Imperfect Information in Health Care Markets

Exercise Session 5 - Selection with fixed coverage

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Questions about the lecture

What are *loading factors* (Slide 11, Adverse Selection)?

↳ those things that insurances "load on top of their expected payouts" to consumers to calculate their premia
(could be administrative costs, profit margin, ...)

Exercise 7

The Wall Street Journal reported in 2006 of "mini-medical insurance plans". These plans cover routine services, but little hospital coverage and usually have a cap on payouts (say of \$10.000). The premium, however, is only \$50 per month. Why might people buy a mini-medical plan? Why are such insurance plans not more popular (in a country where a substantial part of the population did/does not have health insurance)?

Exc. 7

Why people might like such a plan:

- they might have a low WTP and \$50 a month is quite cheap (also, they are risk averse)

- acts as a kind of "consumption smoothing" → don't pay one big amount once, but several small amounts more often

Why are these plans not much more popular?

- large risks are not covered, so it is not really an insurance in the proper sense (people might anticipate / fear higher payments)

- in practice, these plans would probably be too expensive for insurances, since they compare

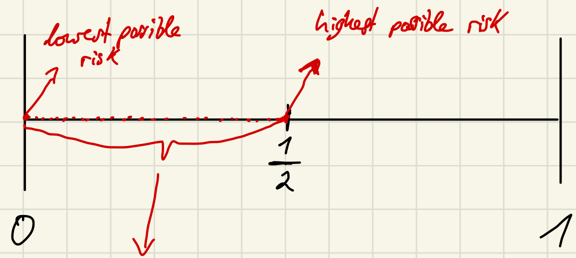
$$50 \overset{?}{>} \underset{\text{risk}}{\alpha} \cdot \underset{\text{loss}}{L} + \text{administrative costs} \quad (+ \text{profit margin})$$

Exercise 10

a) - e): What is the equilibrium? f) Why is it inefficient?
g) - j): What can be done to fix this?

We now have a continuum of people of length $1/2$. More precisely, we have a person i for each $i \in [0, 1/2]$. All people have the same utility function $u(x) = \sqrt{x}$ and the same income of 2500. However, they differ in terms of risk: Person i loses 1600 with probability i. We consider an insurance policy with full coverage, i.e. a policy that pays out 1600 in case of a loss. Every person knows his own risk but insurance companies cannot distinguish people (and will therefore have to offer the same premium to everybody).

a) Determine the willingness to pay for the insurance of person i.
b) For every possible insurance premium, how many people will buy insurance? Use your results to draw the demand for insurance.
c) Determine the marginal cost of person i.
d) Determine the average cost of insuring all people $i \geq j$, i.e. everyone in $[j, 1/2]$.



these are all the different people, the position on the line corresponds to their risk

Exercise 10 (cont.)

e) If many risk neutral insurance companies with no administrative costs are active on this market, what is the market equilibrium?

f) Is the market equilibrium efficient? If not, determine the size of the inefficiency. What would be welfare in "first best", i.e. in a situation in which everyone with a willingness to pay above marginal cost gets insurance? Determine the relative inefficiency due to adverse selection.

g) Consider an insurance subsidy to insurers, i.e. each insurer receives for each sold insurance a subsidy payment s. How high does s have to be to ensure efficiency?

h) Consider an insurance mandate (without subsidies), i.e. everyone is forced to buy an insurance contract. What is the equilibrium insurance premium? Who will benefit from the mandate? Who will lose out with the mandate?

Exercise 10 (cont.)

i) Suppose insurers can now distinguish two groups: The people $i \geq 0.3$ and the people $i < 0.3$. Assume that insurers are allowed to offer different contracts to these two groups. Consequently, there are now two separate markets. What is the equilibrium on the "high risk market"? What is the equilibrium on the "low risk" market? Is the new situation more or less efficient than the one considered in the previous subquestions? Who benefits from group discrimination and who does not?

j) With the previous subquestion in mind, what happens if insurers can identify people better? (For example, distinguish more and more subgroups as in the previous subquestion.) What are the consequences for welfare? Who benefits and who loses?

Exc. 10 a)

WTP = number that, if paid, gives you the same utility as the lottery = (maximal) willingness to pay to avoid the lottery

Certainty Equivalent ($\Rightarrow$ CE = W − WTP)

prob. of a loss

$$\Rightarrow \underbrace{u(2500 - WTP)}_{\text{Certainty Equivalent}} = i \cdot \sqrt{2500-1600} + (1-i)\cdot\sqrt{2500}$$

$$u(2500 - WTP) = \sqrt{2500 - WTP}$$

$$\Leftrightarrow \sqrt{2500 - WTP} = 30i + 50(1-i) = 50 - 20i$$

$$\Rightarrow 2500 - WTP = 2500 - 2000i + 400i^2$$

$$\Leftrightarrow 2000i - 400i^2 = WTP \quad (= WTP(i))$$

Exercise 10 b)

For every possible insurance premium, how many people will buy insurance? Use your results to draw the demand for insurance.

Exc. 10 b)

as the WTP goes up when i goes up

First, note that $i = \frac{1}{2}$ has the highest WTP of $WTP(\frac{1}{2}) = 2000 \cdot \frac{1}{2} - 400 (\frac{1}{2})^2$

$= 1000 - 400 \cdot \frac{1}{4} = 900$

So, nobody will buy an insurance if $p > 900$.

For every premium p, we know that someone with $WTP(i) = p$ will buy this insurance, as will everybody with $WTP > p$.

$\Rightarrow$ for every p, we look for the person i with $WTP(i) = p$.

$$p = WTP(i) = 2000i - 400i^2$$

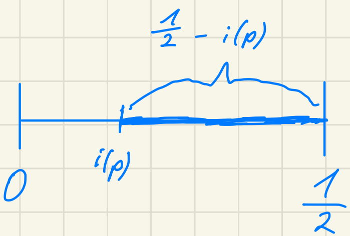
$$\Leftrightarrow \quad 400i^2 - 2000i + p = 0$$

$$\Leftrightarrow \quad i^2 - 5i + \frac{p}{400} = 0$$

$$\Rightarrow \quad \underset{i(p)}{\overset{\parallel}{i}} = 2{,}5 \; \cancel{+} - \sqrt{6{,}25 - \frac{p}{400}}$$

we want $i \in [0, \frac{1}{2}]$

→ for every p, this gives us the lowest person i that still buys insurance at premium p.

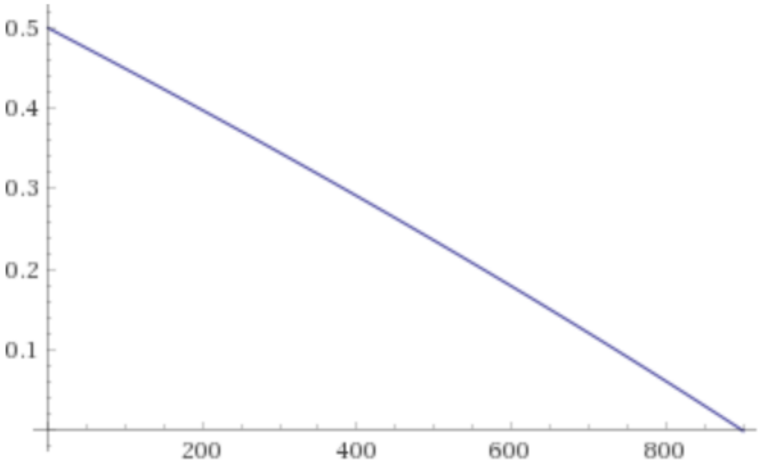


$$\Rightarrow D(p) = \frac{1}{2} - i(p) = \frac{1}{2} - 2{,}5 + \sqrt{6{,}25 - \frac{p}{400}}$$

$$= \sqrt{6{,}25 - \frac{p}{400}} - 2$$

demand of insurance at premium p

Plot of $D(p) = \sqrt{6.25 - \frac{p}{400}} - 2$



Exercise 10 c)

Determine the marginal cost of person i.

Exc. 10c)

The marginal cost of person i for the insurance is just $i \cdot 1600$.

Why is it called "marginal cost"?

→ insurer "produces" insurances

costs of insuring the guys between $\frac{1}{2}$ and i are

$$C(i) = \int_{\frac{1}{2}}^{i} j \cdot 1600 \, dj = \left[\frac{1600}{2} j^2\right]_{\frac{1}{2}}^{i} = \frac{1600}{2} \cdot i^2 - \frac{1600}{2} \cdot \frac{1}{4}$$

$$MC(i) = \frac{\partial C(i)}{\partial i} = \frac{\partial}{\partial i}\left(\frac{1600}{2} i^2\right) = 1600 \cdot i$$

Hence, the marginal cost is the cost for the last/marginal person that is insured.

Exercise 10 d)

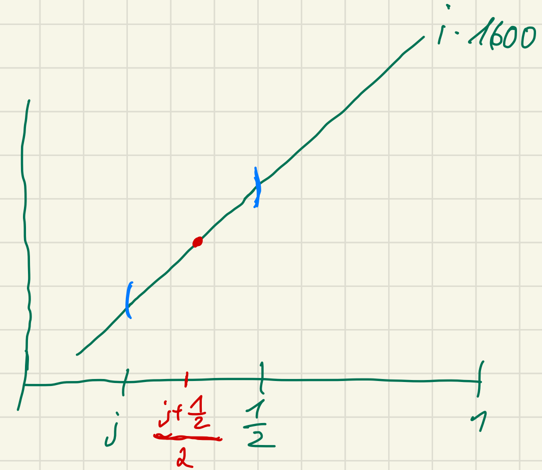
Determine the average cost of insuring all people $i \geq j$, i.e. everyone in $[j, 1/2]$.

Exc. 10 d)

Let us denote the average costs of insuring all people in $[j, \frac{1}{2}]$ by $AC(j)$.
We know that for every i in $[j, \frac{1}{2}]$, the marginal costs are $i \cdot 1600$.

$$\Rightarrow AC(j) = \frac{1}{2}\left(j \cdot 1600 + \frac{1}{2} \cdot 1600\right) = 800\left(\frac{1}{2} + j\right)$$

Why? This just takes the average between both borders of the interval $[j, \frac{1}{2}]$ (respectively both costs for these persons).



Alternatively, you can also compute the integral

$$\frac{1}{\frac{1}{2} - j} \int_j^{\frac{1}{2}} i \cdot 1600 \, di \overset{\text{compute}}{=} 800\left(\frac{1}{2} + j\right)$$

Exercise 10 e)

If many risk neutral insurance companies with no administrative costs are active on this market, what is the market equilibrium?

Exc. 10e)

When there is perfect competition, the premium p will equal the average costs the insurance has from insuring everyone who wants to buy insurance at this premium.

$$AC(i^*) = p = WTP(i^*)$$

holds due to perfect competition (insurances will make zero profit in equilibrium)

i^* is the lowest person who buys insurance at premium p.
(we want to find this person)

this holds because the lowest person that buys the insurance is exactly indifferent between buying and not buying (because his WTP is exactly p)

$$\Rightarrow AC(i^*) \overset{!}{=} WTP(i^*)$$

$$\Leftrightarrow 800\left(\frac{1}{2} + i^*\right) = 2000\, i^* - 400\, i^{*2}$$

$$\Leftrightarrow 400\, i^{*2} - 1200\, i^* + 400 = 0$$

$$\Leftrightarrow i^{*2} - 3\, i^* + 1 = 0$$

$$\Rightarrow i^* = 1{,}5 - \sqrt{2{,}25 - 1} \approx 0{,}38$$

as we look for a solution in $[0, \frac{1}{2}]$

$$p = AC(0{,}38) = 800 \cdot \left(\frac{1}{2} + 0{,}38\right) = 704$$

$\Rightarrow$ In equilibrium, the premium will be 704 and the full insurance contract will be bought by everyone in $[0{,}38 ; 0{,}5]$ and everybody else remains uninsured.

Exercise 10 f)

Is the market equilibrium efficient? If not, determine the size of the inefficiency. What would be welfare in "first best", i.e. in a situation in which everyone with a willingness to pay above marginal cost gets insurance? Determine the relative inefficiency due to adverse selection.

Exc. 10 f)

Let us compute total welfare in the equilibrium from e):

$$\int_{0,38}^{0,5} \underbrace{WTP(i) - \cancel{p}}_{\text{welfare of person } i} + \underbrace{\cancel{p} - MC(i)}_{\text{welfare insurance gets from person } i} \, di = \int_{0,38}^{0,5} WTP(i) - MC(i) \, di$$

$$= \int_{0,38}^{0,5} 2000i - 400i^2 - 1600i \, di = 400 \cdot \int_{0,38}^{0,5} i - i^2 \, di = 400 \left[\frac{1}{2} i^2 - \frac{1}{3} i^3\right]_{0,38}^{0,5} \approx 11,584$$

Efficiency: Everyone with WTP > MC is insured.

$$WTP(i) - MC(i) = 2000i - 400i^2 - 1600i = 400i - 400i^2 > 0 \quad \text{for all } i \text{ in } [0, \tfrac{1}{2}]$$

$\Rightarrow$ efficient to insure <u>everyone</u>.

Total welfare from insuring everyone:

$$\int_{0}^{0,5} WTP(i) - MC(i) \, di = 400 \left[\frac{1}{2} i^2 - \frac{1}{3} i^3\right]_{0}^{0,5} \approx 33,333$$

everyone insured → 0

Relative inefficiency: $\frac{33,333 - 11,584}{33,333} \approx 0,653$ $\Rightarrow$ There is quite an efficiency loss due to adverse selection.

Exercise 10 g)

Consider an insurance subsidy to insurers, i.e. each insurer receives for each sold insurance a subsidy payment s. How high does s have to be to ensure efficiency?

Exc. 10 g)

With the subsidy, the average costs of the insurance are now given by

new average costs with subsidy

$$AC^S(i) = AC(i) - S$$

In equilibrium, $AC^S(i) = WTP(i)$, where i is the lowest type who buys insurance.

To get efficiency, we want $i = 0$.

$$\Rightarrow \quad AC^S(0) \overset{!}{=} WTP(0)$$

$$\Leftrightarrow \quad AC(0) - S \overset{!}{=} 0$$ WTP of 0 type

$$\Leftrightarrow \quad 800 \cdot \left(\tfrac{1}{2} + 0\right) = S$$

$$\Leftrightarrow \quad 400 = S$$

To ensure efficiency, the subsidy payment has to be 400.

Exercise 10 h)

Consider an insurance mandate (without subsidies), i.e. everyone is forced to buy an insurance contract. What is the equilibrium insurance premium? Who will benefit from the mandate? Who will lose out with the mandate?

Exc. 10 h)

In equilibrium under perfect competition, insurances will make zero profits.

$$\Rightarrow \quad p \overset{!}{=} AC(0)$$

$$\Rightarrow \quad p = 400$$

Who benefits from the mandate?

→ Everyone with a WTP of more than 400 benefits.

Who is worse off with the mandate?

→ Everyone with a WTP of less than 400 is worse off.

Exercise 10 i)

Suppose insurers can now distinguish two groups: The people $i \geq 0.3$ and the people $i < 0.3$. Assume that insurers are allowed to offer different contracts to these two groups. Consequently, there are now two separate markets. What is the equilibrium on the "high risk market"? What is the equilibrium on the "low risk" market? Is the new situation more or less efficient than the one considered in the previous subquestions? Who benefits from group discrimination and who does not?

Exc. 10 i)

In the equilibrium on the "high risk market" ($i > 0{,}3$), everything is as before.

(Remember that only people in $[0{,}38 ; 0{,}5]$ bought the contract)

What happens on the "low risk" market?

If one type i in $[0; 0{,}3)$ buys a contract, everyone in $(i ; 0{,}3)$ will also buy this contract.

The new average costs for the insurance in this low risk market are given by

$$AC^{new}(i) = 1600 \cdot \frac{0{,}3 + i}{2} = 800\,(0{,}3 + i)$$

In equilibrium: $AC^{new}(i^*) = p^* = WTP(i^*)$

$$\Rightarrow 800\,(0{,}3 + i^*) = 2000\,i^* - 400\,i^{*2}$$

$$\Leftrightarrow 400\,i^{*2} - 2000\,i^* + 800\,i^* + 240 = 0$$

$$\Leftrightarrow i^{*2} - 3\,i^* + 0{,}6 = 0$$

$\Rightarrow$ as we look for a type $i^* \in [0; 0{,}3)$

$$\Rightarrow i^* = 1{,}5 - \sqrt{2{,}25 - 0{,}6} \approx 0{,}215$$

$\Rightarrow$ on the low risk market, everyone in $(0{,}215 ; 0{,}3)$ buys a contract at premium $800\,(0{,}3 + 0{,}215) = 412$.

- this situation is more efficient as more people are insured
- people in $[0{,}215 ; 0{,}3)$ benefit as they get an insurance at a premium below their WTP
- everyone else is as well off as before

Exercise 10 j)

With the previous subquestion in mind, what happens if insurers can identify people better? (For example, distinguish more and more subgroups as in the previous subquestion.) What are the consequences for welfare? Who benefits and who loses?

Exc. 10 j)

more groups: problem of adverse selection essentially disappears, as $AC < WTP$ for all / nearly all people

$\longrightarrow$ (almost) everyone buys insurance

$\Rightarrow$ welfare increases, people in $[0; 0{,}38]$ will benefit compared to one group,

but people in higher groups might lose

(for example those who are close to 0,5 as they will be offered a higher premium contract than in the one group case)