



# Epsilon School

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# The Situation

- The current student population of the Epsilon School of Math and Science is 490 students
- A new wing is being added so the student population can be increased from 490 students to 630 students
- Historically, the sophomore and senior classes have been equal
- The incoming sophomore class will be 140 more students than the graduating class next year
- Each department has a differing amount of teachers:

<b>6</b>	<b>Math</b>	<b>5</b>	<b>English</b>
<b>3</b>	<b>Chemistry</b>	<b>3</b>	<b>Foreign Language</b>
<b>3</b>	<b>Physics</b>	<b>1</b>	<b>Music</b>
<b>4</b>	<b>Biology</b>	<b>1</b>	<b>Art</b>
<b>5</b>	<b>Social studies</b>		

## The Problem

- The Epsilon school can only hire 7 more teachers to account for the influx of new students
  - Foreign language teachers can teach up to two languages
- Should the school add the 7 teachers to high-priority areas like math and english or should some teachers for music, art, and the sciences be added? Why?

# Assumptions

- Students will take a similar ratio of classes next year
- The current language teachers each teach one language
- All students take exactly one English class each year

# Approach

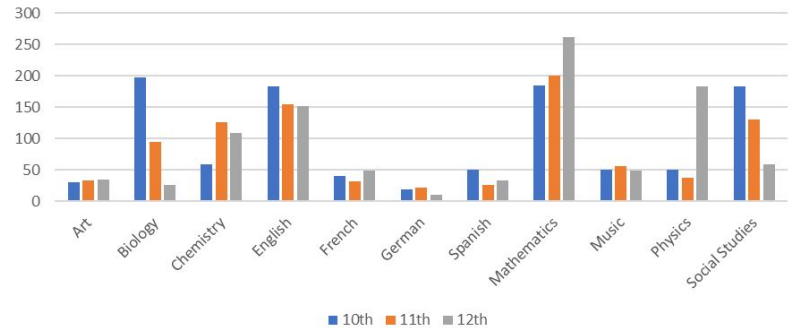
If students take a similar ratio of classes each year, we can predict the anticipated number of students next year in each class.

# Students in Each Class

- This table shows us the number of students in each class both separated by grade and in total
- Every student is taking english and many students take multiple math courses
- From here, we can figure out the % of students taking each class total

Department	10th	11th	12th	Total	Number of teachers
Art	31	33	35	99	1
Biology	198	95	26	319	4
Chemistry	59	126	109	294	3
English	183	155	152	490	5
French	41	32	49	122	1
German	19	22	10	51	1
Spanish	51	26	33	110	1
Mathematics	184	201	262	647	6
Music	50	36	49	155	1
Physics	50	38	183	271	3
Social Studies	183	131	59	373	5

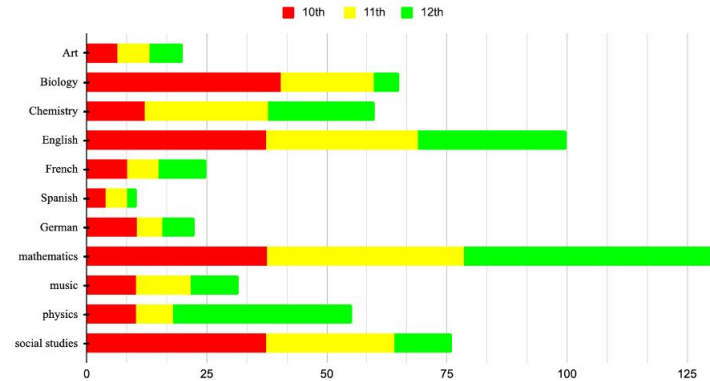
Class Enrollment by Year



# % of Students in Each Class

- This table demonstrates the number of students taking each class split by grade but stacked.
- If we assume that each student has required courses during the year (equal %s of people taking english, math, and social studies during sophomore year), we can assume that those statistics should be roughly the same for the incoming students for the following years

% of students taking a class by grade



# Algorithm

- Each subject was given a “stress factor” based on the ratio of teachers to students
- We added a teacher to the subject area with most stress

Teachers Based on Change in Enrollment	Future number of teachers	New Enrollment to New Teachers	Change in Enrollment per Teacher With Additional Teachers
	1.0	127.3	28.3
	4.0	102.5	22.8
	3.0	126.0	28.0
	5.0	126.0	28.0
	2.0	78.4	-43.6
	1.0	65.6	14.6
	1.0	141.4	31.4
	6.0	138.6	30.8
	2.0	99.6	-55.4
	3.0	116.1	25.8
	5.0	95.9	21.3
Remaining Teachers to Assign		5.0	



# Enrollment

- Calculated based enrollment per teacher from last year to this year
- Rationale: Teachers will benefit when they each have to teach a similar number of students

Enrollment	Future number of teachers	New Enrollment to New Teachers	Change in Enrollment per Teacher With Additional Teachers
	2.0	63.6	-35.4
	4.0	102.5	22.8
	4.0	94.5	-3.5
	6.0	105.0	7.0
	2.0	78.4	-43.6
	1.0	65.6	14.6
	2.0	70.7	-39.3
	7.0	118.8	11.0
	2.0	99.6	-55.4
	3.0	116.1	25.8
	5.0	95.9	21.3

# Change in Enrollment

- Calculated based on change in enrollment per teacher from last year to this year
- Rationale: Teachers will be able to handle class sizes similar to last year

Teachers Based on Change in Enrollment	Future number of teachers	New Enrollment to New Teachers	Change in Enrollment per Teacher With Additional Teachers
	2.0	63.6	-35.4
	4.0	102.5	22.8
	4.0	94.5	-3.5
	6.0	105.0	7.0
	2.0	78.4	-43.6
	1.0	65.6	14.6
	2.0	70.7	-39.3
	7.0	118.8	11.0
	2.0	99.6	-55.4
	3.0	116.1	25.8
	5.0	95.9	21.3

## Z-Scores

What is a z-score?

*A z-score is a measure of the number of standard deviations from the mean.*

The formula for a z score is:

$$z = (x - \mu) / \sigma$$

If we find the z-scores for our student to teacher ratios and the change in said ratios, we could combine both our criteria into one metric, allowing us to account for both factors.

# Z-Scores Method

- We calculated the z-scores for the metrics given by the two previously presented methods and added them
- Rationale: Two metrics are better than one! The z-scores will be more representative.

Z-Score	Z-Score	Z-Score	Z-Score	Stress Factor
0.012368935	0.012368935	-1.911406201	-1.306287671	-3.2
-0.739532128	-0.739532128	0.555109409	1.18748614	1.7
-0.02669086	-0.02669086	0.045498746	0.060079798	0.1
-0.02669086	-0.02669086	0.711390013	0.510429614	1.2
0.910744232	0.910744232	0.684210777	-0.537323019	0.1
-1.862501248	-1.862501248	-1.789099641	0.835171658	-1.0
0.442026686	0.442026686	0.031909128	-0.463796519	-0.4
0.357397129	0.357397129	1.58889104	0.682137335	2.3
2.199717483	2.199717483	0.37164957	-2.164096844	-1.8
-0.326149292	-0.326149292	-0.423343064	0.071823614	-0.4
-0.940690075	-0.940690075	0.135190223	1.124375894	1.3

# Conclusion!

We suggest adding one teacher to Art, Chemistry, English, Mathematics, Music, Physics, and a Language teacher who can teach both French and Spanish.

	New Teachers	Current Teachers	Teachers Added
Art	2.0	1.0	1.0
Biology	4.0	4.0	0.0
Chemistry	4.0	3.0	1.0
English	6.0	5.0	1.0
French	1.5	1.0	0.5
German	1.0	1.0	0.0
Spanish	1.5	1.0	0.5
Mathematics	7.0	6.0	1.0
Music	2.0	1.0	1.0
Physics	4.0	3.0	1.0
Social Studies	5.0	5.0	0.0

## Future Avenues (Where we would take this)

- We don't account for the 5% dropout rate, we would like to use this rate to help find the predicted class sizes for next year.
- We also could adapt the method to account for the data we would have next year to make a more accurate model

# Acknowledgments!

We want to thank Mrs. Burns, the members of the X, Y, and Z groups who may have contributed to any changes in our method, and our parents for making sure we were fed and watered in this process! We would also like to thank the creators of this problem for giving us a headache (in a good way!)