Insight into the Effects of a Peer Math Assistant on Student Academic Performance

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Abstract

This project takes data collected from the Math Achievement Program (MAP) and pairs it with student grade data to find impactful results regarding how a Peer Math Assistant (PMA) can affect student academic performance. Under the Elevating Excellence grant for the Embedded Math Achievement Program, PMAs have worked with mathematics and statistics professors to embed themselves into sections of these courses while providing tutoring to students on these subjects in the dedicated MAP room of the Adel Mathematics building. This program has collected data regarding student visits to the MAP room to gain insight into how this resource has affected student grades for the Fall 2023 semester. The results of this analysis will have an impact as to how significant this program is for funding purposes, if other schools should fund similar resources, and if this program is meaningful and should be further advertised. This insight will be synthesized through data collection, cleaning, and organizing followed by visualization of the data using various data science techniques.

Methods

In the data collection process, data regarding tutor visits was pulled from TracCloud, which tracks student check-in and check-out times, duration, type of visit, tutor visited, class and section. Student final and midterm grade data was collected from Enterprise Reporting. To ensure FERPA compliance, before working with sensitive student data, student names were anonymized with a five-digit identification number across both datasets to protect student information. These two datasets were cleaned to more easily analyze and visualize the data. This consisted of changing the data types of variables, filtering to only include MAP room subjects, and adding a variable to indicate if a student's course had an embedded PMA. The two datasets were joined to create a master dataset with all student grade and MAP room visit information. The final data set consisted of 7590 student visit counts and grade with 19 variables. The data is stored in a long format, where students that never visited the MAP room have only one observation containing their course grade. Students that visited the MAP room more than once had multiple observations for each MAP room visit. The most important variables used were Class, Section, Final Grade, and if a class has an embedded PMA. It was found that these variables produce the most valuable immediate insights into the effects of PMAs on student academic performance. A small portion of the data is described in the tables below.

Final.Grade		Mask.ID		Class.Has.PMA	
B	:2288	93134	: 87	NO :2574	
C	:1990	30748	: 86	YES:5016	
A	:1813	67711	: 66	**Class**	
W	: 607	34826	: 62	MAT 121:1697	
D	: 547	67725	: 62	MAT 136:1840	
(Other): 344		12711	: 58	MAT 137:1451	
NA's	: 1	(Other):7169		MAT 150: 356	
				MAT 155: 45	
				MAT 238: 814	
				STA 270:1387	

*Counts of Student Visits to the MAP Room Faceted on Various Variables
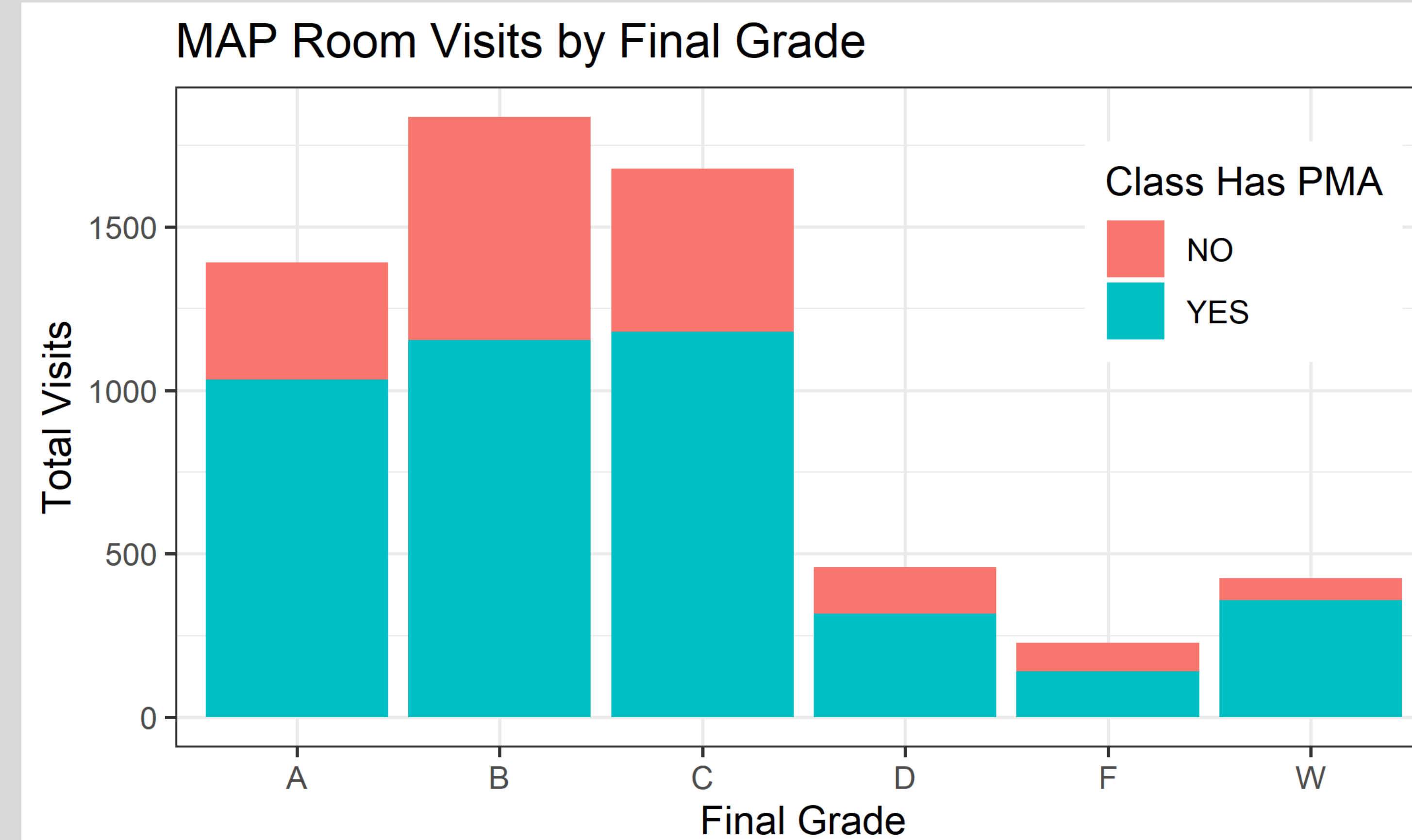
MAP Room Usage By Grade

Figure 1. Bar chart visualization of how frequently students utilized the MAP room based on their final grade in the class. Data is grouped across all MAP room courses. Students that visit the MAP room more frequently associate to earning higher grades while students that do not visit the MAP room as frequently associate with lower grades. It is also observed that classes with an embedded PMA tended to have higher visit counts overall regardless of grade. This graph contains data for students that visited the MAP room at least once and does not account for students that did not visit the MAP room.
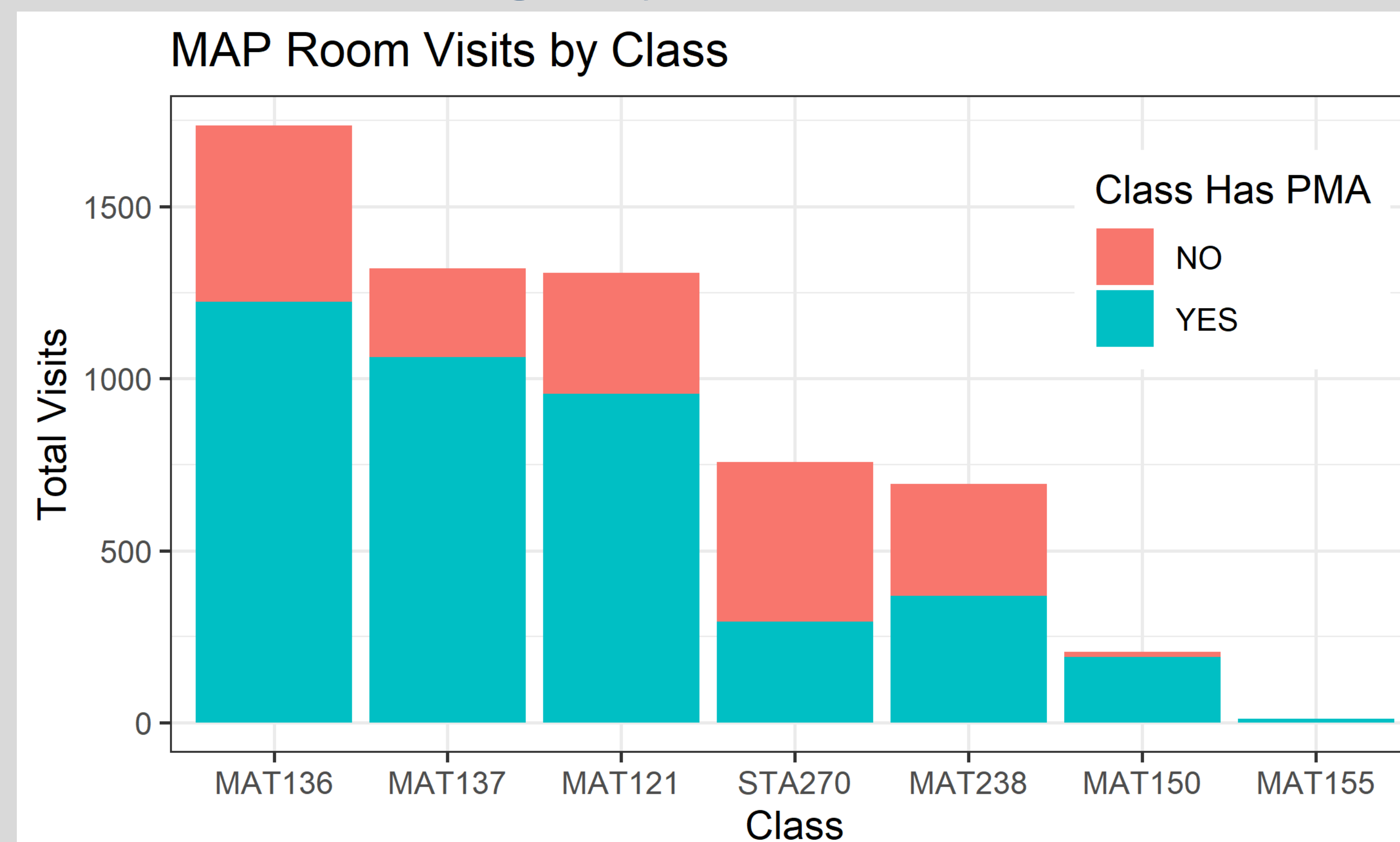
MAP Room Usage By Class

Figure 2. Bar chart visualization of how often students from each class visited the MAP room. We find that students in MAT 136 and MAT 137 classes visit the MAP room the most. However, classes such as MAT150/155 have less sections and students overall, which corresponds to lower visit counts. While taking this into account, STA 270 has the most sections out of all classes, yet visits for this course fall in the middle of total MAP room visits for each class. It can also be observed that STA 270 has many students that do not have a PMA visit the MAP room more frequently than if their class did have a PMA.

Grades Associate with Embedded PMAs

A Pearson's Chi-Squared Test was conducted on the counts of students' final grades based on if there was a PMA present in their class. The test resulted in a significant association with a p-value of 0.03376. This result suggests that the presence of an embedded PMA in a class has a positive association on a student's final grade in that class. This result provides evidence that the presence of a PMA can positively affect the academic performance students. These promising preliminary results could lead to even stronger relationships being found between PMA presence and other academic variables. This test was conducted with the assumptions that the data comes from a random sample and that the students' final grades in each class are independent. Not all assumptions were tested and would require further verification to confidently uphold this result.

```
         Pearson's Chi-squared test

data:  StudentGradesByPMA[, 2:3]
X-squared = 12.076, df = 5, p-value = 0.03376
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*Pearson's Chi-Squared Test Results

Final.Grade	NoPMA	PMA
A	273	351
B	309	416
C	233	331
D	66	83
F	65	93
W	84	179

*Table of Student Counts Sorted by Final Grade and PMA Presence

Conclusion and Future Work

Over the course of the semester, this research project produced:
- a clean, compiled database with MAP room student visit information, student grade information, and student class information.
- visualizations of the data to help readers and other researchers gain a deeper understanding of the relationships between variables.

The student gained:
- valuable experience working with a large, unruly dataset.
- practice utilizing concepts learned in data science classes.

Opportunities for future work regarding the effects of a PMA on student academic performance:
- following a student's progression in math courses over time as a result of utilizing the PMA resource
- comparing student performance across semesters.
- synthesizing a predictive model to predict a student's final grade based on factors relating to the MAP room such as visit frequency and PMA presence.

These areas of research would become more evident as more semesters of data of PMA impact become available. We hope that this project continues in the following years and produces enough data to be forecasted in a time series analysis. These insights would bring further attention and funding to providing useful mathematics resources to university students.

References

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