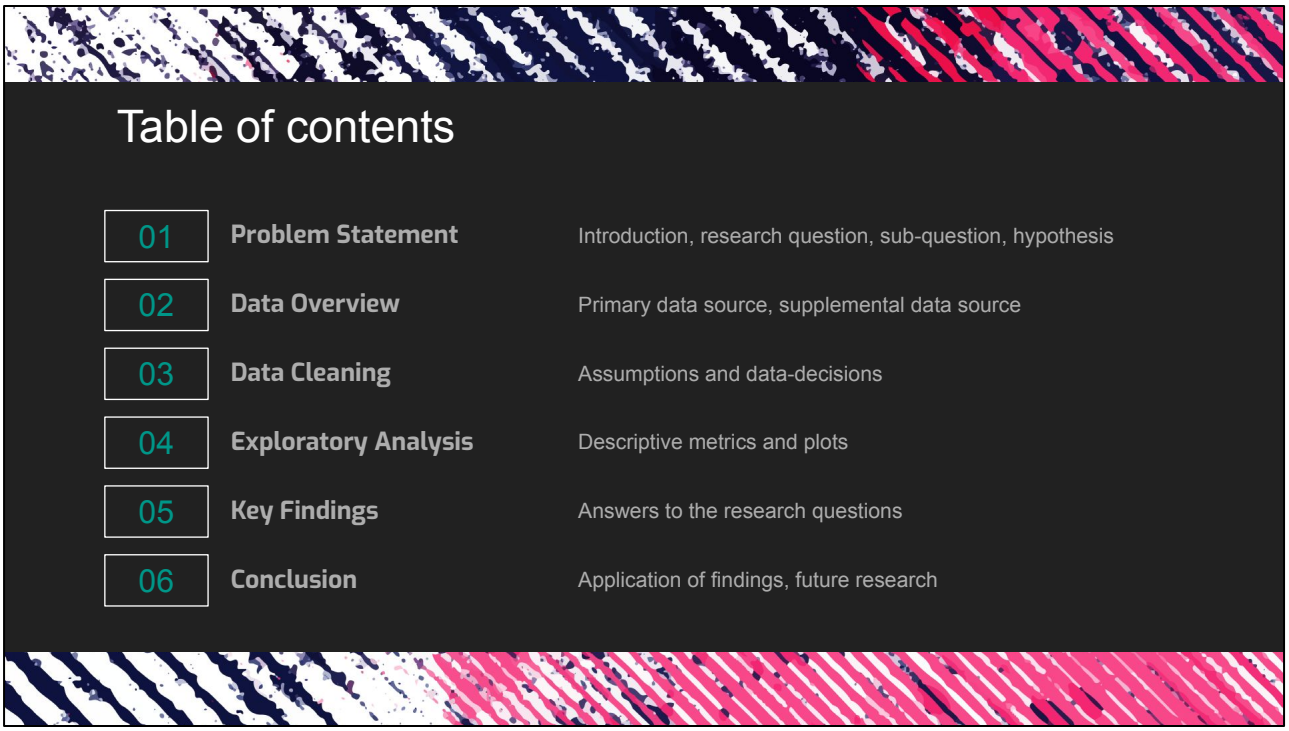
Effect of Temperature on Crime in Denver, CO

Joanna Yang and Kyle Wong
DATASCI 200 Final Presentation
Summer 2023

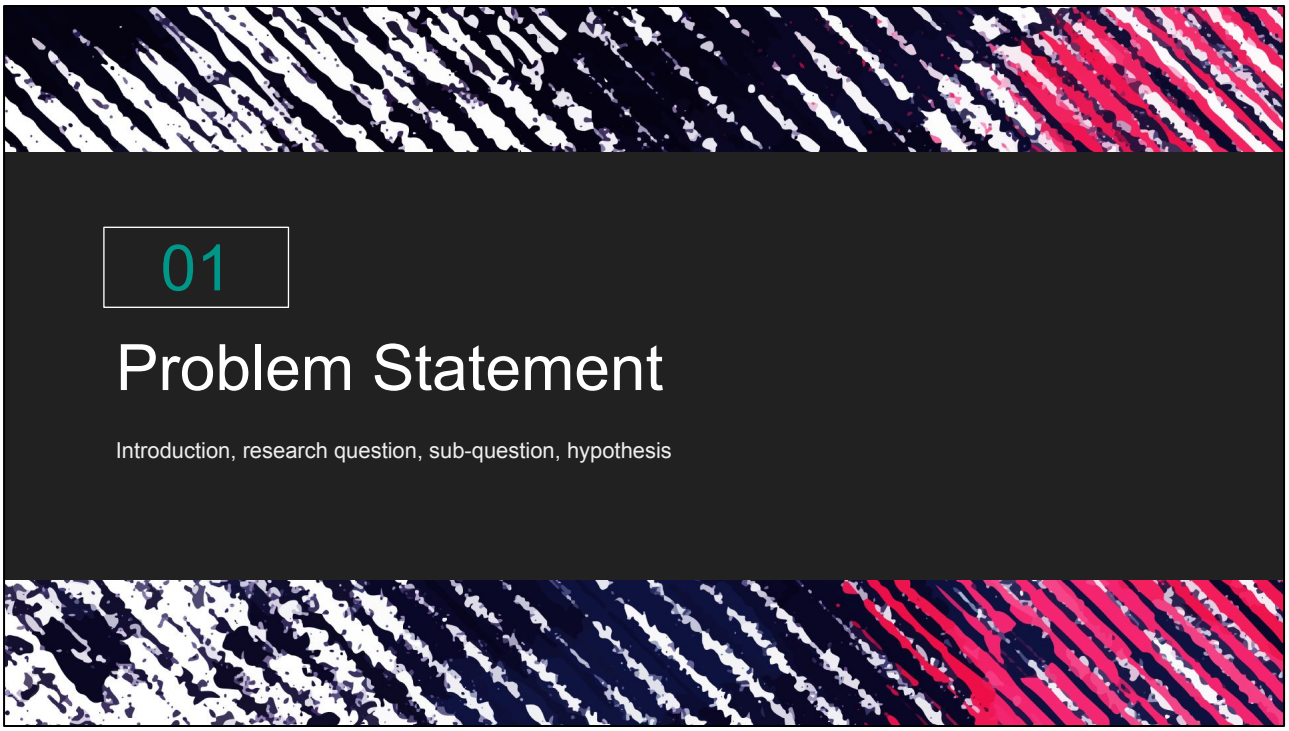
Joanna: slides 1-10
Kyle: slides 11-21

Joanna start here

For our final project, Kyle and I dived into the effect of temperature on crime in Denver, CO.

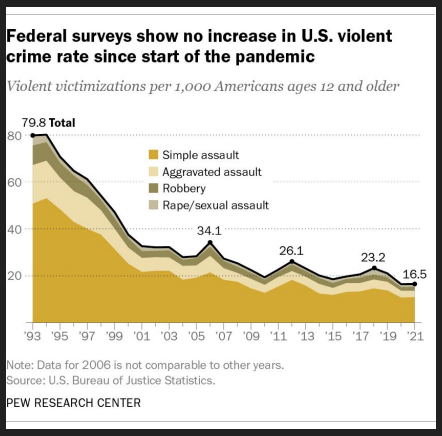


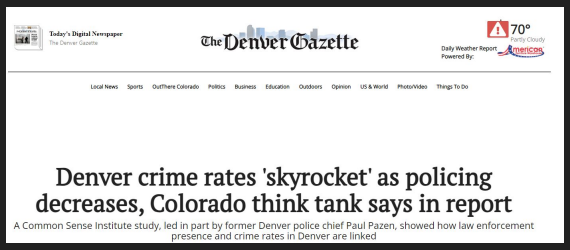
For our presentation, we split it into six section. We want to first give an introduction and overview of the problem, our question, and hypothesis. Then we will give some context into the data sets we used and how we cleaned it. It will be followed up by exploratory analysis of descriptive metrics and plots followed along with their key findings and conclusions.



So starting off, our problem statement.

Crime and Crime Rates





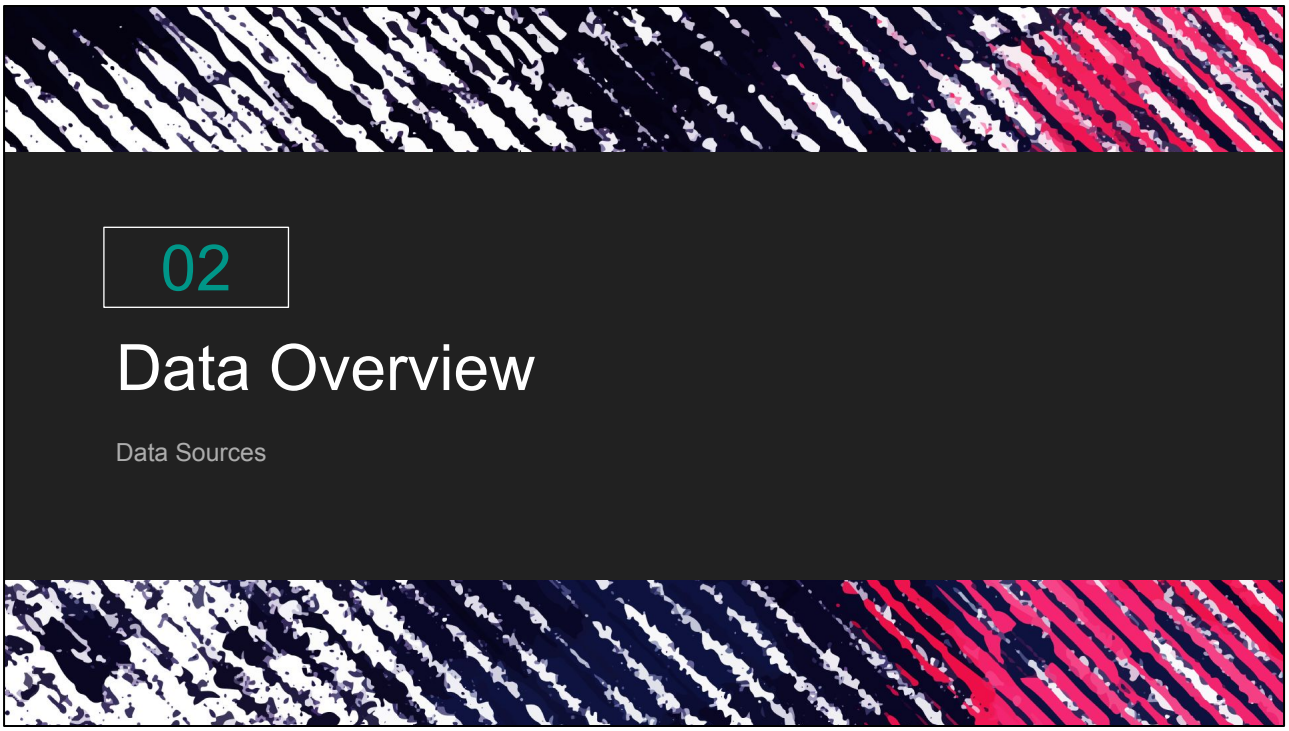
The Bureau of Justice Statistics and the Federal Bureau of Investigations noted a dramatic decline in violent and property crimes in the past two decades. The city of Denver has also followed the general trend of, but in recent years, it noticed an uptick in crime rates compared to the rest of the country. Currently, Denver ranks in the top 10 U.S. cities for crime. Therefore, understanding the underlying issues and formulating policies to tackle the increase is of importance. There are many potential factors that cause an increase in crime, one being ambient temperature. A group of scientists noted that increase in ambient temperature can increase impulsivity and general human activity, which mediates the increase in violent crime. However, this study was completed in Finland and we want to see if such a relationship is also true in Denver. The end goal is to help policymakers understand factors causing an increase in crime rates and help them develop comprehensive plans to decrease Denver crime rates.

Does temperature affect crime rates in the Denver area?

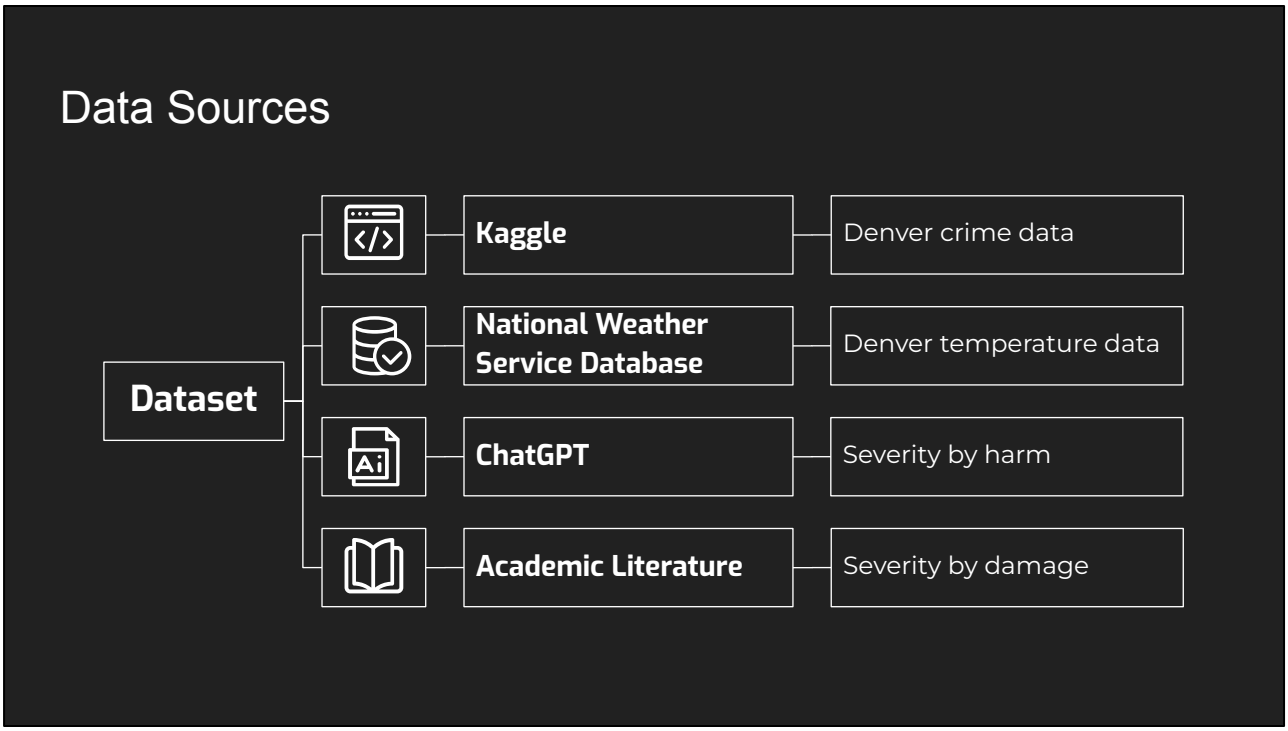
Research Question

Based on the background, our main research question is does temperature affect crime rates in the Denver area?

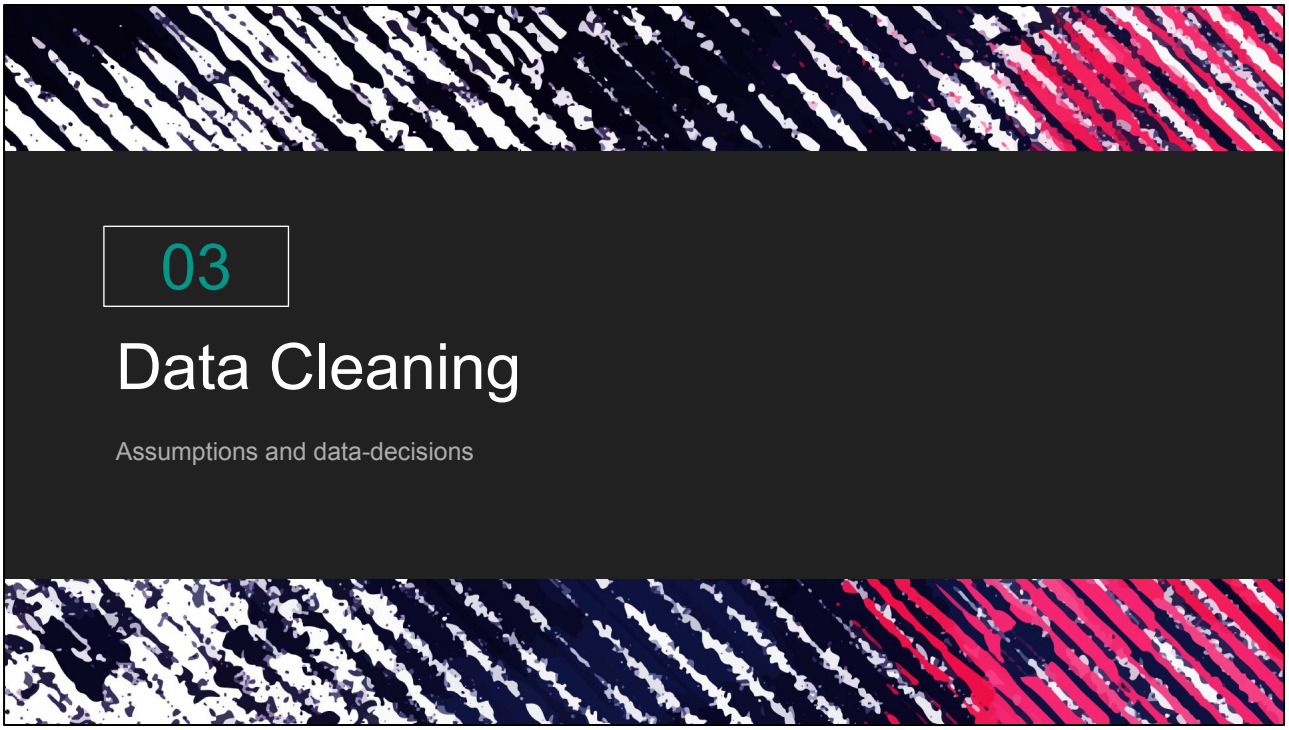
And our hypothesis is that as temperature increases, Denver’s crime rates will also increase. To help us answer the question, we will first understand the data and then look at two subquestions. Subquestion 1 focuses on what is the monthly crime rate compared to the monthly average temperature. The second subquestion is how does the severity of crime compared to the temperature?



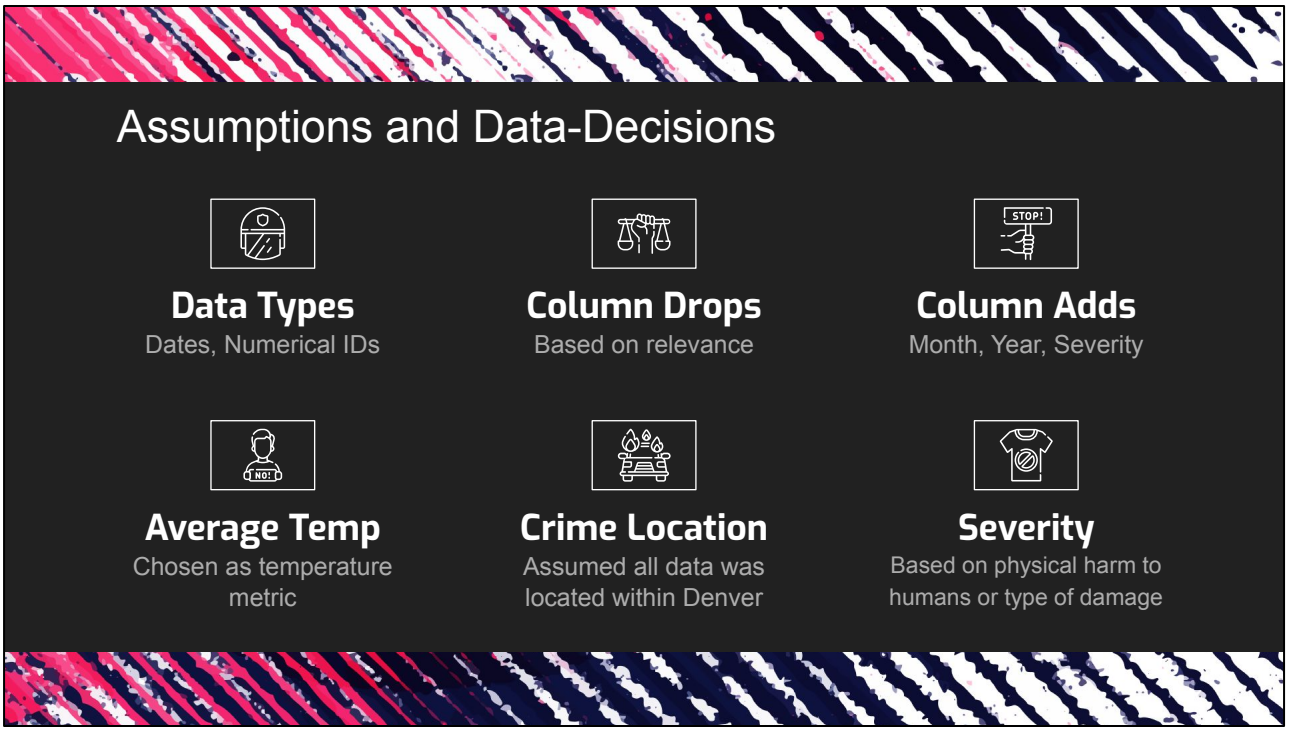
Moving on to the data sets that we have and an overview of them.



Our primary data set revolves around the crime rates in Denver from Jan 2017 to Oct 2022. This dataset originates from Kaggle and is published by the city of Denver. Then we grabbed the temperature data from the National Weather Service Database. We had trouble deciding on a severity scale as we lack information on the punishment of the crime, therefore, we asked ChatGPT to develop one of the scales, which focuses on the harm to person. The other scale we developed was based on popular terms used in media and literature that examines the type of damage.

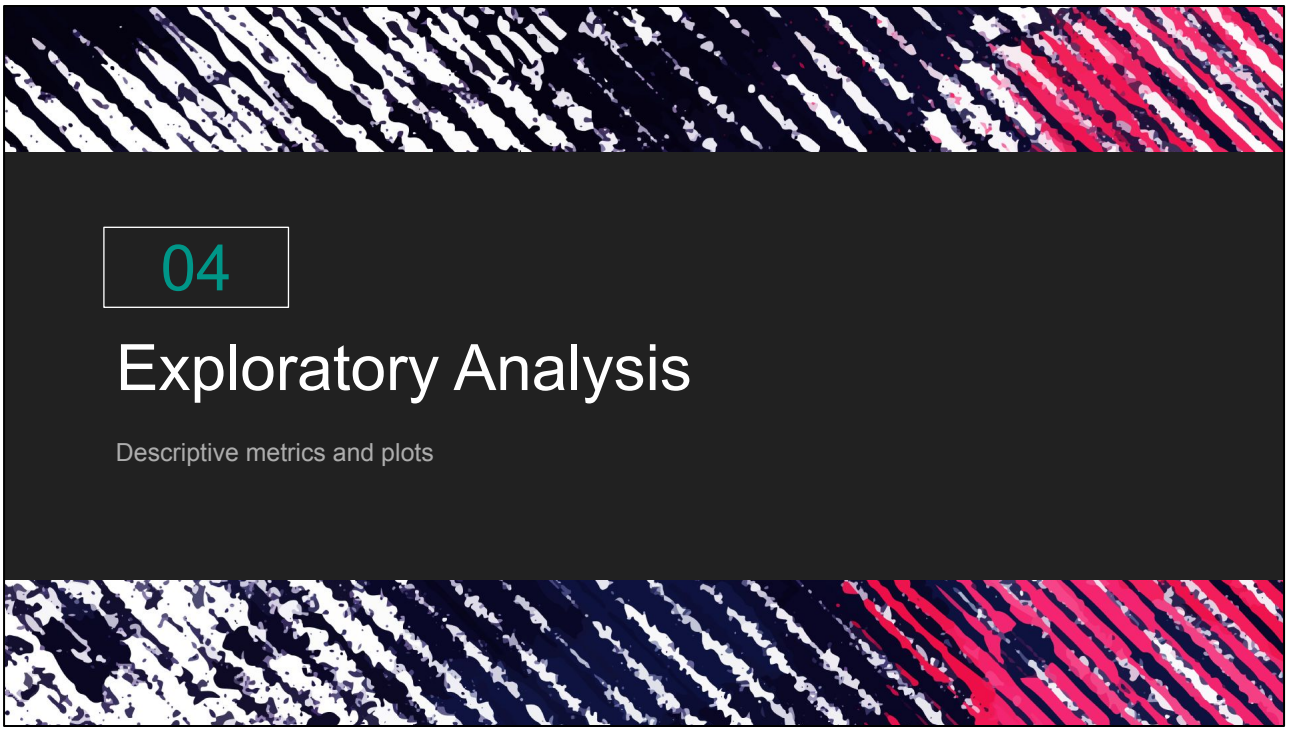


We wanted to combine the crime data set with the weather dataset and add on the severity scales. But before doing so, we had to clean some of the data.



First, we started off ensuring the data types of the columns match the data. So for example, the dates were converted using the datetime module. Then we dropped columns that were not relevant to our question, such as location. We, then, added columns that we needed, such as month, year, and severity. We had three different temperature metrics, min, max, and average temperature. Based on a correlation matrix, we chose average temperature as it strongly correlated with both min and max values. We then made some assumptions where we assumed that all data was located within Denver. We also decided on two severity scales as described earlier. Now, I'll hand it off to Kyle to dive deeper into our findings.

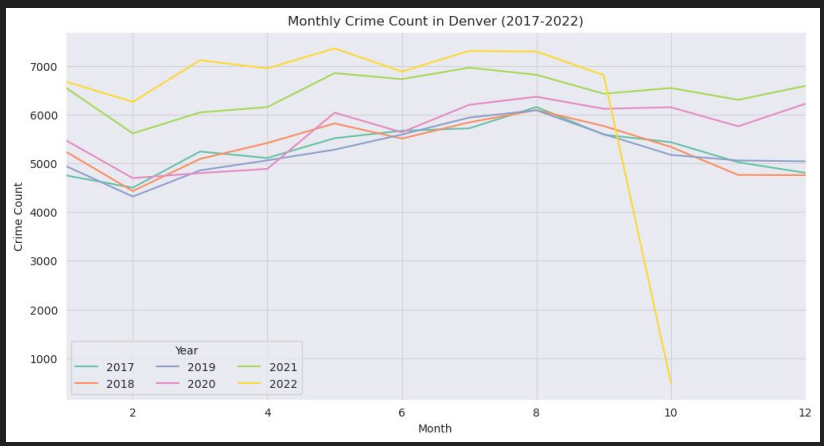
Joanna ends here



Kyle starts here

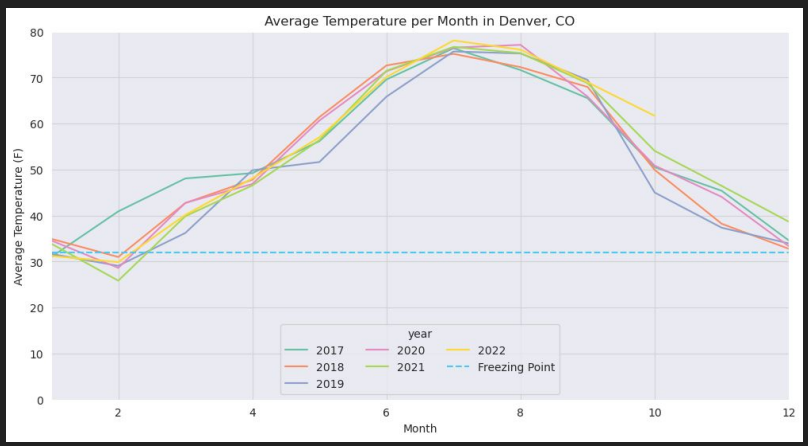
Thanks Joanna! Hi everyone, I'm going to cover some of the analyses we conducted during this project. We'll start with basic descriptive analytics, then get into answering those research questions

Monthly Crime Rates



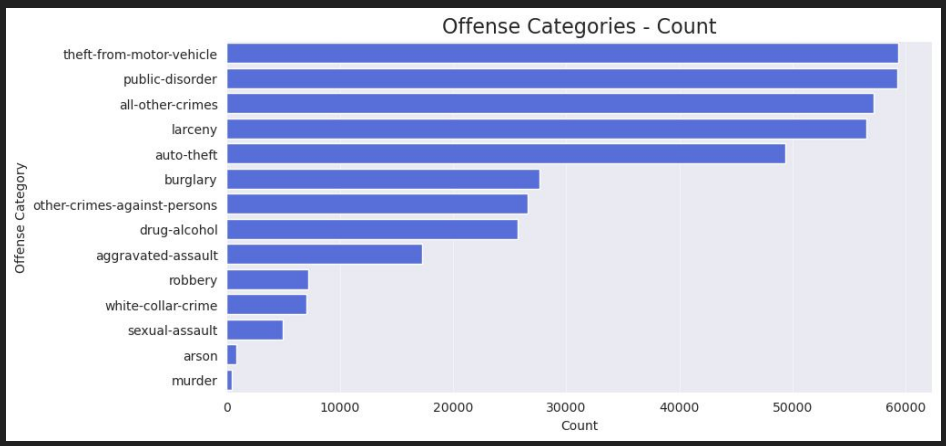
To kick it off, here is a graph of all the crimes committed per month in our dataset. If you look at the legend's color key, you can see that from 2017 to early 2020, crime frequency follows a pretty predictable pattern. There's low variability year over year. However, as we enter the last few month of 2020 and transition into 2021 and 2022, crime frequency begins to grow fast. This graph further emphasizes the point that Joanna mentioned earlier - we need to find the driving factors behind crime increases, and we need to find them before this gets out of control.

Monthly Temperature

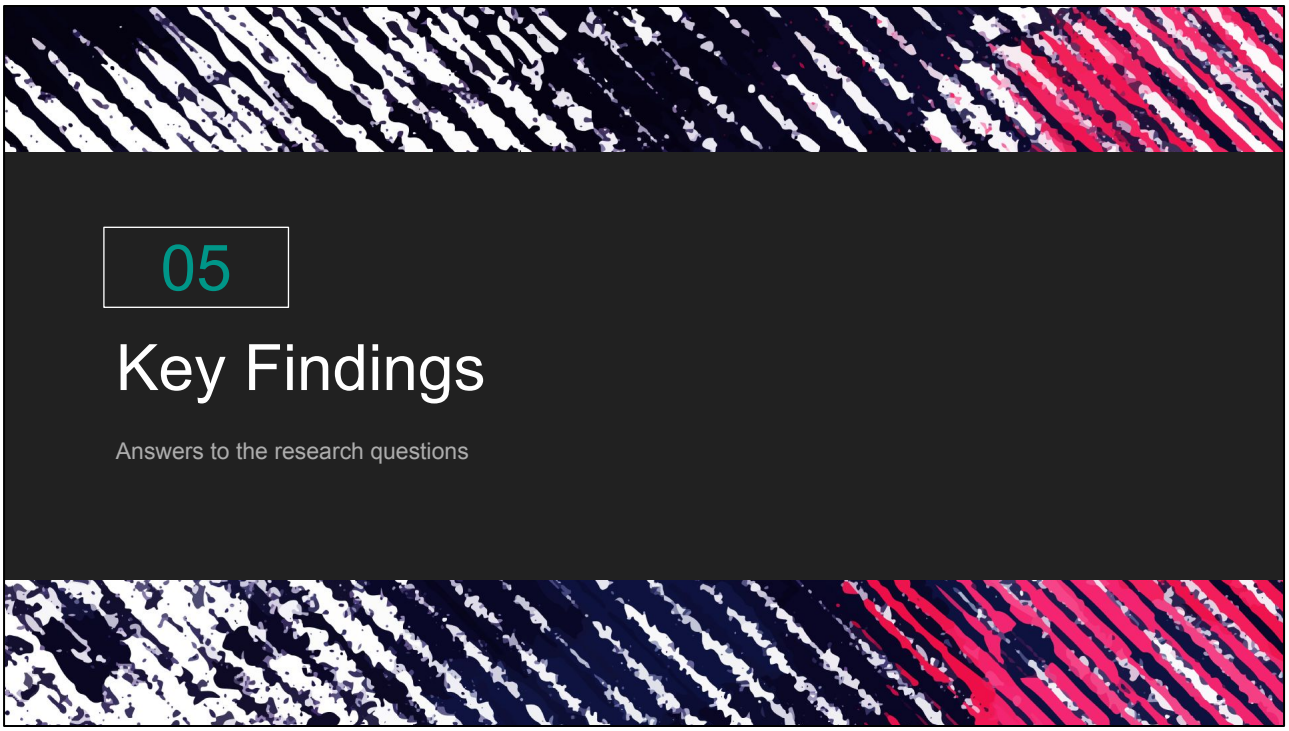


Moving on to the next primary factor, we can see that temperature also follows a low variability, predictable pattern year over year. It looks like 2017 had an exceptionally warm spring, but aside from that, each year's monthly averages fall within a few degrees of one another

Offense Categories

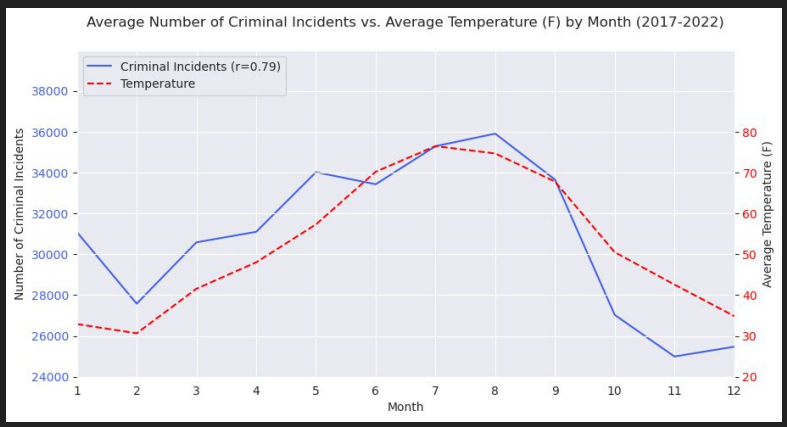


To close out the initial exploration, here is another important variable - criminal offense categories. You can see that motor vehicle theft and public disorder are the leading categories of offenses in Denver. In fact, if you do the math on this graph, there seems to be around 27 separate motor vehicle thefts and public disorders per day in Denver. And, if you keep doing the math, you'll see that the murder rate is significantly lower - thank god.



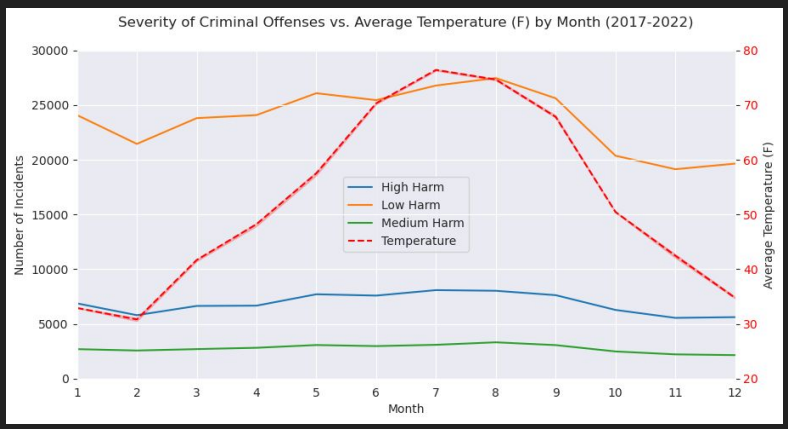
Those were just a few of the variables we explored, but now let’s jump into the key findings and begin answering our research question

Temperature vs Monthly Crime Rates



First, we'll start with the relationship between temperature and monthly crime rate. We're talking about total number of incidents - which is essentially every criminal incident, regardless of how many laws and citations the individual event creates. We can see that crime and temperature are very closely related. In fact, we yield a correlation value of 0.79 supporting our hypothesis that as temperature increases, so will crime rates. Interestingly enough, when we graphed the total number of offenses (so not incidents, offenses), we found pretty much the same thing. I think our correlation value was 0.78 too, so nearly identical. And, that makes sense, most individuals stop after they commit a single crime, they don't go around causing terror.

Temperature vs Crime Severity



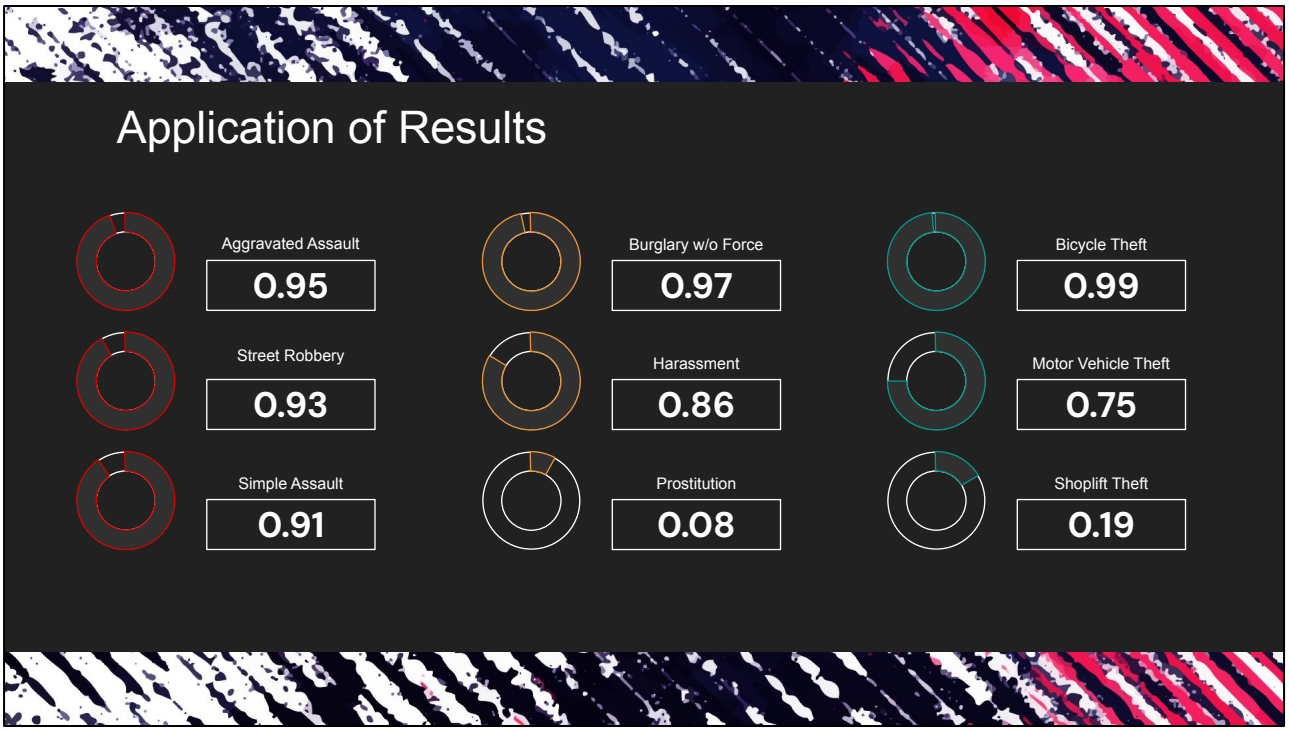
Alright, so we know there exists a positive relationship between temperature and total crime rates. But what about the severity of the crime? If we break up crimes based on the physical harm to other humans, we can see that every level of severity displays a similar positive correlation with temperature. Most notably, High Harm has the largest correlation value at 0.86, followed by medium and low harm correlations of 0.8 and 0.75, respectively.

06

Conclusion

Application of findings
Future research

Okay, so now you know temperature can be a good indicator of crime in Denver. But, I want to leave you all with concrete advice in the event you happen to travel through Denver during a particularly warm period.



Based on our analysis, here are a few of the most notable crimes we observed along with their correlation values against temperature. Some highlights on this slide include the top row of values which are the most correlated crimes per severity level. If it's warm out, you can basically guarantee bicycles will be stolen. Another interesting highlight is at the bottom middle of the slide - we can see that some offenses, such as prostitution, have nearly no correlation with the temperature.

Future Research Questions

Why are there crime spikes in January?

Do other weather factors affect crime (e.g. snow, rain, hail)?

Do other cities experience similar crime-temperature patterns?

Finally, here are a few research questions we believe would help provide more detail into the Denver crime-weather relationship.

Questions