The Epsilon School of Math and Science (ESMS)

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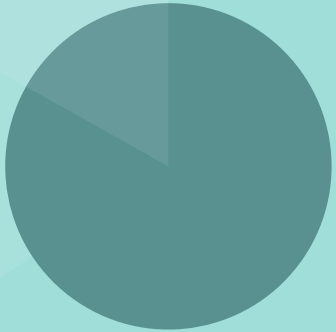
(E/Jacks - Advanced)



Problem Statement

The Epsilon School of Math and Science, which can normally hold 490 students, has recently undergone a renovation that allows them to hold 630 students total.

This increase in students will cause the sophomore class of 25/26 to have 140 more students than the graduating senior class (Class of '25). Due to this increase, the school will be hiring seven new teachers.

Given the current number of teachers and students in each class, how should the seven new teacher be chosen?

Departmental Enrollment Totals: September 2024

Department	10th	11th	12th	Total
Art	31	33	35	99
Biology	198	95	26	319
Chemistry	59	126	109	294
English	183	155	152	490
French	41	32	49	122
German	19	22	10	51
Spanish	51	26	33	110
Mathematics	184	201	262	647
Music	50	56	49	155
Physics	50	58	183	291
Social Studies	183	131	59	373

Assumptions

The assumptions we made were:

- The percent of the class taking the course stays the same every year
- Students can double up on the same course (Ex. Two different math classes)
- Each incoming class is the same size
- All language teachers know all three languages

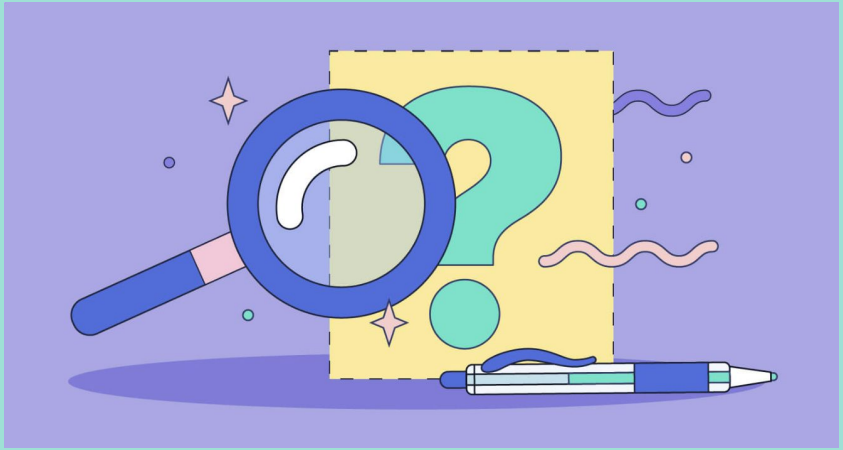
Variables

The variables we took into account were:

- Class size
- Student: Teacher Ratios
- Average Student: Teacher Ratios
- Number of Teachers per subject

Hypothesis

Our hypothesis was that, in order to balance the numbers between teachers and students, we wanted to add 3 Biology Teachers, 2 Social Studies Teachers, 1 Spanish Teacher, and 1 English Teacher.



Process

We started off by putting the table of the current class (24/25) into Excel. We calculated:

- Student teacher ratios for each class (total students taking course / teachers in course)
- # of courses taken (total course enrollment)
- Total number of students
- Average courses taken per student (# of courses / students)

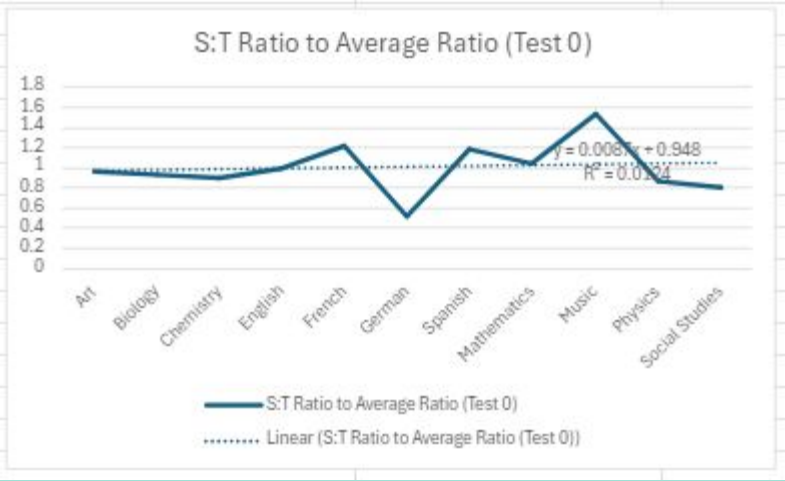
Epsilon School E: Jacks (24/25)	Sophomore (24/25	Teachers (24/25	Student-Teacher Ratio	Juniors (24/25)	Teachers (24/25)	Student-Teacher Ratio	Seniors (24/25)	Teachers (24/25)	Student-Teacher Ratio	Total Students (24/25)	Total Student-Teacher Ratio
Art	31	1	31	33	1	33	35	1	35	99	99
Biology	198	4	49.5	95	4	23.75	26	4	6.5	319	79.75
Chemistry	59	3	19.7	126	3	42	109	3	36.3	294	98
English	183	5	36.6	155	5	31	152	5	30.4	490	98
French	41	1	41.0	32	1	32.0	49	1	49.0	122	122.0
German	19	1	19.0	22	1	22.0	10	1	10.0	51	51.0
Spanish	51	1	51	26	1	26.0	33	1	33	110	110.0
Mathematics	184	6	30.7	201	6	33.5	262	6	43.7	647	107.8
Music	50	1	50	56	1	56	49	1	49	155	155
Physics	50	3	16.7	58	3	19.3	183	3	61.0	291	97.0
Social Studies	183	5	36.6	131	5	26.2	59	5	11.8	373	74.6
Total # of Students (24/25 start)	168			163			159				
Total class enrollment (24/25 end)	1049			935			967				
Total # of Students (24/25 end)	168			159			155				
Avg # of courses	6.26			5.88			6.24				

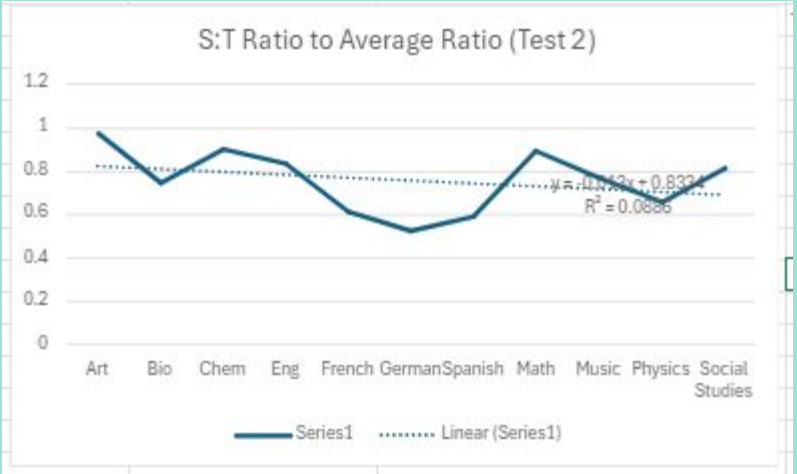
Calculating the # of Students

- **Assumption:** Every incoming class is the same as the graduating senior class + any dropouts.
- Dropout rate is 5% over 2 years as denied by the problem
- We can then say that x + x*sqrt(0.95) + x*0.95 = 490, where x represents the size of the sophomore class
- We got that the sophomore class of 2024-25 is 168. Thus, we can find the junior class by doing 168 * sqrt(0.95) = 163, and the senior class by doing 168 * 0.95 = 159.
- For the next year (2025-26), we added 140 students from the graduating senior class, to get to 299 sophomores.
- The juniors and seniors were also easy to find, since the number of juniors at the start of the year would be the same as the number of sophomores at the end of last year (this is also true for seniors).

Model Design

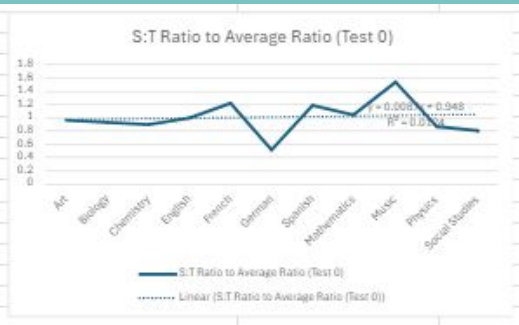
The idea behind the model is that we take the total student-to-teacher ratio across all of their courses and we try to make them as equal as possible in order to be fair.

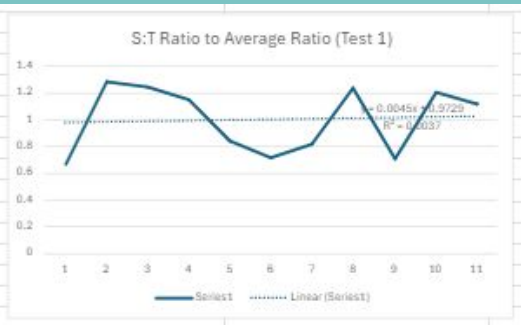


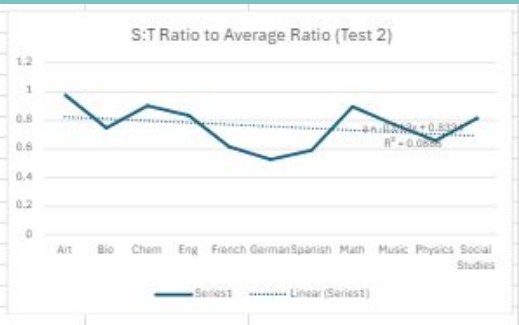


Testing / Results

We ran multiple tests on adding various amounts of teachers and worked through an iterative process to decrease peaks and valleys within our data.

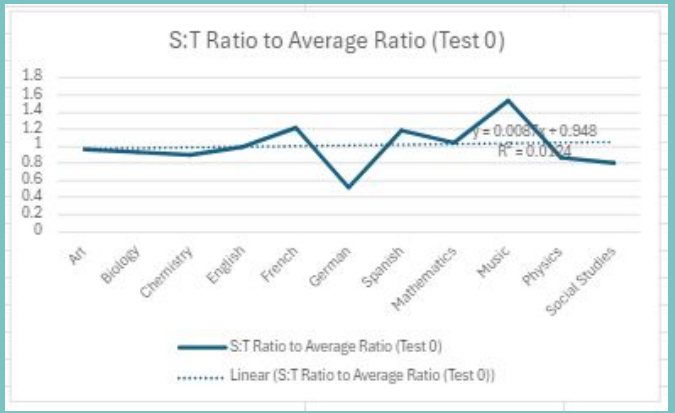


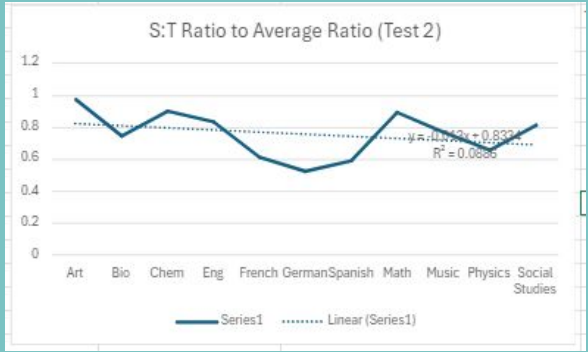




Testing / Results

)Teachers (25/26)	Student-Teacher Ratio	Total Students (25/26)	Total Student-Teacher Ratio	S:T Ratio to Average Ratio (Test 0)
1	36	125	125	0.971800127
4	6.75	478	119.5	0.929040922
3	37.7	348	116	0.901830518
5	31.4	644	128.8	1.001342851
1	51.0	157	157.0	1.22058096
1	10.0	67	67.0	0.520884868
1	34.0	152	152.0	1.181708955
6	45.2	806	134.3	1.044361204
1	51	198	198	1.539331402
3	63.0	338	112.7	0.875915848
5	12.2	523	104.6	0.813202347





Test 2 (Teacher Count)*	New S:T Ratio (Test 2)	S:T Ratio to Average Ratio (Test 2)	*Teachers Added (Test 2)
1	125	0.971800127	0
5	95.6	0.743232737	1
3	116	0.901830518	0
6	107.3333333	0.834452376	1
2	78.5	0.61029048	1
1	67	0.520884868	0
2	76	0.590854477	1
7	115.1428571	0.895166746	1
2	99	0.769665701	1
4	84.5	0.656936886	1
5	104.6	0.813202347	0

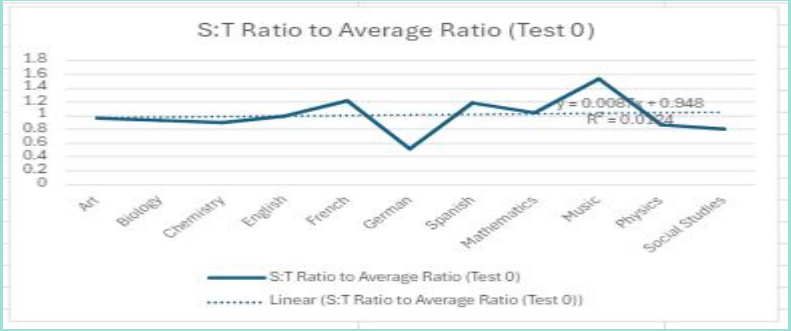
Final Solution

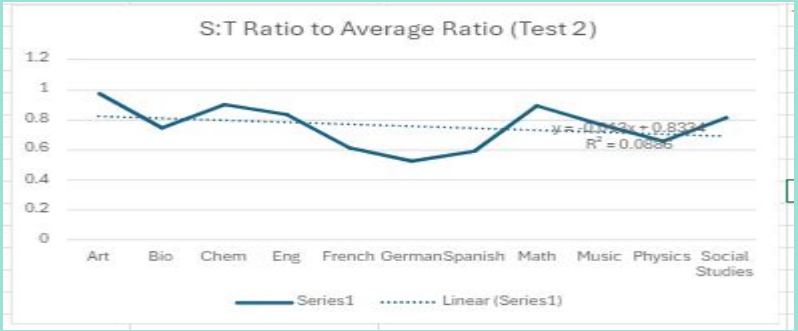
We settled on the conclusion that the most fair way to distribute the seven hires would be to hire exactly 1 teacher for all of these seven classes: Biology, English, French, Spanish, Math, Music, and Physics.

This means that our original hypothesis was rejected.

Strengths and Weaknesses of Model

- Test 2 is much more consistent (The R-squared value is seven times better).
- R-squared values could be impacted by the order of the classes on the x-axis, so looking at ranges may be better.
- Test 2 is still a much better case (the range of Test 0 is >1, whereas the range of Test 2 is <0.5).
- This shows that Test 2 is a fair solution to the question, as no teachers needed to be fired to get to consistent data.





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