1.1 Introduction

This report aims to analyze the relationship between different weather conditions and traffic accidents in Chicago city. The primary question addressed in this report is: **What is the impact of weather on motor vehicle accidents in the city of Chicago in 2023?**
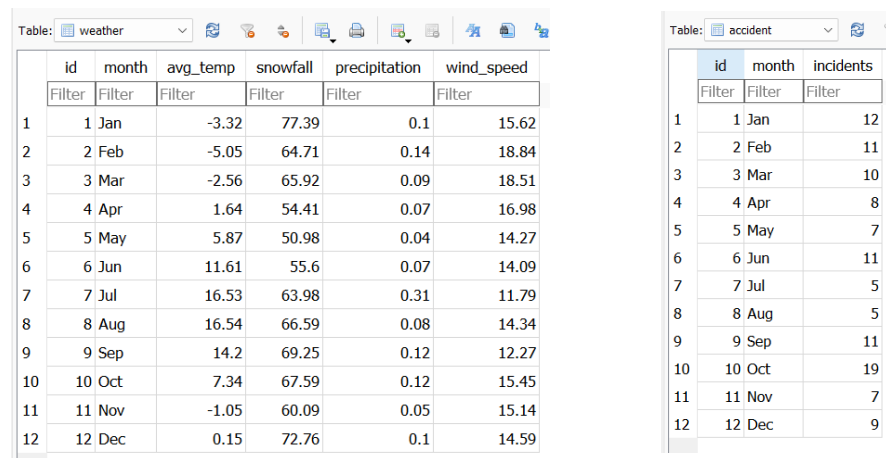Understanding the impact of weather on traffic accidents is crucial for city planning, public safety, and implementing preventive measures. By analyzing monthly accident data alongside weather data, I aim to uncover patterns and correlations that can help mitigate risks and improve road safety.

1.2 Used Data

Weather and Accident Data

The weather data was sourced from **Meteostat**, which provides historical weather data. The specific dataset used includes daily weather records for Chicago. For this analysis, the focus was on the monthly averages of key weather parameters are: **month:** Extracted from date to group data by month, **avg_temp**: Average temperature (°C), **snowfall:** Snowfall (mm), **precipitation:** Precipitation (mm), **wind_speed:** Wind speed (km/h).

Furthermore, the accident data was sourced from the **Data.gov** Portal, specifically from the dataset "Traffic Crashes". This dataset includes detailed records of traffic accidents in Chicago. For this analysis, the focus was on the number of incidents per month for the year 2023. The relevant columns used are: **month:** Extracted from Crash_Date to group incidents by month, **incidents:** The total number of accidents per month.

id	month	avg_temp	snowfall	precipitation	wind_speed
1	Jan	-3.32	77.39	0.1	15.62
2	Feb	-5.05	64.71	0.14	18.84
3	Mar	-2.56	65.92	0.09	18.51
4	Apr	1.64	54.41	0.07	16.98
5	May	5.87	50.98	0.04	14.27
6	Jun	11.61	55.6	0.07	14.09
7	Jul	16.53	63.98	0.31	11.79
8	Aug	16.54	66.59	0.08	14.34
9	Sep	14.2	69.25	0.12	12.27
10	Oct	7.34	67.59	0.12	15.45
11	Nov	-1.05	60.09	0.05	15.14
12	Dec	0.15	72.76	0.1	14.59

id	month	incidents
1	Jan	12
2	Feb	11
3	Mar	10
4	Apr	8
5	May	7
6	Jun	11
7	Jul	5
8	Aug	5
9	Sep	11
10	Oct	19
11	Nov	7
12	Dec	9

Figure 01: Pipeline output for weather and accident table

Data Compliance

Both datasets are used in compliance with their respective licenses. The Chicago Data Portal's open data policy allows for public use and analysis. The Meteostat data is used under the Creative Commons Attribution-NonCommercial 4.0 International License.

1.3 Analysis

Methodology: The steps which followed for the analysis-

Data Cleaning and Preprocessing: Weather data was filtered to include only records from 2023, and monthly averages were calculated for the selected parameters. Accident data was filtered to include only incidents from the year 2023.

Data Integration: Monthly accident data was merged with monthly weather data based on the month.

Visualization and Analysis: Multiple plots were created to visualize the relationship between weather conditions and the number of accidents:

Results: Monthly Trends of Pipeline data-

Average Temperature: The number of accidents showed some variation with temperature changes. Peaks in accident numbers were observed during colder months.

Snowfall: Higher incidents were recorded during months with significant snowfall, suggesting that snowy conditions contribute to higher accident rates.

Precipitation: Similar to snowfall, months with higher precipitation levels saw increased accident incidents.

Wind Speed: Wind speed did not show a strong correlation with the number of accidents, indicating that other weather factors may play a more significant role.

Accident Rates: The rate of accidents was the highest in October and the lowest was in July and August.
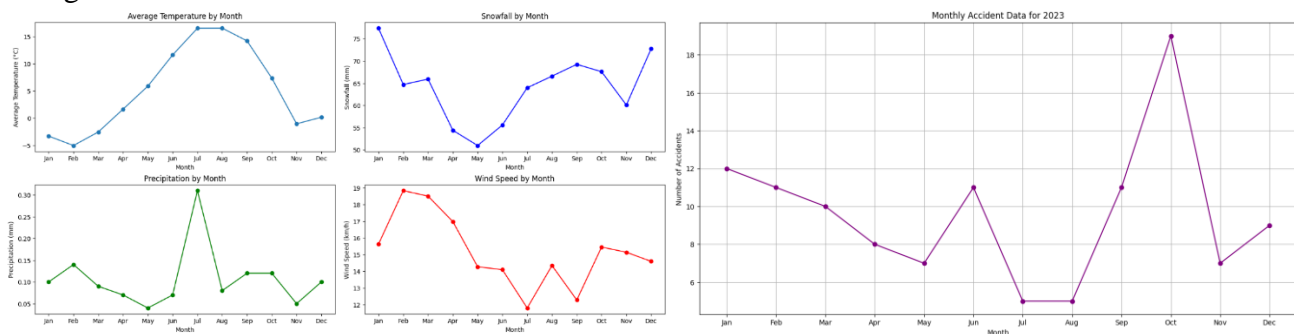

Figure 02: Monthly trends of weather & Accident table

Seasonal Distribution: The violin plot illustrated the distribution of accidents across different seasons. Winter months had a broader distribution and higher median values, indicating more frequent accidents during this season.
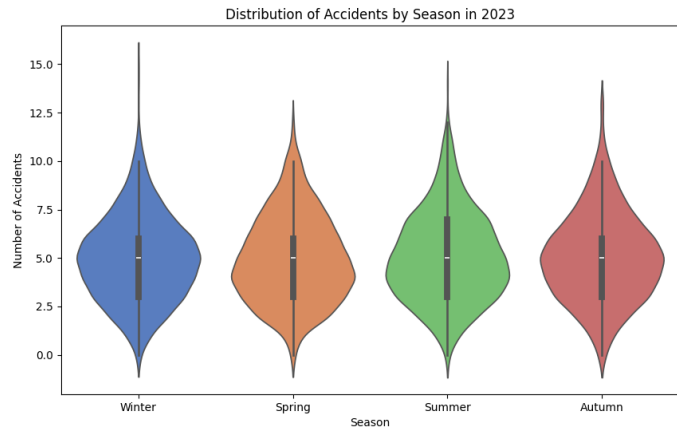

Figure 03: Distribution of accident by season.

Impact of weather condition with accident:

Snowfall vs. Accidents: A positive correlation was evident, with accidents increasing as snowfall amounts rose.

Precipitation vs. Accidents: Similar to snowfall, precipitation showed a positive correlation with accident numbers.

Wind vs. Accidents: A slight partial correlation was observed, with lower accidents during lower average wind. However, there are opposite relations are there as well.
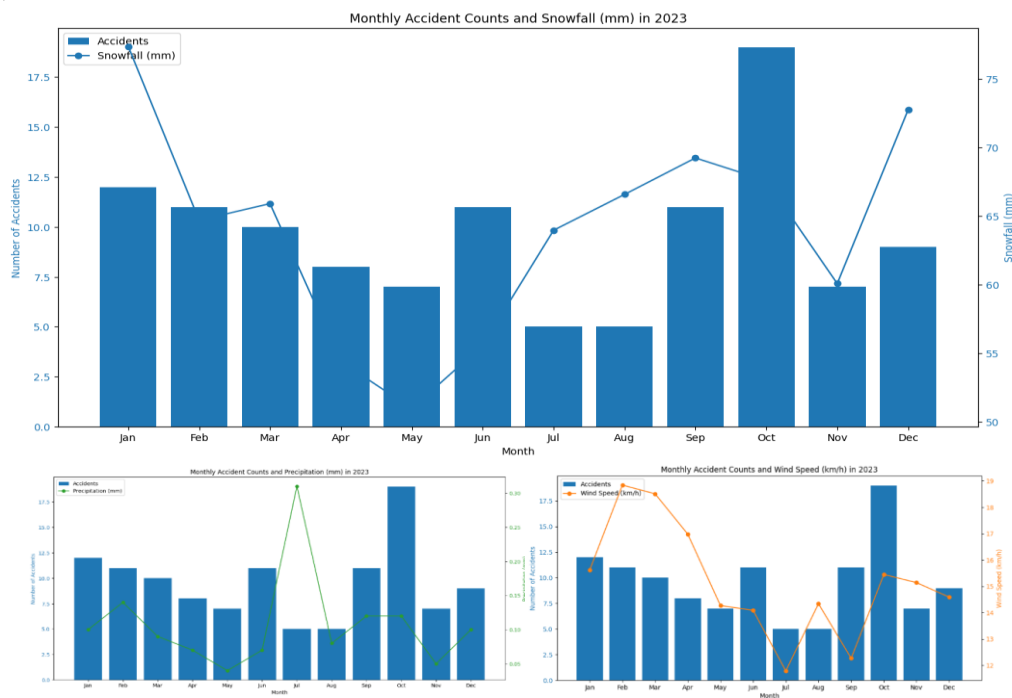

Figure 04: Relation between different weather conditions with accident

1.4 Conclusions

The analysis reveals several key insights into the relationship between weather conditions and traffic accidents in Chicago for 2023:

- **Temperature**: There is a tendency for more accidents during colder months, although the correlation is not strong.
- **Snowfall**: Snowy conditions significantly increase the likelihood of accidents, highlighting the need for enhanced safety measures and road maintenance during winter.
- **Precipitation**: Higher levels of precipitation correlate with an increased number of accidents, emphasizing the importance of proper drainage and road conditions during rainy periods.
- **Wind Speed**: Wind speed does not show a significant impact on accident frequency, suggesting that other weather parameters have a more direct effect.

Reflections and Limitations

- **Completeness**: While the analysis provides valuable insights, the data is limited to reported accidents and weather conditions within the city of Chicago. There may be other contributing factors such as road conditions, traffic density, and driver behavior that are not captured in this data.
- **Uncertainties**: The accuracy of weather data and its precise impact on specific accident incidents can introduce some uncertainty. Further detailed studies could incorporate more granular data and additional variables.
- **Future Work**: Expanding the analysis to include other cities, longer periods, and additional variables (e.g., traffic volume, and road maintenance schedules) would provide a more comprehensive understanding of the factors influencing traffic accidents.

This report underscores the importance of considering weather conditions in traffic safety planning and highlights specific areas where preventive measures could significantly reduce accident rates. The analysis reflects that the authorities should take some initiative during snowy days. Public awareness should increase during that season and road cleaning should be performed regularly. In this way, the traffic authority can decrease the number of accidents.