Epsilon School of Mathematics and Science

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Summary

Restatement of the **problem** and **summary** of work

Problem

The Epsilon School of Mathematics and Science is adding a new wing in 2024 that increases the school's capacity from 490 to 630 students. The incoming sophomore class will have 140 more students than the graduating senior class. To accommodate the increase in the number of students, seven new teachers are being hired. Given the total enrollment of 2023 and the number of teachers in each subject currently, where should these seven new hires go to?

Summary of work

2023:

1. Calculated number of courses each student takes
2. Calculated number of students in each grade
3. Calculated student-to-teacher ratio for each class
4. Calculated the percentage of course enrollment for each grade level

2024:

1. Calculated class sizes using the dropout rate
2. Used class size and percentage of course enrollment in 2023 to determine 2024 enrollment for each course
3. Calculated the student-to-teacher ratio without new hires
4. Made hires based on the student-to-teacher ratios, aiming to balance them out

02

Assumptions

Any **assumptions**, variables and hypotheses

Assumptions

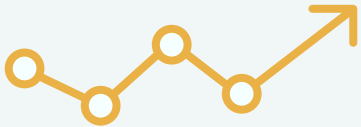
- No new enrollments in 11th or 12th grade before Fall 2024
- Current language teachers teach one language
- No student is held back
- Everyone takes the same number of courses
- Dropout rate is the same each year
- Everyone takes at least one Math and one English course.
- All 10th and 11th graders in 2023 will take the same foreign language in 2024

Variables

- New hires
- Number of courses taken by each student
- Student to teacher ratio

Hypotheses

- German, Art and Music won't need new teachers
- Math, English, Biology will need new teachers
- A language teacher that taught both Spanish and French would be hired



03

Model

The design of the **model**

Class enrollment and student–to–teacher ratios for fall 2023

	A	B	C	D	E	F
1	Department	10th	11th	12th	Total	Student to teacher ratio
2	Art	31	33	35	99	99
3	Biology	198	95	26	319	79.75
4	Chemistry	59	126	109	294	98
5	English	183	155	152	490	98
6	French	41	32	49	122	122
7	German	19	22	10	51	51
8	Spanish	51	26	33	110	110
9	Mathematics	184	201	262	647	107.83
10	Music	50	56	49	155	155
11	Physics	50	58	183	291	97
12	Social Studies	183	131	59	373	74.6
13	Total	1049	935	967	2951	95.2
14	Number of stude	174	155	161	490	

Percentage of students in each grade that take the class

H	I	J	K
Department	10th	11th	12th
Art	17.82	21.26	21.80
Biology	113.79	61.19	16.19
Chemistry	33.91	81.16	67.88
English	105.17	99.84	94.67
French	23.56	20.61	30.52
German	10.92	14.17	6.23
Spanish	29.31	16.75	20.55
Mathematics	105.75	129.47	163.17
Music	28.74	36.07	30.52
Physics	28.74	37.36	113.97
Social Studies	105.17	84.38	36.74

Class enrollment and student–to–teacher ratios for fall 2024

17	Department	10th (new)	11th (old 10th)	12th (old 11th)	Total	Student to teacher ratio before hiring
18	Art	54	36	33	123	123.0
19	Biology	343	105	25	472	117.9
20	Chemistry	102	139	103	344	114.7
21	English	317	171	144	631	126.2
22	French	71	40	31	143	142.7
23	German	33	19	22	73	73.0
24	Spanish	88	50	31	170	169.6
25	Mathematics	318	221	248	788	131.3
26	Music	86	62	46	195	194.6
27	Physics	86	64	173	324	107.9
28	Social Studies	317	144	56	517	103.3
29	Total	1815	1051	913	3778	122
30	Number of stude	301	171	152	624	

Student–to–teacher ratio before and after hires

Student to teacher ratio before hiring	student to teacher ratio after hiring	number of teachers before hiring	no. of new hires
123.0	123.0	1	0
117.9	94.4	4	1
114.7	86.0	3	1
126.2	105.2	5	1
142.7	95.1	1	0.5
73.0	73.0	1	0
169.6	113.1	1	0.5
131.3	112.5	6	1
194.6	97.3	1	1
107.9	80.9	3	1
103.3	103.3	5	0
122	99.4	31	7

04

Justification

Justification and **analysis** of the model

Justification

- When hiring we teachers our goal was to make the student-to-teacher ratios leveled out throughout the courses.
- Google Sheets was the best for modeling this because we were more comfortable using it and it could perform all the equations necessary

How can this model be tested?

- We can calculate future years enrollment and test the student teacher ratio for those years

05

Solution

Our **solution** to the problem

Subjects	Number of new hires
Art	0
Biology	1
Chemistry	1
English	1
French	½
German	0
Spanish	½
Mathematics	1
Music	1
Physics	1
Social Studies	0

06

Discussion

Reflection of **strengths** and **weaknesses**, as well as error analysis

Justification of results

- Biology is a class that is taken predominantly by sophomores so a new teacher would have helped with the increased sophomore class size
- Since everyone takes one Math and English course, adding a new teacher to each of those would help in reducing overall student-to-teacher ratio
- Chemistry and Physics is predominantly taken by upperclassmen so although there student-to-teacher ratios are relatively low right now, in the upcoming years it will increase as the larger classes move up.
- Social Studies already had a manageable student-to-teacher ratio
- Even though art still had a high student to teacher ratio we decided to focus on the major disciplines because the structure of an art class is a lot different and we believe that an art teacher could teach a greater class size
- Although we assumed the same for music, the student to teacher ratio was so great we decided the department was in need of a new teacher.

Strengths and weaknesses

Strengths

- Using student-to-teacher model to determine hires helps teachers who would otherwise have to teach a lot of students
- Provides an easy solution for the language classes
- Accounts for the distribution of students in each grade among classes (e.g. 10th grade bio)

Weaknesses

- May be different/may need to adjust based on the upcoming sophomore classes for future years, depending on size
- Factors like dropout rate and number of classes taken were assumed to be the same for each grade, which may not hold true to the actual circumstances

Error analysis

- Our total number of students was less than the school's capacity
- We kept the student-to-teacher ratio for art relatively high
- Our value for number of classes taken was 6.02244, and though it is an average, someone can't take .02244 of a class.