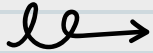


# Epsilon School

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# Problem Statement



Don't forget  
The dropout  
rate is 5%.

The Epsilon School of Mathematics and Science is increasing in size from 490 students to 630 students. Because of this increase, they need to hire 7 new teachers and allocate them across the departments fairly.



# Assumptions



1. Fair means having the same number of class sections per teacher per day.
2. Each student takes 1 English Class per year. This gives us the number of students per grade.
3. Students drop out after 11th grade but before 12th grade.
4. Teachers teach all grades.
5. Students in different grades can be in the same class at the same time.
6. All subjects run the same number of sections per day (eg. 5 English classes per day, 5 math classes per day, 5 music classes per day).
7. All classes are approximately the same size (+/- 20 students).
8. Language teachers teach all languages and the department is combined.

# Initial Variables And Hypothesis

The first few “variables” we used were:

- # of teachers in each department
- Class sizes (# of students per class)
- Graduating class size
- Percent that dropped out
- # of new students

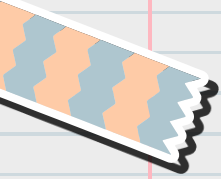
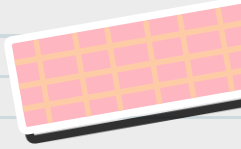
Hypothesis:

- Before creating the model, we hypothesized that out of the 9 departments, we would add a single new teacher to the 7 departments with the greatest number of classes per teacher.





# Problem Analysis



Problem is asking how to hire faculty

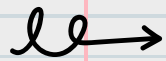
What does the current ratio between teachers and students look like?

Many grades have class requirements, so distribution of students should be similar

What departments would be the most strained w/ current faculty?

Add faculty to these departments

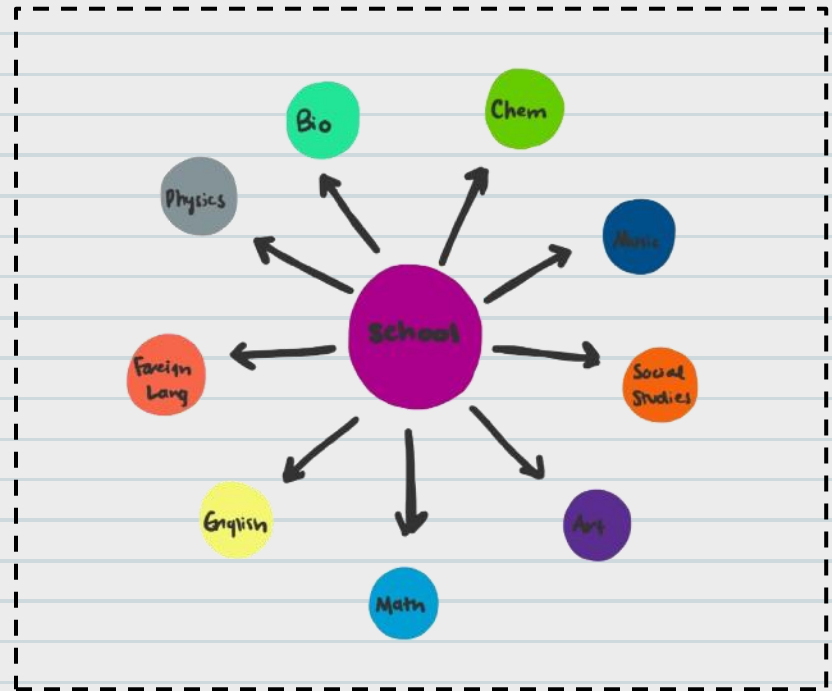




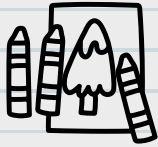
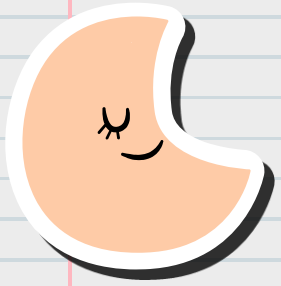
# Model Design



For our model, we decided to find ratios of students in each grade and in each department and use that to determine how many classes each teacher must teach. Then, this information can be used to determine what departments need more support.



# Part 1



## Current # of students per grade

10th grade: 183

11th grade: 155

12th grade: 152

Total number of students in school: 490

## Initial Calculations

Incoming class = graduating class + increase in school size

New graduating class = (2nd to last grade) x (percent remaining after dropout)



# Part 2



## Relative Frequency

Relative frequency of department of grade = # of students in department in grade / # of students in grade



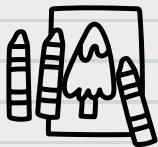
## Example calculation

Relative frequency of 10th grade art =  $31/183 = 0.16939891$

Class	10th Grade	11th Grade	12th Grade
Art	0.16939891	0.2129032	0.2302632
Biology	1.08196721	0.6129032	0.1710526
Chemistry	0.27868852	0.8129032	0.7171053
English	1	1	1
All Lang	0.60655738	0.516129	0.6052632
Math	1.00546448	1.2967742	1.7236842
Music	0.27322404	0.3612903	0.3223684
Physics	0.27322404	0.3741935	1.2039474
Social Studies	0.98360656	0.8451613	0.3881579



# Part 3



## Example calculation

Predicted # of 10th grade art students =  $0.16939891 \times 292$

## Next Year Predictions



Predicted # of students in department in grade = (relative frequency of department of grade) x (# of students in grade)

Predicted Num Students per class (2025)	Class	10th Grade	11th Grade	12th Grade	T
	Art	49.4644809	38.96129	33.90625	
	Biology	315.934426	178.96774	25.1875	
	Chemistry	81.3770492	148.76129	105.59375	
	English	292	183	147.25	
	All Lang	177.114754	94.451613	89.125	
	Math	293.595628	237.30968	253.8125	
	Music	79.7814208	66.116129	47.46875	
	Physics	79.7814208	68.477419	177.28125	
	Social Studies	287.213115	154.66452	57.15625	

# Part 4



## New Department Numbers

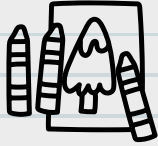
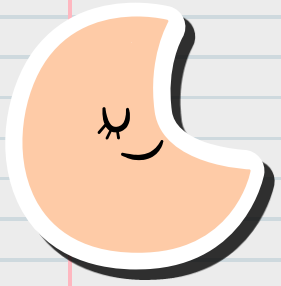
## Example Calculation

Art: 49.46448087 10th grade students +  
38.96129032 11th grade students + 33.90625  
12th grade students = 122.3320212 art students

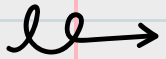
new # of students in a  
department =  $\Sigma$  predicted # of  
students in department per  
grade

Predicted Num Students per class (2025)	Class	10th Grade	11th Grade	12th Grade	Total
	Art	49.4644809	38.96129	33.90625	122.3320212
	Biology	315.934426	178.96774	25.1875	520.0896682
	Chemistry	81.3770492	148.76129	105.59375	335.7320895
	English	292	183	147.25	622.25
	All Lang	177.114754	94.451613	89.125	360.691367
	Math	293.595628	237.30968	253.8125	784.7178058
	Music	79.7814208	66.116129	47.46875	193.3662998
	Physics	79.7814208	68.477419	177.28125	325.5400901
	Social Studies	287.213115	154.66452	57.15625	499.0338809

# Part 5



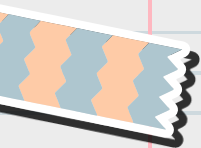
## Student to teacher ratio



Student to teacher ratio per department = new # of students in department / # of teachers in department

## Data from excel

Class	Student to teacher ratio
Art	122.3320212
Biology	130.022417
Chemistry	111.9106965
English	124.45
All Lang	120.2304557
Math	130.786301
Music	193.3662998
Physics	108.5133634
Social Studies	99.80677618



# Part 6



## # of class sections

# of class sections  
needed to run  
department wide per  
school day = new # of  
students in department  
/ class size

## Example

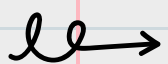
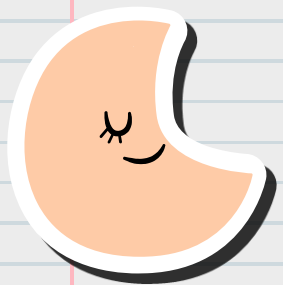
# of class sections needed to run in art  
department =  $122.3320212 / 20$

## Data from excel

Class	Class sections needed (divide by class size: 20)
Art	6.11660106
Biology	26.00448341
Chemistry	16.78660448
English	31.1125
All Lang	18.03456835
Math	39.23589029
Music	9.66831499
Physics	16.27700451
Social Studies	24.95169404



# Part 7



## Classes per teacher

# of classes per teacher per department = # of class sections department-wide / # of teachers in department

## Example Calculation:

# of classes per art teacher =  
 $6.11660106/1 = 6.11660106$



Class sections needed (divide by class size: 20)	Number of classes each teacher has (divide by num of teachers)
6.11660106	6.11660106
26.00448341	6.501120852
16.78660448	5.595534825
31.1125	6.2225
18.03456835	6.011522783
39.23589029	6.539315049
9.66831499	9.66831499
16.27700451	5.425668169
24.95169404	4.990338809



# Part 8



## How we decided to increase teachers

We chose to add teachers to the departments with the highest number of classes. We checked how that affected the outcome, and adjusted our solution accordingly.



## New Classes per teacher

# of classes per teacher per department = # of class sections department-wide / # of teachers in department (increased)

### New # of classes each teacher has

6.11660106
5.200896682
4.196651119
5.185416667
4.508642088
4.904486286
4.834157495
5.425668169
4.990338809



# Solution

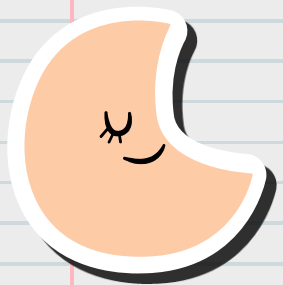
We added the following numbers of teachers to each department:

- 1 to Biology
- 1 to Chemistry
- 1 to English
- 1 to Foreign Languages
- 2 to Mathematics
- 1 to Music

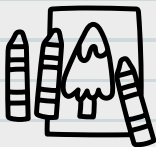
We believe that our model fairly distributes the new teachers because the departments with the most students per teacher now have similar ratios as other departments, and no teacher will have drastically more students than any other.







# Strengths and Weaknesses

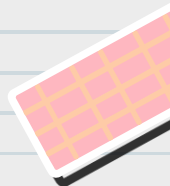
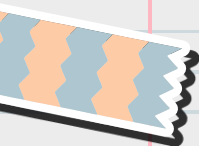


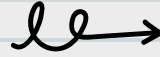
## Strengths

- schools often require similar classes every year, model predicted off of distribution
- model allocates teachers evenly (our definition of fair)

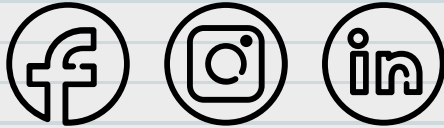
## Weaknesses

- model is based on previous numbers
- students might drop out sophomore year too
- model isn't currently applicable to every situation





# Thanks!



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