Stockholm University
Department of Economics

Course name:	**The Economics of Uncertainty and Asymmetric Information**
Course code:	**EC2110**
Type of exam:	**Written exam**
Examiner:	**Mathias Herzing**
Number of credits:	**7,5 credits**
Date of exam:	**Thursday 10 January 2019**
Examination time:	**3 hours [14:00-17:00]**

Write your identification number on each answer sheet (the number stated in the upper right hand corner on your exam cover).

Start each new question on a new answer sheet.

Explain notions/concepts and symbols. If you think that a question is vaguely formulated, specify the conditions used for solving it. Only legible exams will be marked.

No aids are allowed.

The exam consists of 3 questions. The maximum score of question 1 is 32 points. The maximum score of questions 2 and 3 is 34 points each. The maximum score on the exam is 100 points in total. For the grade E 45 points are required, for D 50 points, for C 60 points, for B 75 points and for A 90 points.

Your results will be made available on your Ladok account (www.student.ladok.se) within 15 working days from the date of the examination.

Good luck!

Department of Economics, Stockholm University
Mathias Herzing
Exam for EC 2110, Uncertainty and asymmetric information, 10 January 2019

1. Short questions:

a) What is a "complete asset market"? State all the conditions that need to be satisfied for an asset market to be complete.

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 $(\bar{c}_1^A, \bar{c}_2^A)$, and individual B is endowed with state claims $(\bar{c}_1^B, \bar{c}_2^B)$. 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) Consider an entrepreneur (the agent) who needs to borrow money for a project. The entrepreneur turns to a bank (the principal) which provides a loan of size k (at cost k). The repayment of the entrepreneur is given by t. The bank's profit is thus given by $V = t - k$. The value of the entrepreneur's output P is determined by the size of the loan and his/her type: $P(k, \Theta) = 2\Theta k^{\frac{1}{2}}$, where $\Theta = \underline{\Theta} = 1$ if the entrepreneur is inefficient and $\Theta = \overline{\Theta} = 4$ if the entrepreneur is efficient. (Note: a higher Θ implies higher efficiency!) The entrepreneur's profit is given by $U_\Theta = P(k, \Theta) - t$. The bank has no information regarding the efficiency of the entrepreneur, but knows that the share of efficient entrepreneurs 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).

d) In the case of hidden-knowledge type of asymmetric information the principal faces the problem of incentive compatibility when designing contracts for different types of agents. Explain why the principal might have an incentive to renegotiate after an agent has chosen a contract. Is renegotiating contracts an equilibrium outcome?

2. Consider an insurance market where the type of insurees is hidden knowledge. Each individual owns a bike worth 25. An individual of type $\underline{\Theta}$ has a probability $\underline{\Theta} = \frac{1}{5}$ of his/her bike being stolen (low-risk type), while an individual of type $\overline{\Theta}$ has a probability $\overline{\Theta} = \frac{2}{5}$ of his/her bike being stolen (high-risk type). The share of type $\underline{\Theta}$ agents is given by $\nu = \frac{3}{5}$. The utility of each individual is given by $u = \sqrt{w}$, where w represents the individual's wealth, which is given by the value of the bike (0 if stolen, 25 else). By purchasing full insurance at premium P, $w = 25 - P$ irrespective of the bike being stolen or not. An individual will buy insurance whenever the expected utility from having insurance $EU(I)$ is at least as large as the expected utility from not being insured $EU(NI)$, i.e. whenever $EU(I) \geq EU(NI)$.

a) For type $\underline{\Theta}$, what is the expected utility of not buying insurance? Determine the highest premium $\widehat{P}_{\underline{\Theta}}$ that a type $\underline{\Theta}$ individual is willing to pay for full insurance.

b) For type $\overline{\Theta}$, what is the expected utility of not buying insurance? Determine the highest premium $\widehat{P}_{\overline{\Theta}}$ that a type $\overline{\Theta}$ individual is willing to pay for full insurance.

c) If $P \leq 9$, which type(s) buy(s) insurance? What is the expected loss per insuree?

d) If $P \in (9, 16]$, which type(s) buy(s) insurance? What is the expected loss per insuree?

e) If $P > 16$, which type(s) buy(s) insurance? What is the expected loss per insuree?

f) Which premium will be offered in a perfectly competitive insurance market?

g) Which premium will be offered by a monopolistic supplier of insurance?

h) So far we have only considered pooling contracts. Explain how insurance contracts could be designed to make it possible to offer separating contracts, one for each type of individual. (No calculations, just words!)

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 ($\overline{S} = 10$) 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 $\pi_0 = \frac{1}{4}$ and $\pi_1 = \frac{1}{2}$. 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 $\frac{1}{2}$, 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 profits in this model. (No formulas, just words!)

h) Illustrate all constraints and your answers in c), e) and f) in a figure, with $\underline{t}$ on the horizontal axis and $\overline{t}$ on the vertical axis.