CHAPTER 8
ADVERSE SELECTION

The health insurance market: an example

Table 1. Seller Cost and Buyer Value in Part 1

	Type 1 Buyer	Type 2 Buyer
Cost to seller	$40	**$70**
Value to buyer	**$50**	**$90**

The health insurance market

- Insurance companies (IC) can accurately assess the each customer's risk-type.
- Customers (C) are willing to pay for the insurance according to their type (expected healthcare costs).
- **Symmetric information:** IC and C have symmetric info about C's risk-type.

The health insurance market

- **Pareto-improving transaction:** a transaction that leaves all parties at least no worse off
- One goal of a market is to make sure all Pareto-improving transactions take place
- In the market we have described, there is nothing to stop all Pareto-improving transactions from taking place
- All costumers buy an insurance and if in perfect competition the premium is equal to the cost

Asymmetric information

- **Definition:** *a situation in which agents in a potential economic transaction do not have the same information about the characteristics of the good being transacted*
- **Assumption:** C know their type but IC does not.
  - C look identical to IC
- The policy is offered at a given price (as in case of community rating).

Seller Cost and Buyer Value in Part 1

	Type 1 Buyer	Type 2 Buyer
Cost to seller	$40	**$70**
Value to buyer	**$50**	**$90**

- 100 individuals: 50 type 1 and 50 type 2
- IC expected cost for a policy sold to C of «unknown» type:

  40x0.5 + 70x0.5 = 55 >50
- In **perfect competition** this would be the (fair) premium offered
- →Only risky type 2 are willing to buy the policy and Low risk type 1 leave the market.

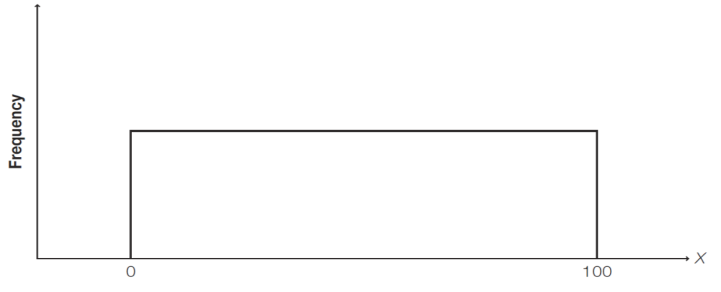
This is an example of ***adverse selection***

Adverse selection

- **Definition:** *Due to asymmetric information, participants who know they are high-risk are more likely to buy health insurance(self-select into the market), while low-risk participants withdraw*
- Adverse selection arises from **asymmetric information**, and it can lead to inefficient market outcomes (**market failures**)

Uniform distribution of types

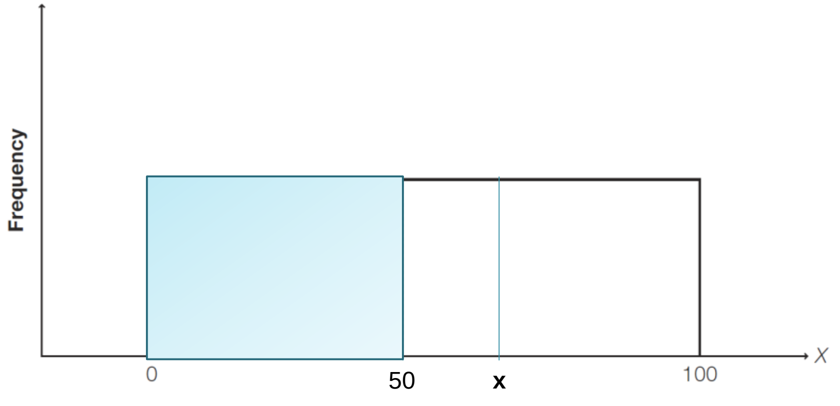
- Types are identified by their (expected) healthcare expenditure (HCE).
- (Expected) healthcare expenditure *X* is uniformly distributed between 0 and 100
- C are equally likely to be of any given type i.e. to have any level of HCE between 0 and 100



Random variables

- x is a random variable in *[a, b]*
- Discrete (x1, x2, … xn)
  - (p1, p2, ….pn)
  - $\sum x_i p_i$
- Continuous
  - f(x) density function: f(**x**)=prob(x=**x**)
  - F(x) cumulative distribution function: F(**x**)=prob(x<**x**) ***F(a)=0 F(b)=1***, why?
  - $E(x) = \int_a^b f(x)dx$

The uniform distribution in [0, 100]



f(**x**)= 1/100 F(**x**)= **x**/100 F(100)=1

E(x)=50 **F(50)=?**

Conditional expectation

- Conditional expectation: expected value of the random variable, given that a certain condition occurs
- x is HCE
- p is the premium
- E(x/p) = expected HCE knowing that the premium is p.
  - Only C with HCE higher than p will buy → the expected HCE given the premium is (100+**p)/2**

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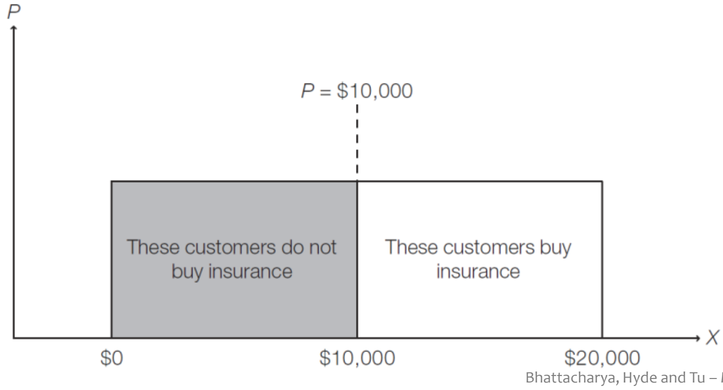
Health insurance market

- Suppose the insurer offers a contract with premium $10,000 for the year.
- What happens? Who stays in the market?



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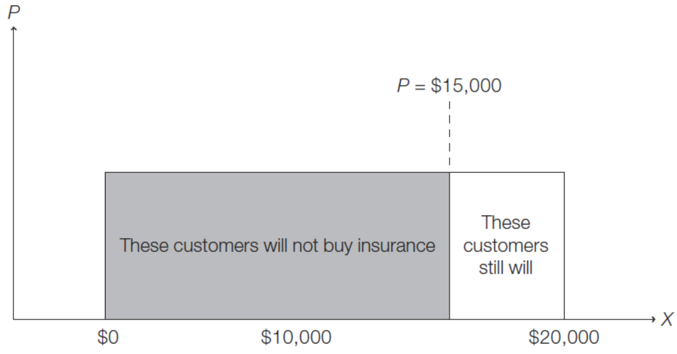
Health insurance market

- Only the least healthy people buy insurance; their average health expenditures are $15,000.
- The insurer raises premiums to $15,000 the next year.



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Adverse selection death spiral

- There is nothing to stop this cycle, which is called an *adverse selection death spiral*.
- **Definition:** successive rounds of adverse selection that destroy an insurance market.
- The heart of the problem is adverse selection: only the worst customers stay in the market when the insurer sets the premium.
- No way for the insurer to turn a profit in this very simple model.

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Akerlof market for "lemons"

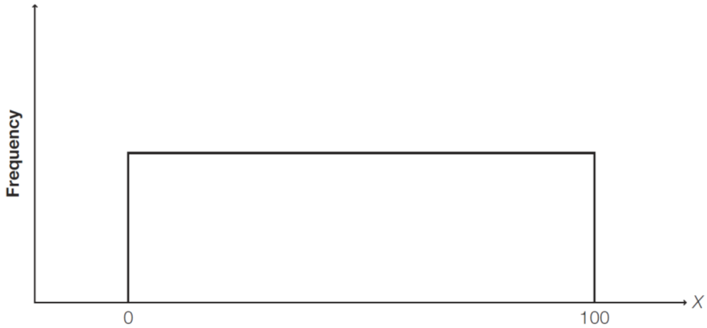
- Imagine a well-functioning **used car market**
- Sellers advertise cars, and buyers can accurately assess the condition of each car for sale
- Some buyers will be willing to pay more for cars in good condition; others are happy to get a deal
- **Symmetric information**: buyers and sellers have symmetric info about car quality.
- **Outcome**: *each car sells for a different price, depending on its quality*

Asymmetric information

- **Assumption**: sellers can determine car quality, *but buyers cannot*
- <u>All cars look identically good to the buyers</u>
- This market will look different from the previous one in several ways:
  - *any cars that sell, sell for the same price*
  - *The best cars will not be offered on the market*
- **Outcome**: only the lower-quality cars stay on the market: ***adverse selection***

Distribution of car quality

- Car quality *X* is uniformly distributed between 0 and 100
- Cars are equally likely to have any quality level between 0 and 100
  - You are equally likely to have a car of quality level 50 as you are to have a car of quality 96, 17, π, 54.2828 or any real number between 0 and 100
- We use the term X_i to denote the quality of car *i*



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Seller and buyer (linear) utility functions

- **Risk neutrality**
- Sellers and buyers derive utility from the cars they own and other goods
- Buyers value cars 50% more than sellers (that's why they are buyers in the first place)
- X_j = quality of the *j*th car owned
- M = utility from other goods

$$U_S = \sum_{j=1}^{n} X_j + M$$

$$U_B = \sum_{j=1}^{n} \frac{3}{2} X_j + M$$

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Information assumptions

- Buyers do not know the true quality of a particular car, but they know the *utility function of the sellers* and know the *distribution* of cars available for sale.

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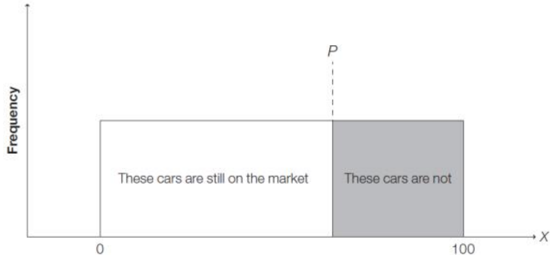
Which cars will sellers offer?

- A seller will put a car on the market if selling it will increase his utility.
- If a seller sells his car of quality *X* for *P* dollars, he loses *X* units of utility but gains *P* dollars
- Hence, he will only put car *j* on the market if $P > X_j$



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When will buyers buy?

- Figuring out when buyers buy is trickier due to uncertainty.
- Like sellers, buyers are trying to maximize utility. But think about a buyer who is considering buying a car of uncertain quality. How does she know what will happen to her utility?
- Buyers have to think in terms of *expected utility*.

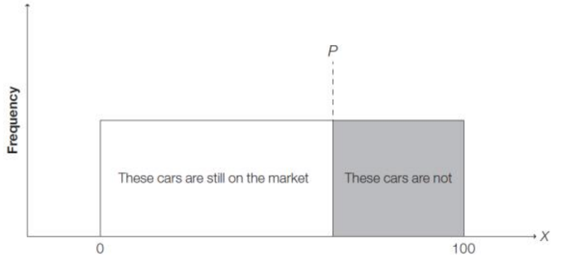
When will buyers buy?

- Suppose a buyer buys a car in this market.
- She pays *P* dollars and thus loses *P* units of utility.
- She gains a car with expected value E[*X*|*P*], so she gains 3/2 E[*X*|*P*] units of utility.
  - Remember, E[*X*|*P*] means "expectation of X conditional on P." We need to think about *P* because it affects sellers' decisions, and hence affects the distribution of quality X.
- Hence, buyers will buy if:

$$\frac{3}{2}E\left[X_i\right] \geq P$$

When will buyers buy?

- We need to find E[*X*|*P*] to decide if buyers will buy
- Remember the distribution of cars now:



- The formula for expectation for a uniform distribution is simply the average of the endpoints. So E[*X*|*P*] = ½ *P*

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When will buyers buy?

- We found E[*X*|*P*] = ½ *P*
- We plug that into our condition for buying:

$$3/2\ E[X|P] > P$$
$$3/2 * ½\ P > P$$
$$¾\ P > P$$

- This is impossible; hence **buyers will not buy for any *P*!**
- No cars sell, **no Pareto-improving trades take place,** the cars stay with sellers (who do not want them as much as the buyers do). The market unravels.

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What just happened?

- To review:
  - A single price P is somehow established in the market
  - Sellers remove all cars of quality greater than P
  - Of the cars that remain, the average quality ($E[X|P]$) is only ½ P
  - Buyers do not like cars enough to buy a car of quality ½ P for a price of P
  - No cars sell, even though buyers like cars better than sellers and all the cars "should" end up with buyers.

What does this used car market have to do with health insurance?

- The health insurance market is similar to the used-cars market :
  - Each customer *i* has an expected amount of health care costs over the course of the year X_i.
  - An insurance company offers a single policy with an annual premium P. This full insurance policy covers all health care costs incurred during the year.
  - Customers are risk-neutral. Customer *i* will purchase insurance if and only if P is less than his expected health care costs X_i.
  - The insurers cannot distinguish healthy and sick customers
  - Expected customer health care costs X_i are distributed uniformly in the population between $0 and $20,000.

What does this used car market have to do with health insurance?

- Analogy between these two markets
  - The "cars" are customers' bodies
  - The "sellers" are customers
  - The "buyers" are insurance companies
  - The sellers try to convince the buyers that the "cars" are healthy; just as a high-quality car is worth a lot to buyers, a healthy customer is worth a lot to insurers
  - Just like high-quality cars leave the market when a universal price is set, high-quality bodies will leave the market when a universal premium is set.

WHEN CAN THE MARKET FOR LEMONS WORK?

Ch 8 | Adverse Selection: Akerlof's Market for Lemons

What if buyers value cars very highly?

- Let's assume new utility functions:

$$U_S = \sum_{j=1}^{n} X_j + M$$

$$U_B = \sum_{j=1}^{n} \frac{5}{2} X_j + M$$

- Now buyers value cars much more than sellers. Will this fix the market?

What if buyers value cars very highly?

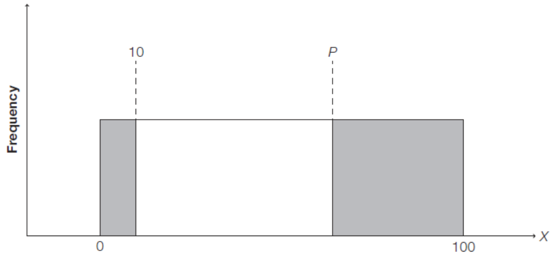
- We need a new condition for buyers:

$$\frac{5}{2} \mathrm{E}\left[X_{n+1}\right] \geq P$$

- Recall that E[X|P] = ½ P. This is unaffected by the buyers' utility function – why?
- The condition now holds: buyers will be willing to buy cars at price P. They know the remaining cars are bad but they value them highly enough to pay P for them.

What if there is a minimum guaranteed car quality?

- The condition for buyers is as it was before, but now E[*X*|*P*] will be different because a different subset of cars is on the market.



- This is promising: the worst cars were forced off the market, so the remaining cars are better.

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What if there is a minimum guaranteed car quality?

- When do buyers buy?
  - If 3/2 E[*X*|*P*] > *P*
- What is E[*X*|*P*]
  - Based on the formula for the expectation of a uniform distribution, E[*X*|*P*] = ½ * (P + 10)
- Buyers buy if:

$$3/2\ E[X|P] > P$$

$$3/2 * ½ * (P + 10) > P$$

$$3/4\ P + 15/2 > P$$

- Buyers will buy if the price is below $30.

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Conclusion

- Asymmetric information causes parties to misrepresent themselves
- Adverse selection removes high-quality goods from the market, leaving only low-quality
- Generally, the market will unravel unless:
  - Someone values a product highly enough to have a positive change in utility
  - Government regulation through a price floor promotes a minimum standard of quality
- **One major concept has been missing in this whole analysis: *risk aversion*.**
- The Rothschild-Stiglitz model combines asymmetric information and risk aversion.

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