Econ 101A
Section 21

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1 Asymmetric Information

- One key focus of the class after the second midterm is about market failures, where (Laissez-Faire) market equilibrium is, in general, not efficient.
- In this class, we focus on three forms of market failure: market power, asymmetric information, and externalities.
- **Asymmetric Information** occurs when one party has more information than the other.
- **Principal-agent problem** is a common framework for asymmetric information. Here is the basic framework:
  - Two entities involved in the game: a principal and an agent
  - The principal will offer some sort of contract to the agent
  - The problem: the principal does not know everything about the agent they are hiring, so they need to design their contract to generate their best-case scenario. In particular, they may not know:
    1. how the agent will act once they receive the contract - this is a **hidden action**, or **moral hazard** problem
    2. the type (e.g. quality) of the agent - this is a **hidden type** or **adverse selection** problem.
- Examples:
  - An employer (principal) is hiring a worker (agent). In this case, the employer may not know (1) how much effort the agent will put in once they are hired (moral hazard), or (2) if they are hiring a high-quality or low-quality worker (adverse selection)
  - A car insurance company (principal) is offering insurance to a driver (agent). In this case, the insurance provider may not know (1) if the driver will be more reckless once they buy insurance (moral hazard), or (2) if they are good/bad drivers to begin with (adverse selection).
  - A researcher is recruiting experiment participants by providing financial incentives. In this case, the researcher may not know (1) how much effort the participants will put in (moral hazard), or (2) if they are hiring a high-quality or low-quality participant (adverse selection)
- In a principle-agent problem, our goal is to find the **optimal decision/contract** of the principle, taking into account the optimal decision of the agent (Does this remind you of something we learned in game theory?)

2 Exercises

2.1 Moral Hazard

Consider the moral hazard (hidden action) problem which we considered in lecture. An agent is offered a contract $w = a + by$, where w is the wage, and y is the output, with $y = e + \varepsilon$, where e is (unobservable) effort and ε is noise with mean 0 and variance σ^2. $c(e)$ is the cost of effort. Remember that the risk-averse agent (with constant risk aversion parameter γ) has expected utility of a contract being equal to[1]

$$EU(e) = E[u(w) - c(e)] = E(w) - \frac{\gamma}{2}var(w) - c(e) = a + be - \frac{\gamma}{2}b^2\sigma^2 - c(e)$$

And the risk-neutral firm has expected profits

$$E\pi = E(y) - E(w) = e - E(w) = e - a - be$$

1. Interpret the terms in $EU(e)$.
2. Remember that effort is costly with cost of effort $c(e)$, which satisfies $c'(e) > 0$ and $c''(e) > 0$ for all e. Without solving for the overall problem, explain intuitively, but also as clearly as you can, why the firm will not set $b^* = 0$ in the optimum. What effort would workers choose for $b = 0$?
3. In light of this, explain qualitatively what it means that the firm is facing a risk-incentive trade-off in setting the optimal piece rate b^*.
4. Now, let's quickly solve an easy version of this model, using our friend Backward Induction:
   (a) Suppose $c(e) = \overline{c}e^2/2$ for some constant $\overline{c}$. Taking the wage contract as given, what is the level of effort that maximizes the agent's expected utility?
   (b) Suppose the agent has a reservation utility of $\overline{u}$. (This is different from lecture! In lecture, we just wanted utility to be non-negative. That is, we set $\overline{u} = 0$). What is the agent's participation condition, given e^* and wage $w(y)$? That is, what condition must be satisfied for the worker to take the contract?
   (c) Recall that the shareholder wants to maximize expected profits $\mathbb{E}[\pi] = e - a - be$. Solve for the optimal a and b given e^* (the optimal effort condition), the participation condition, and the other parameters in this problem (namely γ, σ^2, $\overline{c}$, and $\overline{u}$).

2.2 Adverse Selection (Problem 2, Final, Spring 2009)

Wisdom teeth are usually removed early in life as a preventive measure, to avoid problems that may happen in the future. It is more costly to remove the teeth once the problems have begun.

Suppose there are two types of wisdom teeth: those that are more likely to lead to problems in the future ("bad" teeth) and those that are less likely to lead to problems ("good" teeth). Specifically, assume a good set of teeth has a 10% chance of problems and a bad set of teeth has a 60% chance of problems. All future problems will cost \$500 to solve. However, if the wisdom teeth are removed early in life the probability of future problems is 0. There are N patients with wisdom teeth in Berkeley.

Assume the consumer does not discount between periods and has utility directly equal to his wealth: $u(\$x) = x$. Notice that this means he is risk-neutral.Suppose there is only one oral surgeon in Berkeley, and she operates as a monopolist in wisdom tooth removal. She faces marginal cost \$100 of removing any set of wisdom teeth, whether they are good or bad teeth.

1. How much is an individual willing to pay for the removal of a good set of wisdom teeth? And for the removal of a bad set of wisdom teeth?

[1] $E[u(w)] = E(w) - \frac{\gamma}{2}var(w)$ is a result of the exponential utility $u(w)$. If you are interested in the derivation, see for example: `https://www.tau.ac.il/~spiegel/teaching/corpfin/mean-variance.pdf`

2. First-best scenario: If consumers can identify whether their wisdom teeth are good or bad, what will the oral surgeon monopolist set as the price for removing wisdom teeth (p_{FB}), and which type(s) of teeth will be removed?

3. How much profit will the oral surgeon monopolist make per set of wisdom teeth?

4. Hidden type scenario: Now, suppose individuals cannot tell whether their teeth are good or bad, but they know that across the population, $\frac{2}{5}$ of all peoples teeth are "bad". Solve for the expected benefit to an individual of removing his wisdom teeth, given his (correct) beliefs about the likelihood of each type.

5. Given the expected benefit you found above, what price (p_{HT}) will the monopolist charge to remove a set of wisdom teeth when teeth have hidden type? Which type(s) of teeth will be removed in equilibrium?

6. Calculate the profit of the monopolist in this case (hidden type) and compare it to his profits in the case above (first best). (Remember that there are N patients, and $\frac{2}{5}$ of them have bad wisdom teeth.) Which case does she prefer? Interpret.

7. What about the consumers? compare the aggregate expected utility of all N consumers in the hidden type case with the aggregate in the first-best case. Which case is better, in aggregate?