

Student Result Analysis

A comprehensive examination of how demographic, social, and family-related factors influence academic achievement across Mathematics, Reading, and Writing for over 30,000 students



Project Goals and Scope



Pattern Identification

Analyze how demographic and family factors correlate with academic performance across three core subjects



Data Quality

Perform thorough data cleaning, handle missing values, and remove unnecessary fields to ensure analytical integrity



Insight Generation

Create meaningful visualizations to uncover actionable insights that can guide educational improvement strategies



Dataset Overview

Scale and Structure

The dataset encompasses **30,641 student records** with 14 distinct variables covering demographics, family background, and academic performance.

Key categories include gender, ethnic group, parental education level, lunch type, test preparation status, parental marital status, sports practice frequency, birth order, number of siblings, transportation method, weekly study hours, and scores in three subjects.

Target Variables

- MathScore, ReadingScore, WritingScore
- All score fields complete with zero missing values

Missing Data Profile

While demographic fields contain gaps, all academic scores remain intact:

- **TransportMeans:** 3,134 missing (10.2%)
- **EthnicGroup:** 1,840 missing (6.0%)
- **ParentEduc:** 1,845 missing (6.0%)
- **TestPrep:** 1,830 missing (6.0%)
- **NrSiblings:** 1,572 missing (5.1%)

Score integrity ensures reliable academic pattern analysis without requiring imputation.



Academic Performance

66.6

Math Score

Average across all
students

69.4

Reading Score

Highest performing
subject

68.4

Writing Score

Mid-range performance

Score distributions span the full 0–100 range with no data entry anomalies detected. The 25th to 75th percentile ranges cluster tightly around the mean, indicating consistent performance across the student population with Mathematics showing the widest variation.

Data Preparation and Quality

01

Column Removal

Eliminated the redundant `Unnamed: 0` index column that served no analytical purpose

02

Duplicate Check

Verified **zero duplicate rows**, confirming high data integrity and consistency throughout the dataset

03

Missing Value Assessment

Reviewed gaps in demographic fields while confirming complete score data for accurate academic analysis

04

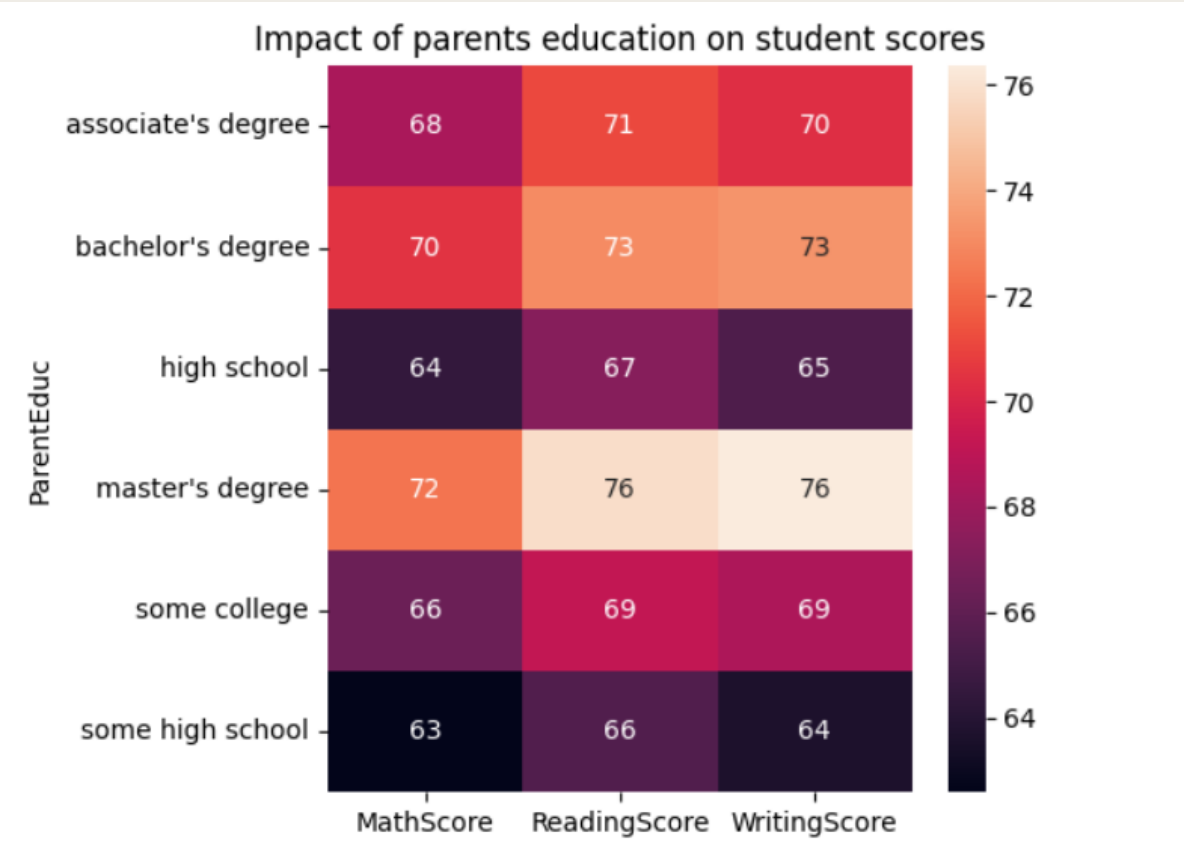
Visualization Readiness

Structured all key fields for clean, reliable exploration and meaningful pattern detection

Key Finding: Parental Education Impact

Students with parents holding Master's degrees consistently achieve the highest scores across Math, Reading, and Writing, while those whose parents completed only some high school score lowest—demonstrating a strong correlation between parental education and student success.

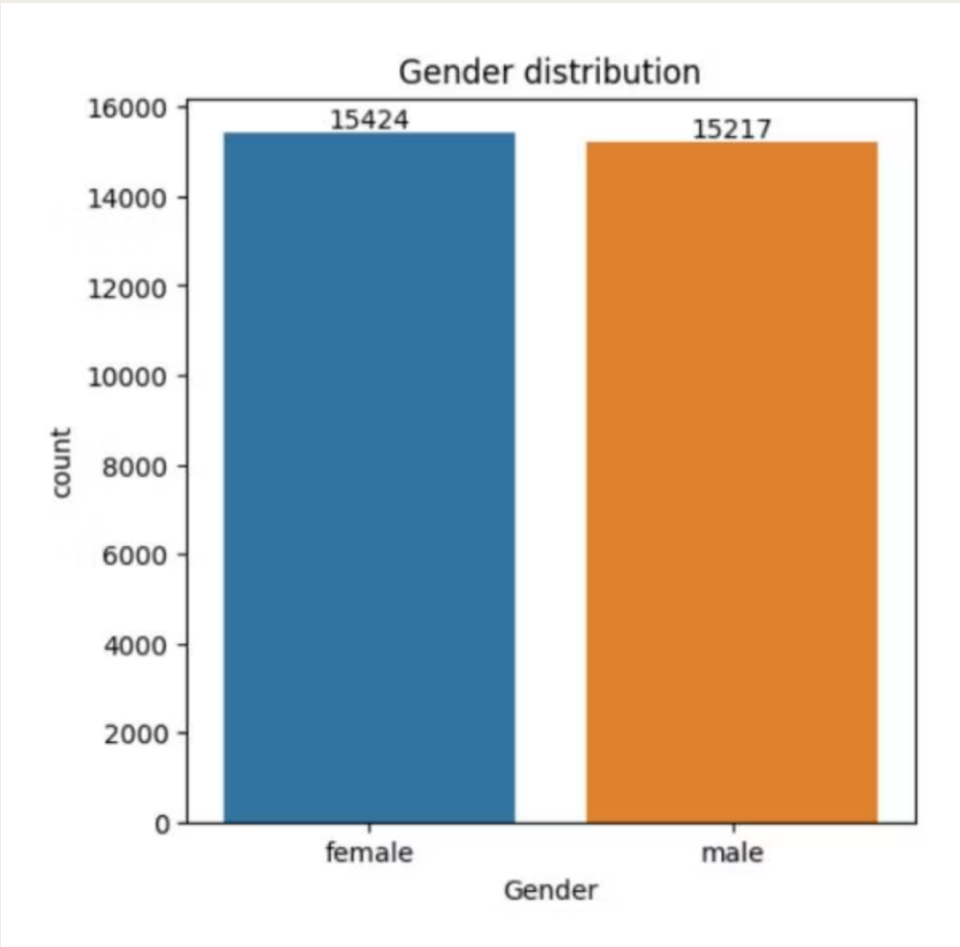
This pattern reveals that parental educational background significantly shapes the academic support, resources, and learning environment available to children, influencing their readiness and motivation to excel.



Gender and Marital Status Insights

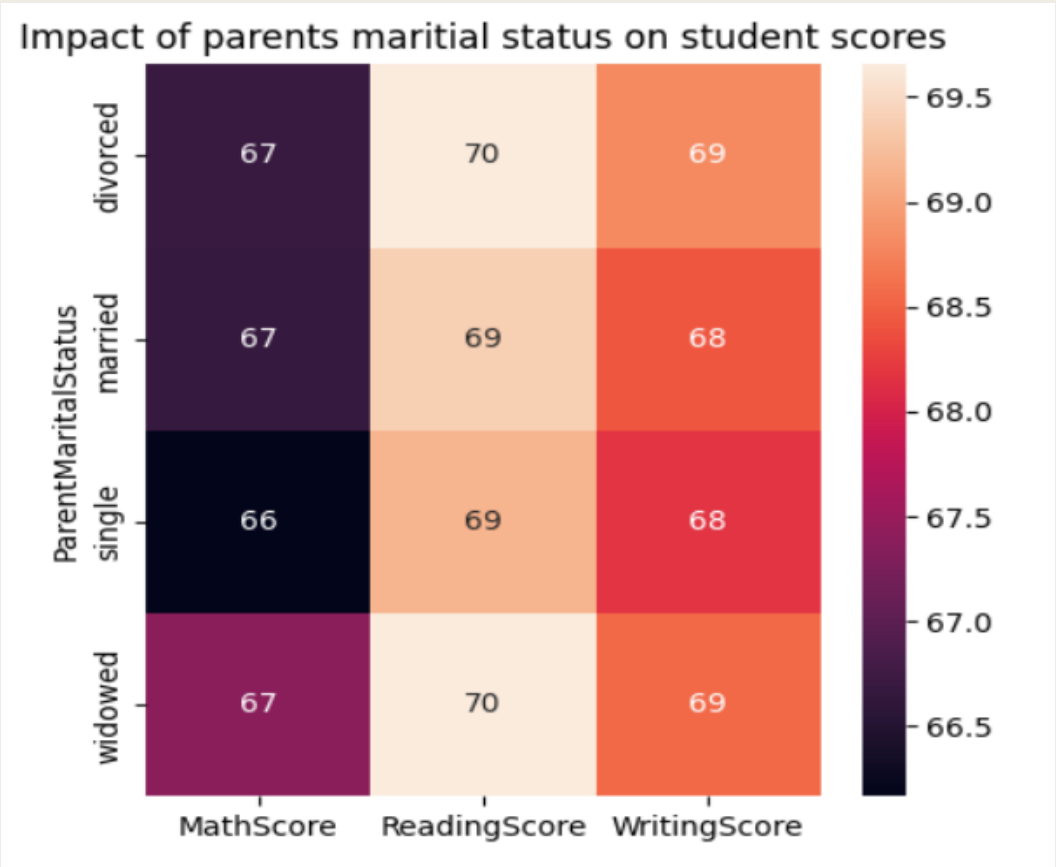
Gender Distribution

The dataset shows a nearly balanced gender split with females slightly outnumbering males. This minimal difference ensures gender-based insights remain naturally unbiased and representative of the full student population.



Marital Status Effect

Analysis reveals **minimal score variation** between students of married, divorced, single, or widowed parents. This suggests that family structure alone does not drive academic outcomes—educational environment and parental involvement matter far more.



Subject Performance and Outlier Analysis

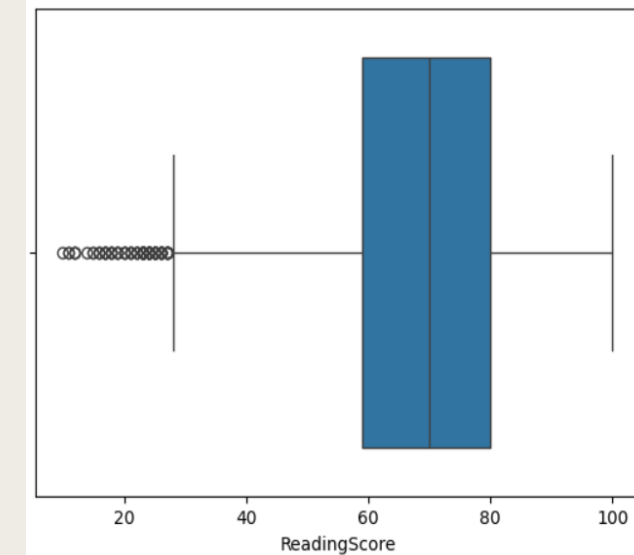
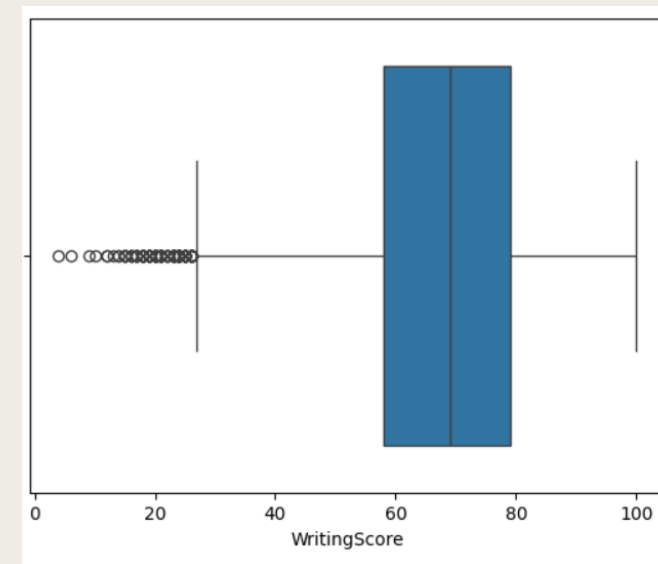
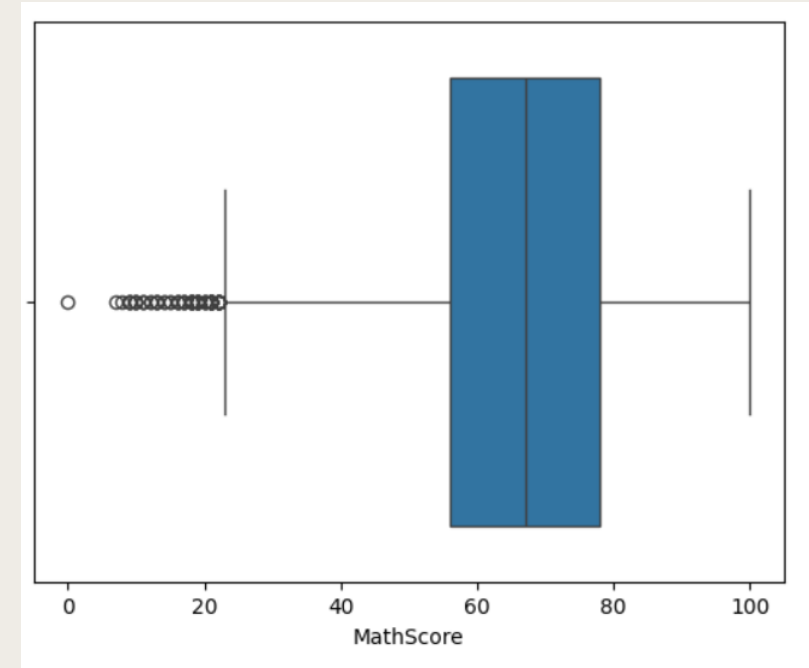
- **Clean Data Distribution**

Boxplots confirm no abnormal outliers—all scores fall within the valid 0–100 range, reinforcing dataset reliability

- **Math Challenges**

Mathematics shows a higher frequency of low scores compared to Reading and Writing, indicating students struggle most with quantitative reasoning

The consistency across Reading and Writing suggests strong verbal skills, while the Math performance gap highlights a clear opportunity for targeted intervention and support strategies.

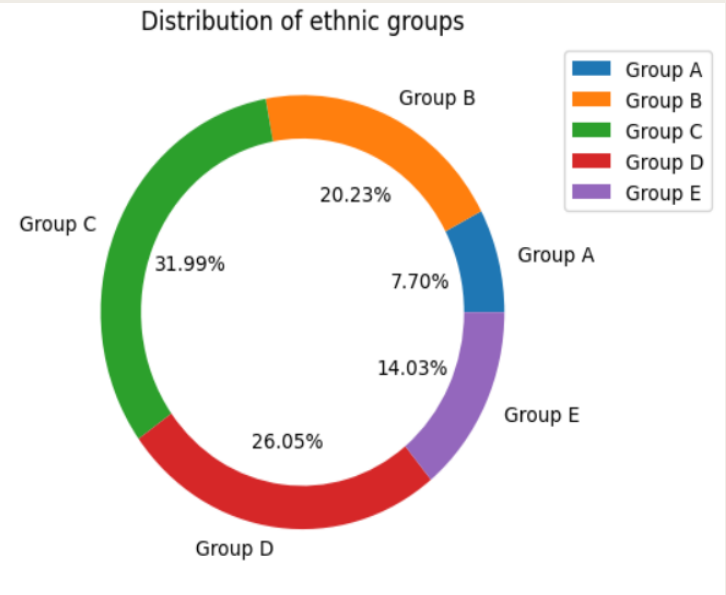
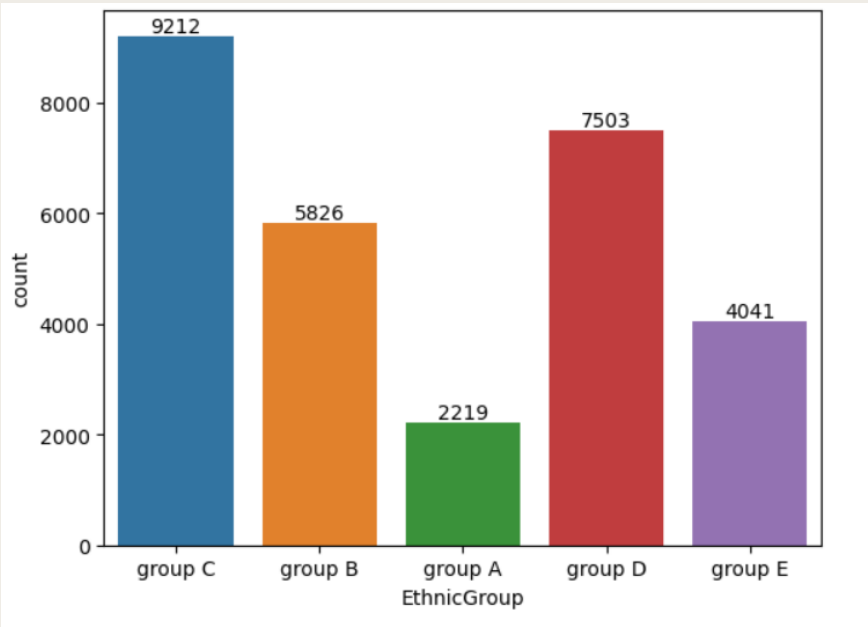


Ethnic Representation and Diversity

Group Distribution

Ethnic Group C represents the largest demographic (9212 – 31.99%), accounting for nearly one-third of all students in the dataset.

Other groups show varying but reasonable representation, enabling meaningful comparative analysis of academic patterns across ethnic categories.



The diverse representation allows for nuanced exploration of how cultural and community factors may intersect with academic achievement, though care must be taken to avoid overgeneralization.

Strategic Recommendations for Educators

1

Strengthen Math Support

Implement remedial classes, concept-based teaching methods, and engaging digital tools to build problem-solving confidence

2

Empower Parents

Provide workshops, simple study guides, and regular communication channels to support families with lower education levels

3

Enhance Test Preparation

Use mock exams, structured revision periods, and guided practice to improve exam readiness and reduce anxiety

4

Create Supportive Spaces

Establish quiet study zones, supervised homework areas, and resource rooms for personalized learning support

5

Track Progress Continuously

Deploy ongoing assessments to identify weak areas early and tailor interventions to individual student needs

6

Foster Literacy and Mentorship

Launch reading clubs, writing workshops, teacher mentorship programs, and small-group learning sessions for focused guidance

Conclusion

Our analysis reveals critical factors influencing student performance, guiding us toward targeted interventions for equitable educational outcomes.

Parental Education Link

Parental educational background is a significant predictor of student academic achievement across all subjects.

Math Performance Gap

Mathematics poses the greatest challenge, indicating a need for specialized support and engaging teaching methods.

Data-Driven Strategy

Insights from demographics and subject-specific trends enable precise and effective educational interventions.

Fostering Growth

Proactive support, inclusive environments, and continuous progress tracking are vital for student success.