# Student Performance Visualization and Reporting

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## 1 Objective

The project aims to create a Python-based visualization dashboard and detailed report that analyzes student performance across various demographic and educational factors. The final report highlights key trends, statistical summaries, and performance disparities in a professional, easy-to-understand format.

## 2 Data Source

- **Dataset:** `StudentsPerformance.csv`
- **Format:** CSV
- **Total Records:** 1,000 students

## 3 Summary Statistics

- **Total Number of Students:** 1000
- **Number of Male and Female Students:**
  - Male: 482 (48.2%)
  - Female: 518 (51.8%)
- **Number of Students per Race/Ethnicity Group:**
  - Group A: 89 (8.9%)
  - Group B: 190 (19.0%)
  - Group C: 319 (31.9%)
  - Group D: 262 (26.2%)
  - Group E: 140 (14.0%)
- **Number of Students by Test Preparation Status:**

  - Completed: 358
  - None: 642

- **Number of Students by Lunch Type:**
  - Standard: 645
  - Free/Reduced: 355

- **Average, Minimum, Maximum Scores per Subject:**

Table 1: Score Summary Statistics

| Subject | Average | Minimum | Maximum |
|---|---|---|---|
| Math | 66.09 | 0.00 | 100.00 |
| Reading | 69.17 | 17.00 | 100.00 |
| Writing | 68.05 | 10.00 | 100.00 |

## 4 Charts Used and Rationale

Table 2: Charts Used and Their Purpose

| Chart | What It Shows | Why It Was Used |
|---|---|---|
| Box Plot: Scores by Gender | Distribution and variability of math, reading, and writing scores for male and female students | To identify performance gaps and score spread between genders |
| Box Plot: Scores by Test Preparation Course | Score distributions for students who completed or did not complete test preparation | To assess the effectiveness of test preparation courses |
| Bar Chart: Avg Scores by Parental Education | Average subject scores by parental education level | To reveal correlation between parental education and student success |
| Bar Chart: Avg Scores by Lunch Type | Average subject scores by lunch type (standard vs. free/reduced) | To highlight disparities based on lunch type as a proxy for socioeconomic status |
| Bar Chart: Avg Scores by Race/Ethnicity | Average subject scores by race/ethnicity group | To understand demographic performance variations |
| Histogram: Score Distributions | Distribution and concentration of scores for each subject | To detect skewness and outliers in subject scores |
| Correlation Heatmap: Subject Scores | Correlation coefficients between math, reading, and writing scores | To understand cross-subject performance trends |
| Grouped Bar Chart: Test Preparation Impact by Gender | Test preparation effect on scores, segmented by gender | To assess gender-specific impact of test preparation |

# 5 Visualizations and Key Insights

## 5.1 Box Plot: Scores by Gender

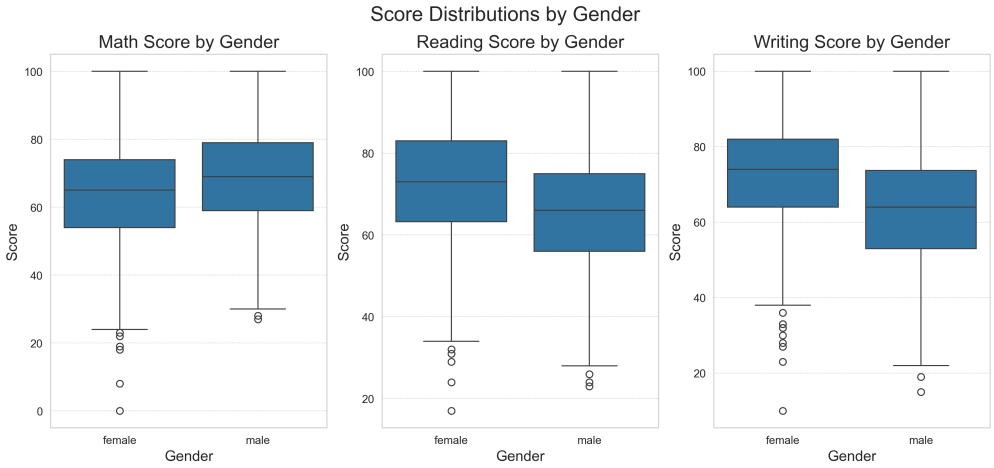


Figure 1: Distribution of Math, Reading, and Writing Scores by Gender

**Key Insight:** Female students outperform males in reading and writing, while males have higher average math scores. Score distributions show greater variability among males in math.

## 5.2 Box Plot: Scores by Test Preparation Course

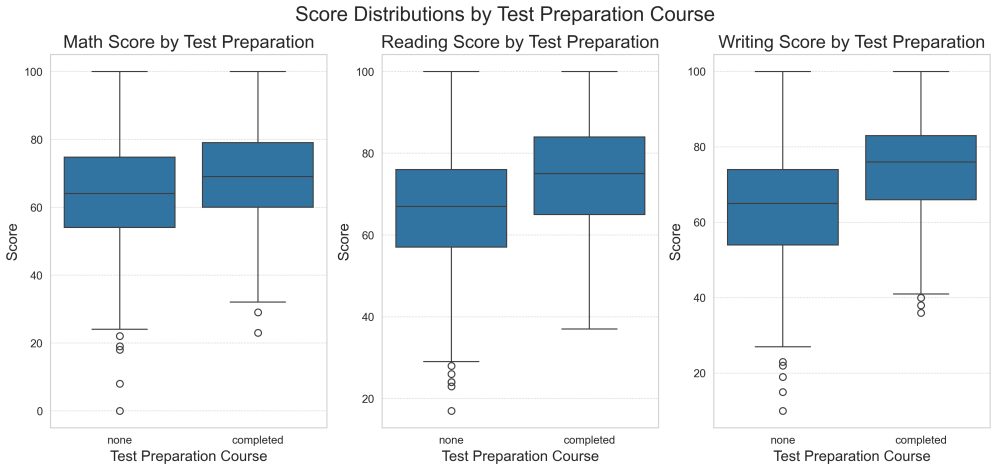


Figure 2: Distribution of Scores by Test Preparation Course

**Key Insight:** Students who completed the test preparation course scored higher on average in all subjects, with the most pronounced effect in writing and reading.

### 5.3 Bar Chart: Average Scores by Parental Education

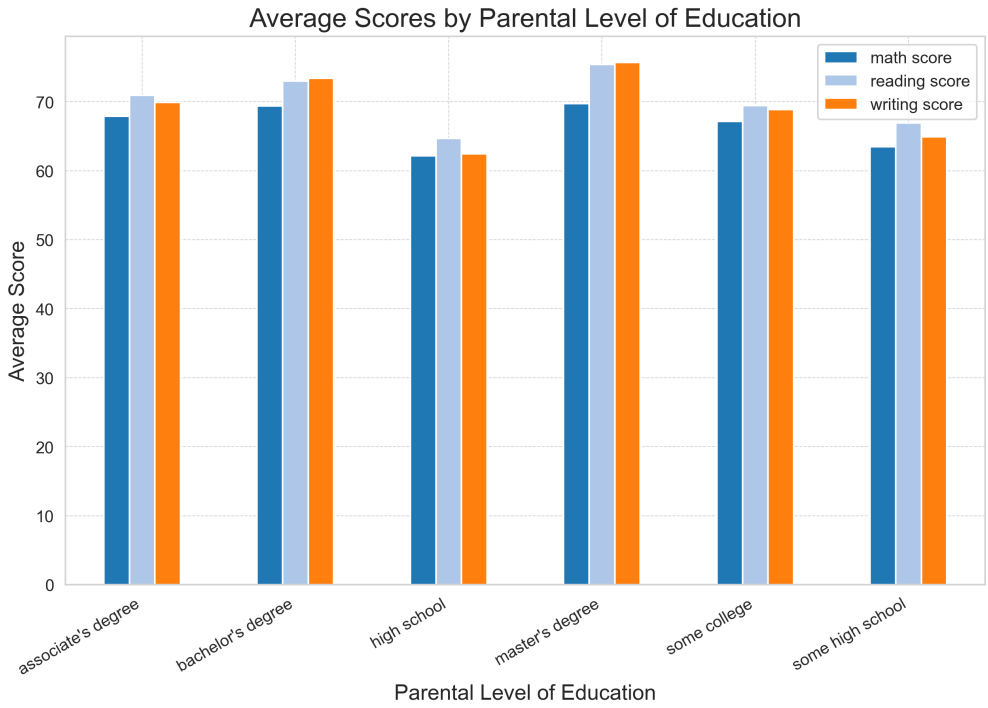


Figure 3: Average Scores by Parental Level of Education

**Key Insight:** Higher parental education levels (bachelor's and master's degrees) are associated with higher student scores across all subjects.

### 5.4 Bar Chart: Average Scores by Lunch Type


Figure 4: Average Scores by Lunch Type

**Key Insight:** Students with standard lunch consistently outperform those with free/reduced lunch, indicating a performance gap likely related to socioeconomic status.

### 5.5 Bar Chart: Average Scores by Race/Ethnicity

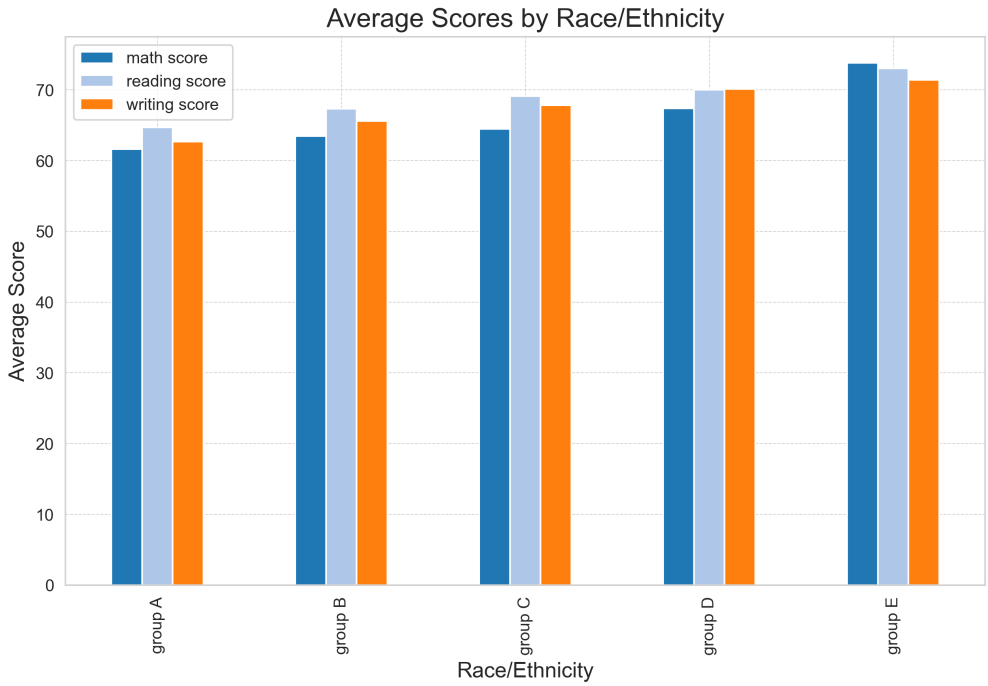


Figure 5: Average Scores by Race/Ethnicity

**Key Insight:** Group E students have the highest average scores, while Groups A and B have the lowest. There is a clear upward trend from Group A to Group E.

### 5.6 Histogram: Score Distributions

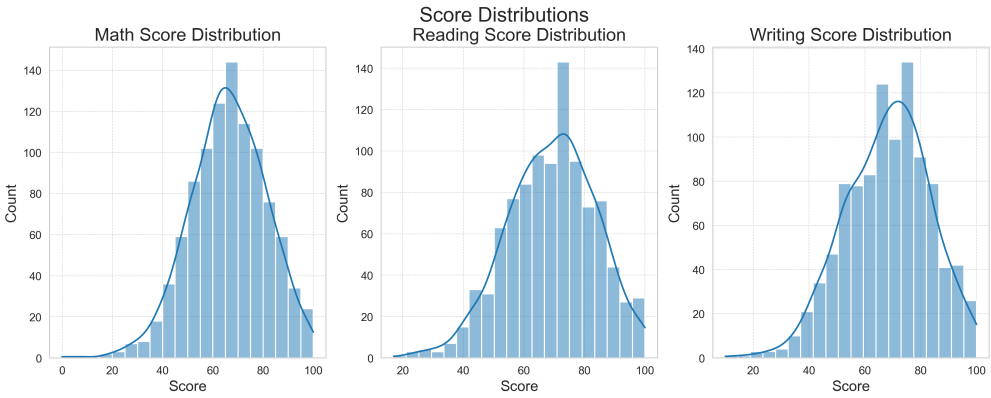


Figure 6: Distribution of Math, Reading, and Writing Scores

**Key Insight:** Math scores are more widely distributed and skewed lower compared to reading and writing, which are more concentrated at higher values.

### 5.7 Correlation Heatmap: Subject Scores

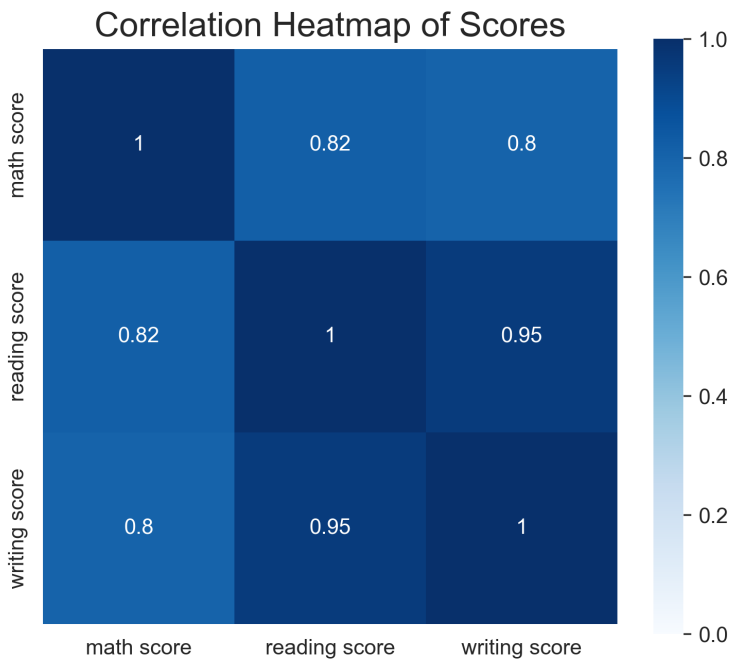


Figure 7: Correlation Heatmap of Math, Reading, and Writing Scores

**Key Insight:** Strong positive correlations exist between all three subjects, especially between reading and writing (0.95).

### 5.8 Grouped Bar Chart: Test Preparation Impact by Gender

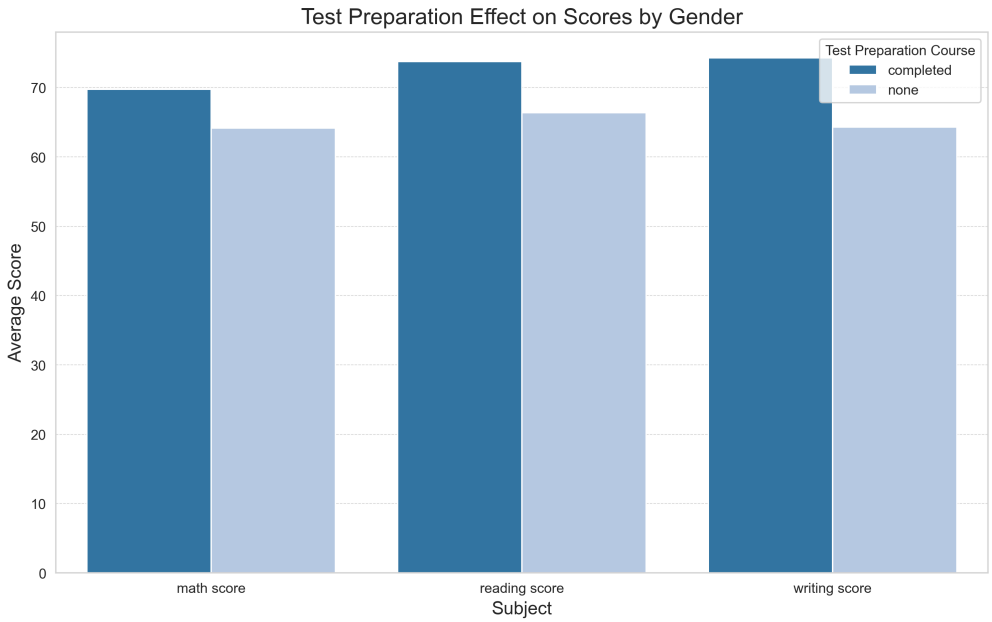


Figure 8: Test Preparation Effect on Scores by Gender

**Key Insight:** Test preparation benefits both genders, but the effect is slightly more pronounced for female students in reading and writing.

## 6 General Performance Trends and Disparities

- Female students excel in reading and writing; males in math. Socioeconomic and parental education factors strongly influence performance. Test preparation is effective for all groups.

## 7 Appendix

- Python code and data files available at: `https://github.com/dmzinc/visualization-dashboard.git`