This equilibrium is separating. The two types of Tudor charger different prices in period 1.

Pooling Equilibrium

- Now suppose that the lower of the production costs for Tudor is 10 instead of 5. With this cost, high cost Tudor charges 20, and low cost Tudor chargers 17.5.

Pooling Equilibrium



Pooling Equilibrium

		FORDOR	
		Regardless (II)	Conditional (OI)
TUDOR	Bluff (LL)	$81 \times 0.4 + 22 \times 0.6 = 45.6$, $-15 \times 0.4 + 5 \times 0.6 = -3$	$112 \times 0.4 + 44 \times 0.6 = 71.2$, 0
	Honest (LH)	$81 \times 0.4 + 28 \times 0.6 = 49.2$, $-15 \times 0.4 + 5 \times 0.6 = -3$	$112 \times 0.4 + 28 \times 0.6 = 61.6$, $5 \times 0.6 = 3$

Pooling Equilibrium

- So, both cost types choose to price at low. Fordor stays out of the market entirely.
- Fordor knows the Tudor is bluffing in equilibrium but the risk of calling the bluff is too great.
- If the probability of being low cost were lower, then this wouldn't be the case.

Semiseparating Equilibrium

- Now assume that the probability of being low cost is 10 percent.
- This new game yields no equilibrium in pure strategies.
- There is however an equilibrium in pure strategies. In this equilibrium, Tudor types are partially separated.
- Tudor plays high price if it has a high cost; however, Tudor plays low price when it is either type.
- Tudor's p-mix is p=1/3. Fordor's q-mix is q=0.727.

Semiseparating Equilibrium

		FORDOR	
		Regardless (II)	Conditional (OI)
TUDOR	Bluff (LL)	$81 \times 0.1 + 22 \times 0.9 = 27.9$, $-15 \times 0.1 + 5 \times 0.9 = 3$	$112 \times 0.1 + 44 \times 0.9 = 50.8$, 0
	Honest (LH)	$81 \times 0.1 + 28 \times 0.9 = 33.3$, $-15 \times 0.1 + 5 \times 0.9 = 3$	$112 \times 0.1 + 28 \times 0.9 = 36.4$, $5 \times 0.9 = 4.5$

Bayes' Rule

		TUDOR'S PRICE		Sum of row
		Low	High	
TUDOR'S COST	Low	0.1	0	0.1
	High	$0.9 \times 1/3 = 0.3$	$0.9 \times 2/3 = 0.6$	0.9
Sum of column		0.4	0.6	

Semiseparating Equilibrium

- If Fordor sees the low price in period 1, it will use this observation to update its belief (using Baye's Theorem) about the probability that Tudor is low cost.
- Using Baye's rule, when Fordor observes Tudor charging a low period 1 price, it will revise its belief about the probability of Tudor being low cost by taking the probability that a low cost Tudor is charging the low price and dividing that by the total prob of the two types of Tudor choosing the low price.

Baye's Rule

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

Semiseparating Equilibrium

- This calculation yields Fordor's updated belief about the probability that Tudor has low costs to be $0.1/0.4 = .25$. Updating Fordor's expected profit from entry shows that it is 0, meaning Tudor's equilibrium mixture is exactly right for making Fordor indifferent between entry and not entering when it sees a low price.
- Bayesian Nash equilibria- strategy profile and beliefs specified for each player about the types of the other players that maximizes the expected payoff for each player given their beliefs about the other players' types and given the strategies played by the other players.
- Perfect Bayesian equilibrium (PBE)- equilibrium concept relevant for dynamic games with incomplete information