BEEM109 Experimental Economics and Finance

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Recap

Last class we looked at the fundamental building blocks of Behavioral Economics:

1) Outcomes are evaluated as changes around a reference point.

2) Losses loom larger than gains

3) Probabilities are not weighed linearly

- Rare events are overweighed
- Very frequent events are underweighted
- There is a discontinuity from *certainty* to *probability*

4) Decision-making is done via mental accounts.

Recap

Last week, the focus was on static decision-making.

Individuals are faced with a one-off decision based on an information set.

However, a lot decisions are made over time (or repeatedly)

As such they require the DM to learn about the environment as the circumstances unfold.

The Monty Hall Problem

Assume you are in a TV game show. The host presents you with three doors: A, B and C.

Behind one of the doors there is a prize, while the other two have nothing behind them.

You choose door A; Monty then proceeds to open door C.

Monty then asks whether you would like to switch doors.

The Monty Hall problem is an interesting case of new events NOT adding new information.

Opening an empty door didnt add any new information about the problem.

As such the underlying probabilities are the same.

The Monty Hall Problem and Bayes' Rule

To see why, we need just apply Bayes Rule:

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

$P(A)$ is the prior probability of A

- Your initial 'belief' on how likely A will occur

$P(A|B)$ is the *conditional* probability of A, given B.

- It is also called the *posterior* probability of A.

$P(B|A)$ is the *conditional* probability of B, given A.

$P(B)$ is the prior probability of B

The Monty Hall Problem and Bayes' Rule

Let C_i denote the case where the prize is behind door i, $i = 1, 2, 3$

Let $H_{i,j}$ denote the case where the player picks door i and Monty opens door j

The Monty Hall Problem and Bayes' Rule

Before the player chooses a door, the probability of the prize being behind any door is the same:

$$P(C_i) = 1/3, \; i = 1, 2, 3$$

Importantly, Monty will NEVER pick the door with the prize out of the two the player didn't pick.

$$\mathrm{P}(\mathrm{H}_{i,j}|C_k) = \begin{cases} 0 & \textit{if} \quad \mathrm{i{=}j} \\ 0 & \textit{if} \quad \mathrm{j{=}k} \\ 1/2 & \textit{if} \quad \mathrm{i{=}k} \\ 1 & \textit{if} \quad \mathrm{i} \neq j \text{ and } i \neq k \end{cases}$$

The Monty Hall Problem and Bayes' Rule

Suppose the player chooses door number 1 & Monty opens door number 3.

The posterior probability of winning by NOT switching doors is:

$\mathrm{P}(\mathrm{C}_1|H_{1,3}) = \frac{P(H_{1,3}|C_1)P(C_1)}{P(H_{1,3})}$
$P(H_{1,3}|C_1) = 1/2$ and

$P(C_1) = 1/3$

Hence the numerator equals $1/3 \times 1/2 = 1/6$

The Monty Hall Problem and Bayes' Rule

Now for the denominator:

$$P(H_{1,3}) = P(H_{1,3}\&C_1) + P(H_{1,3}\&C_2) + P(H_{1,3}\&C_3)$$

$$= P(H_{1,3}|C_1)P(C_1) + P(H_{1,3}|C_2)P(C_2) + P(H_{1,3}|C_3)P(C_3)$$

$$= 1/2 \times 1/3 + 1 \times 1/3 + 0 \times 1/3 = 1/2$$

The Monty Hall Problem and Bayes' Rule

Therefore:

$$P(C_1|H_{1,3}) = \frac{1/6}{1/2} = 1/3 = P(C_1)$$

Notice that this is the initial prior probability of the prize being behind door number 1.

Therefore, Monty's action did not convey any information!

The Monty Hall Problem and Bayes' Rule

So what is the probability of winning if the player switches?

Well, probabilities must add up to one and we know that the door is not behind door number 3...

$$P(C_1|H_{1,3}) + P(C_2|H_{1,3}) + P(C_2|H_{1,3}) = 1$$

$$1/3 + P(C_2|H_{1,3}) + 0 = 1 \iff P(C_2|H_{1,3}) = 2/3$$

Hence the player should always switch!

Bayesian probability

Bayesian probability looks at probability as a measure of the current state of knowledge.

In other words, probabilities reflect our beliefs about the state of the world.

So, we should be able to update our beliefs as new information arises.

As such, it is the way a rational agent incorporates new information into his d-m'ing

Are we Bayesians? (Charness & Levin, 2005)

Two possible states of the world: up or down.

Twofold task: pick an urn & draw a ball

- Black ball gives payoff, white ball does not.

Replace the ball and choose again.

- First draw informs DM about state of the world.

Are we Bayesians? (Charness & Levin, 2005)

Paper wishes to compare Bayesian Updating (BU) with a Reinforcement Heuristic (RH)

Treatment conditions:

- Better signal;
- First draw does not pay out;

Are we Bayesians? (Charness & Levin, 2005)

Drawing from Right urn gives perfect signal about the state of the world.

- Both the BH and RH predict the same outcome.

Drawing from the Left urn gives an incomplete signal.

- BU agent should switch to Right if draw is Black;
- RH predicts the opposite.

Are we Bayesians? (Charness & Levin, 2005)

Result 1: Switching-error rates are low when BU and RH are aligned and high with they are not aligned.

Result 2: Removing affect from initial draw (by not paying out the outcome) reduces the error rate, particularly when outcome is positive (black ball drawn).

Result 4: Taste for consistency. If a subject initially chose Left Urn, he is less likely to switch than if initial Left urn draw is imposed.

Searching

An important class of economic decisions requires DMs to search for the necessary information before making their decision.

- Hiring a new CEO;
- Looking for a new job;
- Purchasing a new car;
- Finding a new supplier.

Therefore, the act of searching itself has economic significance.

Searching

Suppose Jane is looking for a job.
Every time she conducts a search she receives a wage offer w.

- For simplicity assume w is uniformly distributed between 0 and 90.

Searching implies a cost, c;

- Assume for the time being this cost is fixed and equal to 5.

Whats Janes optimal searching condition?

Searching

Suppose Jane receives an offer w. Should she accept or continue to search?

She will be indifferent between searching and stopping if the expected benefit of searching is equal to the cost of searching, c

$E(BoS) = (90 - w)/90x[(90 + w)/2w]$

$C = 5$

Solving $(90 - w)/90x[(90 + w)/2w] = 5$ yields $w = 60$.

Therefore, Jane should accept any offer larger than 60 and continue to search otherwise.

The more risk averse Jane is, the lower her reservation wage, w, will be.

Searching

Of course in reality, individuals have imperfect information about the distribution of wages;

This may mean some learning is necessary before a decision is made.

Another important factor may be a temporal constraint.

Cox and Oaxaca (1989) study search with a finite horizon.

- This means your reservation value will drop the closer you are to the deadline.
- They find that subjects behaviour is consistent with theory