UNIVERSITY OF OREGON

Uncertainty & Information Topics

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EC327 Game Theory

Outline

Topics and Definitions

What is Asymmetric Info?

- We already learned about *symmetric* uncertainty in the models where `Nature` makes a play that *neither* player can observe.
- But sometimes one player will know some things that other do not.

Asymmetric Information

describes situations in which some players have private information that is not accessible to other players.

What is Asymmetric Info?

If you are better informed than others:

- You might be able to *conceal* or *reveal misleading* information strategically in order to manipulate the beliefs of others about you
- You might instead want to *selectively reveal* the truth if it helps you.

If you are less informed than other players:

- You might want to *filter out the truth* from lies or misinformation.
- You could instead strategically *remain ignorant* in order to claim "credible deniability".

Behaviors in Asymmetric Info Games

Cheap Talk

I could let people in on my private info by directly talking to them. But if they know that I have potential incentives to *lie*, they might not believe my *cheap talk*.

Actions Speak Louder Than Words

Signaling

When I know something about myself that would benefit me if *others* knew, I might send a signal through my actions

Examples:

- A 4.0 GPA might signal to potential employers that you are hard-working.
- If you're in the market for a product and you're uncertain of its quality, a money-back guarantee might *signal* that it works.

Behaviors in Asymmetric Info Games

Screening

When I want to know something about *someone else's* private info, I might get them to take an action that would screen out people of different *types*.

Examples:

- An employer might not know if a job candidate is a *lazy* or *industrious* type of worker, but they could try to screen out the *lazy* ones by requiring a portfolio of previous work.

Effectiveness of Different Communication Strategies

When are different strategies effective in actually revealing private info?

- Sometimes direct communication works when players' interests align. But trust might break down when there are incentives to send false messages.
- A signal is only effective if not all types take the same action. We'll discuss breakdowns in signaling using the ideas of Separating vs Pooling equilibria

Asymmetric Info in Market Games

- In 201 or 311 you may have learned about the **perfectly competitive** markets model.
- One of the assumptions of that model is perfect information.
- When this assumption breaks, we might see Adverse Selection or other types of market failures.

Cheap Talk

Cheap Talk Equilibrium - When Interests Align

Suppose that I want to meet up with Jose at a coffee shop on campus.

		Jose	
		$Starbucks$	$Roma$
Dante	$Starbucks$	$1, 1$	$0, 0$
	$Roma$	$0, 0$	$2, 2$

We'll also add a first stage to this game where Dante can send Jose a text message saying either "I'm going to Starbucks" or "I'm going to Roma".

Cheap Talk Equilibria - When Interests Align

The strategy profile where:

- I send the message "going to Starbucks"
- we both go to Starbucks if I send "going to Starbucks"
- or both go to Roma if I send "going to Roma"

is a **Nash Equilibrium** (specifically a subgame perfect NE).

- We'll call this a "cheap talk" equilibrium because it was in my best interest to communicate my actual strategy.
- It cost me nothing to send a *message*.

Cheap Talk vs Babbling Equilibrium

However, this is not the only SPNE of this game. If are strategy profiles in the second stage are:

- Jose will go to Starbucks no matter what message Dante sends
- Dante will go to Starbucks no matter what message he sent

Then Dante will be indifferent between sending either message in the first place.

- We'll call this a "babbling" equilibrium because the initial message sends *no* information about what I will actually do.
- This equilibrium seems unlikely, but if I have an existing *reputation* for always going to Starbucks, this would be plausible and completely rational behavior.

Cheap Talk Equilibria - When Interests are Conflicting

What about a zero-sum game?

		Navratilova	
		DL	CC
Evert	DL	$50, 50$	$80, 20$
	CC	$90, 10$	$20, 80$

- Should Navratilova believe what Evert says she will do?
- Should Navratilova believe that Evert will do *exactly the opposite* of what she says she'll do?

Cheap Talk Equilibria - When Interests are Conflicting

What about a zero-sum game?

		Navratilova	
		DL	CC
Evert	DL	$50, 50$	$80, 20$
	CC	$90, 10$	$20, 80$

- The only equilibrium of this game is a babbling equilibrium.
- There is no message that Evert could send that would give Navratilova any more idea of what she will actually play.

Cheap Talk Equilibria - Partially Aligned Interests

Many real life games have mixtures of conflict and common interest.

- The question of whether direct communication is *credible* or not will depend on the relative degree of each incentive.
- We will use our tools from the first half of the course to make testable predictions based on different ranges of assumptions.

Defensive Medicine

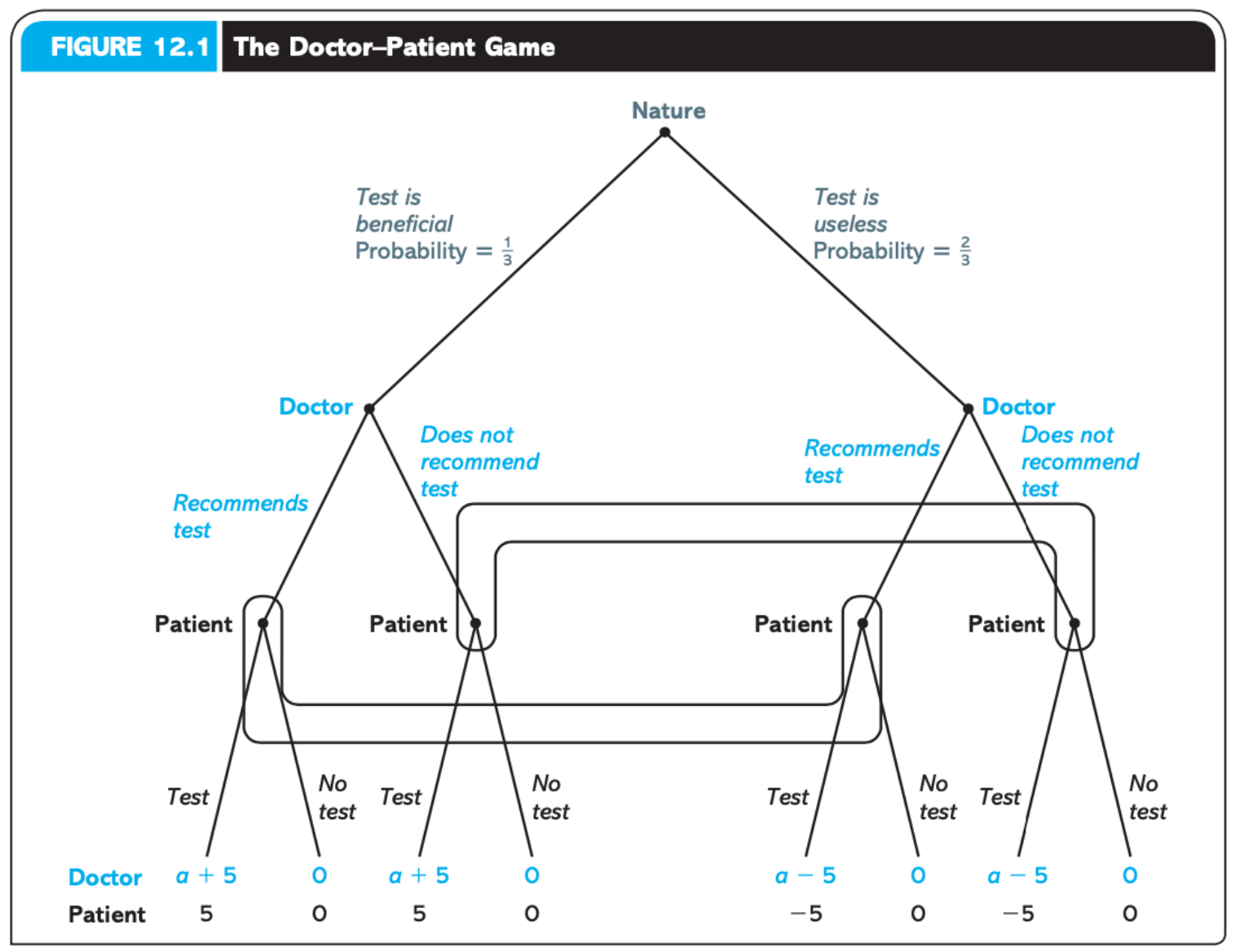
> *In a recent survey of physicians, 93% reported altering their clinical behavior because of the threat of malpractice liability. Of them, 92% used "assurance behavior" such as ordering tests, performing diagnostic procedures, and referring patients for consultation; and 43% reported using imaging technology in clinically unnecessary circumstances.*

Harrington, pg. 461

Defensive Medicine

- Consider a patient who goes to the doctor for an examination.
- The doctor can recommend an expensive test that is not fully covered by the patient's insurance.
- The doctor cares about the patient, but also doesn't want to be sued for malpractice if the patient *does* end up needing the test and the doctor didn't recommend it.
- The patients value v from a beneficial test is 5, and $v = -5$ if the test is useless.
- We'll use a to stand in for the value of a test to a doctor from a malpractice standpoint.

Defensive Medicine



Defensive Medicine - Babbling Strategy

Pooling Equilibrium

- Doctor's Strategy: Recommend the test whether or not it is beneficial.
- Patient's Strategy: Ignore the doctor's recommendation.
- Patient's Beliefs: Ignoring the doctors advice, the probability the test is effective is 1/3.

- This equilibrium is a *babbling equilibrium*.
- The doctor's recommendation contains no real signal to the patient.

Defensive Medicine - Babbling Strategy

Pooling Equilibrium

- Doctor's Strategy: Recommend the test whether or not it is beneficial.
- Patient's Strategy: Ignore the doctor's recommendation.
- Patient's Beliefs: Ignoring the doctors advice, the probability the test is effective is $1/3$.

- The patient's beliefs are consistent, and their expected utility from taking the test is $\frac{1}{3} \cdot 5 + \frac{2}{3} \cdot (-5) = -\frac{5}{3}$.
- Given that the patient will never take the test, the doctor is indifferent between recommending the test or not.
- So this situation in which the doctor always recommends the test and the patient always ignores their advice is *stable*.

Defensive Medicine - Separating Strategies

The previous result was disappointing, but not unexpected.

Insight

For every cheap talk game, there is always a babbling equilibrium.

- But let's now focus on the more interesting question of how to make the doctor's recommendation *meaningful*.

Defensive Medicine - Separating Strategies

Consider the following strategy profile:

- Doctor's Strategy: Recommend the test if and only if it is beneficial.
- Patient's Strategy: Follow the doctor's recommendation.
- Patient's Beliefs:
  - If the doctor recommends the test, then the test is beneficial with 100% probability.
  - If the doctor does not recommend the test, then the test is beneficial with 0% probability.

Defensive Medicine - Separating Strategies

When will the doctor follow the separating strategy?

1. When $EU_d(\text{Rec. when beneficial}, (T, NT)) \geq EU_d(\text{Don't rec. when beneficial}, (T, NT))$

2. and when $EU_d(\text{Don't rec. when useless}, (T, NT)) \geq EU_d(\text{Rec. when useless}, (T, NT))$

Solve for the range of a where this is a NE.

Defensive Medicine - Conclusions

Interpreting our findings:

- When $a = 0$, the doctor's interests are *perfectly* aligned with the patient's.
- When $a \leq 5$, the doctor's interests are *partially* aligned with the patient's interests, and there is an equilibrium where the doctor gives truthful recommendations.
- When $a > 5$, there is only a babbling equilibrium because the doctor's incentives are to not be truthful. Even if they did give a truthful recommendation, the patient would have no reason to believe it would be *credible*.

Defensive Medicine - Conclusions

Connecting with our real-world observations:

- We don't know what doctors' subjective costs of malpractice threats are (a).
- But we can observe their *behaviors*.
- If we see that doctors recommend more tests than are beneficial, it might reveal that a is quite large.

Revealed Preference

The idea that people reveal their true preferences by the choices they make.

Adverse Selection