

Advanced Game Theory

6. Signaling and screening

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Asymmetric information and its solutions.

Signaling: an *informed party* can communicate information by taking costly actions.

Screening: an *uninformed party* can extract information using clever contract design (only briefly)

Signaling

Can an informed party credibly communicate a piece of info to an uninformed party?

- An INSEAD student knows his/her **ability** X , and wish to communicate this to a recruiter.
 - ▶ The recruiter only knows that, at INSEAD, $X \sim U[0, 2]$
- The student could simply tell the recruiter X , but that won't work. Why?
- To simplify the problem:
 - ▶ ability converts 1-to-1 into output per year for every employer.
 - ▶ students' outside options are normalized to zero.

Back to prices and markets!

- If markets are competitive, then each input is paid its expected productivity.
- In this case:
 - ▶ *if ability was known*, each student would receive a wage equal to X .
 - ▶ *If ability is not known*, each student receives a wage equal to 1.

There is a nice class called AGT!

- Completely useless: it does not change X .
- But fun: students enjoyment $F > 0$.
- And tough: it costs C/X .

Case 1: recruiters do not observe who took AGT

- Who should take AGT?

- ▶ A student takes AGT as long as $F > C/X$ or $X > C/F$.



- What happens if F very small? if F very large?

Case 2: recruiters **do** observe who took AGT

- If only the “best” students take AGT, then the recruiter:
 - ▶ can make an inference about the student’s ability by observing the class choice.
 - ▶ the recruiter can offer wages that are contingent on the class choice.
- But now, **the pool of students who select into AGT** depends on:
 - ▶ F, C, X ,
 - ▶ the expected wage premium from attending AGT ...
 - ▶ ... which is a function of **the pool of students who select into AGT**.

Case 2: recruiters do observe who took AGT

- Suppose that there is a threshold \bar{X} such that:
 - ▶ all students with ability above \bar{X} take AGT,
 - ★ all students with ability below \bar{X} do not take AGT,
 - ★ the student with ability level exactly \bar{X} is indifferent between taking AGT or not.
 - ▶ If you do not take AGT, your wage is: $\bar{X}/2$.
 - ▶ If you take AGT your wage is: $(2 + \bar{X})/2$, and your utility is:

$$(2 + \bar{X})/2 + F - C/\bar{X}$$

- ▶ the student with ability level exactly \bar{X} is indifferent whenever

$$(2 + \bar{X})/2 + F - C/\bar{X} = \bar{X}/2$$

or $\bar{X} = C/(F + 1)$.

AGT observable vs AGT not observable.

- Who should take AGT?
- Even when $F = 0$?
- Who are the green types?
- Who benefits? Who loses?



Main lessons.

- Signals work because they are costly - but differentially so for different “types”.
- They reduce asymmetry of information.

The “supply” of signals.

- Suppose there is no class called AGT, and INSEAD is considering creating one.
- Is the introduction of AGT beneficial *to the students*?
 - ▶ What is the average payoff of INSEAD students **before** the creation of AGT?
 - ▶ What is the average payoff of INSEAD students **after** the creation of AGT?

$$\begin{aligned}
 & \underbrace{\frac{C}{2(F+1)}}_{\text{wage if no AGT}} \cdot \underbrace{\frac{C}{2(F+1)}}_{\text{prob. no AGT}} + \\
 & \left(\underbrace{\frac{C+2(F+1)}{2(F+1)}}_{\text{wage if AGT}} - \underbrace{E\left[\frac{C}{X} \mid \frac{C}{F+1} < X < 2\right]}_{\text{average cost of taking AGT}} + F \right) \cdot \underbrace{\left[1 - \frac{C}{2(F+1)}\right]}_{\text{prob. AGT}}
 \end{aligned}$$

which is **smaller than 1** if F is small.

Introducing AGT may hurt INSEAD students!!

The “supply” of signals.

- Suppose INSEAD can set a price P for attending AGT. What P should INSEAD choose?
 - ▶ Once a price P is set, the “enjoyment” of taking AGT becomes $F - P$
- What is the demand for AGT? The number of students with

$$\frac{C}{X} \leq 1 - P + F$$

- If INSEAD can decide the difficulty level C , what C should INSEAD choose?
 - ▶ What should the recruiter infer if you did not take AGT?
- What price P should INSEAD choose?

Takeaway from the model

- Conveying information is possible via signals: costly actions that are less costly for those with the attribute to convey,
- Collectively, signaling may be a bad idea...
 - ▶ Not buying a “signal” has a different meaning before and after the signal is introduced.
- ... but it is profitable for the signal provider.

Screening

Screening: when the uninformed party moves first.

- Creating situations in which the better-informed opponents' observable actions reveal their unobservable traits.
 - ▶ Example: the recruiter can **create a class called AGT to screen clever students**.
- More interestingly, **screening through the contract offered**.

Takeaway points for today.

- Conveying information is possible via signals: costly actions that are correlated with the attribute to convey,
 - ▶ Collectively, signaling may be a bad idea...
 - ▶ ... but it is profitable for the signal provider.
- Information can be extracted via screening:
 - ▶ example: different types of labor contracts.

Administration

- Third problem set will be available tomorrow, due on Monday 8pm.