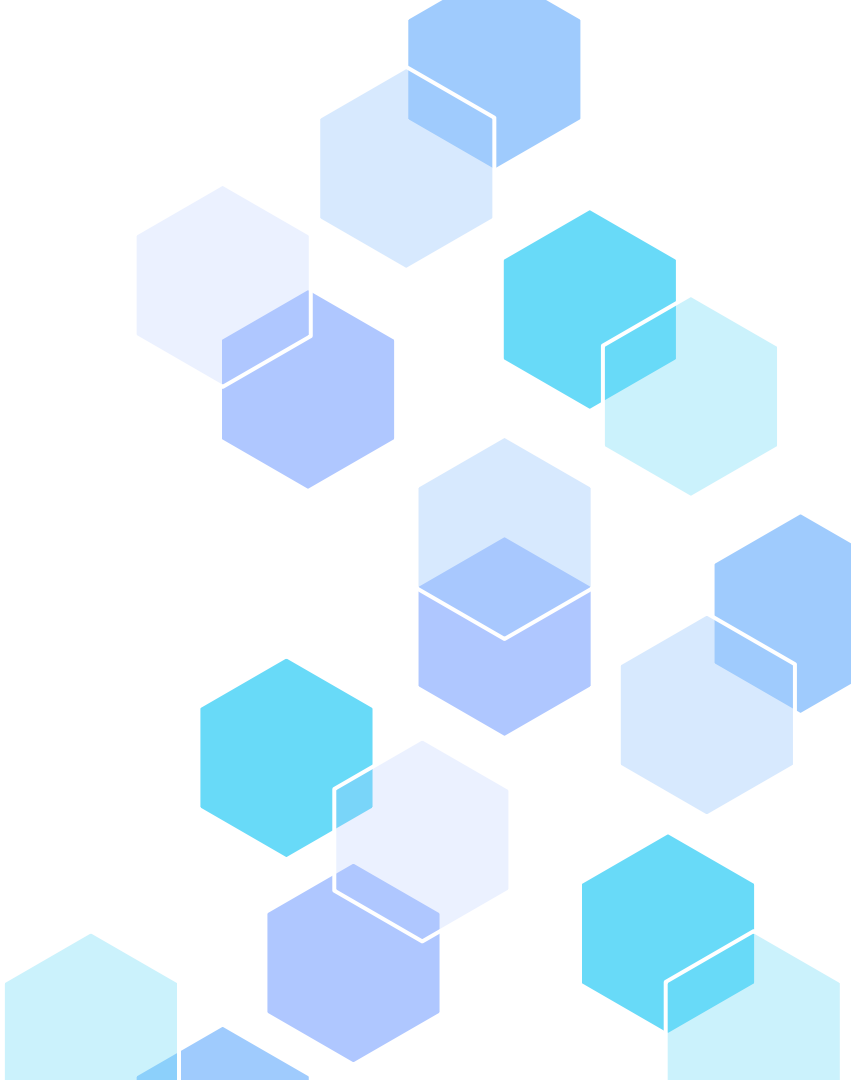
Pandemic Learning Models and Educational Outcomes In Pennsylvania: Causal Inference Using Matching

Mena Tetali, Sara Murley, and Samantha Rudravajhala

Table of contents

01

Motivation



Motivation

As the education system grapples with the consequences of the COVID-19 pandemic, we question if similar school districts with different COVID-19 policy choices have had different educational outcomes in the year following. Our project will:

- Analyze **district level data** in the Commonwealth of Pennsylvania, looking at how long districts were in-person during the 2020-2021 school year.
- Use **matching** to create pairs of districts that share certain characteristics but differ in their COVID-19 policies.
- Examine the **test scores** from **before and after the pandemic**.
- Investigate **differences between district pairs**

02

Data Collection

District Characteristics (covariates)

Future Ready PA

- Enrollment size, racial composition, geographic size, economically disadvantaged, gender, etc. by district

Digital Bridge K-12

- Percentage of students in PA districts who do not have internet access

District Learning Models (treatment)

COVID-19 School Data Hub

- Whether PA districts were virtual, hybrid, or in-person for each month of the 2020-2021 school year.

PSSA Test Scores (outcome)

Commonwealth of Pennsylvania website.

- Percentage of school population who scored proficient in the Pennsylvania System of School Assessment exam

Data Wrangling

PA Learning Models

- Aggregated number of months spent in-person

PSSA Test Scores

- Calculated the average percentage of students in each district who scored proficient in English and Math for both 2019 (pre-COVID) and 2022 (post-COVID) datasets

Merged Dataset

- Merged clean PA Learning Models, PSSA Score, and District Demographics into one dataset to be used for matching
- Resulting dataset contains 1 row per district

03

Methods

Matching

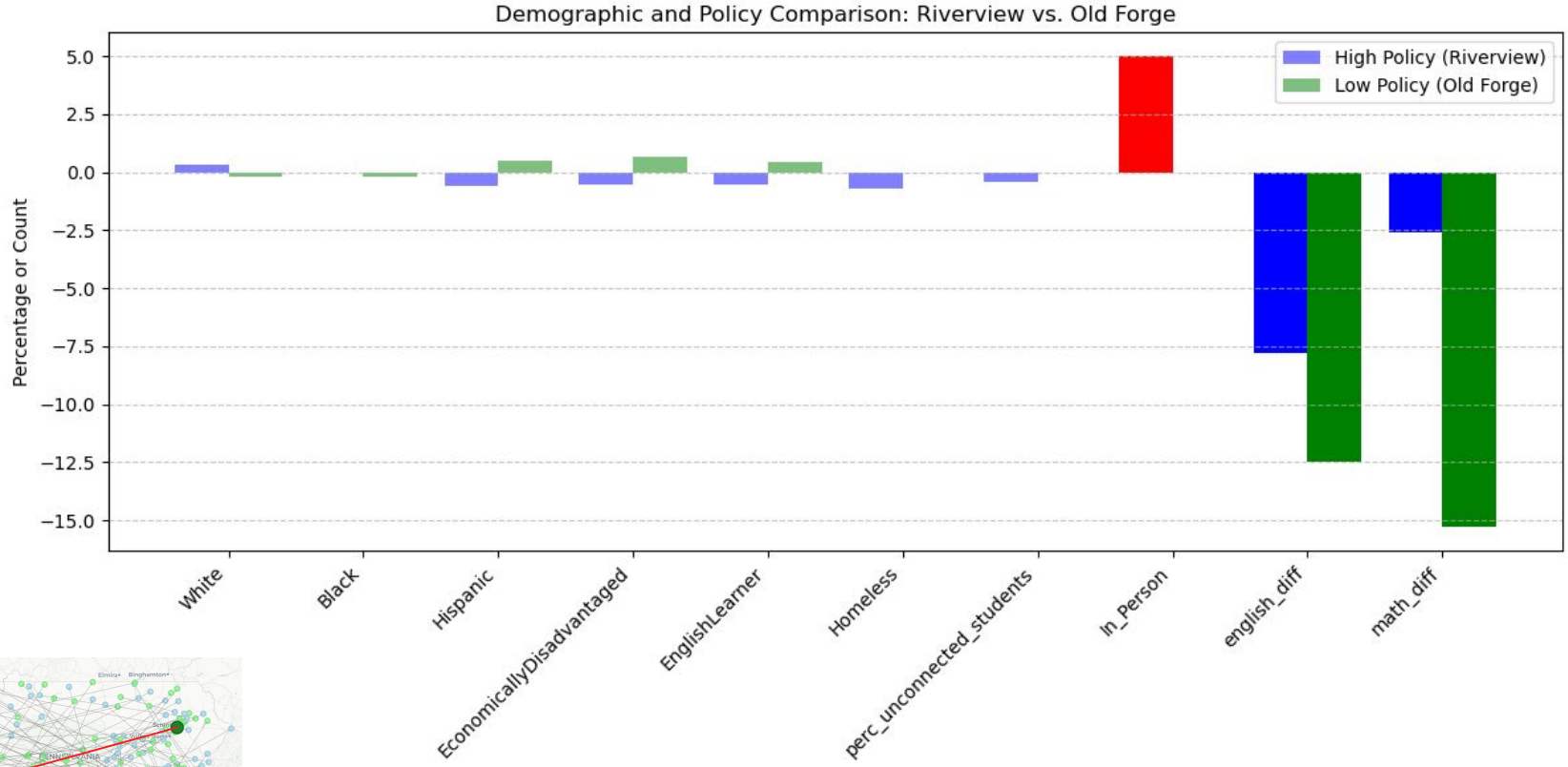
- Process that matches schools with similar characteristics (covariates) that **differ in their COVID learning models**

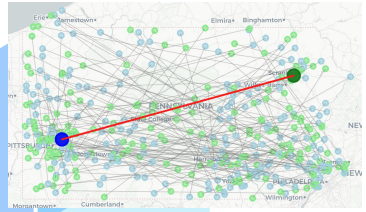
- Allows us to assess causal impact of COVID-19 policy (when schools went back in-person) on educational outcomes by correcting for endogeneity

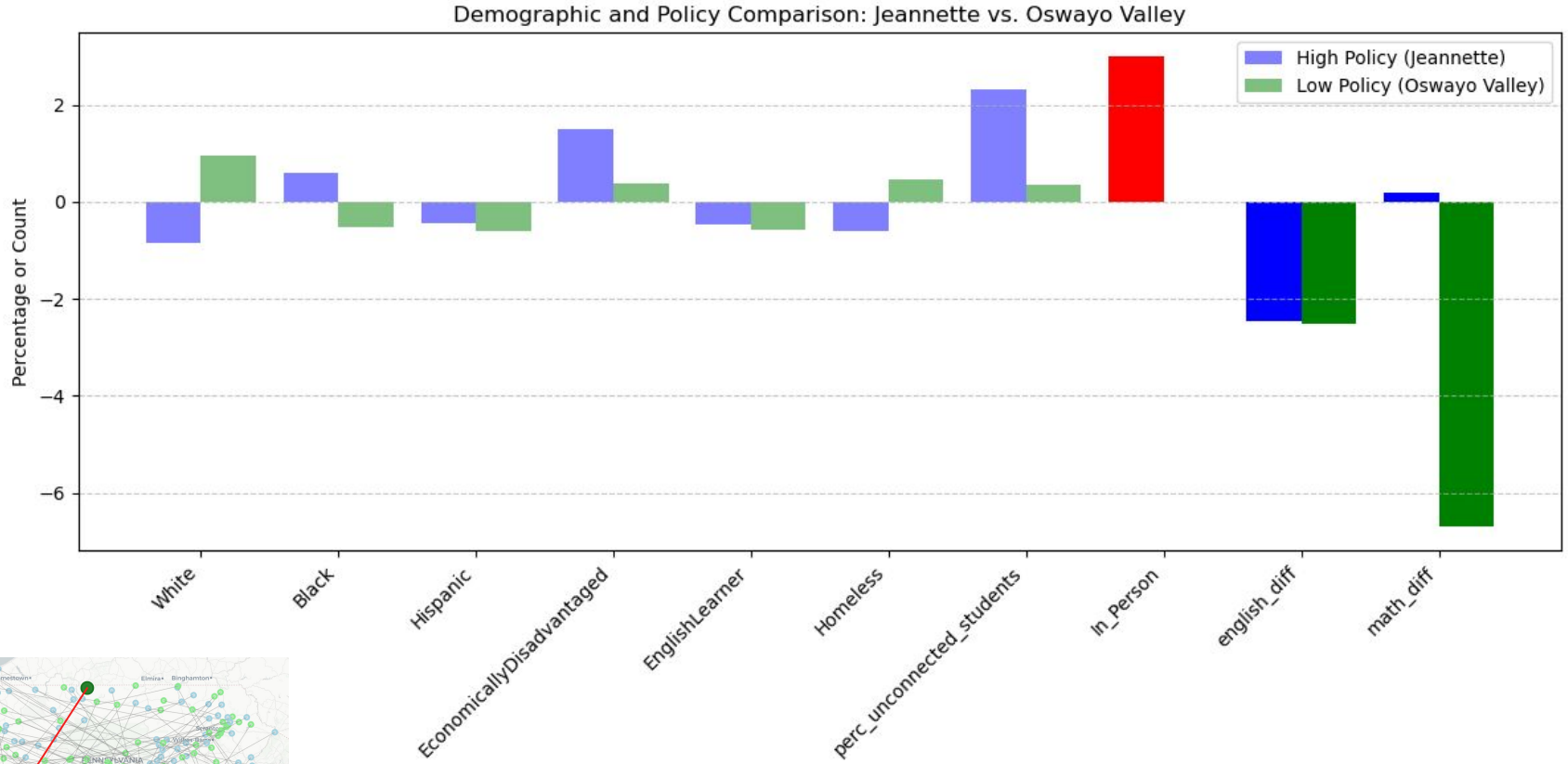
Matching Steps

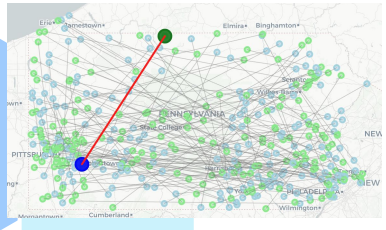
1. Clean data and merge datasets
2. Scale numerical features (mean of 0, sd of 1)
3. Create treatment variable
    a. 1 - districts with at least 1 month fully in person in the 9 month range
    b. 0 - districts with no months in person in the 9 month range
4. Find pairs using MatchIt in R with the nearest neighbor method that combine 1 school district with the treatment and 1 school district without the treatment
5. Perform paired samples t-test across all pairs for both english and math scores to assess significance of results

Example Pairs

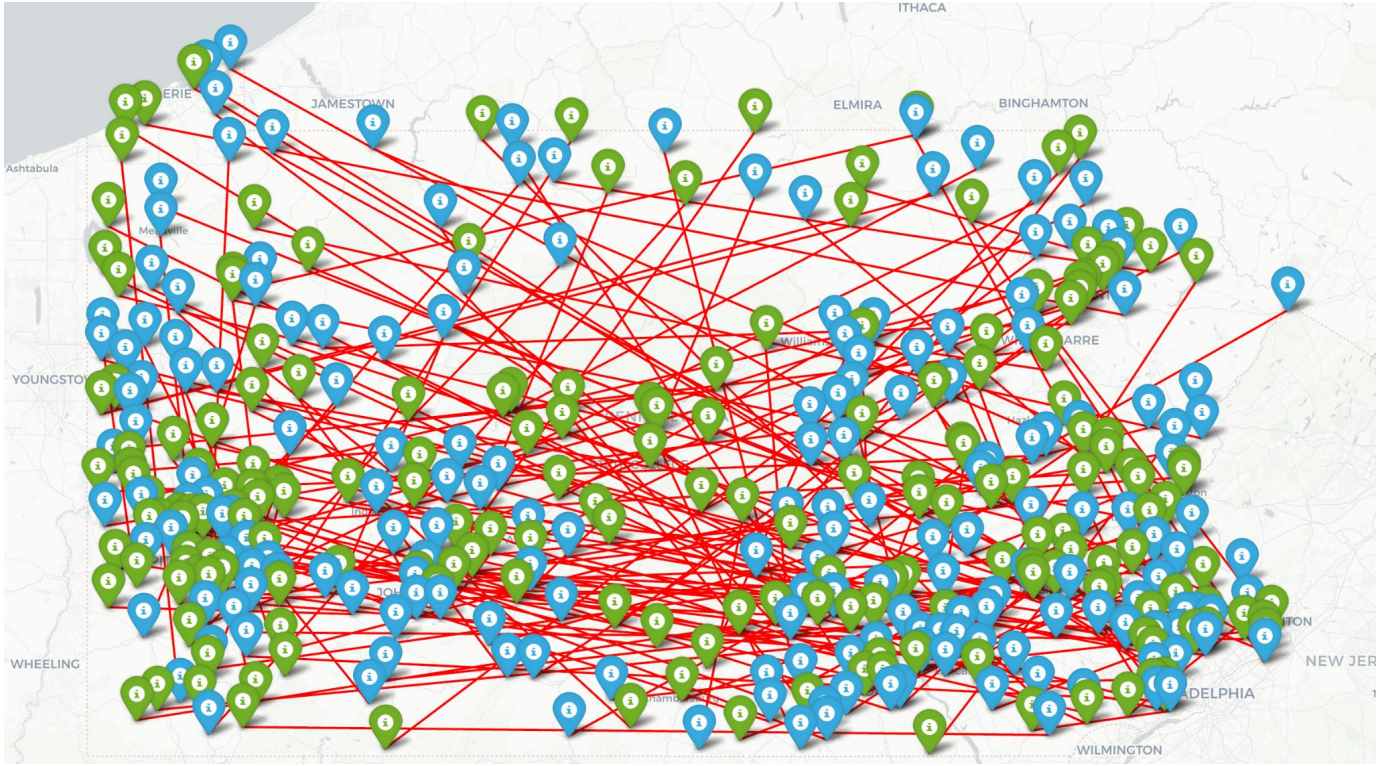

Demographic and Policy Comparison: Riverview vs. Old Forge
High Policy (Riverview)
Low Policy (Old Forge)
Percentage or Count
5.0
2.5
0.0
−2.5
−5.0
−7.5
−10.0
−12.5
−15.0
White
Black
Hispanic
EconomicallyDisadvantaged
EnglishLearner
Homeless
perc_unconnected_students
In_Person
english_diff
math_diff




Demographic and Policy Comparison: Jeannette vs. Oswayo Valley
High Policy (Jeannette)
Low Policy (Oswayo Valley)
Percentage or Count
2
0
−2
−4
−6
White
Black
Hispanic
EconomicallyDisadvantaged
EnglishLearner
Homeless
perc_unconnected_students
In_Person
english_diff
math_diff



Matching Map



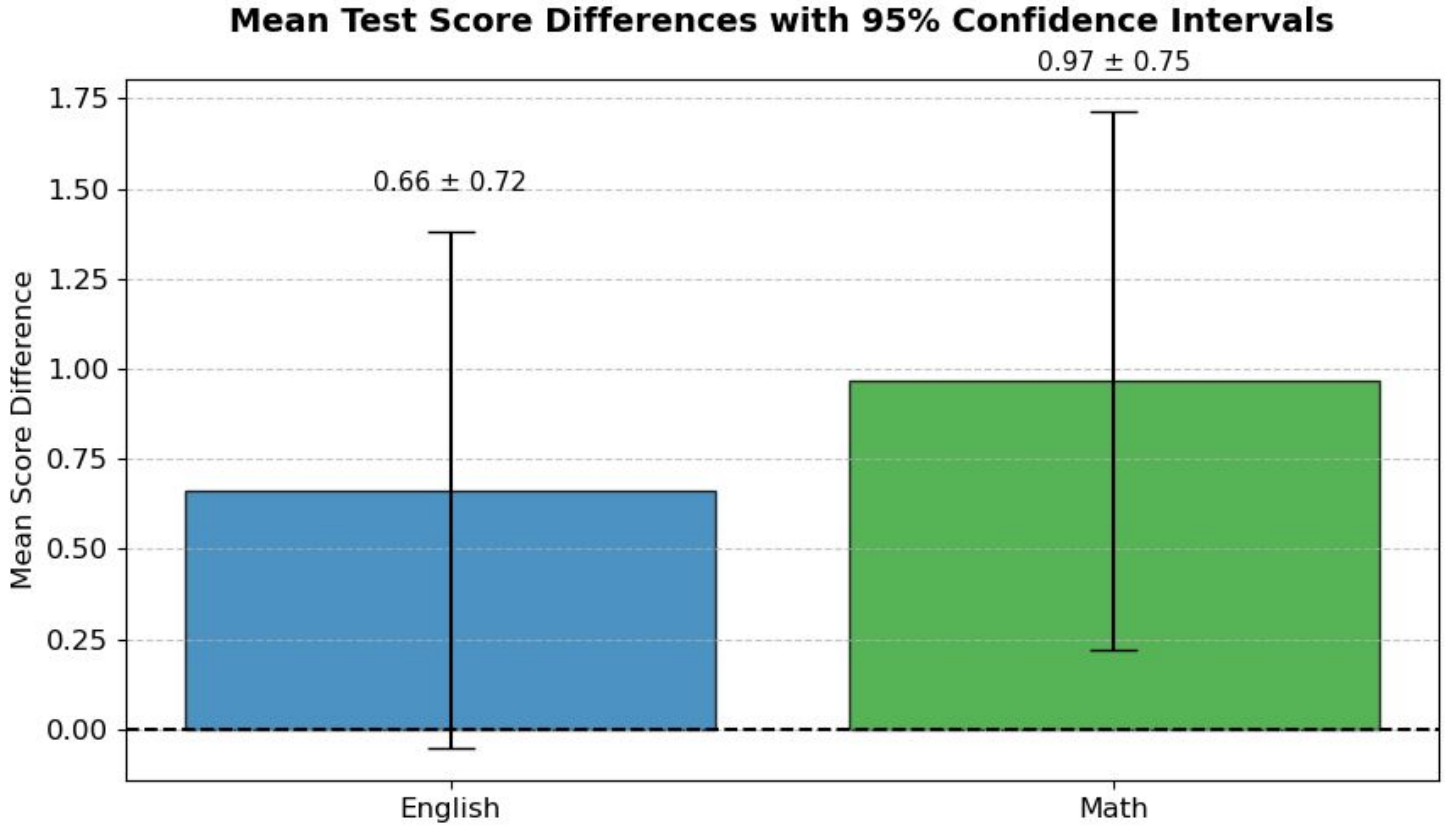
04

Results

T-Test Results

Test	Statistic	P-Value	Degrees of Freedom
English T-Test	1.81	0.071	188
Math T-Test	2.54	0.012	188

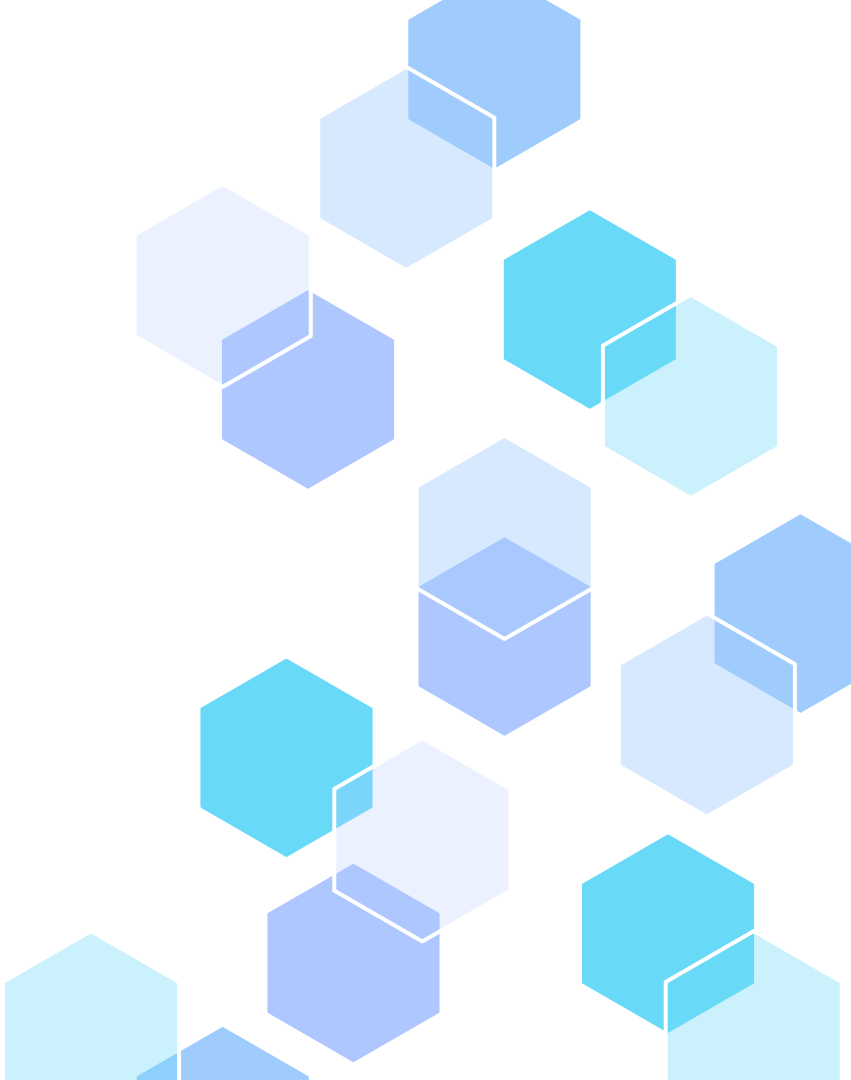
Table 1: T-Test Results for English and Math Test Scores


Mean Test Score Differences with 95% Confidence Intervals
0.97 ± 0.75
0.66 ± 0.72
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
Mean Score Difference
English
Math

Conclusion

Schools that spent more time in-person during the examined period experienced a **smaller decline in math test scores**, with an **average difference of 0.97 percentage points** (t=2.54, df=188) compared to schools that had no in-person instruction. The result is significant at the 0.05 significance level.

Schools that spent more time in-person during the examined period experienced a **smaller decline in english test scores**, with an **average difference of 0.66 percentage points** (t=1.81, df=188)compared to schools that had no in-person instruction.



05

Lessons Learned

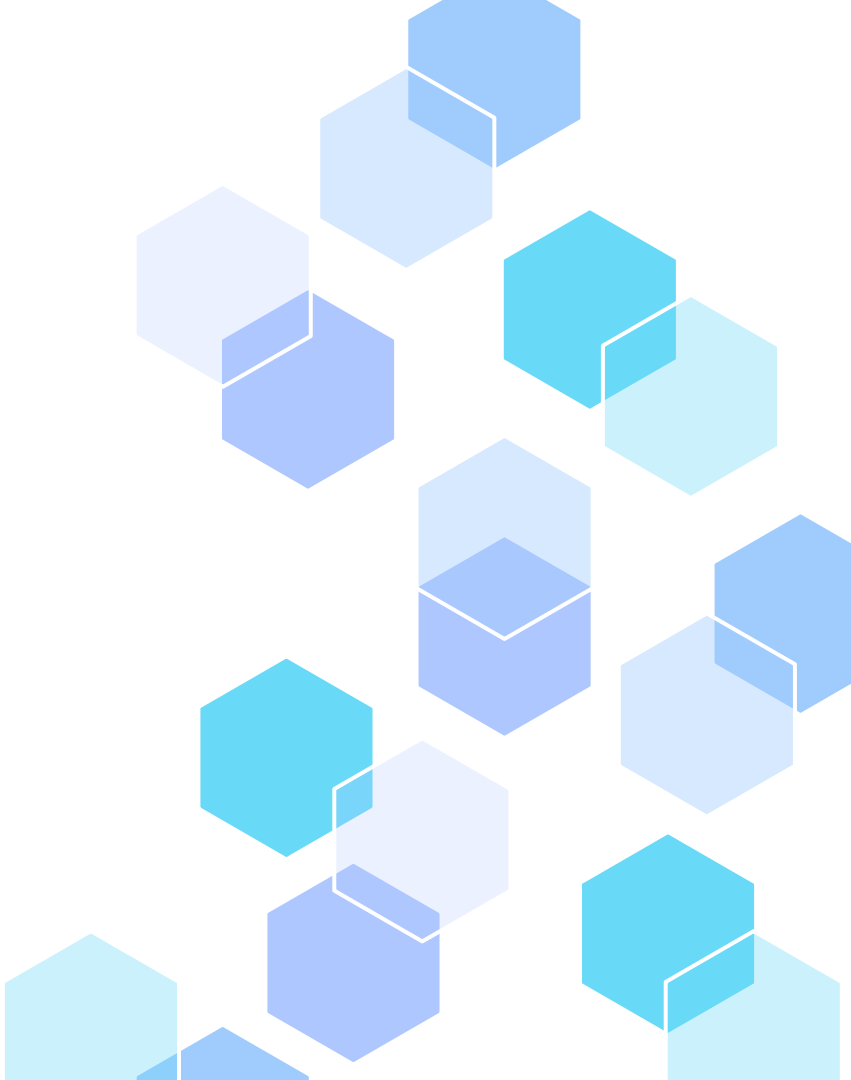
Learning Models Matter

- In Pennsylvania, in person learning was an important factor in explaining whether students in similar districts performed better – more in person learning revealed a smaller decline in scores for Math

- Our results indicate the potentially imperative effect of immersive learning with a link to less negative student performance in certain subject areas and should be prioritized for future pandemics

06

Next Steps



Further Analysis

- Conduct analysis of learning models across different demographics:
    - Is the impact of COVID-19 policies on educational outcomes different for some pairs? For example, do policies have more of an impact for pairs of low-income districts or those with lower internet access?
- Experiment with different matching methods or spatial matching techniques to assess robustness of results
- Determine the impact of learning models on differences in test scores for different states