Epsilon School

RATIONAL OF NECESSITY HIRING NEW TEACHERS PER DEPARTMENT

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problem

EPSILON SCHOOL HAS 490 STUDENTS IN GRADES 10, 11, AND 12. TRADITIONALLY, ALL GRADES ARE APPROXIMATELY THE SAME SIZE.

THIS YEAR, THE INCOMING SOPHOMORE CLASS WILL CONTAIN 140 MORE STUDENTS THAN PAST YEARS. THE SCHOOL WANTS TO HIRE 7 NEW TEACHERS TO ACCOMODATE THIS CHANGE IN STUDENT BODY SIZE.

THE EPSILON SCHOOL WANTS TO MAKE SURE THEY ARE HIRING TEACHERS FOR THE RIGHT SUBJECTS.

question

WHAT DEPARTMENTS SHOULD THE SCHOOL HIRE TEACHERS FOR?

given

NUMBER OF STUDENTS PER DEPARTMENT (STUDENTS WHO DOUBLE UP IN A SPECIFIC SUBJECT ARE COUNTED TWICE)

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

6	Mathematics faculty
3	Chemistry faculty
3	Physics faculty
4	Biology faculty
5	Social studies faculty
5	English faculty
3	Foreign language faculty
1	Music instructor
1	Art instructor

NUMBER OF TEACHERS IN EACH DEPARTMENT CURRENTLY

THERE ARE AROUND THE SAME AMOUNT OF KIDS IN EACH GRADE (CURRENTLY)

A LANGUAGE TEACHER CAN TEACH TWO LANGUAGES

assumptions

- THE SCHOOL IS ONLY CONCERNED WITH THE CLASS SIZES FOR NEXT YEAR
- SOPHOMORES, JUNIORS, AND SENIORS HAVE DIFFERENT REQUIRED CLASSES
- THE INCOMING SOPHOMORE CLASS WILL FOLLOW THE SAME CLASS DISTRIBUTION AS THE CURRENT SOPHOMORE CLASS
- THE STUDENT TEACHER RATIOS SHOULD STAY SIMILAR BEFORE AND AFTER THE CHANGE
- THE SAME PROPORTION OF STUDENTS DROP OUT SOPHOMORE, JUNIOR, AND SENIOR YEAR
- A LANGUAGE TEACHER THAT TEACHES TWO LANGUAGES COUNTS AS HALF A TEACHER FOR EACH

Assumptions - Drop Out Rate

We assume that the same amount of students drop out during sophomore, junior, and senior year. We also assume dropout rate is the percent of students who enter sophomore year and don't graduate. Finally, we assume that class size is measured at the beginning of the year. Thus,

let x = # of kids at the beginning of sophomore year

y = # of kids at the end of senior year

$$y = 0.95x$$

let a = proportion of kids that drop out each year.

Thus ax = # of kids at the start of junior year

a^2x = # of kids at the start of senior year

$a^3x = y$ = # of kids at the end of senior year

So,

$$x + ax + a^2x = 490 \quad (i)$$

and

$$a^3x = 0.95x \quad (ii)$$

$$\therefore a^3 = 0.95 \quad (ii)$$

$$\therefore a = 0.983 \quad (ii)$$

$$x + 0.983x + 0.983^2x = 490$$

$$\therefore 2.949x = 490$$

$$\therefore x = 166 = \text{\# of kids at the start of sophomore year}$$

$$\therefore 0.983x = 163 = \text{\# of kids at the start of junior year}$$

$$0.983^2x = 161 = \text{\# of kids at the start of senior year}$$

variables

CURRENT KIDS PER GRADE

CURRENT GRADE - SUBJECT DISTRIBUTIONS

PREDICTED GRADE - SUBJECT DISTRIBUTIONS

CURRENT STUDENT TO TEACHER RATIOS

PREDICT STUDENT TO TEACHER RATIOS BEFORE AND AFTER HIRING

hypothesis

TEACHERS SHOULD BE ADDED TO CATEGORIES WITH STUDENT-TEACHER RATIOS THAT CHANGE THE MOST AFTER ADDING THE NEW STUDENTS.

problem analysis

FIND THE STUDENT-TEACHER RATIOS THAT INCREASED THE MOST AFTER THE NEW STUDENS WERE ADDED

model design

- PREDICT NUMBER OF STUDENTS PER GRADE
- CURRENT PRECENTAGE DISTRIBUTION OF CLASSES
- ADDDITONAL SOPHOMORES PER CATEGORY
- CHANGE IN STUDENT TO TEACHER RATIOS

trials

Department	Percent of 10th graders	Percent of 11th graders	Percent of 12th graders	Percent of Total school	# of Teachers	Current # of 11th graders	Current # of 12th graders	Current # of 10th graders	additonal per category
German	11.44578313	13.49693252	6.211180124	10.40816327	1	22	10	19	16
Art	18.6746988	20.24539877	21.73913043	20.20408163	1	33	35	31	26
Spanish	30.72289157	15.95092025	20.49689441	22.44897959	1	26	33	51	43
French	24.69879518	19.63190184	30.43478261	24.89795918	1	32	49	41	35
Music	30.12048193	34.35582822	30.43478261	31.63265306	1	56	49	50	42
Physics	30.12048193	35.58282209	113.6645963	59.3877551	3	58	183	50	42
Chemistry	35.54216867	77.3006135	67.70186335	60	3	126	109	59	50
Biology	119.2771084	58.28220859	16.14906832	65.10204082	4	95	26	198	167
Social Studies	110.2409639	80.36809816	36.64596273	76.12244898	5	131	59	183	154
English	110.2409639	95.09202454	94.40993789	100	5	155	152	183	154
Mathematics	110.8433735	123.3128834	162.7329193	132.0408163	6	201	262	184	155
Foreign Language	66.86746988	49.0797546	57.14285714	57.75510204	3	80	92	111	94

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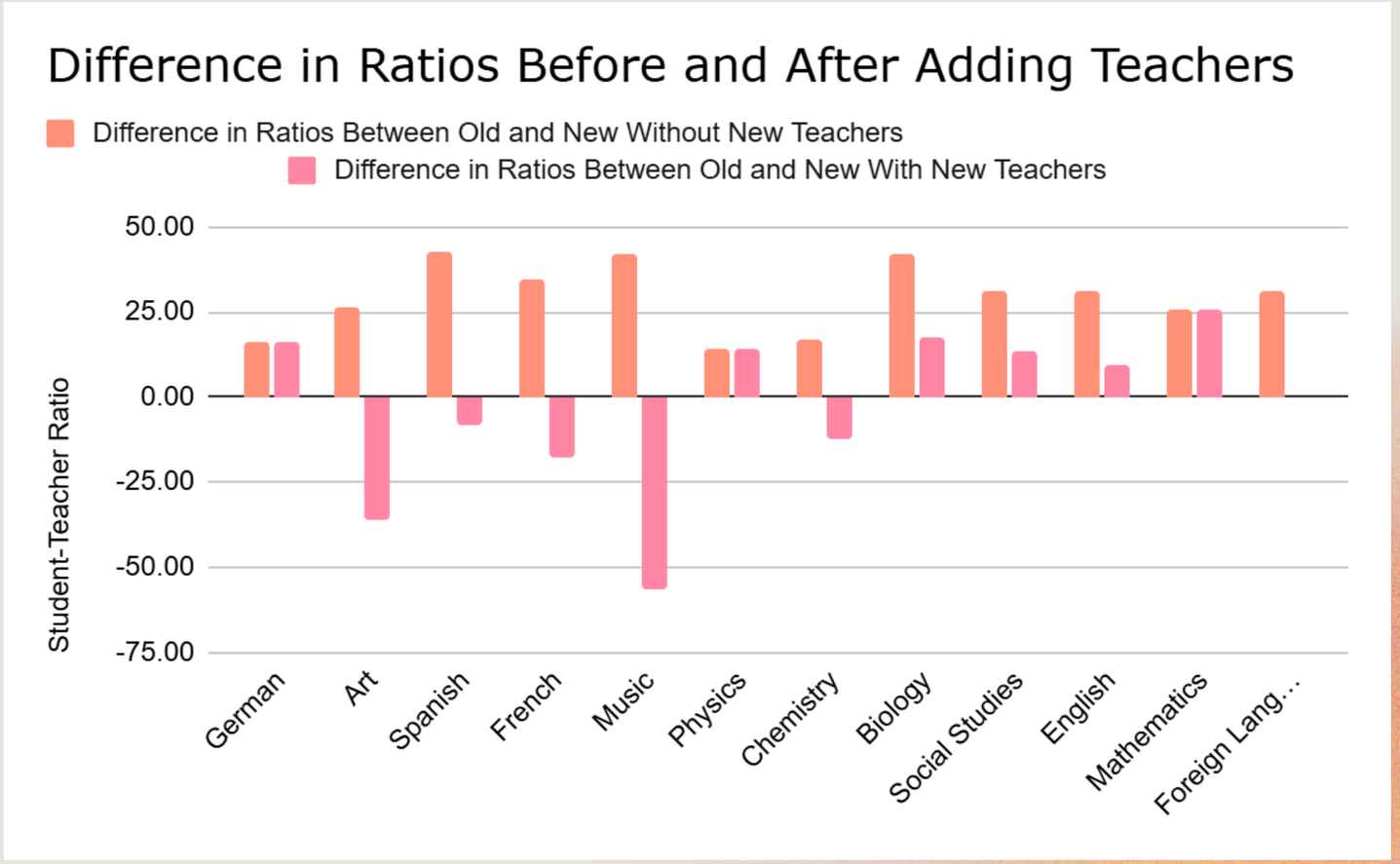
French	41	32	49	122
German	19	22	10	51
Spanish	51	26	33	110
Mathematics	184	201	262	647
Music	50	56	49	155
Physics	50	58	183	291
Social Studies	183	131	59	373

solution

- FIND THE SUBJECTS WITH A HIGH STUDENT-TEACHER RATIO
- ADD AN EXTRA TEACHER AND SEE IF THERE IS A DIFFERENCE IN RATIO
- CHANGE IN STUDENT TO TEACHER RATIOS

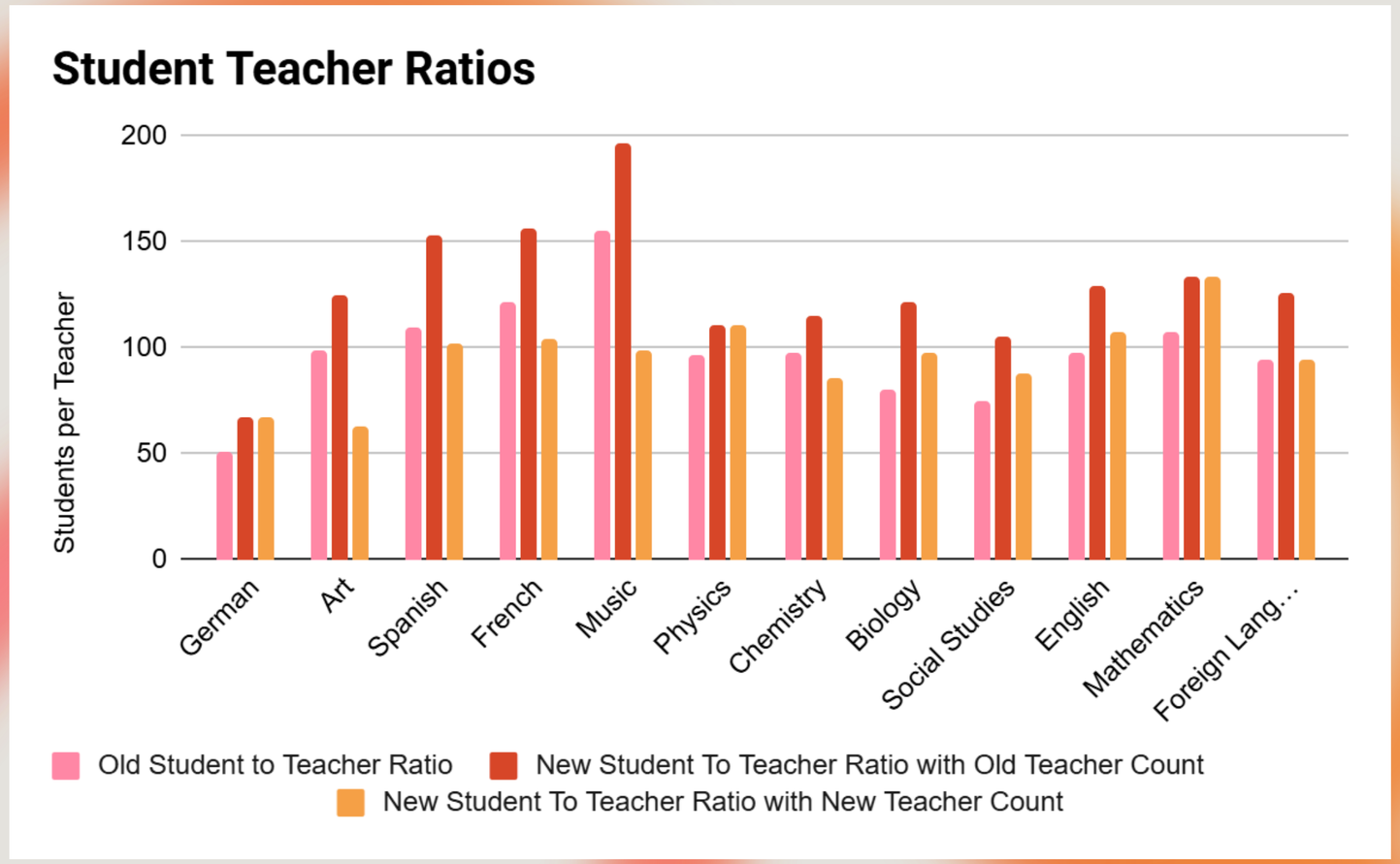
Department	additonal per category	New 10th grade class (total per incoming class)	Old Student to Teacher Ratio	New Student To Teacher Ratio with Old Teacher Count	New Teachers per Category	New Student To Teacher Ratio with New Teacher Count	Difference in Ratios Between Old and New Without New Teachers	Difference in Ratios Between Old and New With New Teachers
German	16	35	51	67.02	0	67.02	16.02	16.02
Art	26	57	99	125.14	1	62.57	26.14	-36.43
Spanish	43	94	110	153.01	0.5	102.01	43.01	-7.99
French	35	76	122	156.58	0.5	104.39	34.58	-17.61
Music	42	92	155	197.17	1	98.58	42.17	-56.42
Physics	42	92	97	111.06	0	111.06	14.06	14.06
Chemistry	50	109	98	114.5863454	1	85.94	16.58634538	-12.06
Biology	167	365	79.75	121.50	1	97.20	41.75	17.45
Social Studies	154	337	74.6	105.47	1	87.89	30.87	13.29
English	154	337	98	128.8674699	1	107.39	30.86746988	9.39
Mathematics	155	339	107.83	133.70	0	133.70	25.86	25.86
Foreign Language	94	205	94.33	125.54	1	94.15	31.20	-0.18

solution



Department	New Teachers per Category
German	0
Art	1
Spanish	0.5
French	0.5
Music	1
Physics	0
Chemistry	1
Biology	1
Social Studies	1
English	1
Mathematics	0
Foreign Language	1

justification



discussion

STRENGTHS:

- MANY STUDENT TO TEACHER RATIOS HAVE DECREASED TO EVEN LESS THAN WHAT THEY WERE BEFORE THE NEW STUDENTS/NEW TEACHERS (ART, SPANISH, FRENCH, MUSIC, CHEMISTRY)
- TAKES INTO ACCOUNT DROPOUT RATE IN ORDER TO ACCOUNT FOR THE LOSS OF STUDENTS PER CLASS.
- LOOKS AT REQUIRED CLASSES FOR SOPHOMORES → USED THE CLASS AVERAGES FOR SOPHOMORES

WEAKNESSES:

- THE DROP OUT RATE IS DIVIDED EVENLY BETWEEN INDIVUAL YEARS BUT NOT IN REALITY THE STUDENTS THAT DROP OUT ARE RANDOM THROUGHOUT THE YEARS.
- THE CLASSES THAT THE SOPHMORES WOULD GO INTO WAS BASED ON ESTIMATED VALUES NOT EXACT DATA SO PERCENTAGES PER CLASS MIGHT CHANGE IN REAL LIFE.
- SOME STUDENT TO TEACHER RATIOS HAD INCREASE QUITE A BIT COMPARED TO WHAT THEY WERE BEFORE

thank you

questions?

further explanation

SPREAD SHEET:

HTTPS://DOCS.GOOGLE.COM/SPREADSHEETS/D/1TXG43GLUNJYUDF1HJHMOIZ_TQLYMNBGS5JGARN8CQYE/EDIT?USP=SHARING