School SHSHAT Performance Determinants

Research Question

What are the key factors affecting schools' performance in SHSAT assessments?

Introduction

The Specialized High School Admissions Test (SHSAT) is a required test for all elementary students applying to specialized high schools in New York City. New York City has nine specialized high schools, which provide more rigorous curriculums and educational resources than other public high schools in the city. According to the Department of Education, these schools are intended to support the needs of students who excel academically and artistically. Students from specialized schools in New York City are consistently admitted to the most elite universities and rank amongst the highest-performing high school students in the United States. Specialized high schools provide their students with better resources and opportunities to gain entry to the top universities, and subsequently, the top jobs, they play a critical role in shaping upward socioeconomic mobility.

As an education received at the nine specialized high schools are therefore the most competitive and sought-after. The SHSAT is the only criterion for admissions to the eight of nine New York City Specialized High Schools Performance on SHSAT overwhelmingly determines which students are admitted to the most elite public high schools in the state. Using a 2016 panel data set that includes observations of the 1271 elementary schools registered in Department of Education in New York City, we will look at the relationship between the average proficiency on the SHSAT of schools and the location of the schools in the City, as well as the relationship between the average proficiency on the SHSAT of schools and the economic need of their students.

The outcome variable is the average SHSAT performance of each school in 2016, measured by the average ELA proficiency and average Math proficiency as provided in the dataset. The first explanatory variable I will examine is the location of each school. The variable of the geographic location of each school is particularly interesting as it can serve as an indicator for the quality of teaching and resources available for students, which can positively or negatively impact the students' performance on the SHSAT. However, the ability to academically perform well is not simply a direct outcome of how good the quality of teaching is at school; we need to take into account that a student's effort and performance may also hinge on other hidden factors, such as parental support and supplementary resources such as outside-of-school tutoring. The second explanatory variable I will examine is the economic need index of the school's students, which measures the socioeconomic circumstances of a school's population. This can indicate the students' access to educational support and resources outside of formal school setting, which can also positively or adversely impact students' SHSAT performances.

Importing data of Elementary Schools in New York City in 2016

In [1]:
```
import pandas as pd
import matplotlib.pyplot as plt
```

In [2]:
```
#importing and reading the data
data = pd.read_csv("2016 School Explorer.csv")
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1272 entries, 0 to 1271
Columns: 161 entries, Adjusted Grade to Grade 8 Math 4s - Economically Disadvantaged
dtypes: float64(5), int64(123), object(33)
memory usage: 1.6+ MB
```

In [3]:
```
#identifying all the variables
pd.options.display.max_seq_items = None
display(data.columns)
```

```
Index(['Adjusted Grade', 'New?', 'Other Location Code in LCGMS', 'School Name',
       'SED Code', 'Location Code', 'District', 'Latitude', 'Longitude',
       'Address (Full)', 'City', 'Zip', 'Grades', 'Grade Low', 'Grade High',
       'Community School?', 'Economic Need Index', 'School Income Estimate',
       'Percent ELL', 'Percent Asian', 'Percent Black', 'Percent Hispanic',
       'Percent Black / Hispanic', 'Percent White', 'Student Attendance Rate',
       'Percent of Students Chronically Absent', 'Rigorous Instruction %',
       'Rigorous Instruction Rating', 'Collaborative Teachers %',
       'Collaborative Teachers Rating', 'Supportive Environment %',
       'Supportive Environment Rating', 'Effective School Leadership %',
       'Effective School Leadership Rating', 'Strong Family-Community Ties %',
       'Strong Family-Community Ties Rating', 'Trust %', 'Trust Rating',
       'Student Achievement Rating', 'Average ELA Proficiency',
       'Average Math Proficiency', 'Grade 3 ELA - All Students Tested',
       'Grade 3 ELA 4s - All Students',
       'Grade 3 ELA 4s - American Indian or Alaska Native',
       'Grade 3 ELA 4s - Black or African American',
       'Grade 3 ELA 4s - Hispanic or Latino',
       'Grade 3 ELA 4s - Asian or Pacific Islander', 'Grade 3 ELA 4s - White',
       'Grade 3 ELA 4s - Multiracial',
       'Grade 3 ELA 4s - Limited English Proficient',
       'Grade 3 ELA 4s - Economically Disadvantaged',
       'Grade 3 Math - All Students tested', 'Grade 3 Math 4s - All Students',
       'Grade 3 Math 4s - American Indian or Alaska Native',
       'Grade 3 Math 4s - Black or African American',
       'Grade 3 Math 4s - Hispanic or Latino',
       'Grade 3 Math 4s - Asian or Pacific Islander',
       'Grade 3 Math 4s - White', 'Grade 3 Math 4s - Multiracial',
       'Grade 3 Math 4s - Limited English Proficient',
       'Grade 3 Math 4s - Economically Disadvantaged',
       'Grade 4 ELA - All Students Tested', 'Grade 4 ELA 4s - All Students',
       'Grade 4 ELA 4s - American Indian or Alaska Native',
       'Grade 4 ELA 4s - Black or African American',
       'Grade 4 ELA 4s - Hispanic or Latino',
       'Grade 4 ELA 4s - Asian or Pacific Islander', 'Grade 4 ELA 4s - White',
       'Grade 4 ELA 4s - Multiracial',
       'Grade 4 ELA 4s - Limited English Proficient',
       'Grade 4 ELA 4s - Economically Disadvantaged',
       'Grade 4 Math - All Students Tested', 'Grade 4 Math 4s - All Students',
       'Grade 4 Math 4s - American Indian or Alaska Native',
       'Grade 4 Math 4s - Black or African American',
       'Grade 4 Math 4s - Hispanic or Latino',
       'Grade 4 Math 4s - Asian or Pacific Islander',
       'Grade 4 Math 4s - White', 'Grade 4 Math 4s - Multiracial',
       'Grade 4 Math 4s - Limited English Proficient',
       'Grade 4 Math 4s - Economically Disadvantaged',
       'Grade 5 ELA - All Students Tested', 'Grade 5 ELA 4s - All Students',
       'Grade 5 ELA 4s - American Indian or Alaska Native',
       'Grade 5 ELA 4s - Black or African American',
       'Grade 5 ELA 4s - Hispanic or Latino',
       'Grade 5 ELA 4s - Asian or Pacific Islander', 'Grade 5 ELA 4s - White',
       'Grade 5 ELA 4s - Multiracial',
       'Grade 5 ELA 4s - Limited English Proficient',
       'Grade 5 ELA 4s - Economically Disadvantaged',
       'Grade 5 Math - All Students Tested', 'Grade 5 Math 4s - All Students',
       'Grade 5 Math 4s - American Indian or Alaska Native',
       'Grade 5 Math 4s - Black or African American',
       'Grade 5 Math 4s - Hispanic or Latino',
       'Grade 5 Math 4s - Asian or Pacific Islander',
       'Grade 5 Math 4s - White', 'Grade 5 Math 4s - Multiracial',
       'Grade 5 Math 4s - Limited English Proficient',
       'Grade 5 Math 4s - Economically Disadvantaged',
       'Grade 6 ELA - All Students Tested', 'Grade 6 ELA 4s - All Students',
       'Grade 6 ELA 4s - American Indian or Alaska Native',
       'Grade 6 ELA 4s - Black or African American',
       'Grade 6 ELA 4s - Hispanic or Latino',
       'Grade 6 ELA 4s - Asian or Pacific Islander', 'Grade 6 ELA 4s - White',
       'Grade 6 ELA 4s - Multiracial',
       'Grade 6 ELA 4s - Limited English Proficient',
       'Grade 6 ELA 4s - Economically Disadvantaged',
       'Grade 6 Math - All Students Tested', 'Grade 6 Math 4s - All Students',
       'Grade 6 Math 4s - American Indian or Alaska Native',
       'Grade 6 Math 4s - Black or African American',
       'Grade 6 Math 4s - Hispanic or Latino',
       'Grade 6 Math 4s - Asian or Pacific Islander',
       'Grade 6 Math 4s - White', 'Grade 6 Math 4s - Multiracial',
       'Grade 6 Math 4s - Limited English Proficient',
       'Grade 6 Math 4s - Economically Disadvantaged',
       'Grade 7 ELA - All Students Tested', 'Grade 7 ELA 4s - All Students',
       'Grade 7 ELA 4s - American Indian or Alaska Native',
       'Grade 7 ELA 4s - Black or African American',
       'Grade 7 ELA 4s - Hispanic or Latino',
       'Grade 7 ELA 4s - Asian or Pacific Islander', 'Grade 7 ELA 4s - White',
       'Grade 7 ELA 4s - Multiracial',
       'Grade 7 ELA 4s - Limited English Proficient',
       'Grade 7 ELA 4s - Economically Disadvantaged',
       'Grade 7 Math - All Students Tested', 'Grade 7 Math 4s - All Students',
       'Grade 7 Math 4s - American Indian or Alaska Native',
       'Grade 7 Math 4s - Black or African American',
       'Grade 7 Math 4s - Hispanic or Latino',
       'Grade 7 Math 4s - Asian or Pacific Islander',
       'Grade 7 Math 4s - White', 'Grade 7 Math 4s - Multiracial',
       'Grade 7 Math 4s - Limited English Proficient',
       'Grade 7 Math 4s - Economically Disadvantaged',
       'Grade 8 ELA - All Students Tested', 'Grade 8 ELA 4s - All Students',
       'Grade 8 ELA 4s - American Indian or Alaska Native',
       'Grade 8 ELA 4s - Black or African American',
       'Grade 8 ELA 4s - Hispanic or Latino',
       'Grade 8 ELA 4s - Asian or Pacific Islander', 'Grade 8 ELA 4s - White',
       'Grade 8 ELA 4s - Multiracial',
       'Grade 8 ELA 4s - Limited English Proficient',
       'Grade 8 ELA 4s - Economically Disadvantaged',
       'Grade 8 Math - All Students Tested', 'Grade 8 Math 4s - All Students',
       'Grade 8 Math 4s - American Indian or Alaska Native',
       'Grade 8 Math 4s - Black or African American',
       'Grade 8 Math 4s - Hispanic or Latino',
       'Grade 8 Math 4s - Asian or Pacific Islander',
       'Grade 8 Math 4s - White', 'Grade 8 Math 4s - Multiracial',
       'Grade 8 Math 4s - Limited English Proficient',
       'Grade 8 Math 4s - Economically Disadvantaged'],
      dtype='object')
```

In [4]:
```
data.head()
```

Out[4]:

	Adjusted Grade	New?	Other Location Code in LCGMS	School Name	SED Code	Location Code	District	Latitude	Longitude	Address (Full)	...	Grade 8 Math - All Students Tested	Grade 8 Math 4s - All Students
0	NaN	NaN	NaN	P.S. 015 ROBERTO CLEMENTE	310100010015	01M015	1	40.721834	-73.978766	333 E 4TH ST NEW YORK, NY 10009	...	0	0
1	NaN	NaN	NaN	P.S. 019 ASHER LEVY	310100010019	01M019	1	40.729892	-73.984231	185 1ST AVE NEW YORK, NY 10003	...	0	0
2	NaN	NaN	NaN	P.S. 020 ANNA SILVER	310100010020	01M020	1	40.721274	-73.986315	166 ESSEX ST NEW YORK, NY 10002	...	0	0
3	NaN	NaN	NaN	P.S. 034 FRANKLIN D. ROOSEVELT	310100010034	01M034	1	40.726147	-73.975043	730 E 12TH ST NEW YORK, NY 10009	...	48	1
4	NaN	NaN	NaN	THE STAR ACADEMY - P.S.63	310100010063	01M063	1	40.724404	-73.986360	121 E 3RD ST NEW YORK, NY 10009	...	0	0

5 rows × 161 columns

In [5]:
```
#there are 1272 schools in the school dataset, 161 variables
data.shape
```

Out[5]: (1272, 161)

Checking for missing values for our outcome and explanatory variables

In [6]:
```
#checking if our outcome variable and explanatory variables have missing values
missing = data.isnull()
missing
```

Out[6]:

	Adjusted Grade	New?	Other Location Code in LCGMS	School Name	SED Code	Location Code	District	Latitude	Longitude	Address (Full)	...	Grade 8 Math - All Students Tested	Grade 8 Math 4s - All Students	Grade 8 Math 4s - American Indian or Alaska Native
0	True	True	True	False	False	False	False	False	False	False	...	False	False	False
1	True	True	True	False	False	False	False	False	False	False	...	False	False	False
2	True	True	True	False	False	False	False	False	False	False	...	False	False	False
3	True	True	True	False	False	False	False	False	False	False	...	False	False	False
4	True	True	True	False	False	False	False	False	False	False	...	False	False	False
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
1267	True	True	True	False	False	False	False	False	False	False	...	False	False	False
1268	True	True	True	False	False	False	False	False	False	False	...	False	False	False
1269	True	True	True	False	False	False	False	False	False	False	...	False	False	False
1270	True	True	True	False	False	False	False	False	False	False	...	False	False	False
1271	True	True	True	False	False	False	False	False	False	False	...	False	False	False

1272 rows × 161 columns

In [7]:
```
#seeing how many are missing values there are per column
missing_total = missing.sum().sort_values(ascending=False)
missing_total.head()
```

Out[7]:
```
Other Location Code in LCGMS    1271
Adjusted Grade                  1270
New?                            1245
School Income Estimate           396
Student Achievement Rating        86
dtype: int64
```

In [9]:
```
missing_total[['Economic Need Index', 'Average ELA Proficiency', 'Average Math Proficiency', 'Location Code',
       'Address (Full)', 'City', 'Zip']]
```

Out[9]:
```
Economic Need Index         25
Average ELA Proficiency     55
Average Math Proficiency    55
Location Code                0
District                     0
Latitude                     0
Longitude                    0
Address (Full)               0
City                         0
Zip                          0
dtype: int64
```

Our variables of interest are: Economic Need Index, Average ELA Proficiency, Average Math Proficiency, and variables concerning Location.

There are several schools with missing values for Average ELA Proficiency, Average ELA Math Proficiency, and Economic Need Index. Because such schools lack the information we need to answer our research question, we will omit the schools with the missing values concerning our variables of interest from our evaluation.

In [10]:
```
#dropping schools that have missing values with avg ELA prof, avg Math prof, and economic need index

data = data.dropna(subset=['Average ELA Proficiency', 'Average Math Proficiency', 'Economic Need Index'])
```

In [11]:
```
#checking whether our updated dataset have any missing values for our variables of interest
missing = data.isnull().sum().sort_values(ascending=False)
missing[['Economic Need Index', 'Average ELA Proficiency', 'Average Math Proficiency', 'Location Code', 'Dist
       'Address (Full)', 'City', 'Zip']]
```

Out[11]:
```
Economic Need Index         0
Average ELA Proficiency     0
Average Math Proficiency    0
Location Code               0
District                    0
Latitude                    0
Longitude                   0
Address (Full)              0
City                        0
Zip                         0
dtype: int64
```

At this points, there are no more missing values for our variables of interest, and we do not need to further clean our dataset to account for missing values.

Data Cleaning

In [12]:
```
#cleaning percentages to floats

#creating a helper function

def str_prc_to_float(x):
    "converts percentages in strings to a float decimal"
    return float(x.strip('%')) / 100

#applying function

data["Percent Asian"] = data["Percent Asian"].astype(str).apply(str_prc_to_float)
data["Percent Black"] = data["Percent Black"].astype(str).apply(str_prc_to_float)
data["Percent Hispanic"] = data["Percent Hispanic"].astype(str).apply(str_prc_to_float)
data["Percent White"] = data["Percent White"].astype(str).apply(str_prc_to_float)
data["Percent Black / Hispanic"] = data["Percent Black / Hispanic"].astype(str).apply(str_prc_to_float)
data["Rigorous Instruction %"] = data["Rigorous Instruction %"].astype(str).apply(str_prc_to_float)
data["Collaborative Teachers %"] = data["Collaborative Teachers %"].astype(str).apply(str_prc_to_float)
data["Supportive Environment %"] = data["Supportive Environment %"].astype(str).apply(str_prc_to_float)
data["Effective School Leadership %"] = data["Effective School Leadership %"].astype(str).apply(str_prc_to_fl
data["Strong Family-Community Ties %"] = data["Strong Family-Community Ties %"].astype(str).apply(str_prc_to_
data["Trust %"] = data["Trust %"].astype(str).apply(str_prc_to_float)
data["Student Attendance Rate"] = data["Student Attendance Rate"].astype(str).apply(str_prc_to_float)
data["Percent of Students Chronically Absent"] = data["Percent of Students Chronically Absent"].astype(str).a


data['School Income Estimate'] = data['School Income Estimate'].apply(str).str.replace(',', '')
data['School Income Estimate'] = data['School Income Estimate'].apply(str).str.replace('$', '')
data['School Income Estimate'] = data['School Income Estimate'].apply(str).str.replace(' ', '')
data['School Income Estimate'] = data['School Income Estimate'].astype(str).apply(str_prc_to_float)
```

```
/var/folders/xz/7f46dqgn7631zr_snzyl0zn40000gn/T/ipykernel_14444/4160667054.py:27: FutureWarning: The default
value of regex will change from True to False in a future version. In addition, single character regular expr
essions will *not* be treated as literal strings when regex=True.
  data['School Income Estimate'] = data['School Income Estimate'].apply(str).str.replace('$', '')
```

In [13]:
```
#Percentages changed to floats
loc_data = pd.DataFrame(data.groupby(['District','City']).mean())
loc_data.head()
```

Out[13]:

District	City	SED Code	Latitude	Longitude	Zip	Economic Need Index	School Income Estimate	Percent Asian	Percent Black	Percent Hispanic	Percent Black / Hispanic
1	NEW YORK	3.101001e+11	40.721398	-73.982651	10004.769231	0.682923	446.401589	0.135385	0.192308	0.511923	0.702308
2	NEW YORK	3.102000e+11	40.743920	-73.984067	10037.520833	0.356063	949.857981	0.260833	0.084583	0.192292	0.277500
	ROOSEVELT ISLAND	3.102000e+11	40.763969	-73.948468	10044.000000	0.293000	933.880600	0.290000	0.160000	0.140000	0.300000
3	NEW YORK	3.103002e+11	40.794513	-73.964938	10025.153846	0.573385	613.573881	0.049487	0.364872	0.320256	0.684103
4	NEW YORK	3.104002e+11	40.794150	-73.941331	10030.593750	0.788000	317.496919	0.044063	0.321562	0.571875	0.893125

5 rows × 141 columns

Since we have converted our numeric values into floats, we do not have to further clean and convert the types of our data.

Summary Statistics

Average Proficiency and Economic Need Index

For the purposes for summary statistics, I will combine Average ELA Proficiency and Average Math Proficiency, and organize schools based on their combined average performance in Math and English.

In [35]:
```
#creating a new column for the average ELA and average Math proficiency combined
data['Average ELA and Math Proficiency'] = data[['Average ELA Proficiency','Average Math Proficiency']].mean(
data[['School Name', 'Average ELA Proficiency','Average Math Proficiency', 'Average ELA and Math Proficiency'
```

Out[35]:

	School Name	Average ELA Proficiency	Average Math Proficiency	Average ELA and Math Proficiency
0	P.S. 015 ROBERTO CLEMENTE	2.14	2.17	2.155
1	P.S. 019 ASHER LEVY	2.63	2.98	2.805
2	P.S. 020 ANNA SILVER	2.39	2.54	2.465
3	P.S. 034 FRANKLIN D. ROOSEVELT	2.48	2.47	2.475
4	THE STAR ACADEMY - P.S.63	2.38	2.54	2.460

In [36]:
```
data[['Average ELA and Math Proficiency', 'Economic Need Index']].describe()
```

Out[36]:

	Average ELA and Math Proficiency	Economic Need Index
count	1217.000000	1247.000000
mean	2.601586	0.672281
std	0.410410	0.210959
min	1.895000	0.049000
25%	2.275000	0.550000
50%	2.515000	0.731000
75%	2.860000	0.841000
max	4.040000	0.957000

Here, in the summary statistics of our outcome (y) variables Average ELA Proficiency and Average Math Proficiency, and our first explanatory (x_1) variable Economic Need Index, we can see that average elementary school has the proficiency levels for English and Math of 2.6, and an average economic need index of 0.67.

Average Proficiency and Location of School

In [66]:
```
loc_data = data.groupby(['City']).describe()
loc_data2 = loc_data[['Average ELA and Math Proficiency']]

#sorting values to show the top cities with the highest average combined proficiency levels
loc_data2.sort_values([('Average ELA and Math Proficiency', 'mean')], ascending=False)
```

Out[66]:

	Average ELA and Math Proficiency							
	count	mean	std	min	25%	50%	75%	max
City								
DOUGLASTON	1.0	3.390000	NaN	3.390	3.39000	3.3900	3.39000	3.390
LITTLE NECK	3.0	3.348333	0.145717	3.185	3.29000	3.3950	3.43000	3.465
BAYSIDE	12.0	3.302083	0.172554	3.010	3.20250	3.3000	3.35250	3.640
FOREST HILLS	5.0	3.193000	0.310898	2.815	2.94000	3.2600	3.38500	3.565
FLORAL PARK	3.0	3.188333	0.229692	3.020	3.05750	3.0950	3.27250	3.450
BELLEROSE	4.0	3.165000	0.188768	2.890	3.12250	3.2300	3.27250	3.310
WHITESTONE	5.0	3.126000	0.143239	2.970	3.02500	3.1050	3.20000	3.330
BROAD CHANNEL	1.0	3.090000	NaN	3.090	3.09000	3.0900	3.09000	3.090
FLUSHING	28.0	3.011607	0.245410	2.420	2.85125	3.0375	3.12750	3.650
KEW GARDENS	1.0	3.010000	NaN	3.010	3.01000	3.0100	3.01000	3.010
MIDDLE VILLAGE	4.0	2.970000	0.187661	2.710	2.91625	3.0075	3.06125	3.155
ROOSEVELT ISLAND	1.0	2.955000	NaN	2.955	2.95500	2.9550	2.95500	2.955
ASTORIA	6.0	2.945000	0.620613	2.125	2.65625	2.7925	3.31500	3.860
MASPETH	3.0	2.933333	0.098658	2.820	2.90000	2.9800	2.99000	3.000
COLLEGE POINT	2.0	2.902500	0.314663	2.680	2.79125	2.9025	3.01375	3.125
REGO PARK	6.0	2.895000	0.223942	2.545	2.76875	2.9525	3.04625	3.135
HOWARD BEACH	3.0	2.891667	0.090875	2.790	2.85500	2.9200	2.94250	2.965
GLENDALE	4.0	2.875000	0.314828	2.585	2.63375	2.8300	3.07125	3.255
ELMHURST	7.0	2.854286	0.186959	2.505	2.78250	2.9150	2.97500	3.045
WOODSIDE	7.0	2.814286	0.244582	2.360	2.73500	2.8550	2.96500	3.085
ROCKAWAY PARK	5.0	2.814000	0.617185	2.230	2.45500	2.5500	3.06000	3.775
LONG ISLAND CITY	21.0	2.800238	0.412579	2.045	2.50500	2.8150	2.98000	3.990
WOODHAVEN	3.0	2.760000	0.175855	2.575	2.67750	2.7800	2.85250	2.925
RICHMOND HILL	7.0	2.760000	0.173445	2.525	2.68500	2.7300	2.81000	3.075
JACKSON HEIGHTS	8.0	2.751250	0.206341	2.425	2.62375	2.7875	2.92500	2.975
QUEENS VILLAGE	6.0	2.736667	0.196994	2.540	2.60750	2.6900	2.80250	3.080
STATEN ISLAND	60.0	2.722083	0.326516	2.145	2.43500	2.8100	2.97625	3.420
NEW YORK	220.0	2.707795	0.516989	1.895	2.25875	2.5750	3.11625	4.040
OZONE PARK	6.0	2.695833	0.064064	2.625	2.64125	2.6950	2.73750	2.785
EAST ELMHURST	3.0	2.680000	0.342089	2.385	2.49250	2.6000	2.82750	3.055
SOUTH OZONE PARK	10.0	2.670500	0.234633	2.355	2.45125	2.7375	2.81750	2.995
CAMBRIA HEIGHTS	2.0	2.657500	0.434871	2.350	2.50375	2.6575	2.81125	2.965
SOUTH RICHMOND HILL	1.0	2.650000	NaN	2.650	2.65000	2.6500	2.65000	2.650
RIDGEWOOD	7.0	2.619286	0.243506	2.340	2.48000	2.5650	2.69250	3.085
JAMAICA	31.0	2.578710	0.319851	2.175	2.35750	2.4850	2.73500	3.480
BROOKLYN	394.0	2.563020	0.376640	1.925	2.27500	2.4775	2.78875	4.010
SAINT ALBANS	5.0	2.467000	0.220074	2.225	2.39000	2.4050	2.49500	2.820
CORONA	8.0	2.446250	0.127132	2.275	2.37250	2.4400	2.53125	2.630
HOLLIS	4.0	2.425000	0.107781	2.335	2.35375	2.3950	2.46625	2.575
ROSEDALE	4.0	2.421250	0.196527	2.215	2.28250	2.4125	2.55125	2.645
SPRINGFIELD GARDENS	10.0	2.407000	0.190543	2.170	2.27375	2.3775	2.56750	2.705
BRONX	280.0	2.383036	0.286281	1.905	2.19500	2.3100	2.53500	3.600
FAR ROCKAWAY	13.0	2.324615	0.226784	2.060	2.17000	2.2700	2.43000	2.855
ARVERNE	2.0	2.302500	0.413657	2.010	2.15625	2.3025	2.44875	2.595
ROCKAWAY BEACH	1.0	2.120000	NaN	2.120	2.12000	2.1200	2.12000	2.120

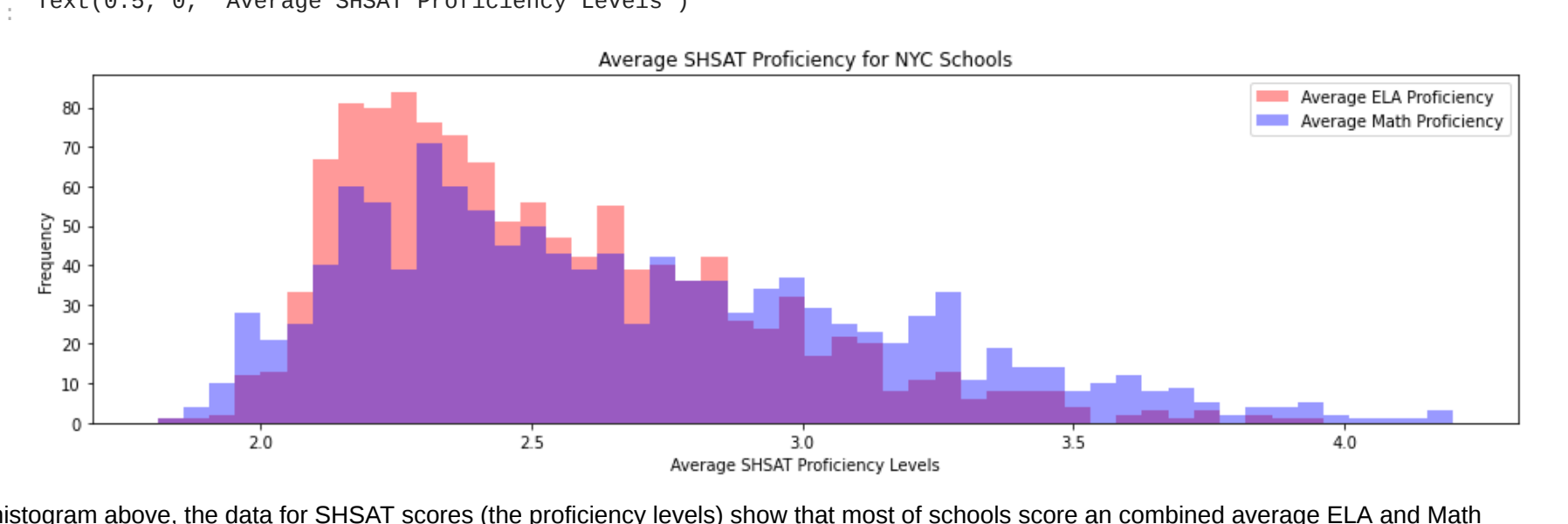
Here, in the summary statistics of our outcome variable (y) Average ELA Proficiency and Average Math Proficiency, and our second explanatory variable (x_2) Economic Need Index, we can see the cities with the top average combined ELA and Math proficiency scores. However, it is important to note that there is a large discrepancy between the number of schools within each city (as denoted by the column count). New York City and the Bronx both has over 200+ schools, while the cities that ranked in the top 10 of the highest average combined proficiency levels have 12 or less schools.

Histogram of Outcome Variable

In [74]:
```
#creating a dataframe with just the proficiency variables
data_p = data[['Average ELA Proficiency', 'Average Math Proficiency']]

#creating a histogram
fig,ax = plt.subplots(figsize=(16,4))
data_p.plot.hist(bins=50,ax=ax, alpha=0.4, #making the colour value lower
          color=['r','b'],
          title='Average SHSAT Proficiency for NYC Schools')
ax.set_xlabel('Average SHSAT Proficiency Levels')
```

Out[74]: Text(0.5, 0, 'Average SHSAT Proficiency Levels')



From the histogram above, the data for SHSAT scores (the proficiency levels) show that most of schools score an combined average ELA and Math level of 2.3-2.4, and only a very slim minority of schools are able to score beyond levels of 3.25. We also that the distribution peaks at proficiency levels of 2.3, and that see fewer and fewer schools score past that point. This right-skewed distribution can be reasonably explained because it becomes increasingly more difficult to score higher marks, and the number of schools taper off as we move towards a student population who are able to score near-perfect.

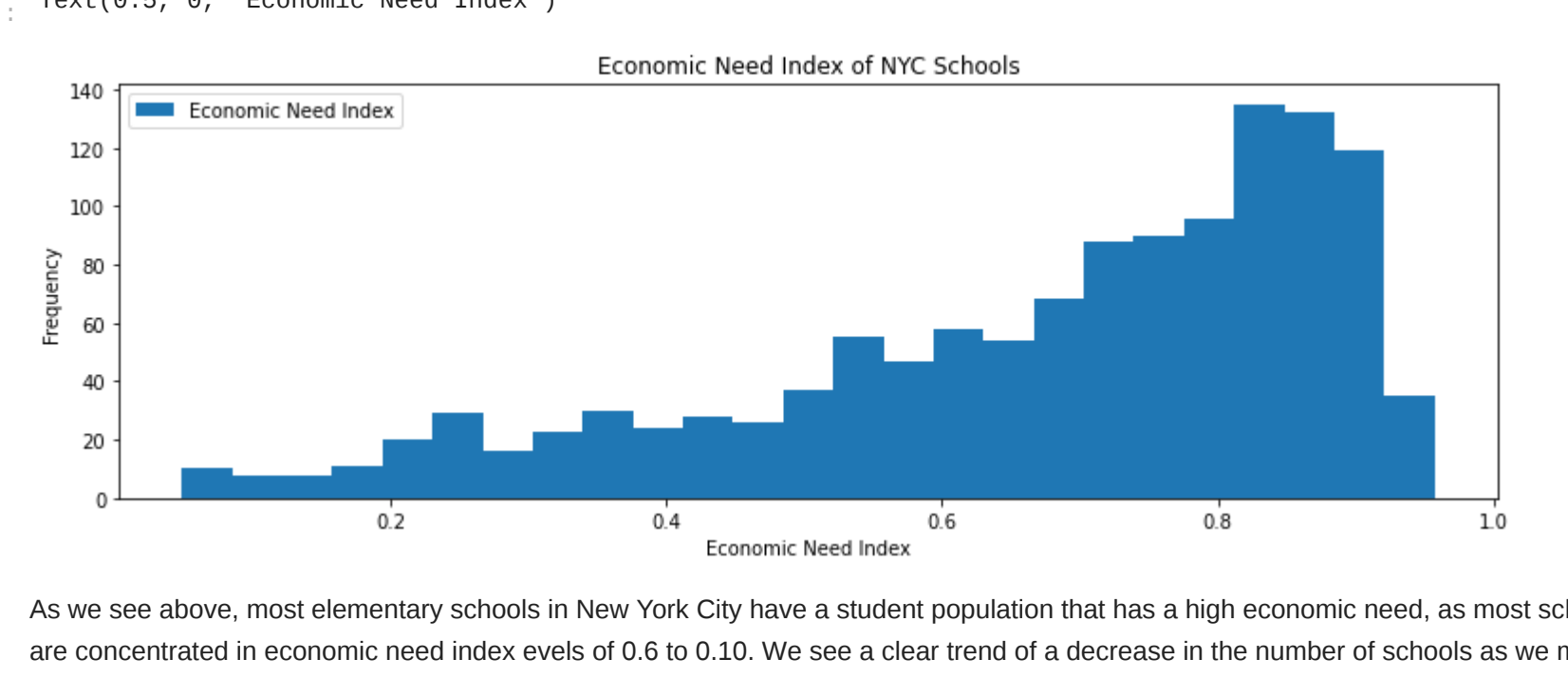
Graphs of Explanatory Variables

Histogram of Economic Need Index

In [71]:
```
data_e = data[['Economic Need Index']]

fig,ax = plt.subplots(figsize=(13,4))
data_e.plot.hist(bins=25,ax=ax, title='Economic Need Index of NYC Schools')
ax.set_xlabel('Economic Need Index')
```

Out[71]: Text(0.5, 0, 'Economic Need Index')



As we see above, most elementary schools in New York City have a student population that has a high economic need, as most schools are concentrated in economic need index evels of 0.6 to 0.10. We see a clear trend of a decrease in the number of schools as we move leftward towards a lower economic need index. This pattern of distribution makes sense as it approximately reflects the household income distribution in New York City. The majority of New York City household annual incomes are 60, 000orbelow, andfewerandfewerhouseholdsearningincomesof60,00-100, 000bracket, andasmallminorityofhouseholdsearningincomesof100,000 and more.

Groupby Table and Boxplot of Locations of School

In [134…
```
#creating a table counting the number of schools per city
gb_data = data.groupby(['City'])
schools_per_city = gb_data['School Name'].count().sort_values(ascending=False).reset_index().set_index('City'
schools_per_city.rename(columns={'School Name':'Number of Schools'}, inplace=True)
schools_per_city.head(20)
```

Out[134…

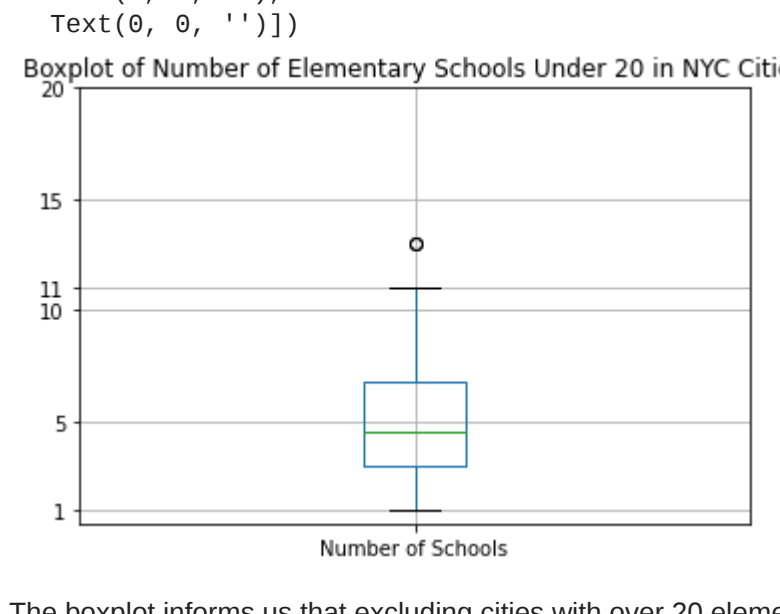
	Number of Schools
City	
BROOKLYN	411
BRONX	297
NEW YORK	232
STATEN ISLAND	60
JAMAICA	32
FLUSHING	30
LONG ISLAND CITY	21
BAYSIDE	13
FAR ROCKAWAY	13
SPRINGFIELD GARDENS	11
SOUTH OZONE PARK	10
CORONA	9
JACKSON HEIGHTS	8
ELMHURST	8
WOODSIDE	7
RICHMOND HILL	7
RIDGEWOOD	7
FOREST HILLS	6
QUEENS VILLAGE	6
OZONE PARK	6

There are three clear outliers: Brooklyn has 411 schools, Bronx has 297 schools, and New York has 232 schools. There are four other datapoints that may be considered as outliers: Staten Island, Jamaica, Flushing, and Long Island City. These four cities have over 20 elementary schools, which the rest of the cities in New York City do not.

To get a better visualization of the lower quartile, median, upper quartiles, we will look at the boxplot with cities under 20 schools.

In [140…
```
#creating a boxplot
under_20 = schools_per_city <= 20
schools_per_city[under_20].boxplot()
plt.title('Boxplot of Number of Elementary Schools Under 20 in NYC Cities')
plt.yticks([1, 5, 10, 11, 15, 20])
```

Out[140…
```
([<matplotlib.axis.YTick at 0x7fcda40c4eb0>,
  <matplotlib.axis.YTick at 0x7fcda40c4730>,
  <matplotlib.axis.YTick at 0x7fcda40d2190>,
  <matplotlib.axis.YTick at 0x7fcda42d5d30>,
  <matplotlib.axis.YTick at 0x7fcda42df4c0>,
  <matplotlib.axis.YTick at 0x7fcda42dfc10>],
 [Text(0, 0, ''),
  Text(0, 0, ''),
  Text(0, 0, ''),
  Text(0, 0, ''),
  Text(0, 0, ''),
  Text(0, 0, '')])
```



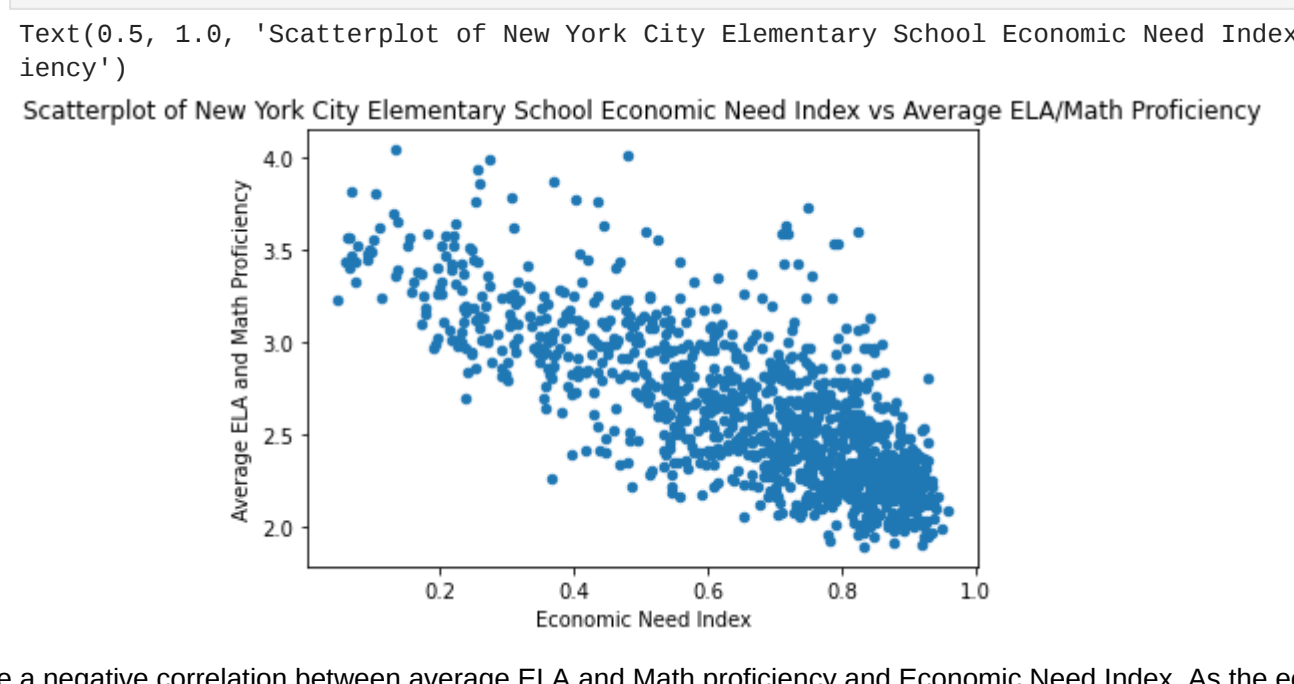
The boxplot informs us that excluding cities with over 20 elementary schools, we observe that the school in the 50th percentile has around 5 schools and the local maximum for the number of elementary schools in a NYC city is 11.

Scatterplot of y, x_1, and x_2 variables

Economic Need Index vs SHSAT Proficiency

In [169…
```
#creating a scatterplot
data.plot.scatter(x='Economic Need Index', y='Average ELA and Math Proficiency')
plt.title('Scatterplot of New York City Elementary School Economic Need Index vs Average ELA/Math Proficiency
```

Out[169…
```
Text(0.5, 1.0, 'Scatterplot of New York City Elementary School Economic Need Index vs Average ELA/Math Profic
iency')
```

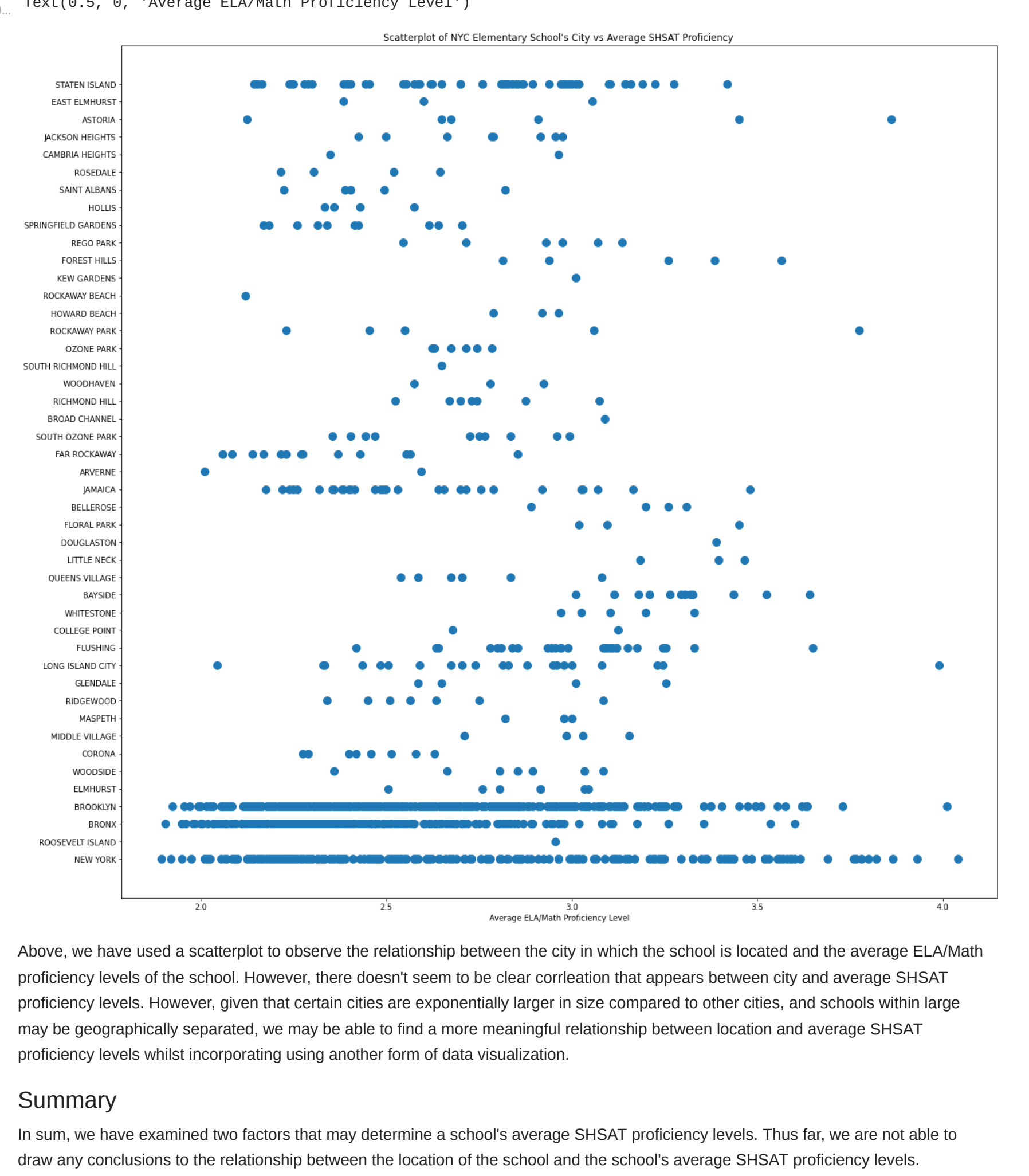


Here, we see a negative correlation between average ELA and Math proficiency and Economic Need Index. As the economic need of the school's student populations are higher, the average ELA/Math proficiency decreases. This is an expected and logical outcome; students who are socioeconomically better off tend to do better academically due to the additional resources and support they are able to acquire, while students who are socioeconomically disadvantaged cannot access or afford such capital, like parental support and supplementary classes.

Location of School vs SHSAT Proficiency

In [170…
```
#creating a scatterplot
plt.figure(figsize=(20,20))
plt.scatter(x=data['Average ELA and Math Proficiency'], y=data['City'], s=100)
plt.title("Scatterplot of NYC Elementary School's City vs Average SHSAT Proficiency ")
plt.xlabel('Average ELA/Math Proficiency Level')
```

Out[170…
```
Text(0.5, 0, 'Average ELA/Math Proficiency Level')
```



Above, we have used a scatterplot to observe the relationship between the city in which the school is located and the average ELA/Math proficiency levels of the school. However, there doesn't seem to be clear corrleation that appears between city and average SHSAT proficiency levels. However, given that certain cities are exponentially larger in size compared to other cities, and schools within large may be geographically separated, we may be able to find a more meaningful relationship between location and average SHSAT proficiency levels whilst incorporating using another form of data visualization.

Summary

In sum, we have examined two factors that may determine a school's average SHSAT proficiency levels. Thus far, we are not able to draw any conclusions to the relationship between the location of the school and the school's average SHSAT proficiency levels. However, there seems negative relationship between the school's SHSAT proficiency and the economic need of the school's student population.

Future Steps

To further examine the factors that determine a school's average performance in the SHSAT, we should examine more closely the location, particularly utlizing the other variables available to denote geographic location other city.

In [ ]: