Precarity:
Modeling the Long Term Effects of Compounded Decisions on Individual Instability

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Abstract

What is (financial) precarity? The long term precariousness of one's existence caused in part by the compounding effect of (automated) decisions on interconnected aspects of one's life (income, health, etc.). Precarity captures conditions that standard measures of inequality do not capture, because it focuses on trajectories rather than snapshots.
Our three contributions are a) collecting and evaluating a quantifiable notion of precarity and b) building a simulation framework to explore how dynamic aspects of decision making affect it and c) exploring some intervention ideas to reduce precarity.

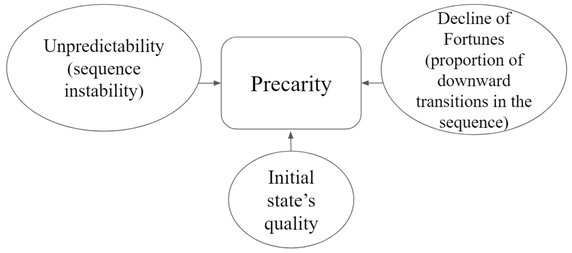
Why Precarity?

- **Previous Studies**: The study of the social impact of automated decision making has focused largely on issues of fairness at the point of decision, evaluating the fairness (with respect to a population) of a sequence or pipeline of decisions, or examining the dynamics of a game between the decision-maker and the decision subject.
- **Example**: Consider an Uber driver and a teacher in a situation such as the COVID-19 pandemic.

The Missing Piece: An examination of precarity, a term to describe an unstable state of existence in which negative decisions can have ripple effects on one's well-being

Precarity Quantification

Individual's trajectory is described as a sequence of states $\sigma = s_1, s_2, \ldots, s_t$ where $s_i \in S$ and S is the set of states sorted by "quality" or financial wherewithal [1].



A Simulation Framework for Precarity

- **Agents**: The agents are households who interact with simulated environments in an alternating loop.
  - Each agent is specified by their income, net worth, and health. They incur expenses each time period and earn income.
  - Agents must make decisions about their assets whether to consume, pay for expenses, save, or improve their health.
- **States**: We associate each agent with a set of three states (one for each of income, net worth, and health). Each state indicates which decile of the overall population they are in for that attribute.

Modeling Long Term Effects on Precarity

- **Rational Agents and Income Fluctuations Problem**: An agent finds a consumption-asset path $\{(c_t, a_t)\}$ where a_t is the assets (net worth) at point t, and c_t is the consumption at point t, with the goal of maximizing

$$\mathbb{E}\left\{\sum_{t=0}^{\infty} \beta^t u(c_t)\right\} \quad (1)$$

such that

$$a_{t+1} = R_{t+1}(a_t - c_t) + Y_{t+1} \text{ and } 0 \le c_t \le a_t \quad (2)$$

Where, $\beta \in (0, 1)$ is the discount factor, Y_t is non-capital income (i.e., via labor), and R_t is the interest rate on savings [2, 3].
- **MDP Model**: Each agent will occupy a state of a Markov decision process, with transitions out of each node based on locally reasonable decisions about asset management.

Income Classes and Interventions

- Precarity effects income classes non-uniformly. We look at precarity distributions segmented by income level. These classes are the lower 29% of the incomes, the middle 52% of incomes, and the upper 19% incomes.
- **Fixed stimulus intervention**: A fixed stimulus intervention as a fixed monthly value of $1500.
- **Precarity resistance**: Reducing the probability of a transition to a poorer state after an adverse decision.

Takeaways

- Introduced the concept of precarity to the AI community.
- Showed how the underlying population gets more precarious in a long-term compounded decision setting using a newly designed simulation framework.
- Illustrated that less financially secure income classes (e.g., lower income class) get more precarious over time compared to higher income classes.
- Illustrated the effective mitigating effects of policy interventions.
- Potential for future studies about group discrepancies and more sophisticated bounded rationality models.

References

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Precarity Evolution