Violent crime and Temperature:

Correlation in Chicago

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Introductions!

“And I ponder what's worse between knowing it's over and dying first.
Cause everybody dies in the summer.
Wanna say ya goodbyes, tell them while it's spring.
I heard everybody's dying in the summer, so pray to God for a little more spring.”

Chance the Rapper
Paranoia, Acid Rap

Overview

01 Inquiry

Question, Hypothesis, Definitions

02 Coding

Data sources, acquisition, rendering

03 Visualisation & Analysis

Plotting, map overlays

04 Results

Correlation, causation, limits, more questions

01

Inquiry

Purpose

Our group set out to investigate the relationship between violent crime and the temperature outside in Chicago.

- What is violent crime?
- What is the nature of the relationship? What are we interrogating?

Definition

Per Corcoran and Zahnow in their metadata analysis, 79% of studies of this relationship define violent crime as:
"...a category that includes rape and sexual assault, robbery, assault, crimes against the person and murder." [3]

We **defined violent crime** as the following: instances of **assault, battery, criminal sexual assault, and homicide.**

- Data exploration: CSV data

Narrowing the Scope

Is there a positive **correlation** between instances of violent crime and the temperature? Is this also a **causation** relationship?

Violent crime is a complex amalgam of socio-economic and psychological factors: drawing a clear causation relationship would be tenuous at best.

Definition dual purpose: relating to correlation *and* causation

- Example: Car theft would be subsumed within assault if assault took place.

Narrowing the Scope (further)

Relationship as either direct or indirect

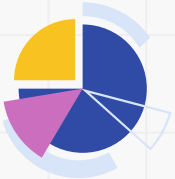
- **Indirect causation:** If it's hotter outside, more people will be outside – leading to more crime being committed
- **Direct causation:** If it's hotter outside, people will suffer greater psychological effects of heat – causing more crime being committed

Indirect causation would see instances of violent crime plateau at a certain temperature. Direct causation would see the temperature and instances of violent crime increase linearly.

Ultimately, our hypothesis is one of indirect causation.

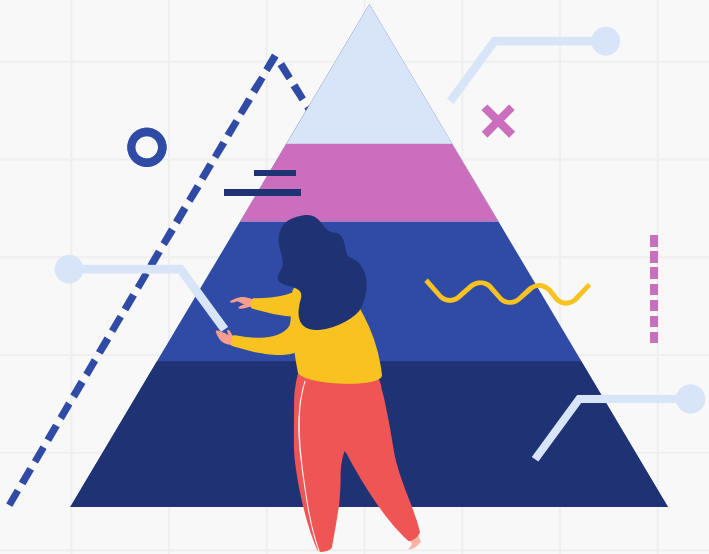
Alternative Hypothesis

If it is hotter outside, then there will be more instances of violent crime.



Null Hypothesis

The weather outside has no impact on the prevalence of violent crime.



02

Coding

Data Sources

We drew data from two sources, a weather data API and a crime data CSV

- Weather data api: Open-Meteo Historical Weather API, limited to 4 year scope (2012 - 2016)
- Crime data csv: Chicago Crime Report (2012 - 2016)

Weather Data API

Hourly dataframe

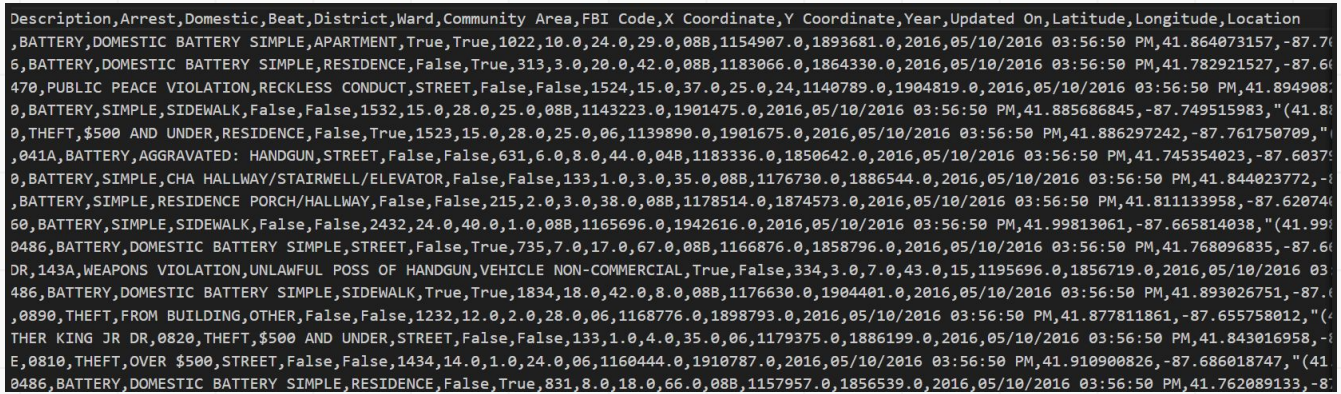
Located min/max of each day

Created new dataframe

- Date
- Max temp
- Min temp

```
Coordinates 41.8629150390625°E -87.64877319335938°N
Elevation 179.0 m asl
Timezone None None
Timezone difference to GMT+0 0 s
                     date  temperature_2m
0     2012-01-01 00:00:00       38.581699
1     2012-01-01 01:00:00       38.041698
2     2012-01-01 02:00:00       38.041698
3     2012-01-01 03:00:00       38.491699
4     2012-01-01 04:00:00       39.211700
...                   ...             ...
52603 2017-12-31 19:00:00       12.661701
52604 2017-12-31 20:00:00       13.471699
52605 2017-12-31 21:00:00       12.661701
52606 2017-12-31 22:00:00       10.411701
52607 2017-12-31 23:00:00        8.071699
```

Crime Data CSV



```
Description,Arrest,Domestic,Beat,District,Ward,Community Area,FBI Code,X Coordinate,Y Coordinate,Year,Updated On,Latitude,Longitude,Location
,BATTERY,DOMESTIC BATTERY SIMPLE,APARTMENT,True,True,1022,10.0,24.0,29.0,08B,1154907.0,1893681.0,2016,05/10/2016 03:56:50 PM,41.864073157,-87.7
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THER KING JR DR,0820,THEFT,$500 AND UNDER,STREET,False,False,133,1.0,4.0,35.0,06,1179375.0,1886199.0,2016,05/10/2016 03:56:50 PM,41.843016958,-
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```

A staggering amount of crime data: cleaned by checking for duplicates, blanks, dropping irrelevant columns (such as “Case Number” and “Updated on”), and converted data/time

Filtered based on our **definition of violent crime**

Combined Dataframe (Total)

	ID	Date	Primary Type	District	Community Area	Year	temperature_2m_max	temperature_2m_min
279103	10254059	2015-09-27	ASSAULT	25.0	18.0	2015	71.611702	63.331699
184582	9533399	2014-03-15	CRIM SEXUAL ASSAULT	18.0	8.0	2014	41.011700	29.131701
7269	9670409	2014-06-26	ASSAULT	5.0	50.0	2014	66.931702	55.861702
172107	9438842	2013-12-24	BATTERY	22.0	75.0	2013	13.651701	-3.178299
195366	9608547	2014-05-12	ASSAULT	7.0	67.0	2014	75.661697	63.961700
226951	9819518	2014-10-15	BATTERY	9.0	61.0	2014	59.551701	52.261700
181155	9507419	2014-02-21	BATTERY	15.0	25.0	2014	47.221699	24.541698

Sample of 7

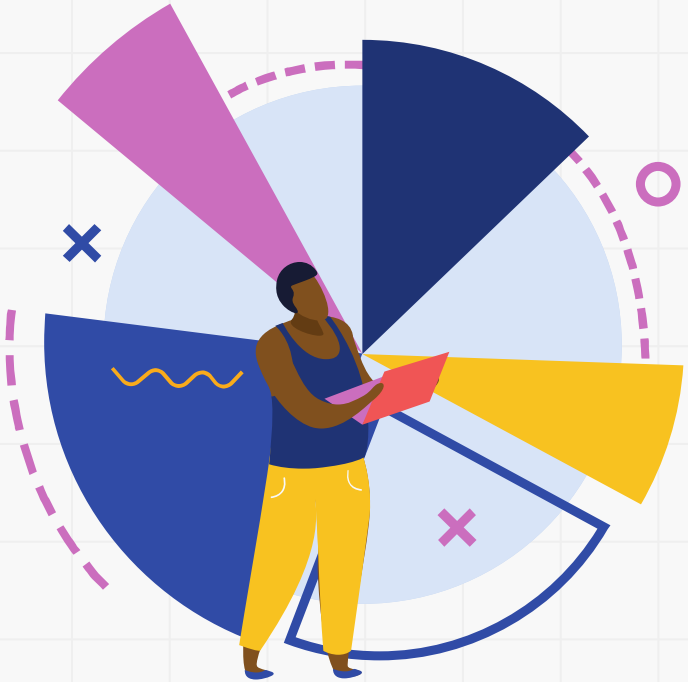
Yearly Count

Year	Primary Type	ID	Date	District	Community Area
2012	ASSAULT	19898	19898	19898	19894
	BATTERY	59132	59132	59132	59129
	CRIM SEXUAL ASSAULT	1406	1406	1406	1406
	HOMICIDE	503	503	503	503
2013	ASSAULT	17971	17971	17971	17971
	BATTERY	54003	54003	54003	54003
	CRIM SEXUAL ASSAULT	1264	1264	1264	1264
	HOMICIDE	422	422	422	422

03

Visualisation & Analysis

With our dataframe cleaned and organized, we can start visualising.



Graphs, Charts, & Analysis

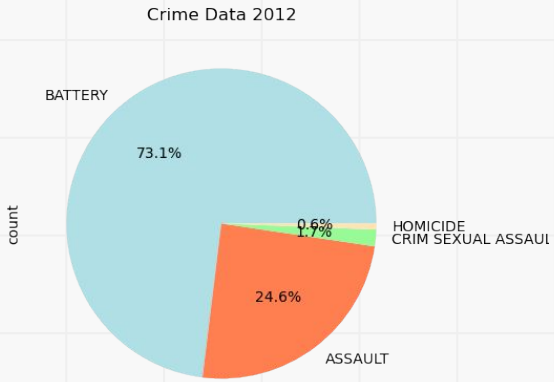
1.) Pie charts for breakdown of crime categories per year

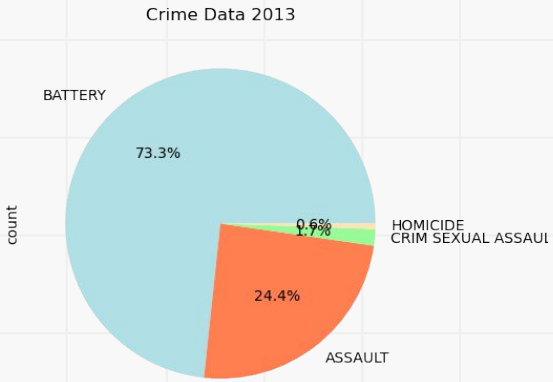
2.) Bar graph displaying crime vs temperature

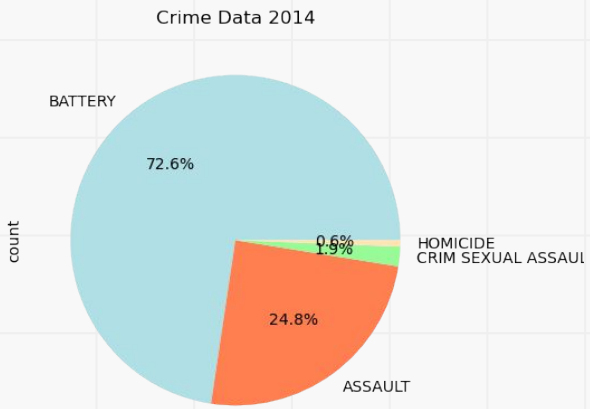
3.) Scatter plots that show crime vs temperature

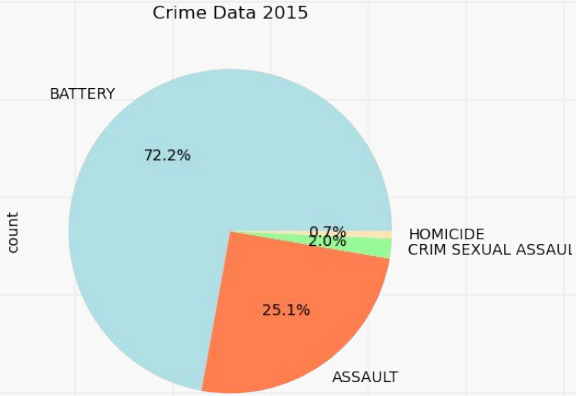
4.) ANOVA hypothesis testing

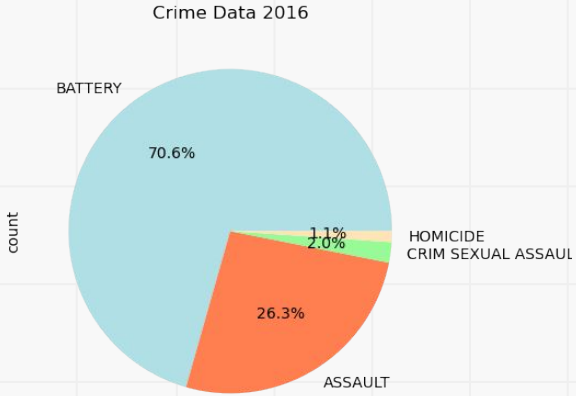
Pie Charts

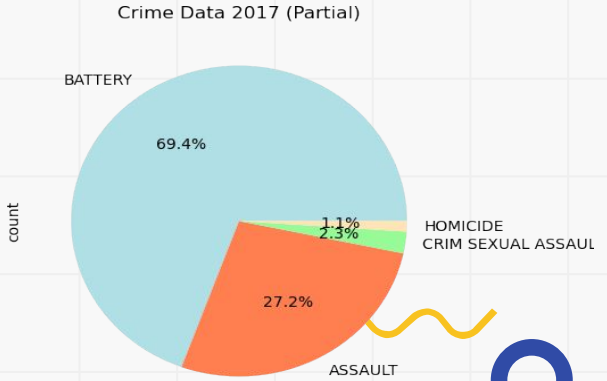

Crime Data 2012
BATTERY
73.1%
0.6%
1.7%
HOMICIDE
CRIM SEXUAL ASSAUL
24.6%
ASSAULT
count


Crime Data 2013
BATTERY
73.3%
0.6%
1.7%
HOMICIDE
CRIM SEXUAL ASSAUL
24.4%
ASSAULT
count

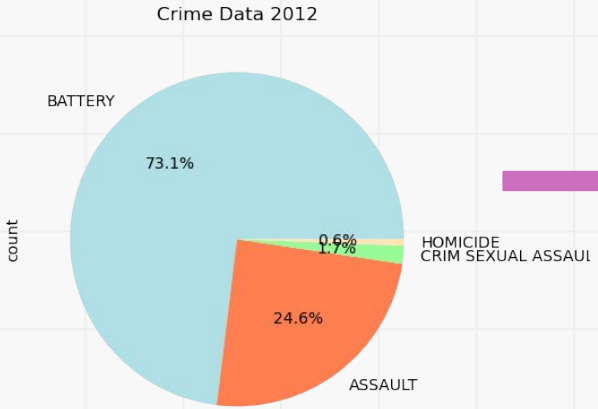

Crime Data 2014
BATTERY
72.6%
0.6%
1.9%
HOMICIDE
CRIM SEXUAL ASSAUL
24.8%
ASSAULT
count

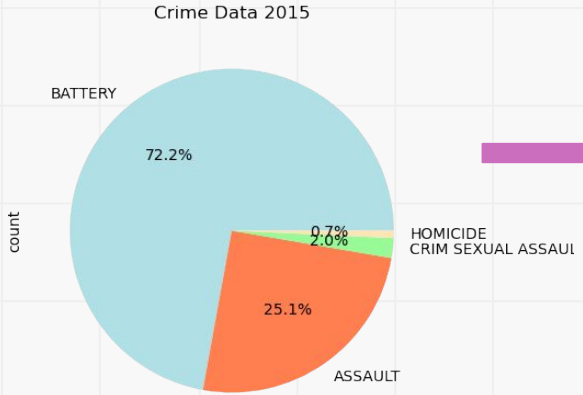

Crime Data 2015
BATTERY
72.2%
0.7%
2.0%
HOMICIDE
CRIM SEXUAL ASSAUL
25.1%
ASSAULT
count

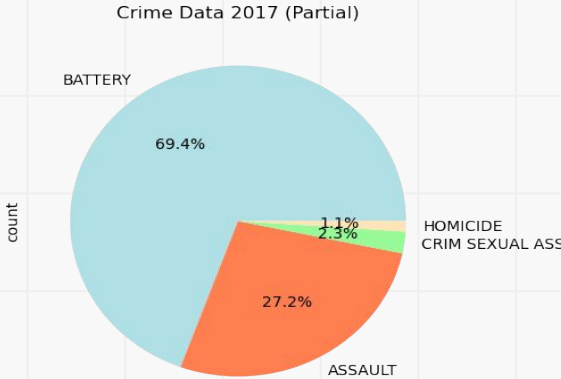

Crime Data 2016
BATTERY
70.6%
1.1%
2.0%
HOMICIDE
CRIM SEXUAL ASSAUL
26.3%
ASSAULT
count


Crime Data 2017 (Partial)
BATTERY
69.4%
1.1%
2.3%
HOMICIDE
CRIM SEXUAL ASSAUL
27.2%
ASSAULT
count

Pie Charts Observations



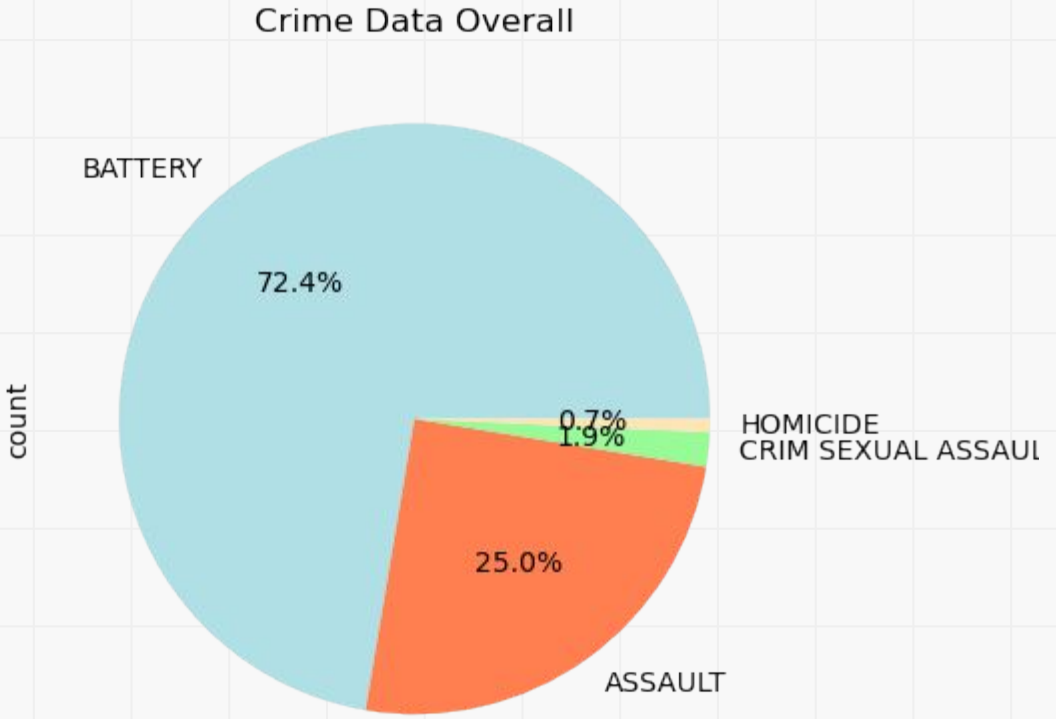




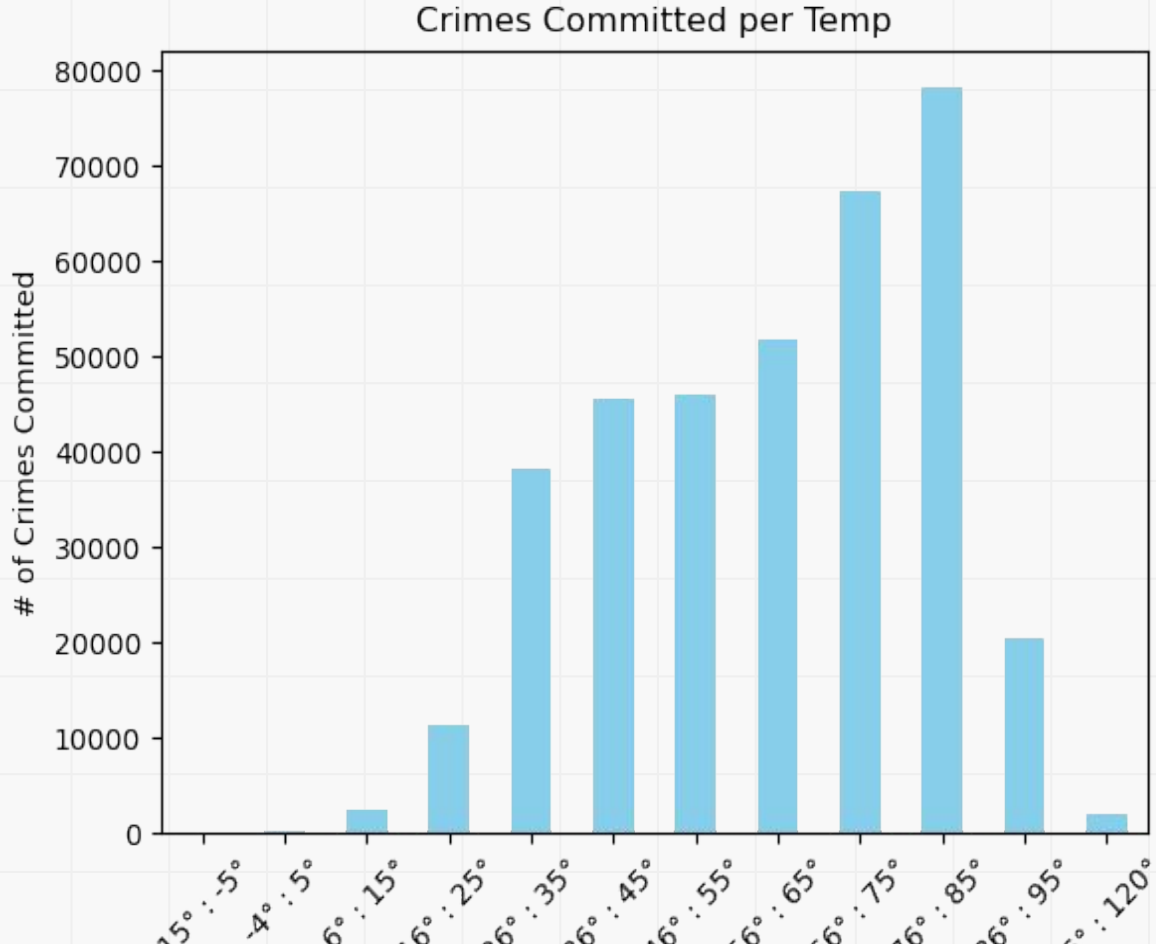
- Steady decrease in battery from 2012 to 2017
- Increase in assault, criminal sexual assault, and homicide

Overall

- Consistent breakdown of totals of the different crime types
  - *Shows societal trends*

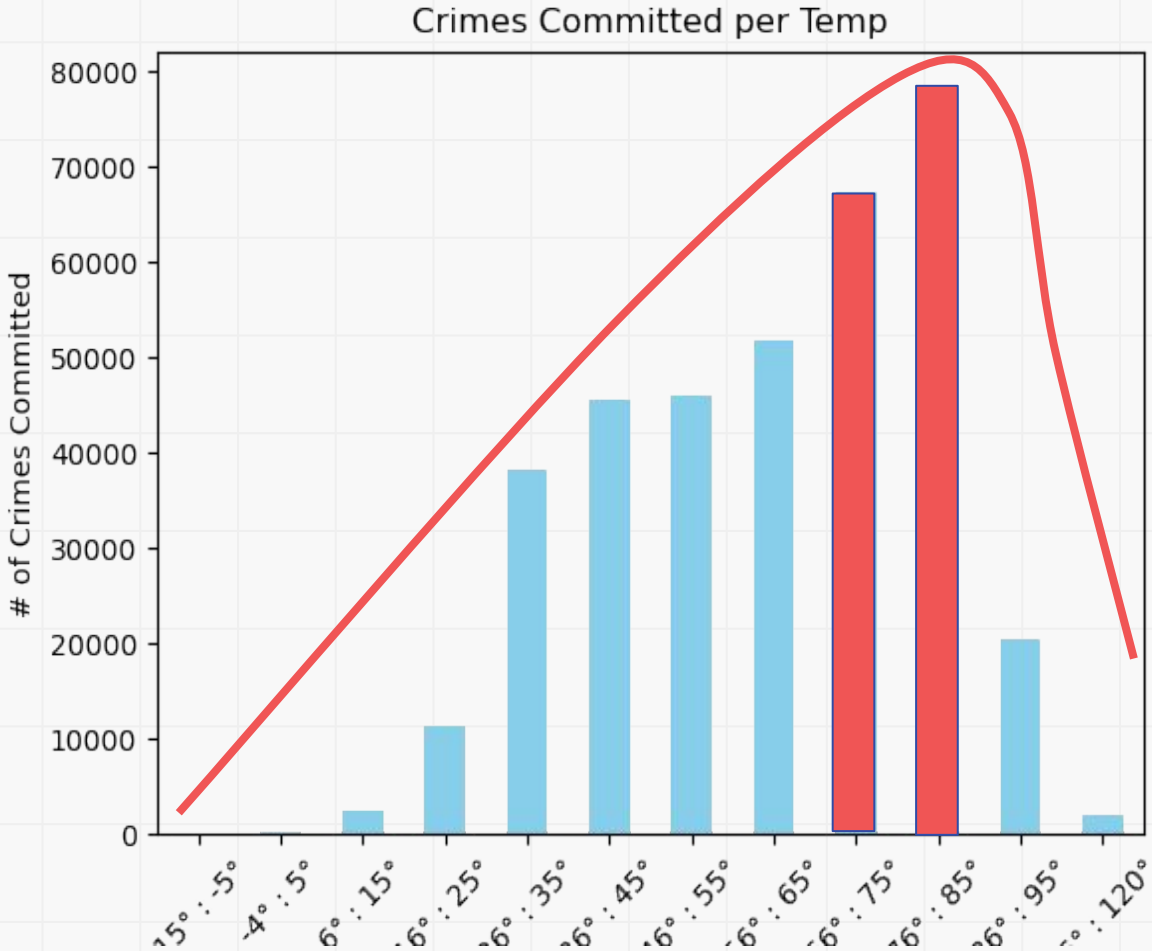


Crime by Temperature (Bar Chart)



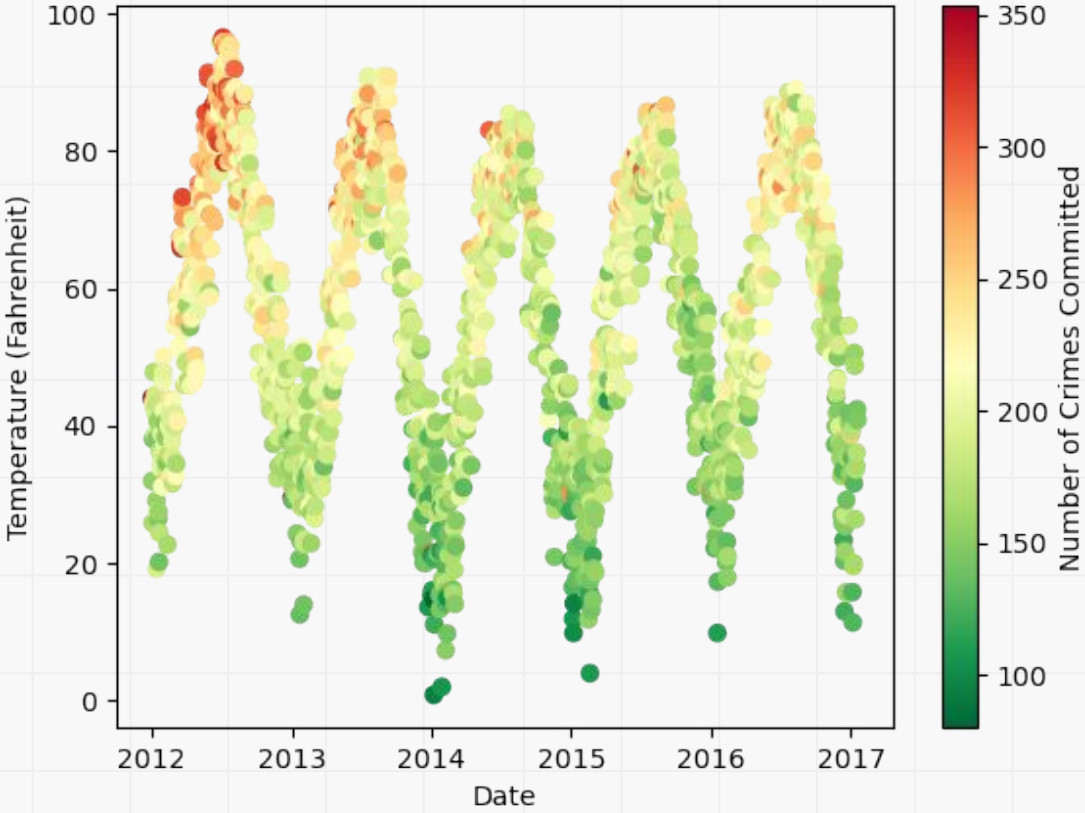
Crime by Temperature (Bar Chart)

- The temperature ranges with the greatest amount of crimes committed falls within 66℉ to 85℉



- Left skewed distribution
  - The spread of data towards the lower temperature values is greater than towards the higher temperature values

Crime by Temperature (Heat Map)



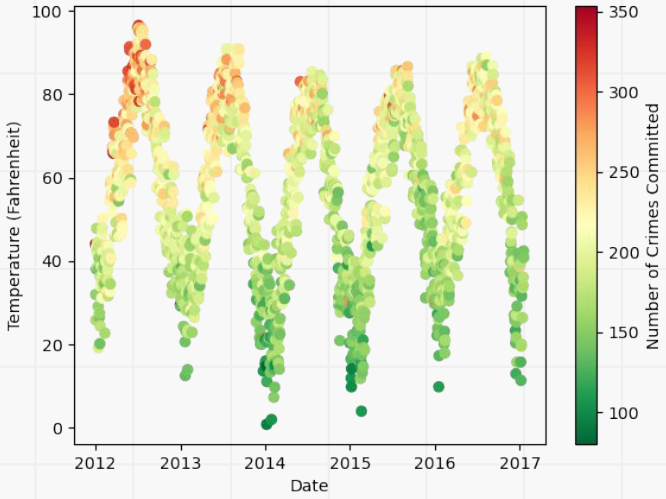
Discussing 2012

Direct Causation

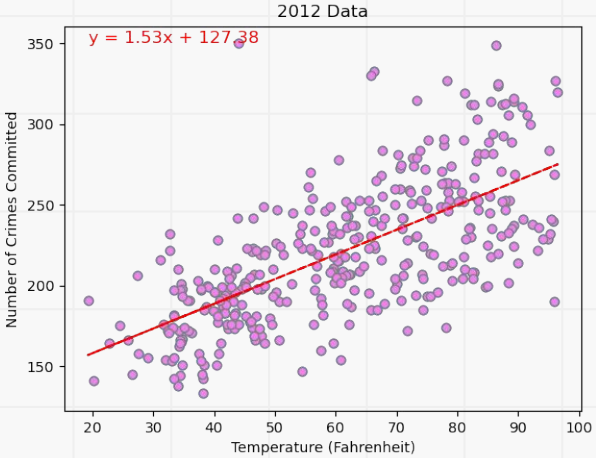
- 2012 was the hottest summer in Chicago since 1911
- Homicides up by 38% over 2011

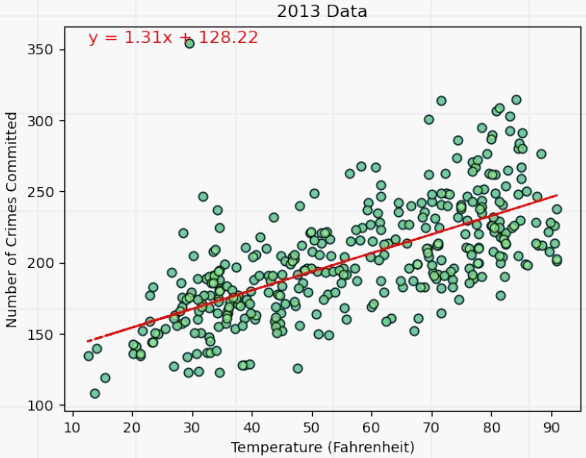
Indirect Causation

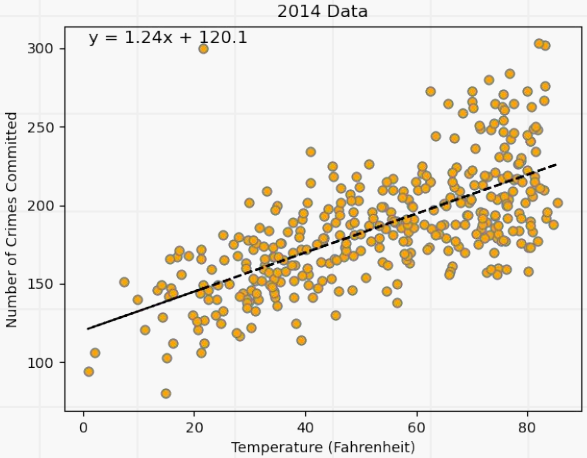
- We don't have data for 2010, 2011: we can't see if this is an outlier
- Increase attributed to gang fragmentation



2012, 2013, 2014







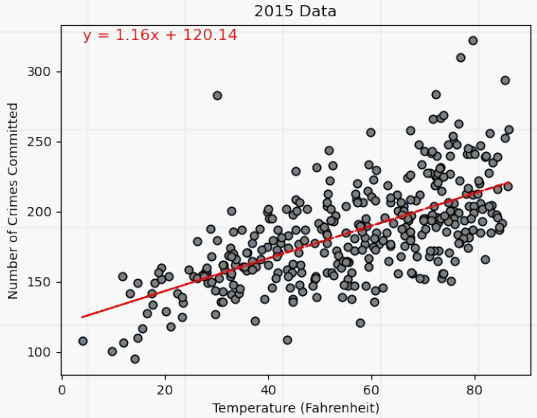
R= 0.68

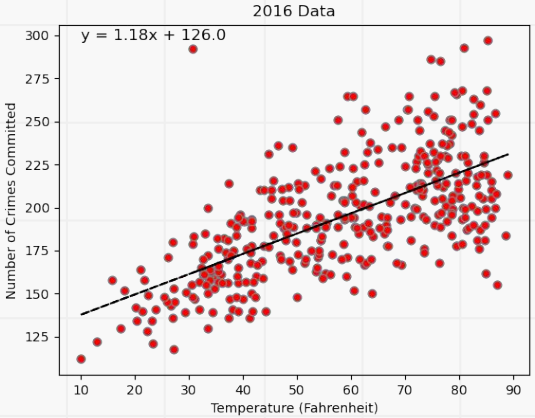
R= 0.66

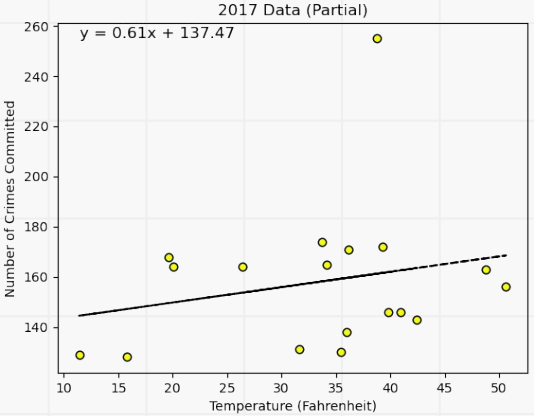
R= 0.68

All regression models display a positive linear relationship, as temperature increases the number of crimes increase.

2013, 2014, 2015







R= 0.63

R= 0.66

R= 0.23

2015 and 2016 show that as temperature increases the number of crimes increase.

**Limited data points for 2017

Hypothesis Statement

We've demonstrated a correlation and indirect causation relationship between the weather and instances of violent crime.

Alternative Hypothesis: If it is hotter outside, then there will be more instances of violent crime.

Null Hypothesis: The weather outside has no impact on the prevalence of violent crime.

Correlation Testing

ANOVA results:

```
F_onewayResult(statistic=535.0646207738067, pvalue=0.0)
```

Significance of p-value = 0.0

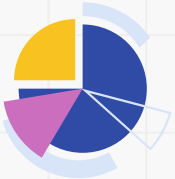
- Extremely strong correlation

F-statistic of 535.0646207738067

- indicates a great difference between the group means

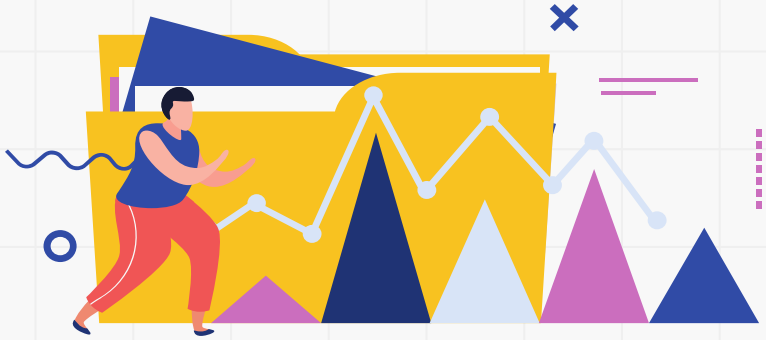
Alternative Hypothesis

If it is hotter outside, then there will be more instances of violent crime.



Null Hypothesis

The weather outside has no impact on the prevalence of violent crime.



04

Results

Results

We've demonstrated a positive **correlation** and **indirect causation** relationship between the weather and instances of violent crime: as it gets hotter, there is more violent crime.

Our results plateau, with most instances occurring in the high 70s range.

What avenues could we explore to query a **direct causation** relationship?

How can we go further?

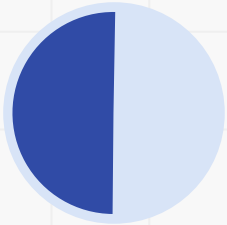
Who has access to air conditioning? **Who doesn't?**

- Areas with high concentration of poverty would *most likely* be areas of lower AC ownership.

Where can we look for access to AC in impoverished areas? Possibly public housing?

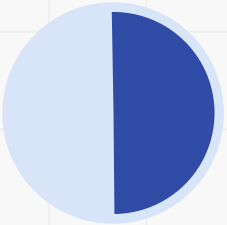
- Air conditioning was not required in public housing until 2023
    - Will this cause a drop in crime rates going forward?

Correlation or Causation?



Indirect Causation

As it gets hotter, more people will be outside.

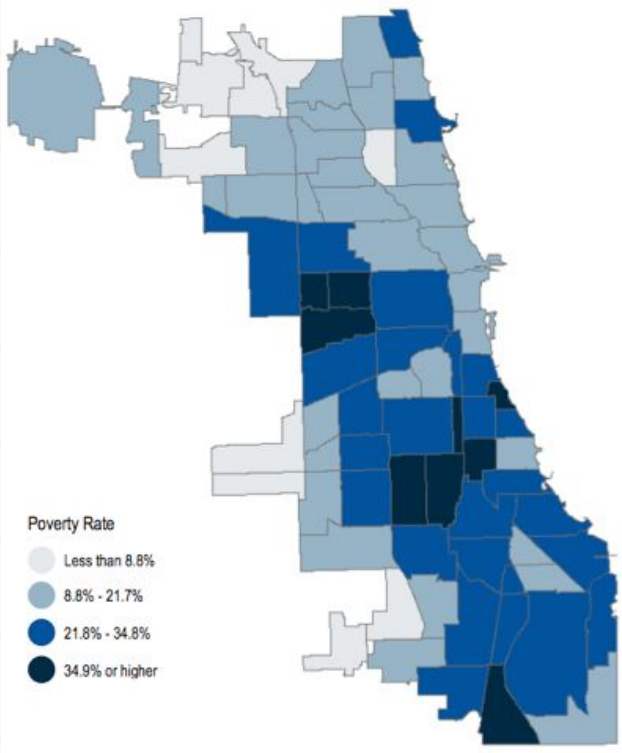


Direct Causation

As it gets hotter, people without access to air conditioning will suffer greater psychological effects of extreme discomfort.

Analysis: Psychological Impact

- Impoverished areas are more likely to lack access to AC
- Heat map of poverty



Limitations of Analysis

Time and scope

Data availability

Psychological and physiological effects are a contributing factor, but as one among many for this complex issue

Open Discussion & Questions

Sources

[1] Weather Data API

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