Arthur

Epsilon School

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Summary of the Problem

- Epsilon school is adding 140 students next year and hiring 7 new faculty. The challenge: decide how to fairly distribute these hires among departments based on enrollment demands
- While considering additional parameters such as the option for a foreign language teacher to teach two languages and an average dropout rate of 5%.

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Main Question

How should the 7 new faculty members be added to each department to accommodate for the increased school size? For example, should each major discipline receive 1 new faculty member, or should some departments get two while others get none?

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Initial Idea

Our initial idea was to find the student teacher ratio for each year, and vary the amount of teachers to make the current and next year's student teacher ratios as close as possible.

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Data added:

- Number of teachers now
- Student count per class now

This data will also help us calculate current student : teacher ratios.

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Data added:

- Sophomores taking class this year
- Percentage of sophomores taking class this year

Using the number of sophomores taking the class in the current year, we calculate the percentage of sophomores taking the class in the current year.

We know the total amount of sophomores in the current year due to the English row in the original table, which shows 490 total students and 183 students in the sophomore section.

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Data added:

- Sophomores taking class next year

Using the assumption that the percentage of sophomores interested in a class stays roughly the same over years, we calculated the number of sophomores taking the class next year, using the following formula:

$$(P_{next} / 100)* T_{sophomores}$$

P_{next} = Percentage of sophomores taking a class next year

$T_{sophomores}$ = Number of sophomores taking class next year

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Data added:

- Total students taking a class next year

Using the assumption that most students choose to continue with the class they're taking, we add the number of current sophomores taking a class, current juniors taking a class, and sophomores that will take the class next year - to get the total students taking the class next year.

J = Number of juniors taking a class next year
S = Number of sophomores taking class next year
S_e = Number of seniors taking class next year

$J + S + S_e$ = total

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Data added:

- Student : Teacher ratio now
- Student : Teacher ratio next year

We can calculate Student : Teacher ratios for this year and next year.

We decide how many teachers to add next year by adding/removing teachers from next year's teacher count, and attempting to minimize difference between current and next year's Student : Teacher ratio.

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Analysis

- Metrics used: students per teacher and 10th-grade shares
- Oversaturated departments: Math, English, Chemistry, Physics, Foreign Language.
- Math & English also face the largest demand increase.
- Departments with larger 10th-grade enrollments will absorb a bigger share of the new students.

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Our Model & Justification

The model works by estimating the amount of new students taking each course next year. It then helps minimize difference between current and coming Student : Teacher ratios.

The goal of the model was to conserve existing Student : Teacher ratios.
Any additional teachers not allocated were given to classes with the highest Student : Teacher ratios.

Our solution:

Department	AVERAGE of St	AVERAGE of St	SUM of Teacher
art	99	113.4644809	1
bio	79.75	93.19535519	4
chem	98	93.04735883	3
eng	98	126	5
for	94.33333333	122.704918	3
math	107.8333333	113.0992714	6
music	155	185.7814208	1
physics	97	62.59380692	3
soc	74.6	121.2	5
Grand Total	**100.3907407**	**114.5651791**	**31**

Department	SUM of Addition	AVERAGE of St
art	0	113.4644809
bio	1	74.55628415
chem	0	93.04735883
eng	2	90
for	1	92.02868852
math	0	113.0992714
music	1	92.89071038
physics	-1	93.89071038
soc	3	75.75
Grand Total	**7**	**93.19194495**

- This table shows our calculations of student teacher ratios per class for the current year, and next year.
- It also shows an average

- This table shows the average after adding teachers to the appropriate departments
  - %14 difference to %7 difference

Our solution was created by calculating for these ratios, and trying to match the new ratio to the old, by adding/removing teachers where necessary.

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Strengths & Weaknesses

Strengths:

- The model was adaptable - instead of using magic numbers, we directly referenced results of other calculations. This means that if we make a change somewhere, the change cascades up the rest of the model and reflects itself in the solution.
- The model was simple - simplicity would help a client understand how it works, instead of expecting them to accept our math.
- The model used historical data - this means that as long as existing patterns continue, the model should be accurate.

Weaknesses:

- The model depends on historical data. This is both a pro and a con - the second the situation diverges from original patterns, the model stops working.
- The model makes assumptions that might not necessarily be true in every school - each school would have to make sure that their policies/patterns align with the assumptions made while writing the model.

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Conclusions

Acknowledgements:

- Thank you to Mrs. Durost for the problem, and to the developers of excel...

Future Work:

- Track enrollment shifts and faculty workloads
- Look at long-term subject demand.
- Apply model to other resource decisions (labs, classrooms, meals, etc)
- Inform planning and budgeting at the district level

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Thank you

Any questions?