Recitation 10: Projection Bias and Attribution Bias

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Outline

Overview

- Understand the influence of future vs. past states
    - Projection bias: mis–prediction of influence of **future** states
    - Attribution bias: mis–prediction of influence of **past** states

Outline

Projection Bias

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Projection Bias: Model

- True utility at time t is $u(c_t, s_t)$
- True utility depends on consumption c_t and the state s_t at time t
  - State could be anything that affects utility from consumption, e.g., level of hunger or addiction
- At time t, predict future utility from consuming c_τ in state s_τ at time $\tau > t$:

$$\hat{u}(c_\tau, s_\tau) = (1-\alpha)u(c_\tau, s_\tau) + \alpha u(c_\tau, s_t)$$

- $\alpha \in [0, 1]$ is the degree of projection bias.

Projection Bias: Example Problem

- Maddie's dog, Emma, suffers from severe projection bias. Emma's true utility at hour t, $u(c_t, s_t)$

$$
\begin{aligned}
u(c_t = whine, s_t = hungry) &= -3, \\
u(c_t = don't\ whine, s_t = hungry) &= -10, \\
u(c_t = whine, s_t = not\ hungry) &= -5, \\
u(c_t = don't\ whine, s_t = not\ hungry) &= 0
\end{aligned}
$$

- At time t, Emma predicts her future utility of whining at time $\tau > t$ to be

$$\hat{u}_t(c_\tau, s_\tau) = (1-\alpha)u(c_\tau, s_\tau) + \alpha u(c_\tau, s_t),$$

where $\alpha \in [0, 1]$.

Projection Bias: α Parameter

- What does α measure?
  - α measures the degree of projection bias
- What does it mean for α to equal 0?
  - $\alpha = 0$ means there is no projection bias (rational expectations)
- What does it mean for α to equal 1?
  - $\alpha = 1$ means there is full projection bias

Projection Bias: Predicted Utility

- Suppose $\alpha = \frac{3}{4}$. Consider time period $\tau > t$ when Emma will be hungry $s_\tau = hungry$
- How much utility will Emma expect to get from whining if she is hungry in period t?

$$\begin{aligned}
\hat{u}_t(c_\tau, s_\tau) &= (1-\alpha)u(c_\tau, s_\tau) + \alpha u(c_\tau, s_t) \\
\hat{u}_t(whine, hungry) &= (1-\alpha)u(whine, hungry) + \alpha u(whine, hungry) \\
\hat{u}_t(whine, hungry) &= -3(\frac{1}{4}) + -3(\frac{3}{4}) = -3
\end{aligned}$$

- How much utility will Emma expect to get from whining if she is not hungry in period t?

$$\begin{aligned}
\hat{u}_t(c_\tau, s_\tau) &= (1-\alpha)u(c_\tau, s_\tau) + \alpha u(c_\tau, s_t) \\
\hat{u}_t(whine, nothungry) &= (1-\alpha)u(whine, hungry) + \alpha u(whine, not\ hungry) \\
\hat{u}_t(whine, nothungry) &= -3(\frac{1}{4}) + -5(\frac{3}{4}) = -4.5
\end{aligned}$$

- Do the utilities differ? Why?
- Yes. If she is hungry at t, she correctly predict future utility. If she is not hungry at t, she incorrectly “projects” her lo[illegible] utilit[illegible] from whining [illegible] to the future

Outline

1. Projection Bias
2. Attribution Bias

Attribution Bias

- Definition
  - When judging the value of a good, people are overly influenced by the state in which they previously consumed it
- Examples
  - More likely to return to a restaurant first tried when hungry
  - More likely to negatively rate a movie seen while tired
  - Less likely to recommend a zoo to a friend if it rained during last visit

Attribution Bias: Model

- Predict utility of consuming c_t while in state s_t, given prior consumption experience of c_t was in state $s_{t-1}(c_t)$:

$$\hat{u}(c_t, s_t) = (1-\gamma)u(c_t, s_t) + \gamma u(c_t, s_{t-1}(c_t))$$

  where $\gamma \in [0, 1]$ is the degree of attribution bias.
- Recall in the Projection bias model $\tau > t$ and

$$\hat{u}(c_\tau, s_\tau) = (1-\alpha)u(c_\tau, s_\tau) + \alpha u(c_\tau, s_t)$$

- $\alpha \in [0, 1]$ is the degree of projection bias.

Attribution Bias: Experimental Evidence (Haggag et al. 2019)

- Basic structure
  - Randomly manipulate the thirst levels of participants
  - Have participants drink a new mixed drink
  - Elicit preference measures while in a later neutral state
- Suppose participants who were thirsty say the like the drink better in the neutral state
- Why can we take this as evidence of attribution bias? I.e., how do we know the state of prior consumption explains the difference?

Experiment outline

1. Manipulation of thirst
   - Treatment group: drink 3 cups of water
   - Control group: drink 1/2 cup of water
2. Answer demographic questions, measure of current thirst (7-pt scale)
3. Stir together ingredients for new mixed drink:
   - 1 cup milk
   - 1/3 cup orange juice
   - 1 tablespoon sugar
4. Consume the mixed drink
5. Answer "how enjoyable was drinking the mixed drink?" (7-pt scale)

Ingredient photo upload

Summary of experiment

- Experiment manipulated state (thirst) during new experience (drink)
- Thirsty individuals like the drink better.
- Since the two groups were randomized, we know that any difference must be due to the differential thirst across groups.
- In the absence of attribution bias, people's willingness to have the same drink again shouldn't depend on thirst when first consuming it.
- But people who were thirsty during their first experience are more willing to have the drink again.

Attribution Bias Example Problem

- Maddie's true utility from exercising on day t, $u(c_t, s_t)$ depends not only on the type of exercise c_t (run or gym), but also on the state s_t (hot or cool):

$$\begin{aligned} u(c_t = run, s_t = hot) &= 5, \\ u(c_t = gym, s_t = hot) &= 6, \\ u(c_t = run, s_t = cool) &= 10, \\ u(c_t = gym, s_t = cool) &= 7. \end{aligned}$$

Attribution Bias: Predicted Utility

- Fall arrives and the weather in Cambridge today is $s_t = cool$
- Suppose Maddie most recently went to the gym when it was hot and ran when it was hot
- Will she choose to run or go to the gym?
  - Maddie will choose the form of exercise that gives the higher predicted utility.

$$\begin{aligned}
\hat{u}_t(c_t, s_t) &= (1-\gamma)u(c_t, s_t) + \gamma u(c_t, s_{t-1}(c_t)) \\
\hat{u}_t(run, cool) &= (1-\gamma)u(run, cool) + \gamma u(run, hot) \\
\hat{u}_t(run, cool) &= 10(1-\gamma) + 5\gamma \\
\hat{u}_t(run, cool) &= 10 - 5\gamma
\end{aligned}$$

$$\begin{aligned}
\hat{u}_t(c_t, s_t) &= (1-\gamma)u(c_t, s_t) + \gamma u(c_t, s_{t-1}(c_t)) \\
\hat{u}_t(gym, cool) &= (1-\gamma)u(gym, cool) + \gamma u(gym, hot) \\
\hat{u}_t(gym, cool) &= 7(1-\gamma) + 6\gamma \\
\hat{u}_t(gym, cool) &= 7 - \gamma
\end{aligned}$$

  - Maddie will run if $10 - 5\gamma > 7 - \gamma$ or if $\gamma < 3/4$

Attribution Bias: Predicted Utility II

- Suppose Maddie most recently went to the gym when it was hot and ran when it was cool
- Will she choose to run or go to the gym?
  - Maddie will choose the form of exercise that gives the higher predicted utility.

$$\begin{aligned}\hat{u}_t(c_t, s_t) &= (1-\gamma)u(c_t, s_t) + \gamma u(c_t, s_{t-1}(c_t)) \\ \hat{u}_t(run, cool) &= (1-\gamma)u(run, cool) + \gamma u(run, cool) = u(run, cool) = 10\end{aligned}$$

$$\begin{aligned}\hat{u}_t(c_t, s_t) &= (1-\gamma)u(c_t, s_t) + \gamma u(c_t, s_{t-1}(c_t)) \\ \hat{u}_t(gym, cool) &= (1-\gamma)u(gym, cool) + \gamma u(gym, hot) \\ \hat{u}_t(gym, cool) &= 7(1-\gamma) + 6\gamma \\ \hat{u}_t(gym, cool) &= 7-\gamma\end{aligned}$$

  - Maddie will run if $10 > 7 - \gamma$ or if $\gamma > -3$. This is always true.
  - Intuition: Maddie last ran when it was cool (the best time to run). She last went to the gym when it was hot (the worst time to go to the gym). Her attribution bias works in favor of running (which is her preferred choice when it is cool under her true utility function anyway)

Attribution Bias: Predicted Utility III

- Suppose Maddie most recently went to the gym when it was cool and ran when it was cool
- Will she choose to run or go to the gym?
  - Maddie will choose the form of exercise that gives the higher predicted utility.

$$\begin{aligned}\hat{u}_t(c_t, s_t) &= (1-\gamma)u(c_t, s_t) + \gamma u(c_t, s_{t-1}(c_t)) \\ \hat{u}_t(run, cool) &= (1-\gamma)u(run, cool) + \gamma u(run, cool) = u(run, cool) = 10\end{aligned}$$

$$\begin{aligned}\hat{u}_t(c_t, s_t) &= (1-\gamma)u(c_t, s_t) + \gamma u(c_t, s_{t-1}(c_t)) \\ \hat{u}_t(gym, cool) &= (1-\gamma)u(gym, cool) + \gamma u(gym, cool) = u(gym, cool) = 7\end{aligned}$$

  - In this case, attribution bias has no effect because the current state is the same as the state for prior consumption
  - Thus γ is irrelevant

Attribution Bias: Wrong Choices

- In which of the three cases above and for which values of γ might we say Maddie makes the "wrong" choice?
- When it is cool, best choice is to run
- First case
  - Her prior run and gym visit were both when it was hot
  - Her predicted utility is biased because of attribution bias
  - If $\gamma \geq 3/4$, then she will go to the gym (i.e., when she is close to full attribution bias)
- Second case
  - Her predicted utility makes running even more preferable (because her past experiences running were good and at the gym were bad)
  - She runs for any $\gamma \in [0, 1]$
- Third case
  - Her predicted utility happens to have no bias (because the current state is the same as the prior ones)
  - She runs for any $\gamma \in [0, 1]$