

# Summary of *Machine Learning as a Tool for Hypothesis Generation*

JENS LUDWIG AND SENDHIL MULLAINATHAN(QJE, 2024)

2024.05.28 ShiWanqing

## 1. What are the research questions?

- How can machine learning generate novel and interpretable hypotheses?

## 2. Why are the research questions interesting?

- Science is curiously asymmetric.
  - asymmetry between idea generated(intuition) versus tested(data, statistics,models).
  - idea generation is also an empirical activity.(brain analysis data, output)
- Two developments change to formalism.
  - ML can notice patterns in the world, including patterns people not notice.
  - data on human behavior is exploding: mental data become actual data

## 3. What is the paper's contribution?

- contribute to literature aims to integrate ML into the way science is conducted.
  - **Prior:**
    - \* closed world problems:predictions,improve computational power.(He et al,2019)
    - \* open world problems:ML generate unexpected findings(Pierson et al.,2021);  
explore investigator-generated hypotheses(Mullainathan and Obermeyer ,2022)
  - **Extend:** show a hypothesis generation procedure-broadly applicable,novel.

## 4. What hypotheses are tested in the paper?

- H1: ML can produce novel, interpretable hypotheses from high-dimensional data set.

### a) Do these hypotheses follow from and answer the research questions?

- Yes, by create counterfactual synthetic images.

### b) Do these hypotheses follow from theory? Explain logic of the hypotheses.

- human judgments have a great deal of “noise”.The intuition is related to “overfitting.
- ML generate predictions in new (out-of-sample) data but ”black box”
- algorithm discover new signal and then have humans name that discovery.

## 5. Sample: comment on the appropriateness of the sample selection procedures.

- cautious. Chose white males and also retained the lock-box hold-out set.

## 6. Comment on the appropriateness of variable definition and measurement.

- Are psychological traits such as trustworthiness, based on HITs, subjective?

## 7. Comment on the appropriateness of the regress/predict model specification.

- large number of images for human selection cause attention issues?

## 8. What difficulties arise in drawing inferences from the empirical work?

- Are there interact features?

## 9. Describe at least one publishable and feasible extension of this research.

- ML generation of systemic financial risk drivers.
- Explain the economic mechanisms behind superior asset pricing of ML.
- How to find the interpretability of interactions and higher-order features in ML.