

INSIGHTS FROM EARLY CHILDHOOD EDUCATION DATA IN THE
SCHOOL DISTRICT OF BELOIT

CASE STUDY 1

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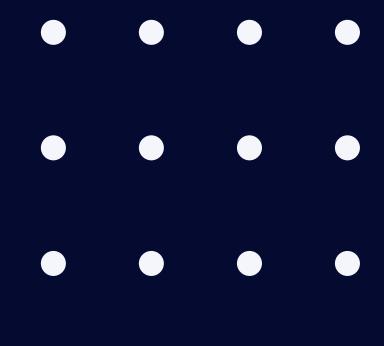
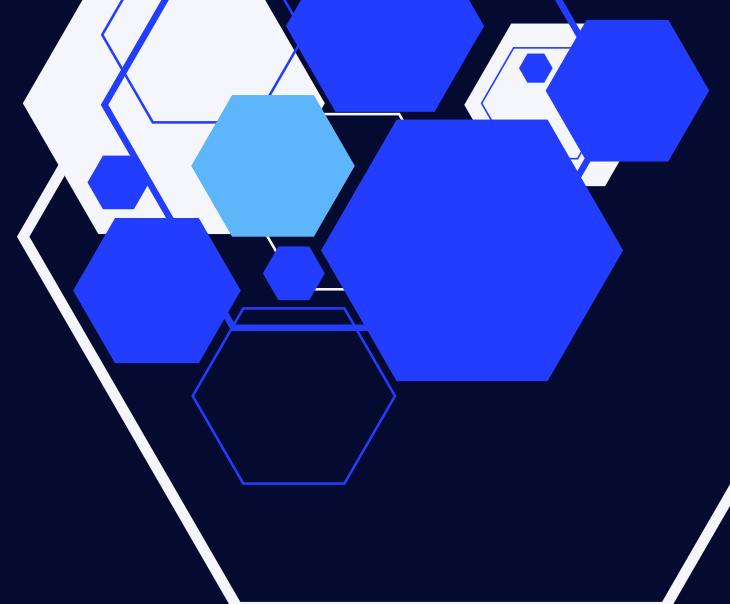


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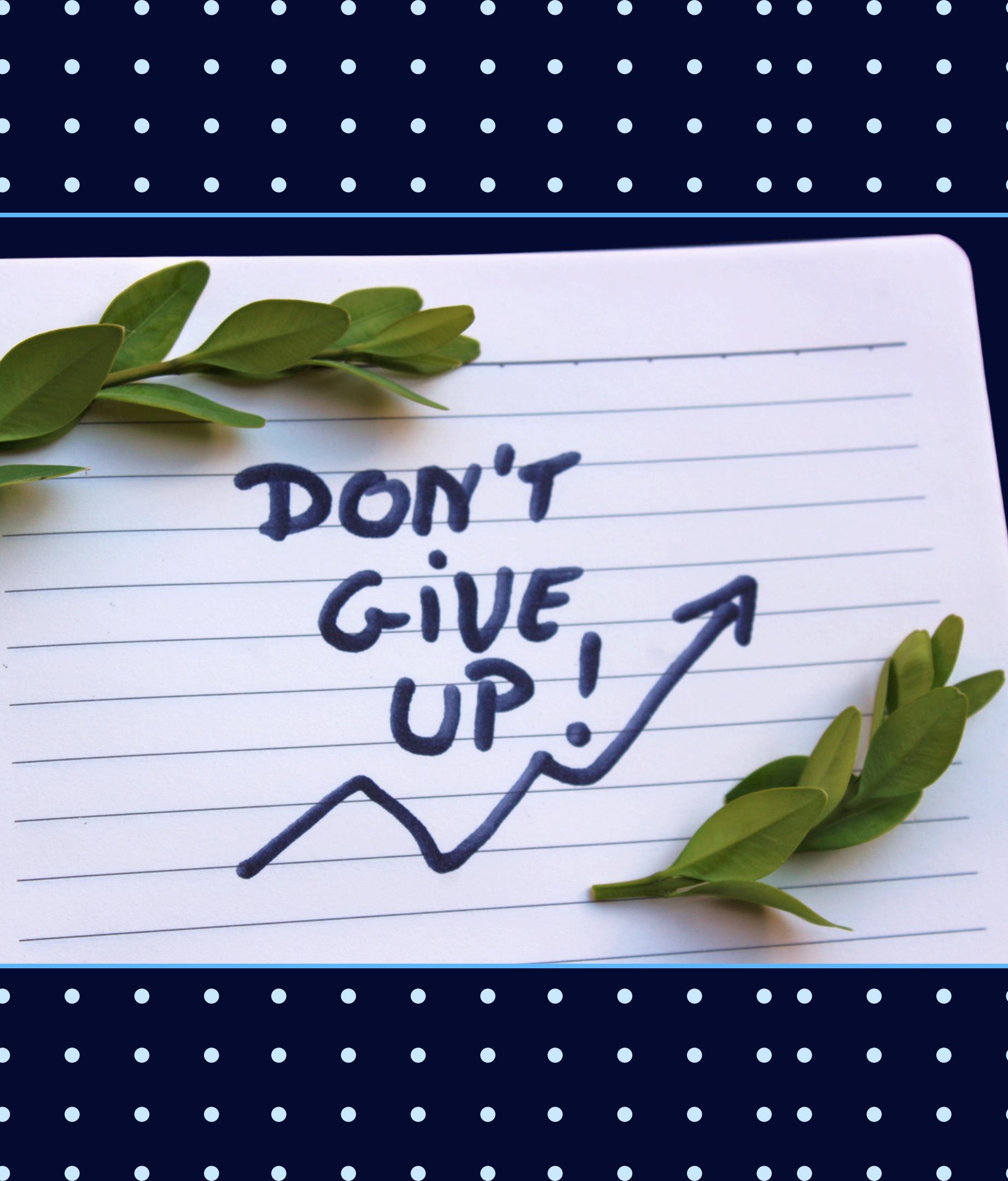
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INTRODUCTION



Why this case study is important?

- Early Intervention
- Data-Driven Policy Making
- Community Impact
- Informed Use of Resources

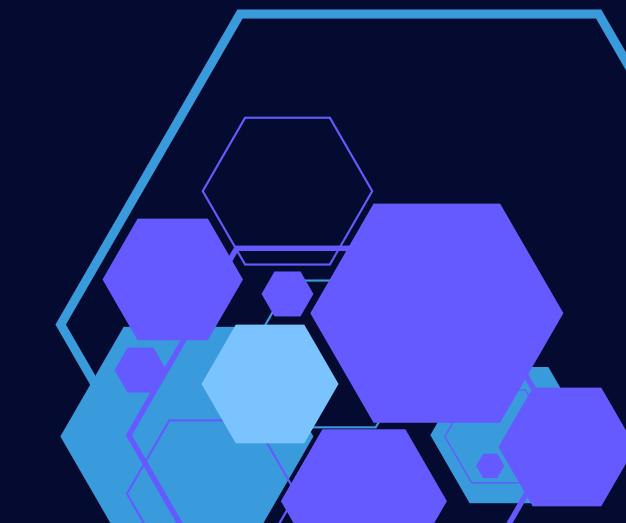
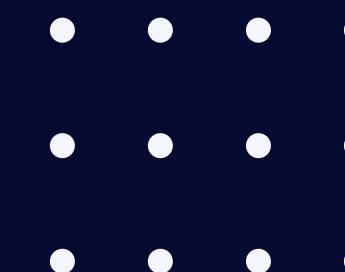


ALL ABOUT OUR DATA



Data Cleaning

- Variable Isolation
 - We began by isolating each variable independently, allowing for targeted and precise cleaning measures tailored to the unique characteristics of each variable.
- Visualization and Feature Interaction
 - To identify trends and outliers, we visualized each variable against performance scores using both Tableau and Python.
- Sorting Variables
 - Based on the insights gained from our visualizations, we sorted the variables into predictors and control variables.
- Ambiguity Resolution
 - We thoroughly cleaned data that was ambiguous and contributing to noise in the dataset.
- Handling Missing Values: Missing values were addressed systematically. Each field was considered individually:
 - Manual Correction
 - Median Imputation



Tools and Purpose

- **Google Sheets**

- We used this application to manually clean the data.
- Filtering and sorting of data.

- **Python**

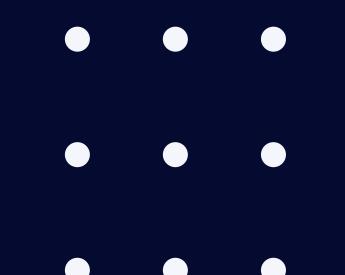
- Exploratory Data Analysis (EDA), handling missing values, converting categorical to continuous labels, & regression models training.

- **Tableau**

- We used this feature for visualizing the data in order to provide us more information on our target, predictors, & control variables.

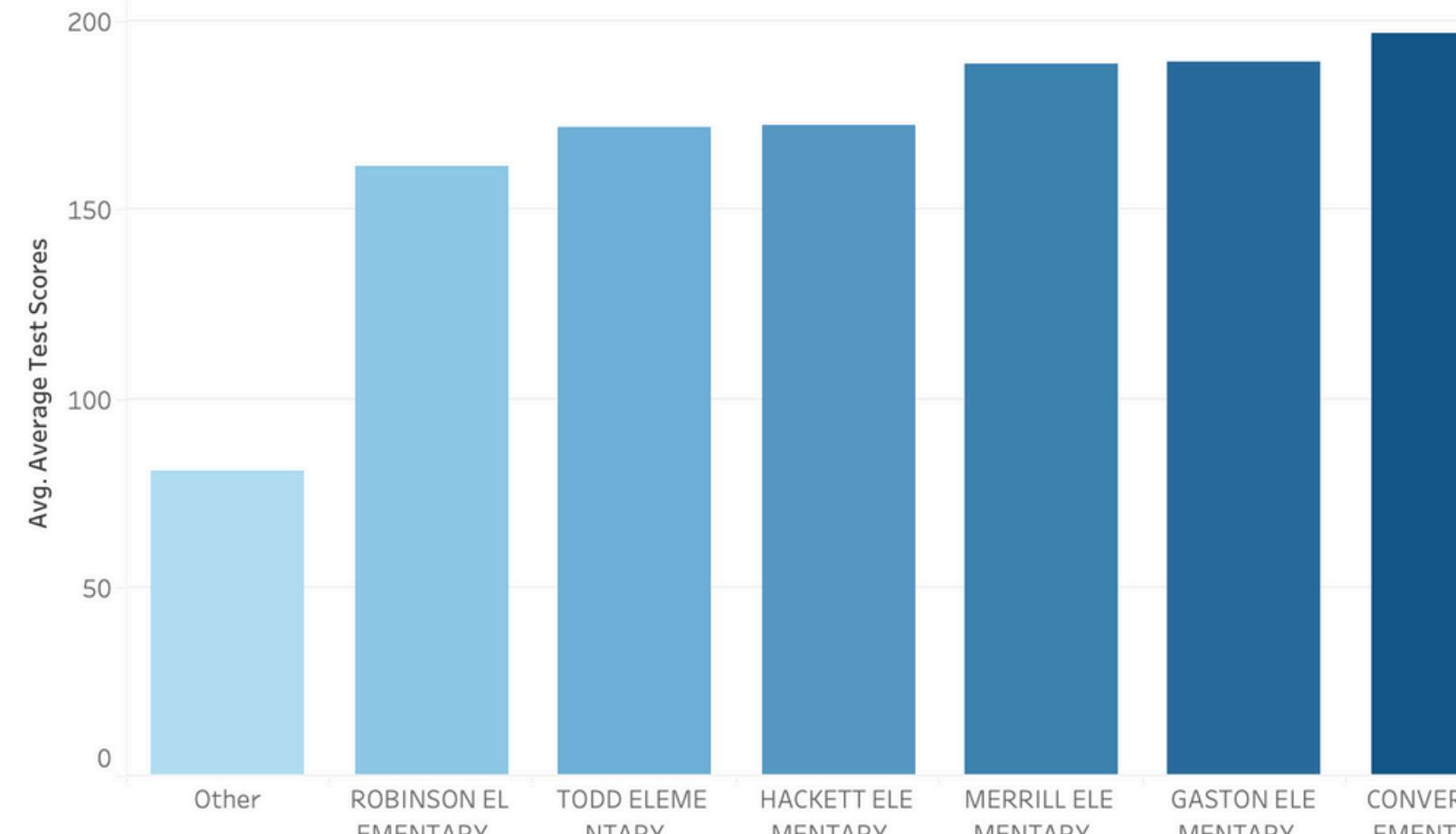
- **R-programming**

- Deeper linear regression model trainings, model evaluation (R^2 , MAE).

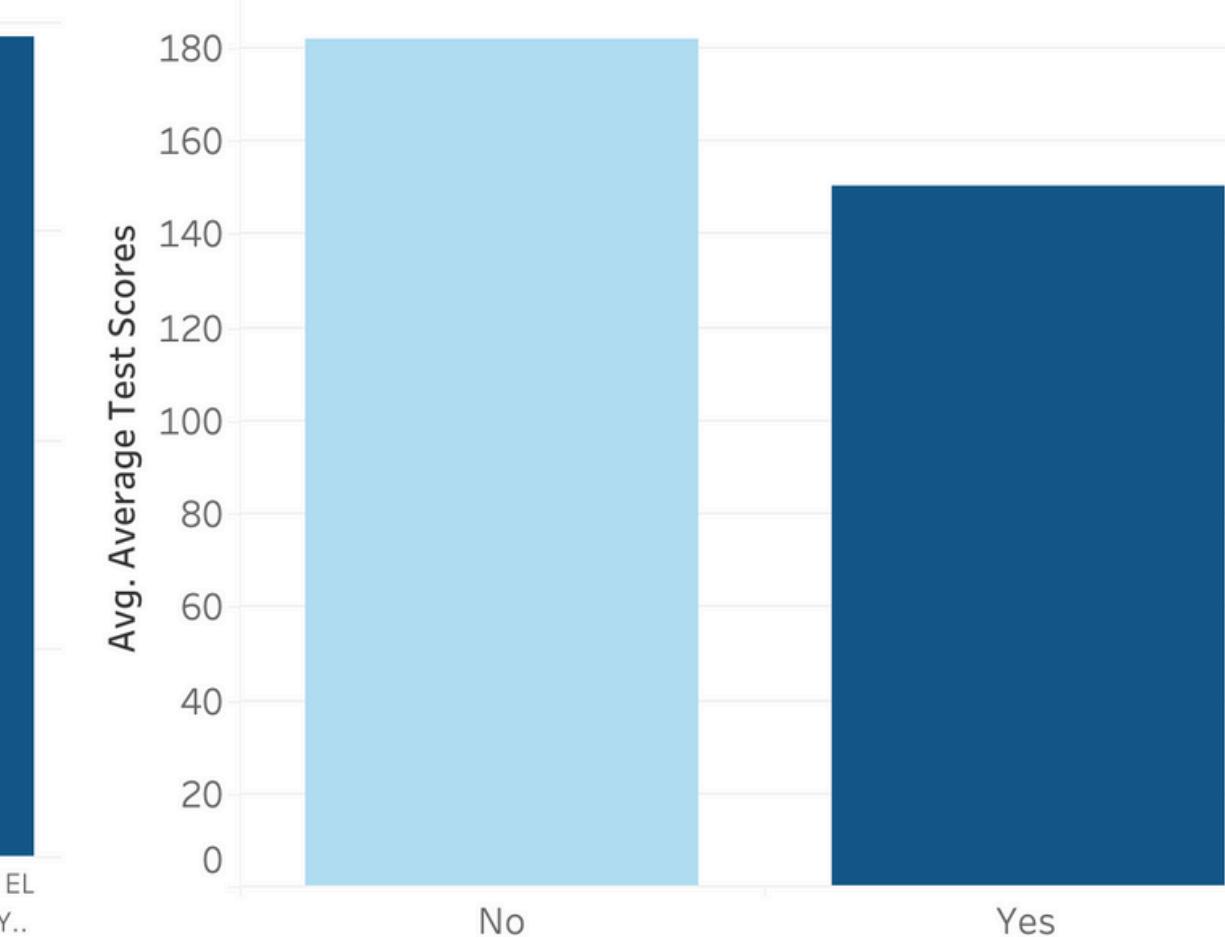


DESCRIPTIVE VISUALS

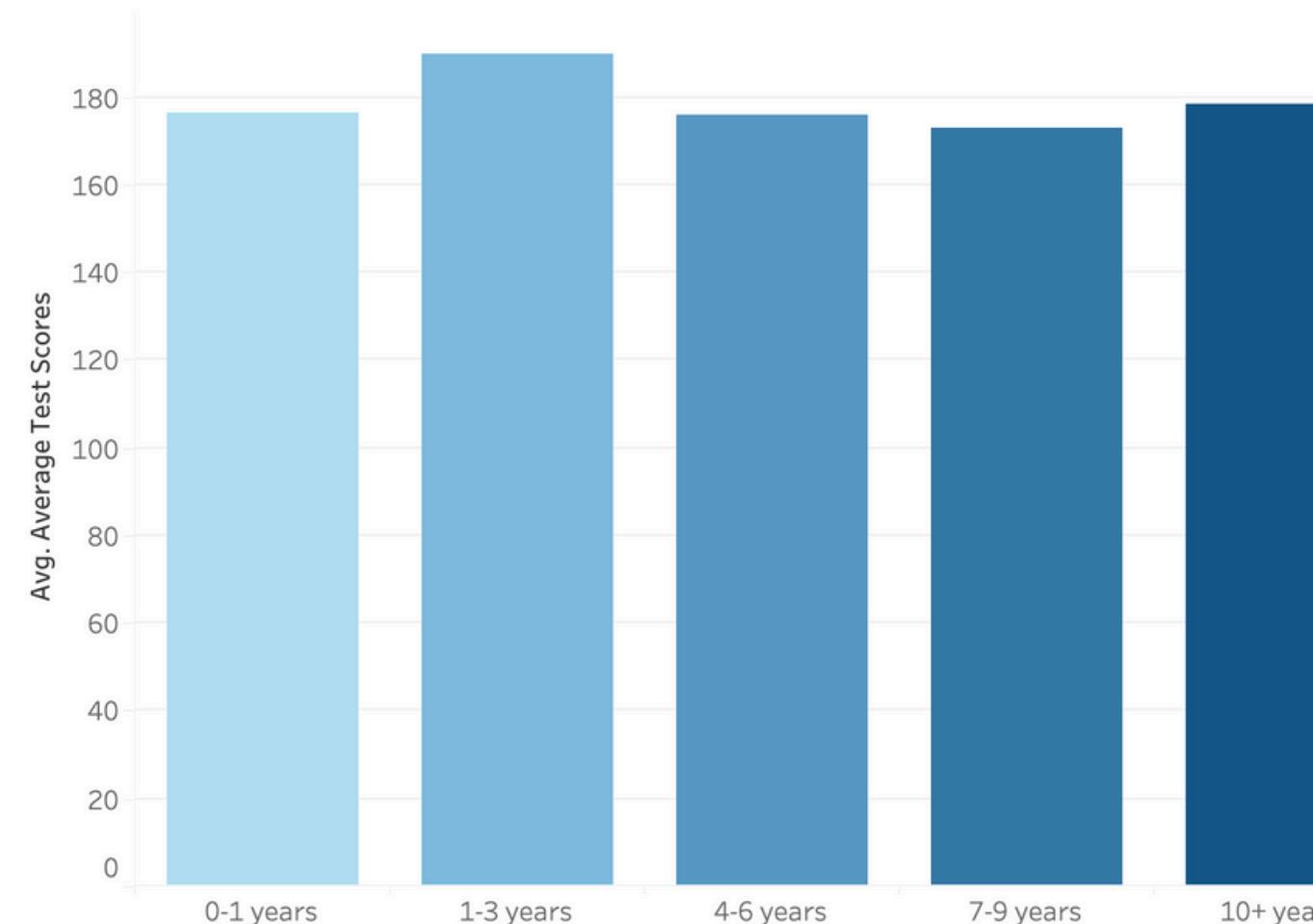
Average Test Scores for Each School



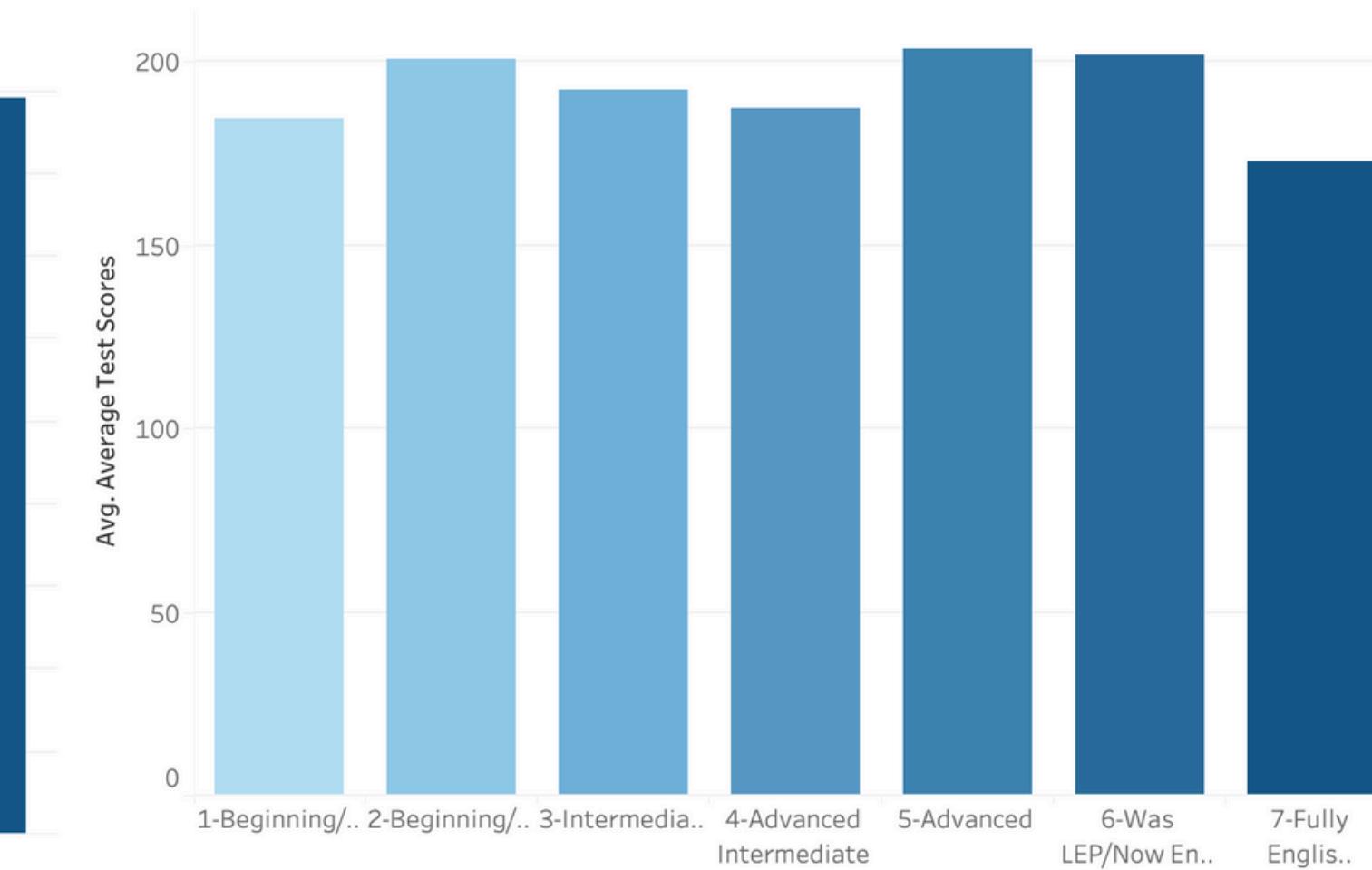
Avg Test Scores vs Special Education Needs



Average Test Scores vs. Number of Years Lived in Beloit



English Proficiency Level vs. Average Test Score



OUR RESEARCH QUESTION

"How do factors such as old schooling, special education status, English proficiency, and duration of residency in Beloit influence academic achievement among students?"

EXPERIMENTAL MODEL

$$\text{AA}_i = \beta_0 + \beta_1 \times (\text{OSL})_1 + \beta_2 \times (\text{SE})_2 + \beta_3 \times (\text{EP})_3 + \beta_4 \times (\text{NY})_4 + \epsilon_i$$

AA → Academic Achievement (Outcome)

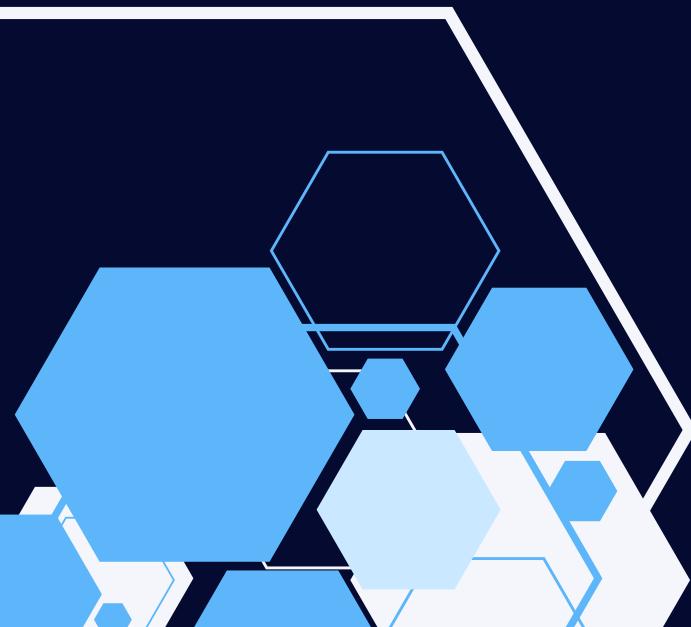
OSL → Old School Label

SE → Special Education

EP → English Proficiency

NY → # of years lived in Beloit

ϵ_i → Error Term



OUTCOME

Residuals:

| Min | 1Q | Median | 3Q | Max |
|----------|---------|--------|--------|--------|
| -103.330 | -16.130 | 3.034 | 21.150 | 73.391 |

Coefficients:

| | Estimate | Std. Error | t value | Pr(> t) |
|-----------------------------------|-----------|------------|---------|--------------|
| (Intercept) | 119.11892 | 28.40135 | 4.194 | 4.25e-05 *** |
| old_School_Label | 6.01077 | 1.33246 | 4.511 | 1.15e-05 *** |
| Sex | -4.61760 | 4.97522 | -0.928 | 0.354562 |
| Special_Ed | -27.52978 | 12.04914 | -2.285 | 0.023466 * |
| Disability | 1.22525 | 9.65305 | 0.127 | 0.899135 |
| Fed_RaceAsian | -23.71699 | 37.00024 | -0.641 | 0.522323 |
| Fed_RaceBlack or African American | -9.17626 | 9.25620 | -0.991 | 0.322810 |
| Fed_Racewhite | 0.05034 | 7.61560 | 0.007 | 0.994734 |
| Eng_Prof | 6.12752 | 1.69541 | 3.614 | 0.000389 *** |
| Q1_3 | 2.66060 | 3.54744 | 0.750 | 0.454208 |
| Q1_7 | 2.84274 | 2.02354 | 1.405 | 0.161756 |
| Q2_1 | 1.31662 | 4.73769 | 0.278 | 0.781399 |
| Q2_2 | -4.20287 | 4.21271 | -0.998 | 0.319753 |
| children_Per_Adult | 8.69045 | 7.19923 | 1.207 | 0.228930 |
| Q2_3 | -4.92158 | 2.30116 | -2.139 | 0.033775 * |
| Q2_5 | 0.76982 | 0.93070 | 0.827 | 0.409231 |
| Q3_1 | 8.28008 | 8.76677 | 0.944 | 0.346161 |
| Q3_2 | -2.11593 | 1.96231 | -1.078 | 0.282320 |
| Q3_4 | -0.36004 | 1.61714 | -0.223 | 0.824062 |
| Q4_1 | -0.75359 | 5.68624 | -0.133 | 0.894711 |
| Q4_2 | 0.19277 | 2.27620 | 0.085 | 0.932599 |
| Q4_4 | 1.23445 | 1.68410 | 0.733 | 0.464489 |
| Q5_1 | 2.69052 | 7.17492 | 0.375 | 0.708100 |
| Q6_1 | 0.50049 | 2.14803 | 0.233 | 0.816022 |
| Q6_3 | -0.04626 | 2.72117 | -0.017 | 0.986456 |
| Q6_4 | 1.63471 | 2.81237 | 0.581 | 0.561777 |
| Q6_5 | -0.81766 | 2.06757 | -0.395 | 0.692955 |
| Q6_7 | -2.30984 | 2.92448 | -0.790 | 0.430645 |
| Q6_8 | 2.44345 | 2.75605 | 0.887 | 0.376465 |

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 33.66 on 184 degrees of freedom

Multiple R-squared: 0.3431, Adjusted R-squared: 0.2431

F-statistic: 3.432 on 28 and 184 DF, p-value: 2.803e-07

OUTCOME

| Minimum | 1st Quartile | Median | 3rd Quartile | Maximum |
|---------|--------------|--------|--------------|---------|
| -111.34 | -15.57 | 5.303 | 22.354 | 73.967 |

| Coefficients | Estimate Std. | Error | t value | Pr(> t) |
|------------------------|---------------|-------|---------|---------------|
| Intercepts | 143.081 | 9.848 | 14.529 | < 2e^-16 *** |
| Old_School_Label | 5.974 | 1.238 | 4.825 | 2.70e^-06 *** |
| Special_Ed | -29.854 | 7.491 | -3.985 | 9.32e^-05 *** |
| Eng_Prof | 5.876 | 1.162 | 5.055 | 9.41e^-07 *** |
| Q2_3 (Years in Beloit) | -4.561 | 2.091 | -2.181 | 0.0303 * |

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

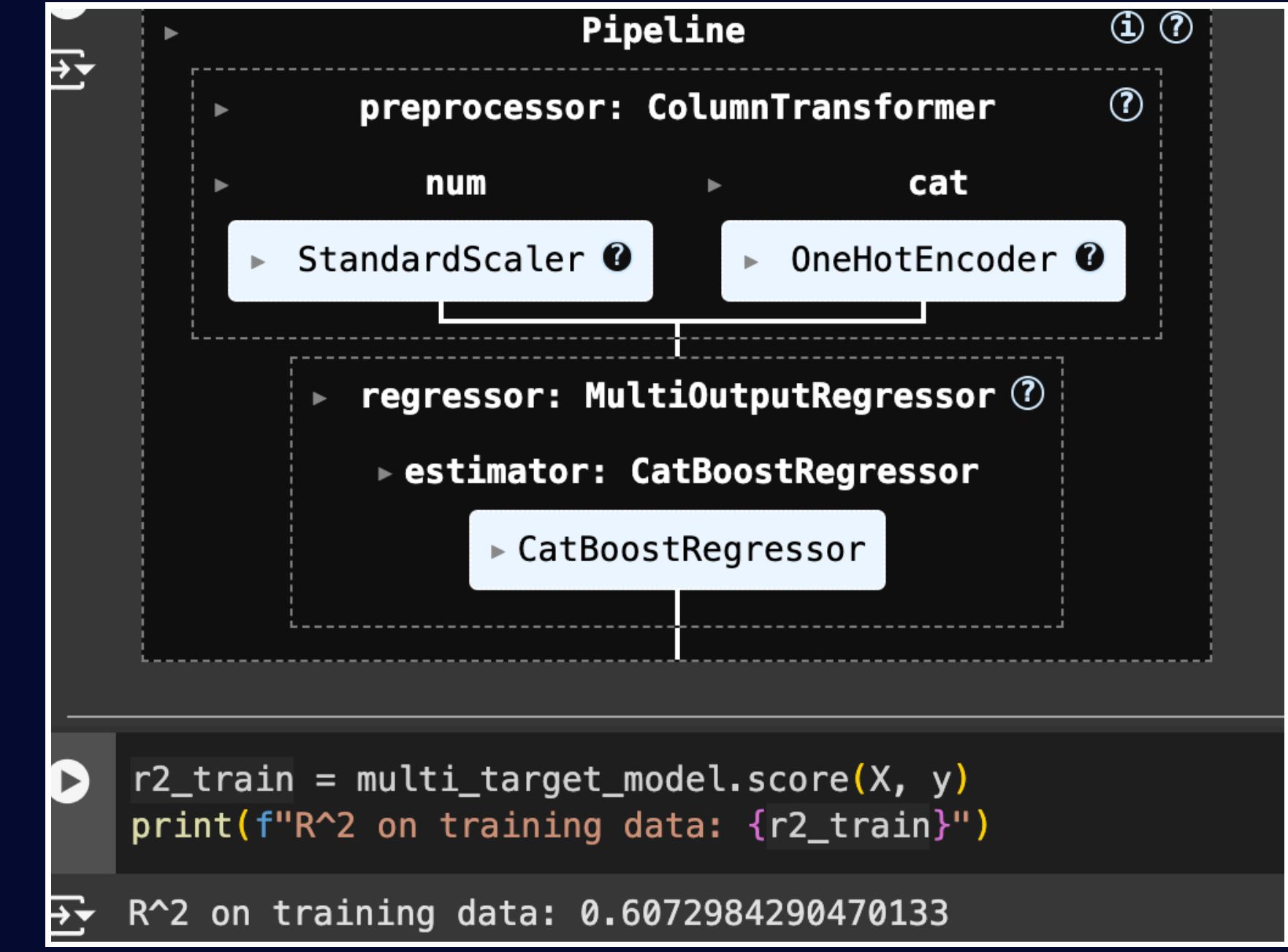
Residual standard error: 33.13 on 208 degrees of freedom
Multiple R-squared: 0.2808, Adjusted R-squared: 0.267
F-statistic: 20.3 on 4 and 208 DF, p-value: 3.919e-14

OTHER MODELS

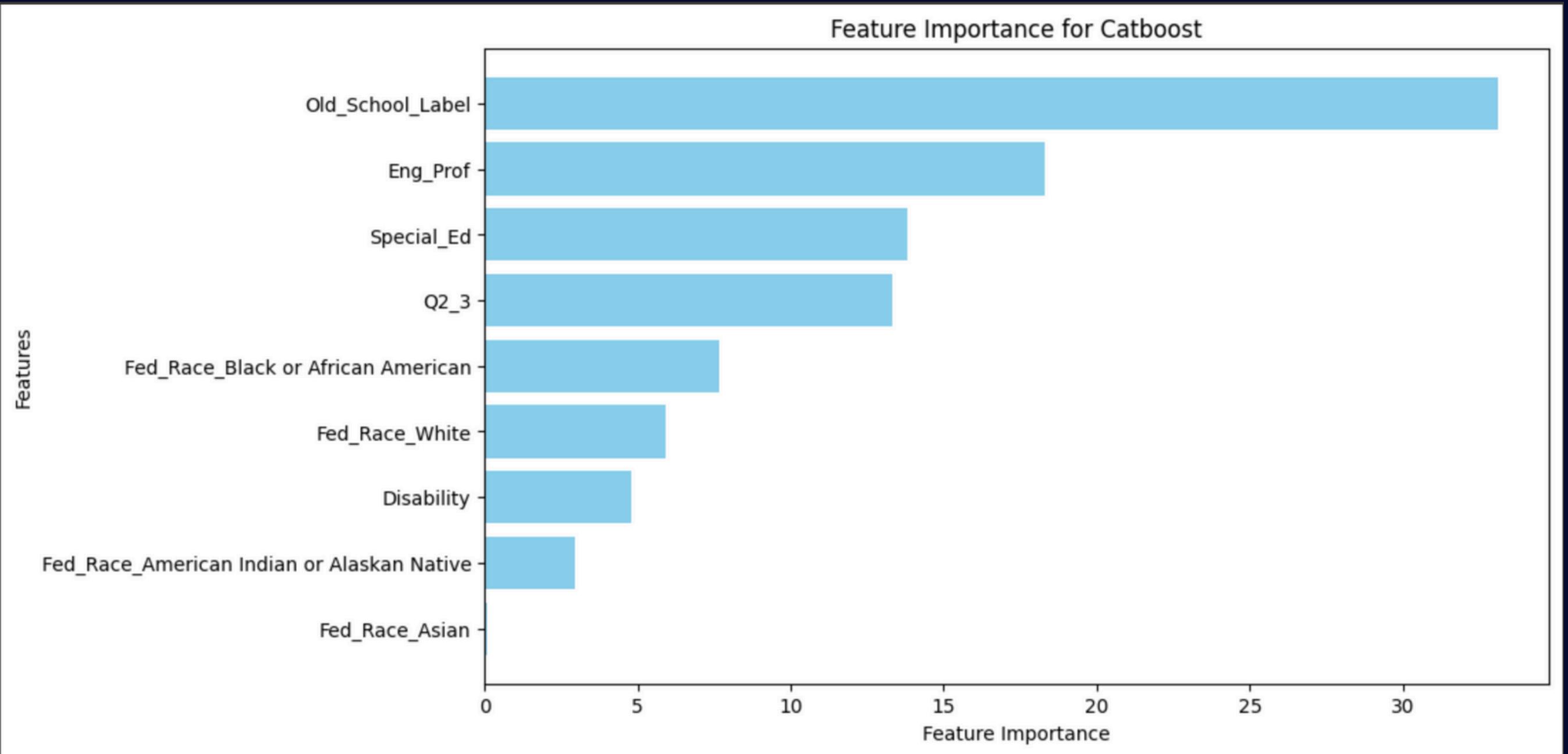
1. XGBoost: - 0.6 (R^2)



2. Catboost - 0.6 (R^2)



FEATURE IMPORTANCE



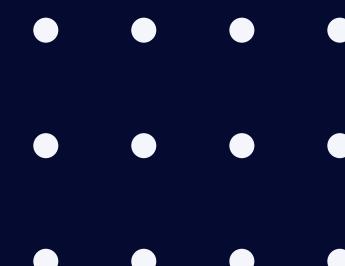
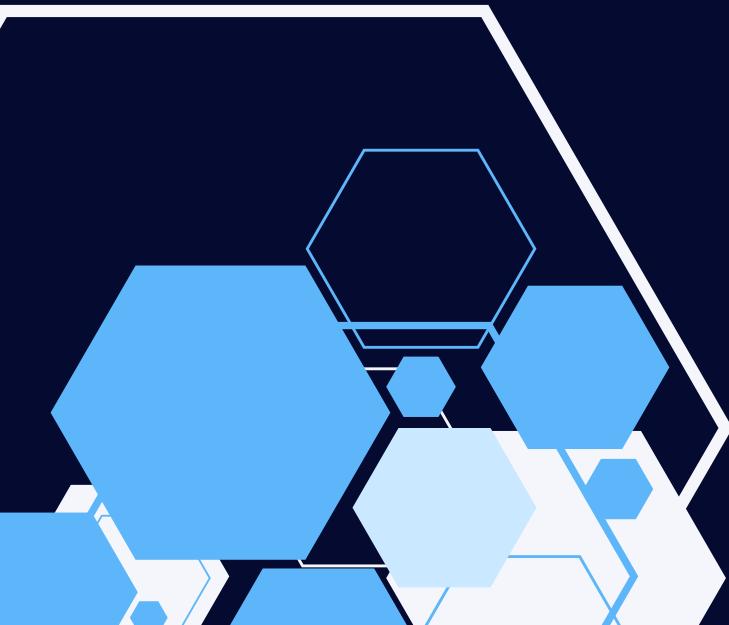
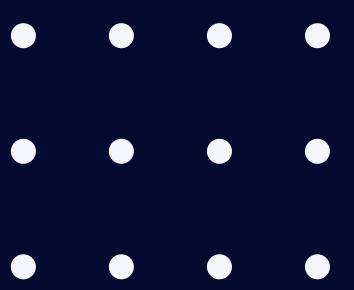
MAE FOR MATH 18-19: 20.72939415306791

MAE FOR READ 18-19: 32.20628298305619

OVERALL MAE: 26.46783856806205

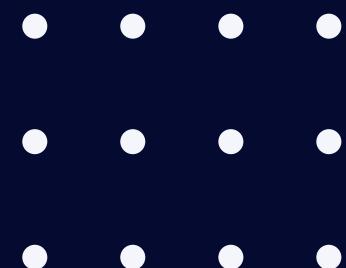
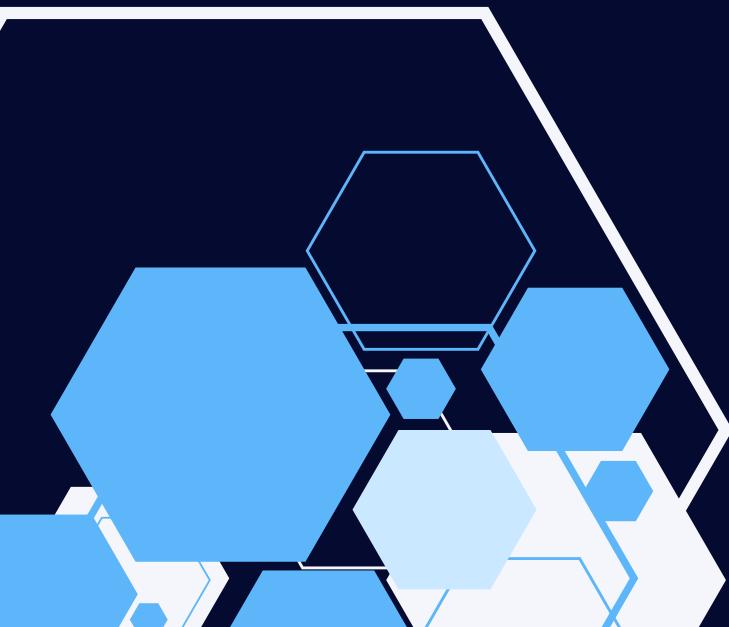
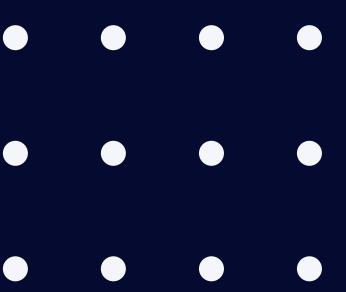
POLICY RECOMMENDATIONS

1. Increase support for special education programs. This could include additional resources, specialized staff, and adaptive learning materials to address the needs of these students. Personalized learning plans and dedicated mentorship could help mitigate the negative impact.



POLICY RECOMMENDATIONS

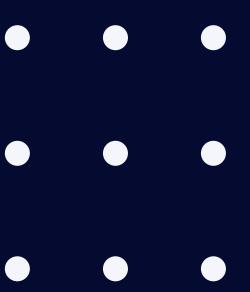
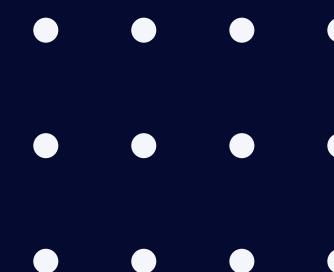
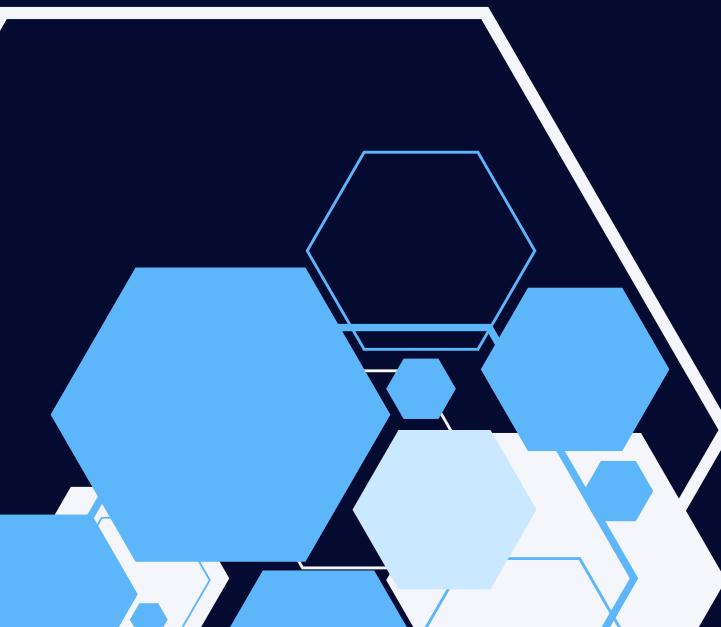
2. We believe that in order to support the student well-being schools must implement school-based health screenings and mental health resources, ensuring students have access to necessary healthcare services.



POLICY RECOMMENDATIONS

3. Establish a comprehensive Mandatory English Language Development Program within educational institutions, aimed at students with lower English proficiency levels. This program should include the following key components:

- Curriculum Design, Assessment & Placement, & Monitoring Support



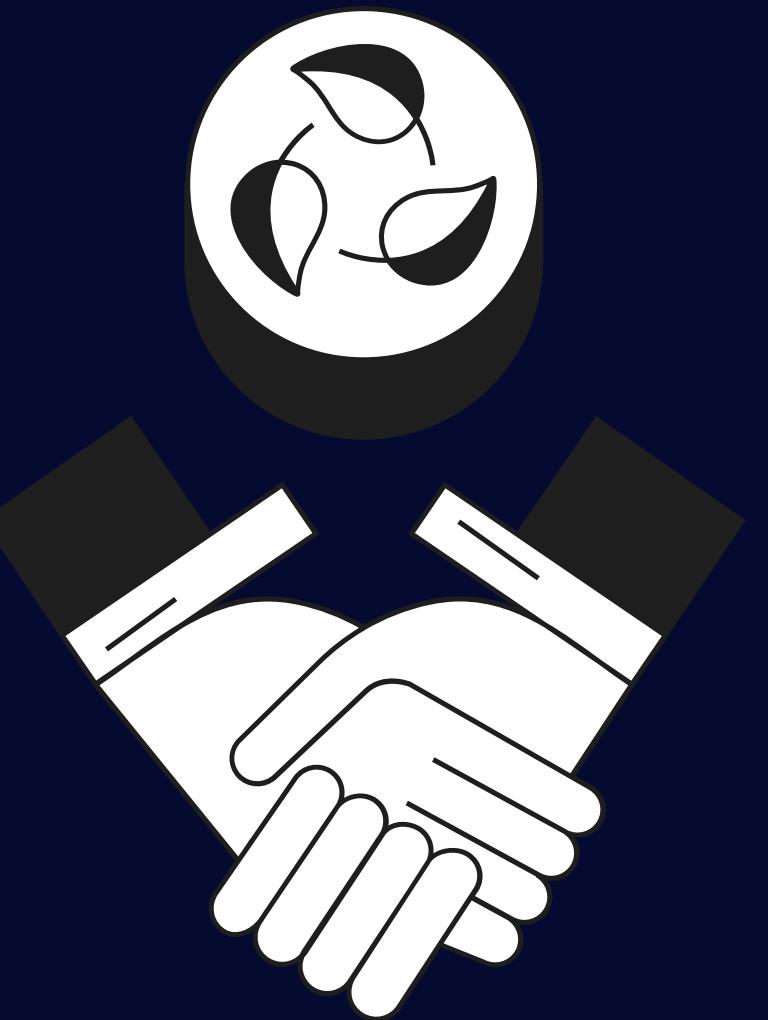
Limitations of our Analysis !

- Data quality and completeness
- Self reported data
- Number of observations
- Lower R-squared value
- Time period of the survey taken
- Biased data



Ethical Considerations

- Confidentiality and Privacy
- Informed Consent
- Accurate Representation of Data
- Impact on Educational Outcomes:
- Bias and Fairness
- Transparency



Acknowledgements

We acknowledge the use of artificial intelligence tools in outlining our case study and assisting with code cleaning for our model. These AI technologies were instrumental in enhancing our understanding and streamlining our analysis, contributing significantly to the precision and efficiency of our research.

We also extend our gratitude to Dr.Phan for sharing the data with us.

THANK YOU

Any Questions?