The role of prior knowledge in risky choice

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Background

- Risk and uncertainty are fundamental features of the decisions people face in everyday life.
- While use of prior probabilities is crucial to solving many real-world tasks optimally [1], their effects on people's risk preferences is not well known.

Research goals

- We establish a paradigm in which risky options' prior probabilities can be manipulated and their exact posterior values computed.
- We test whether changes in prior probabilities impact people's risk preferences in the appropriate way.

Frequentist models of risky choice

- Studies on decisions from experience (DFE) [2] typically compare people's choices with either options' true values or their maximum likelihood (ML) values [3].
- To compute these ML values, suppose a decision maker chooses between risky option O_R paying either V_R or 0 and a safe option O_S always paying V_S.
- Before making a decision, she observes n samples of the risky option, z of which pay off.
- The risky option should then be chosen if

$$\mathbb{E}[O_R|Data] = \frac{zV_R}{n} = \hat{\theta}V_R > V_S$$

References

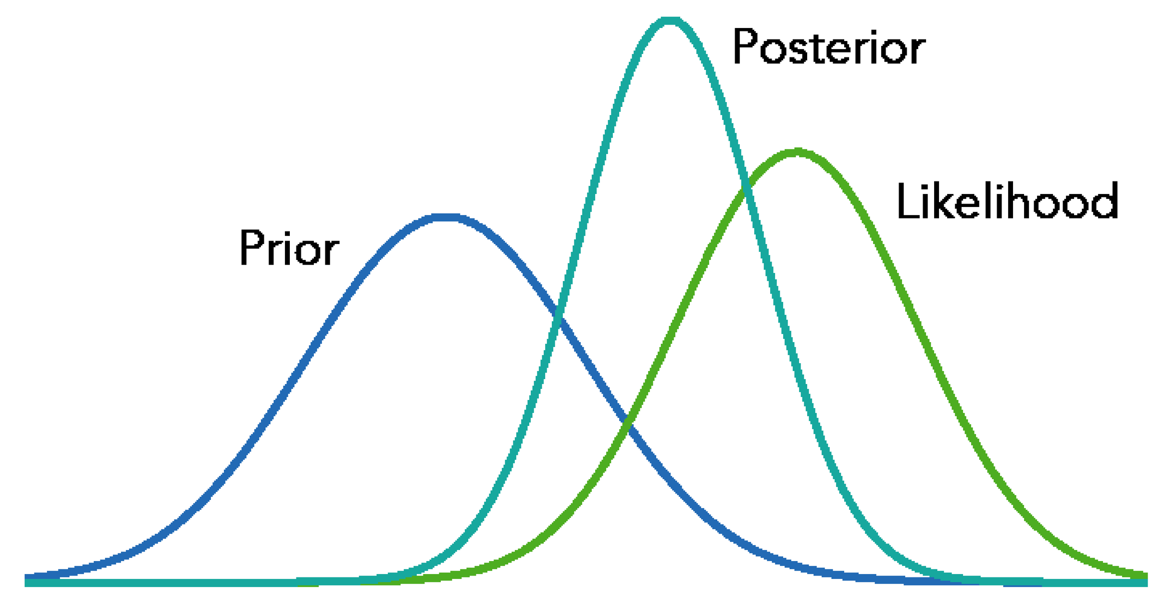
[1] Anderson, J. R. (1990). Studies in cognition. the adaptive character of thought. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

[2]] Hertwig, R., & Erev, I. (2009). The description-experience gap in risky choice. Trends in Cognitive Sciences, 13(12), 517-523.

[3] Wulff, Dirk & Mergenthaler-Canseco, Max & Hertwig, Ralph. (2017). A meta-analytic review of two modes of learning and the description-experience gap. Psychological Bulletin, 144(2), 140-176.

Bayesian models of risky choice

- The expected value of O_R can also be estimated by combining the likelihood with prior probabilities of θ.



- In this setup, the risky option should be chosen if

$$\mathbb{E}[O_R|Data] = \int_{\theta\in\Theta} p(\theta|Data)\mathbb{E}[O_R|\theta]d\theta > V_S$$

- A strength of Bayesian models is their ability to perform both prediction and inference.
- If the risky choice task is based on prediction — that is, the value of the next sample drawn — then the value of the risky option can be computed as

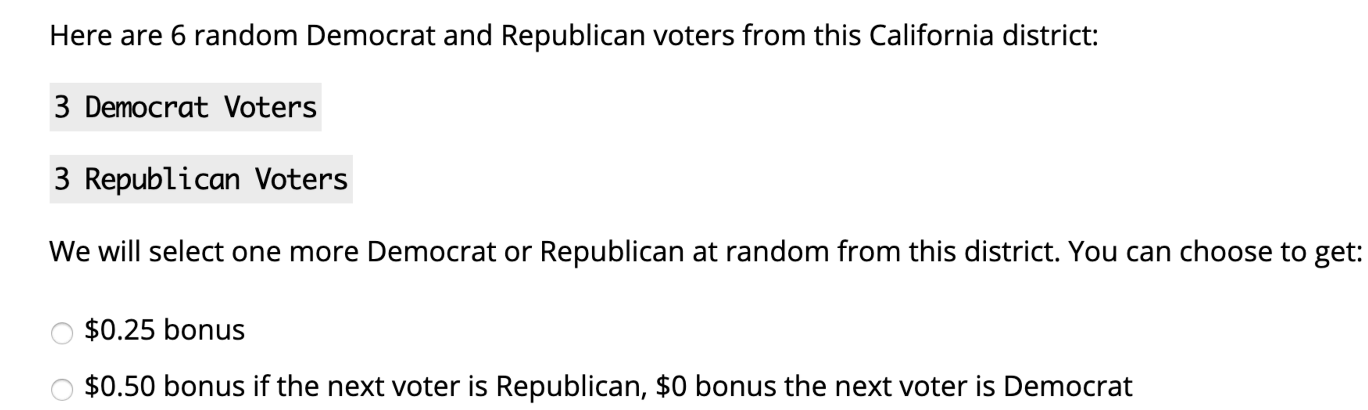
$$\mathbb{E}[O_R|Data] = \int_{\theta\in\Theta} \theta p(\theta|Data)d\theta\ V_R$$

- If the risky option pays if the true value of θ is in some range or set C, then the task one of inference and the value of the risky option can be computed as

$$\mathbb{E}[O_R|Data] = \int_{\theta\in\Theta} I_C(\theta)p(\theta|Data)d\theta\ V_R$$

Results

- Participants observed a sample of voters from an unknown congressional district in a known US state.


Here are 6 random Democrat and Republican voters from this California district:

3 Democrat Voters

3 Republican Voters

We will select one more Democrat or Republican at random from this district. You can choose to get:

- $0.25 bonus
- $0.50 bonus if the next voter is Republican, $0 bonus the next voter is Democrat

- These voter samples were held constant while the state varied between participants.