Univariate Analysis - Student Performance Dataset

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1. Introduction

In this document, I present my univariate analysis for the Student Performance dataset. My analysis covers the following variables:

Binary/Nominal Variables: sex, paid, activities, higher, internet

Ordinal Variables: Medu (Mother's Education), famrel (Family Relationships)

Numeric Discrete Variable: age

Additionally, I include one bivariate analysis: **Medu vs G3** (Mother's Education vs Final Grade).

2. Data Loading

```
# Load the selected dataset
data <- read_csv("student-mat-selected.csv")

# Display structure
glimpse(data)
```

```
## Rows: 395
## Columns: 13
## $ sex        <chr> "F", "F", "F", "F", "F", "M", "M", "F", "M", "M", "F", "F",~
## $ age        <dbl> 18, 17, 15, 15, 16, 16, 16, 17, 15, 15, 15, 15, 15, 15, 15,~
## $ Medu       <dbl> 4, 1, 1, 4, 3, 4, 2, 4, 3, 3, 4, 2, 4, 4, 2, 4, 4, 3, 3, 4,~
## $ traveltime <dbl> 2, 1, 1, 1, 1, 1, 1, 2, 1, 1, 1, 3, 1, 2, 1, 1, 1, 3, 1, 1,~
## $ studytime  <dbl> 2, 2, 2, 3, 2, 2, 2, 2, 2, 2, 2, 3, 1, 2, 3, 1, 3, 2, 1, 1,~
## $ failures   <dbl> 0, 0, 3, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 3, 0,~
## $ paid       <chr> "no", "no", "yes", "yes", "yes", "yes", "no", "no", "yes", ~
## $ activities <chr> "no", "no", "no", "yes", "no", "yes", "no", "no", "no", "ye~
## $ higher     <chr> "yes", "yes", "yes", "yes", "yes", "yes", "yes", "yes", "ye~
## $ internet   <chr> "no", "yes", "yes", "yes", "no", "yes", "yes", "no", "yes",~
## $ famrel     <dbl> 4, 5, 4, 3, 4, 5, 4, 4, 4, 5, 3, 5, 4, 5, 4, 4, 3, 5, 5, 3,~
## $ absences   <dbl> 6, 4, 10, 2, 4, 10, 0, 6, 0, 0, 0, 4, 2, 2, 0, 4, 6, 4, 16,~
## $ G3         <dbl> 6, 6, 10, 15, 10, 15, 11, 6, 19, 15, 9, 12, 14, 11, 16, 14,~
```

```
## Dataset Dimensions: 395 rows x 13 columns
```

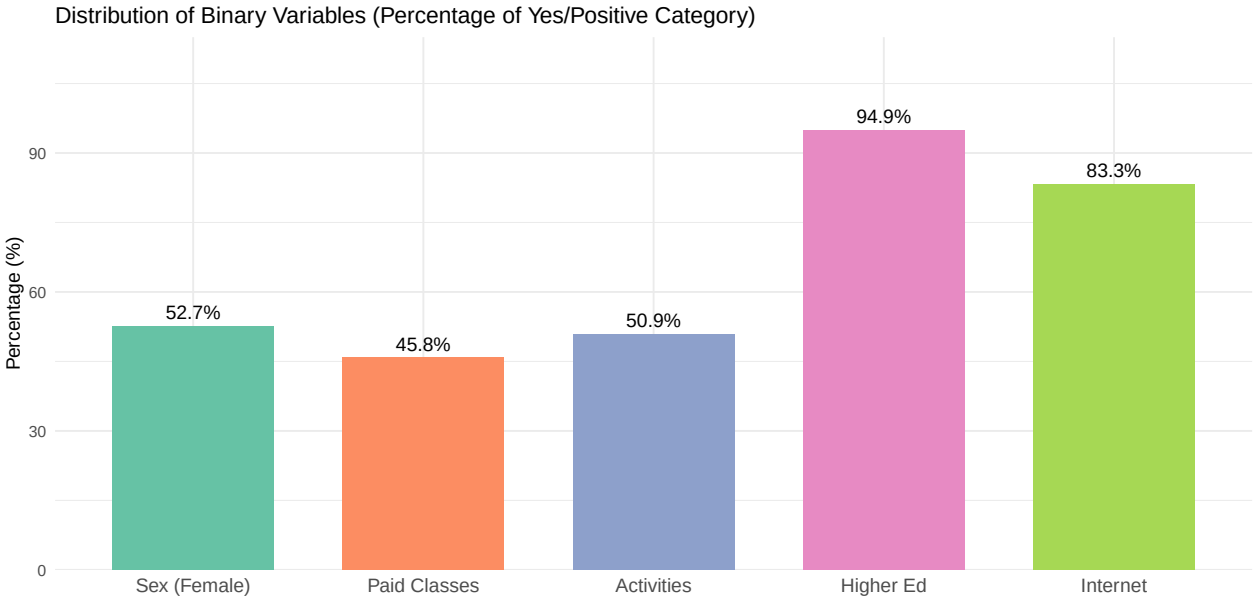
---

3. Univariate Analysis - Binary Variables

The binary variables in my analysis are: **sex**, **paid** (extra paid classes), **activities** (extra-curricular), **higher** (wants higher education), and **internet** (home internet access).

Table 1: Frequency Distribution of Binary Variables

Variable	Absolute_Freq	Relative_Freq
sex (Female)	208	0.527
sex (Male)	187	0.473
paid (yes)	181	0.458
paid (no)	214	0.542
activities (yes)	201	0.509
activities (no)	194	0.491
higher (yes)	375	0.949
higher (no)	20	0.051
internet (yes)	329	0.833
internet (no)	66	0.167



Interpretation:

- **Sex:** The dataset contains 208 female (52.7%) and 187 male (47.3%) students - relatively balanced.
- **Paid classes:** 45.8% of students take extra paid math classes.
- **Activities:** 50.9% participate in extra-curricular activities.
- **Higher education:** An overwhelming 94.9% want to pursue higher education.
- **Internet:** 83.3% have internet access at home.

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4. Univariate Analysis - Ordinal Variables

4.1 Medu (Mother's Education Level)

Mother's education is coded as:

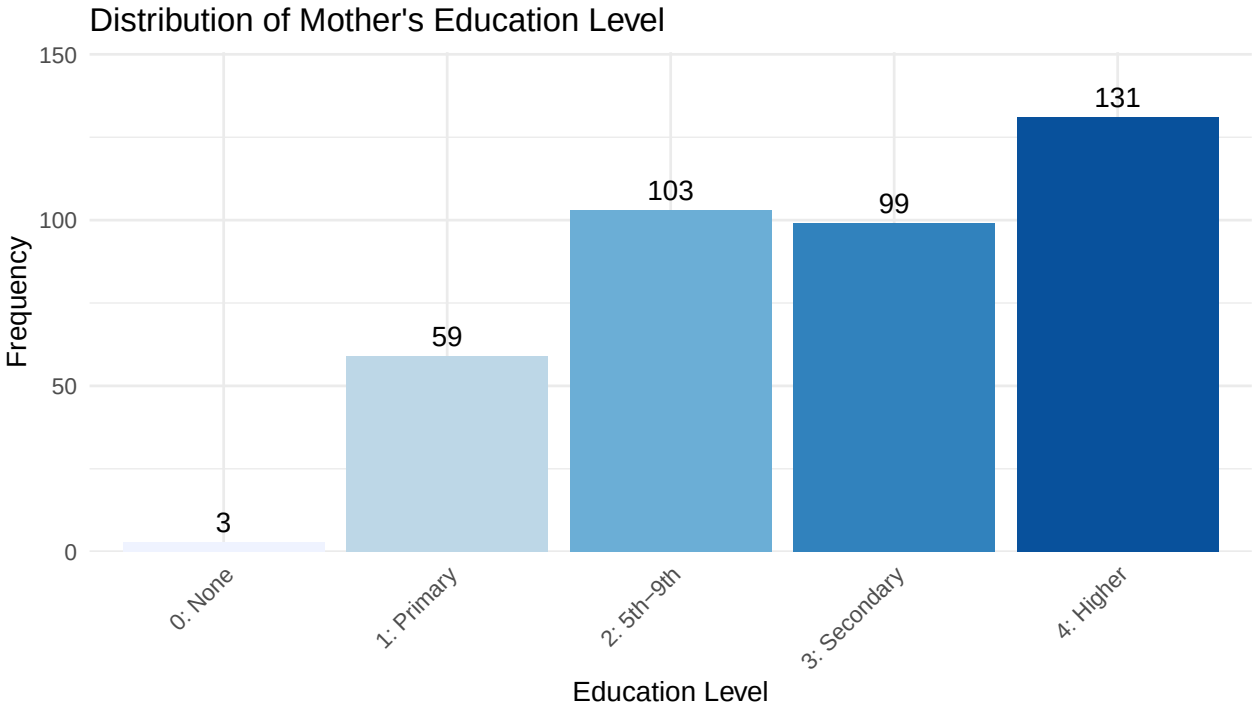
- 0: None
- 1: Primary education (4th grade)
- 2: 5th to 9th grade
- 3: Secondary education
- 4: Higher education

Table 2: Frequency Distribution of Mother's Education

Level	Absolute_Freq	Relative_Freq	Cumulative_Freq
0	3	0.008	0.008
1	59	0.149	0.157
2	103	0.261	0.418
3	99	0.251	0.668
4	131	0.332	1.000

```
##
## Mode: 4
```

```
##
## Median: 3
```



Interpretation: The most common mother's education level is 4 (mode), with a median of 3. This indicates that most mothers have at least secondary education or higher.

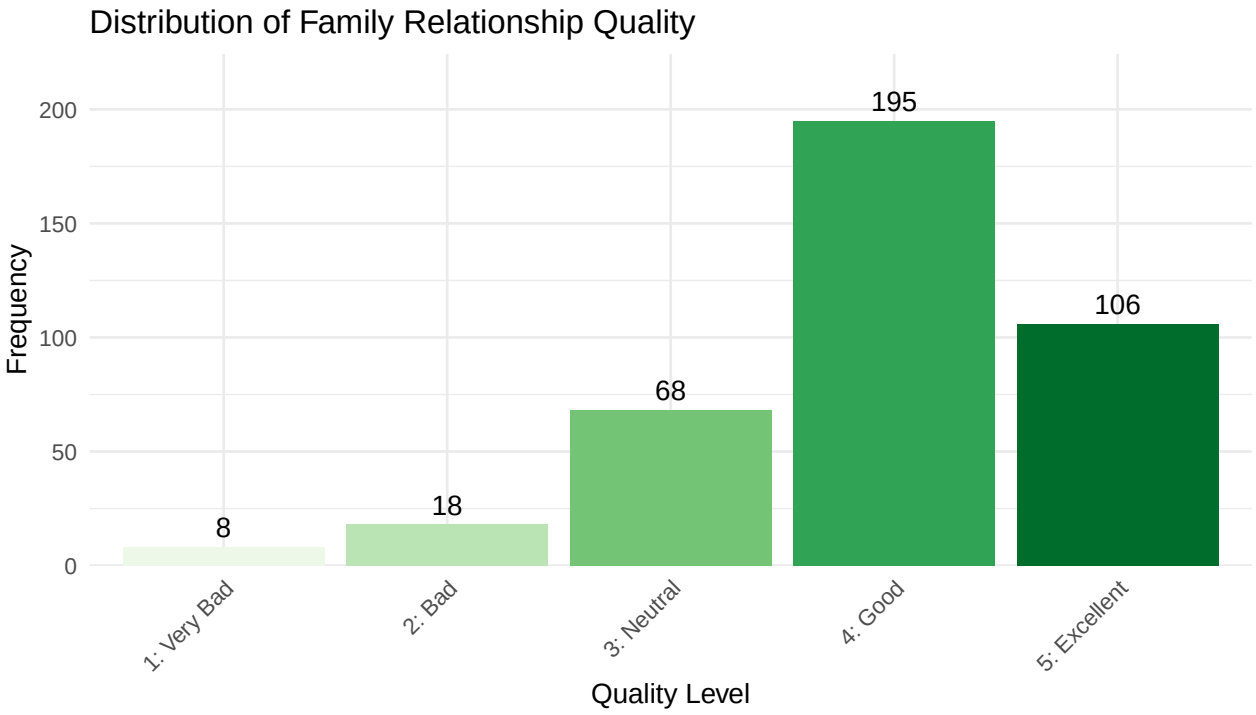
4.2 Famrel (Quality of Family Relationships)

Family relationship quality is coded on a scale from 1 (very bad) to 5 (excellent).

Table 3: Frequency Distribution of Family Relationships

Level	Absolute_Freq	Relative_Freq	Cumulative_Freq
1	8	0.020	0.020
2	18	0.046	0.066
3	68	0.172	0.238
4	195	0.494	0.732
5	106	0.268	1.000

```
##
## Mode: 4
##
## Median: 4
```



Interpretation: Most students report good to excellent family relationships (mode = 4, median = 4). Only a small minority report poor family relationships.

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5. Univariate Analysis - Numeric Variable

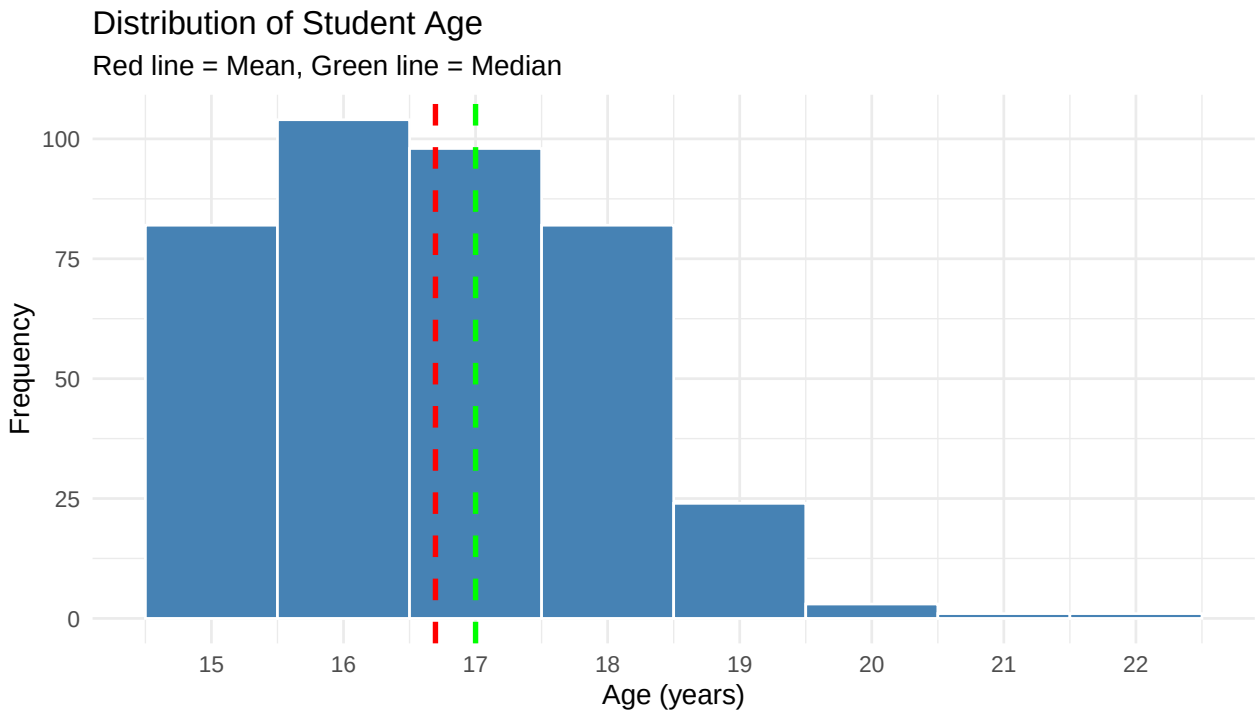
5.1 Age (Student's Age)

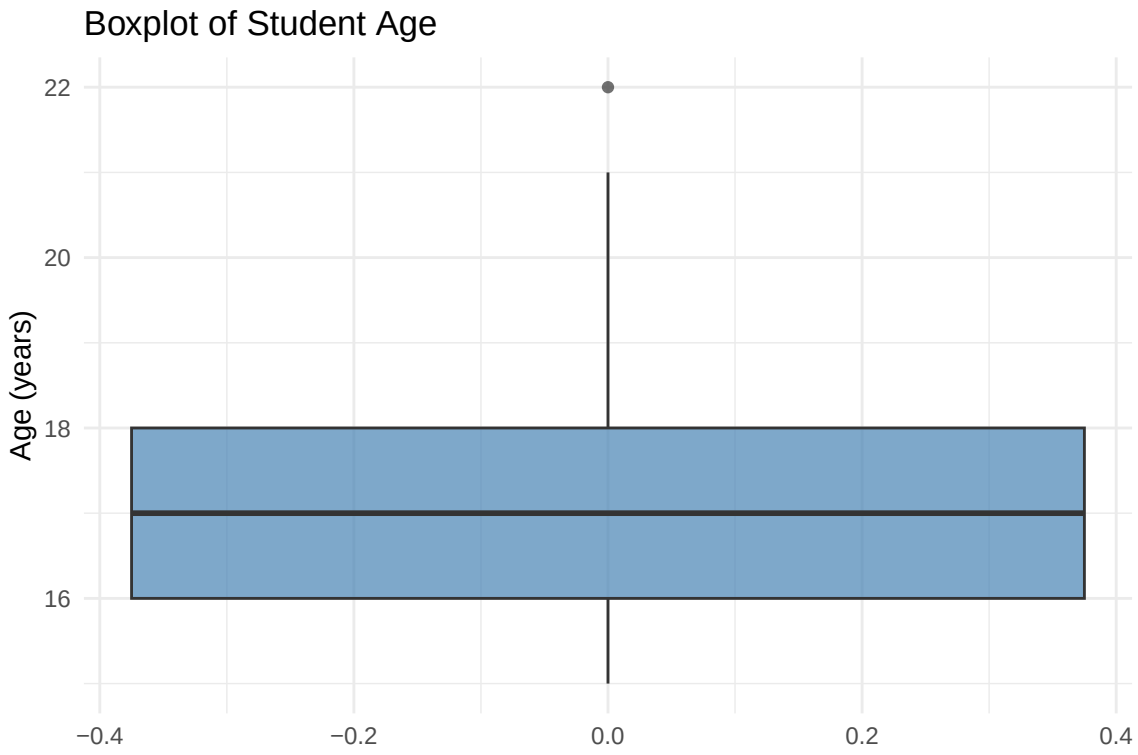
```
## === Central Tendency ===
## Mean: 16.7
## Median: 17
## Mode: 16
##
## === Dispersion ===
```

```
## Variance: 1.63

## Standard Deviation: 1.28

## Range: 15 - 22

## IQR: 2

## Coefficient of Variation: 7.64 %

##
## === Five-Number Summary ===

## [1] 15 16 17 18 22

##
## === Quartiles ===

##   0%  25%  50%  75% 100%
##   15   16   17   18   22
```

Table 4: Frequency Distribution of Age

Age	Absolute_Freq	Relative_Freq	Cumulative_Freq
15	82	0.208	0.208
16	104	0.263	0.471
17	98	0.248	0.719
18	82	0.208	0.927
19	24	0.061	0.987
20	3	0.008	0.995
21	1	0.003	0.997
22	1	0.003	1.000





Interpretation:

- Students' ages range from 15 to 22 years
- Mean age is 16.7 years (SD = 1.28)
- The distribution is slightly right-skewed (mean > median), indicating some older students
- Most students (IQR) are between 16 and 18 years old
- The mode is 16 years, the most common age

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6. Summary Table - All Variables

Table 5: Summary Statistics for Raju's Variables

Variable	Type	n	Mode	Median	Mean	SD
sex	Binary	395	F	-	-	-
age	Numeric	395	16	17	16.7	1.28
Medu	Ordinal	395	4	3	-	-
paid	Binary	395	no	-	-	-
activities	Binary	395	yes	-	-	-
higher	Binary	395	yes	-	-	-
internet	Binary	395	yes	-	-	-
famrel	Ordinal	395	4	4	-	-

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7. Bivariate Analysis: Mother's Education vs Final Grade

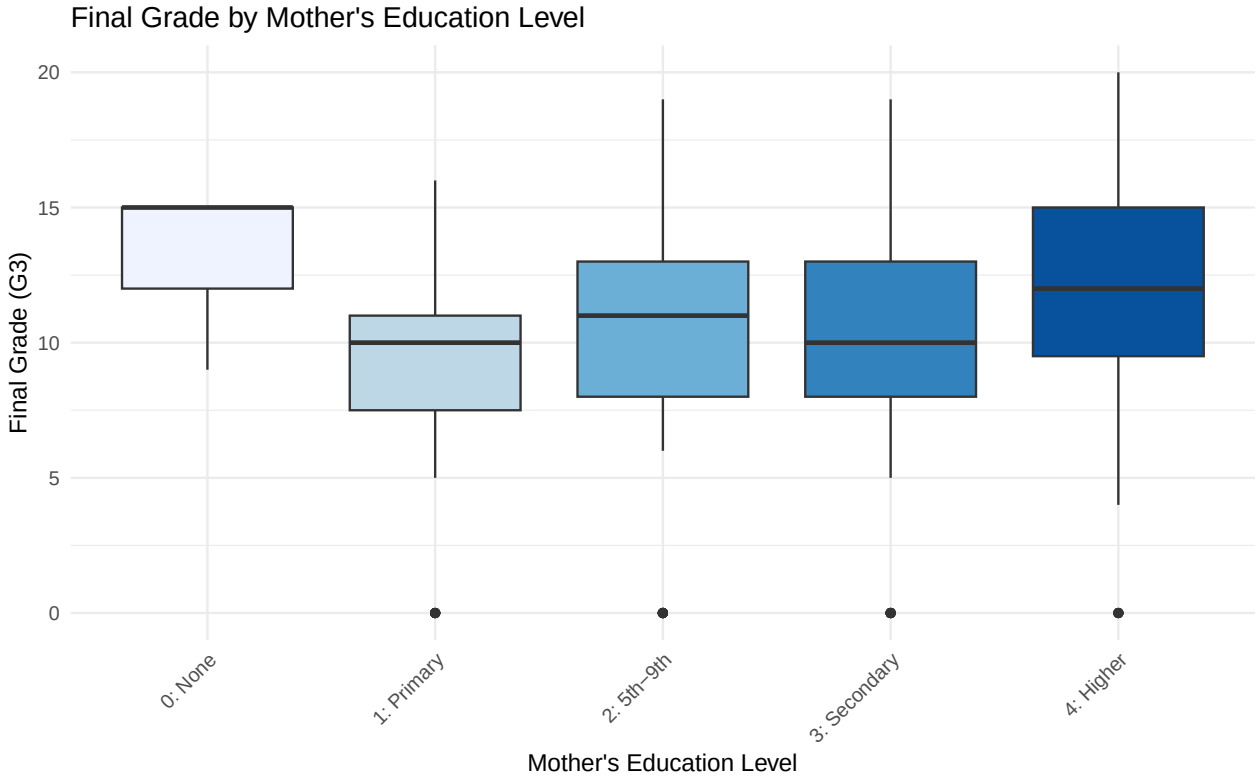
This section examines the relationship between mother's education level (Medu) and student's final grade (G3).

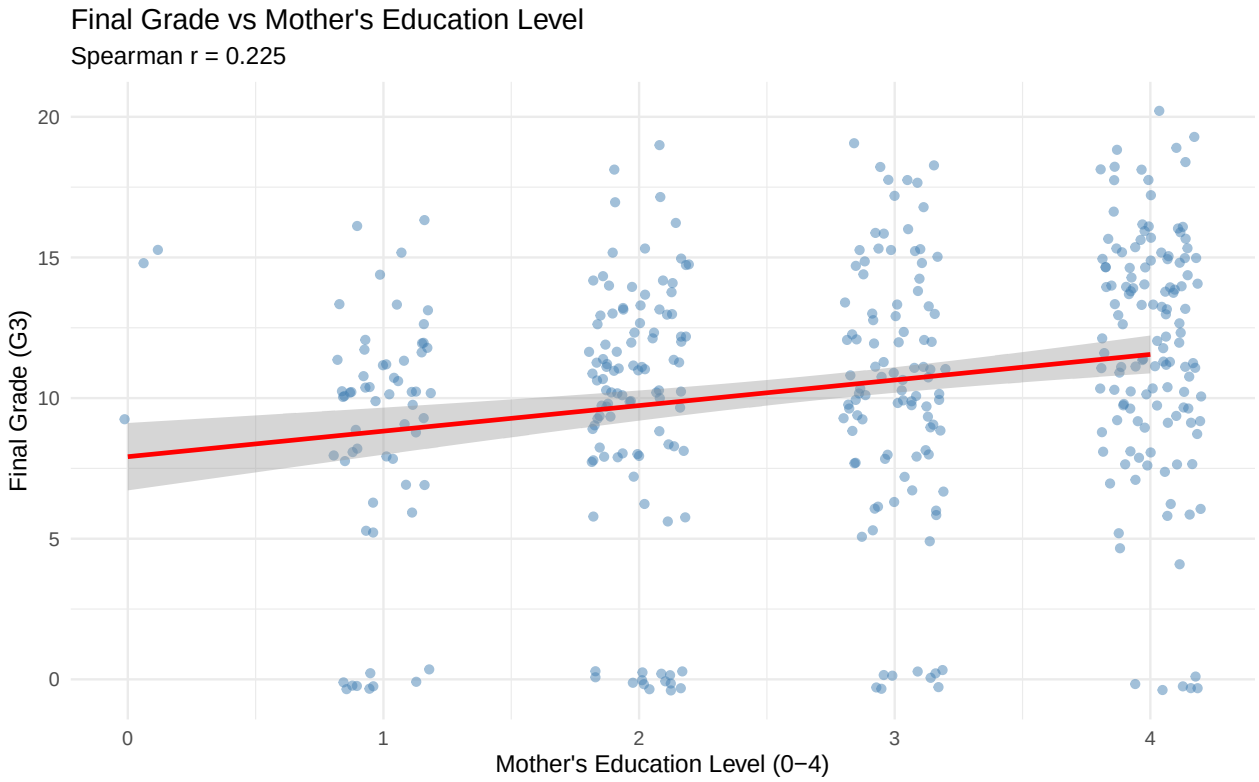
Table 6: Final Grade (G3) Statistics by Mother's Education Level

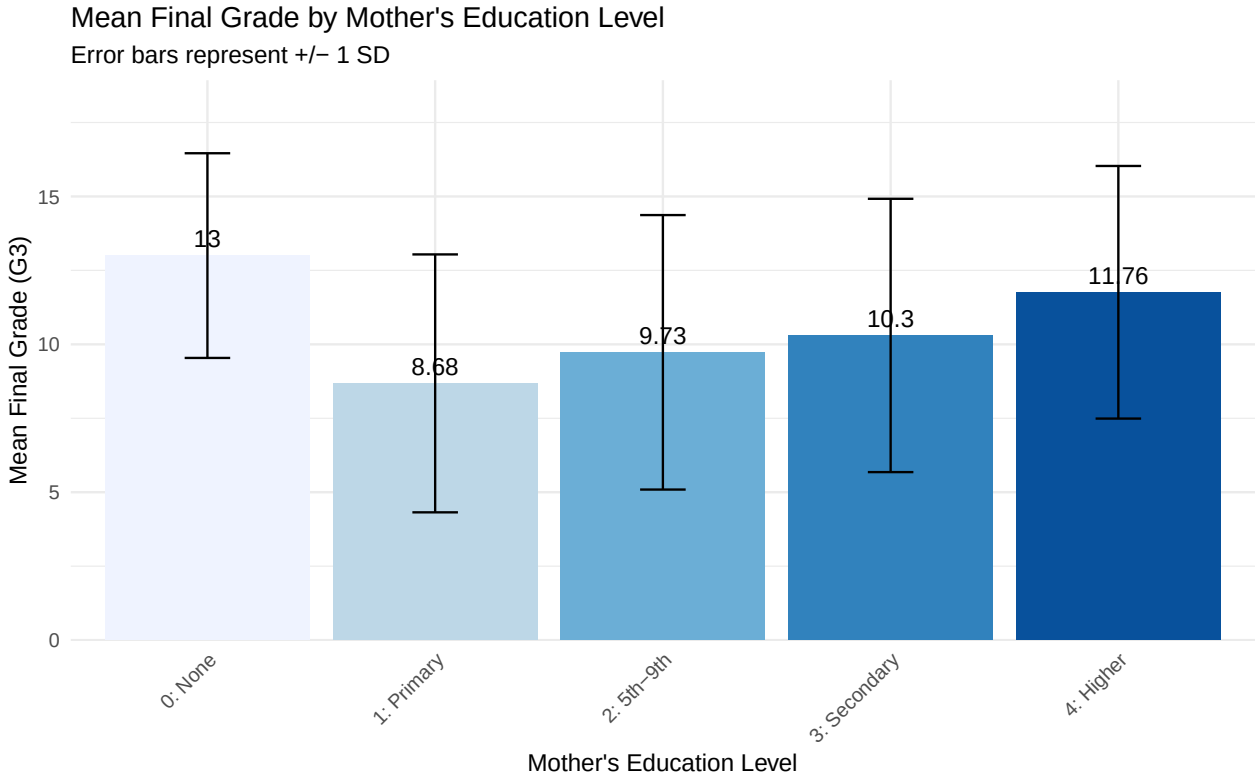
Medu	n	Mean_G3	SD_G3	Median_G3	Min_G3	Max_G3
0	3	13.00	3.46	15	9	15
1	59	8.68	4.36	10	0	16
2	103	9.73	4.64	11	0	19
3	99	10.30	4.62	10	0	19
4	131	11.76	4.27	12	0	20

```
## Spearman Correlation (Medu vs G3): 0.225
```

```
## Pearson Correlation (Medu vs G3): 0.217
```







Interpretation:

- There is a **positive correlation** between mother's education and student's final grade (Spearman r = 0.225)
- **Important caveat:** Medu = 0 shows a high mean (13.0), but this is a **small sample artifact** with

only n = 3 students (grades: 9, 15, 15). This group should be excluded from trend interpretation.

- **Excluding Medu = 0**, there is a clear positive trend: as mother's education increases from level 1 to 4, mean grades increase ($8.68 \rightarrow 9.73 \rightarrow 10.30 \rightarrow 11.76$)
- Students with mothers who have higher education (level 4) achieve the highest mean grade (11.76)
- Students with mothers having only primary education (level 1) have the lowest mean grade (8.68)
- The relationship suggests that **parental education is a meaningful predictor** of student academic performance