Bayesian Model of Behaviour in Economic Games

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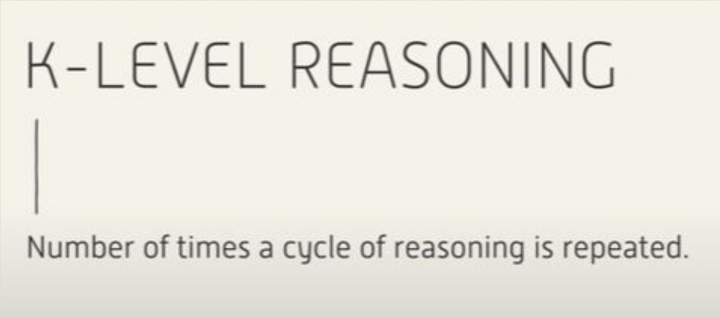


- **Images Reference**: https://ed.ted.com/

Introduction:

- Classical game theoretic approaches that make strong rationality assumptions have difficulty modeling human behaviour in economic games.
- The paper investigate the role of finite levels of iterated reasoning and non-selfish utility functions in a Partially Observable Markov Decision Process model that incorporates game theoretic notions of interactivity.
- The generative model captures a broad class of characteristic behaviours in a multi-round Investor-Trustee game.
- Finally, it invert the generative process for a recognition model that is used to classify 200 subjects playing this game against randomly matched opponents.

Objectives:

- To analyse and identify abilities of human reasoning internal state(belief and action)

- To identify and study pattern exhibited by humans in a multi-round Investor-Trustee game, By inclusion of social factors like crudely, envy and guilt.

- Algorithms to compute BNE solutions have been developed but, in the general case, are NP-hard and thus infeasible for complex multi-round games so the aim is to approximate the equilibrium solution.

- To build a generative model that captures classes of observed behavior in multi-round trust tasks.

Hypothesis:

- Presence of model which predicts human behaviour is necessary because it may be applied in different situations like while making critical decisions, investments in stocks, etc.

- The builded recognition model can also have application in pathological populations, looking at some conditions as autism and borderline personality disorder.

- Model can also be extended to relate tasks such as Public Goods games.

- There is lack of source to predict which of a collection of Bayes-Nash equilibria is most likely to arise(given psychological factors about human utilities)

Research methodology:

In the framework of Bayesian games, player i's inequity aversion type $T_i = (\alpha_i, \beta_i)$

Defined softmax policy in the paper is,

$$P(a_i^{(t)} = a | \mathcal{D}^{(t)}) = \exp\left(\phi Q_i^{(t)}(\vec{b}_i^{(t)}, a)\right) / \sum_b \exp\left(\phi Q_i^{(t)}(\vec{b}_i^{(t)}, b)\right)$$

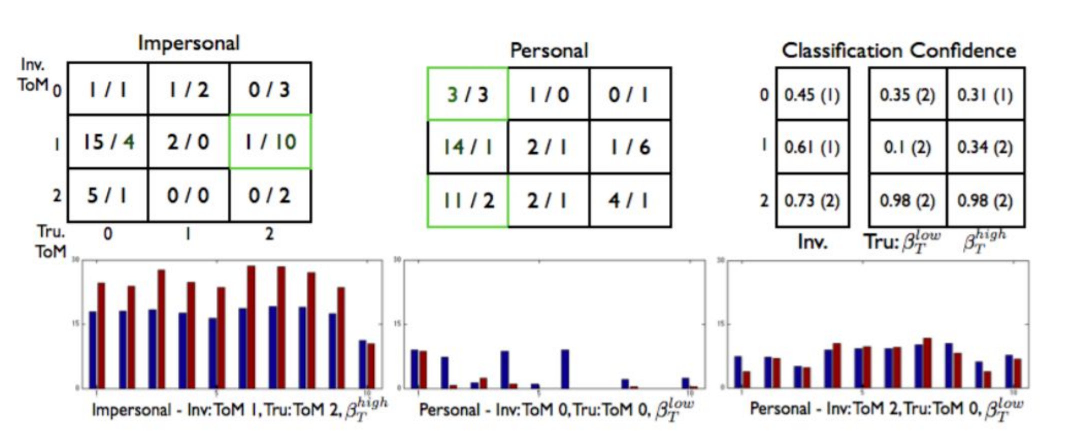
The utility of an action obtained by marginalizing over the beliefs is:

$$U_i^{(t)}(a_i^{(t)}) = \sum_{k=1:K} b_{ik} Q_i^{(t)}(b_{ik}^{(t)}, a_i^{(t)})$$

Later on the attempt was made to generate a rich tapestry of behavior by varying the prior expectations as to β_T and the values of strategic (k) level (0,1,2) for the players.

Conclusion:

- Investors with $k_I = 1$ make the most amount of money playing against a cooperative Trustee while $k_I = 0$ Investors make the least. The best dyad consists of a $k_I = 1$ Investor playing with a cooperative Trustee with $k_T = 0$ or 1



- A very wide range of patterns of dyadic interaction, including the main observations, can be captured by just varying the limited collection of parameters in the model. Recognition model tends to misclassify Trustees with low β_T as having $k_T = 2$

References:

- Paper source: https://papers.nips.cc/paper/2008/hash/92cc227532d17e56e07902b254dfad10-Abstract.html
- Knowledge source: Wikipedia_POMDP

THANK YOU!