Friedrich-Alexander-Universität
Erlangen-Nürnberg

Methods of Advanced Data Engineering
Winter Semester 2024/25

Analysis of Shootings Incidents and Weather Data

Presented by:
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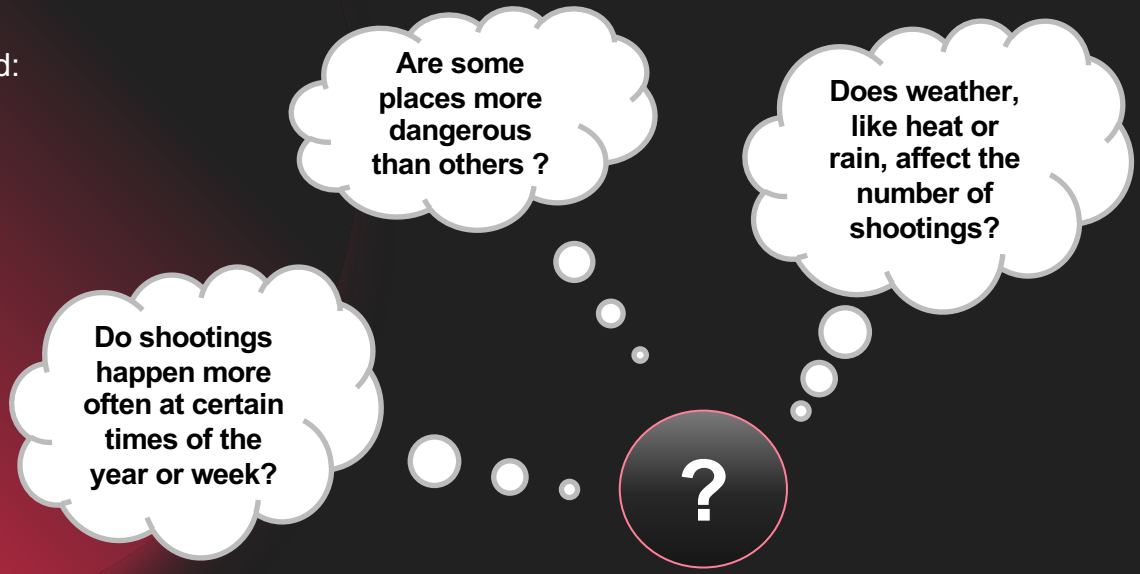
MOTIVATION

I chose this project to understand the factors influencing shooting incidents in the United States. With over 30,000 incidents recorded between 2015 and 2020, this data provides an opportunity to uncover meaningful patterns. Combining information about demographics, locations, and weather offered a unique way to study these incidents.

As I explored the data,
Few simple questions came to mind:



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INTRODUCTION

Gun violence remains a pressing concern in the United States, affecting thousands annually. This analysis explores patterns using **demographic, geographic, and weather data** to uncover trends and inform solutions.

This study focuses on three primary dimensions

- Temporal Patterns
- Spatial Clustering
- Environmental Influence

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DATA SOURCES

Dataset	Source	Original Timeframe	Filtered Timeframe	Attributes	Purpose
Shooting Incidents	Kaggle - US Police Shootings Dataset	2015–2020	2015–2020	Date, city, state, race, gender, armed status, mental illness, body camera use.	Analyse temporal, spatial, and demographic patterns in shooting incidents.
Weather Data	Kaggle - Weather Dataset for the US [United States Daily Climate Observations (GHCN-Daily)]	1992-2021	2015–2020	TMAX, TMIN, PRCP, snowfall, snow depth.	Explore correlations between weather conditions and shooting frequencies.

Data Snippets

	id	name	date	manner_of_death	armed	\
0	3	Tim Elliot	2015-01-02	shot	gun	
1	4	Lewis Lee Lembke	2015-01-02	shot	gun	
2	5	John Paul Quintero	2015-01-03	shot and Tasered	unarmed	
3	8	Matthew Hoffman	2015-01-04	shot	toy weapon	
4	9	Michael Rodriguez	2015-01-04	shot	nail gun	
...	...	...	...	...	...	
4890	5916	Rayshard Brooks	2020-06-12	shot	Taser	
4891	5925	Caine Van Pelt	2020-06-12	shot	gun	
4892	5918	Hannah Fizer	2020-06-13	shot	unarmed	
4893	5921	William Slyter	2020-06-13	shot	gun	
4894	5924	Nicholas Hirsh	2020-06-15	shot	gun	

	age	gender	race	city	state	signs_of_mental_illness	\
0	53.0	M	Asian	Shelton	WA	True	
1	47.0	M	White	Aloha	OR	False	
2	23.0	M	Hispanic	Wichita	KS	False	
3	32.0	M	White	San Francisco	CA	True	
4	39.0	M	Hispanic	Evans	CO	False	
...	...	...	...	...	...	...	
4890	27.0	M	Black	Atlanta	GA	False	
4891	23.0	M	Black	Crown Point	IN	False	
4892	25.0	F	White	Sedalia	MO	False	
4893	22.0	M	White	Kansas City	MO	False	
4894	31.0	M	White	Lawrence	KS	False	

	threat_level	flee	body_camera	arms_category
0	attack	Not fleeing	False	Guns
1	attack	Not fleeing	False	Guns
2	other	Not fleeing	False	Unarmed
3	attack	Not fleeing	False	Other unusual objects
4	attack	Not fleeing	False	Piercing objects
...	...	...	...	...
4890	attack	Foot	True	Electrical devices
4891	attack	Car	False	Guns
4892	other	Not fleeing	False	Unarmed
4893	other	Other	False	Guns
4894	attack	Car	False	Guns

Shootings Data

Weather Data

	ID	DATE	TMAX	TMIN	EVAP	PRCP	Latitude	\
0	US1MDHW0012	2015-10-14	189.0	56.0	NaN	0.0	39.3387	
1	USC00206510	2018-08-02	267.0	156.0	NaN	28.0	45.3614	
2	US1PALH0005	2016-07-20	189.0	56.0	NaN	0.0	40.6474	
3	US1TNDV0152	2020-01-29	189.0	56.0	NaN	0.0	36.1124	
4	US1TXUV0032	2018-12-29	189.0	56.0	NaN	0.0	29.2242	
...	...	...	...	...	...	...	...	
46230812	US1WIRS0001	2017-03-28	189.0	56.0	NaN	5.0	45.4818	
46230813	US1OKCC0009	2018-05-04	189.0	56.0	NaN	5.0	34.5898	
46230814	USC00144608	2017-06-26	189.0	56.0	NaN	5.0	38.4161	
46230815	US1IACG0011	2019-06-04	189.0	56.0	NaN	5.0	43.1329	
46230816	US1NEDG0029	2019-06-15	189.0	56.0	NaN	5.0	41.2140	

	Longitude	Elevation
0	-76.9468	166.1
1	-84.9511	228.0
2	-75.6505	143.9
3	-86.8117	191.4
4	-100.0654	294.7
...	...	...
46230812	-91.1468	347.5
46230813	-98.4766	353.9
46230814	-95.8511	358.1
46230815	-93.2079	358.1
46230816	-96.1908	366.1

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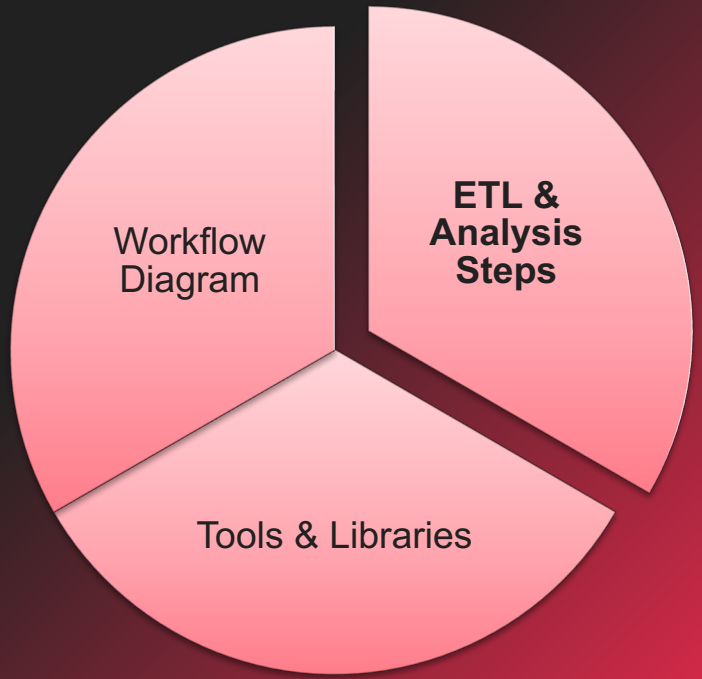
Workflow Diagram
ETL & Analysis Steps
Tools & Libraries

ETL & Analysis Steps

Extraction
Downloaded datasets (shootings: 2015–2020, weather: 1992–2021) using Kaggle CLI

Transformation
Filtered weather data to 2015–2020, handled missing values (e.g., TMAX, PRCP), and standardized formats

Loading
Stored cleaned data in SQLite database with 2 tables: shootings and weather

Temporal
Identified trends by year, month, and day of the week

Spatial
Visualized hotspots using Folium maps and heatmaps

Environmental
Correlated weather variables (e.g., TMAX, PRCP) with shooting frequencies

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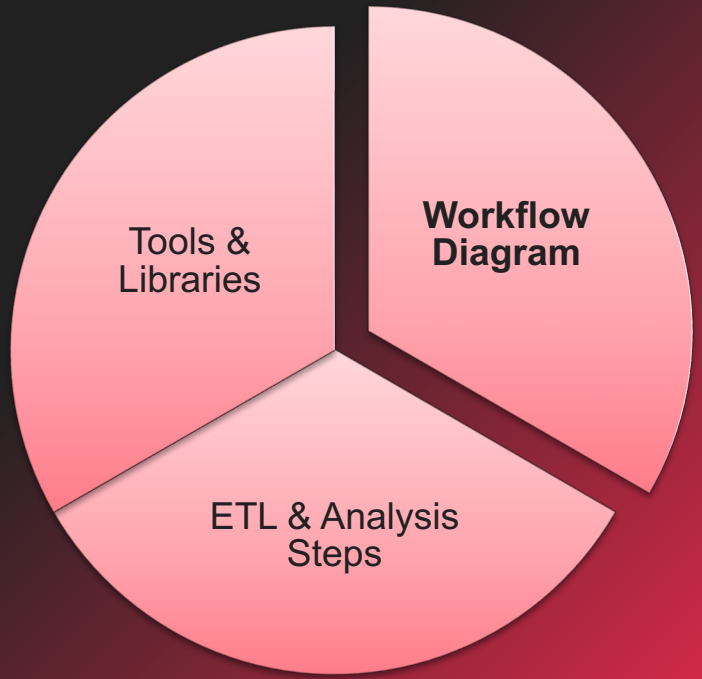
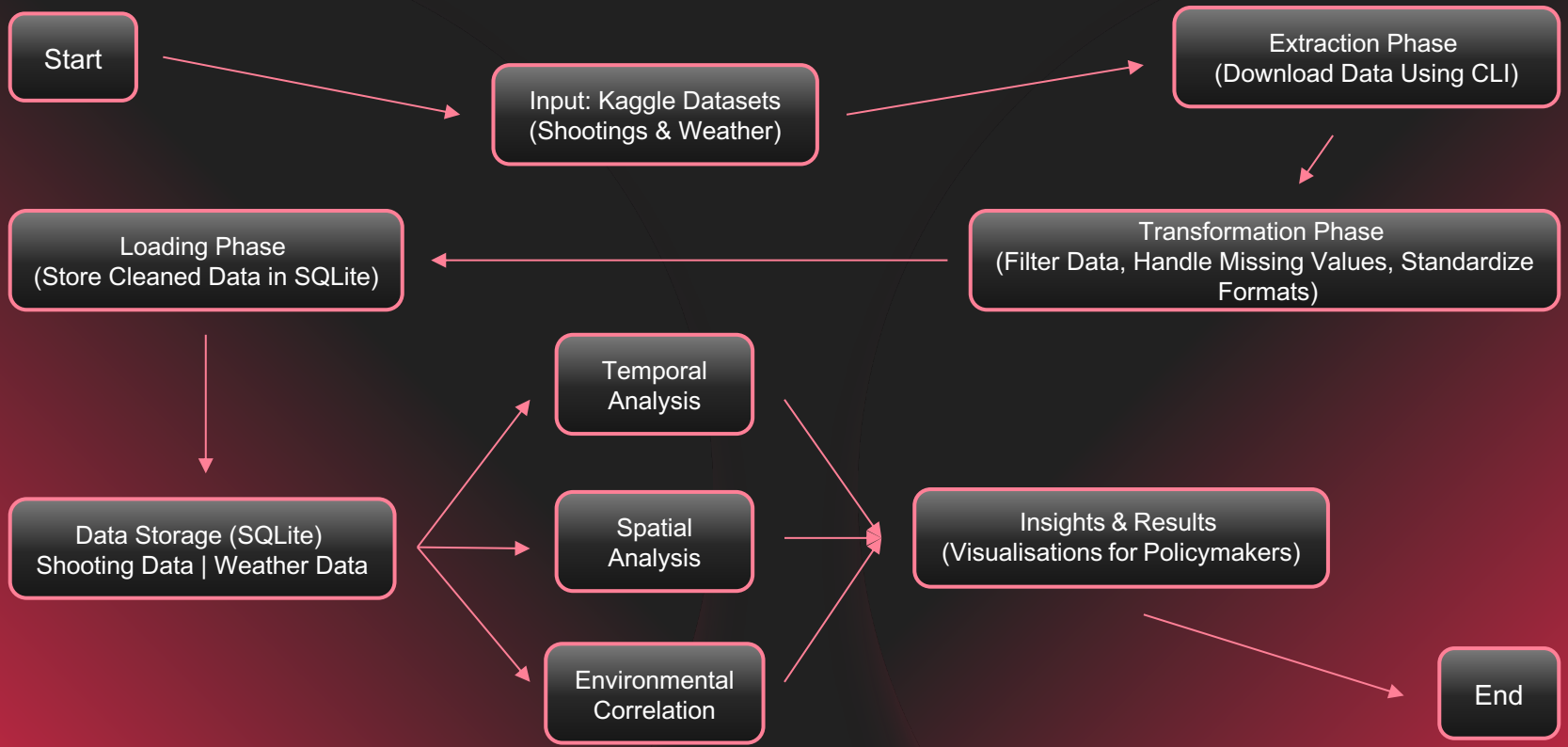

Tools &
Libraries
Workflow
Diagram
ETL & Analysis
Steps

Workflow Diagram



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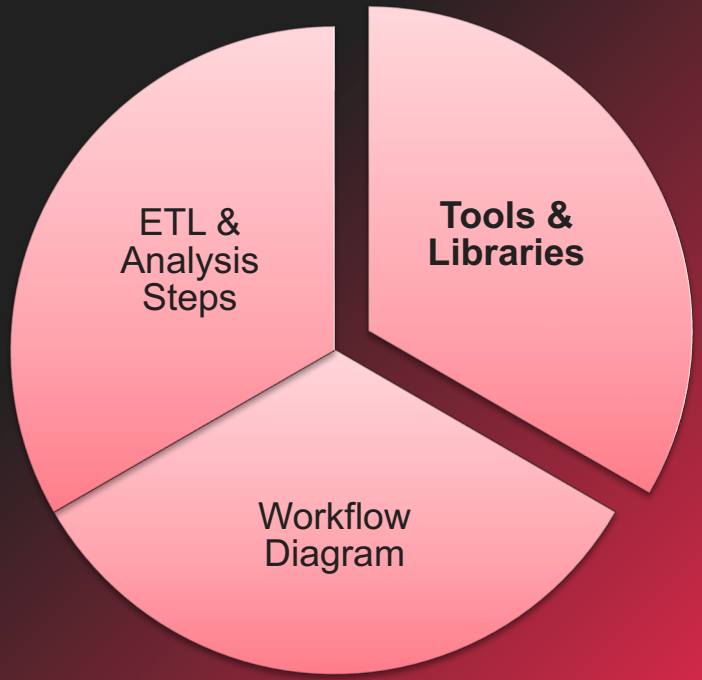
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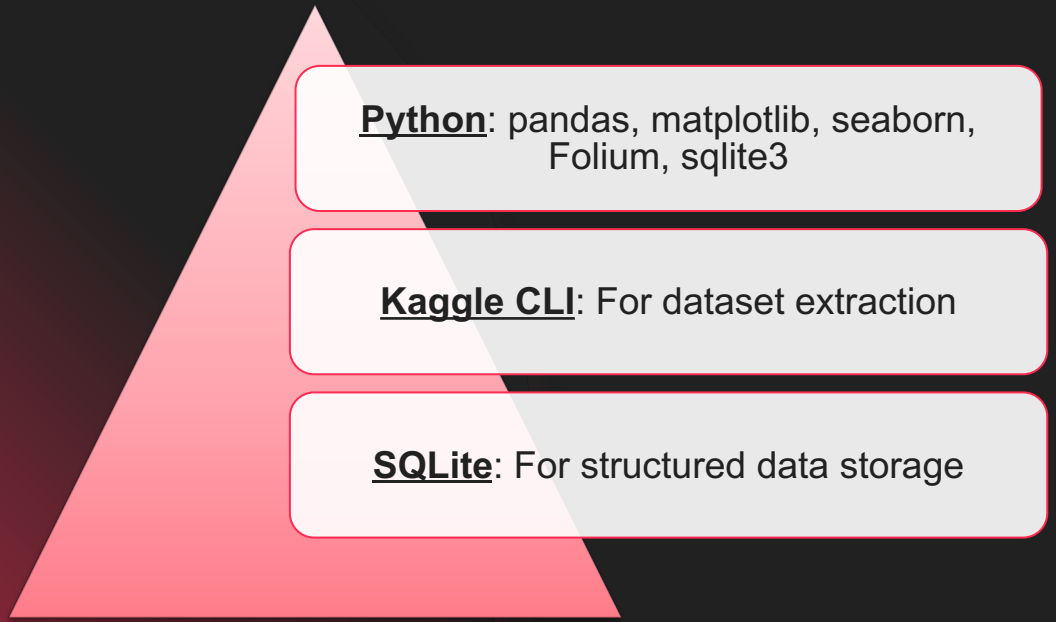
Python: pandas, matplotlib, seaborn, Folium, sqlite3
Kaggle CLI: For dataset extraction
SQLite: For structured data storage

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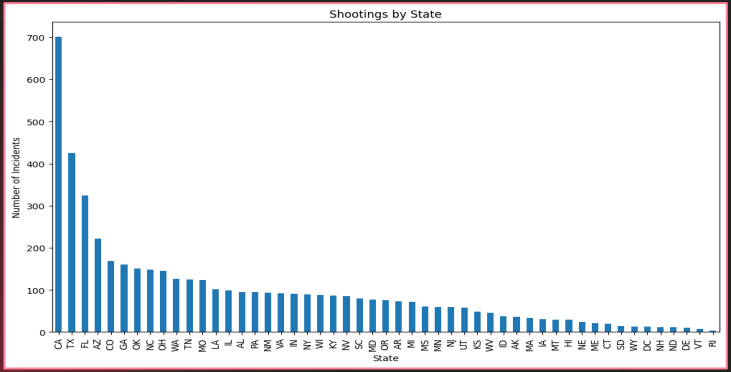
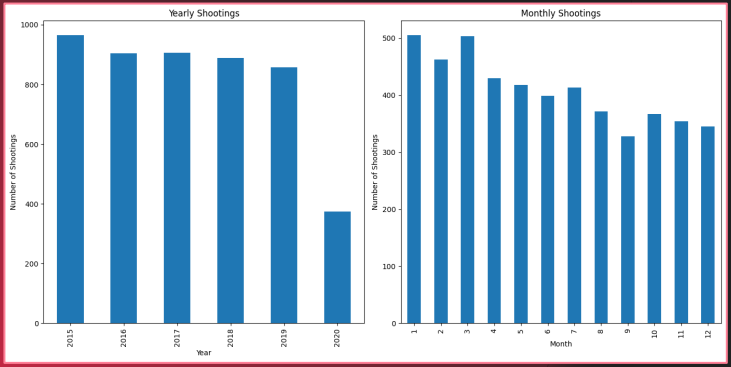
FINDINGS





QUESTION 1

What are the spatial and temporal patterns of shooting incidents, and can these trends help identify high-risk areas and times for potential future incidents?

Shooting incidents peak during January – March, then again during July and are concentrated in high-risk states like California, Texas, and Florida, with significant urban clustering.

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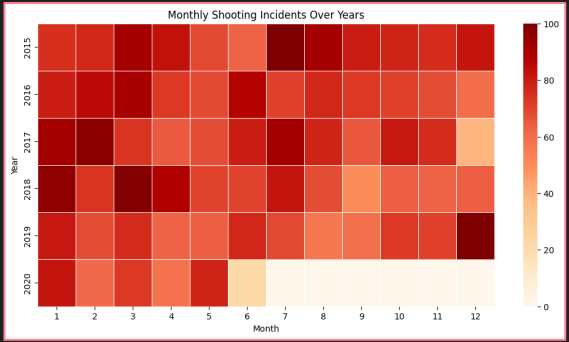
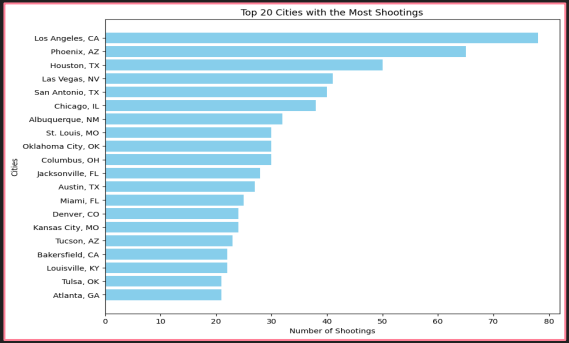
FINDINGS





QUESTION 2

What are the trends in shooting incidents across different locations and times?

Shootings are more frequent during January – March, then again during July, and cities like Los Angeles, Houston, and Phoenix emerge as urban hotspots for incidents.

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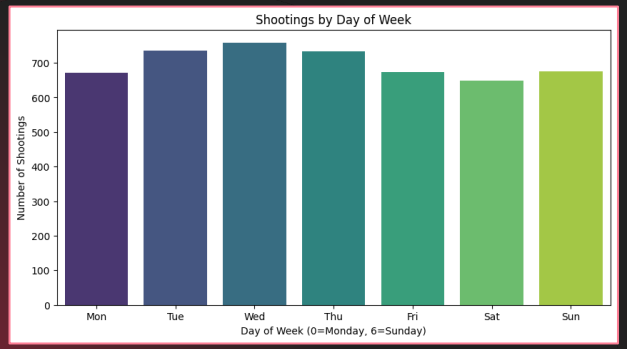

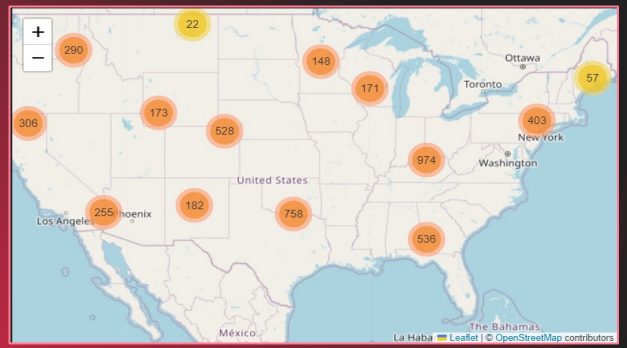

QUESTION 3

How do factors like time, day, or location influence the frequency of shootings?

Tuesday – Thursday has slightly higher shooting frequencies, with dense regional clusters observed in urban areas.

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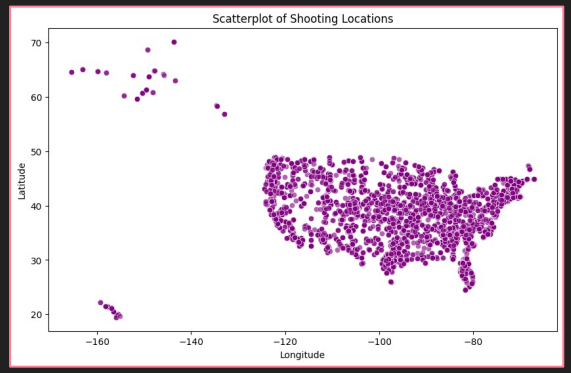
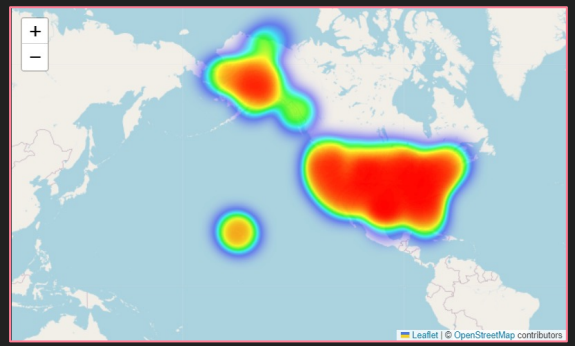
FINDINGS





QUESTION 4

Can we identify hotspots or predict shooting occurrences based on historical data?

Heatmaps highlight high-risk areas, and scatterplots reveal detailed spreads, aiding hotspot identification and predictive modelling.

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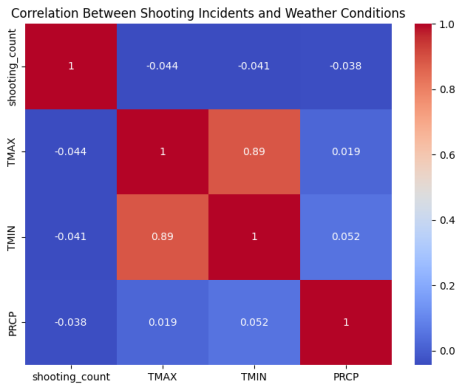
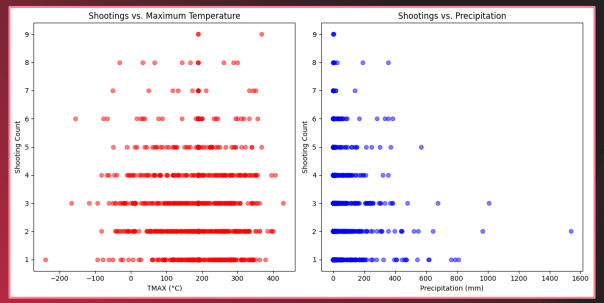


QUESTION 5

How do weather conditions (such as temperature, humidity, and precipitation) correlate with the frequency and distribution of shooting incidents across different locations and times, and can certain weather patterns be linked to higher shooting occurrences?



The correlation matrix shows that as temperature and precipitation increase, shootings decrease. This suggests that warmer or wetter days see fewer shootings, as illustrated in the scatterplots.

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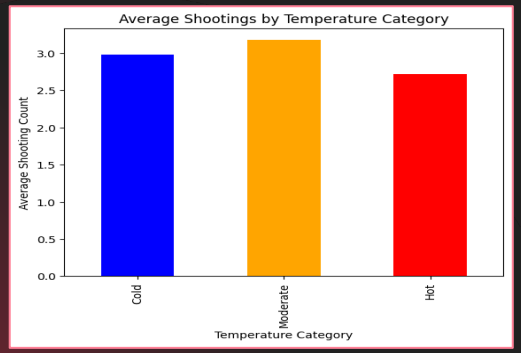
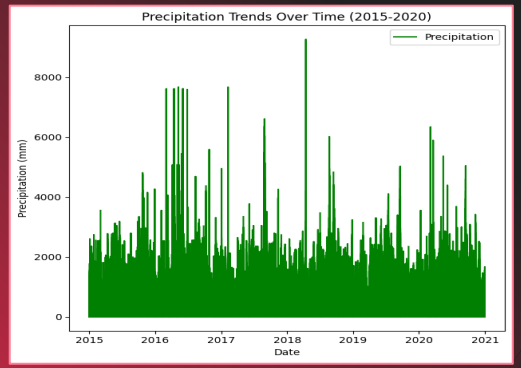


Temperature Trends: **Moderate temperatures** see the **highest shooting rates**, with **incidents dropping in colder** and **minimal in hotter conditions**.



Precipitation Trends: The precipitation graph shows seasonal rainfall variations, with **higher rainfall periods correlating with fewer shootings**, likely **due to reduced outdoor activities**.

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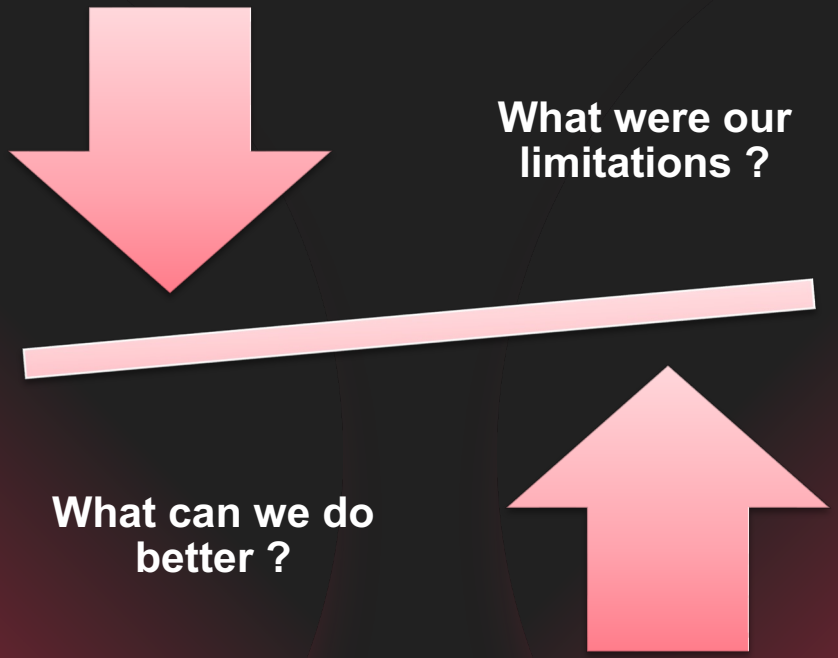
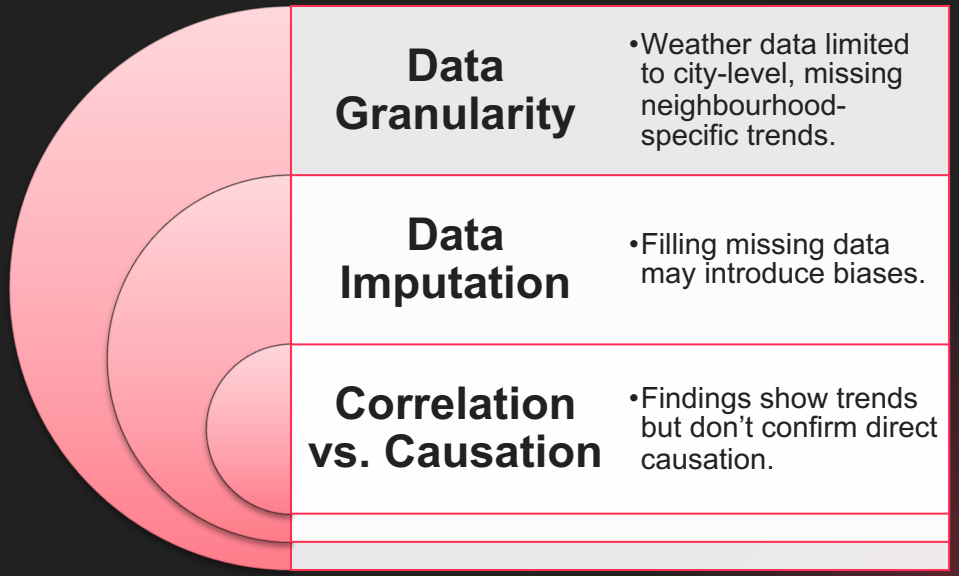

What were our limitations ?
What can we do better ?

Limitations



- Integrate neighbourhood-level socio-economic and weather data for finer insights.
- Develop predictive models combining temporal, spatial, and weather patterns.
- Explore behavioural and social factors affecting shooting trends.

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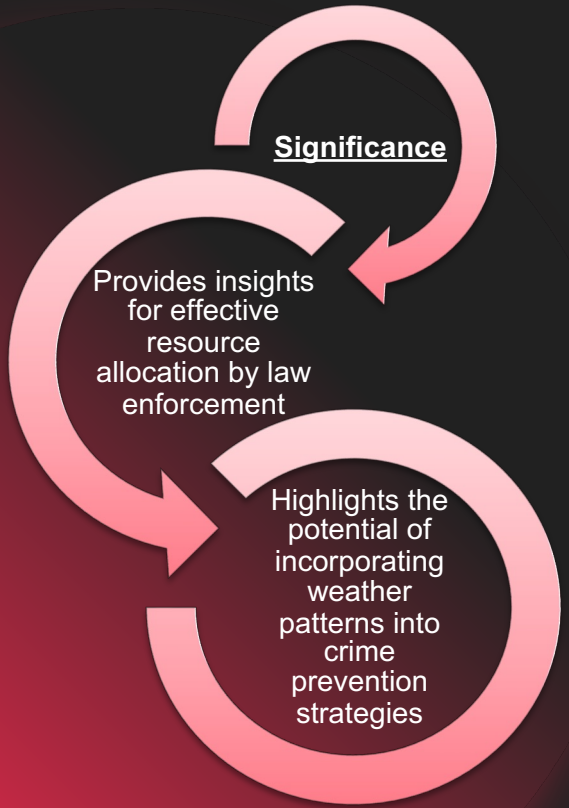
CONCLUSION



Key Takeaways:

- **Temporal Patterns**: Shootings peak January–March and mid-week.
- **Spatial Trends**: Hotspots in California, Texas, and urban areas.
- **Environmental Influence**: Lower temperatures increase incidents; rain reduces them slightly.

Implications:

- Encourage targeted interventions in high-risk areas and times.
- Address socio-economic factors in identified hotspots to reduce long-term incidents.

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Datasets:

- Kaggle - US Police Shootings Dataset
- Kaggle - Weather Data US

Thank you for listening !!