SIMPLE BETS TO ELICIT PRIVATE SIGNALS

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1. MOTIVATION

Task: elicit high-quality private information from crowds

1. Why? gather knowledge and guide decision-making
   - opinions in social-economic surveys
   - tastes/experiences of movies, hotels ...
   - idea evaluation, brand recognition...
2. What is **high-quality** information?
   - incentives: participation; efforts; truth-telling
3. How? design payment schemes to align incentives
   - verifiable truth: "Will it rain tomorrow?" proper scoring rule; prediction market...
   - unverifiable truth: "Are you happy?" peer prediction; Bayesian truth serum...
4. Challenges?
   - practice: complicated
   - theory: common prior, homogeneity, risk neutral

This paper: top-flop and threshold betting methods

- can elicit informative and unverifiable truth;
- is simple to implement; and
- relax heavy theoretical assumptions.

2. BETTING EXAMPLES

Scenario: after the premiere of a new "Avengers X" movie, the producer offers you two bets to win a prize.

Top-flop betting method:

- **(top bet)**: "Avengers X" has a **higher** rotten tomato (RT) score than another random superhero movie.
- **(flop bet)**: "Avengers X" has a **lower** rotten tomato (RT) score than another random superhero movie.

Threshold betting method:

- **(bet on the movie you watched)**: "Avengers X" has a RT score higher than 0.8.
- **(bet on the random movie)**: another random superhero movie has a RT score higher than 0.8.

3. INTUITIVE RESULTS

For each betting method,

1. Will you participate in this bet?
2. Which bet will you choose
   - if you **like** "Avengers X"?
   - if you **do not like** "Avengers X"?

Intuitive reasoning:

- After watching the "Avengers X", I found I **liked** it.
- $\Rightarrow$ (Bayesian) it is more likely that "Avengers X" will also be liked by others
- $\Rightarrow$ "Avengers X" is more likely to have a higher RT
- $\Rightarrow$ top bet is more likely to win a prize

With top-flop and threshold betting, agents will participate and reveal private signals through their choices.

- positive signal $\Rightarrow$ bet "top" or "Avengers X"
- negative signal $\Rightarrow$ bet "flop" or random movie

4. SETTINGS

Decision Process:

In stage I:

- a collection of items $\mathcal{K} = \{1, 2, ..., K\}$
- each item has a score Y_k (RT or box office)
- prior for Y_k is $H_k(\cdot)$

In stage II:

- "Avengers X" = item i
- the bettor has a binary signal $t_i \in \{1, 0\}$
- producer wants to know t_i

In stage III and IV:

- producer randomly selects another item $j \neq i$ and formulates top-flop or threshold-y bets:
  - top bet: $y_i > y_j$
  - flop bet: $y_i < y_j$
  - bet on item i: $y_i > y$
  - bet on item j: $y_j > y$
- prize for a winning bet is $\pi \succ 0$

5. KEY ASSUMPTIONS

When does top-flop and threshold betting (not) work?

Assumption 1 ***(on assorted signal technologies)***
$Pr(t_i = 1 | Y_i > \delta) > Pr(t_i = 1 | Y_j > \delta)$ *for* $j \in \mathcal{K} \setminus \{i\}$.

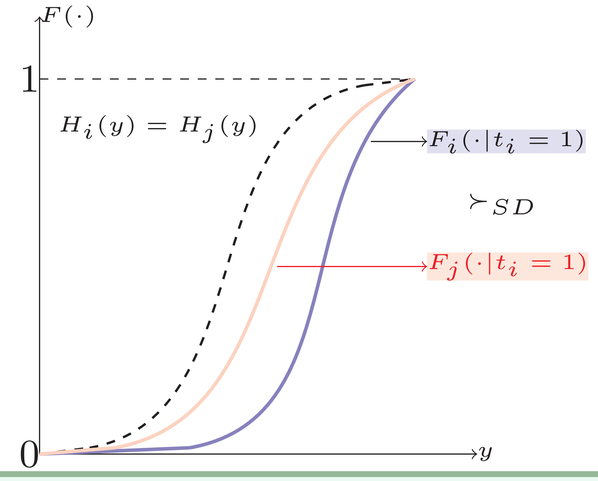
- RT score of "Avengers X" is more informative about your likelihood of loving "Avengers X".
- implement: formulate bets on relevant scores

Assumption 2 ***(on priors of item scores)***
Bettor has the same non-degenerate prior $H(\cdot)$ *for all items.*

- items in the collection $\mathcal{K}$ are "informationally non-differentiable" ex-ante
- implement: select similar items for the collection

Compare winning probabilities of:

- top: $P(Y_i > Y_j \mid t_i)$
- flop: $P(Y_i < Y_j \mid t_i)$
- bet i: $P(Y_i > y \mid t_i)$
- bet j: $P(Y_j > y \mid t_i)$



6. EXTENSIONS

1. What if the scores are endogenously determined?
   - transform individual betting problems into strategic betting games with imperfect information
   - truth-telling is a strict NE w/o common prior
2. What if private signals are costly in efforts?
   - more efforts $\Rightarrow$ more precise signals $\Rightarrow$ easier to tell which bet wins $\Rightarrow$ exert full efforts