What is Adverse Selection

- In markets with perfect information all profitable trades (those in which the value to the buyer is higher than the value to the seller) take place
- Not necessarily so in markets with asymmetric information
- When participants in a market have asymmetric information price may fail to bring the market into equilibrium
- When there is excess supply in the market a drop in price may fail to bring demand and supply into equilibrium
  - This may happen because at a lower price only lower value good may be brought to the market which reduces the price that the buyers are willing to pay
- First analyzed by the celebrated paper:

Lemons Problem

- Two types of used cars: good cars and lemons
- Proportion of lemons is $\lambda$
- Sellers know if their car is good or a lemon
- Buyers only know that a proportion $\lambda$ is a lemon
- A good car is worth $2,000$ and a lemon $1,000$ to a buyer
- A good car is worth $1,600$ and a lemon $800$ to a seller
- Under complete information
  - Price will depend on the number of sellers and buyers
  - If there are more sellers then the lemons will be sold at $800$ and good cars at $1,600$

What is the price under asymmetric information?
- Average quality?
  - $p = \lambda 800 + (1 - \lambda)1600$
- Note that $800 < p < 1600$
- Only lemons will be brought to the market
- But then buyers will not be willing to pay more than $1,000
  - If $p > 1000$ no cars are sold
  - If $p \leq 1000$ only lemons are sold
Lemons Problem

- The quality of the cars in the market depends on the price
- If \( p < 1600 \) only lemons are in the market and if \( p \geq 1600 \) both are
- Therefore, the value of a car for a buyer is given by

\[
V(P) = \begin{cases} 
1000, & p < 1600 \\
\lambda 1000 + (1 - \lambda) 2000, & p \geq 1600
\end{cases}
\]

- Suppose in equilibrium \( p \geq 1600 \). Then both types are in the market and the buyers are willing to pay at most

\[
\lambda 1000 + (1 - \lambda) 2000
\]

- For good cars to come to the market we need

\[
\lambda 1000 + (1 - \lambda) 2000 \geq 1600
\]

or \( \lambda \leq 0.4 \)

- So, if \( \lambda \leq 0.4 \) there is an equilibrium with \( p = 1600 \) and both types are sold

Lemons Problem

- If \( \lambda > 0.4 \), then \( p < 1600 \) and only lemons are in the market
- Buyers are willing to pay at most $1,000
- Only lemons are sold at price $800
- At any price if good cars are in the market so are lemons
- If there are a lot of lemons in the market the average quality is low and buyers are not willing to pay the reservation price of good cars
- This causes only lemons to be sold in the market
  - Bad cars drive out the good
- This is the case even though every car is worth more to the buyer than the sells
- The outcome is not efficient
- With more types of cars the result could be only worst types are sold.
  If the worst type is not worth buying at all this would mean that the market collapses altogether

Lemons Problem

- How can the sellers of good cars improve their situation?
- They can get their cars verified as a good car
  - Authorized second hand
  - Inspection by a mechanic with good reputation
- If verification is not very costly, then the good car owners would do it
- All the cars without verification would be known to be a lemon
- With more than two types of cars, all the types other than the worst would have an incentive to verify
  - Known as Full Disclosure Principle

Adverse Selection in Insurance Markets

- Insurance markets suffer from adverse selection and moral hazard
- We will study the effects of asymmetric information and adverse selection
- Classic:
Adverse Selection in Insurance Markets

- Population of individuals subject to risk of loss (of life, property, health, income, etc.)
  - Let’s call it an accident and use accident insurance as an example
  - Wealth if accident does not happen is \( w > 0 \)
  - If accident happens loss of wealth is \( L (0 < L < w) \)
  - Utility of wealth level \( w \): \( u(w) \)
    - \( u \) is \( C^2 \), strictly increasing, and strictly concave
- There are two types of individuals
  - High risk: probability of accident \( p_H \)
  - Low risk: probability of accident \( p_L \) \((0 < p_L < p_H)\)
- Proportion of \( H \) in the population \( \lambda \in (0, 1) \)

Adverse Selection in Insurance Markets

- An insurance policy is \((I, D)\)
  - \( I \): insurance premium
  - \( D \): deductible
- Wealth with insurance policy \((I, D)\)
  - No accident: \( w - I \)
  - Accident: \( w - D - I \)
- Expected utility of type \( i = L, H \) with insurance \((I, D)\)
  \[
  U_i(D, I) = p_i u(w - D - I) + (1 - p_i) u(w - I) 
  \]
- So, the insurance company earns
  - No accident: \( I \)
  - Accident: \( I - (L - D) \)
  - Profit if risk is \( \mu \): \( I - \mu (L - D) \)
- Assume
  - insurance companies are risk neutral
  - insurance market is perfectly competitive
  - Implies that in equilibrium expected profit of each company is zero

Homogenous Population

- Only one type with accident probability \( p \)
- Zero profit implies \( I - p(L - D) = 0 \)
- In equilibrium the expected payoff of each insuree must be maximized subject to the zero profit condition
  - Otherwise a company can offer an alternative policy that would be strictly preferred by insurees and would make strictly positive profits
Homogenous Population

- Easiest to see this on a diagram
- Introduce the following change of variables
  - No accident wealth \( w_n = w - I \)
  - Accident wealth \( w_a = w - D - I \)

For each contract \((I, D)\) there is a \((w_n, w_a)\)

- Expected utility of insuree with risk \( p \)
  \[
  p u(w_a) + (1-p) u(w_n)
  \]

- Expected profit of the company who attracts average risk \( p \)
  \[
  I - p(L - D) = w - w_n - p(L - (w_n - w_a))
  = w - pL - pw_a - (1-p)w_n
  \]

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Homogenous Population

- Point \( O \): no insurance
- Full insurance line \( w_a = w_n \)
- Below there is less than full insurance
- Insurance coverage increases as one moves towards full insurance line

- Profit is zero on fair odds line (or at actuarially fair rates) given by
  \[
  w_a = \frac{w - pL}{p} - \frac{(1-p)}{p} w_n
  \]

- Contract above FO makes a loss and below makes positive profit

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Homogenous Population

- Suppose equilibrium is with less than full insurance: at \( E \)
  - A company can offer \( A \)
    - attracts everybody
    - makes strictly positive profits
  - Equilibrium is at \( E' \)

- In equilibrium there is full insurance: \( D = 0 \)
- Slope of the indifference curve \( = -(1-p)/p \)
- Companies make zero profits
- Insuree’s expected utility is maximized subject to zero profit condition

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Heterogenous Population: Complete Information

- At any point, low type’s indifference curve is steeper than high type’s:
  \[
  \frac{1 - p_L}{p_L} u'(w_n) < \frac{1 - p_H}{p_H} u'(w_n)
  \]
- Single crossing condition is satisfied
- Similar to homogenous population case
- Each type buys full insurance: \( D = 0 \)
- High risk type pays higher premium
  \[ I_H = p_H L > p_L L = I_L \]

Heterogenous Population: Asymmetric Information

- There can be two types of equilibria
- Both types buy the same policy: Pooling equilibrium
- Each type buys a separate policy: Separating equilibrium
- Let us first consider pooling equilibrium
- Since both types buy the same policy, expected company profits:
  \[
  w - \mu L - \mu w_a - (1 - \mu) w_n
  \]
  where \( \mu \) is the expected risk
- Slope of fair odds line is \(-1/\mu\)

Pooling Equilibrium

- Suppose there is a pooling equilibrium
- It must be on expected fair odds line
- Low type must prefer it to no insurance: say \( E \)
- Then high type also prefers it
- Low risk is worse off and high risk is better off compared to complete information
- Company makes losses on high risk and profit on low risk
- Low risk cross-subsidizes high risk

- So, is \( E \) an equilibrium?
- What happens if a company offers \( d \)?
  - less insurance (higher \( D \)) at lower premium
  - High risk remains with old policy
  - Low risk switches from \( E \) to \( d \)
  - Company that offers it has only low risk
  - known as cream skimming
    - makes positive profit
  - All the other companies are left with high risk
    - they make losses
  - \( E \) violates 3rd condition of Rothschild-Stiglitz equilibrium
  - There is no pooling equilibrium!
Separating Equilibrium

- What happens if complete information policies ($F_H, F_L$) were offered?
  - High risk buys Low risk’s policy.
- Since Low does not want to mimic High risk keep offering High risk $F_H$.
- But, have to offer Low risk a policy that High doesn’t want to mimic.
- Has to be on fair odds line.
- Equilibrium candidate is $E_L$.
- Best that can be done for Low risk without attracting High risk.

- Did we find an equilibrium?
  - Consider policy $d$.
  - Both types prefer $d$ to their current policies.
  - Does it make profit?
  - Depends on $\mu = \lambda p_H + (1 - \lambda)p_L$.
  - $\lambda^+$: average fair odds line with high $\lambda$.
  - $\lambda^-$: average fair odds line with low $\lambda$.
  - If $\lambda$ is high ($\lambda^+$) $d$ does not make positive profit.
    - We found an equilibrium.
  - If $\lambda$ is low ($\lambda^-$) $d$ makes positive profit.
    - What we found is not an equilibrium.

- Note that High risk are fully insured.
  - $D_H = 0, \quad I_H = p_H L$.
- Low risk is partially insured at a lower premium.
  - $D_L = 0, \quad I_L < I_H$.
- This is the only way to separate Low risk from High.
  - Low risk is willing to accept higher deductible.
    - deductible is paid in case of an accident, which is a lower probability event for Low risk.
  - In exchange for a lower premium.
- Compared to complete information case.
  - Low risk is worse off.
  - High risk is indifferent.
  - Companies still make zero profit.
- Asymmetric information has a welfare cost.

- What is going on?
  - In the candidate separating equilibrium Low risk gets low insurance coverage.
    - they don’t like this because they are risk averse.
  - They prefer a pooling policy such as $d$ although they are cross-subsidizing high risk.
  - If the proportion of High risk ($\lambda$) is low, a firm can offer $d$, attract both types and still make profit.
  - This destroys the candidate equilibrium.
Summary: Adverse Selection in Insurance Markets

- There is no pooling equilibrium
- There may not be a separating equilibrium either
- If there is an equilibrium
  - High risk gets full insurance at higher premium
  - Low risk gets partial coverage at lower premium
- There is a welfare cost of adverse selection
  - entirely borne by Low risk individuals