Epsilon School of Mathematics

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START!

Problem Overview:

At the Epsilon School of Mathematics, the student body was increased from 490 to 630 people. To account for this, 7 new faculty members need to be hired and distributed throughout all of the departments.

Main Question

What is the best way to distribute the 7 faculty members across the departments?

What is "Fair"?

- Keep as low of a change as possible to old student teacher ratio as possible
- Have a class size increase less than 25%

What We Know:

- 11 Departments
- Students per department in 2024
- Student number increases: 490 → 630
- Drop out rate: 5%

Department Split: Given

Department	Student Total
Art	99
Biology	319
Chemistry	294
English	490
French	122
German	51
Spanish	110
Mathematics	647
Music	155
Physics	291
Social Studies	373

Teacher Split: Given

Department	Teacher Total
Mathematics	6
Chemistry	3
Physics	3
Biology	4
Social Studies	5
English	5
Foreign Language	3
Music	1
Art	1

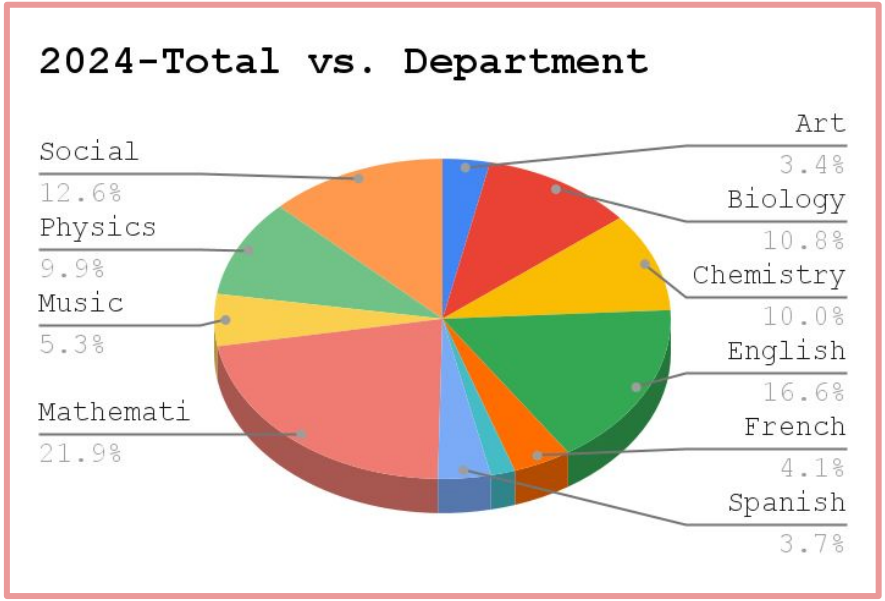
Variables

- T_{24} = Total student body in 2024
- T_{25} = Total student body in 2025
- N_{T24} = Number of teachers in a department in 2024
- N_{T25} = Number of teachers in a department in 2025
- N_{S24} = Number of students in a department in 2024
- N_{S25} = Number of students in a department in 2025
- C = Number of new teachers to add
- d = drop out rate

Assumptions:

- One language teacher per language
- The ratio of students in each department is the same for 2025 as it is for 2024
- Each teacher teaches 5 classes per day
- We considered the school as a whole, not individual grades (ratio would stay the same)

Data relationships (Our Process)



To account for the student dropout rate, the size of the class was multiplied by 95%

Process

$$\frac{\text{Students 2024 per subject}}{\text{Teachers per subject}} = \text{Student Teacher Ratio 2024 for each subject}$$

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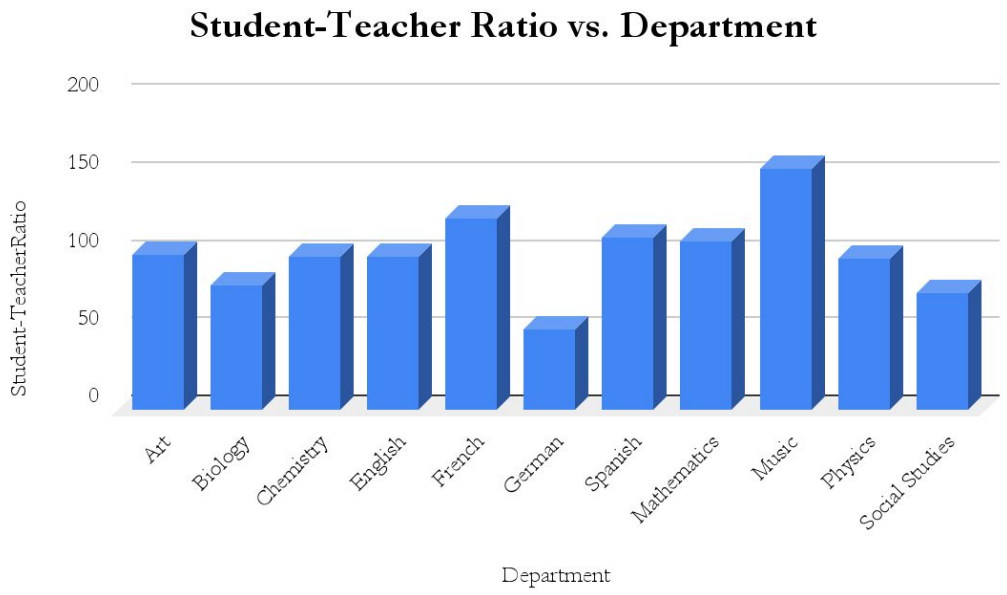
Data relationships (Our Process)



Process

$$\frac{\text{Students per subject 2025}}{\text{Student-teacher Ratio 2024}} = \text{Teachers needed per subject 2025}$$

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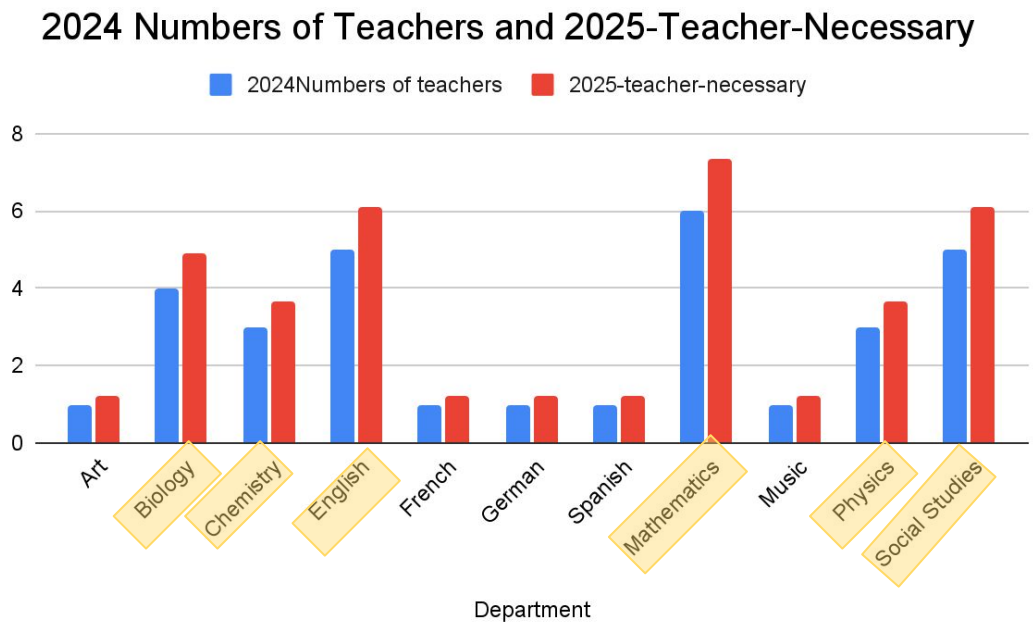
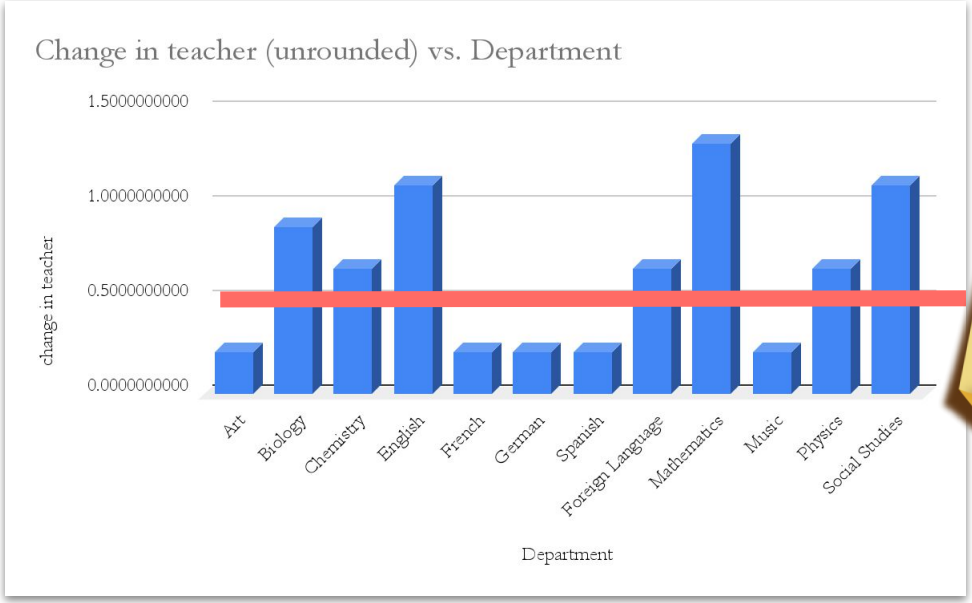


Our Model

$$\left\lfloor \frac{\frac{N_{S24}}{T_{24}} \cdot T_{25} \cdot (1-d)}{\frac{N_{S24}}{N_{T24}}} + 0.5 \right\rfloor - N_{T24} = C$$

Results



Teachers We Add:

1 teacher for Biology, Chemistry, English, Math, Physics, Social Studies

1 teacher who teaches French and Spanish

French, Spanish, and German alone don't mathematically need another teacher.

But...

The foreign language department overall does...

So...

So we need a teacher to teach Spanish and French.

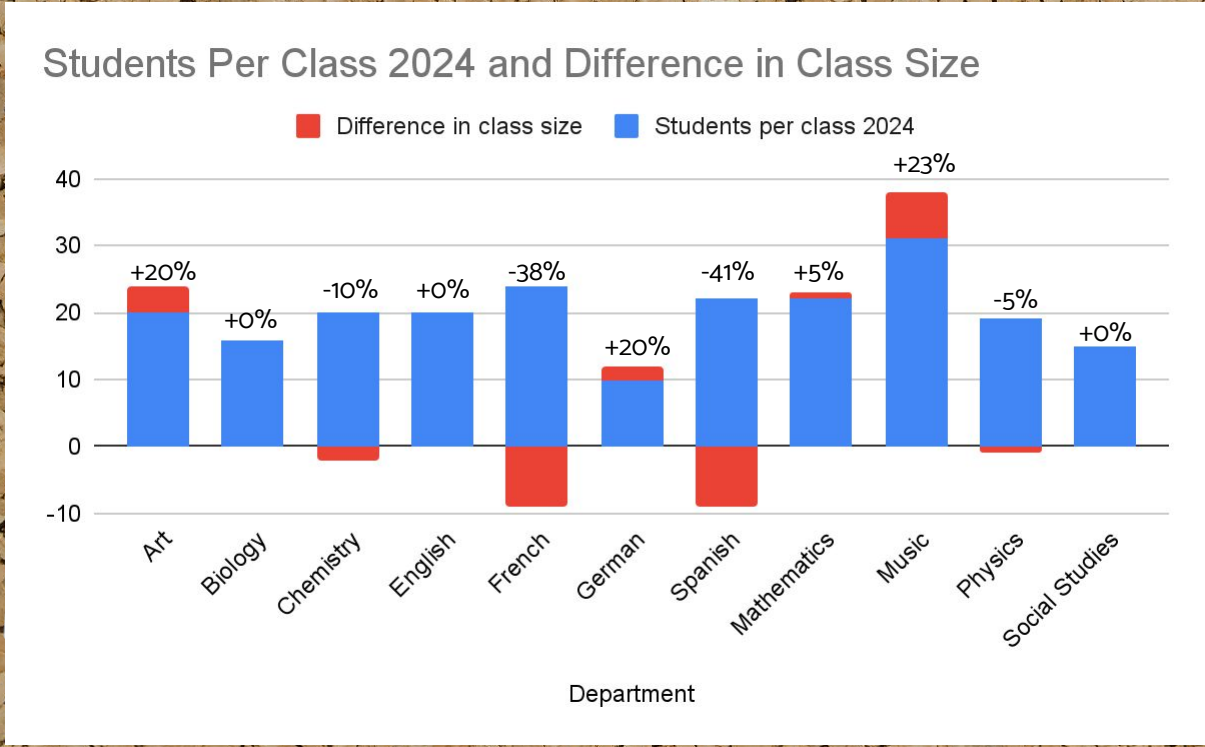
Without a teacher that teaches spanish and french, class size increases by 23% and 25%

Class Size Calculations

$$\frac{\text{Student Teacher ratio}}{\text{5 Classes}} = \text{Students in each class}$$

Justification

- Student-teacher ratio doesn't increase drastically
- Checked using only 10th grade numbers and found it works
- % class size increase is under threshold



Strengths

- Accounts for drop out rate
- Easily modifiable for any year
- Reflects past data well
- Overall trends

Weaknesses

- We assumed that interest won't change
- Possibility of overfitting due to having data for one year
- Multiple changing variables
- Type of class and which classes have different ratios
- Mixed grade classes not considered

Future Steps / Next Questions

- How can the model account for
  - teachers that teach different classes within the subject?
  - have different expertise for specialized electives?
  - have different certifications (AP)
  - Teach different levels?
  - Students in different levels?
  - Mapping out where each student is in a period to make sure each one has a class?

Thank you!

Questions?

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