Unlocking Brighter Futures

Evaluating Educational Programs Impact on Texas Students

1 Problem

TEA is the state agency in charge of public education in Texas. TEA designs programs to boost student performance and aims to measure its impact. However, Texas is diverse and causal inference is a challenge.

2 Objective

The objective of this project is to measure the causal impact of TEA’s initiatives on student success by optimally matching classes that taught a new curriculum to control groups that didn’t.

3 Data & EDA

We have 4 data sources

- Student demographics
- District data
- Teacher demographics
- Survey data

We compared treatment to control units

The units overlap, but there is selection bias

4 Timeline

Timeline:

- Initial steps
  - Receive data
  - Define scope
  - Literature
  - EDA
- Selection bias
  - Propensity scores
  - Dimension reduction
  - Feature selection
  - Hard constraints
- Distance
  - Optimization model
  - KNN
- Matching
  - Metric definition
  - Model comparison
- Evaluation
  - Flexible script
  - Report
- Deliverables

5 Propensity Scores (PS)

Propensity scores (PS) account for selection bias in observational studies

6 Distance

Distance:

- Calculate distance for all combinations of treated and control
- Features to include
  - All features or subset of relevant features
- Weighting features
  - Importance of high, medium, or low
- Adding penalties
  - Ensures features are exact matches
- Distance matrix

7 Matching

Matching:

- Wide range of matching options:
  - 1:1 or 1:k
  - with or w/o replacement
  - Feature example:
    - District type factor
    - demographics
- Optimization model
  - Problem formulation
  - Decision variable
    - Binary (1 if pair is selected, 0 otherwise)
  - Constraints
    - C1: Each treatment is matched with at least 1 control unit
    - C2: Each control is matched at most 1

8 Results

Results:

- Balance
  - Our matching results have proven to significantly reduce bias and increase balance across features, which allows TEA to confidently evaluate programs and communicate results to stakeholders
- Treatment effect
  - Our tool performs a difference-in-difference analysis, where applicable, to measure the treatment effect. This automation will allow TEA to easily gauge the effect and significance of their initiatives.
- Scalability
  - We have a scalable optimization model and a greedy model that can perform with varying data set sizes and different rationales between control and treatment.

9 Deliverables

Deliverables:

- Flexible Script
- Documentation
- Project overview

We presented these deliverables for TEA to summarize our project

10 Next Steps

Next Steps:

- Implementation
  - Implementation on other use cases
- Selection
  - Choosing a matching method to evaluate 2023 CRIMSI results
- Communication
  - Communicate project with stakeholders

The next steps for our project are the following ones

- 89% Bias Reduction from unmatched data
- 80% Bias Reduction from last year’s baseline matching
- 100+ Different ways our script can be used to match