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1. Short questions:

a) Consider an individual who may end up in two states. Unfortunately it is not possible to directly trade in state claims. However, there exists an asset market where it is possible to buy and sell assets. The following matrix illustrates how much available assets yield in the two states:

	State 1	State 2
Asset A_1	$z_{11} = 2$	$z_{12} = 1$
Asset A_2	$z_{21} = 1$	$z_{22} = 2$

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It is not possible for the individual to go bankrupt, but he/she is allowed to hold a negative amount of an asset. State the four conditions that need to be satisfied for an asset market to be complete. Verify that each of these conditions is satsified for this asset market. (Note: you should demonstrate this by using the available information.)

b) Kim has the following elementary utility function: $v(c) = \sqrt{c}$, where c is the value of Kim's fortune which consists of a bike worth 100. The likelihood of the bike being stolen is 30%. Kim can choose between two different insurance contracts. Under insurance contract A the premium is $P_A = 36$ and there is no deductible. Insurance contract B specifies a premium of $P_B = 19$ and a deductible of $D_B = 32$. Which of the two insurance contracts does Kim prefer?

c) Provide four reasons for why we observe non-actuarial prices in the insurance market. What is the consequence of non-actuarial prices?

d) Consider a market with a monopsonist employer. There are two types of workers. Type 0 has marginal product $\Theta_0 = 1$ and an outside opportunity wage of $w_0(\Theta_0) = 1$. Type 1 has marginal product $\Theta_1 = 4$ and an outside opportunity wage of $w_0(\Theta_1) = 2.8$. The share of type 1 workers is given by $\frac{2}{3}$. Workers know their own type but the employer cannot tell the high from the low productivity workers. In the absence of any educational screening, will there be adverse selection in the market?

2. Consider a factory owner who needs to hire staff. The value of output produced is given by $S(q) = \frac{3}{2}q^{\frac{2}{3}}$, where q is the amount of effort exerted by an employee. The factory owner pays a wage t to employees. Profit per employee is thus given by $\pi = S(q) - t$.

   There are two types of employees who differ with respect to their cost of effort. Employees of type $\underline{\Theta} = \frac{1}{2}$ incur cost $C(q, \underline{\Theta}) = \frac{1}{2}q$, while employees of type $\overline{\Theta} = 1$ incur cost $C(q, \overline{\Theta}) = q$ when exerting effort q. Employees' utilities are given by $u_\Theta(q, t) = t - C(q, \Theta)$. The share of type $\underline{\Theta}$ agents is given by $\nu = \frac{2}{3}$.

   a) What are the socially optimal effort levels of each employee type?

   b) Will the socially optimal effort levels generate a social surplus?

   c) Which wages will be paid to employees if the factory owner has all bargaining power? Which is the first-best menu of contracts?

   d) Calculate the information rent that efficient employees can extract by mimicking inefficient employees.

   Assume now that information regarding employees' types is hidden to the factory owner.

   e) State the factory owner's optimization problem and all constraints that need to be satisfied. Which constraints are relevant? Explain why the other constraints are not relevant.

   f) Simplify the optimization problem by taking into consideration that the factory owner has all bargaining power. Solve the optimization problem to determine the second-best menu of contracts.

   g) Explain in words who gains and who loses when second-best contracts instead of first-best contracts are implemented? (Note: You are not supposed to calculate gains and losses!)

3. Consider an entrepreneur (the agent) who plans to set up a production facility. However, the entrepreneur needs to borrow an amount of I from a bank (the principal) to be able to carry out the project. If the bank offers a loan, the return from production equals $\overline{V} = 9$ with probability π_e and $\underline{V} = 3$ with probability $1 - \pi_e$, where $e \in \{0, 1\}$ represents the entrepreneur's effort level, and $\pi_1 = \frac{1}{3}$ and $\pi_0 = \frac{1}{6}$. The cost of exerting effort $e = 1$ is $\Psi_1 = 1$ (the cost of exerting no effort is zero).

   The loan contract specifies how much the entrepreneur has to pay back to the bank. If the return is high ($V = \overline{V}$), the entrepreneur has to make the repayment $\overline{z}$, and if the return is low ($V = \underline{V}$), the entrepreneur has to make the repayment $\underline{z}$. Hence, the entrepreneur will end up with $\overline{t} = \overline{V} - \overline{z}$ if the return is high and with $\underline{t} = \underline{V} - \underline{z}$ if the return is low. The risk neutral entrepreneur's expected profit is thus given by $EU_1 = \pi_1\overline{t} + (1 - \pi_1)\underline{t} - \Psi_1$ if $e = 1$ and $EU_0 = \pi_0\overline{t} + (1 - \pi_0)\underline{t}$ if $e = 0$. The bank's expected profit for offering a high-effort inducing loan contract is given by

$$EV_1 = \pi_1\overline{z} + (1 - \pi_1)\underline{z} - I = \pi_1(\overline{V} - \overline{t}) + (1 - \pi_1)(\underline{V} - \underline{t}) - I.$$

   a) State the participation constraint of the entrepreneur.

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

   c) Given that the bank is the only money lender, which contract(s) will be offered under complete information? Illustrate your answer in a figure, with $\underline{t}$ on the horizontal axis and $\overline{t}$ on the vertical axis.

   d) What will the bank's expected payoff for implementing the contract(s) be? For what range of I is it optimal to offer the high-effort inducing contract(s)?

   Now assume that information regarding the entrepreneur's actions is hidden to the bank.

   e) Which constraints need to be satisfied? Which contract(s) will be offered? Illustrate your answer in the same figure as above.

   f) What will the bank's expected payoff for implementing the contract(s) be? For what range of I is it optimal to offer the high-effort inducing contract(s)?

   Now assume that the entrepreneur's liability is limited such that no losses can be incurred.

   g) Which constraints need to be satisfied? Which contract(s) will be offered? Illustrate your answer in the same figure as above.

   h) What will the bank's expected payoff for implementing the contract(s) be? For what range of I is it optimal to offer the high-effort inducing contract(s)?

   i) Provide an intuitive explanation for why limited liability leads to a lower expected payoff for the bank. Assuming that there are many entrepreneurs who require different loan amounts I, explain how limited liability and moral hazard lead to an economically inefficient outcome.