Imperfect Information in Health Care Markets

Exercise Session 8 - Genetic Tests and Premium Risk

Questions about the lecture

Exercise 17

Assume that all people in our economy are similar and have the same Bernoulli utility function $u(x) = \sqrt{x}$. A person has wealth $W = 9$ and falls ill with probability $1/2$. When falling ill the person needs treatment costing $L = 5$. Assume that many insurance companies without administrative costs compete perfectly in the insurance market.

a) Determine the risk premium of a consumer for a full coverage contract. What contract will be offered in equilibrium?

Exc. 17 a)

RP = what the consumer would pay more than his expected costs to avoid the lottery.

$E(x) = \frac{1}{2} \cdot 9 + \frac{1}{2} \cdot (9-5) = 6,5$ expected income

$E(u) = \frac{1}{2} \cdot \sqrt{9} + \frac{1}{2} \sqrt{9-5} = 2,5$ → expected utility without insurance

RP is given by $u(E(x) - RP) = E(u)$

$\Rightarrow \sqrt{6,5 - RP} = 2,5$

$\Rightarrow 6,5 - RP = 6,25$

$\Leftrightarrow RP = 0,25$

in equilibrium: full coverage contract at a fair premium $p = 0,5 \cdot 5 = 2,5$

(this leads to an expected utility $E(u) = \sqrt{9 - 2,5} \approx 2,55$)

↳ expected utility from insurance contract

Exercise 17 b)

Suppose a genetic test becomes available: The test results can be either "high risk" (h) or "low risk" (l). Those that test have a 50% chance of getting either result. High risk people have probability 3/4 and low risk people have the probability 1/4 of falling ill.

1. Calculate the risk premium of an *h* type and the risk premium of an *l* type (again using a full coverage contract).
2. Assume everyone gets tested and the insurance companies can make their contracts dependent on the test result. What contracts will they offer? How do profits and expected utility change compared to a)?
3. Assume that insurance companies are prohibited from making their contracts contingent upon the test results. How do expected utility and insurance profits change compared to a)? (Note: you do not have to calculate the equilibrium contracts to answer this question qualitatively.)

Exc. 17 b)

1. h-type's utility of no insurance:

$$E(u) = \frac{3}{4}\cdot\sqrt{9-5} + \frac{1}{4}\sqrt{9} = \frac{9}{4}$$

$$\longrightarrow \quad \frac{9}{4} \overset{!}{=} \sqrt{\underbrace{9-\frac{3}{4}\cdot 5}_{5{,}25 \,=\, \frac{84}{16}} - RP} \quad \iff \quad RP = \frac{3}{16}$$

l-type's utility of no insurance:

$$E(u) = \frac{1}{4}\sqrt{9-5} + \frac{3}{4}\sqrt{9} = \frac{11}{4}$$

$$\longrightarrow \quad \frac{11}{4} \overset{!}{=} \sqrt{9-\frac{5}{4}-RP} \quad \iff \quad \frac{121}{16} = \frac{124}{16} - RP$$

$$\iff \quad RP = \frac{3}{16}$$

2. offered contracts with observability:

full coverage contracts at premium $p_h = \frac{3}{4}\cdot 5 = 3{,}75$ for high type

and $p_l = \frac{1}{4}\cdot 5 = 1{,}25$ for low type

Profits are zero for insurances (perfect competition)

Expected utilities:

$E(u_h) = \sqrt{9-3{,}75} \approx 2{,}29$ for high type

$E(u_l) = \sqrt{9-1{,}25} \approx 2{,}78$ for low type

$\Rightarrow$ on average, $E(u) \approx 2{,}53 < \underset{\substack{\downarrow \\ E(u) \text{ in a) without tests}}}{2{,}55}$

3. equilibrium contracts given by the RS-model:

- h-type gets the same contract as in the observable case
- l-type gets a partial coverage contract he likes less than in the observable case

$\Rightarrow$ Consumer surplus is lower than in the observable case, hence also lower than without tests.

Insurances still make zero profits.

Exercise 17 c)

Consider now a profit maximizing insurance monopolist. How does your answer in a) and b.1) and b.2) change?

Exc. 17c)

Remember from a): $RP = \frac{1}{4}$ without the test

the insurance monopolist will offer full insurance contracts at premium $p^{mon} = \underbrace{\alpha \cdot L}_{\text{fair premium under perfect competition}} + RP$

maximal amount the monopolist can extract

$$= 0,5 \cdot 5 + \frac{1}{4} = 2,75$$

in b.1): $RP = \frac{3}{16}$ for both types

$\Rightarrow$ the monopolist will offer the contracts

$p_h^{mon} = 0,75 \cdot 5 + \frac{3}{16} = \frac{63}{16}$, $q_h^{mon} = 1$ for the high type

and $p_\ell^{mon} = 0,25 \cdot 5 + \frac{3}{16} = \frac{23}{16}$, $q_\ell^{mon} = 1$ for the low type

in b.2): profits of the monopolist from each contract are $\pi = \overset{RP}{\frac{3}{16}} < \frac{1}{4} = \pi_{\text{without tests}}$

exp. utility of the high type: $E_h(u) = \sqrt{9 - \frac{63}{16}} = \sqrt{\frac{81}{16}} = \frac{9}{4}$

— " — low type: $E_\ell(u) = \sqrt{9 - \frac{23}{16}} = \sqrt{\frac{121}{16}} = \frac{11}{4}$

$\rightarrow$ on average, $E(u) = \frac{10}{4} = 2,5$, the same utility consumers had without the test

Exercise 18

In Germany (private) health insurers are required to charge a constant premium over the life cycle. We use the premium risk model from the lecture: 2 periods, income W in each period, everyone has low risk α_l of a loss L in period 1, probability $1 - \lambda$ of an increase of risk to α_h in period 2, perfect competition.

a) Calculate the constant premium that yields zero expected profits to insurers under the assumption that no one switches insurers in period 2.

Exc. 18 a)

What are the expected costs for the insurance in period 1 and 2?

In period 1: $\alpha_e \cdot L$

In period 2: $(\lambda \cdot \alpha_e + (1-\lambda) \cdot \alpha_n) \cdot L$

$\Rightarrow$ to make exactly zero profits, insurances will charge the constant premium

$$p = \underbrace{\frac{\alpha_e + \lambda \cdot \alpha_e + (1-\lambda) \cdot \alpha_n}{2} \cdot L}_{\text{average expected costs per period}}$$

Exercise 18 b)

Given the premium from the previous subquestion, what would happen if consumers could switch insurers in period 2?

Exc. 18 b)

low risk types would want to switch insurers as $\alpha_l < \frac{\alpha_l + \lambda \alpha_l + (1-\lambda)\alpha_h}{2}$

↳ in period 2

<u>and</u> insurances would offer them contracts at premium α_l due to perfect competition.

Exercise 18 c)

Compare the premium of the first subquestion with the premiums under "guaranteed renewal". What are the implications?

Exc. 18c)

guaranteed renewal: the insurance guarantees the same premium in the second as in the first period for same fee the consumer pays in the first period (additional to his premium)

→ consumer pays for the risk of an increase in risk level in period 2 already in period 1, hence no one has an incentive to switch in period 2

premia under guaranteed renewal:

$$p_1^g = \underset{\substack{\downarrow \\ \text{fair insurance} \\ \text{premium}}}{\alpha_e \cdot L} + \underbrace{(1-\lambda)\,(\alpha_h - \alpha_e) \cdot L}_{\substack{\text{fee for premium guarantee} \\ = \text{expected added cost for insurancer} \\ \text{in period 2}}}$$

$$p_2^g = \alpha_e \cdot L$$

implications: now, the consumer pays in total a higher amount in period 1 and a lower amount in period 2. This might lead to budget constraints.

Exercise 18 d)

Suppose now that in period 2 everyone's health deteriorates. More precisely, assume that the risk is $\alpha_m > \alpha_l$ with probability λ and $\alpha_h > \alpha_m$ with probability $1 - \lambda$.

1. Calculate the constant premium that yields zero profits to insurers (without switching).
2. Compare it to the premiums with "guaranteed renewal".

Exc. 18d)

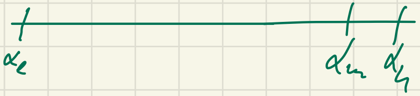
1. constant premium that yields zero profits to insurers:

$$p^{const} = \frac{\alpha_l + \lambda \alpha_m + (1-\lambda)\alpha_h}{2} \cdot L$$

2. guaranteed renewal: (where the lower premium $\alpha_m \cdot L < \alpha_h \cdot L$ is guaranteed for period 2)

$$p_1^g = \alpha_l \cdot L + (1-\lambda)(\alpha_h - \alpha_m) \cdot L$$

$$p_2^g = \alpha_m \cdot L$$



- note: for $\alpha_m \approx \alpha_h$ being very large compared to α_l,

  $p^{const} < p_2^g$ is possible. So you would pay more in the second period

  $\Rightarrow$ in general, it is not so clear whether budget constraints are relaxed more by the constant premium

Exercise 19

Discuss the advantages and disadvantages of using ”last year health care expenditures of insured” as an explanatory variable in a risk adjustment scheme.

Exc. 19

advantages:
- reduces the incentives for insurances to engage in risk selection (but this might be achieved with other measures as well)
- in theory, much higher prediction power as health care expenditures tend to be serially correlated

disadvantages:
- reduced incentives for insurers to cut costs (high expenditures today lead to high payments next year)
  => more waste has to be expected
- variable not available for new inflow (kids, people from abroad,...)

Conclusion:
- expenditure should not include administrative costs or costs of bonus benefits (gym subscription,...)
- HCC might be a better measure since it is harder for the insurance to misrepresent it
  ↳ "hierarchical coexisting conditions"