Project Proposal

Impact Of Weather And Snowfall On Traffic Incidents

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Introduction

This project is conducted by a multidisciplinary team: Ali Afkhami, a chemical engineer and data scientist with experience in both industries; Evan Losier, a computer scientist with experience in software development; and Alejandra Sierra, who holds a bachelor's degree in marketing with experience in consumer behavior research.

Road safety is a critical issue in Calgary, where every journey reflects a narrative of connection, ambition, and at times, tragedy. In 2022 alone, the city recorded 33,317 traffic collisions, resulting in over 2,000 injuries and the tragic loss of 16 lives in Calgary (Calgary Safer Mobility Plan, 2023). These statistics underscore the urgent need for solutions to enhance user safety, mitigate human suffering, and alleviate the economic burden of accidents. For city planners and policymakers, addressing this challenge requires a multifaceted approach, integrating infrastructure improvements, evidence-based interventions, and public awareness efforts.

Calgary's extreme climate further complicates the landscape of traffic safety, with temperatures fluctuating from below -40°C in winter to over 35°C in summer. These conditions profoundly impact road dynamics and accident patterns, raising questions about how weather shapes risk across different areas of the city. This project seeks to pinpoint traffic hotspots during days with temperatures above and below 0°C to explore how weather affects accident locations. By identifying these patterns, the findings can guide targeted interventions, such as awareness campaigns and infrastructure enhancements, to create safer roads for everyone.

Guiding Questions

This project aims to explore traffic accident patterns in Calgary under various weather conditions and identify actionable insights. The following research questions provide a clear framework to understand specific challenges and guide targeted safety measures.

1. **What are the hotspots for traffic incidents in Calgary when temperatures are above/below 0°C in 2024?**
   This question identifies locations with the highest risk of accidents under specific temperature conditions, helping to prioritize areas for infrastructure improvements or preventive measures tailored to seasonal needs.
2. **What are the hotspots for traffic incidents in Calgary when there is snowfall or pre-existing snow in 2024?**
   Snow conditions significantly affect road safety. This question offers insights into how road conditions impact safety, informing strategies for snow removal, road treatment, and driver preparation in winter months.
3. **How do the hotspots for traffic incidents during days below 0°C compare to those on days above 0°C?**
   This question aims to identify accident hotspots where frequency remains largely unaffected by temperature differences. These areas, where climate plays a minimal role, warrant further investigation into other potential contributing factors, such as infrastructure design, speed limits, insufficient traffic signals, or a lack of preventive awareness campaigns. By pinpointing these locations, the government can prioritize targeted interventions to address underlying issues beyond weather-related causes.
4. **What time of day do most incidents occur in these hotspots?**
   By analyzing the timing of accidents in high-risk locations, this question supports efforts to optimize traffic management, law enforcement, and public awareness campaigns during peak accident hours.

Relevance and Impact of the Study

Addressing these questions is crucial for enhancing road safety in Calgary. By analyzing traffic patterns influenced by weather and time of day, this project provides:

- Guidance for State Interventions: The findings will serve as a foundation for governmental actions, such as targeted investigations in high-accident areas. These insights can help determine the most effective solutions, whether through infrastructure improvements or preventive campaigns, ultimately reducing both the human and economic toll of accidents.
- Public Awareness and Preparedness: As publicly accessible information, the results can raise awareness among drivers and stakeholders, fostering greater preparedness and encouraging safer driving behaviors.

Ultimately, these efforts aim to enhance the quality of life for Calgary's residents, ensuring safer and more efficient travel across the city under all weather conditions.

Datasets

For this project, we will use two datasets, both provided in .csv format. These datasets are structured and tabular, with each row representing either a traffic incident or a day of weather data.

1. City of Calgary Traffic Incidents

This dataset, provided by the City of Calgary, contains data on traffic incidents. It includes 52,210 rows and 10 columns, but for our analysis, we will focus on a filtered subset from 2024, consisting of at least 7,493 rows (representing incidents from 2024 only) and a minimum of 3 columns: START_DT, Longitude, and Latitude. We have permission to use this data under the following license Open Calgary Terms of Use. The dataset can be accessed at City of Calgary Traffic Incidents.

INCIDENT INFO	DESCRIPTION	START_DT	MODIFIED_DT	QUADRANT	Longitude	Latitude	Count	id	Point
Westbound 16 A	Stalled vehicle	2022-06-21 7:31	2022-06-21 7:33	NE	-114.02669	51.06748512	1	2022-06-21T	POINT (-114.026686722326 72 51.067485129276236)
11 Avenue and 4	Traffic incident	2022-06-21 4:02	2022-06-21 4:12	SW	-114.07148	51.04262449	1	2022-06-21T	POINT (-114.071480576609 25 51.04262449261462)
68 Street and M	Traffic incident	2022-06-20 23:53	2022-06-20 23:55	NE	-113.93555	51.0524735	1	2022-06-20T	POINT (-113.935553325751 51.0524735056658)
Eastbound 16 Av	Traffic incident	2022-06-20 16:43	2022-06-20 17:17	NE	-113.98922	51.06708565	1	2022-06-20T	POINT (-113.989219053115 66 51.06708565896752)

Figure 1. Screenshot of first 4 rows of the traffic incident dataset, 2025.

2. Historical Climate Data for Calgary (2024)

The weather dataset is sourced from Environment Canada and includes 366 rows and 31 columns. For our analysis, we will primarily use all 366 rows, focusing on a minimum of 4 columns: Date/Time, Mean Temperature, Total Snow (cm), and Snow on Ground (cm). We have permission to use this data under the following license: Environment Canada Terms of Use. The dataset can be accessed at Historical Climate Data for Calgary.

Longitude (x)	Latitude (y)	Station Name	Climate ID	Date/Time	Year	Month	Day
-114.01	51.12	CALGARY INTL A	3031092	1/1/2025	2025	1	1
-114.01	51.12	CALGARY INTL A	3031092	1/2/2025	2025	1	2
-114.01	51.12	CALGARY INTL A	3031092	1/3/2025	2025	1	3
-114.01	51.12	CALGARY INTL A	3031092	1/4/2025	2025	1	4

Data Quality	Max Temp (°C	Max Temp Fla	Min Temp (°C	Min Temp Fla	Mean Temp (°	Mean Temp F	Heat Deg Da	Heat Deg Da	Cool Deg Da	Cool Deg Da
	4.2		-4.2		0		18		0	
	3.1		-7.3		-2.1		20.1		0	
	-4		-8.3		-6.2		24.2		0	
	4.4		-8.3		-2		20		0	

Total Rain (m	Total Rain Fla	Total Snow (c	Total Snow Fl	Total Precip (	Total Precip F	Snow on Grn	Snow on Grn	Dir of Max Gu	Dir of Max Gu	Spd of Max G	Spd of Max Gu
2		0		2					M		M
0		0		0					M		M
0		0		0					M		M
0		0		0				28		35	

Figure 2. Screenshot of first 4 rows of the weather dataset, 2025.

Tasks

The data wrangling tasks will consist of cleaning, combining, and filtering the data.

Cleaning the data is necessary to ensure we don't have any incomplete or incorrect data. The cleaning will be done by Alejandra and Ali.

Combining the datasets is required to gain more insights about the impact of weather on traffic incidents. When the datasets are combined, we will be able to match information about weather patterns on any given day with the corresponding traffic incidents that occurred. This will be done by Ali.

Filtering the data involves narrowing our focus to include only a certain subset of the entire dataset. This allows us to answer more specific questions and exclude data that is irrelevant to our study. Data filtering will be done by Evan.

The data visualization tasks consist of creating visualizations from the data, to tell the story of our findings and develop conclusions and suggestions based on the analysis.

Most of our visualizations will involve creating heatmaps of where incidents occurred given their latitude and longitude. These heatmaps will be overlaid on top of a map of the city to show us in real-world terms where the incident hotspots are. These heatmaps will be created by Evan.

After visualizations have been completed, we will draw conclusions and insights based on our findings from the data analysis. This will involve telling a story about how the data answered our guiding questions and forming suggestions for what action can be taken to address our findings and decrease traffic incidents. Our conclusions and insights will be done by Alejandra.

Finally, a report must be created to summarize the entire data analysis process into a comprehensive medium that can be understood by all audiences. All three group members will be responsible for contributing to the report.

References

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