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Exam for EC 2110, Uncertainty and asymmetric information, 8 January 2017

1. Short questions:

a) Hen has the following elementary utility function: $v(c) = \sqrt{c}$, where c is the value of Hen's fortune which consists of a bike worth 3600. Hen has to take a decision on whether to buy bike theft insurance. The likelihood of the bike being stolen is $\frac{1}{6}$. Calculate the highest premium that Hen is willing to pay for full insurance.

b) Consider an economy consisting of two individuals (A and B), who will end up in state 1 with probability π and in state 2 with probability $1 - \pi$. Individual A is endowed with state claims $(\overline{c}_1^A, \overline{c}_2^A)$, and individual B is endowed with state claims $(\overline{c}_1^B, \overline{c}_2^B)$. Both individuals are risk averse. Their elementary utility functions are $v_A(c)$ and $v_B(c)$. It is possible for A and B to trade state claims. Let (c_1^{A*}, c_2^{A*}) and (c_1^{B*}, c_2^{B*}) denote the market equilibrium amounts of state claims. State all six conditions that need to be satisfied to obtain the market equilibrium under uncertainty. (Note: You are not supposed to calculate the equilibrium outcome. Just state the conditions that have to be satisfied.)

c) Which are the two main types of hidden information? Explain briefly how deductibles can be used to deal with these two types of informational asymmetry in the insurance market.

d) Consider a farmer (the agent) who needs to borrow money to grow crops. The farmer turns to a bank (the principal) which provides a loan of size k (at cost k). The repayment of the farmer is given by t. The bank's profit is thus given by $V = t - k$. The value of the farmer's output P is determined by the size of the loan and his/her type: $P(k, \Theta) = 3\Theta k^{\frac{1}{3}}$, where $\Theta = \underline{\Theta} = 1$ if the farmer is inefficient and $\Theta = \overline{\Theta} = 4$ if the farmer is efficient. (Note: a higher Θ implies higher efficiency!) The farmer's profit is given by $U_\Theta = P(k, \Theta) - t$. The bank has no information regarding the efficiency of the farmer, but knows that the share of efficient farmers is ν. State the bank's optimization problem and the two relevant constraints that are binding given that it has all bargaining power. Use the two binding constraints to simplify the bank's optimization problem (i.e. express the bank's expected payoff in terms of $\underline{k}$ and $\overline{k}$ only).

2. Consider a labor market with two types of workers. Type 0 has a marginal productivity of $\Theta_0 = 1$ and an outside opportunity wage of $w_0(\Theta_0) = 1$. Type 1 has a marginal productivity of $\Theta_1 = 3$ and an outside opportunity wage of $w_0(\Theta_1) = 2$. The cost of education z is given by $C(z, \Theta_0) = \frac{z}{\Theta_0} = z$ for type 0 and $C(z, \Theta_1) = \frac{z}{\Theta_1} = \frac{z}{3}$ for type 1. A worker's utility function is given by $U(w, z, \Theta) = w - C(z, \Theta)$. The share of type 0 workers is given by $\frac{3}{4}$. Workers know their own type but the employer cannot tell the high from the low productivity workers.

   a) In the absence of any educational screening, will there be adverse selection in the market?

   b) When educational screening is possible, what contract will be offered to type 1 workers if there is just one monopsonist employer? For simplicity assume that, if two contracts yield the same level of utility, a type 0 worker prefers the one with less education. Illustrate your answer in a figure with wage on the y-axis and the amount of education on the x-axis.

   c) What contract will be offered to type 1 workers if there are many employers competing for workers? Illustrate your answer in the same figure. What will type 1 workers utility be under this contract?

   Now assume that type 2 workers enter the labor market. Type 2 has a marginal productivity of $\Theta_2 = 4$ and an outside opportunity wage of $w_0(\Theta_2) = 2$. The cost of education z is given by $C(z, \Theta_2) = \frac{z}{\Theta_2} = \frac{z}{4}$ for type 2 workers, and the utility function is given by $U(w, z, \Theta) = w - C(z, \Theta)$ as above.

   d) Given that a separating equilibrium is feasible, what contract will be offered to type 2 workers when there are many employers? For simplicity assume that, if two contracts yield the same level of utility, a type 1 worker prefers the one with less education. Illustrate your answer in the same figure as above. What will type 2 workers utility be under this contract?

   e) Assume that the average productivity of type 1 and type 2 workers is given by $\overline{\Theta}_{12} = 3.3$. Explain why no employer has an incentive to offer a pooling contract to type 1 and type 2 workers. Identify the most profitable pooling contract that an employer can offer in the same figure as above.

3. The owner of a farm hires a worker to grow crops. The crop yield is random (depending on e.g. weather conditions), either high ($\overline{S} = 11$) or low ($\underline{S} = 2$). However, the probability of the crop yield being high π_e also depends on the effort $e \in \{0, 1\}$ that the worker exerts, such that $\pi_0 = \frac{1}{3}$ and $\pi_1 = \frac{2}{3}$. The cost that the worker incurs from exerting effort e is $\Psi(e) = e$. The farm owner, who is the only employer, offers a contract $(\underline{t}, \overline{t})$ that specifies the transfers to be paid to the worker, depending on the crop yield. The farm owner's expected profit is given by $EV_e = \pi_e(\overline{S} - \overline{t}) + (1 - \pi_e)(\underline{S} - \underline{t})$, and the worker's expected utility is given by $EU_e = \pi_e \overline{t} + (1 - \pi_e)\underline{t} - \Psi(e)$.

   a) State the participation constraint of the worker for contracts that specify effort $e = 1$.

   b) State the farm owner's optimization problem under complete information.

   c) What high-effort-inducing contract(s) will be offered?

   Assume now that information regarding the worker's actions is hidden to the farm owner.

   d) Which constraints need to be satisfied?

   e) What high-effort-inducing contract(s) will be offered?

   f) If the worker's liability is limited such that losses from transfers cannot exceed 0.5, which constraints need to be satisfied? What high-effort-inducing contract(s) will be offered?

   g) Provide an intuitive explanation for why hidden action and limited liability lead to a decrease in the farm owner's profit in this model. (No formulas, just words!)

   h) Illustrate your answers in c), e) and f) in a figure, with $\underline{t}$ on the x-axis and $\overline{t}$ on the y-axis.