The Effect of Education on Crime Rate in Bristol, UK.

A DATA SCIENCE CAPSTONE PROJECT

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Introduction

Background

Bristol is a bustling city enveloped in the hills of South West England and straddling the River Avon. The centuries-old heritage and classical architecture give this place its own unmistakable identity.

The city dwellers of Bristol grew in population from 535,907 in 2011, to 679,000 in 2019 as its high street markets and shopping districts continued to prosper. Hence, the original plan for this project was to investigate the growth of population against the growth of retail stores and businesses. However, with the current state of COVID19 in the UK, future growth has become much harder to predict.

As an aerospace engineer, Bristol is a key area for me – it is home to the British Ministry of Defence, BAE Systems, Airbus, MBDA, to name a few. Therefore, I would personally like to know what areas are considered better than others, and why. To kickstart this journey, I will look at education and crime – two opposites that can either make or break a district.

Figure 1: Houses in Clifton.

The Problem

Bristol is generally a safe place. However, there is still moderate risk of petty crimes such as pickpocketing and robbery. The more built-up districts of the city have a generally higher rate of crime compared to lesser areas. This is due to many reasons, but my question for this report is:

"Does education directly affect crime rate in Bristol?"

Search engines would most certainly have multiple answers, accompanied by many arguments. However, I wish to explore this question thoroughly with unbiased, publicly available data, and then go even deeper by looking at neighbourhoods individually and pinpointing locations that would greatly benefit from having a better education system.

A safer city will most definitely result in a better economy. Thus, being able to identify weak points in the system to better educate the population is a very powerful tool indeed. This investigation will cover all ages from nursery to university, as different age groups may provide insight into which stage(s) of education may be struggling the most.

Aims

The primary goal of this report is to explore each district in Bristol, comparing their education systems with their crime rates each year from 2016 to 2020. With these findings, I hope to make recommendations for each district on what they should do next, so that the population may feel safer and more secure in their respective neighbourhoods.

As a secondary goal, I hope to show that there is a strong correlation between the two, as that could reinforce the belief that people who commit crime generally have poor childhoods.

Objectives

The investigation will begin by determining the most suitable method of comparing education and crime. Then gathering that information and turning it into data that can be manipulated and analysed.

By using machine learning and visualisation techniques, I will discuss predictions and any anomalies that occur. Following this, I will come up with suggestions based on the data from each district.

Throughout this report, I must use Foursquare's API and Python's data science packages to be able to meet the requirements of the IBM capstone project.

Data

How?

Data can be used to solve this problem by providing valuable information on crime rate and education. Through visualisation techniques, the data can show different trends and patterns that otherwise would be very difficult to see.

When using data science tools such as Python's Pandas, Numpy, and sci-kit learn packages, the data can be extracted from multiple sources, collated, manipulated and analysed to provide future predictions and recommendations.

What?

The data that this project is going to need includes crime records of every district in Bristol from 2016-2020, along with all local schools ranging from nursery to university.

For choropleth charts and data mapping, I will also require geographical coordinates of the districts and crime reports.

Where?

The crime data must come from a reliable, unbiased source. Preferably from local councils or government websites. Therefore, the crime data will be taken from Bristol's government website (opendata.bristol.gov.uk). Foursquare's API will be used to gather information on the schools in each district.

Geographical data can be obtained either from the same sources as the other data, or by using Python packages to turn addresses into geographical coordinates (latitude, longitude). Fortunately, the same site where the crime data is found also provides GeoJSON data.

Preferably, the data should be in CSV and JSON format for ease of use. However, Python can be used to scrape tabular data from HTML pages (websites) should the need arise.

Methodology

Data Analysis and Results

The crime data had a column that would not allow Pandas to read the file, so I had to use an external tool to remove it. The resulting data frame is below:

	Ward Code	Ward Name	Time Period	Latest Mid-Year Population Estimates for Ward	All Crimes (number)	All Crimes (rate per 1000 ward population)	Violent & Sexual Offences (number)	Violent & Sexual Offences (rate per 1000 ward population)	Burglary (number)	Burglary (rate per 1000 ward population)	geo_point_2d
0	E05010889	Bishopsworth	2016/17	11553	1504	130.182637	419	36.267636	116	10.040682	51.4217865816, -2.61645797497
1	E05010906	Knowle	2016/17	13425	1124	83.724395	362	26.964618	91	6.778399	51.4327758412, -2.57233571619
2	E05010909	Redland	2016/17	13251	790	59.618142	159	11.999094	135	10.187910	51.4752437813, -2.60115989823
3	E05010911	St George Troopers Hill	2016/17	5891	227	38.533356	68	11.543032	24	4.074011	51.4534343901, -2.53032305762
4	E05010914	Southville	2016/17	12118	2085	172.058095	484	39.940584	170	14.028718	51.4433202033, -2.60399275913

Figure 2: Bristol Crime Data

I intended to use the geographical coordinates provided by this data frame (the far-right column). But, in its current format, it would not work. To fix this, I split them up into two separate columns, then concatenated them to the above data frame, dropping the original column. The format of these new columns had to be corrected also, since they flagged as objects when they are floats.

Foursquare's API was used to find education-related buildings in Bristol. While the gathering of place names and locations is very useful, the value of this tool lied in its ability to retrieve metadata for every place it found such as reviews, images, open hours etc. However, while extra metadata would benefit this investigation, the amount of data to work with would sky-rocket, and because not every place has metadata, it would be extremely difficult and time-consuming to sift through them. As this project continued, I discover that I do not even need the extra information from Foursquare to conclude anyway.

By isolating the columns that I needed from the crime data frame, I found it far easier to use Foursquare's API. These columns were the names of each ward, latitude, and longitude. After calling my own function to gather the relevant data from Foursquare, I received the following data frame.

	Ward	School	School Latitude	School Longitude	School Category
0	Bishopsworth	Bishopsworth Library	51.419068	-2.616849	College Library
1	Bishopsworth	Bedminster Down Secondary School	51.422320	-2.620947	High School
2	Bishopsworth	St Peters School bishopsworth	51.417530	-2.616770	School
3	Knowle	Knowle Library	51.434223	-2.566695	College Library
4	Knowle	Arran	51.435455	-2.573173	Fraternity House
...	...	...	...	...	...
306	Windmill Hill	Bloodhound Education Centre	51.444061	-2.586576	Trade School
307	St George Central	Footsteps Playgroup	51.465015	-2.524005	General College & University
308	St George Central	Orchard Lea Day Nursery	51.461829	-2.524184	College Academic Building
309	St George Central	Speedwell Nursery	51.465626	-2.532309	Nursery School
310	St George Central	Bristol Brunel Academy	51.467687	-2.528173	High School

311 rows × 5 columns

Figure 3: Schools in Bristol

This lists every school and school-related building in all of Bristol.

This investigation heavily relied on the ability to map information relating to crime and education. Through trial and error, I found Folium to be the best representation of my data. Folium is a Python library that, amongst other things, plots geospatial data. In other words, if data is linked to areas in the world, Folium can be a great way of visualising the behaviour or distribution of it.

Since this project focused purely on Bristol and its wards, I needed to acquire the geographical coordinates of Bristol itself. This could easily be obtainable from a search engine, but it was worth using Python to demonstrate its versatility.

The crime data is recorded over multiple years. Therefore, to understand the behaviour of crime rate, I needed to see maps of every year. To speed up the process of doing that, I created a function that does all the work of creating a choropleth map (heatmap) for us.

I also wanted to see every point on the map where there was an education-related building, so I added that also. Most of the points were densely packed together, so to make it look more professional, I clustered them. The clusters would split apart the closer you zoomed in - eventually showing points of each place where, when you clicked them, would reveal more information.

I used the function to generate the following four maps you see below.

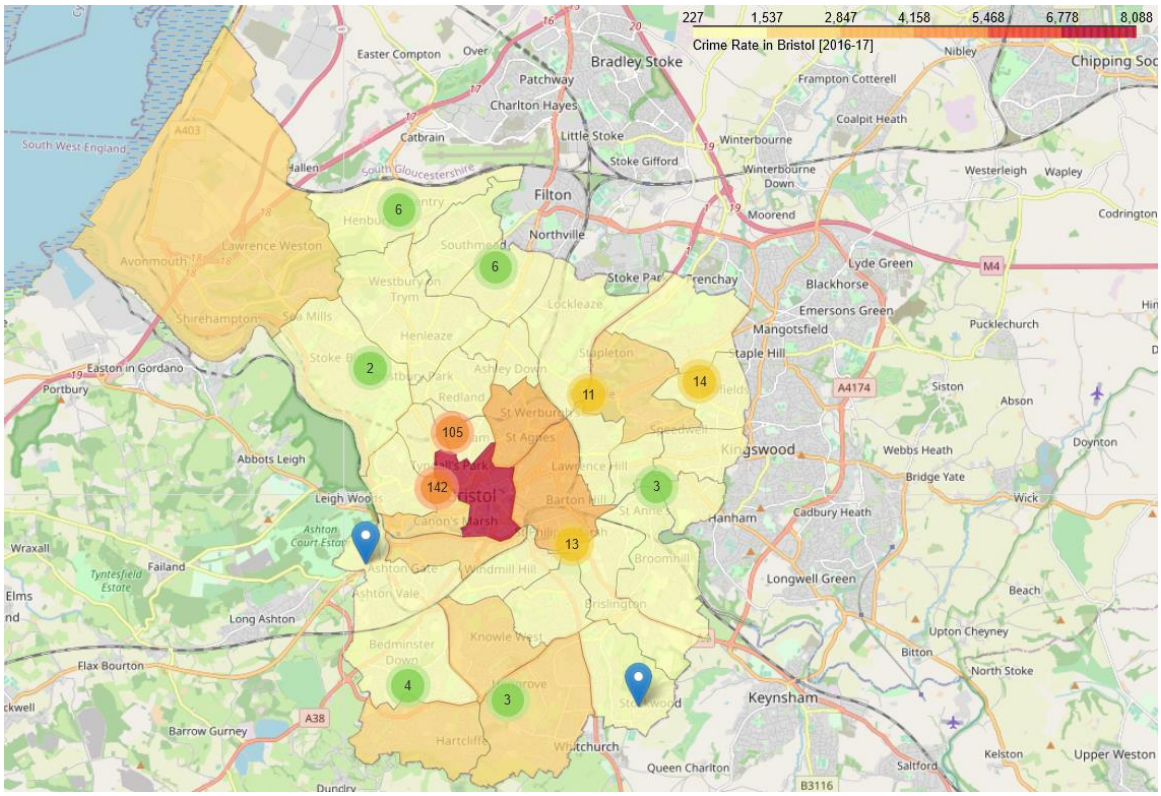

Figure 4: Bristol Crime Rate and Education (2016/17)

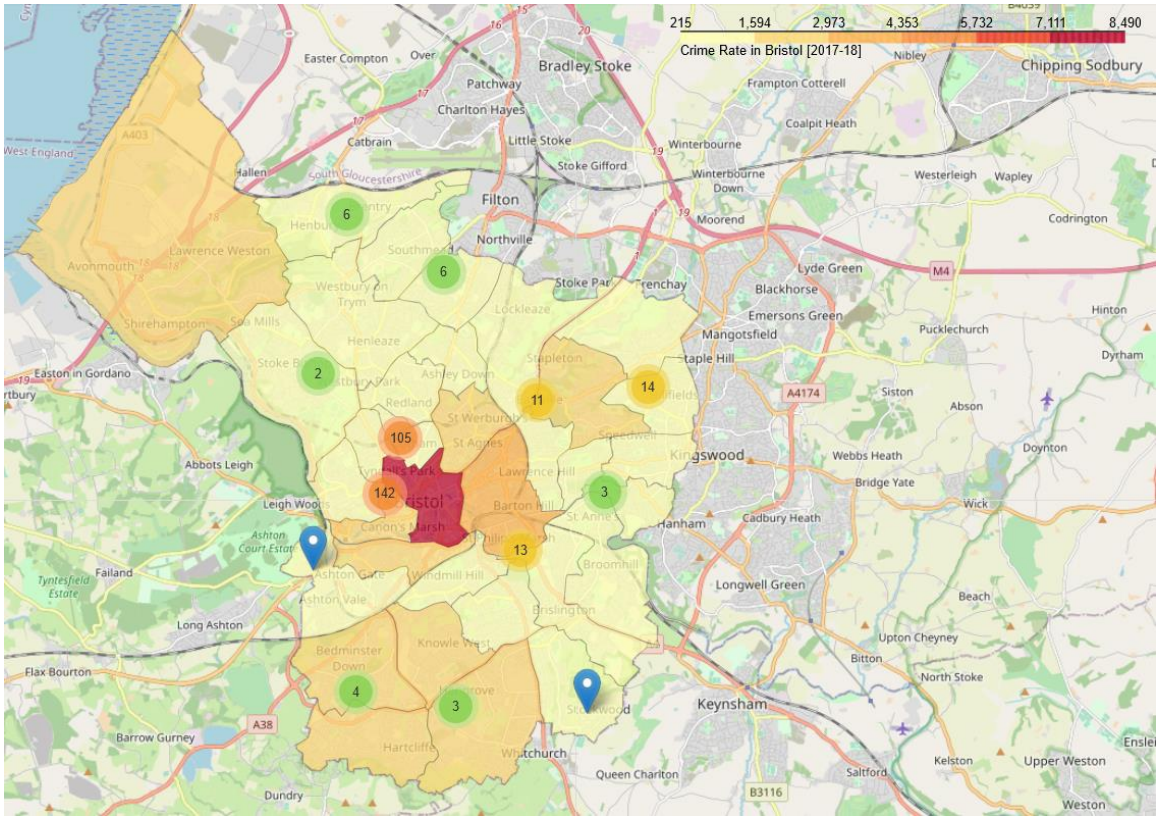

Figure 5: Bristol Crime Rate and Education (2017/18)

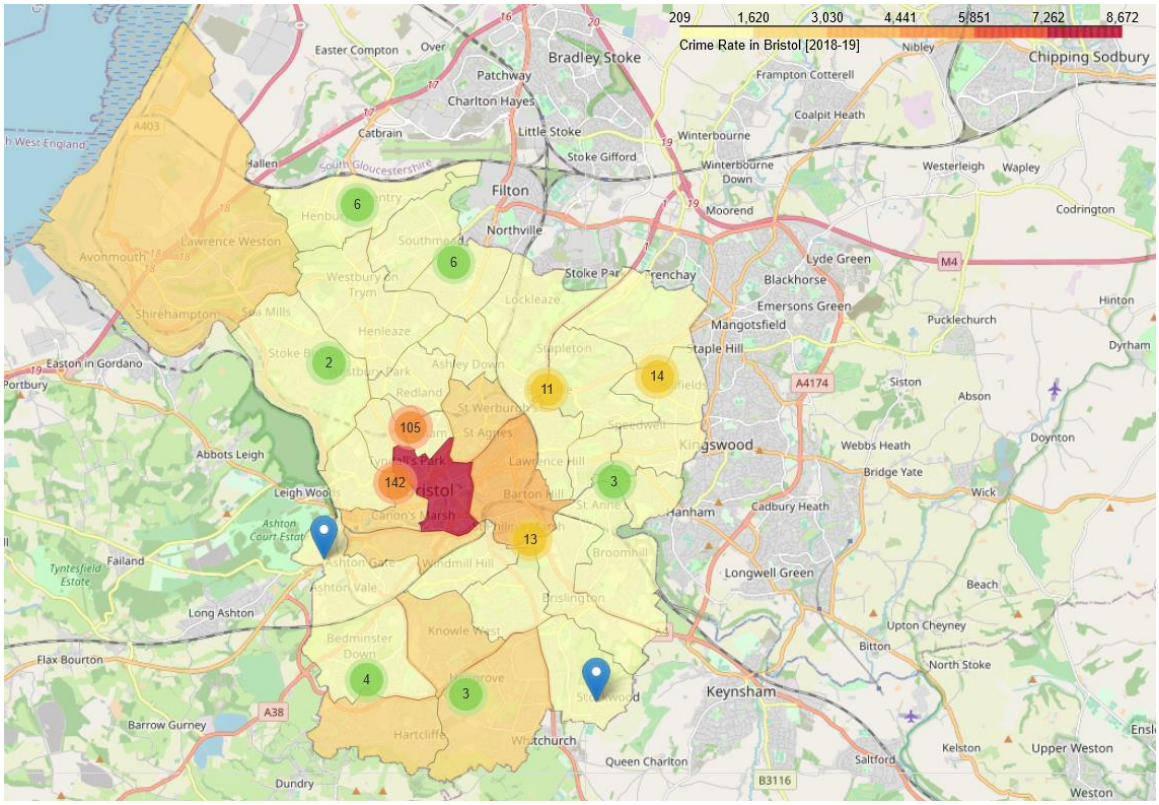

Figure 6: Bristol Crime Rate and Education (2018/19)

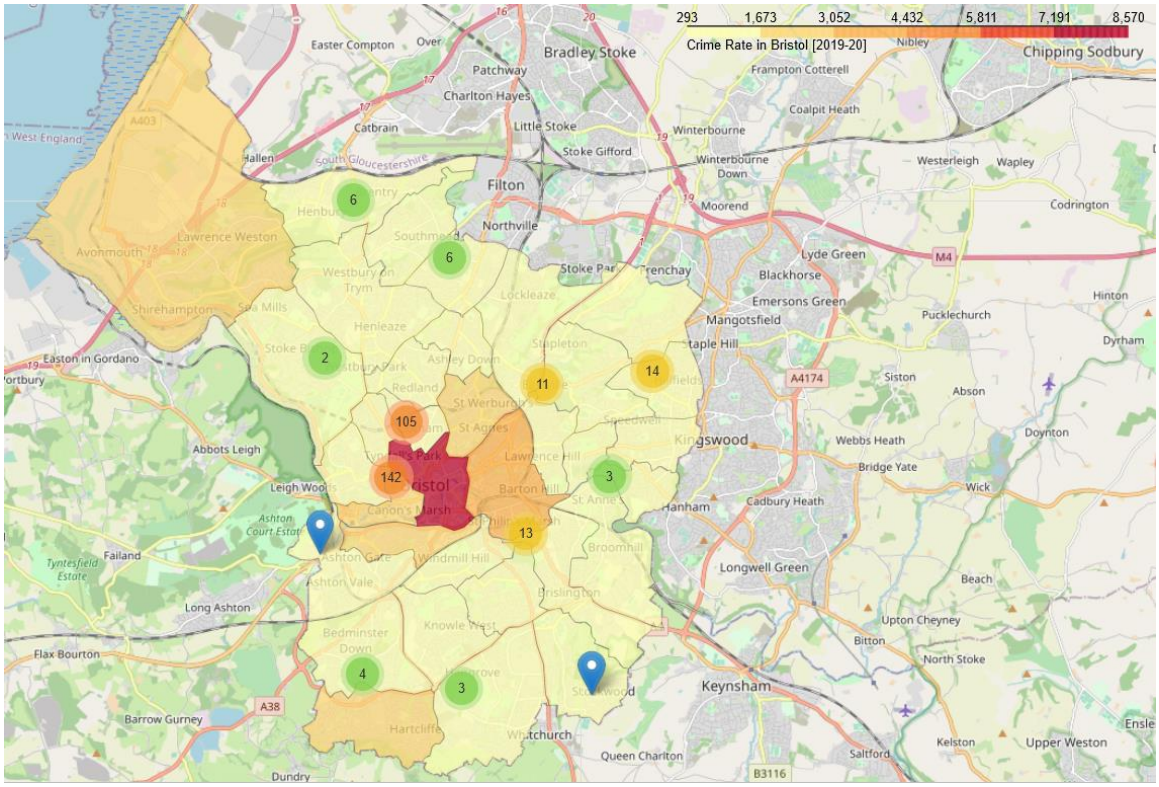

Figure 7: Bristol Crime Rate and Education (2019/20)

After comparing each chart to each other, they became apparent that crime rate had not changed significantly at all. Apart from minor fluctuations with certain wards, most wards kept a consistent colour. However, that did not necessarily mean that was a good sign. For Bristol had remained red throughout all the years I analysed.

Next, I wanted to know how many schools were in each ward. With Pandas, I was easily able to do that. Below are five wards with the most school-related buildings.

	Ward	No. of Schools
0	Central	47
1	Cotham	47
2	Clifton Down	41
3	Hotwells & Harbourside	37
4	Clifton	36

Figure 8: Wards with Most Schools.

From this, you can see that Cotham and Central ranked the highest. Cotham is next to Central, yet its crime rate remained significantly lower compared to Central. From this, I wanted to know exactly how much crime occurred in each ward.

	Ward	Total Crimes
0	Central	8088
1	Lawrence Hill	3549
2	Ashley	3119
3	Hartcliffe & Withywood	2453
4	Avonmouth & Lawrence Weston	2397

Figure 9: Wards with Most Crime.

Central was already known from the choropleth maps, but the others were not what I expected. I had expected to see crime rate climb, the closer it got to Central. But it did not. In fact, it was sporadic.

Combining the two new data frames, you can see that Central, while having the highest crime rate, also had the most schools.

	Ward	No. of Schools	Total Crimes
0	Central	47	8088
1	Lawrence Hill	7	3549
2	Ashley	6	3119
3	Hartcliffe & Withywood	1	2453
4	Hotwells & Harbourside	37	2337

Figure 10: Schools in High-Crime Wards.

Using the data frame in figure 10, I tried to find correlation between number of schools and crime. I used a package called Seaborn, to quicken the process.

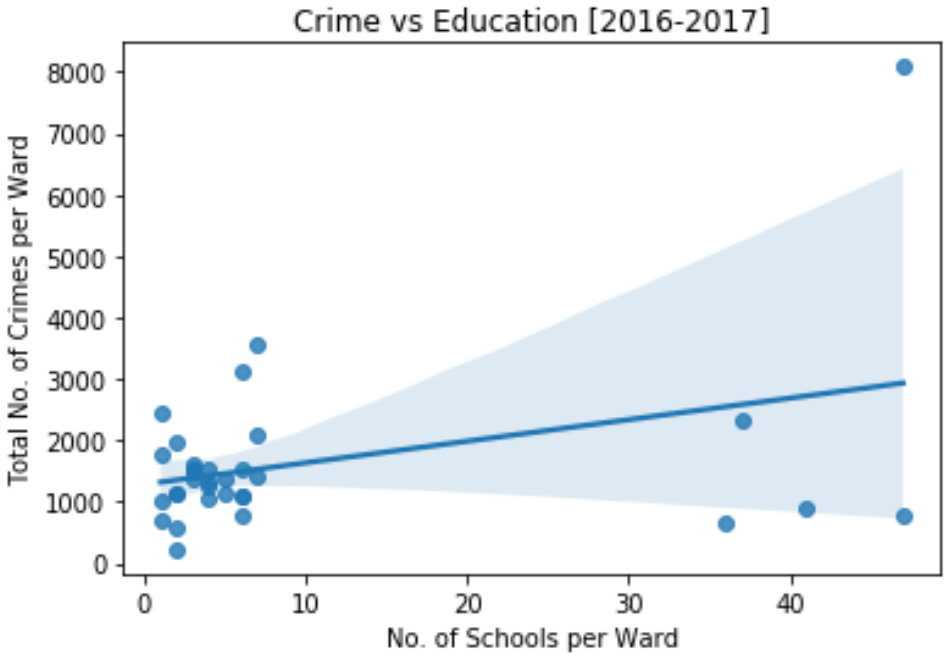

Figure 11: Crime vs Education - Regression.

Unfortunately, while the regression line did show a slight indication of positive correlation, it was not enough to determine. I needed to look at this problem from a different perspective. I began looking at what types of schools were in each ward. Starting with Central.

```
College Residence Hall            9
College Science Building          6
College Academic Building         4
College Lab                       4
College Administrative Building   3
College Library                   3
General College & University      3
University                        3
Student Center                    3
College Auditorium                2
College Engineering Building      2
Language School                   1
Community College                 1
College Math Building             1
College Gym                       1
Hospital                          1
Name: School Category, dtype: int64
```

Figure 12: Types of Schools in Central.

As we know, Central is the highest-ranking ward for crime, and now we know that the only form of education there are universities and colleges. Now I wanted to look for a pattern. I found that Lawrence Hill, the second highest ward for crime also had mostly high-level education.

On the other hand, Westbury-on-Trym & Henleaze, very low-ranking wards for crime consisted of only high schools and elementary schools. Henbury and Brentry, another pair of low-ranking crime wards, had purely lower-level schools.

```
School              2
Language School     1
Middle School       1
Elementary School   1
Name: School Category, dtype: int64
```

Figure 13: Henbury and Brentry List of School Types.

After this analysis, I believe that it may be more than a coincidence that there is only high-level education in the high-crime rate wards. There is nowhere local for younger people to learn, and that may play a part in why the crime-rate is so high.

I understand that population and tourism need to be considered when it comes to crime also, but are those other two parameters not affected too by poor education? A citizen's education can make a big difference on how safe a place can be.

Furthermore, an article written by the Safer Bristol association in 2015 mentions the average person that gets arrested in Bristol is 33 years old. At that age, they should be in a stable job somewhere with a decent life. Instead, they are committing crime.

Machine Learning

For this section of the project, I wanted to be able to visualise every type of school on a map, not just points. The machine learning technique I chose was KMeans because this is an algorithm that clusters data together. You may have noticed that the data was already clustered with the Folium maps, but this takes it a step further by considering the types of schools, and distances to each other. Using this algorithm would provide more insight.

KMeans is one of the most popular machine learning techniques out there, and for good reason. But first I needed to prepare the data. This is because KMeans will only work with categorical data that is in numerical format – it will not work with strings.

I split each school category up into their own columns, then if the school were in that category, the corresponding column would have a value of 1, 0 if they were not.

This data frame would work, but it is generally considered good practice to normalise the data first. This is because KMeans uses something known as Eulidean distance, which measures the distance between each centroid (a fixed point in a pre-determined location) and data point. The data point is clustered depending on which centroid it is closest too. Therefore, normalising the data makes the result unbiased.

I instructed the algorithm to create 5 clusters, and to loop 50 times. This is because centroids will move to the point in its cluster where it is at the mean distance to all other points. Therefore, letting the algorithm perform this task 50 times should be enough for this small dataset. The output was an array of integers ranging from 0 to 4. I now wanted this array to be integrated into a main data frame. So, I began creating a data frame that shows the top 5 most common school categories in each ward.

	Ward	1st Most Common School Category	2nd Most Common School Category	3rd Most Common School Category	4th Most Common School Category	5th Most Common School Category
0	Ashley	University	Community College	College Academic Building	College Quad	High School
1	Bedminster	Elementary School	High School	University	College History Building	College Soccer Field
2	Bishopston & Ashley Down	Elementary School	Community College	School	Music School	College Classroom
3	Bishopsworth	School	College Library	High School	University	College Gym
4	Brislington West	Elementary School	Community College	Music School	General College & University	University

Figure 14: Top 5 School Categories in Each Ward.

I already shown four examples of the apparent effect of school types in districts. But now you can see them all. Figure 14 is truncated as the list is quite long. However, the notebook shows the data frame in its entirety. Notice how all lower-crime wards all tend to have at least one low-tier school. I was now ready to plot the clusters I had created.

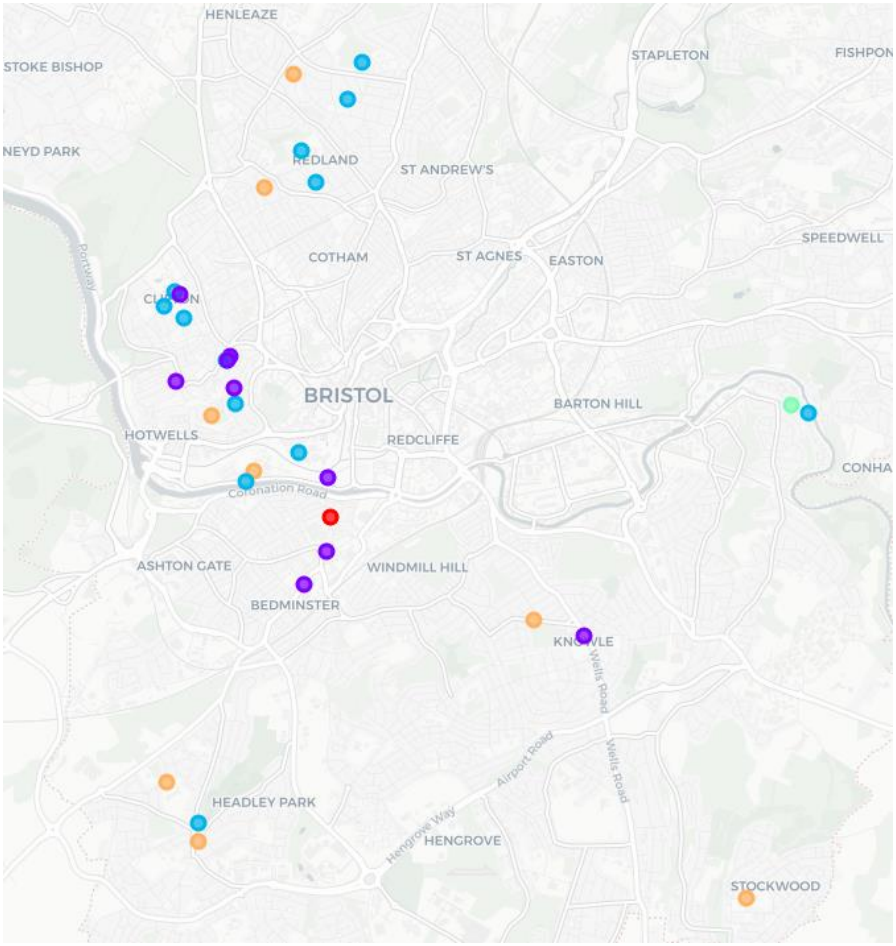

Figure 15: KMeans Clusters.

Figure 15 visualises the clusters so it is easier to see the distribution of school categories in Bristol. The map shows that the higher-tier schools tend to be closer to Central than lower-tier schools.

For further detail, I created a data frame that shows which school categories each cluster is assigned to. The tables are rather large, but they are necessary in this report. So, they can be found in the appendix.

Discussion

The analysis and results has shown that all 32 wards of Bristol share a common trait – that is, they all seem to behave the same when it comes to what type of school appears the most, compared to the rate of crime. We have found that wards with more crime records have higher-level education (colleges, universities etc.). Whereas the safer wards have lower-level education (nursery, elementary, high school).

If there is truly a connection between them (and not simply coincidence), would it not be a good idea to have schools for younger ages in the higher-crime wards? It sounds counter-intuitive seeing as there would probably be more tourism and high-rise businesses closer to Central but seeing as the other wards have significantly lower crime, it may not be such a bad idea.

The youths who live in Central must travel to other wards, far from home to even get an education in the first place. Bristol already has a big traffic problem, hence the diesel car ban coming in 2021, an article about this is in the reference section. The point is that there is more traffic than there needs to be in Bristol due to children travelling far to get to school. Would it not be safer for everyone if there were more local schools, especially in Central?

Then there is the economic side of the spectrum. Some families simply cannot afford to send their children to schools using busses, trains etc. While it would cost money and resources to maintain more schools in Bristol, I would say that it outweighs the money lost to crime every day. Businesses are forced to invest in tighter security measures, and there is still demand for more working-class people. A brand-new high school is due to open in Lockleaze by 2021, but looking at the results of this report, was that the best spot to have a new school? There is already a decent selection there, and crime rate is one of the lowest in the city.

On the other hand, I can certainly understand the appeal to parents for sending their children to safer places to learn. Given the decision, it would be very difficult to ignore that fact. The reputation of a school also plays a part in this, as well as the resources and teaching ability available to pupils.

Conclusion

I starting this project hoping to find out that education directly affected crime rate in Bristol and ended up knowing that education really is just one of so many aspects to consider. It is a conundrum - crime rate would decrease with the presence of lower-level education in wards that do not have them, but it is easier said than done.

Python was used here to try and tackle my question, and I can say I am satisfied with the answer. I always knew it would be open-ended, but with the help of the visualisations and results, I can understand the problem much more clearly, and thus apply this report to as many other cites (even countries) as I desire. I used Bristol because I am familiar with it, so it was easier to work with, but this behaviour would most likely be the same in any other city in the UK.

The report itself went quite well, considering. There were many hurdles due to my inexperience, but they were eventually fixed. One big hurdle was using the Foursquare API to find the schools. If I were using it for venues such as stadiums or restaurants, I would probably have much more information to work with. As I was building the function to search for all schools in the city, I found that I could not acquire information on addresses or reviews, simply because not every place had that information. Foursquare definitely revealed its limitations in this report, but I do not believe it hindered the outcome of this investigation.

Which finally leads me to what I would change next time round. I would consider venues that provided more metadata. I would also change my methods so that I could use different visualisations and machine learning techniques, such as histograms and recommendation engines, just to see how they behave. And given the choice, I would use a different API that maybe has more information, because Foursquare was not the best option for this investigation.

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Appendix 1 – Cluster 1

	Ward	School	School Latitude	School Longitude	School Category	Cluster Labels	1st Most Common School Category	2nd Most Common School Category	3rd Most Common School Category	4th Most Common School Category	5th Most Common School Category
187	Hartcliffe & Withywood	Merchants Academy	51.410237	-2.613107	College Gym	0	College Gym	Trade School	College Stadium	College Soccer Field	College Science Building

Appendix 2 – Cluster 2

	Ward	School	School Latitude	School Longitude	School Category	Cluster Labels	1st Most Common School Category	2nd Most Common School Category	3rd Most Common School Category	4th Most Common School Category	5th Most Common School Category
0	Bishopsworth	Bishopsworth Library	51.419068	-2.616849	College Library	1	School	College Library	High School	University	College Gym
1	Bishopsworth	Badminster Down Secondary School	51.422320	-2.620947	High School	1	School	College Library	High School	University	College Gym
2	Bishopsworth	St Peters School bishopsworth	51.417530	-2.616770	School	1	School	College Library	High School	University	College Gym
13	Southville	Holy Cross Rc Primary School	51.443853	-2.599627	Elementary School	1	Elementary School	University	School	College Cafeteria	Law School
14	Southville	Compass Point Primary School	51.438425	-2.603009	Elementary School	1	Elementary School	University	School	College Cafeteria	Law School
15	Southville	Dockyard. Creative Hub + Coffee	51.447592	-2.609527	College Cafeteria	1	Elementary School	University	School	College Cafeteria	Law School
16	Southville	HH Wells Labs	51.447102	-2.599967	University	1	Elementary School	University	School	College Cafeteria	Law School
17	Southville	Include	51.441077	-2.600098	School	1	Elementary School	University	School	College Cafeteria	Law School
18	Southville	Lewis Wing, Wills Memorial Building	51.449047	-2.603805	Law School	1	Elementary School	University	School	College Cafeteria	Law School
19	Southville	Spike Island (Art Centre & Gallery)	51.446723	-2.610583	Art Gallery	1	Elementary School	University	School	College Cafeteria	Law School
145	Henbury & Brentry	Language school	51.511560	-2.616771	Language School	1	School	Language School	Elementary School	Middle School	University
146	Henbury & Brentry	Henbury Court Primary School	51.509570	-2.628007	Elementary School	1	School	Language School	Elementary School	Middle School	University
147	Henbury & Brentry	Henbury School	51.509376	-2.631104	School	1	School	Language School	Elementary School	Middle School	University
148	Henbury & Brentry	brentry nursery	51.512269	-2.611865	School	1	School	Language School	Elementary School	Middle School	University
149	Henbury & Brentry	Blaise Primary	51.507055	-2.622836	Middle School	1	School	Language School	Elementary School	Middle School	University
150	Hillfields	Briarwood School	51.477243	-2.522229	School	1	Student Center	School	Elementary School	High School	University
151	Hillfields	Minerva Primary Academy	51.472469	-2.515713	Elementary School	1	Student Center	School	Elementary School	High School	University
152	Hillfields	Bristol Brunel Academy	51.467687	-2.528173	High School	1	Student Center	School	Elementary School	High School	University
153	Hillfields	Hillfield Baby Group	51.473029	-2.516143	Student Center	1	Student Center	School	Elementary School	High School	University
154	Westbury-on-Trym & Henleaze	Red Maids' School	51.490176	-2.615381	School	1	School	Elementary School	College Cafeteria	College Library	High School
155	Westbury-on-Trym & Henleaze	Badminton School	51.484987	-2.617270	High School	1	School	Elementary School	College Cafeteria	College Library	High School
156	Westbury-on-Trym & Henleaze	St Ursula's. An E-ACT School	51.486260	-2.613804	School	1	School	Elementary School	College Cafeteria	College Library	High School
157	Westbury-on-Trym & Henleaze	Урок Химии	51.485603	-2.618071	College Lab	1	School	Elementary School	College Cafeteria	College Library	High School
158	Westbury-on-Trym & Henleaze	Dining Hall	51.485309	-2.616616	College Cafeteria	1	School	Elementary School	College Cafeteria	College Library	High School
159	Westbury-on-Trym & Henleaze	Westbury On Trym Primary School	51.485536	-2.622072	Elementary School	1	School	Elementary School	College Cafeteria	College Library	High School
160	Westbury-on-Trym & Henleaze	School Library	51.485286	-2.618489	College Library	1	School	Elementary School	College Cafeteria	College Library	High School
178	St George West	Summerhill Academy	51.461548	-2.542017	School	1	School	University	College Gym	College Soccer Field	College Science Building
198	Lockleaze	Purdown BT Transmitter	51.485630	-2.561936	College Communications Building	1	School	Elementary School	College Classroom	College Communications Building	University
199	Lockleaze	Stoke Park Primary School	51.487717	-2.564929	School	1	School	Elementary School	College Classroom	College Communications Building	University
200	Lockleaze	The Lodge - Priory Hospital	51.479553	-2.566986	College Classroom	1	School	Elementary School	College Classroom	College Communications Building	University
201	Lockleaze	Filton Avenue Infanty School	51.489020	-2.571310	Elementary School	1	School	Elementary School	College Classroom	College Communications Building	University
295	Horfield	St. Teresa's Catholic Academy	51.500359	-2.589601	Elementary School	1	College & University	School	Elementary School	Medical Center	University
296	Horfield	Orchard School	51.497369	-2.580460	College & University	1	College & University	School	Elementary School	Medical Center	University
297	Horfield	St John Hall	51.491479	-2.586432	Medical Center	1	College & University	School	Elementary School	Medical Center	University
298	Horfield	Horfield C of E School	51.493846	-2.594607	School	1	College & University	School	Elementary School	Medical Center	University
301	Windmill Hill	Victoria Park Primary School	51.436704	-2.587765	Elementary School	1	Trade School	School	Cooking School	Elementary School	College Engineering Building
302	Windmill Hill	Little Kitchen	51.442042	-2.578588	Cooking School	1	Trade School	School	Cooking School	Elementary School	College Engineering Building
303	Windmill Hill	St. Mary Redcliffe C Of E Primary School	51.441822	-2.589523	School	1	Trade School	School	Cooking School	Elementary School	College Engineering Building
304	Windmill Hill	Bristol Hackspace	51.443161	-2.593931	College Lab	1	Trade School	School	Cooking School	Elementary School	College Engineering Building
305	Windmill Hill	S&B Automotive Academy	51.443873	-2.586585	College Engineering Building	1	Trade School	School	Cooking School	Elementary School	College Engineering Building
306	Windmill Hill	Bloodhound Education Centre	51.444061	-2.586576	Trade School	1	Trade School	School	Cooking School	Elementary School	College Engineering Building

Appendix 3 – Cluster 3

	Ward	School	School Latitude	School Longitude	School Category	Cluster Labels	1st Most Common School Category	2nd Most Common School Category	3rd Most Common School Category	4th Most Common School Category	5th Most Common School Category
3	Knowle	Knowle Library	51.434223	-2.566695	College Library	2	Fraternity House	College Library	University	College Theater	College Soccer Field
4	Knowle	Arran	51.435455	-2.573173	Fraternity House	2	Fraternity House	College Library	University	College Theater	College Soccer Field
5	Redland	St. Bonaventure's School	51.477758	-2.597445	High School	2	High School	College Academic Building	College Rec Center	Nursery School	University
6	Redland	Redland Green School	51.473540	-2.603400	High School	2	High School	College Academic Building	College Rec Center	Nursery School	University
7	Redland	Bishop Road School Field	51.480698	-2.595603	College Rec Center	2	High School	College Academic Building	College Rec Center	Nursery School	University
...	...	...	...	...	...	...	...	...	...	...	...
300	Stoke Bishop	Trinity College	51.476801	-2.628839	University	2	University	College Residence Hall	Trade School	College Stadium	College Soccer Field
307	St George Central	Footsteps Playgroup	51.465015	-2.524005	General College & University	2	College Academic Building	Nursery School	General College & University	High School	University
308	St George Central	Orchard Lea Day Nursery	51.461829	-2.524184	College Academic Building	2	College Academic Building	Nursery School	General College & University	High School	University
309	St George Central	Speedwell Nursery	51.465626	-2.532309	Nursery School	2	College Academic Building	Nursery School	General College & University	High School	University
310	St George Central	Bristol Brunel Academy	51.467687	-2.528173	High School	2	College Academic Building	Nursery School	General College & University	High School	University

Appendix 4 – Cluster 4

	Ward	School	School Latitude	School Longitude	School Category	Cluster Labels	1st Most Common School Category	2nd Most Common School Category	3rd Most Common School Category	4th Most Common School Category	5th Most Common School Category
197	Filwood	Knowle West Media Centre	51.425299	-2.59352	Convention Center	3	Convention Center	University	College Theater	College Soccer Field	College Science Building

Appendix 5 – Cluster 5

	Ward	School	School Latitude	School Longitude	School Category	Cluster Labels	1st Most Common School Category	2nd Most Common School Category	3rd Most Common School Category	4th Most Common School Category	5th Most Common School Category
20	Stockwood	Waycroft Academy	51.412947	-2.545628	Elementary School	4	Elementary School	University	College Theater	College Soccer Field	College Science Building
161	Bishopston & Ashley Down	Bishop Road Primary School	51.480038	-2.593917	Elementary School	4	Elementary School	Community College	School	Music School	College Classroom
162	Bishopston & Ashley Down	Bobby's Place	51.482452	-2.585923	Music School	4	Elementary School	Community College	School	Music School	College Classroom
163	Bishopston & Ashley Down	Ashley Down Infant School	51.483632	-2.584845	School	4	Elementary School	Community College	School	Music School	College Classroom
164	Bishopston & Ashley Down	Brunel Field Primary School	51.478412	-2.582722	Elementary School	4	Elementary School	Community College	School	Music School	College Classroom
165	Bishopston & Ashley Down	B2.20	51.478022	-2.580910	College Classroom	4	Elementary School	Community College	School	Music School	College Classroom
166	Bishopston & Ashley Down	City of Bristol College - Ashley Down Centre	51.477220	-2.581335	Community College	4	Elementary School	Community College	School	Music School	College Classroom
173	Bedminster	Ashton Park School	51.440339	-2.630206	High School	4	Elementary School	High School	University	College History Building	College Soccer Field
174	Bedminster	Luckwell Primary School	51.437276	-2.612720	Elementary School	4	Elementary School	High School	University	College History Building	College Soccer Field
175	Eastville	Bristol Turkish Community T.C Diyanet Egitim M...	51.472684	-2.551870	Community College	4	Community College	College Academic Building	Elementary School	University	College History Building
176	Eastville	Bristol Childrens Playhouse	51.472280	-2.551690	Elementary School	4	Community College	College Academic Building	Elementary School	University	College History Building
177	Eastville	St Matthias PRU	51.477669	-2.554009	College Academic Building	4	Community College	College Academic Building	Elementary School	University	College History Building
179	Brislington West	Holymead Primary School (Lower)	51.436455	-2.549169	Elementary School	4	Elementary School	Community College	Music School	General College & University	University
180	Brislington West	Bristol School Of Performing Arts	51.433343	-2.547911	General College & University	4	Elementary School	Community College	Music School	General College & University	University
181	Brislington West	Piano Lessons in Bristol with Jack Vaughan	51.437012	-2.551168	Music School	4	Elementary School	Community College	Music School	General College & University	University
182	Brislington West	Holymead	51.437514	-2.552447	Elementary School	4	Elementary School	Community College	Music School	General College & University	University
183	Brislington West	Holymead Primary Upper Site	51.438313	-2.551978	Community College	4	Elementary School	Community College	Music School	General College & University	University
184	Easton	City of Bristol Academy	51.459096	-2.562754	General College & University	4	Elementary School	General College & University	University	College History Building	College Soccer Field
185	Easton	whitehall primary school	51.464865	-2.555790	Elementary School	4	Elementary School	General College & University	University	College History Building	College Soccer Field
186	Easton	Bannerman road primary school	51.464148	-2.565007	Elementary School	4	Elementary School	General College & University	University	College History Building	College Soccer Field
188	Hengrove & Whitchurch Park	South Bristol Skills Academy	51.410819	-2.585071	College Academic Building	4	College Academic Building	Elementary School	University	College History Building	College Soccer Field
189	Hengrove & Whitchurch Park	Wandsdyke Primary School	51.406964	-2.578667	Elementary School	4	College Academic Building	Elementary School	University	College History Building	College Soccer Field
190	Lawrence Hill	Screenology	51.450515	-2.573199	College Arts Building	4	Elementary School	College Math Building	College Academic Building	College Arts Building	General College & University
191	Lawrence Hill	Kaplan	51.452205	-2.579400	College Math Building	4	Elementary School	College Math Building	College Academic Building	College Arts Building	General College & University
192	Lawrence Hill	Hannah More Primary School	51.453976	-2.578661	College Academic Building	4	Elementary School	College Math Building	College Academic Building	College Arts Building	General College & University
193	Lawrence Hill	Kaplan Bristol	51.452126	-2.579482	College Math Building	4	Elementary School	College Math Building	College Academic Building	College Arts Building	General College & University
194	Lawrence Hill	Easton Primary School	51.456860	-2.576808	General College & University	4	Elementary School	College Math Building	College Academic Building	College Arts Building	General College & University
195	Lawrence Hill	St Nicholas of Tolentine Primary School	51.459971	-2.576981	Elementary School	4	Elementary School	College Math Building	College Academic Building	College Arts Building	General College & University
196	Lawrence Hill	Barton Hill Academy	51.453911	-2.564373	Elementary School	4	Elementary School	College Math Building	College Academic Building	College Arts Building	General College & University