ACCIDENT ANALYSIS

VISUAL ANALYTICS OF ROAD ACCIDENTS WITH POWER BI

A PROJECT REPORT

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GREATER NOIDA, 201310, UTTAR PRADESH, INDIA

July 2025

1. Introduction

Road traffic accidents are one of the leading causes of injury and death worldwide. In densely populated urban areas with increasing vehicle usage, the risk of traffic-related incidents is even more pronounced. Analysing traffic accident data helps authorities, planners, and the public understand how and why accidents occur, and what can be done to prevent them.

This project was undertaken to apply data analytics and visualization tools to gain insights from actual accident datasets. The specific goals of the project include:

- Classifying accidents based on severity and identifying the key risk factors
- Analysing the relationship between driver characteristics and accident involvement
- Studying how road and environmental conditions impact accident outcomes
- Investigating the effectiveness of police response and emergency handling
- Creating interactive dashboards to visually explore accident trends and hotspots

Through this analysis, we aim to identify actionable findings that can inform better policy decisions, enhance road infrastructure, and ultimately reduce accident rates.

2. Data Sources & Cleaning Process

2.1 Data Overview

Three datasets were used:

- **Accidents Data**: Contains 60,000+ records, each representing a unique traffic accident, with fields like date/time, location, severity, weather, and road surface condition.
- **Vehicles Data**: Includes vehicle type, fuel type, driver age, and journey purpose.
- **Casualties Data**: Captures the age, gender, casualty type, and severity of individuals injured in accidents.

2.2 Data Cleaning & Integration

The data cleaning process was essential to prepare for analysis:

- Removed rows with missing or inconsistent values in critical fields such as severity, driver age, and coordinates.
- Mapped driver age into bands (e.g., 17–25, 26–35, etc.) for better group analysis.
- Standardized categorical values like road types, fuel types, and weather conditions.
- Used Accident Index as the primary key to merge accident, vehicle, and casualty datasets into a unified model.
- Created derived fields such as "Time of Day" (morning, afternoon, evening) and “Peak Hour Flag” for temporal analysis

3. Dashboard Design & Visualization Approach

3.1 Tools Used

All visualizations were created using **Microsoft Power BI**, a business intelligence tool wellsuited for interactive reports and dashboards. It supports dynamic filtering, drill-downs, and real-time data manipulation.

3.2 Dashboard Layout

The final dashboard was structured into three core pages:

- **Overview Page**: Includes KPIs for total accidents, severity distribution, gender split, and driver age group.
- **Severity & Conditions Page**: Focuses on how environmental factors like weather and road surface affect severity.
- **Time & Location Trends Page**: Explores accident trends over time, daily and monthly patterns, and high-incident regions.

3.3 Visualization Techniques

- **Pie Charts** for showing the proportion of casualties by severity and gender.
- **Stacked Bar Charts** to show accident severity by vehicle type, road surface, and road class.
- **Line Graphs** to capture accident frequency by hour of the day and by month.
- **Tables and Maps** to compare local authority regions and highlight accident hotspots.

Each visual element was chosen to highlight a particular trend or correlation in the data. Colors were standardized (e.g., red for fatal, orange for serious, blue for slight) for clarity.

Datasets

1. Accidents Dataset

This dataset contains detailed records of road accidents. Key attributes include date and time of occurrence, road and weather conditions, type and number of vehicles involved, as well as the severity of each accident.

2. Casualties Dataset

The casualties dataset records individual casualty cases linked to the accidents. It provides information on the severity of injuries, age, gender, and role of the individuals involved (driver, passenger, pedestrian).

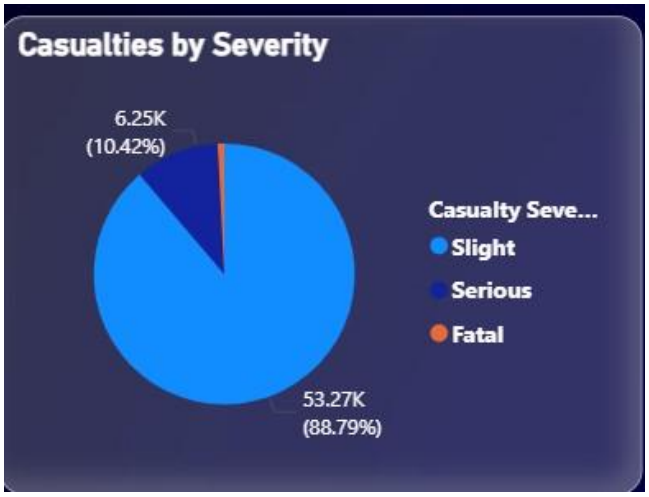
3. Vehicles Dataset

The vehicles dataset provides extensive vehicle-level data per accident, including vehicle type, age, engine capacity, and skidding or overturning instances. It enables detailed profiling of vehicle-related accident risk.

4. Key Trends and Insights

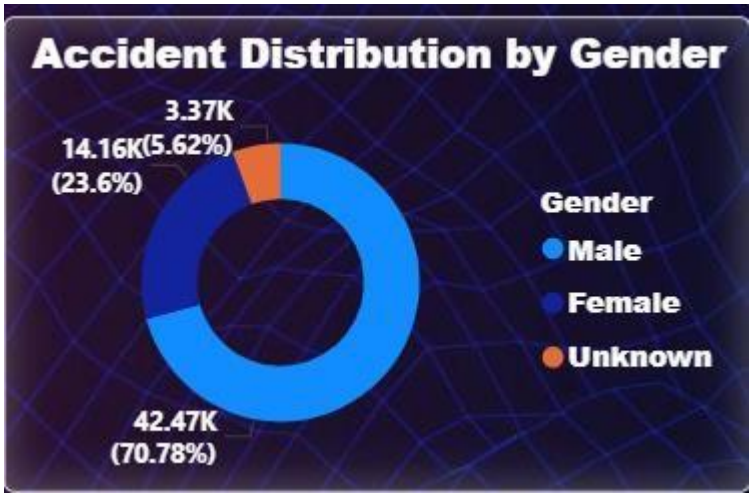
4.1 Accident Severity and Casualty Outcomes

- **Slight injuries** accounted for approximately **88.8%–89%** of all recorded casualties.
- **Serious injuries** made up around **10%**, while **fatalities** were under **1.3%**.
- Fatal accidents were more likely to occur on **motorways and major roads**, especially during **wet conditions** or **low visibility**.
- ➤ *Implication:* While most incidents are non-fatal, they still strain healthcare systems and impact quality of life.



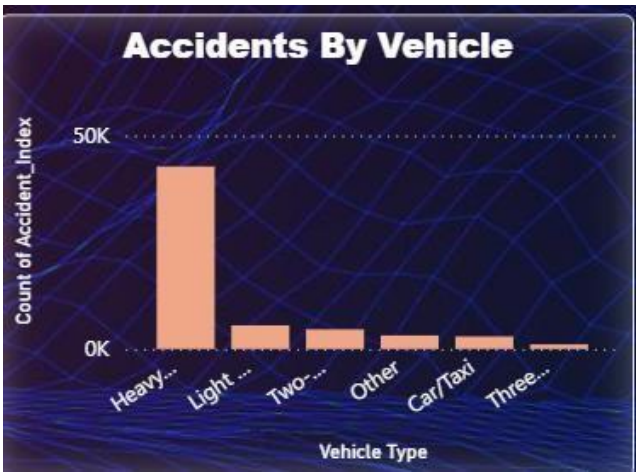
4.2 Driver Demographics and Behaviour

- **Male drivers** were involved in **71%** of all reported accidents.
- The age group **26–45** accounted for over **half of all drivers** in accidents.
- The **26–35** subgroup showed the **highest involvement rate**.
- ➤ *Insight:* Road safety campaigns should target **younger male drivers** with behaviour-focused training and awareness.



4.3 Vehicle Type and Accident Risk

- **Cars and motorcycles** were involved in a majority of accidents.
- **Two-wheelers**, especially in wet conditions, had **higher skidding and overturning rates**.
- **Larger vehicles** like buses had fewer incidents but often resulted in **more severe outcomes**.
- **Light commercial vehicles** featured in over **70%** of accident reports.
- **Petrol vehicles** dominated the dataset; **hybrid and electric** vehicles had minimal presence.
- ➤ *Implication:* Greater emphasis is needed on **motorcycle safety**, **fleet driver training**, and **vehicle stability measures**.



4.4 Road Surface and Weather Conditions

- Accidents were most frequent during **evening hours (5–7 PM)**, aligning with **commute peaks**.

- **Wet or icy surfaces** showed a noticeable rise in **accident frequency and severity**.
- Surprisingly, most accidents occurred during **clear weather** with **good visibility**, indicating a stronger influence of **driver behavior** than environmental hazards.
- ➤ *Recommendation:* Implement **public awareness on responsible driving**, regardless of weather conditions, and improve **road maintenance** in wet-prone zones.

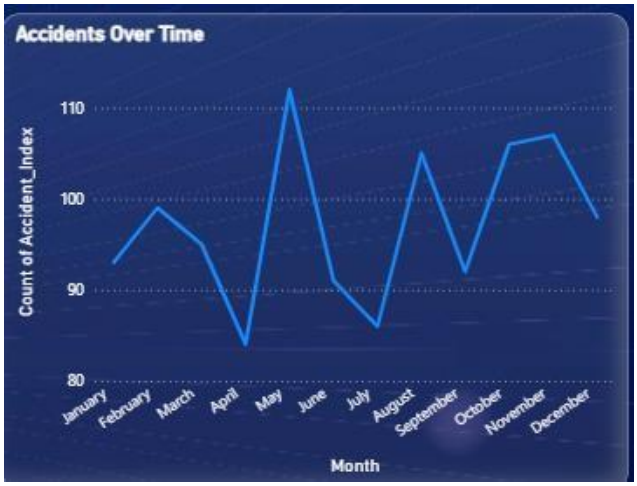
Weather_Conditions	Fatal	Serious	Slight	Total
1	16	226	1551	**1793**
2	3	21	253	**277**
3			4	**4**
4	1	4	22	**27**
5		3	13	**16**
6		1		**1**
7			3	**3**
8		3	27	**30**
9	1	1	25	**27**
Total	**21**	**259**	**1898**	**2178**

4.5 Casualty Role and Vulnerability

- **Children and the elderly** had higher proportions of **pedestrian injuries**.
- **Passengers** made up a large share of **serious casualties**.
- ➤ *Insight:* Pedestrian and passenger protection infrastructure must be prioritized—especially in urban areas and near schools or hospitals.

4.6 Temporal and Regional Patterns

- Accident spikes were observed in **June and December**, aligning with **holiday travel and seasonal shifts**.
- Several **local authorities** reported **disproportionately high accident counts**, pointing to potential **infrastructure gaps** or **higher traffic volumes**.
- **Police attendance** was confirmed in most **fatal and serious** cases, but **response rates varied** by region.
- ➤ *Recommendation:* Analyze region-wise trends to optimize **police deployment** and **local traffic planning**.



Recommendations for Road Safety Improvements

1. Awareness Campaigns for High-Risk Groups

Develop targeted awareness programs for younger male drivers aged 18–35. Incorporate realcase stories and statistics into driver training modules to make safety messages more relatable and impactful.

2. Improve Infrastructure for Vulnerable Road Users

Build safer pedestrian crossings, enforce speed limits near schools and hospitals, and develop senior-friendly infrastructure. Prioritize well-lit zebra crossings, audible signals, and tactile paving for increased pedestrian safety.

3. Promote Motorcycle Safety

Mandate advanced safety features in motorcycles such as anti-lock braking systems (ABS). Conduct regular awareness drives on helmet usage, safe speeds, and lane discipline.

4. Monitor and Maintain Road Surface Conditions

Use data-driven tools to identify accident-prone zones where skidding is common. Implement regular resurfacing, drainage improvements, and high-friction road materials to reduce road hazards.

5. Enhance Emergency Medical Response

Invest in faster and smarter emergency services, particularly in rural areas. Equip ambulances with real-time GPS tracking and train first responders in trauma care.

6. Integrate Vehicle Telematics

Encourage the adoption of telematics in both private and commercial vehicles to monitor driver behavior, speed, and sudden braking events. Incentivize safe driving with insurance discounts or tax benefits

Conclusion

This data-driven analysis of road traffic accidents provides a clear view into the who, what, where, and why of traffic incidents. Most accidents are slight in severity but occur frequently and disproportionately affect young male drivers and vulnerable road users like children and pedestrians. Skidding, weather factors, and regional patterns offer important clues for targeted intervention.

Through interactive dashboards and integrated datasets, this project identifies practical and strategic ways to improve road safety. If implemented, the recommendations outlined here can support smarter infrastructure investment, more effective enforcement, and ultimately, safer roads for all.