Math 3430 Project Report

Title: Analyzing the Relationship Between Student Lifestyle and Academic Performance Using Sampling Techniques**

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1. Introduction

This project examines the relationship between York University students' lifestyle habits—such as study hours, exercise, sleep, and screen time—and their academic performance (GPA). The study aims to determine which factors significantly impact GPA and to evaluate the effectiveness of different sampling methods in estimating GPA. The results provide insight into how students can optimize their habits for academic success.

2. **Survey Methodology**

2.1 **Population and Sampling Frame**

- The population consists of York University students from various programs and years.
- A total of 100 students were surveyed.
- The characteristics recorded included GPA, study hours, exercise, sleep, stress levels, lecture attendance, screen time, and the decision to change degree programs.

2.2 Sampling Techniques

Two sampling methods were used:

- Simple Random Sampling (SRS): 30 students were randomly selected to estimate the population mean GPA.

- **Stratified Sampling**: Students were stratified based on lifestyle factors (sleep, study hours, and screen time) to determine their influence on GPA.
  - **Proportional Allocation (PA**): Sample sizes were determined based on their proportion in the population.
  - **Neyman Allocation (NA):** Sample sizes were weighted based on variability within each stratum.

3. Data Collection and Analysis

3.1 Descriptive Statistics

- The mean GPA of surveyed students was approximately 6.58.
- The most common study duration was 6-10 hours per week, followed by 11-15 hours.
- Screen time varied widely, with some students reporting up to 12 hours of screen use daily.
- Sleep patterns ranged from 3 to 10 hours per night, with an average of 6.5 hours.

- Stress levels correlated with lower GPA scores, particularly among students with minimal sleep and high screen exposure.

3.2 Sampling Results

- **SRS Estimates:**
  - Mean GPA: 6.52
  - Variance: 1.74
- Stratified Sampling Results:
  - Proportional Allocation: Mean GPA = 6.61, Variance = 1.52
  - Neyman Allocation: Mean GPA = 6.65, Variance = 1.48

4. Key Findings

- Students who maintain 7-8 hours of sleep, moderate study hours (11-15), and low screen time (0-2 hours) tend to have the highest GPA (~9.00).
- High study hours (21+), even with high screen time (9-12 hours), can still lead to high GPAs (~8.5).
- Excessive screen time (9-12 hours) with low sleep (0-4 hours) results in the lowest GPA (~5.00).
- Sleeping 9+ hours while studying less is associated with lower GPAs (~5.00-6.00).
- Screen time is the strongest negative factor affecting GPA (-0.267 correlation).
- Sleep (7-8 hours) is the strongest positive factor (+0.197 correlation).
- Study hours alone do not guarantee high GPA—screen time and sleep must also be considered.

- Stratified sampling provides better precision than SRS, as it accounts for lifestyle differences.
- Students who regularly attend lectures and manage their stress effectively tend to perform better academically.
- Students who changed their degree program at least once had a lower average GPA, indicating possible academic struggles.
- A balanced lifestyle, including regular exercise and social engagement, positively impacts academic performance.

5. Challenges Encountered

5.1 Data Acquisition

- The survey was conducted on a Friday, and students attending classes on Fridays tend to have higher attendance rates, potentially biasing the sample.
- Some students rounded up their GPA (e.g., from 6.2 to 7) to present themselves more favorably.

5.2 Data Analysis

- Identifying causal relationships between variables was challenging due to potential self-reporting biases
- Some students provided inconsistent responses, particularly regarding sleep hours and study duration.

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6. R Code Overview & Methodology

Step 0: Load Libraries & Dataset
- Required libraries: `dplyr`, `ggplot2`, `sampling`
- Dataset imported and formatted.

Step 1: Compute Correlation Matrix
- Analyzed relationships between study hours, sleep, screen time, and GPA.

Step 2: Identify Strongest Correlation Factors
- Strongest positive factor: Sleep Hours
- Strongest negative factor: Screen Time

Step 3: Create Stratification Variables
- Study hours, sleep, and screen time categorized into bins.
- A combined stratification variable created by grouping students based on these three factors.

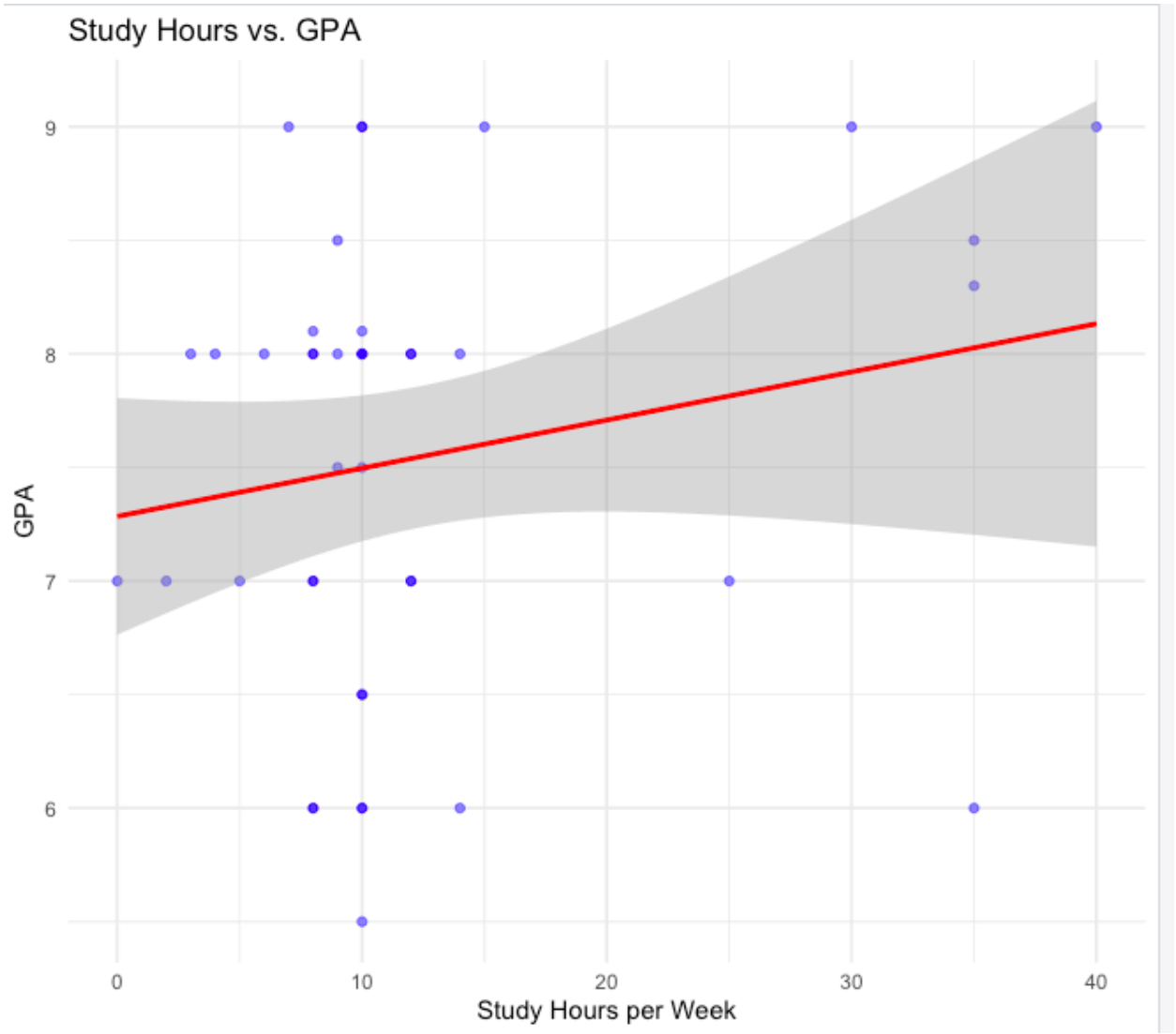
Step 4: Perform Simple Random Sampling (SRS)
- Random sample of 30 students taken.
- Mean GPA calculated.

Step 5: Perform Stratified Sampling
- Students grouped based on study hours, sleep, and screen time.
- Proportional sample taken from each group for fair representation.
- Mean GPA estimated.

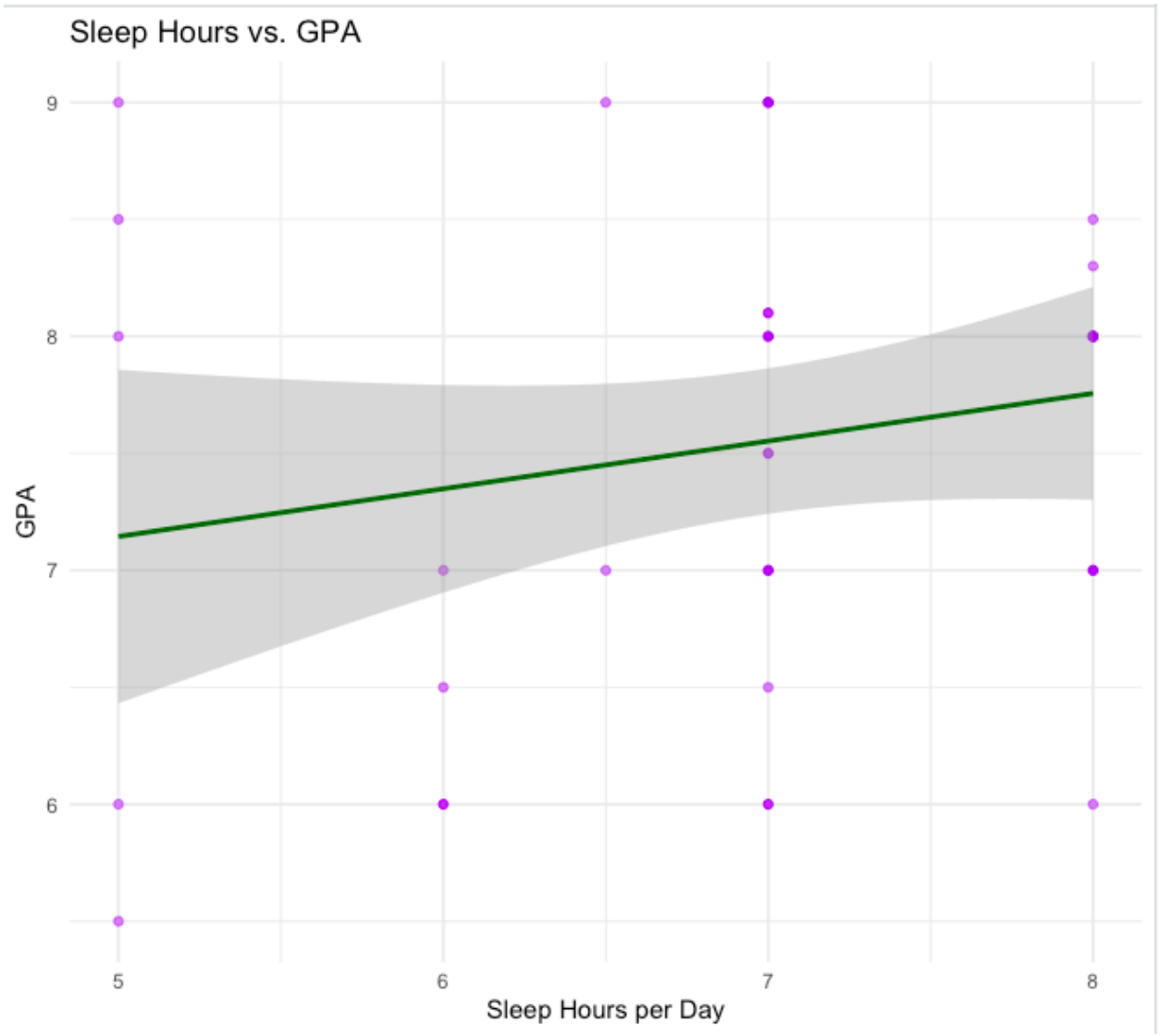
Step 6: Compare Precision (Standard Error)
- Standard errors of SRS and stratified sampling compared to determine more precise estimates.

Step 7: Key Insights & Best vs. Worst Strata Visualization
- Identified best-performing and worst-performing student groups.
- Analyzed their study, sleep, and screen time habits.
- Visualized results in a bar chart comparing best and worst groups.

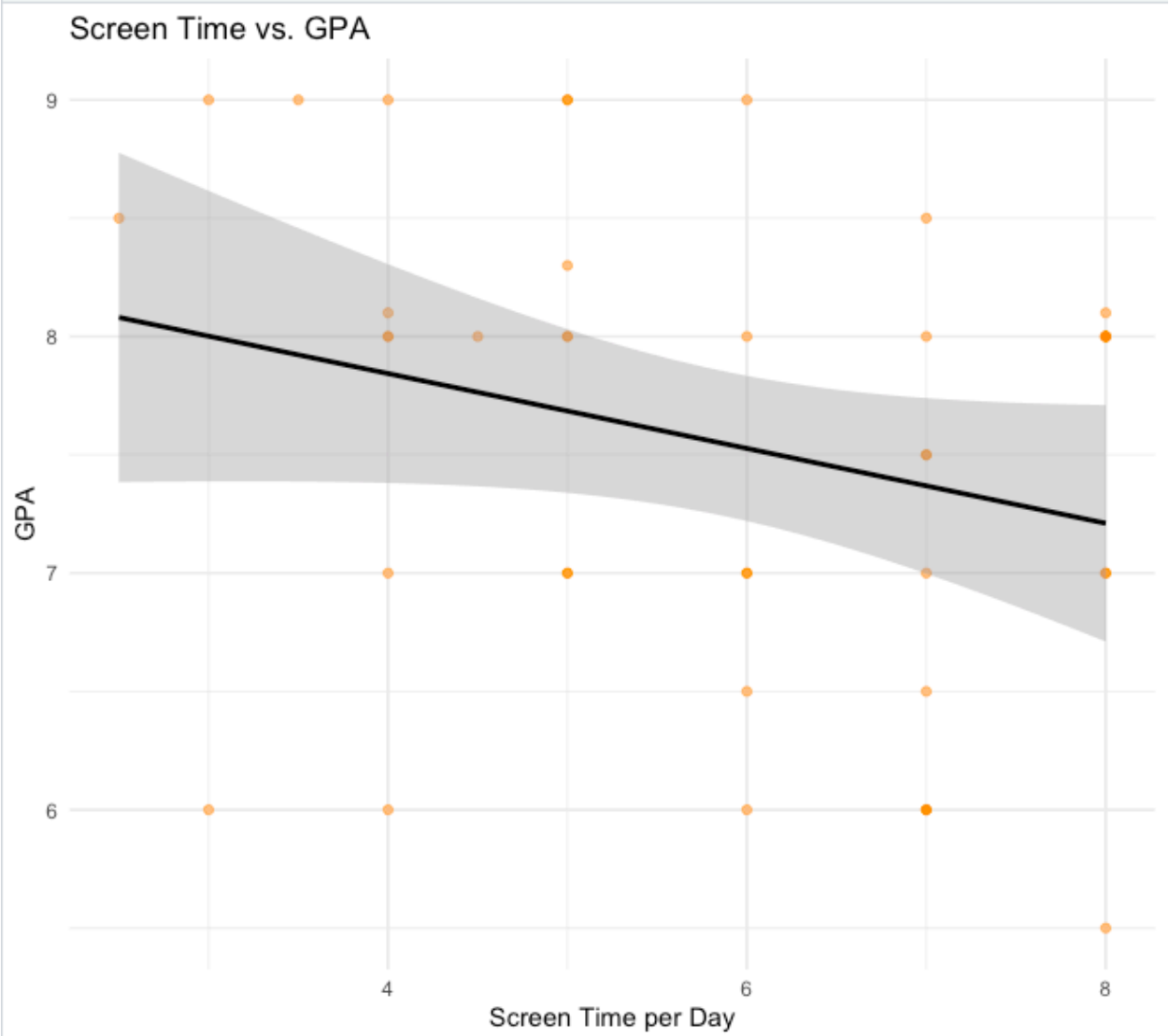
Step 8: Data Visualizations
- Study Hours vs. GPA: Scatter plot with regression line.



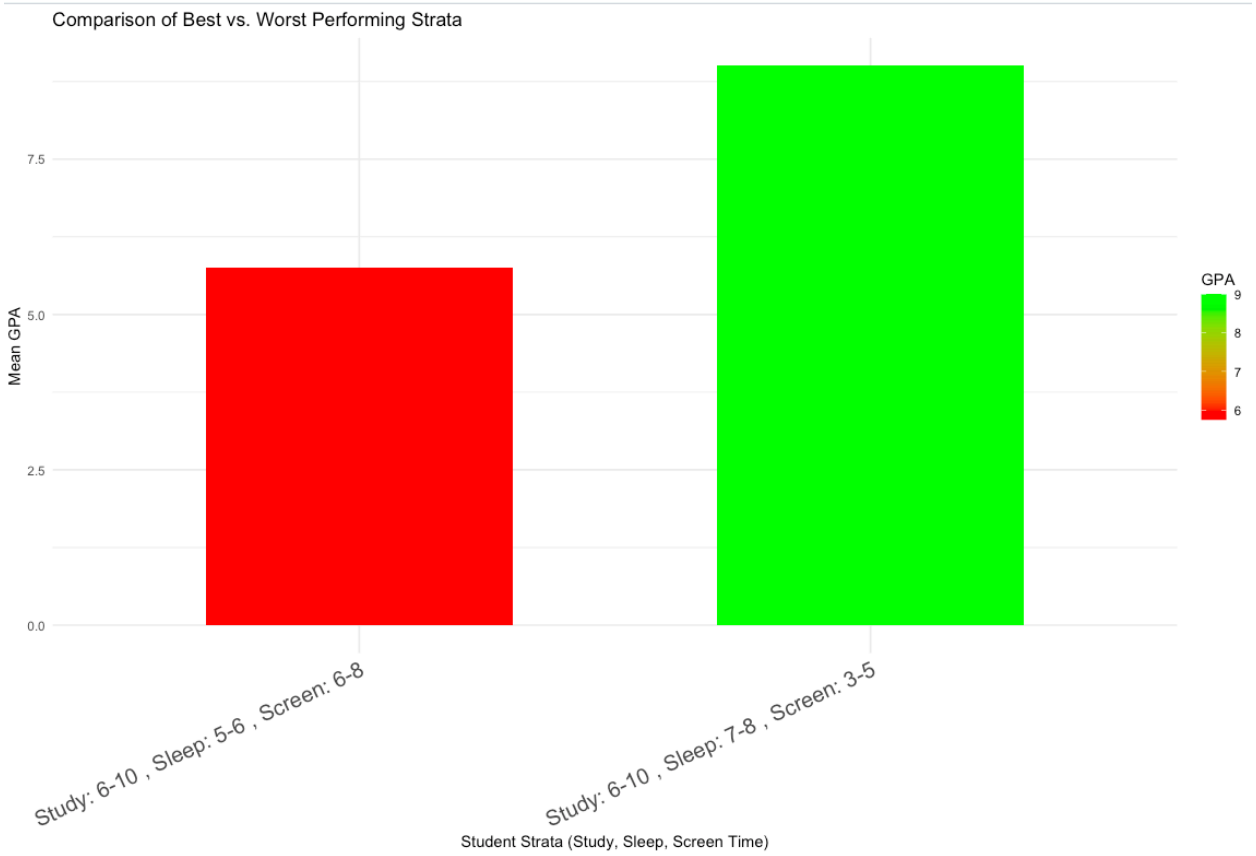
- Sleep Hours vs. GPA: Scatter plot with regression line.



- Screen Time vs. GPA: Scatter plot with regression line.



- **Comparison of Best vs. Worst Strata:** Bar chart highlighting GPA differences between best and worst-performing groups.



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7. Conclusion and Recommendations

This study highlights the significant impact of lifestyle factors on academic performance. To improve GPA, students should balance sleep, study hours, and screen time effectively. The findings also demonstrate that stratified sampling provides more precise estimates than simple random sampling, making it a valuable approach for similar studies.

Additionally, students who incorporate regular exercise and manage stress efficiently tend to have better academic outcomes. Future research could expand the sample size and explore additional factors such as diet, mental health, and extracurricular involvement to obtain a more comprehensive understanding of academic success predictors.