EPSILON SCHOOL

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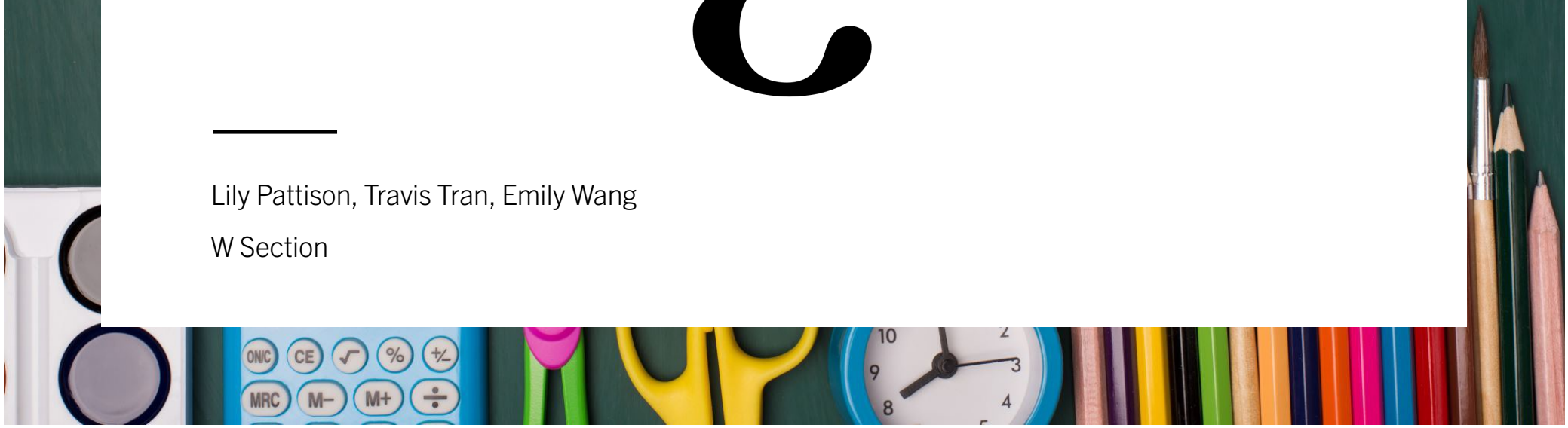
W Section



THE PROBLEM

- Epsilon School is grades 10 to 12
- Epsilon School is adding 140 students to their incoming sophomore class to occupy a new wing
- The total student population will increase from 490 (current 2022-2023 Sept. student population) to 630 (2023-2024 Sept. population)
- 7 additional faculty will be hired to accommodate the increase of students
- The size of the incoming sophomore class is equal to the graduating senior class (plus any students who dropped out during the year)
- 5% of the incoming class drop out prior to graduation
- Lang teachers can teach multiple languages
- How would you hire the new faculty?

2022-2023 SCHOOL YEAR ENROLLMENTS (SEPTEMBER)

Department	Grade 10	Grade 11	Grade 12	Total	Teachers
Art	31	33	35	99	1
Biology	198	95	26	319	4
Chemistry	59	126	109	294	3
English	183	155	152	490	5
French	41	32	49	122	1
German	19	22	10	51	1
Spanish	51	26	33	110	1
Mathematics	184	201	262	647	6
Music	50	56	49	155	1
Physics	50	58	183	291	3
Social Studies	183	131	59	373	5

ASSUMPTIONS

- English enrollments reflect each grade size
  - Epsilon is a math and science school
  - English enrollments throughout the school total up to 490: the school's size
- Dropout rate each year is 1.695%
  - It is given that the average dropout rate prior to graduation in 5%
  - Over the span of three years, this equates to 1.695% each year
  - The cubed root of 0.95 (from 5% dropping out) is 0.983048
  - Subtracting from 1 will yield 0.01695, or a 1.695% dropout rate yearly for three years
- Foreign Language
  - Beginning: each teacher teaches only one language
  - End: each teacher must now teach two languages
- Ratio of enrollments per grade and enrollments per teacher are constant to 2022-2023 Sept. ratios
  - Assume students and teachers are happy with the current ratios and that the current ratios are satisfactory to the administration

ANALYSIS

- Should every major discipline (English, Social Studies, Mathematics, Physics, Biology, Chemistry, and Foreign Language) each receive one new teacher, or does the demand for courses argue that some departments should receive two new teachers while others receive none?
  - We concluded that the latter option is the better one because the current enrollment to teacher ratios should be kept to keep the dynamic of the school's educational operations the same
- Goal: determine where to place each of the 7 new teachers

OUR MODEL

We determined the ratio of enrollments to students for 2022-2023 as well as enrollments to teachers for 2022-2023

Used enrollments to students ratio to find 2023-2024 grade and class sizes

- Found grade sizes based on English class and dropout rate

Calculated expected teachers per department by using the enrollments to teachers ratio from 2022-2023

- Rounded to 7 teachers and accounted for language teacher assumptions

RATIO OF ENROLLMENTS TO STUDENTS (USING '22-'23)

Department	10th grade	11th grade	12th grade	Total
Art	0.169398907	0.212903226	0.230263158	0.202040816
Biology	1.081967213 = enrollments / 10th graders = 198/183	0.612903226	0.171052632	0.651020408
Chemistry	0.322404372	0.812903226	0.717105263	0.6
English	1	1	1	1
French	0.224043716	0.206451613	0.322368421	0.248979592
German	0.103825137	0.141935484	0.065789474	0.104081633
Spanish	0.278688525	0.167741935	0.217105263	0.224489796
Mathematics	1.005464481	1.296774194	1.723684211	1.320408163
Music	0.273224044	0.361290323	0.322368421	0.316326531
Physics	0.273224044	0.374193548	1.203947368	0.593877551
Social Studies	1	0.84516129	0.388157895	0.76122449
Foreign Language	0.606557377	0.516129032	0.605263158	0.57755102

2023-2024 SCHOOL YEAR ENROLLMENTS (SEPTEMBER)

2022-2023 (September)

English	183	155	152	490

2023-2024 (September)

Department	Grade 10	Grade 11	Grade 12	Total
Art	50.48087432	38.32258065	35	127.2857143
Biology	322.4262295 = (enrollments : 10th graders 2022-2023) * '23-'24 10th graders = 1.081967213 * 298	110.3225806	26	410.1428571
Chemistry	96.07650273	146.3225806	109	378
English	298 = 152 + 6 +140	180 = 183 – 3	152 = 155 - 3	630
French	66.76502732	37.16129032	49	156.8571429
German	30.93989071	25.5483871	10	65.57142857
Spanish	83.04918033	30.19354839	33	141.4285714
Mathematics	299.6284153	233.4193548	262	831.8571429
Music	81.42076503	65.03225806	49	199.2857143
Physics	81.42076503	67.35483871	183	374.1428571
Social Studies	298	152.1290323	59	479.5714286

RATIO ENROLLMENTS : TEACHERS '22-'23

Department	Total Ratio
Art	99
Biology	79.75 = Total Enrollments / Teachers = 319 / 4
Chemistry	98
English	98
French	122
German	51
Spanish	110
Mathematics	107.8333333
Music	155
Physics	97
Social Studies	74.6
Foreign Language	94.33333333

TEACHERS PER DEPARTMENT

Department	2022-23 Faculty	2023-24 Faculty
Art	1	1.29 ≈ 1
Biology	4	5.14 ≈ 5 = Total Enrollments / (Total Enrollments per teacher) = 410.1428571 / 79.75
Chemistry	3	3.86 ≈ 4
English	5	6.43 ≈ 6
Mathematics	6	7.71 ≈ 8
Music	1	1.29 ≈ 1
Physics	3	3.86 ≈ 4
Social Studies	5	6.43 ≈ 6
Foreign Language	3	3.86 → 3 (teachers can teach multiple classes)

- The additional faculty added for 2023-2024 equals 7

- Teachers added:
  - Biology 1
  - Chemistry 1
  - English 1
  - Mathematics 2
  - Physics 1
  - Social Studies 1

JUSTIFICATION

- We assume that the students and teachers are happy with the current ratios and that the current ratios are satisfactory to the administration
  - Our model holds these ratios effectively

TEST MODEL SCENARIO

There is a school with one grade. It has an English class (50 students, 1 teacher), Math class (20 students, 1 teacher), and Biology class (30 students, 1 teacher).

- Total grade size = 50 students
- Want to add 50 students to next year's grade, increasing grade size from 50 to 100
- Want to add three teachers next year
- Which department will the new faculty be in?

TEST TABLES

2022-2023 School Year

Class	Enrollments	Teachers
Biology	30	1
English	50	1
Math	20	1

TEST

Enrollments : Students Ratio '22-'23

Class	Enrollments	Teachers	Ratio
Biology	30	1	3/5 =30/50
English	50	1	1
Math	20	1	2/5

Enrollments '23-'24

Class	Enrollments	Teachers
Biology	60 =3/5* 100	----
English	100 =50+50	----
Math	40	-----

TEST

Total Enrollments : Teachers Ratio '22-'23

Class	Enrollments	Teachers	Ratio
Biology	30	1	30/1
English	50	1	50/1
Math	20	1	20/1

Teachers '23-'24

Class	Enrollments	Teachers
Biology	60	2 = (enrollments in class) / (ratio of enrollments: teachers) =60/30
English	100	2
Math	40	2

TEST RESULTS

'23-'24 Expected # Teachers

Class	Enrollments	Teachers
Biology	------	2
English	100	2
Math	-------	2

'23-'24 Calculated # Teachers

Class	Enrollments	Teachers
Biology	60	2 = (enrollments in class) / (ratio of students : teachers) =60/30
English	100	2
Math	40	2

SUMMARY OF MODEL

We determined the ratio of enrollments to students for 2022-2023 as well as enrollments to teachers for 2022-2023

Used enrollments to students ratio to find 2023-2024 grade and class sizes

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STRENGTHS AND WEAKNESSES

- Strengths:
  - Keeps current students to teachers ratio, which most likely works for the teachers
  - Maximizes efficiency of faculty by changing the foreign language teachers' responsibilities to teach two languages
  - Accounts for dropouts over three years
- Weaknesses:
  - If the current student to teacher ratio does not work, this would not solve the problem
  - Does not work if dropout rate changes each year
  - Does not work if English does not reflect class size

FUTURE WORK

- Adapt our model to decrease our assumptions and weaknesses
  - Identify a way to analyze of the current student to teacher ratios are effective (what should change or stay the same?)
  - Prove that the English class represents the population

ACKNOWLEDGMENTS

- Excel
- Ms. Burns
- Students from X, Y, and Z groups

QUESTIONS?