CONVEX PROJECT

STUDENT SCORE EXAM OPTIMIZATION

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STUDENT EXAM SCORE

The project focuses on analyzing and optimizing student exam scores to create a fair and balanced grade distribution. By studying the score distribution, we aim to minimize grade disparities while adhering to constraints like minimum and maximum grades. Convexity is analyzed to ensure the fairness of the objective function. Non-convexity is introduced by modifying the data, and optimization techniques are applied to restore a convex, equitable distribution. This process is crucial in educational systems to address grading inconsistencies, promote fairness, and ensure grades reflect actual performance. The outcome helps in improving assessment methods and supporting data-driven educational reforms.

BRIEF OF EQUATION AND CONSTRAINT

the Score Constraint is Range
X>=0
X<=100

$$\mathrm{Var}(x) = \frac{1}{n}\sum_{i=1}^{n} x_i^2 - \mu^2$$

$$\frac{\partial^2 f(x)}{\partial x_j^2} = \frac{2}{n}$$

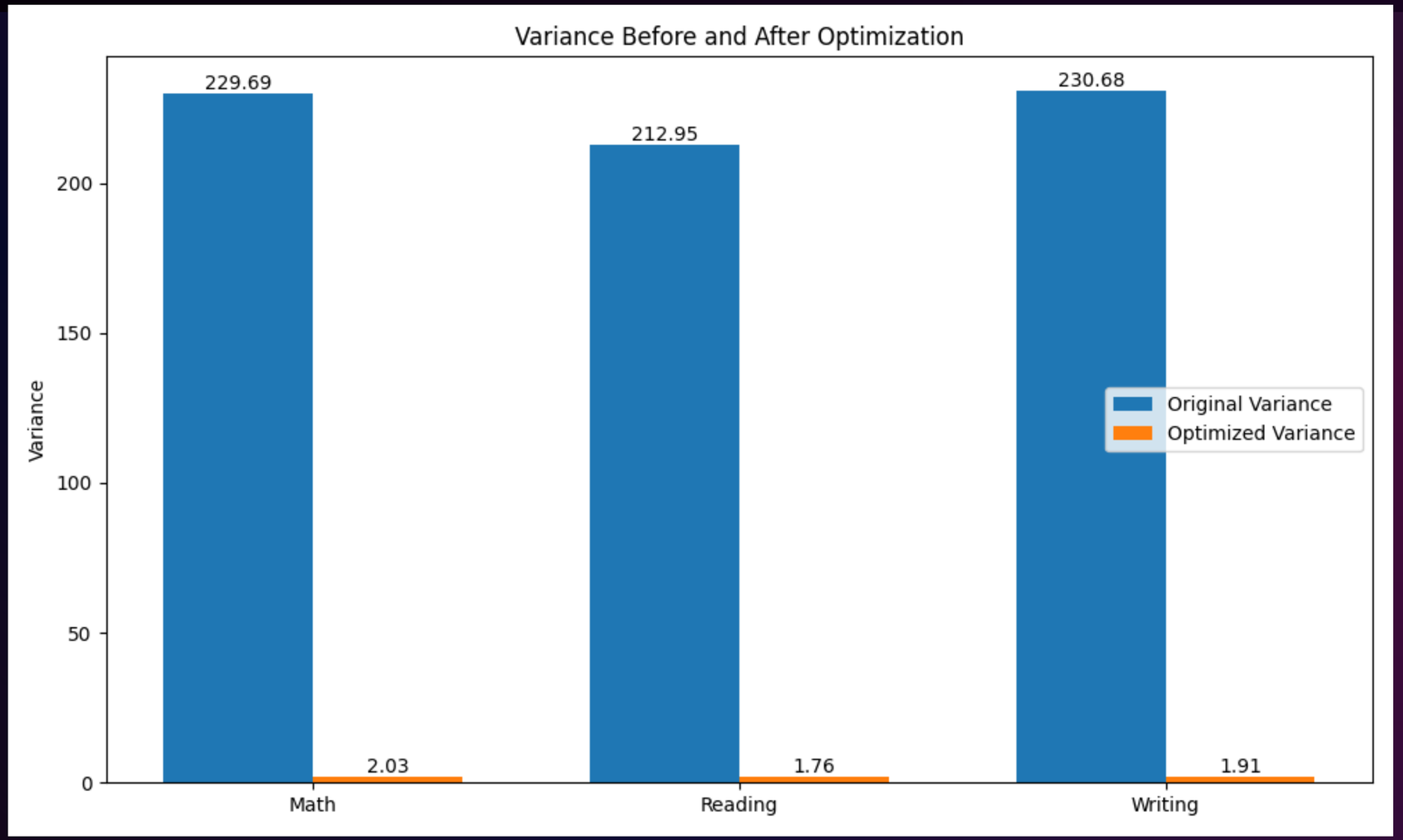
The term of sum is a quadratic function, which is convex because its Hessian matrix (identity matrix scaled by a constant) is positive semidefinite

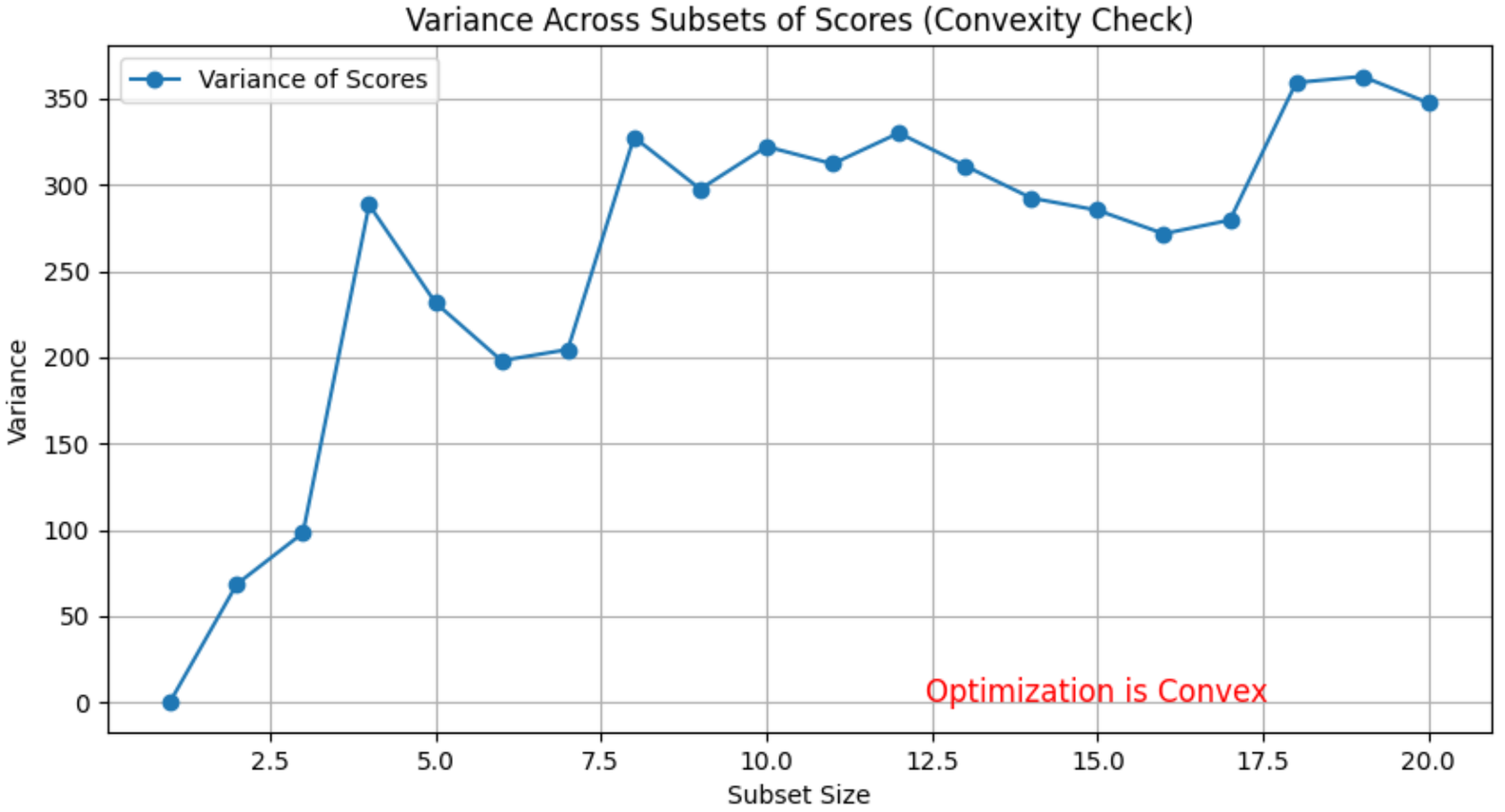
REAL DATASET
(STUDENT PERFORMANCE IN EXAM)

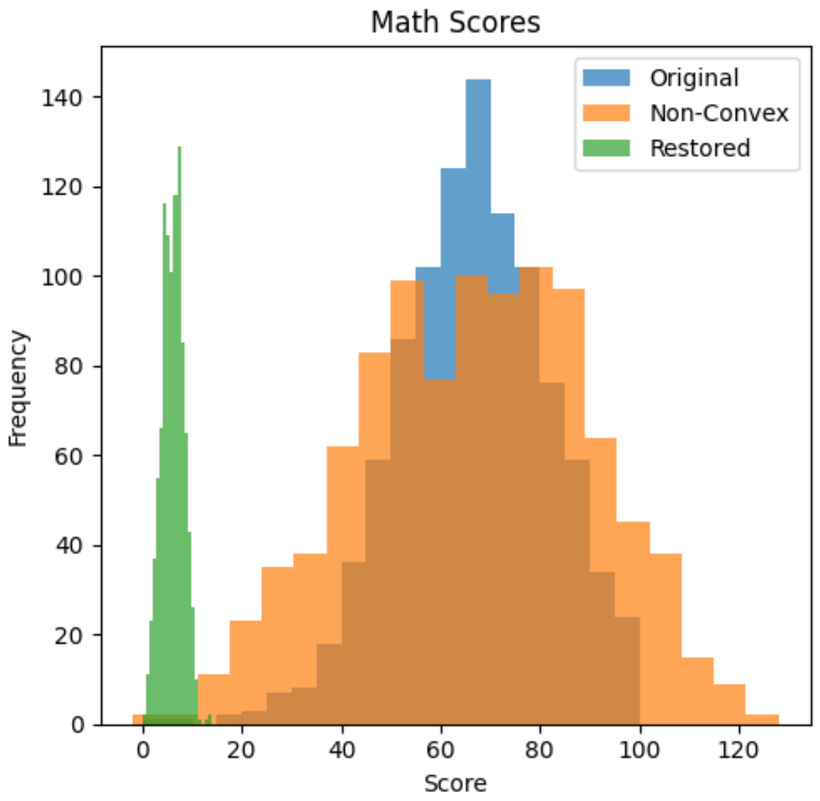
https://www.kaggle.com/datasets/spscientist/students-performance-in-exams

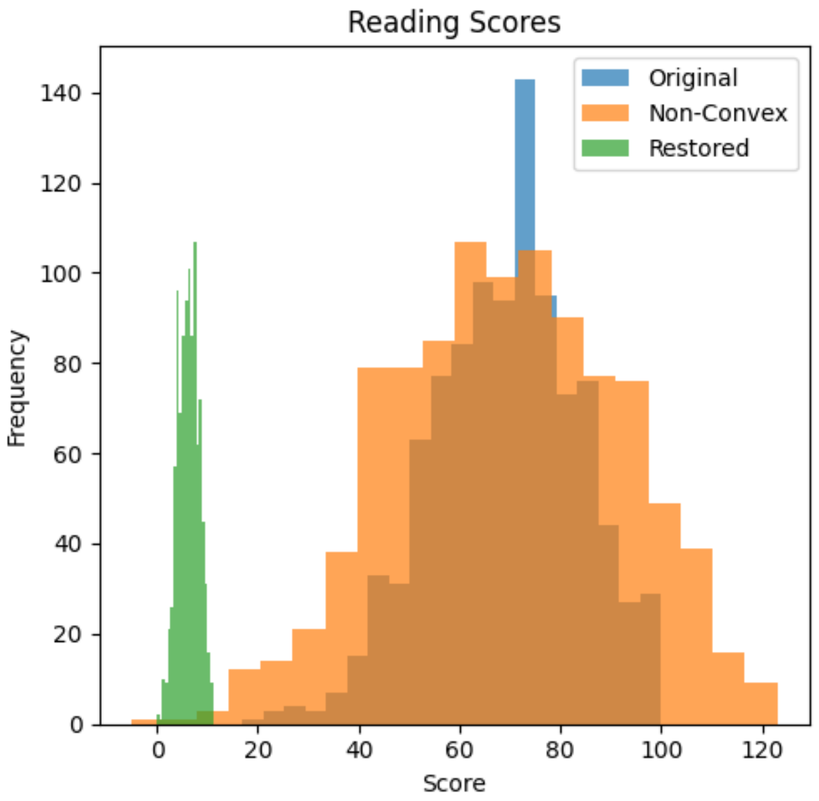
Link Of DataSet

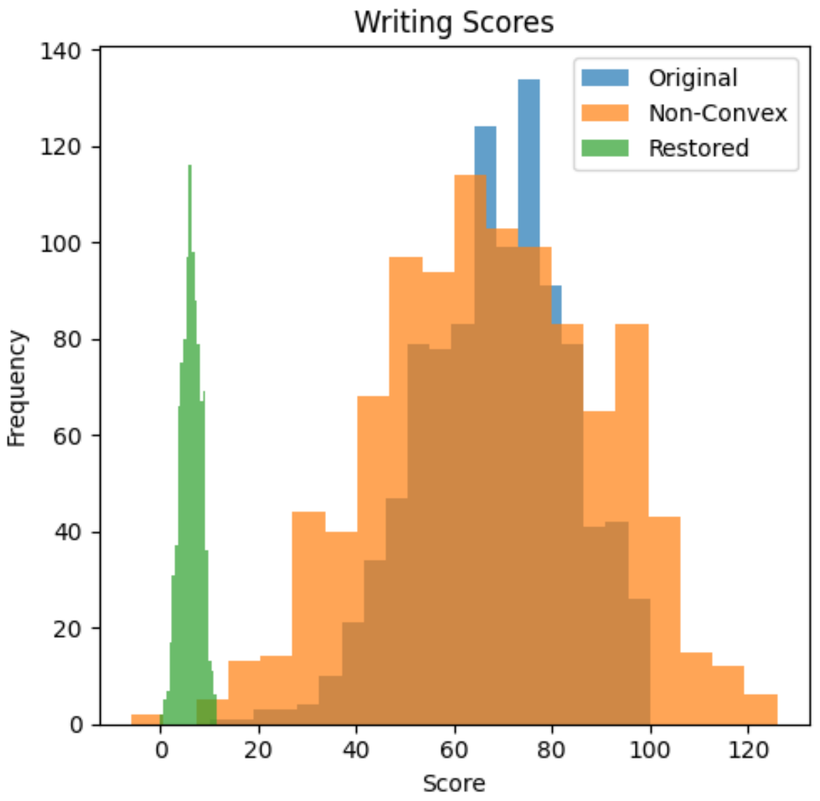
the Dataset Shows Test Score for three Suject For 1000 Student about (Math - Reading - Writing)


Variance Before and After Optimization
229.69
212.95
230.68
2.03
1.76
1.91
200
150
100
50
0
Variance
Original Variance
Optimized Variance
Math
Reading
Writing

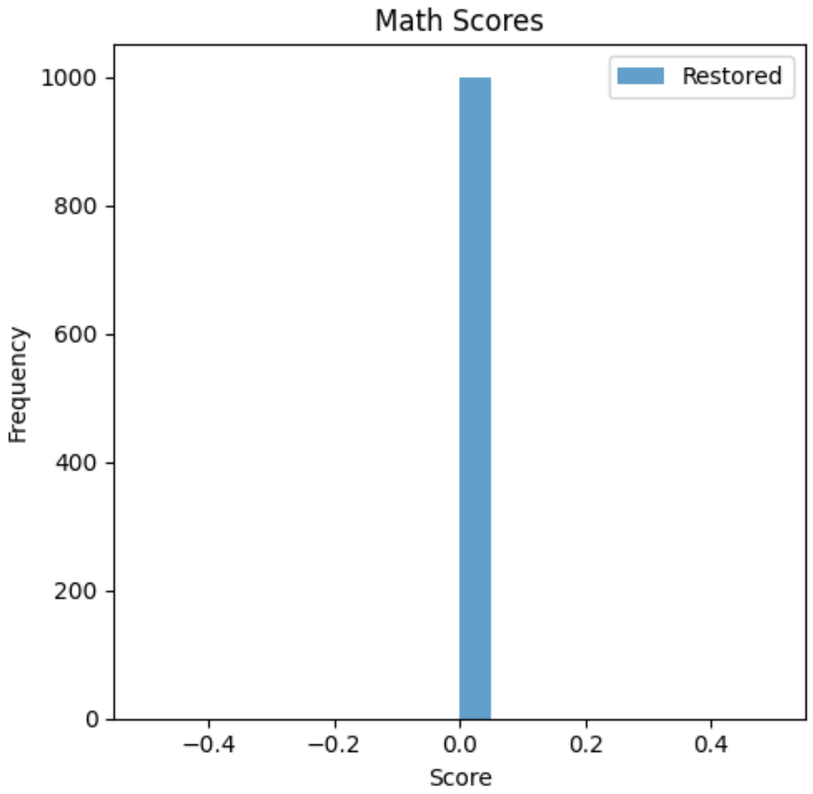

Variance Across Subsets of Scores (Convexity Check)
Variance of Scores
Variance
Subset Size
0
50
100
150
200
250
300
350
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
Optimization is Convex

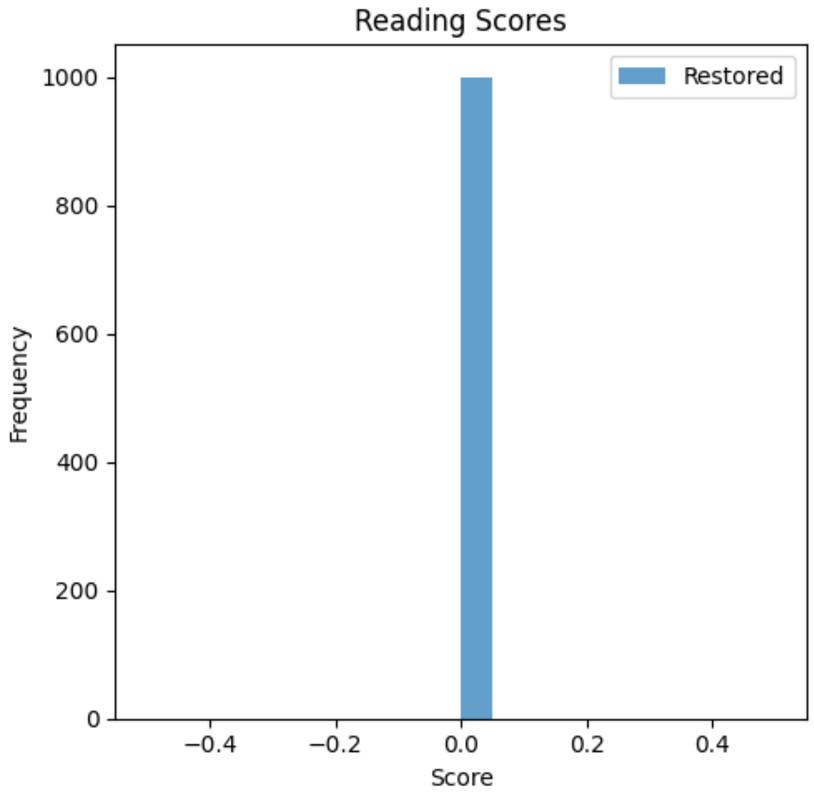

Math Scores
Original
Non-Convex
Restored
Frequency
Score
0
20
40
60
80
100
120
140

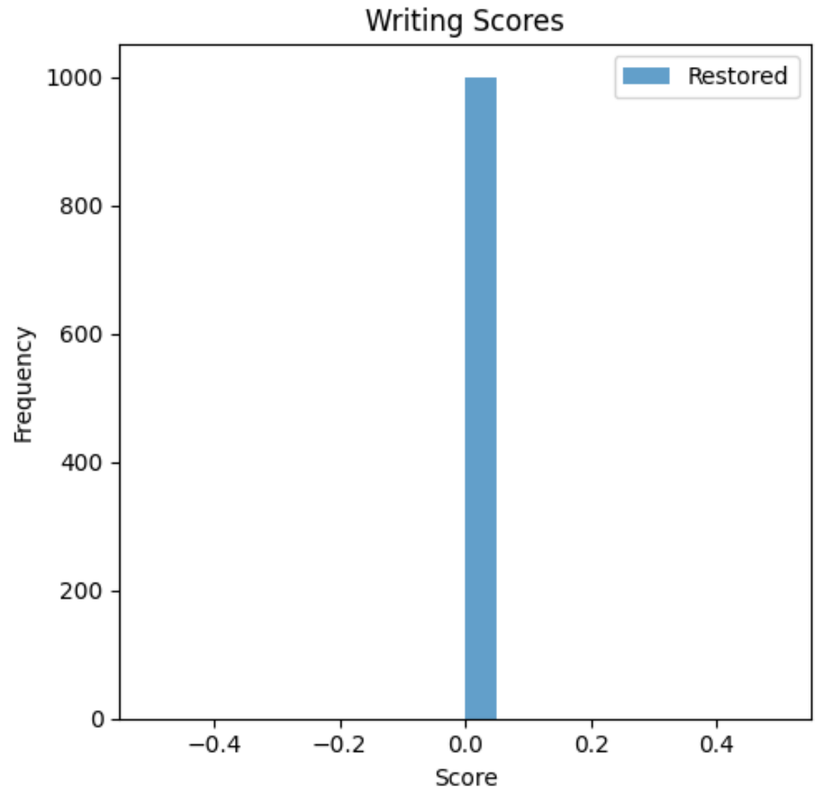

Reading Scores
Original
Non-Convex
Restored
Frequency
Score
0
20
40
60
80
100
120
140


Writing Scores
Original
Non-Convex
Restored
Frequency
Score
0
20
40
60
80
100
120
140

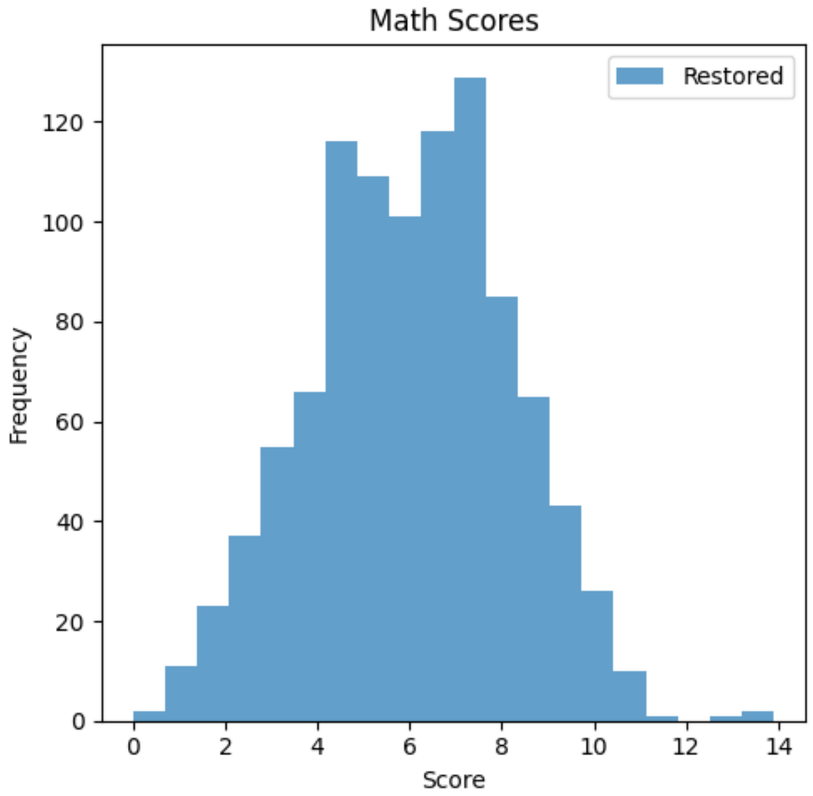
When Global Minimum

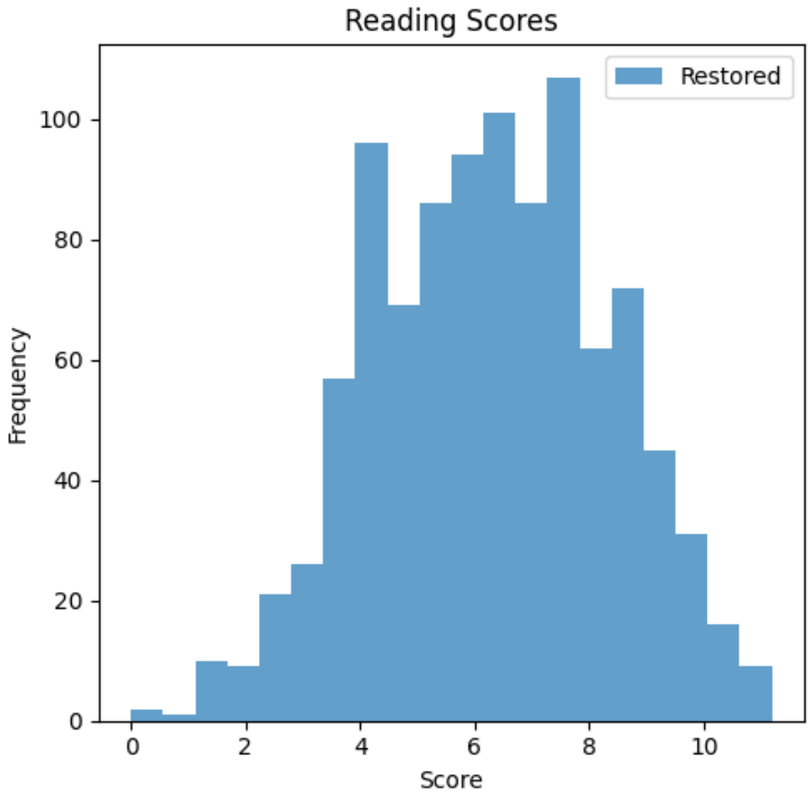


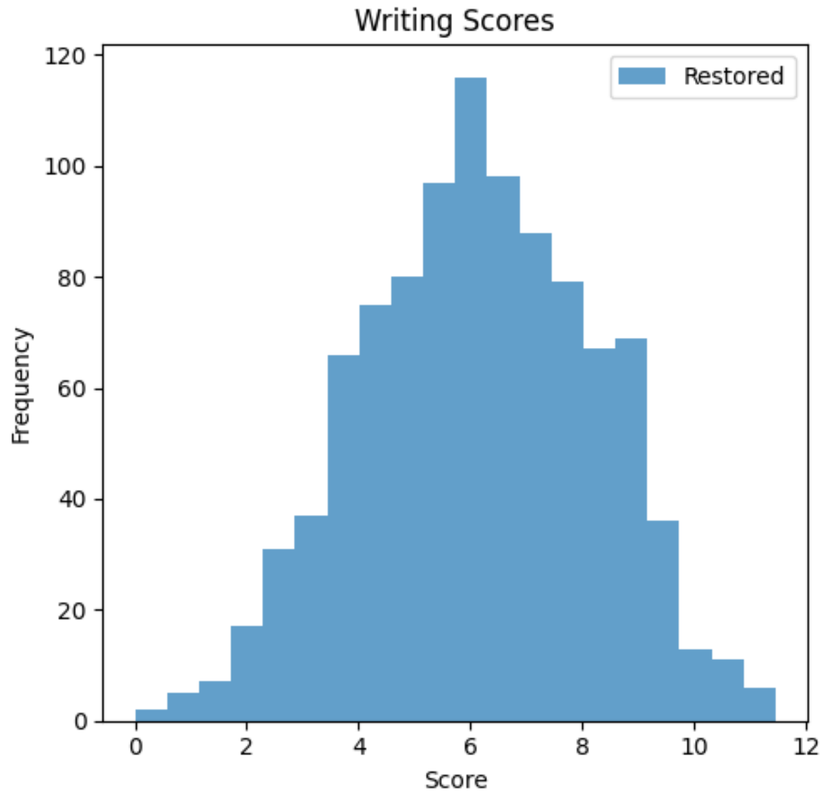




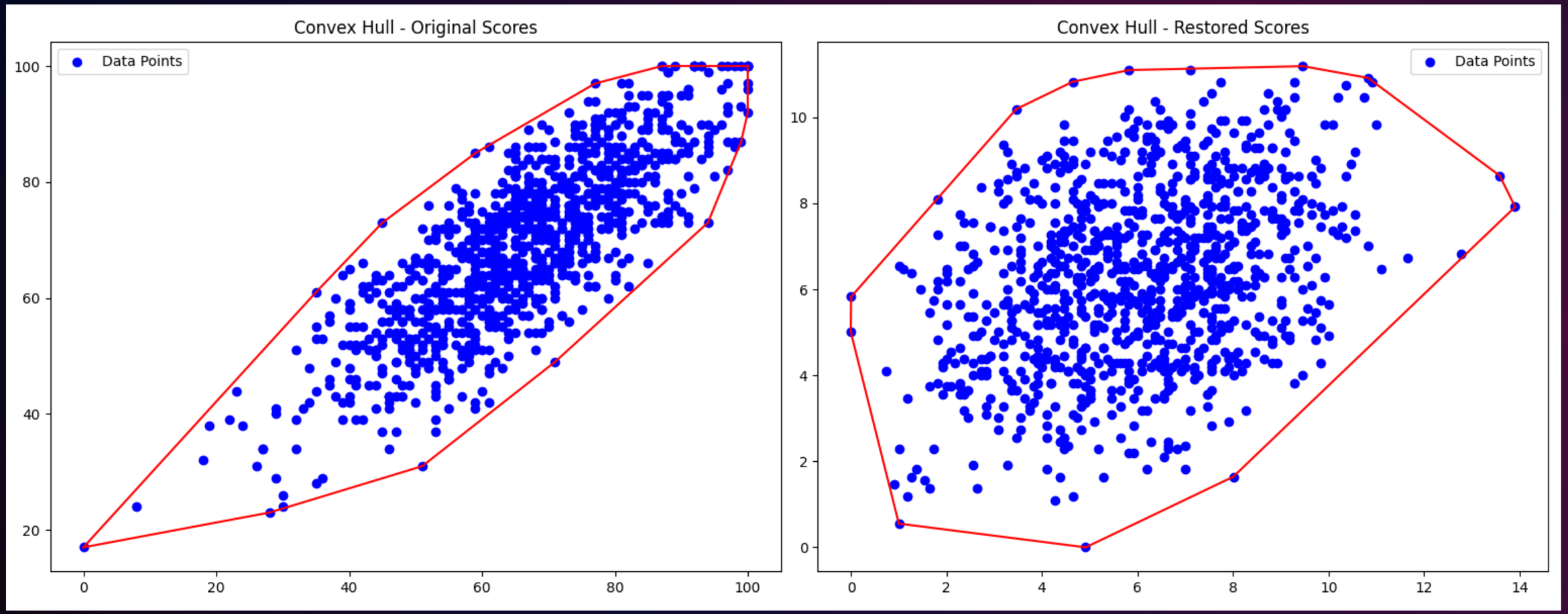
When Alpha near to original Score



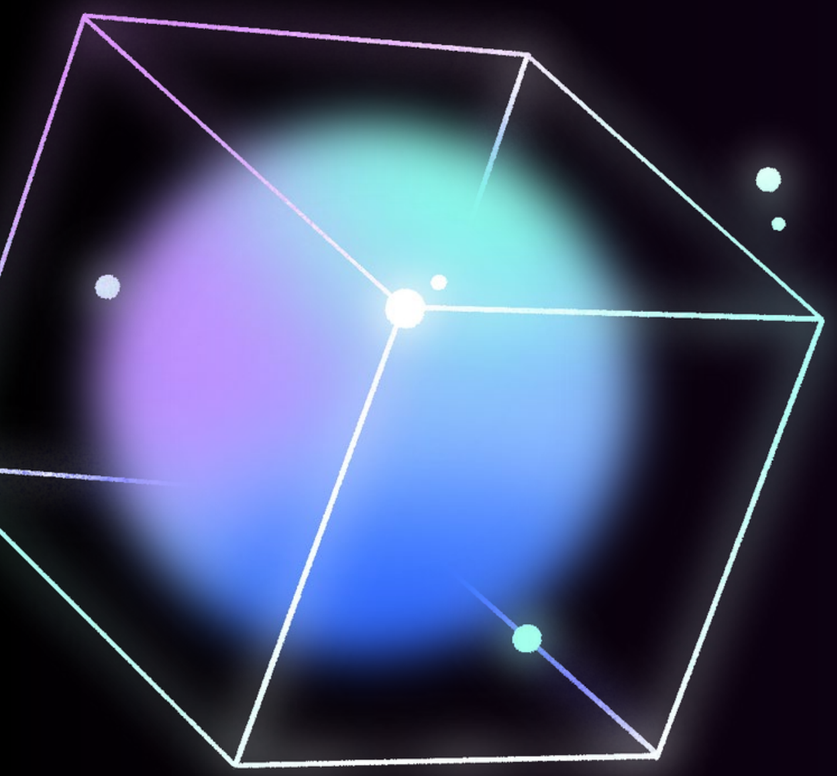




Convex Hull For all 2 Level (MATH-Reading)



RESULTS



In this project, we analyzed student exam scores with the goal of minimizing variance to promote fairness in grade distribution. Initially, we confirmed the convexity of the score distribution using the variance equation, verified mathematically and visually.

The original dataset's distribution was visualized, showing a balanced spread. To introduce non-convexity, we added outliers, disrupting the constraints and creating an irregular distribution, as depicted in Figure 3, and restored datasets.

STEPS

Optimze BY CVXPY

Violate Constraints BY Outler

Restored By Checking Constraints

Finally, we restored convexity by removing outliers and reintroducing constraints, achieving a more organized distribution. The optimization process minimized variance, reaching a global minimum of **Variance = 0** , and the results were effectively demonstrated through comparative visualizations of the original, mod

THANK YOU!