Academic Data Models: Freshmen Registration Data Analysis

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1 INTRODUCTION

One of the most important events for freshmen students is the selection of their initial class schedule. The classes a student will take can shape the rest of their college career. This is where the expectation for what the student will gain from there classes forms. At some colleges this initial class schedule is determined faculty members. Thus it becomes incredibly important for the faculty to create the best possible schedules for freshmen students.

There are several advantages for freshmen students when faculty members are responsible for creating their initial class schedule. One of these advantages is the faculty members experience. Faculty members are intimately familiar with the class requirements a student needs to complete to graduate at their institution. An incoming freshmen student can benefit immensely from this knowledge and are put in a much stronger academic position by using the faculty generated schedule. Another advantage is a good number of credit hours for the student. Faculty generated schedules aim to have around 16 credit hours on a freshmen students schedule, ensuring that the student is not overworked.

Studies have shown that high quality academic advising has a large impact on academic performance. The performance of the student can be measured in terms of GPA, future employment opportunities, and satisfaction with the institution[4]. A strong faculty created course schedule can improve academic advising quality by providing strong base classes for the student to build upon.

In addition to academic performance, there have been studies on the effects college orientation has on student persistence in college [5]. A large part of the college orientation process is the initial student registration process. Thus to increase student persistence in college it is vital to create and maintain an excellent registration experience for students. At institutions where the initial class schedule is created by faculty members, creating a strong initial schedule will help improve the registration process for freshmen students. A schedule is considered strong by faculty members if it contains

- A class that fulfills a competency
- RCC class (in other schools this class would be a freshmen seminar)
- Class in a students expressed major of interest

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- An elective class outside a students expressed major of interest

A schedule that satisfies these four requirements sets up a student for graduation on time and provides the student with a class they may not have taken otherwise.

Strong faculty created academic schedules will also make sure that a student will begin taking classes that will give necessary prerequisites and competencies they need to graduate on time. Taking these competencies early will guarantee that every freshmen student is in a class that will give them the requirements to graduate early. In addition, the faculty generated schedule makes sure that students have the opportunity to take classes in a major that they have expressed an interest in. This combination of possible major classes and class competencies will make sure that the student begins their college career with the best possible course schedule.

In order to make sure that students are receiving the best possible course schedule during their freshmen year there must be some way of determining what makes a course schedule good. The freshmen registration data is examined using a custom program to find trends and commonalities. These trends can then help us determine what the highest registered classes among freshmen students are and commonalities among the schedules of different students.

The registration data from 2017-2021 is analyzed and to find trends, the faculty chosen schedule is compared to the students final schedule after the add/drop period. Additionally, the registration data can help give an idea on how the students choice of classes compare to the faculty choices. Then several statistics can be calculated based on this data which tell how successful the chosen schedule was. Some of these statistics include percentage of students who removed at least one class chosen by the faculty members, average percentage of classes that remained on the students schedule that were in the initial schedule, and the percentage of classes in the final schedule that were within the faculty chosen classes.

Though the registration data gives a lot of information about the modifications students make to their initial class schedules, it does not give any information on why the students are making these changes. For example a student may drop a math class. The registration information will tell us that this student dropped the math class, how many credit hours were removed, how many students dropped a similar class, and so on. However, there is no information as to why the student dropped the math class. Maybe they did not want to pursue a math major when they previously indicated they did. Maybe there was a more interesting class that conflicted with the math class. There are many more reasons as to why they may have made this change and the question of why cannot be answered using the registration data.

2 LITERATURE REVIEW

In this section, all of the supporting articles that help support this thesis are introduced. In each of the following sections the articles are briefly summarized. Then after the article is summarized, an explanation is provided into how each article supports or contributes to the research described in this thesis. The following articles are used to support this thesis:

- Section 2.1: *Perceived Quality of Academic Advising: The Effect on Freshman Attrition*
- Section 2.2: *Orientation to College and Freshman Year Persistence / Withdrawal Decisions*
- Section 2.3: *The Impact of Registration Timing on Student Performance*
- Section 2.4: *First Things First: Developing Academic Competence in the First Year of College*
- Section 2.5: *What the Research Says About the Summer Melt*

These articles highlight the importance in creating excellent class schedules for freshmen students. Additionally, they provide perspective into many of the aspects beyond registration that contribute to a freshmen students success in their first year.

2.1 Perceived Quality of Academic Advising: The Effect on Freshman Attrition

The first article that helps support the need for great faculty generated class schedules is titled *Perceived Quality of Academic Advising: The Effect on Freshman Attrition*. This article analyzes the relationship between high quality advising and student attrition. [4].

In this article, student attrition was measured through effects on a students measure of success. These measures include "effects on GPA, satisfaction in the role of a student, value of a college education for future employment, and intent to leave the university"[4].

To find the correlation between high quality advising and student attrition, this paper models the attrition process for students that are older than 24, live off campus or are a part time student. Using this model the researchers are able to predict how well the student is likely to perform and how likely the student is to remain at the college. Using this model, the relationship between the advising quality that was given and student attrition is established. [4]

The model described in this article found 14 of the variables that were used to analyze academic performance were responsible for around 30% of the variance in dropout. These 14 variables are shown below .

Variables used to analyze academic performance

- Intent to leave
- GPA
- Utility
- Satisfaction
- Good advising
- Poor Advising
- Opportunity to transfer
- Outside encouragement
- Family responsibilities
- Hours of employment
- Age
- Gender
- Ethnicity
- High school performance

The study showed most of the effects of high quality advising were apparent through indirect positive effects to satisfaction, utility, GPA, and intent to leave. The results of this study showed the biggest contributor to students dropping out was grades. [4]

This article shows that high quality academic advising can help increase a students academic performance. An important part of advising is when advisors help create a students initial schedule for their first semester. If faculty members create a strong initial first schedule, then it can help increase the quality of advising which will then help increase academic performance of the freshmen students.

Our research builds from this article by exploring ways to increase the quality of our academic advising through creating excellent faculty generated class schedules for freshmen students. In doing so we hope to see more of the benefits from high quality academic advising that are described in this article.

2.2 Orientation to College and Freshman Year Persistence / Withdrawal Decisions

The next article is called *Orientation to College and Freshman Year Persistence / Withdrawal Decisions*. This article studies the reasons students may stay in higher education until graduation or withdraw before they have a chance to graduate. One of the factors that was looked at in this study was the effects of orientation on student persistence through college. [5]

Orientation to College and Freshman Year Persistence / Withdrawal Decisions builds upon previous research done by Spady[8][9], Tinto[10], and Bean[2]. These authors have previously studied the reasons students graduate or withdraw from college. Ernest, the author of this paper, specifically mentions the work that Tinto completed using his conceptual model of students persistence and withdrawal processes. Ernest main area of study in this paper was how student persistence is effected by investigating the effect college orientation has. [5]

Tintos paper attempts to build a conceptual model of student dropouts that aims to explain rather than just describe the reasons students drop out of college. To accomplish this goal Tito describes a theoretical model to describe dropout behavior. The model created specifies the conditions in which students drop out from college by creating a longitudinal model of dropout. The end result of this paper was the tools needed to build a theoretical model that is able to specify the reasons a student drops out from college [10].

As mentioned previously, the authors expanded upon Tintos conceptual model of students persistence and withdrawal processes to include orientation experiences between background characteristics and initial commitments in the model. After statistical analysis the authors concluded that students who participated in a two day orientation were more likely to persist through one year of college than a students who did not attend the orientation. [5]

Some of the important orientation activities *Orientation to College and Freshman Year Persistence / Withdrawal Decisions* included was an introduction into administrative regulations and expected behaviors in the institution, student organizations and activities, acquaintance with available student services, help designing an academic program, and providing opportunities for students to meet informally with faculty outside of the classroom. In general, the goal of the orientation is to facilitate the students successful integration into a new and unfamiliar academic and social setting [5].

We hope to build upon this research through our work by improving the orientation process. Our method of generating strong faculty created freshmen student schedules should help improve the orientation process by encouraging students to meet faculty members informally by speaking about their schedules. Additionally, the faculty generated schedules may encourage students to improve any academic programs they have designed during orientation by providing a strong base to build upon.

In conclusion, this study helps support this research because creating strong faculty schedules may help increase the quality of orientation. Increasing the quality of orientation will encourage more students to refrain from dropping out thus helping increase student persistence in our institution.

2.3 The Impact of Registration Timing on Student Performance

The next article that was used to support this research is called *The Impact of Registration Timing on Student Performance*. This article studies the outcomes of student learning based on registration times of the students. This article also looks at how other factors such as student race, Pell Grant status, gender, program of study, and age effected the outcome of students learning.

To find these results, the study uses registration data from three different community colleges in Mississippi. Registration data was then collected from all three schools. In addition, different schools had different registration times. This helped ensure a large sample size of data was collected. Creating a large sample size ensures that the results were statistically significant and accurate. After analyzing the data the study found that the students who registered as early as they are able to had significantly higher semester grades and course completion than students who registered as late as they were able to. [3]

The findings of this article greatly helped to support this research because it found a positive correlation between early student registration and strong academic performance and course completion. By creating strong faculty generated class schedules the students are already registered for classes before freshmen orientation. This can reduce the stress students may feel to get into their classes and help increase academic performance and course completion during their first semester.

2.4 First Things First: Developing Academic Competence in the First Year of College

The next article that was used to help support this research is called *First Things First: Developing Academic Competence in the First Year of College*. This article examines the multiple forces and settings in which students and organizations operate that can effect a students learning and development of important life skills such as critical thinking during their first year in college. [6]

To accomplish this the study looked at seven "foundational dimension statements". Each of these statements identifies different features intuitions have that are effective in promoting persistence among first year college students. These foundational statements are shown below:

(1) Have Organizational Structures and Policies that Provide a Comprehensive, Integrated, and Coordinated Approach to the First Year
(2) Facilitate Appropriate Recruitment, Admissions, and Student Transitions Through Policies and Practices that are Intentional and Aligned with Institutional Mission
(3) Assign the First College Year a High Priority for the Faculty
(4) Serve All First-Year Students According to their Varied Needs
(5) Engage Students, Both in and Out of the Classroom, in Order to Develop Attitudes, Behaviors, and Skills Consistent with the Desired Outcomes of Higher Education and the Institution's Philosophy and Mission
(6) Ensure that all First-Year Students Encounter Diverse Ideas, World views, and People as a Means of Enhancing their Learning and Preparing them to Become Members of Pluralistic Communities
(7) Conduct Assessment and Maintain Associations with other Institutions and Relevant Professional Organizations in Order to Achieve Ongoing First-Year Improvement

These statements provide the framework that supports the results this paper contains.[6]

There are several settings that were examined to find the factors that influenced students academic growth. The first of these settings was curricular experiences. An example of this provided in the text was students who

focus or major in the physical sciences had much higher scores on the quantitative section of tests such as the GRE. [6]

Another setting examined was the students experiences in the classroom. This includes things such as faculty members in-class behaviors, student learning, and differences between teaching methods across faculty members. In fact, this paper found that innovative teaching that promote student involvement in the classroom drastically improved a students learning ability and cognitive skill development. [6]

The final setting explored was the students out of class experiences. This included student experiences such as institutional organizations. Some examples of these institutional organizations are student body government or clubs such as the Association for Computing Machinery (ACM). These experiences have the potential to drastically increase development in skills such as critical thinking for students who take advantage of these experiences. [6]

Overall there were 10 indicators that independently contributed to the persistence of college freshman. These indicators are listed below:

(1) supporting all students
(2) cognitive engagement
(3) academic engagement
(4) institutional challenge
(5) preparing faculty
(6) diverse interactions
(7) peer environment
(8) coherent first year
(9) out of class engagement
(10) faculty development

These indicators were also predictors of future growth and academic competence for the students. In summary, this paper identifies the seven foundational dimensions that help analyze influences on a students ability to learn measured on the academic competence scale. [6]

Some of these dimensions such as a coherent first year, academic engagement, and supporting all students are strengthened by creating strong faculty generated schedules for freshmen students. One reason for this is good first year schedules can help a student get ahead with their studies. This will help increase the coherence of the first year which by the results of the study done in this article will help increase student persistence.

2.5 The Summer Melt

This section is a overview of two articles which are titled *What the Research Says About the Summer Melt* and *United States Department of Education: Summer Melt* respectively. These articles examine why many students who apply to colleges in the fall do not actually attend in the fall. This phenomenon is called the summer melt.[7]

A big reason for the occurrence of the summer melt is lack of support from family members. This lack of support takes the form of failure to support the potential students in several areas including, applications necessary to enroll, getting financial aid, housing, and paying tuition bills. This can be especially prevalent with first generation college students because they do not have the same support structure from a parent who previously

went through the process. [7]

One example that was found to help mitigate this is 2-3 hours of additional summer support. This has shown increased enrollment of 3-4 percent overall and 8 percent increase in low income students. Additionally, support from the students high school in the form of counseling and automatic electronic reminders can help potential students be prepared for college in the fall. [7]

To provide more legitimacy to the summer melt phenomena the article titled *United States Department of Education: Summer Melt* was published by the United States department of Education. This article adds credibility to the summer melt because other articles which describe this phenomena are not peer reviewed.

United States Department of Education: Summer Melt expands upon the first article described in this section. Many of the students who are at the highest risk of "melting" away during the summer are from low income families who lack the necessary resources and support to get everything ready for college. [1]

United States Department of Education: Summer Melt also mentions that the summer melt severely effects Latino communities because the Latino population is increasing the in US. By addressing this issue we can ensure that there is more diversity among people who graduate. [1]

Finally, the article mentions that the summer melt is a problem which is really easy to mitigate. Some ways to prevent students melting away during the summer is to remain in contact with school counselors, teachers, and college admins to ensure that all of the students questions and concerns will be addressed. [1]

These articles help support our research because it goes in depth into reasons why students do not attend college. This understanding can help encourage more students to attend college by working to mitigate the issues that create the summer melt phenomena. For example, great faculty advice about registration could help reduce student changes to the faculty created schedule. Reducing changes to the faculty generated schedule may reduce stress for the student by providing the opportunity to get course requirements for graduation early.

3 METHODS

To analyze the registration data from the freshmen students it was necessary to create a program to help organize and analyze all of the data. This program allows for storing and retrieving information about the students and classes that make it simple to find commonalities in the classes each student is taking.

To make it easy to write and edit the code this program is written in python, an object oriented coding language. Writing the code in python makes it possible to organize the code into different classes with common attributes and behaviors which allow the registration data to be easily analyzed. It also provides a simple way to edit and add functionality to the program if needed. Section 3.1 goes into further detail about the organization and classes involved in the program.

The program will organize the classes the students are taking into two categories. These two categories are the faculty generated schedule and the student modified schedule. All the following sections describe how to use these two categories of classes to calculate the statistics. For example the program may find that a student was registered for the classes in table 1 by the faculty members and was registered for the classes in table 2 after they

modified their schedule.

Term Code	CRN Key	Subject Code	Course Number	Section Number	Credit Hours	Competency
201709	90845	RCC	100	13	4	None
201709	90408	SPN	101	1	5	None
201709	90192	ENG	140	12	4	WCMP
201709	90146	COM	100	1	4	None

Table 1. Faculty Generated Schedule

Term Code	CRN Key	Subject Code	Course Number	Section Number	Credit Hours	Competency
201709	90845	RCC	100	13	4	None
201709	90192	ENG	140	12	4	WCMP
201709	90146	COM	100	1	4	None
201709	90224	FRN	101	1	5	None
201709	90049	ARH	110	1	4	None

Table 2. Student Modified Schedule

These tables contain example schedules for a student registering at Rollins College. All of the different categories such as term code, CRN key, etc are described in more detail in section 3.1.

There are some unique registration practices that Rollins follows which are not seen in other schools. The biggest registration practice is the RCC or Rollins Conference Course which takes the place of a freshmen seminar class at other schools. The RCC class is required for all freshmen and is not able to be removed by the student. Due to this fact the RCC classes are often removed from the statistical analysis described in the following sections.

Additionally, there have been some changes to the registration process during the years which are analyzed. These changes include things such as new competencies, removal of old competencies, and giving the students the ability to wait list for courses. Other non-registration specific factors such as online courses during COVID-19 have also effected the registration process in unique ways during specific years.

Trends and patterns or anomalies in the data may be attributed to these unique factors but we can not say definitively that they are the reason for the changes. Thus as mentioned previously it becomes important to keep in mind that there are many possible explanations the data behaviours and we cannot say for sure what those reasons are.

There are several different methods for analyzing the registration data. Each method can give unique insight into the strength of the initial course schedule. All together these methods can be used to spot trends and patterns in the registration data. These patterns and trends can then be used as a basis to form better initial faculty created course schedules. The following subsections describe these different methods for analyzing the registration data in more detail.

3.1 Framework

As mentioned previously, the program follows an object oriented design pattern. This allows for many benefits such as the easy addition or removal of features, code organization and re-usability, and much more. This program uses two classes to organize all of the code. These classes are the Student class and the Registration class. A UML class diagram shown in Figure 1 was created to show all of the class variables, functions, and relationships between these classes.

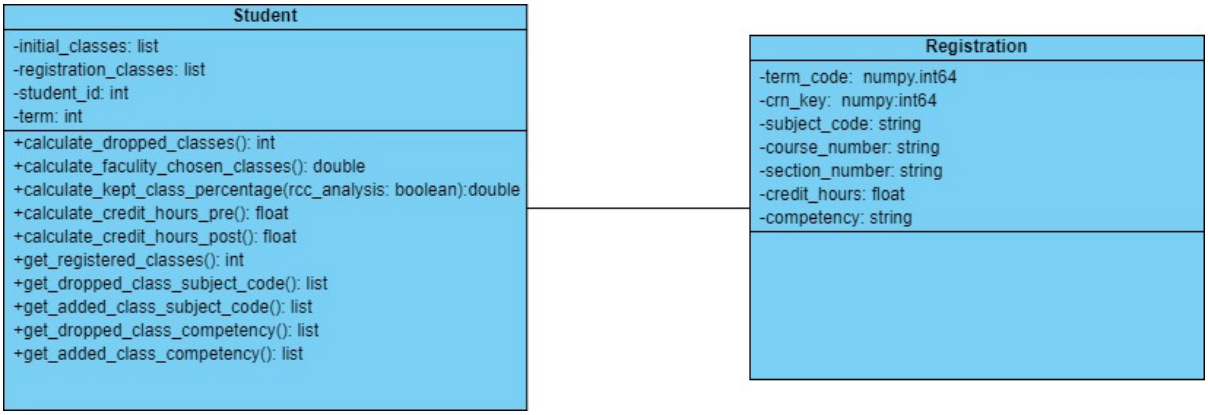

Fig. 1. UML Class Diagram

The `student` class is a wrapper for all of the functionality and attributes for students in the program. In the program a `student` is an object that contains an initial class list or the faculty chosen class schedule and a registration classes list or the classes the student has after they have the chance to change their initial schedule during the add/drop registration period. Each `student` also contains a unique student ID which allows the `student` to have a unique identifier. Finally each `student` contains a term which gives information on what year the student was taking classes in.

The `Student` class also contains several functions which are required for calculating the students statistics. Each `student` object has its own copy of these behaviours and attributes to get unique statistics for each student. These statistics can then be used to calculate a mean statistic or be charted in a histogram or bar chart. Each function is described in detail in the following subsections 3.2-3.6 where their calculations are used to find the statistic described.

The `Registration` class is a wrapper for all of the information about one specific class a student can be registered for. This information includes a CRN key, subject code, course number, section number, credit hours, course year, and competency.

The CRN key is a unique identifier for a specific class. These keys can be reused from year to year so it is important to make sure the desired year is being searched when using a CRN key.

The subject code is a unique code that lets sorts each class into a subject. Some examples for different subject codes could be MAT for math classes or CMS for computer science classes. This information is useful when looking a different subjects that students may drop or add more often when changing their faculty generated schedules.

The next piece of information needed for registration objects is the course number. This number is an identifier that gives information about the level of the course. Generally speaking, courses that begin with a 1 should be taken freshmen year and courses that end with a 4 are courses that are recommended for a senior.

The section number is a identifier for identical classes that take place during different time blocks. Many classes have a cap on the total number of students who can be registered for a class. Classes that are extremely popular such as competency classes or business classes often have more students trying to register than the class cap. Thus to combat this problem multiple sections of the class are offered so students who would otherwise be unable to take the class have the opportunity to take the class during a different time block.

Credit hours is the number of credit hours the specific class is. Generally, classes with higher credit hours meet for longer periods of time every week. Additionally, classes with a lot of credit hours usually require a larger time commitment outside of the classroom.

The term code gives information about the year the class is being offered. This information is important to note because course CRN numbers are reused between different academic years. If there are two classes that have an identical CRN number than the term code can be used to see what year the class was offered in. Thus the term code is vital to make sure the correct classes are being analyzed for a student who was registered for classes during a specific year.

Finally, the last piece of information that all classes have is the competency. To graduate, a student must have completed several different competencies. Competencies include math, writing, ethics, and heath. To obtain these competencies students must register for and pass a class that awards a competency. This information tracks what competencies a class awards to students who pass the required classes.

3.2 Class Percentages

The goal for analyzing class percentages is to see a general overview of big trends in the data. This overview disregards some class information such as credit hours, subject type, or other categorical information that later analysis takes into account.

The class percentage calculations are divided into three different parts. These parts are the dropped class percentage, kept classes percentage and the faculty chosen class percentage. Each of these calculations can be done over one selected year or aggregated across several years. Each of these calculations give general information about the classes different students are changing during the add drop period.

The first statistic calculated is the dropped class percentage. This statistic is calculated by finding all the students who removed at least 1 class from the faculty chosen class schedule after changing their schedule during the add drop period. The number of students who did this is then divided by the total number of students in the freshmen class for that year.

For example, if there are 500 students during the analyzed years and 324 of those students had a class on their final schedule that did not appear in their initial schedule than the dropped class percentage would be $\frac{324}{500}$ or 64.8%. From this example we would determine that 64.8% of students removed a faculty chosen class from their final modified schedule and would show the dropped class percentage to be 64.8%.

The second statistic calculated is the kept class percentage. This statistic is calculated for every student then averaged to find a percentage for all students. This statistic is calculated by finding the number of total courses the student had in their faculty chosen class schedule and finding how many of those classes are in the students schedule after the add drop period. The number of classes that remained in the final schedule is then divided by the number of classes in the faculty generated schedule.

The kept class percentage is calculated twice once with RCC analysis and once without RCC analysis. This is significant because in general students are not able to change the RCC class they were assigned on their faculty chosen class schedule. Due to each student not having the option to change their RCC class the statistic can be analyzed both with and without the RCC class having weight in the final calculations.

For example, let a students faculty chosen class schedule contained all of the classes in table 1 and their modified schedule contained the classes shown in table 2. Then the number of classes in the faculty chosen class schedule which appear in the final student modified schedule is 3. Next, the kept class percentage would be calculated as $\frac{3}{4}$ because there were 4 class initially in the faculty generated class schedule. This process would be repeated for all the freshmen students in the year analyzed and the mean percentage would be found.

If the kept class percentage were to be analyzed using the same data but with the RCC class removed from consideration then the calculation would go slightly differently. First, the number of classes from the faculty chosen schedule that appear in the students modified schedule would be 2. Then the kept class percentage would be calculated as $\frac{2}{3}$ because two classes from the faculty chosen class schedule remained in the modified schedule and there were 3 classes in the faculty chosen schedule with the RCC class removed.

The final class percentage statistic calculated is the faculty chosen class percentage. Like the the kept class percentage this statistic is calculated both with RCC analysis and without RCC analysis due to students being unable to change this class.

This statistic is calculated by finding the total classes the student has after they have made modifications to their faculty chosen class schedule. Then the number of classes that the student has on their modified schedule that are also on the faculty chosen class schedule is found. This number is then divided by the number of classes the student has after modifying their schedule.

For example, let a students faculty chosen class schedule contained all of the classes in table 1 and their modified schedule contained the classes shown in table 2. Then the number of classes in the students modified schedule which appear in the faculty chosen class schedule is 3. Next, the kept class percentage would be calculated as $\frac{3}{5}$ because there were 5 classes in the students modified schedule. This process would be repeated for all the freshmen students in the year analyzed and the mean percentage would be found.

If the faculty chosen class percentage were to be analyzed using the same data but with the RCC class removed from consideration then the calculation would go slightly differently. First, the number of classes from the faculty chosen schedule that appear in the students modified schedule would be 2. Then the kept class percentage would

be calculated as $\frac{2}{4}$ because two classes from the modified schedule remained in the faculty chosen class schedule and there were 4 classes in the faculty chosen schedule with the RCC class disregarded.

3.3 Credit Hours

The goal of the credit hours calculation is to find the number of credit hours each student was registered for before and after they had a chance to modify their faculty chosen schedule. The number of credit hours a student is registered for can give insight into how many hours a student may need to put in per week on classes. Additionally, it can be interesting to note how many students are changing the number of credit hours the faculty members are putting them in.

This statistic is calculated by finding the number of credit hours each student was registered for before they modified their schedule and after they modified their schedule. To find the number of credit hours a student was registered for, each class the student had on their schedule was examined for the the number of credit hours the class offered. This number was then added to the total credit hours the student was registered for.

The process for determining the number of credit hours a student was registered for is then repeated for their faculty chosen schedule and the student modified schedule after the add/drop student registration period. This information is then saved into two lists representing the faculty chosen schedule and student modified schedule and displayed graphically as a histogram.

For example, let a students faculty chosen class schedule contain the classes shown in table 1 and the students modified class schedule contain the classes shown in table 2. Then the students initial credit hours would be calculated as 17 and their credit hours after modifying their schedule would be calculated as 21.

These two numbers would then be added to two lists, faculty chosen credit hours and student modified credit hours which contain the credit hours for all students in the respective categories. This information in these lists are then graphically displayed on a histogram. The X axis of the histogram represents the number of credit hours the student is taking and the Y axis shows the number of students that were registered for those credit hours.

The number of credit hours before and after the student had a change to modify their schedules is displayed side by side. An example can be seen in figure 2. The pre registration label in the legend represents the faculty chosen class schedule and the post registration represents the schedule after student modifications. This allows the data to be analyzed easily.

3.4 Faculty Schedule Changes

The goal of the faculty schedule changes which is also called the dropped class percentage calculation is to find how many classes each student has on their modified schedule that are also on the faculty generated schedule. This calculation is a per student view of the kept class percentage calculation described in section 3.2.

The faculty schedule changes calculation allows us to determine how many classes students are removing from their faculty chosen class schedules. The number of classes removed from a schedule is a good indicator for how strong the faculty chosen class schedule is. If there is a year where many students dropped a low percentage of their classes than we can think of that year as having strong faculty generated class schedules.

The faculty schedule change statistic is calculated by finding all of the faculty chosen classes that are no longer on the students schedule after they have the chance to modify their schedule during the add drop period. This number is then divided by the number of classes on the faculty chosen class schedule. This process is identical to the method for calculating the kept class percentage.

For example, let a students faculty chosen class schedule contained all of the classes in table 1 and their modified schedule contained the classes shown in table 2. Then the number of classes in the faculty chosen class schedule which appear in the final student modified schedule is 3. Next, the kept class percentage would be calculated as $\frac{3}{4}$ because there were 4 class initially in the faculty generated class schedule. This process would be repeated for all the freshmen students in the year analyzed and then the percentages would be displayed on a histogram.

After calculating this statistic for a student the information is then saved to a list and multiplied by 100 to get a percentage. This list of class percentages is then displayed graphically on a histogram. The X axis on this histogram represents the percentage of classes the faculty has chosen that do not appear on the students final schedule. The Y axis of this histogram represents the number of students that have removed that percentage of classes from their final schedules. The histogram allows a user to see the schedule changes for every student opposed to one average percentage for all students. An example of this histogram can be seen in figure 7.

3.5 Class Subject Changes

The goal of the class subject changes calculation is to find how many students have removed particular subjects from their faculty chosen class schedules. The class subject changes calculation also finds which subjects students add to their schedules during the add drop period. An example of this could be if a student had a math class on their faculty chosen class schedule but removed this class during the add/drop period. The result of this calculation would be to add one student to the math subject class drops.

This statistic is calculated by finding the classes that the student had in their faculty chosen schedules but did not have in the modified schedules after the add drop period. The subject codes for these classes are then found and added to a list of subject codes which also have been removed from the faculty chosen schedules.

Next a list containing labels for the subject codes is checked to see if the subject code the student has removed from their faculty chosen schedule is in the label list. If not the label is added to the list. Otherwise the number of students that has removed a class with that subject from their faculty chosen schedules is added by 1.

This process is then repeated in reverse by finding the classes that exist in the students modified schedule but do not exist in the faculty chosen schedule. If the subject codes of those classes do not exist in the faculty chosen schedules the number of students that have added that subject code is added by 1. These values are then displayed graphically to the user in a bar chart.

For example, let a students faculty chosen class schedule contained all of the classes in table 1 and their modified schedule contained the classes shown in table 2. Then the subject code for SPN would be added by one on the dropped class list to show that this student removed a Spanish class which was chosen for them by faculty members. The program would also add one to FRN and ARH on the added class list to show that this student registered for these subjects after they modified their schedule.

The X axis on this bar chart represents the subject distributions that have been removed or added to the modified student schedules. The Y axis on the bar chart represents the number of students who have added or removed that class. The dropped classes bar represents the subject codes that were initially on the faculty chosen schedule and removed and the added classes represents the subjects that were not on the faculty chosen schedule and added. An example of this bar chart can be seen in figure 12.

3.6 Class Competency Changes

The goal of the class competency changes calculation is to find the competencies students have removed from their faculty generated class schedules or added to their modified schedules. A class competency is an award a student will receive from passing certain classes. A student must have a certain number of competencies to graduate.

An example class competency calculation could be if the student had a class that contained a ethics competency on their faculty chosen schedule that the student removed in favor of another class. The calculation would add one student to the dropped ethics competency list. The class competency list would track all of the students who have dropped the ethics competency and would show as a bar chart with the Y axis as the number of students and the X axis as the competency.

This statistic is calculated very similarly to the class subject changes which was explained in section 3.5. First the classes a student has on their faculty chosen class schedules but do not have on their modified student schedules are found. Then these classes are searched for any competencies they may award. If any competencies are found, they are added to a dropped competency list.

Next, a list containing labels for all the competencies is checked to see if the competency the student has removed from their faculty chosen schedule is in that list. If the label is not in the list then it is added. Otherwise the number of students that removed a class with that competency is added by 1.

Then this process is repeated for the competency classes in the modified students schedule. First, the classes that the student has on their modified schedule which are not in the faculty generated schedule are found. These classes are then searched for any competences they may award. If any competences are found then 1 is added to the added competency class list.

Another example could be if a student contained the classes in table 1 on their faculty chosen class schedule and the classes in table 2 on their student modified schedule. Then there would be no changes added in this graph because all of the competency classes that appear on the faculty generated schedule also appear in the students modified schedule.

After these values are found the competency information is then displayed graphically to the user in the form of a bar chart. The X axis of this bar chart contains all of the competencies that a student have added or dropped from their modified schedules. The Y axis represents the total number of students who have added or dropped that particular competency.

In this graph added competency means added a competency to the modified schedule that was not on the faculty chosen schedule. Similarly dropped competency refers to a competency that was on the faculty chosen

schedule but was removed from the students modified schedule after the add drop registration period. An example of this chart can be seen in figure 17.

4 RESULTS

The results from the statistics described in section 3 give much information about the registration trends of students. These trends can then be analyzed to help create faculty generated schedules that students are less likely to change. As mentioned previously in section 1 this is beneficial to the freshmen students because they can benefit much from the faculty members greater experience and knowledge about their institution.

The results from the statistics is broken down into the different years the data comes from. The years range from 2017 to 2021. The majority of the results results are graphical visualizations of the calculations described in section 3 but in the case of the class percentages the results are single statistics calculated from the data.

4.1 Class Percentages

4.1.1 Class Percentages Data Analysis. As mentioned previously in section 3.2 the results form the class percentages can give a lot of insight about the changes students are making to their schedules generally. Additionally, the results from running the class percentage calculations can give insight into the best way to craft schedules for incoming freshmen students. Information such as how many students removed a class that the faculty has chosen, the number of classes the faculty has chosen that appeared on the final schedule, and the number of classes on the final schedule that appear on the initial schedule is all included in the class percentage calculations.

Each of the class percentages can tell us something unique about the general changes students are making to their schedules. The Dropped Class Percentage is a good overall indicator for how strong the faculty schedules are overall. The less students make changes to their faculty generated schedules the lower the Dropped Class Percentage will be and the stronger the faculty generated schedule is.

The Kept Class Percentage with RCC and Kept Class Percentage without RCC are both good indicators for how well the faculty members have chosen the classes on the initial schedules. The higher the kept class percentage is the more classes remain on the students modified schedule. When more classes remain on the students modified schedule we can say that the faculty generated class schedule contained well chosen classes.

Finally, the Faculty Chosen Class Percentage with RCC and Faculty Chosen Class Percentage without RCC are both great indicators for how the students feel about the classes that are on the faculty chosen class schedule. In this case a high Faculty Chosen Class Percentage with RCC or Faculty Chosen Class Percentage without RCC means that more faculty chosen classes have remained on the students modified schedule. The more faculty chosen classes there are on the modified schedule the more the student liked those classes.

4.1.2 Class Percentages Data. Table 3 contains all of the data that is relevant to the class percentages. The first column of the table contains the year the class data came from. The second column contains the Dropped Class Percentage (DCP). As mentioned previously in section 3.2 the Dropped Class Percentage (DCP) is the percentage of students who have removed one class from their faculty chosen class schedule.

The third column in table 3 contains the Kept Class Percentage with RCC (KCPR). As mentioned previously in section 3.2 this calculation is the percentage of classes that a student has kept on their modified schedule when the RCC classes are included in the analysis. The fourth column contains the Kept Class Percentage without RCC

Years	DCP	KCPR	KCP	FCCPR	FCCP
2017	Percentage: 69% Number of Students who removed a faculty chosen class: 366 Total number of students: 530	70.6%	63%	72.2%	64.8%
2018	Percentage: 78.3% Number of Students who removed a faculty chosen class: 430 Total number of students: 549	67.5%	58.2%	69.1%	59.9%
2019	Percentage: 65.3% Number of Students who removed a faculty chosen class: 363 Total number of students: 556	74.8%	68.3%	77.7%	71.5%
2020	Percentage: 70.8% Number of Students who removed a faculty chosen class: 357 Total number of students: 504	70.3%	64.2%	74%	68.4%
2021	Percentage: 64.3% Number of Students who removed a faculty chosen class: 353 Total number of students: 549	76.2%	69.3%	78.3%	71.8%

Table 3. Class Percentages 2017-2021

(KCP) which is the percentage of classes a student has kept on their modified schedule when the RCC class is disregarded in the calculation.

The fifth column in the table is the Faculty Chosen Class Percentage with RCC (FCCPR). As mentioned previously in section 3.2 this calculation is the percentage of classes that the faculty have chosen on the final schedule when RCC classes are included in the analysis. The sixth and final column is the Faculty Chosen Class Percentage without RCC (FCCP). The Faculty Chosen Class Percentage without RCC (FCCP) is the percentage of classes on the students modified schedule which have been chosen by the faculty when the RCC class is disregarded in the analysis.

4.1.3 Class Percentage Discussion. As we can see from table 3 the Dropped Class Percentage was highest during 2018 at 78.3% and lowest during 2021 at 64.3%. From this data we can infer that the faculty chosen class schedules were weakest during 2018 and strongest during 2021. There are some factors that may play into these results. One of biggest changes during 2018 was the introduction of the wait-list. It is possible that the ability to wait-list desired courses had some impact on the Dropped Class Percentage during this year though we cannot say for sure.

By looking at the schedules that were created during low Dropped Class Percentage years such as 2019 and 2021 and comparing those schedules to the years with higher dropped class percentages such as 2018 and 2020 may give some insights into why more students did not remove any of the classes chosen by the faculty in 2019 and 2021. Understanding this distinction may help immensely to create excellent faculty schedules for freshmen with a higher chance of adoption by the students.

Table 3 shows us that the year with the highest Kept Class Percentage without RCC (KCP) was 2021 and the year with the lowest Kept Class Percentage without RCC (KCP) was 2018. The Kept Class Percentage with RCC (KCPR) contains the same highest and lowest year as the Kept Class Percentage without RCC (KCP). From this data we can infer that the faculty members have chosen great classes for students in 2021 but may not have

picked the best classes for students in 2018.

The higher kept class percentage seems to be related in some way with the dropped class percentage. The years that had the highest dropped class percentage 2019 and 2021 also contain the highest kept class schedules. The relationship, if it truly exists, could be interpreted as the more likely a student is to make remove one faculty chosen class the higher the likelihood that student will remove more than one class from their schedule.

Similarly to the highest kept class percentage sharing a year with the lowest dropped class percentage the lowest kept class percentages occur in the same years as the highest dropped class percentages. The years in which these percentages occur are 2018 and 2020. This correlation lends more weight to the hypothesis a student is more likely to drop a second class if they have already dropped one class.

Finally, the looking at table 3 shows us that the Faculty Chosen Class Percentage without RCC (FCCP) was highest during 2021 and lowest during 2018. Similarly, the Faculty Chosen Class Percentage with RCC (FCCPR) had the same high and low years as the Faculty Chosen Class Percentage without RCC (FCCP). From this data we can infer that the students liked many of their faculty chosen class schedules during 2021 and liked their classes less in 2018.

The Faculty Chosen Class Percentage without RCC (FCCP) and Faculty Chosen Class Percentage with RCC (FCCPR) both seem to share the same relationship with the Dropped Class Percentage (DCP) as the Kept Class Percentage without RCC (KCP) does. All of these percentages contain the same highest and lowest years. Though the different years do not share the same percentage rank for all of the class percentages the order does not change drastically throughout all the years. This shows that a possible relationship exists between all of these percentages.

4.2 Credit Hours

4.2.1 Credit Hours Data Analysis. The number of credit hours is one of the most important aspects of a students schedule. Too many credit hours can leave a student overwhelmed while too little credit hours can cause a student to fall behind their expected graduation date. Thus analyzing the number of credit hours students have been registered for and how many they end up taking is vital to building strong faculty chosen class schedules.

Faculty members generally try to register students for 16-17 credit hours per semester. Looking to see how many students ended up registered for 16-17 credit hours after modifying their schedules can be an indicator for how ambitious the student is. The more classes they take the more credit hours they end up registered for. Additionally, looking at the number of students who have been registered for more than 16 credit hours can be an indicator for how strong the faculty generated schedules are. The more students that have been registered for 16 credit hours by faculty the stronger the faculty generated schedules are.

4.2.2 Credit Hours Data. The number of credit hours each student was registered for can be seen graphically as a histogram. As previously mentioned in section 3.3 the x-axis represents the number of credit hours a student was registered for while the y-axis represents the number of students. In the legend there are two entries. The first credit hours pre-registration represents the number of credit hours a student was registered for in their initial class schedules. The second entry credit hours post registration represents the number of credit hours a student was registered for after they had a chance to modify their schedules during the add/drop period.

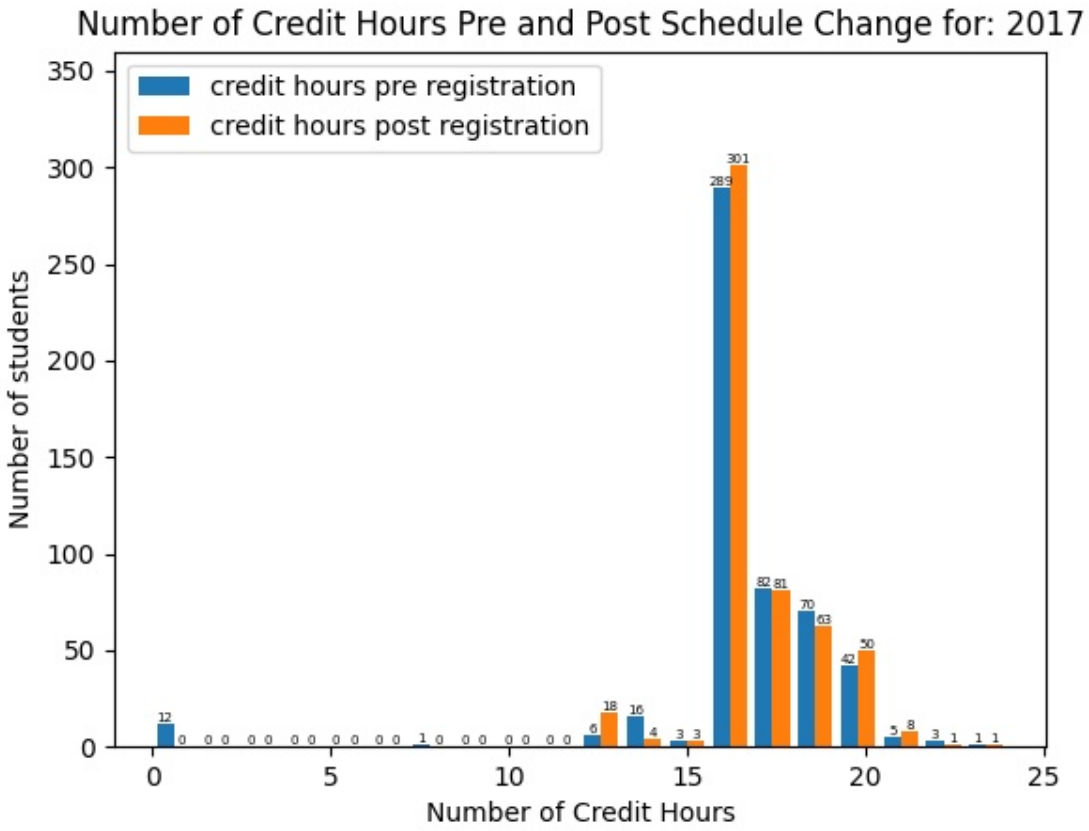

Fig. 2. Credit hours histogram for year 2017

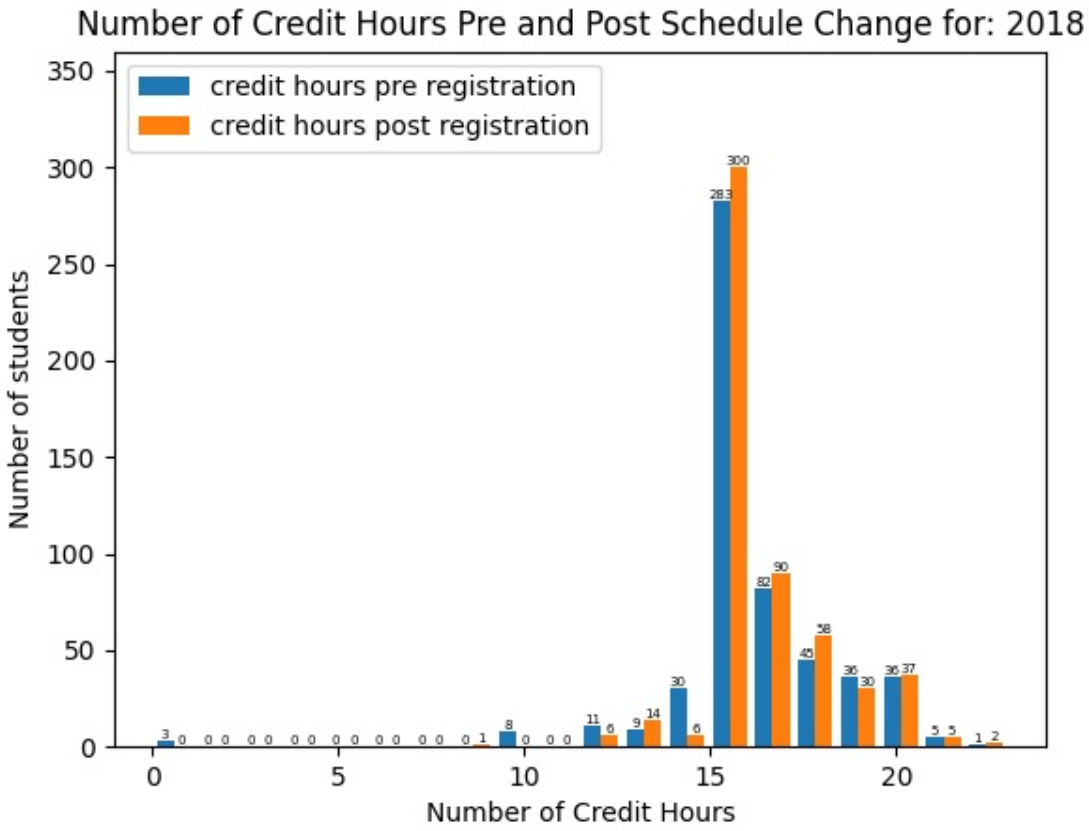

Fig. 3. Credit hours histogram for year 2018

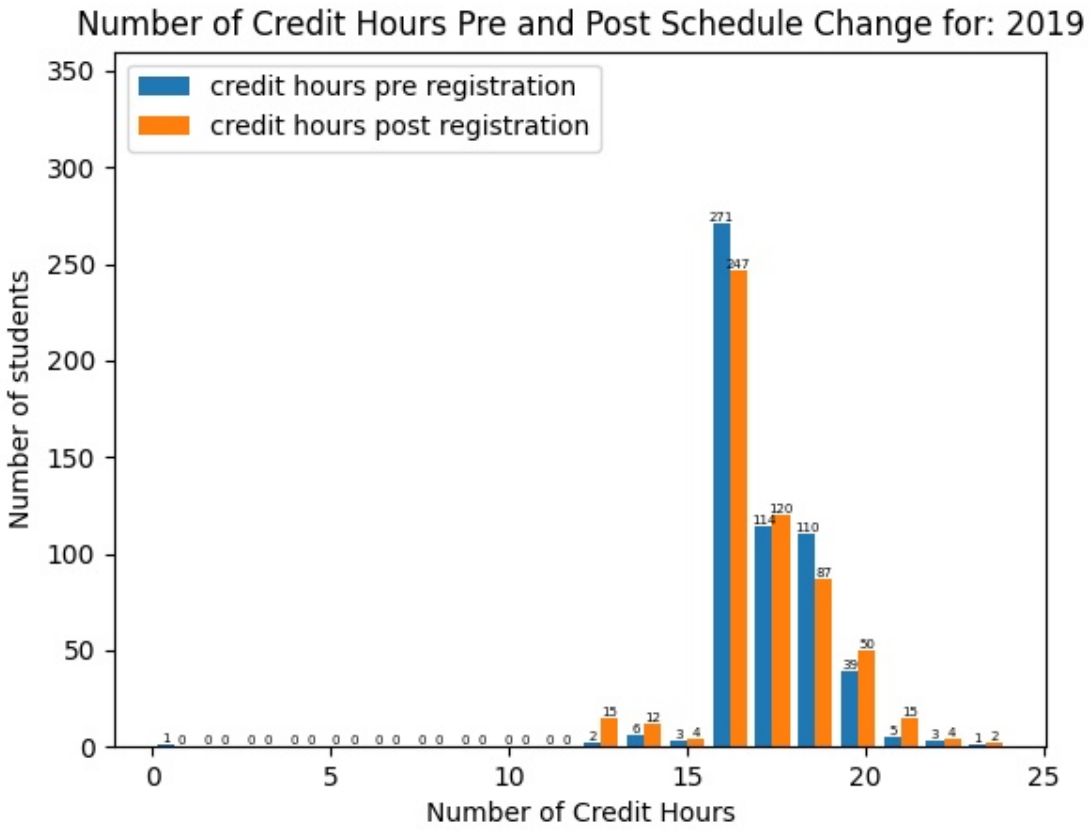

Fig. 4. Credit hours histogram for year 2019

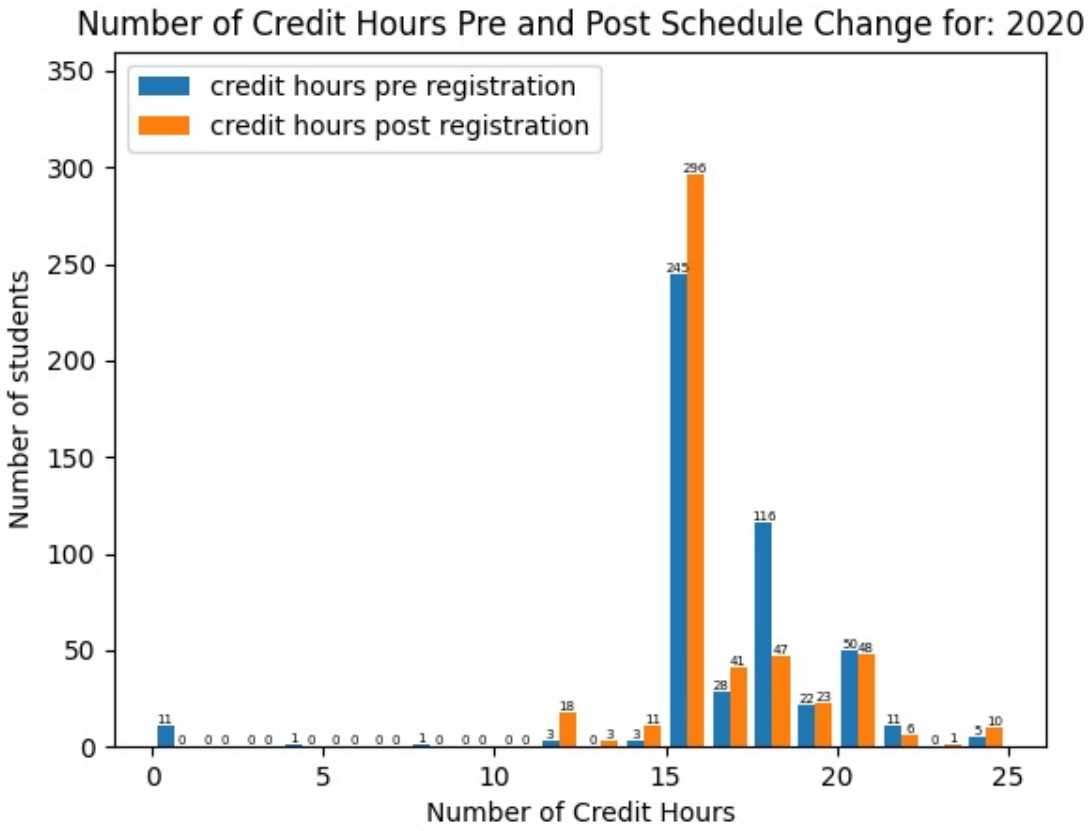

Fig. 5. Credit hours histogram for year 2020

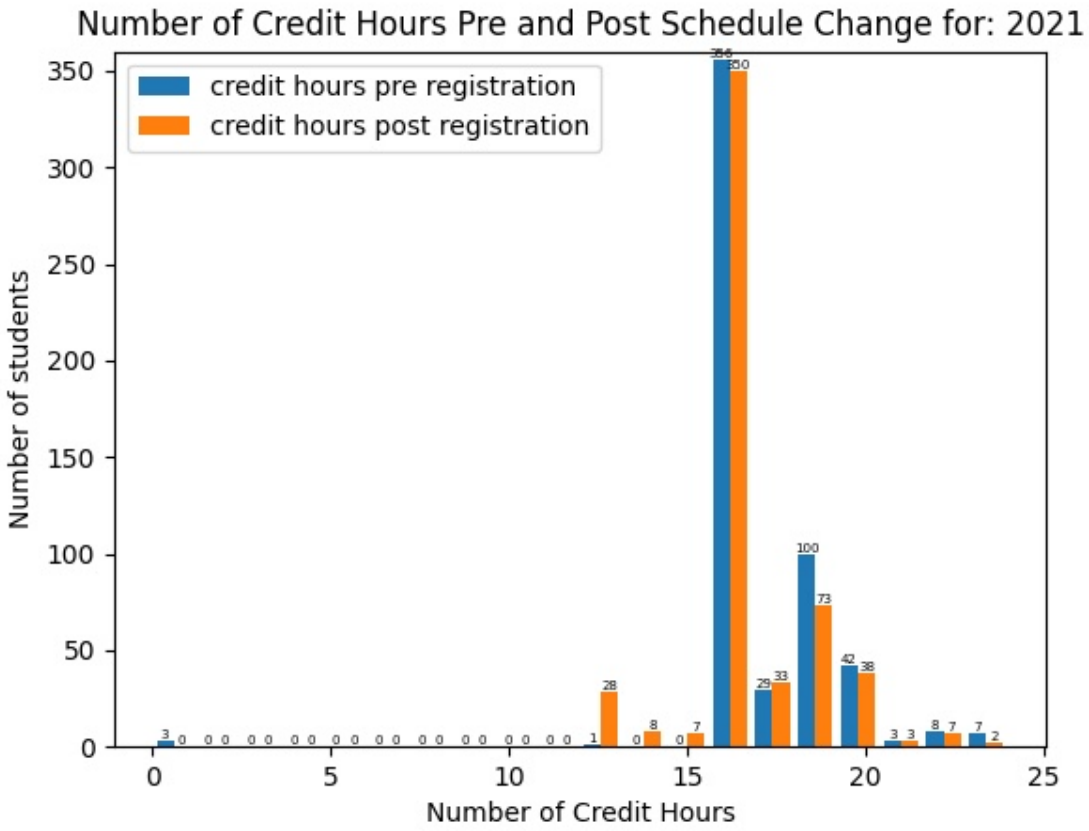

Fig. 6. Credit hours histogram for year 2021

4.2.3 Credit Hours Discussion. In all of the years that were student registration data was analyzed the majority of students were registered for around 16 credit hours. Additionally, though there were some students who were registered for more than 16-20 credit hours by faculty members these students were in the minority. This means that throughout all the years analyzed, in terms of credit hours the faculty generated class schedules were very strong.

Additionally, in all the years analyzed the majority of students ended up taking between 16 and 20 credit hours after they modified their faculty generated schedules. For freshmen students, taking between 16-20 credit hours is perfect because there is enough credit hours to keep on track for graduation without being overwhelmed by class work.

In some years such as 2020 there have been a large amount of students who have taken more than 20 credit hours. By taking more than 20 credit hours students run the risk of being overworked in their first year. One possible reason for students taking more credit hours than normal during 2020 could be the hybrid classroom setting that was introduced.

Overall, the majority of freshmen students from 2017-2021 have been registered for an excellent amount of credit hours by faculty members. Encouragingly, many students remained in the 16-20 credit hour range after modifying their schedules during the add/drop period. This means that in terms of credit hours the faculty generated class schedules are very strong. However, registration data in 2020 should be investigated further to find reasons for the disproportionate amount of students who have taken over 20 credit hours.

4.3 Faculty Schedule Changes

4.3.1 Faculty Schedule Changes Data Analysis. The faculty schedule changes shows a graphical representation of the kept class percentage. However, rather than a average percentage for all the classes a student is taking, the faculty schedule changes calculation shows a graphical representation of the dropped classes percentage for every student. The graphical representation has an advantage over the calculated statistic because it shows the highest percentages and lowest percentages of dropped classes for every year. Then the percentage raking shown in the graphical representation can help give insight about how to increase faculty chosen class retention.

When analyzing the faculty schedule changes we are looking for years in which there is a very high amount of students removing a low percentage of classes. When students remove a low percentage of classes, it can be argued that the faculty generated schedule was strong. If there are a lot of students who are removing a large portion of their classes, than the opposite can be said about the faculty generated class schedule.

4.3.2 Faculty Schedule Changes Data. The interpretation of the dropped class percentage histograms is very similar to the credit hours graphical interpretation. The x-axis represents the percentage of faculty classes the student has removed from their schedule. The y-axis contains the number of students who have removed the percentage of classes from their schedule denoted on the x-axis. Below are the histograms generated for every year when calculating the faculty schedule changes.

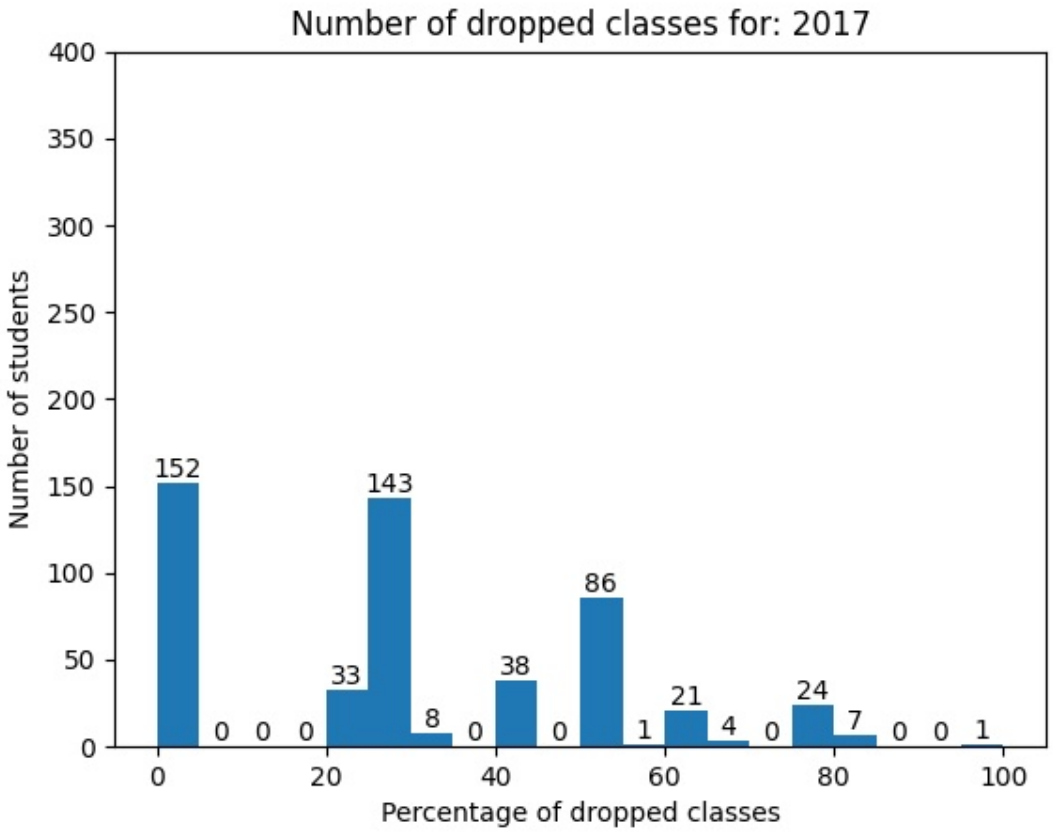

Fig. 7. Faculty Schedule Changes for Year 2017

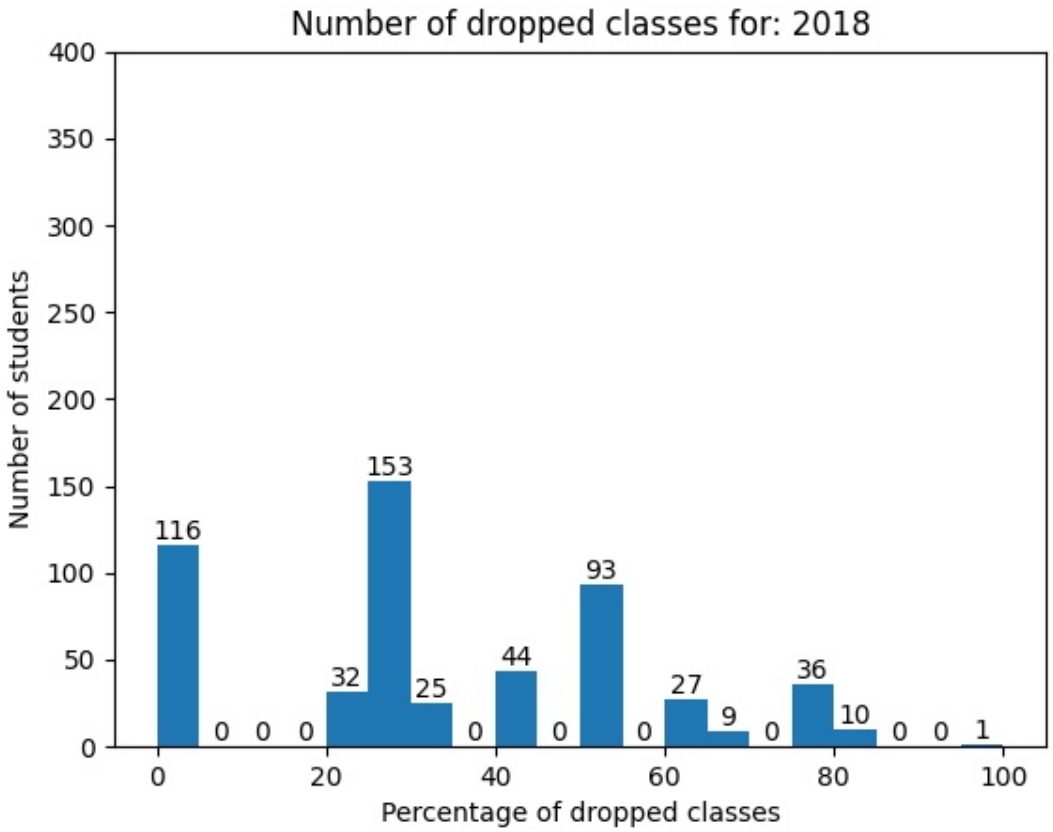

Fig. 8. Faculty Schedule Changes for Year 2018

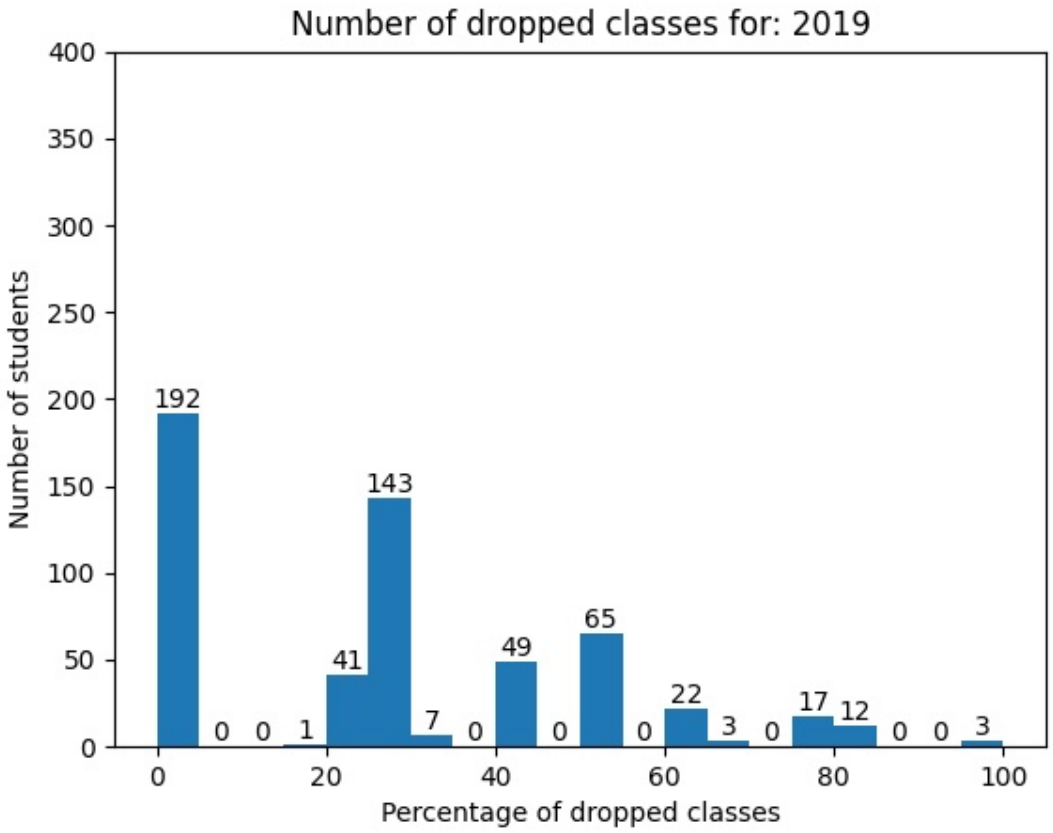

Fig. 9. Faculty Schedule Changes for Year 2019

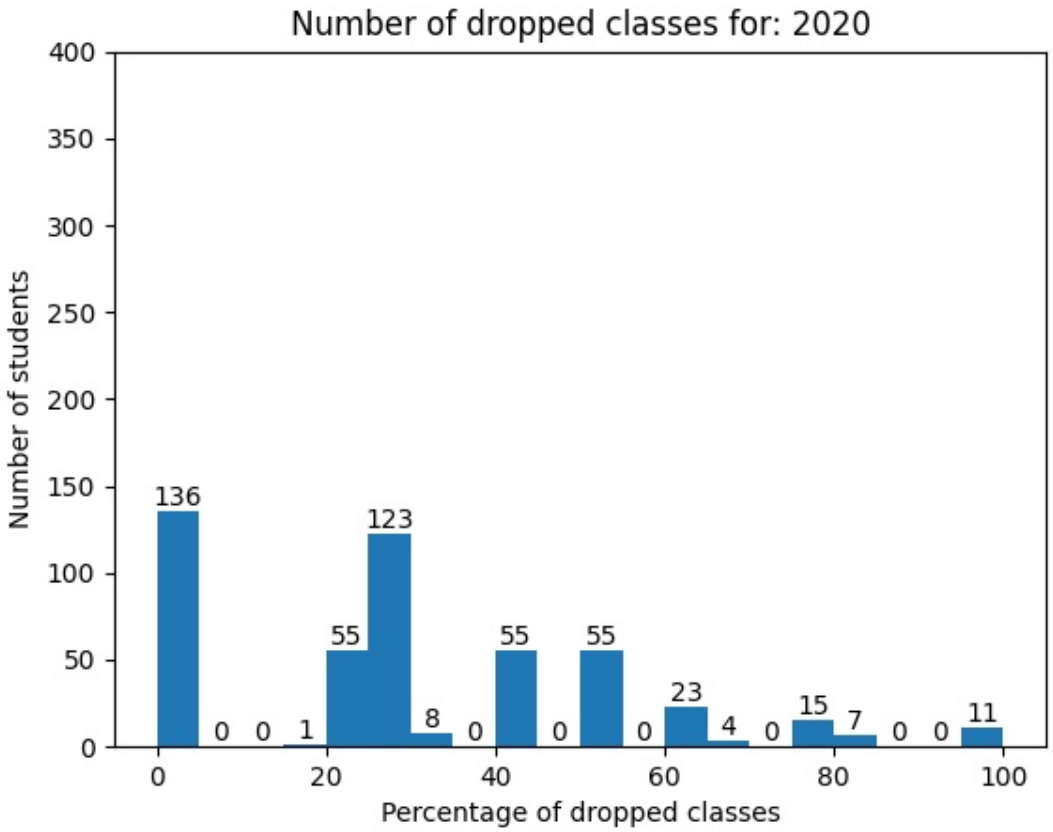

Fig. 10. Faculty Schedule Changes for Year 2020

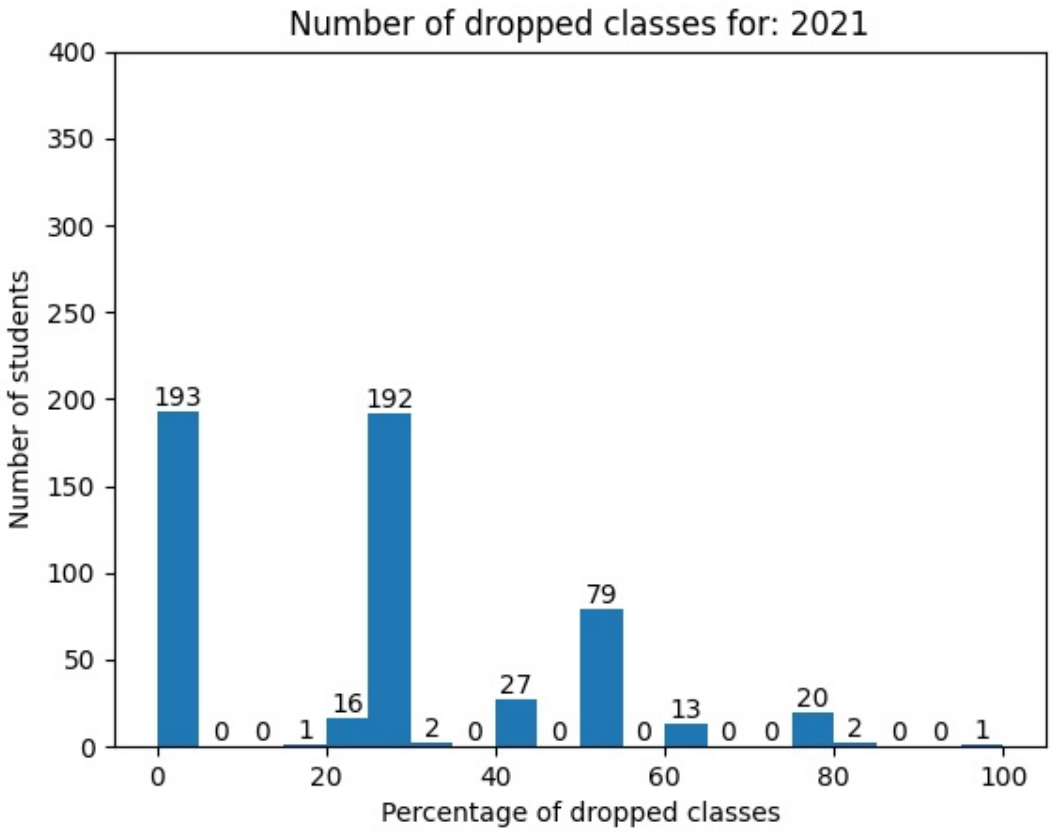

Fig. 11. Faculty Schedule Changes for Year 2021

4.3.3 Faculty Schedule Changes Discussion. As we can see from the data the majority of students either dropped no classes from their faculty generated class schedule or dropped less than 25% of their classes. Dropping so few classes is a great indicator for very strong faculty generated class schedules throughout all the years that were analyzed.

The next largest range among all of the years analyzed was between 25%-50%. Though these students have removed more classes from their faculty generated class schedules than the previous years, the students are still keeping more than half of the classes the faculty have chosen. Dropping less than half of the classes is still a great indicator for strong faculty generated class schedules throughout all of the years.

Finally, there were several students who removed more than 50% of the classes on their faculty generated class schedules. However, these students were a small minority among the freshmen students that were registering for classes that year.

Overall, the class results from the faculty schedule changes calculation showed that in terms of the number of classes students are removing the faculty generated class schedules are very strong. Some more investigation could be done into years with higher amounts of classes removed such as 2018 or 2020.

4.4 Class Subject Changes

4.4.1 Class Subject Changes Data Analysis. As mentioned previously in section 3.5 the class subject changes calculation finds what subjects students are removing from their class schedules and what subjects they are adding to their class schedules.

This analysis does not tell us much about the strength of the faculty generated schedules. Since we do not know what students are removing the classes we cannot say anything specific about the schedules the students have.

The class subject changes analysis is valuable because it tells us what subjects were popular among students from year to year. Information like this can be very valuable when it comes to creating schedules for students in future years because it allows faculty members to register students for popular subjects.

4.4.2 Class Subject Changes Data. The data for the class subject changes is a bar chart. The X-axis in the bar chart is the subject that is being examined. The y-axis is the number of students who have taken a particular action for this subject. For each subject there are two bars. The blue bar is the number of students who have dropped a particular subject and the orange bar is the number of students who have added that particular subject.

For example if the blue bar for the MAT subject is at 90, then 90 students have dropped a course with the subject code MAT from their modified schedules. If the orange bar for MAT is 30, then 30 students have added a course with the subject code MAT to their modified schedules.

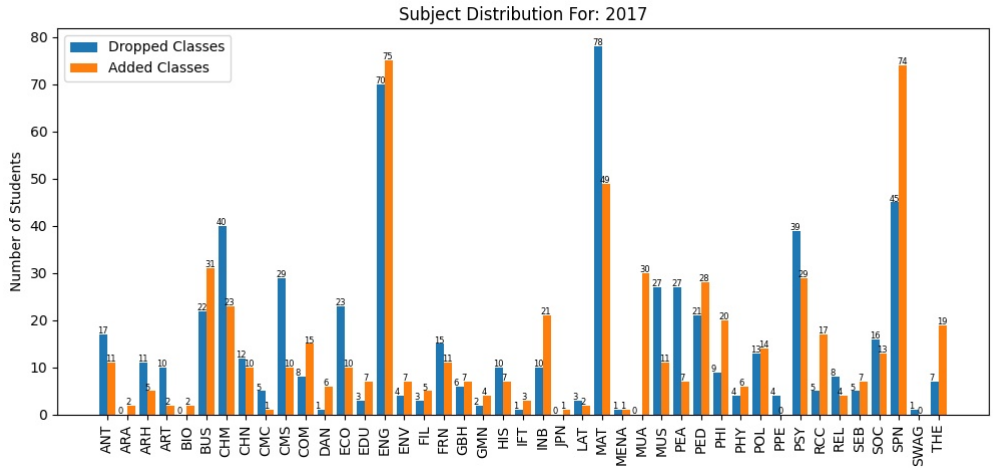

Fig. 12. Subject Distribution for Year 2017

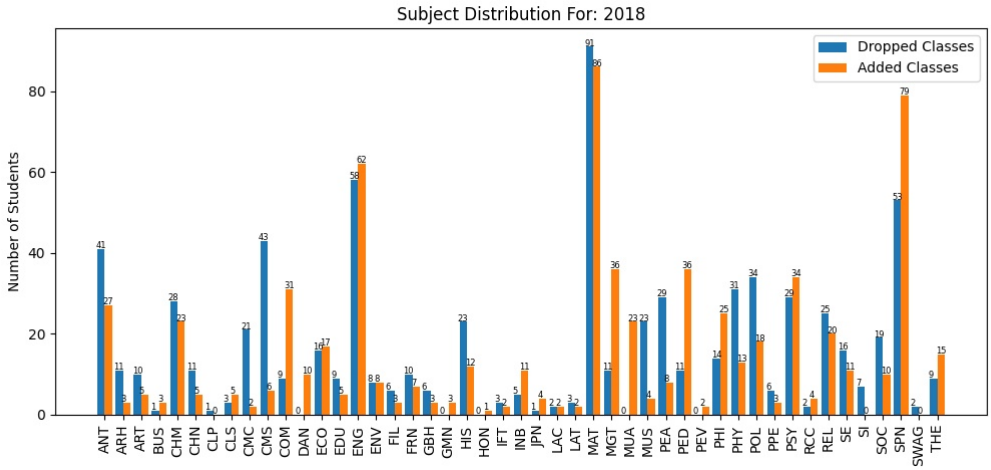

Fig. 13. Subject Distribution for Year 2018

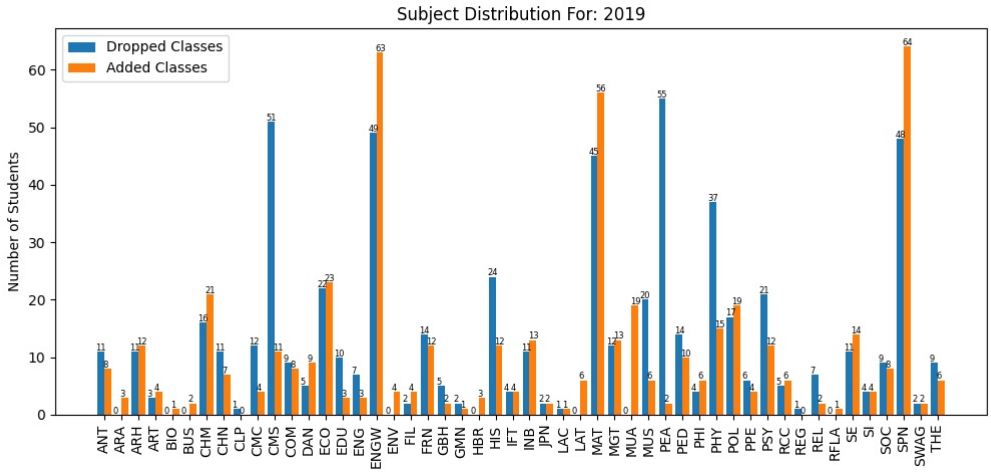

Fig. 14. Subject Distribution for Year 2019

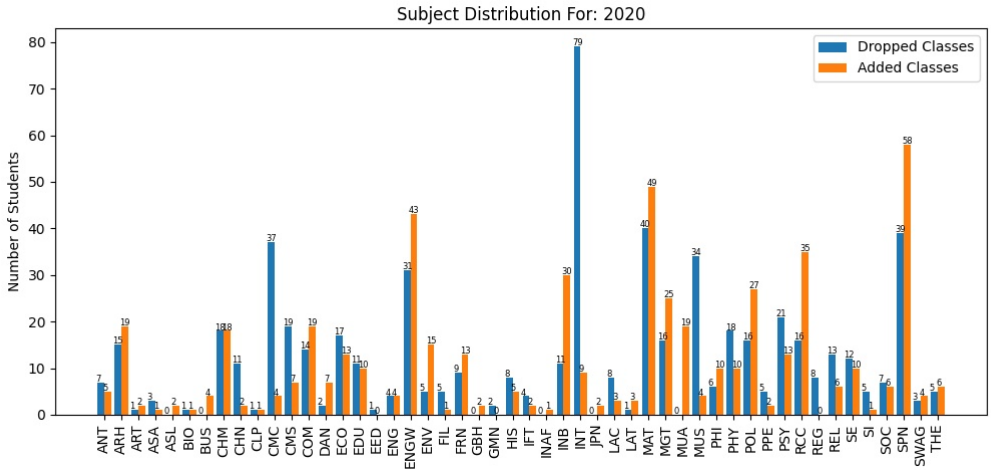

Fig. 15. Subject Distribution for Year 2020

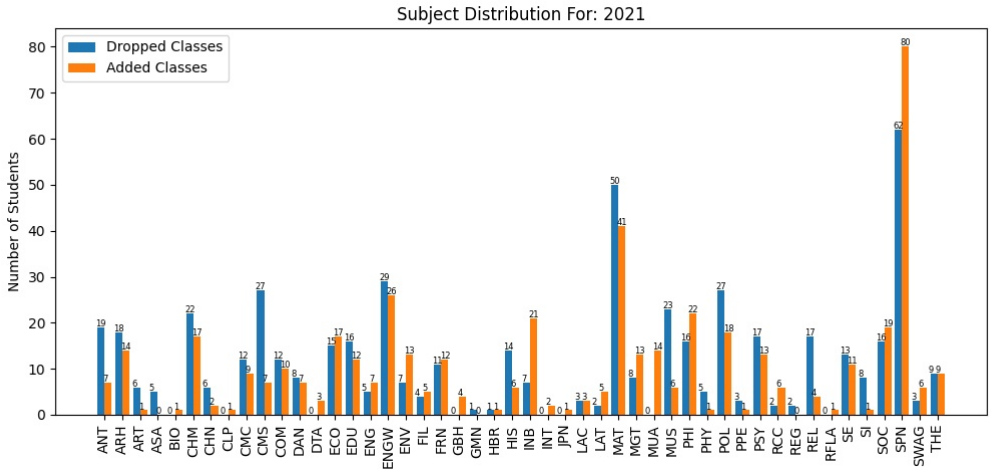

Fig. 16. Subject Distribution for Year 2021

4.4.3 Class Subject Changes Discussion. Unlike the previous calculations, every year there were different popular subjects to remove and add to the modified schedules. However, there are still some trends that can be seen throughout all of the years analyzed. For example, throughout all of the analyzed years, math was one of the more popular subjects to remove. Though we can not definitively say why math was more popular classes to remove, we know that many students do not like their math classes which could be a possible reason for this behaviour.

Some other trends that can be seen from the data include English as a very popular class to remove and add to the students modified schedules in 2017 and 2018. However, in the rest of the years analyzed there were very few students who removed a class with this subject code from their schedules.

In conclusion, there are some trends that we can see from year to year among the different subject distributions that are added and removed from the students modified schedules. Some constants throughout all the years analyzed some subjects such as MAT were very popular drop classes and other subject such as Spanish were very popular classes to add to students schedules. Information about the popularity of subjects can be used to create stronger faculty generated schedules and further decrease other statistics such as the faculty schedule changes calculation.

4.5 Class Competency Changes

4.5.1 Class Competency Changes Data Analysis. The final statistic that was calculated in this project was the class competency changes. As mentioned previously in section 3.6 this statistic finds the competencies that have been removed and added to the students modified class schedules.

The class competency changes statistic can be used to find popular competencies among students in the years analyzed. The popular competencies can be used to great effect when creating class schedules because a vital part of a good schedule according to faculty members includes at least one competency class.

Like with the class subject changes mentioned in section 4.4.1 we cannot say anything about the reasons students add or drop these competencies. The analysis for the competencies is focused on the which competencies were popular in each year and how we can use this information to increase competency retention in the faculty generated class schedules.

4.5.2 Class Competency Changes Data. Like the subject distribution data shown in section 4.4.2, the class competency changes data is shown in a bar chart. The x-axis in the bar chart shows the competency that the student took an action on. The y-axis shows how many students took that action.

There are two bars for each subject. The blue bar shows how many students have removed a class with the competency from their faculty generated class schedules. The orange bar shows how many students have added a class with that competency to their modified schedule.

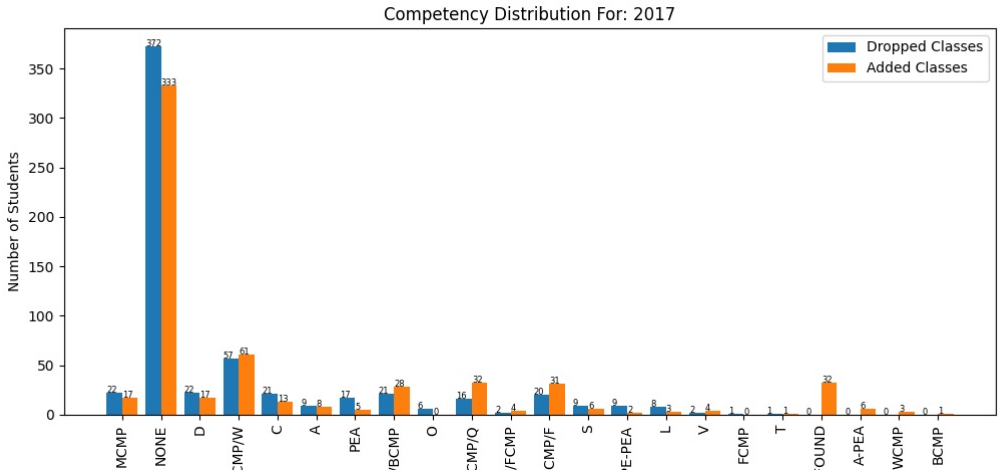

Fig. 17. Competency Distribution for Year 2017

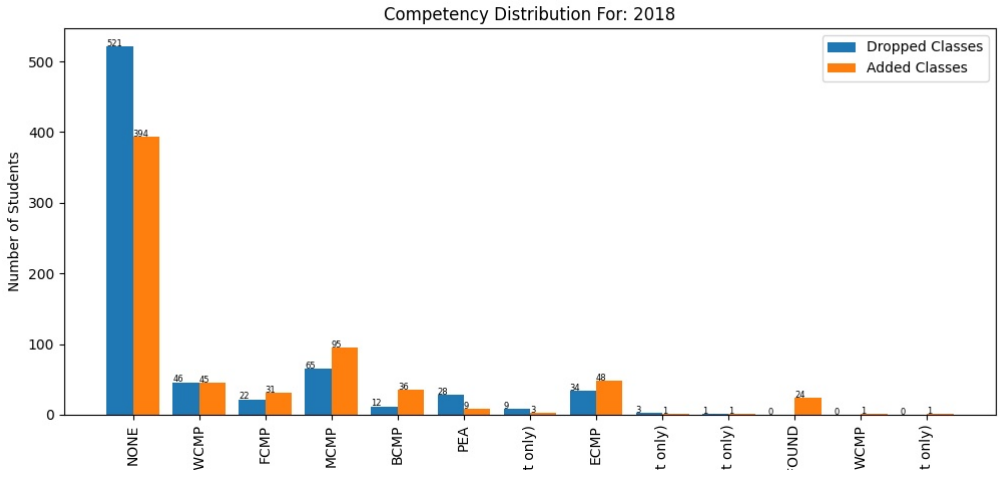

Fig. 18. Competency Distribution for Year 2018

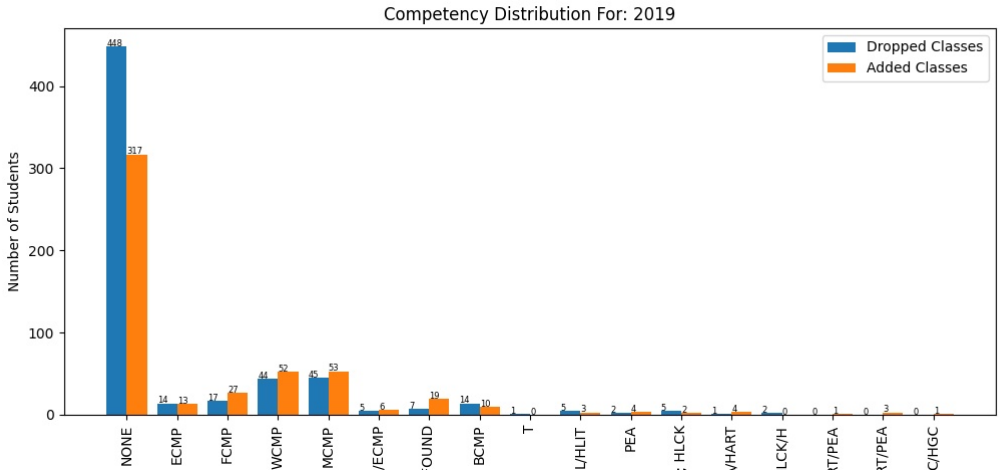

Fig. 19. Competency Distribution for Year 2019

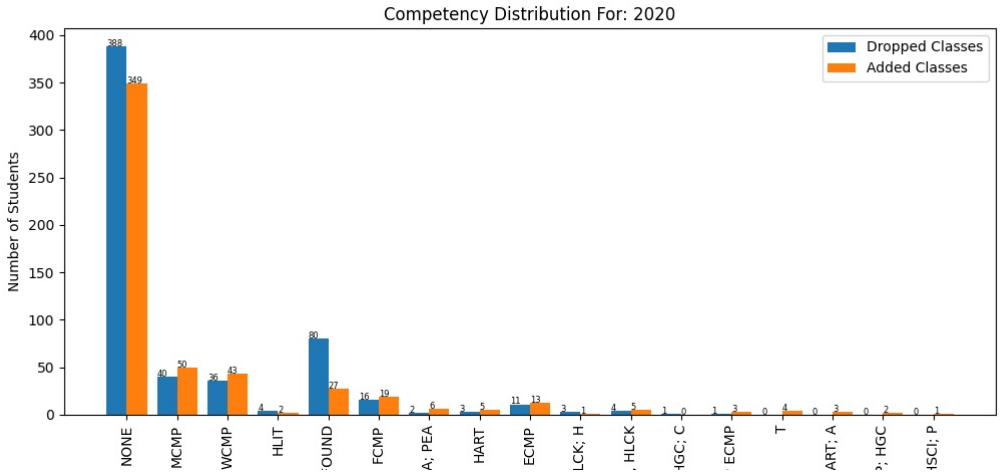

Fig. 20. Competency Distribution for Year 2020

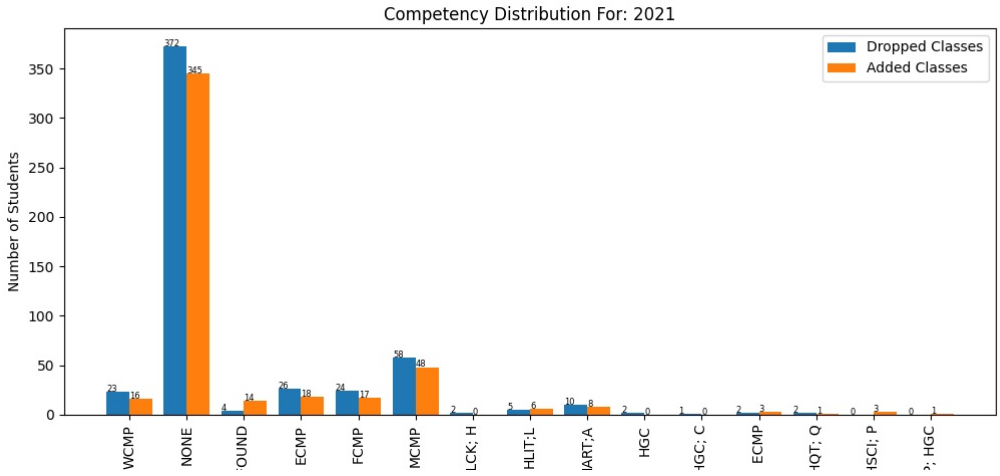

Fig. 21. Competency Distribution for Year 2021

4.5.3 Class Competency Changes Discussion. Throughout all the years analyzed, the math competency was one of the most popular competencies added and dropped. Like with previous calculations we do not know the reasons student may have added or dropped the math competency from their schedules. However, we can use this information to create stronger schedules in the future.

In 2018-2021 the WCMP competency was also a very popular competency for students to add an drop from their schedules. From this information we can focus on classes that contain a MCMP and WCMP competency for students in the future.

There are other trends that can be seen from year to year when looking through the class competency data. The trends which are contstant such as the MCMP and WCMP competencies being relatively popular to add and drop in most of the years analyzed can be used to create much stronger faculty generated class schedules moving forward.

One final important thing to note from this section is that the data analysis only counts language competencies for the 200 level classes. Though a student may be placed in an intro to Spanish class this will not count as a language competency by the program because that particular class does not offer the competency even though that class can still be counted towards a language competency.

5 CONCLUSION

In this thesis I have discussed

- The importance of creating a strong initial schedule for freshmen students
- A program which analyzed registration data from 2017-2021
- An explanation about the calculations for the statistics used to analyze the data
- An analysis on the results from the data

There are several different ways this work can be improved upon in the future. One major factor that can be used to analyze the strength of the faculty schedule is class retention. If students are staying in their classes until the end of the semester then that students schedule would be better than a student who dropped one or more of their classes before the end of the semester.

Another aspect not considered in this analysis of student schedules is GPA. A student who finishes with a high GPA could have a stronger schedule than a student with a lower GPA. GPA can be used in conjunction with some other statistics calculated in this thesis such as credit hours to make a stronger case for the right amount of credit hours for freshmen students.

Next, relationships between the different statistics should be analysed in a more mathematical way. These statistics should be checked for correlations with high P-values and other indicators for statistical significance.

Finally, the competency distribution calculation should be expanded to include all classes that eventually end in a language competency rather than just the classes that award the competency. Including all of the classes that award the competency will give a much clearer picture of the competencies students drop because the majority of students need to take lower level language classes.

In conclusion, this project gives a good foundation for analyzing faculty generated class schedules for freshmen students. Using this information going forward it is possible to increase the quality of the faculty generated class schedules.

ACRONYMS

ACM Association for Computing Machinery. 6

DCP Dropped Class Percentage. 15–17

FCCP Faculty Chosen Class Percentage without RCC. 15–17
FCCPR Faculty Chosen Class Percentage with RCC. 15–17

KCP Kept Class Percentage without RCC. 15–17
KCPR Kept Class Percentage with RCC. 15, 16

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