Information Discrepancy in Strategic Learning

International Conference on Machine Learning
Baltimore, USA, July 2022

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Strategic Learning

Settings which:
1. Involve decision making over human individuals.
2. Certain outcomes more desirable than others.

Example: loan approvals
Strategic Learning

Individuals would like to receive more favorable assessments

→ Act strategically

→ Strategic feature modifications

Example: loan approvals
Strategic Feature Modification

Ideally:
1. $\pi(x') >> \pi(x)$.
2. $\text{Cost}(x, x')$ is small.

\[
\begin{align*}
\pi(z) &= 0 & \pi(z) &= 1 \\
\text{“Likely to default”} & & \text{“Likely to repay”}
\end{align*}
\]
Strategic feature modification

Key assumption: deployed policy is accessible.
Strategic feature modification

Often in reality: Policy is inaccessible.
Strategic feature modification

Instead: Past labelled examples, explanations, …
Our Work

Focus on strategic learning when decision rules are inaccessible.

Model based on learning from peers.

Instead of observing the decision rule, individuals try to learn about it from friends, acquaintances who applied previously.
Strategic Learning with Inaccessible rules

Due to information discrepancy, different peer-networks may form **different estimates** of the deployed rule.

Individuals in each sub-population attempt to improve using **its own estimation** of the rule.
Strategic Learning with Inaccessible rules

Q: What are the effects of information discrepancy between different sub-populations on the ability of individuals to improve?
Adult Dataset

Publicly available at UCI repository.
• ~50K datapoints
• 14 attributes including Age, Country, Workclass, Education, Race, etc.
• Label (annual income): = 50K

Our process:
• 4 experiments separating subpopulations based on:

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Subpopulation 1</th>
<th>Subpopulation 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>&lt;35 yrs old</td>
<td>&gt;=35 yrs old</td>
</tr>
<tr>
<td>Country</td>
<td>All others</td>
<td>Western countries</td>
</tr>
<tr>
<td>Education</td>
<td>All others</td>
<td>Above high school</td>
</tr>
<tr>
<td>Race</td>
<td>All others</td>
<td>White</td>
</tr>
</tbody>
</table>

Predict **income improvement** (final income – original income) for each sub-population.
Results Snapshot: Adult Dataset

- Total income improvement currently subpopulation 1
- Total income improvement currently subpopulation 2
Results Snapshot: Adult Dataset

Sub-populations may end up worse off.

- Total income improvement currently subpopulation 1
- Total income improvement currently subpopulation 2
Results Snapshot: Adult Dataset

Total improvement may be **very unequal** across sub-populations.

- Total income improvement currently subpopulation 1
- Total income improvement currently subpopulation 2
Results

We make explicit a connection between:
1. Information available to different sub-populations.
2. Ability of individuals to improve.

Theoretical characterizations for when, across all sub-populations:
1. Do-no-harm.
2. Equal improvements.
3. Effort is exerted optimally.
Information Discrepancy in Strategic Learning

Thank you!

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