ON THE STREETS OF OTTAWA
A perspective on crime, drugs and homelessness

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1. Introduction

The three of us live and/or study in Ottawa. Like a lot of people, we could not help but notice some issues in our streets have been seemingly increasing for the past years: more homelessness, more ambulances coming to handle overdoses, an intensified presence of the police to prevent crimes… But are these increases a real fact? If so, is there a reason behind it? And what has been done to address it? These are the questions this report seeks to answer.

In the time and resource constraints of an undergraduate project, we studied the progression of crime during these last years, both space- and timewise, and searched for new insights of it through clustering and trajectory analysis. We likewise questioned the use of fentanyl and other drugs, to see how overdoses and prevention have developed for the past years. Lastly, we tackled the topic of homelessness, investigating its evolution in the last decade and analyzing how inflation cruelly complicates a return to a stable life for the victims of poverty.

On a further note, alongside this report, we developed a dashboard that gives you access to most of our graphs and results interactively. You can scan the QR code to open it on any tablet (smartphones do not support it well) or open it on your computer *via* the following link: bit.ly/3RDDYUU.

2. Ethical concerns

The observations of this study could be misleading/inflammatory if taken out of context. Homelessness and drug addiction are sensitive topics. Nothing is meant to disrespect persons experiencing those tough conditions in any manner. This report is only considering numbers, assessing evolutions, correlations, and in some cases suggesting causation and causes to explain the latter, but as possibilities only. The respect of individuals as human beings, with a right of dignity, is one of our priorities and, as a matter of fact, one of the principal reasons that motivated this project.

3. An analysis of crime in Ottawa

3.1. About the data

The main datasets for this section were the *Crime Offences Open data* (let us refer to it as '**Crime data**'), *OPS Neighbourhoods Open Data* (let us refer to it as '**Neighbourhoods data**'), *Community Police Centres Open Data* (let us refer to it as **Police Centers data**'), provided by the Police of Ottawa through the platform ottawapolice.ca, and *Hospitals* provided by the City of Ottawa through the platform open.ottawa.ca. The *Crime data* gives the occurrence date, reported date, year (of the reported date), occurrence hour, weekday, offence summary, offence category, Neighbourhood Name, Sector, Division, Census Tract of crimes reported between 2018 and 2022 in Ottawa. It is important to note that the crime occurrence date falls between June 1973 and December 2022. *Neighbourhood data* gives names of the neighbourhoods in Ottawa and its geographic shape. *Police Centers data* and *Hospitals* gives a list of community police centers locations and hospitals locations in Ottawa respectively.

3.2.   Methodology

For this section Python was used with classic libraries such as *pandas* for data cleaning and wrangling. The clustering was made with k-means and DBSCAN using *scikit-learn*. In addition, R was used with *Group-Based Multivariate Trajectory Modeling (gbmt)* library.

3.3.   Results

In this section, we will analyze crime between 2016 and 2022 in Ottawa geographically and over time, and the services provided by the city. We excluded all crimes that occurred before 2016, since there is not enough data about those crimes in our dataset.

For the first part of this section, we grouped all crime reports according to the year of occurrence and neighbourhood. To get a sense of what the crime distribution looks like in Ottawa and how the city placed their community police centres to control the situation, we plotted them on a map (see *Figure 1*) such that crimes are presented as bubbles and their size represents the number of crimes reported per year.
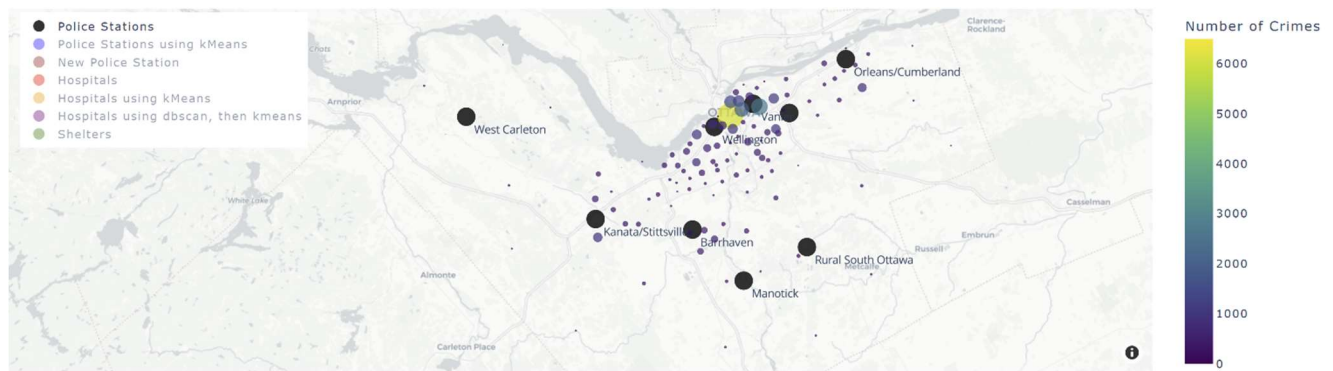

Figure 1 - Crime reports distributed in the city of Ottawa in 2022 and police centres locations

We noticed that there is a non-uniform distribution of crimes; the police centres' locations are related to that distribution. Crimes are more concentrated when we get closer to *Centertown* where there are up to 6,000 crimes per year. In addition, it seemed police centres were placed in crime-concentrated areas. We proceeded to a k-means clustering of crimes (with k = 10) to verify this observation. It turns out the police centres are indeed close to the centres of the crime clusters (see *Figure 2*).
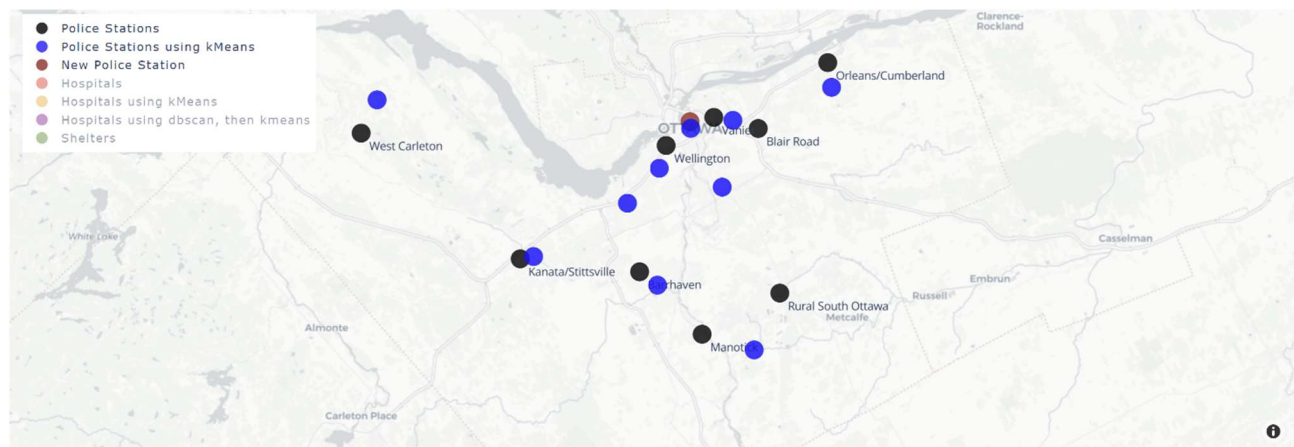

Figure 2 - Comparing the actual police centres locations and the centres of k-means clustering

Also, it is important to note that a new police centre will open in Rideau Centre CBC. (2023, October 19). However considering the clustering results, the next station should be placed farther from Centertown. Now, our data does not take into account all the factors to consider, and the police may have some specific reasons unknown to us to choose that location.

We repeated the previous procedure using only the following crimes: "Assaults", "Other Violations Involving Violence or The Threat of Violence", "Violations Causing Death", "Arson", "Failure to Stop after Accident" to compare the k-means clustering centres to the hospitals in the city of Ottawa.
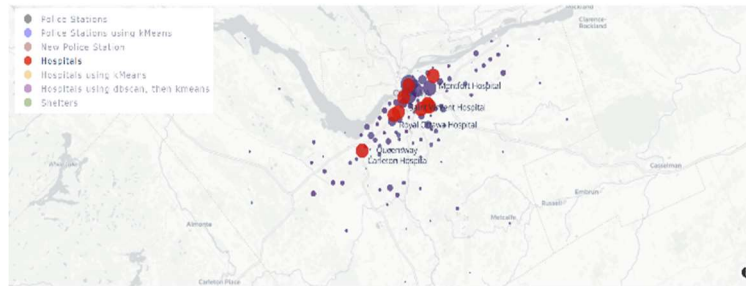

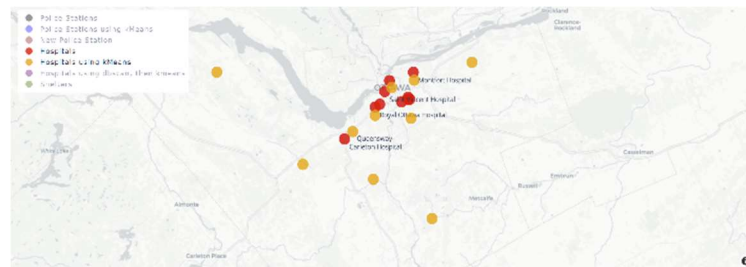*Figure 3 - Hospitals compared to Assaults in 2016*

Figure 4 - Hospitals compared to k-means clustering centres

This time, the locations of hospitals are more concentrated near *Centertown* where there are more crimes and people (see *Figure 3*). Therefore, we used a density-based clustering non-parametric algorithm (DBSCAN) using an epsilon value of 0.0001 and minimum points of 50. The algorithm finds clusters based on the density of the data and groups every observation that is not in a dense area as outliers. We used the non-outlier reported crimes given by the DBSCAN algorithm and then clustered the data using k-means (k = 10). Hospitals compared to k-means clustering centres

The results of the non-outliers clustering better represent the correlation between the reported crimes and the location of the hospitals. Unlike the community police centres, the hospitals are not well spread since their distribution ignores the neighbourhoods far for *Centertown.*
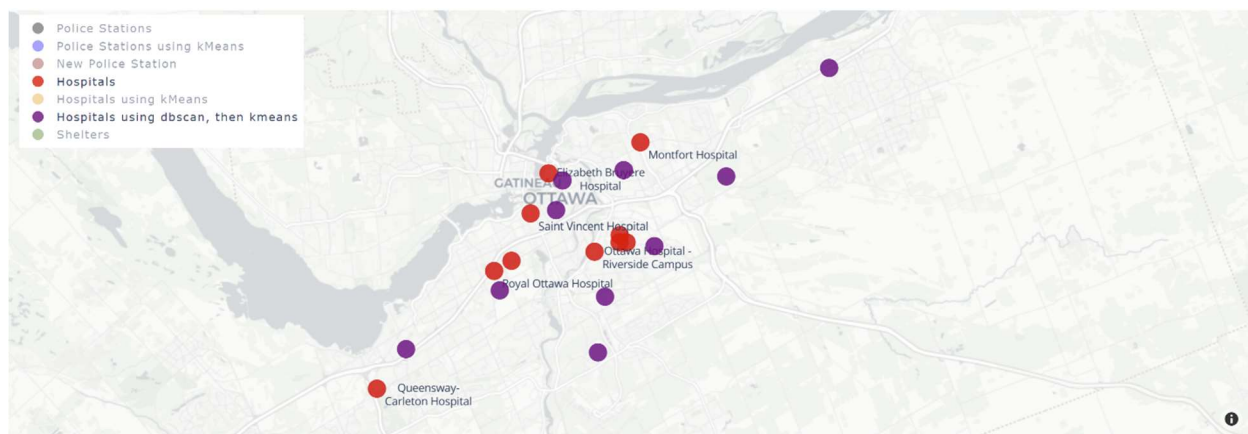

Figure 5 - Hospitals compared to k-means clustering centers using non outliers

For the second part of this section, we will analyze the reported crimes over time according to the place of the occurrence and the type of crime. Since we have 30 crime types and 109 neighbourhoods in the dataset, it is difficult to find trends in the data especially when each category or neighbourhood has a significant
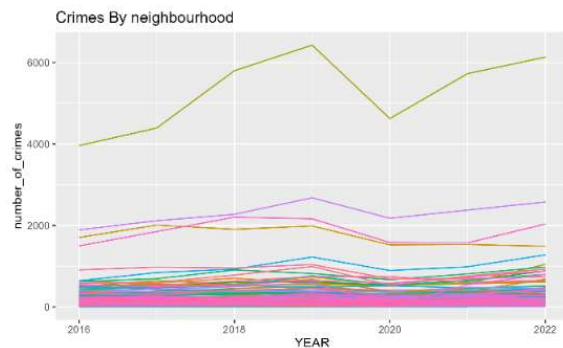
Figure 6 - Evolution of crime per neighbourhood in Ottawa

different range (see *Figure 6*). Therefore, we decided to use Group-Based Multivariate Trajectory Modeling, which is a statistical method that finds groups of objects based on the trend of a multivariate time series. For this analysis, we just used the crimes occurred analysis between 2016 and 2022. For each analysis, we grouped the dataset by year of occurrence and, first neighbourhood, then crime type. GBMT takes number of groups, scaling method and degree. We started by grouping reported crimes by neighbourhoods, we choose the relationship between the number of crimes according to year to be polynomial of degree at most three, then scaled the data using logarithmic ratio to the mean method and set number of groups to be two.

We can classify the neighbourhoods in Ottawa into two groups. The first group has an increasing rate of crimes between 2016 and 2022. The second group is the neighbourhoods that has a decrease in the number of crimes between 2016 and 2020, then an increase in the number of crimes between 2020 and 2022 (see *Figures 7 & 8*).
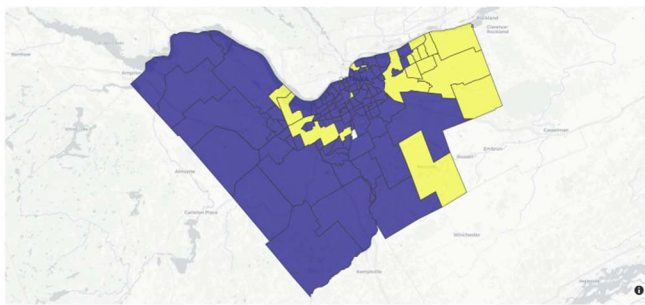

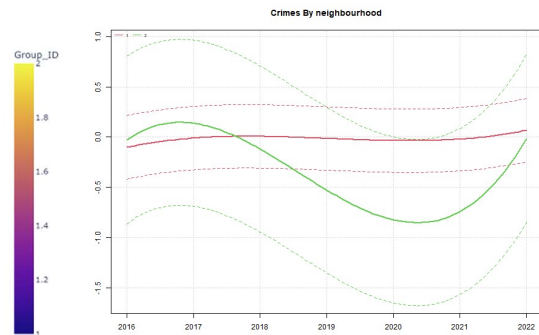*Figure 7 - Group locations*

Figure 8 - Evolution of crime for each neighbourhood group

We repeated the same procedures using crime type instead of neighbourhoods, and we found two interesting groups. We choose the relationship between the number of crimes according to year to be polynomial of degree at most three, we scaled the data using logarithmic ratio to the mean method and set number of groups to be four. We just focused on two of those groups.
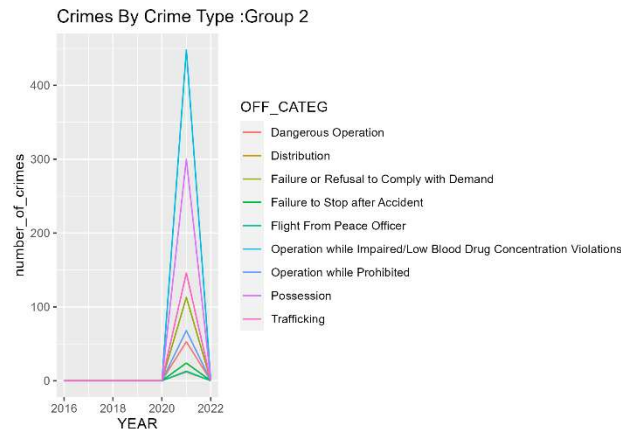

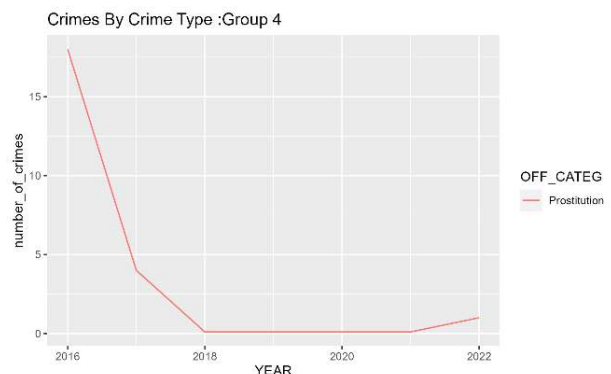*Figure 9 - Second group of trajectory analysis for crime type*

Figure 10 - Fourth group of trajectory analysis for crime type

The second group consists of crimes that only appeared in the dataset in 2021 *(see Figure 9).* Some of these crimes are related to drugs, but we could not find a reason to explain that trend. However we believe it is possible that there are missing reports in the data, but we could not prove or disprove it. The fourth group consists of only one crime, which is prostitution *(see Figure 10).* It is the only crime that increased significantly between 2016 and 2022. Nevertheless, we could not know for sure if the number *Prostitution* was significantly higher before 2016 or 2016 is an outlier since our data is reliable between 2016 and 2022. To conclude, trajectory analysis helps us understand our data and points out elements to further investigate.

4. An analysis of drugs in Ottawa

4.1. About the data

For this section, we used three main datasets. *Overdose Calls Open Data* (let us refer to it as "overdose calls") is provided by Ottawa Police through their open data platform data.ottawapolice.ca (Police of Ottawa, 2023). This dataset gives us information about the emergency calls related to overdoses with a precise date (includes day of the week, day of the month, month, and year) and time of the report, and with information telling us if Narcan was administered. This dataset covers the period from 2018 to 2022. Note that the data description was not always detailed.

Opioid overdose emergency department visit count by month (let us refer to it as "overdose emergencies") is provided by the City of Ottawa through their platform open.ottawa.ca (City of Ottawa, 2018). This dataset gives us information regarding the count of patient emergency visits to Ottawa hospitals with an overdose's diagnosis. It covers the period from April 2017 to August 2023.

Confirmed Opioid related Deaths of Ottawa Residents (let us refer to it as "overdose related deaths") is also provided by the City of Ottawa through their platform open.ottawa.ca (City of Ottawa, 2023). This dataset provides information on the number of deaths of Ottawa residents by quarter and year. It covers the period from April 2017 to June 2023.

4.2. Methodology

We used Python and some libraries like *pandas* and datetime to clean, wrangle, and improve the use of the datasets. Most notably in overdose calls we filled the null entries, which only appeared before 2020, regarding Narcan administration with "unknown" values. F- and t-tests were done using *scipy.stats* and TukeyHSD tests were done with *statsmodels.stats.multicomp*; all used a confidence threshold of 95%.

4.3. Results

One of the first questions we asked ourselves was if there was a particular day of the week or month in which people tended to overdose more. As the only dataset that contained a specific date-time figure was the overdose calls dataset, we decided to test this hypothesis on this dataset. It first seemed there was no statistically significant difference between any day, or month, or day of the week.

However, when examining periods before and after pandemic separately, we did get different results. We have enough statistical evidence to assert that there was an increase of overdoses after 2020, in terms of overdose related calls. There is as well enough evidence to say there is a difference in the number of calls received between the days of the month both before 2020 as well as after 2020. Further investigation into this behaviour with a Tukey test shows that the cause of this difference lies on the first day of each month both before and first day after the pandemic.
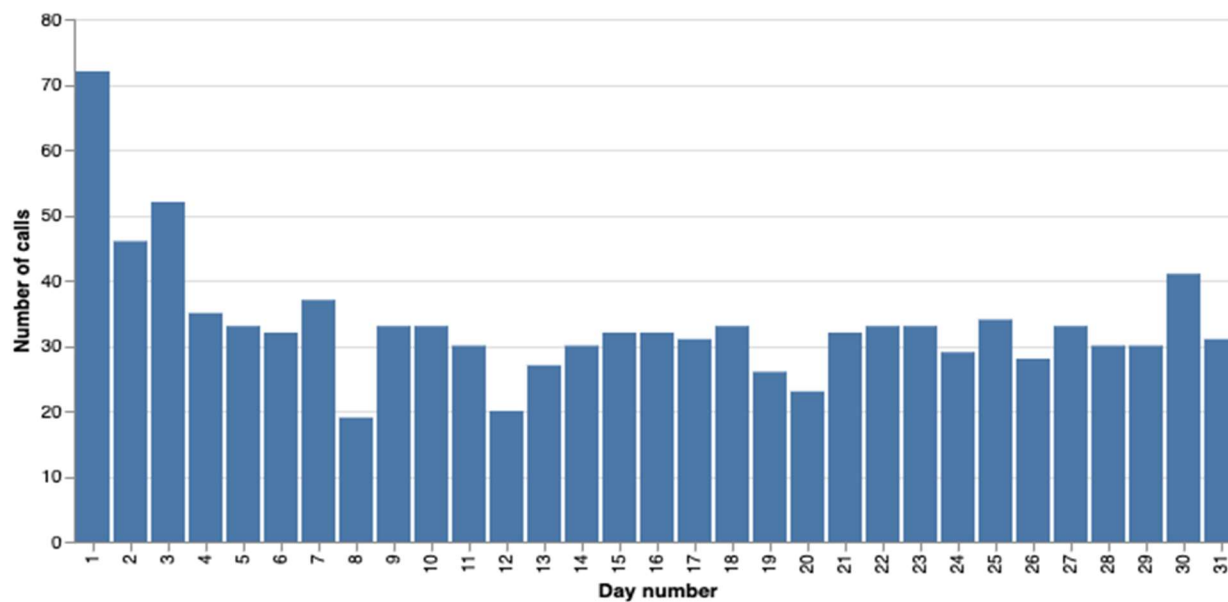
Figure 11 - Number of calls by day before 2020

Before the pandemic the first day of each month has the highest number of calls, and according to Tukey test this behaviour is significant compared to all the other days except the 3rd, 4th, 7th, and 30th days.
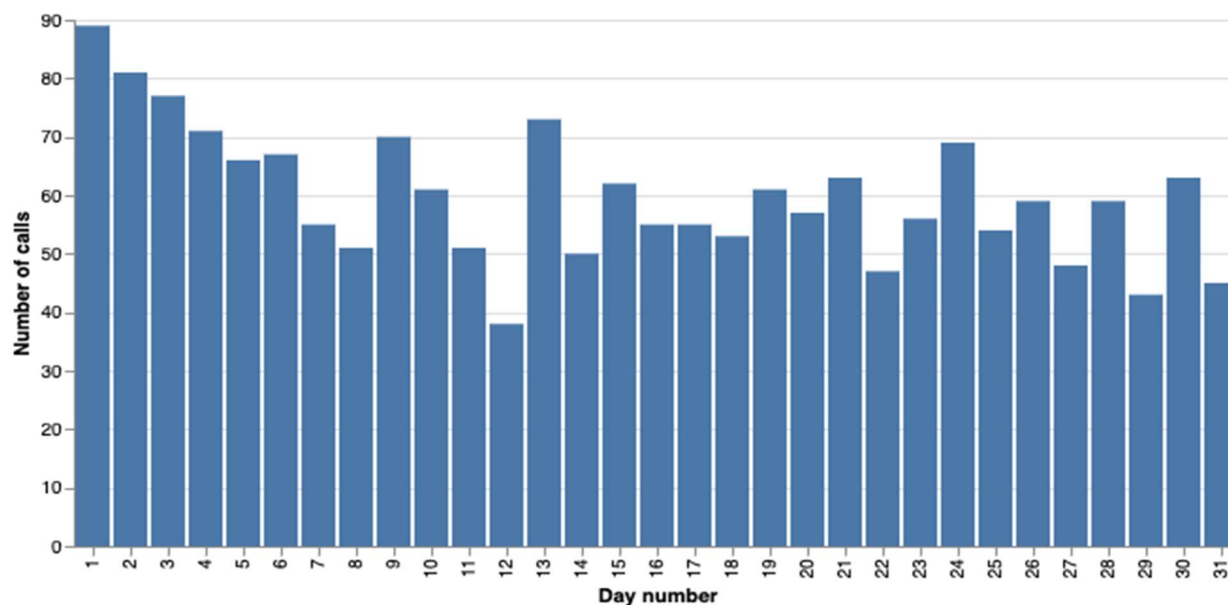

Figure 12 - Number of calls by day after 2020

Similarly, after 2020 the first day of the month is the one with the highest number of calls. Tuckey test tells us that there is not enough statistical evidence to assert a difference between the days of the month except for between the 1st and the 12th day, and the 1st and 29th day. We are led to believe that something changed after 2020 that changed the days in which people overdose; the significance of the difference between the first day and the others was greatly reduced as shown both in the difference between the graphs (see *Figures 11 & 12*) and the difference between the Tukey test results.

*0*Another important change across the years that this dataset covers is the amount of calls in which Narcan was administered. To put into context Narcan (commonly referred to as Naloxone) is a fast-acting drug that reverses the effects of an opioid overdose (University of Ottawa, n.d.).

We see a steep increase between the years of 2020 and 2021 in the use of Narcan and a decrease of it's none use between 2021 and 2022 (see *Figure 13*). This is remarkable information as 93% of people who use Naloxone survive the overdose (Kounang, 2017). The administration of Naloxone before paramedics arrive can save the life of the people at risk.

In the overdose emergencies dataset, we see a sharp increase in the number of visits to the emergency department of Ottawa hospitals after 2020 (see *Figure 14*). With a peek in 2021 although it is important to note that the information for 2023 covers until August of the same year. As before we have enough statistical evidence to assert that there was an increase of overdoses after the pandemic (2020), this time in terms of overdose related visits to the hospital. It is also important to notice that there is not enough

Figure 13 - Number of calls by year

statistical evidence to believe that there is a difference between the number of individuals received in hospitals for overdoses over months, this matches our previous result on overdose calls.
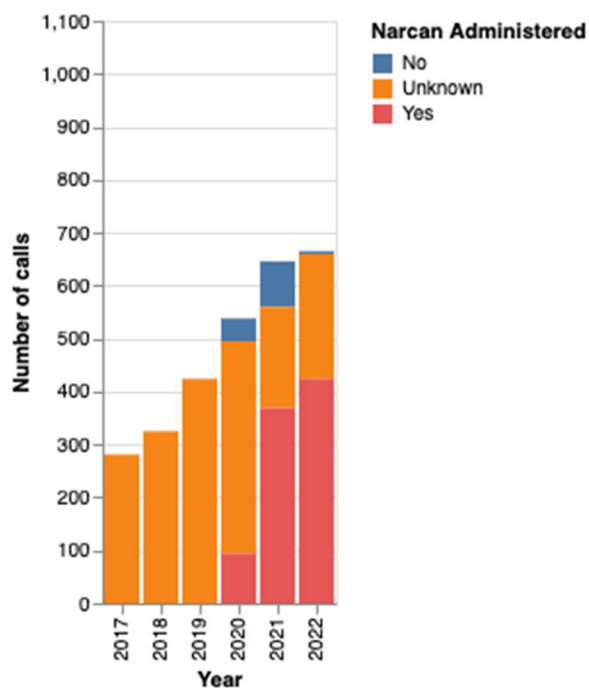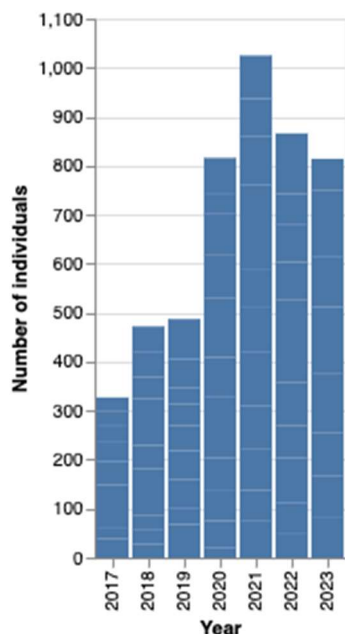

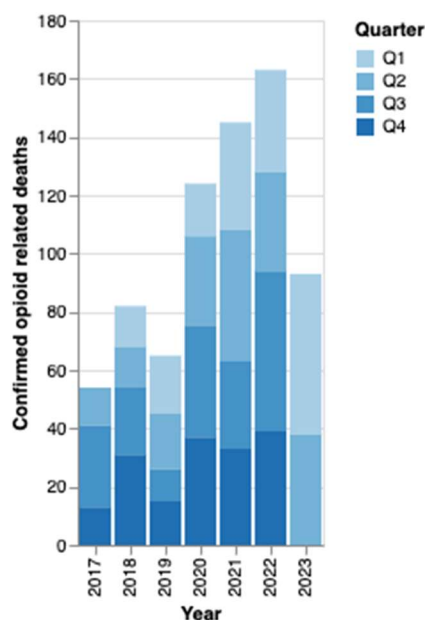*Figure 14 - Hospitals overdose visits per year*

Figure 15 - Overdose related deaths per year

In the overdose related deaths dataset, we do not have enough statistical evidence to support the belief that there is a difference between the number of deaths by quarter of the year.

It is important to note that this dataset does not have information for the entirety of the year 2017 and the year 2023, in the case of the year 2023 we just have information about the first two quarters of the year (till June 2023). As before we have enough statistical evidence to assert that there was an increase of overdoses after 2020, this time in terms of overdose related deaths of Ottawa residents (see *Figure 15*).

In all our datasets for this section we see a sharp increase of overdoses after the year 2020, in particular an increase in the number of overdose related deaths. This behaviour seems counterintuitive when we see an increase of Narcan use. We should mention that this may be caused by a new drug on the streets. According to multiple health officials a new drug has flooded the streets of Canada, Xylazine (Canadian Broadcasting Corporation, 2023). This drug which was originally used as horse tranquilizer (Hoffman, 2023), has been mixed into conventional popular drugs like fentanyl and heroin as it serves as an adulterant increasing profit for drug traffickers (U.S. Department of Justice & Drug Enforcement Administration, 2022). Xylazine has been found in the drug seized by the police in Canada and with particularly high numbers in Ontario (Government of Canada, 2023). This is important as Naloxone is inefficient when Xylazine is in the system of the individual overdosing (Hoffman, 2023). This drug became popular on the US market around the days of the pandemic for its easy availability as it is legal in the US (Hoffman, 2023). The situation is likely to be the same in Canada as Xylazine has not been banned in Canada as of December 2022 (Government of Canada, 2023). The amount of Xylazine found in seized tested drugs is not representative of the amount of Xylazine found on the streets (Government of Canada, 2023). Therefore although we do not have any concrete evidence in terms of the amount of Xylazine found during the year 2020, there were only 9 samples found in 2020 compared to the 414 in 2021 (Government of Canada, 2023), it would be plausible and likely that Xylazine is one of the main reasons together with the increased use of fentanyl for the rise in overdoses and deaths.

The increase used in Xylazine could also explain the reason for the uniformity in the number of overdose calls by day after the pandemic, as Fentanyl already has a higher overdose rate than other drugs (Canadian Broadcasting Corporation, 2023) and its combination with Xylazine worsen its effects.

5. An analysis of homelessness in Ottawa

5.1. About the data

Collected by the Housing Individuals and Families Information System, the main dataset for this section was the *Housing Services monthly HIFIS data*, provided by the City of Ottawa through the platform open.ottawa.ca, which gives the monthly aggregated data of unique clients and/or families in shelter system. It also indicates the total length of stay, but the unit and meaning is not clear and not as crucial, so we chose not to include it. The data is renewed monthly; our version goes from January 2014 to September 2023 included.

For additional charts, new data was needed about rentals and vacancy rents in Ottawa. We used data from Canada Mortgage and Housing Corporation. As for the minimum wage question, the information comes from the official website of the Government of Canada, which gives the changes of minimum wage in every province since 1965.

5.2. Methodology

Python only was used here, with classic libraries such as *pandas* and *datetime* for data cleaning and wrangling. The predictions were made with linear regression using *scikit-learn,* using only the period between the January 2021 and September 2023.

5.3.   Results

As you can see on the *Figure 16*, the number of people in shelter has generally increased since 2014, but with an **important drop during Covid-19**, i.e. between 2020 and 2022, after reaching a significant peak of 3,500 individuals in December 2019. This is due to a municipal incentive to place as many shelters residents as possible in hotels or motels, to prevent the pandemic from expanding. It would appear the City did not have the funds or priority to maintain that situation, though, as the chart indicates that the drop was followed immediately by a sudden increase. The head count has kept climbing up for almost 2 years now. Note how similar the slope is to the one before pandemic. If the numbers keep growing at this alarming rate, we will reach back the peak of 2020 by the end of 2026.

Figure 16 - Evolution of shelters population

On a further note, although the number of people in shelters is one of the main indicators to measure homelessness, the Points-in-time counts made by the City in 2018 and 2021 (City of Ottawa, 2018; City of Ottawa, 2021) assess the number of people in **shelters represent only 55% of the whole population of homeless**. This means there are probably not 3, but nearly 5.5 thousand individuals in Ottawa without a home at the moment (Fall 2023).

When we consider different categories of individuals inside shelters (see *Figure 17*), **most categories seem to keep the same headcount but one: family household members**, i.e. individuals living in shelters with their families. The change in their number does reflect the pandemic drop in the whole shelters' population mentioned earlier, which leads us to believe it was the families that the City placed in hotels, logically, when health concerns raised with the pandemic. This does not give us new information, but it at least confirms the data reflects the truth with numbers that match recognized facts.
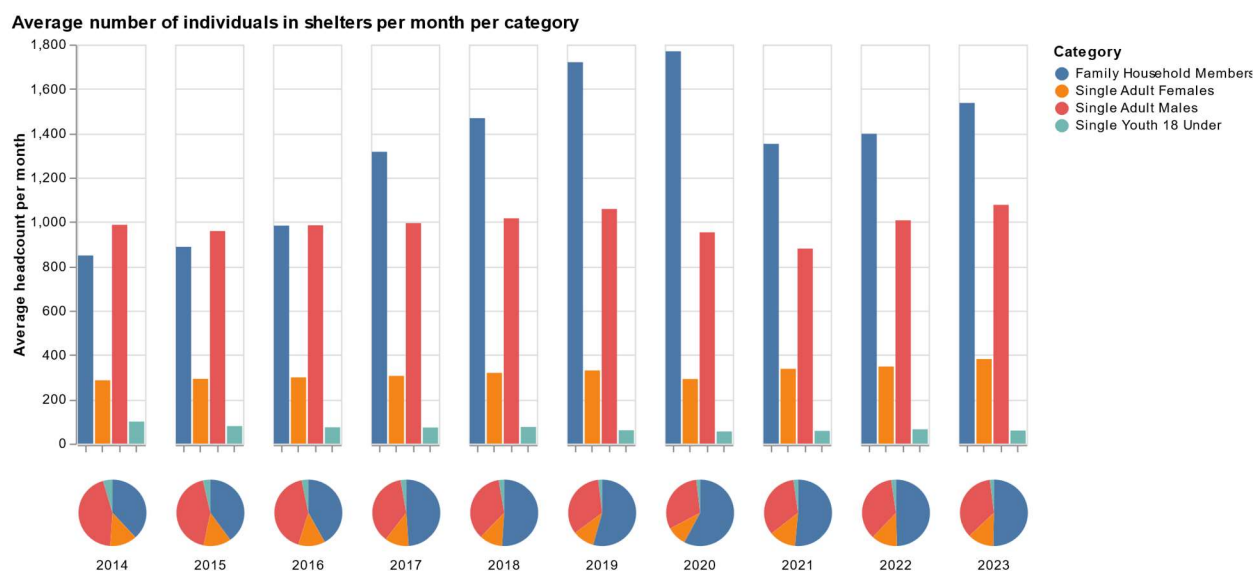

Figure 17 - Evolution of shelters' population by categories of individuals

It also tells us **the proportion of single males has been quite significant** since 2014, representing half the whole population in shelters for now 3 years, and even more during the pandemic. As a matter of fact, there are currently almost four times as many single males as single females in shelters.

We applied Group-Based Multivariate Trajectory Modeling (GBTM) to the shelters data using only the categories that are not redundant, which are *Family Household Members, Single Adult Females, Single Adult Males, Single Youth 18 under*. The purpose is to obtain groups of them based on the trend of a multivariate time series (see section 1.3). GBMT takes number of groups, scaling method and degree. In this case, we chose the relationship between the number of people in shelters according to time to be polynomial of degree at most two, we standardized the data and set number of groups to be two.

The first group found by the trajectory model (see *Figure 19*) consists of *Family Household Members, Single Adult Females, Single Adult Males* which is decreasing, with in particular that strong decrease between 2020 and 2022, the very same mentioned twice earlier in this section.

The second group found by the trajectory model (see *Figure 20*) consists of *Single Youth 18 under* which is the only category that consistently decreasing since 2014.

Unfortunately, the inflation, and particularly **the rising cost of housing**, **complicates a possible return to a stable situation for those in situation of homelessness** (*Figure 21*). The Point-in-time counts estimate 10% of homeless people have found employment, and even less of them as a full-time job. For those who have less than full-time, it is not conceivable to even afford a bachelor. Most of them resort to financial aid from different institutions. The majority use Ontario Works, a financial (and employment) assistance program run by the
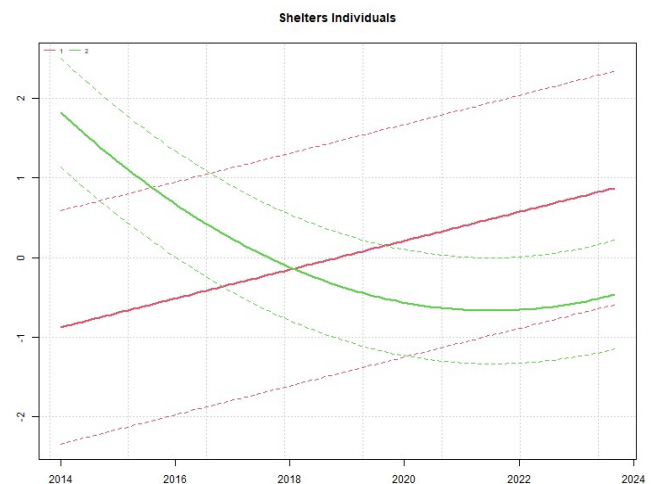

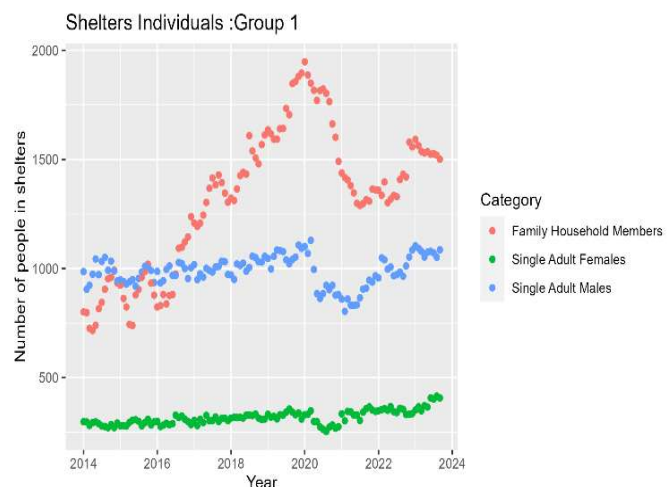*Figure 18 - Trajectory analyse differentiates two groups of categories*

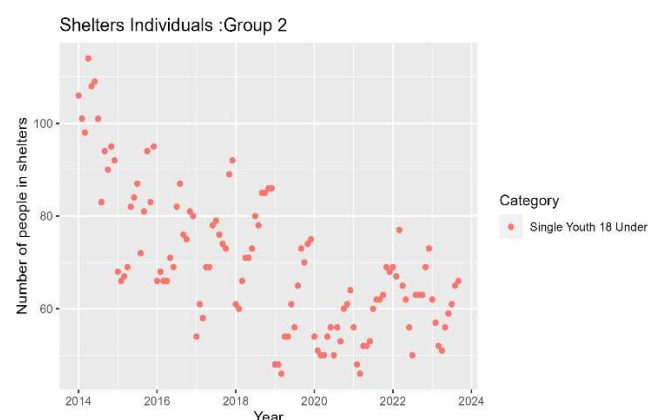*Figure 19 - Evolution of the categories in the first group*

Figure 20 - Evolution of the category in the second group

province; the point-in-time counts assess this concerns about 45% of them (50% in 2018 and 40% in 2021). Regrettably, the current maximum amount this program can give every month is $733 per individual. The only type of accommodation one can find at such a rate is a private room, either in an apartment-share, in which case there is much chance of insalubrity, or in the house of a private individual; it would not leave enough funds to buy food and primal supplies either way. Besides, it is likely that landlords would rather prioritize students or young professionals, who all come in great numbers in town, over someone who has experienced homelessness for a certain amount of time.
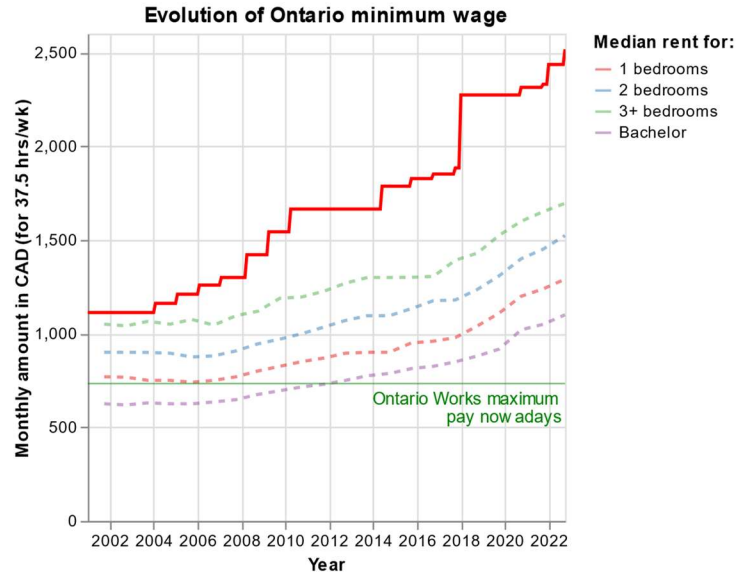

Figure 21 - Evolution of Ontario minimum wage and rents

Thus the main factor of homelessness is the lack of employment. A solution would be to provide persons in this situation with job opportunities and occasions to develop new skills if needed. Other factors that this short project does not mention include mental health and addiction problems. Obviously, there are many charities and institutions working on those subjects. We can assume the main issue is the funds.

Now, geographically speaking, when looking at the locations of the different **shelters and services available in town**, it turns out there is a **strong accumulation of them around Rideau Street/Byward Market**, which explains why we find so many persons in difficulty in that area (see *Figure 22*).
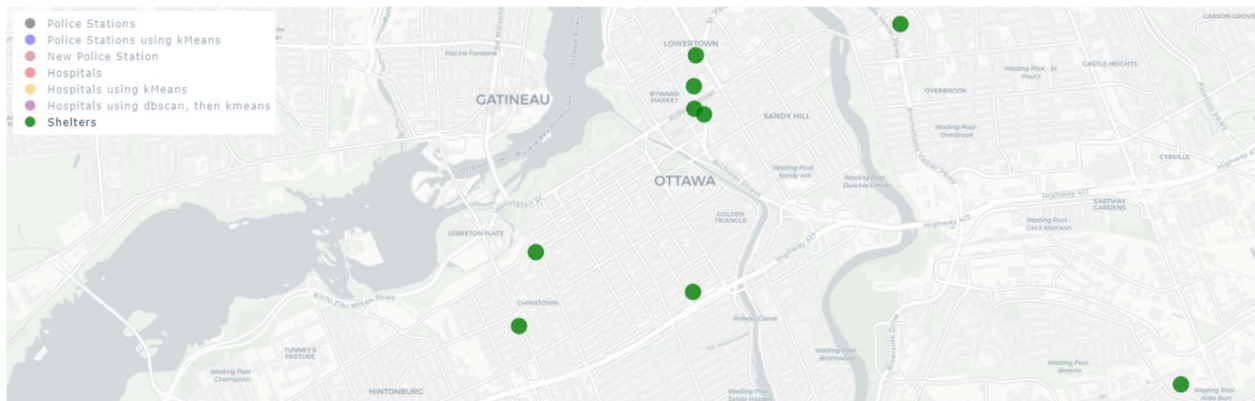

Figure 22 - Locations of shelters around Downtown Ottawa

6. Conclusion

In conclusion, the strongest **concentration of crimes is in Centretown**. The police stations are quite well spread in the city, but the hospitals are too close to Downtown and hard to access from farther neighbourhoods. **The amount of overdoses has overall increased**. The use of Narcan has quite escalated as well, which saves a lot of lives in case of overdoses of fentanyl and similar drugs, and yet the number of deaths has grown too. Our analysis leads us to think it is due to the **apparition of a new drug, Xylacine**, traditionally used as a horse tranquilizer, which often gets mixed with samples of other drugs, and **against which Narcan is inefficient**. As for **homelessness**, the recent incentives of the City during Covid-19 to give a home to shelters residents has been efficient only temporarily. The **numbers of going up** again and will reach back 2020's peak by the end of 2026 if nothing is done. Families and single males represent more than 75% of the shelters residents. The inflation, and more specifically the **housing crisis**, are the main factor that prevent people experiencing homelessness to return to a stable situation. Looking for help, most of them head toward Downtown Rideau and Centretown, where most of the shelters are concentrating.

7. Contributions

Regarding the tasks distributions, Kevin (Tawadros) and Emiliano (Jiménez Guadarrama) implemented the interactive map. Emiliano developed a major part of the dashboard and focused on the drugs issues datasets. Kevin applied the trajectories analysis on most datasets and proceeded to the neighbourhoods clustering. Alexis (Taillardat) focused on the analysis of homelessness and took the lead on the report's writing.

We would like to give special thanks to Dr. Tim Aubry, Professor in Psychology and Senior Researcher in homelessness and community mental health issues at the University of Ottawa, whom we met to talk about our project, and who gave us interesting leads and documentation to consider. We also wish to thank Dr. Tanya Schmah for her guidance and insights throughout this project.

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