Project Report : Road Safety Analytics

Executive Summary

Road accidents are a significant public health concern, causing substantial loss of life and injury. This project analyzes comprehensive road accident data to identify patterns, risk factors, and actionable insights. By examining variables such as location, weather, time, and vehicle type, the study supports targeted interventions to reduce accident frequency and severity.

Objectives and Scope

Objectives:

- Identify key patterns and high-risk scenarios in road accidents
- Analyze the impact of environmental, temporal, and vehicular factors on accident severity
- Provide data-driven recommendations for improving road safety

Scope:

- Covers urban and rural regions
- Analyzes weather, lighting, road conditions, and time-based trends
- Focuses on accident frequency and severity

Methodology

- Data Source: 2021 and 2022 data
- Tools Used: Excel for pivot analysis and charts, Power BI for visualization
- Approach:
    - Cross-tabulation and KPI analysis
    - Visual representation of trends

- Addressed 8 core research questions using segmentation and percentages
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Data Analysis and Key Insights

1. Accident Severity and Distribution

- Total Casualties: 417,883
  - Fatal: 7,135
  - Serious: 59,312
  - Slight: 351,436
- Urban areas have more casualties; rural areas have higher fatality rates per accident

2. Vehicle Safety Analysis

- Safest: Agricultural vehicles, bicycles
- Most Risky: Motorcycles
- Vans and buses are relatively safer than motorcycles and cars

3. Environmental Factors

- High winds and fog lead to more serious/fatal accidents
- Flooded rural roads are dangerous
- Poor lighting increases fatality risk in rural areas

4. Temporal Patterns

- Fridays and Wednesdays show peak casualties
- 61% of all casualties occur in 30 mph (urban) speed zones

Findings by Research Question

1. Which day had the highest casualties in each month?
   - Fridays and Wednesdays consistently rank high
2. Are accidents more severe during certain weather conditions?
   - Yes. Fog/mist and high winds contribute to severity
3. Urban vs Rural monthly breakdown:
   - Urban: 255,864
   - Rural: 162,019
4. Do same road conditions cause equal damage?
   - No. Rural areas suffer more from flooding and poor lighting
5. Severity by lighting conditions:
   - Poor lighting significantly increases fatality rates in rural areas
6. Do high-speed zones result in more casualties?
   - Fewer accidents overall, but more severe per accident

7. Which vehicle is safest?
    - Bicycles and agricultural vehicles (when adjusted for usage)

Recommendations

For Policymakers:

- Focus on 30 mph zones and rural roads
- Improve lighting in rural areas
- Infrastructure upgrades in flood-prone zones
- Motorcycle-specific safety interventions

For Road Users:

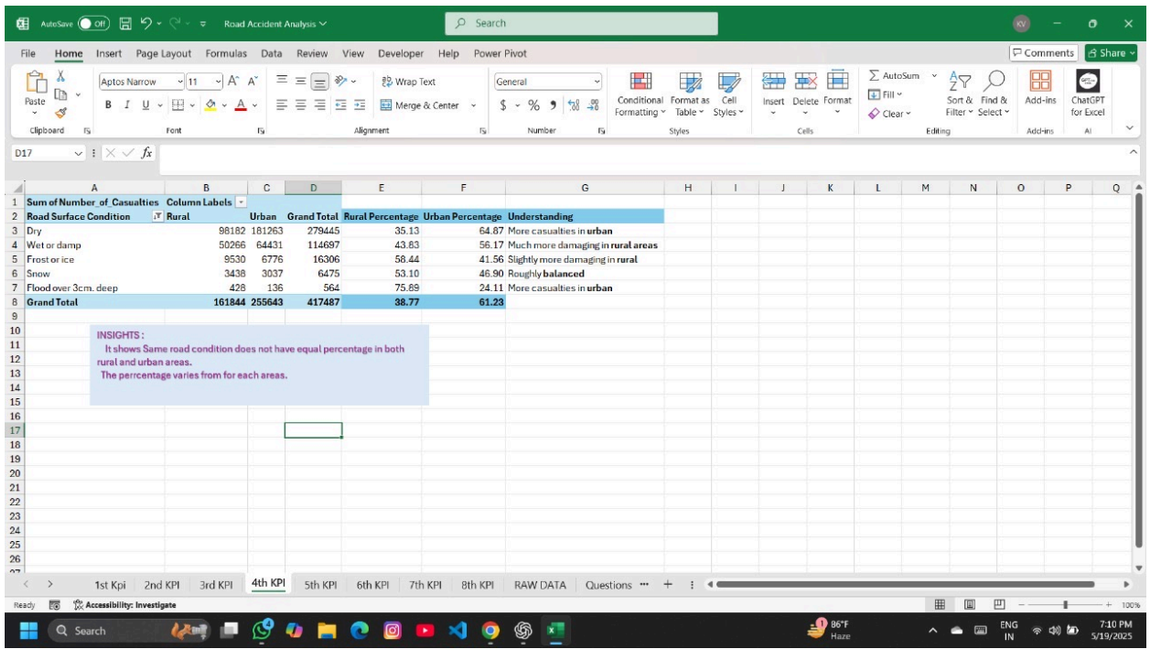
- Avoid travel in high wind/fog conditions
- Be cautious on Fridays and Wednesdays

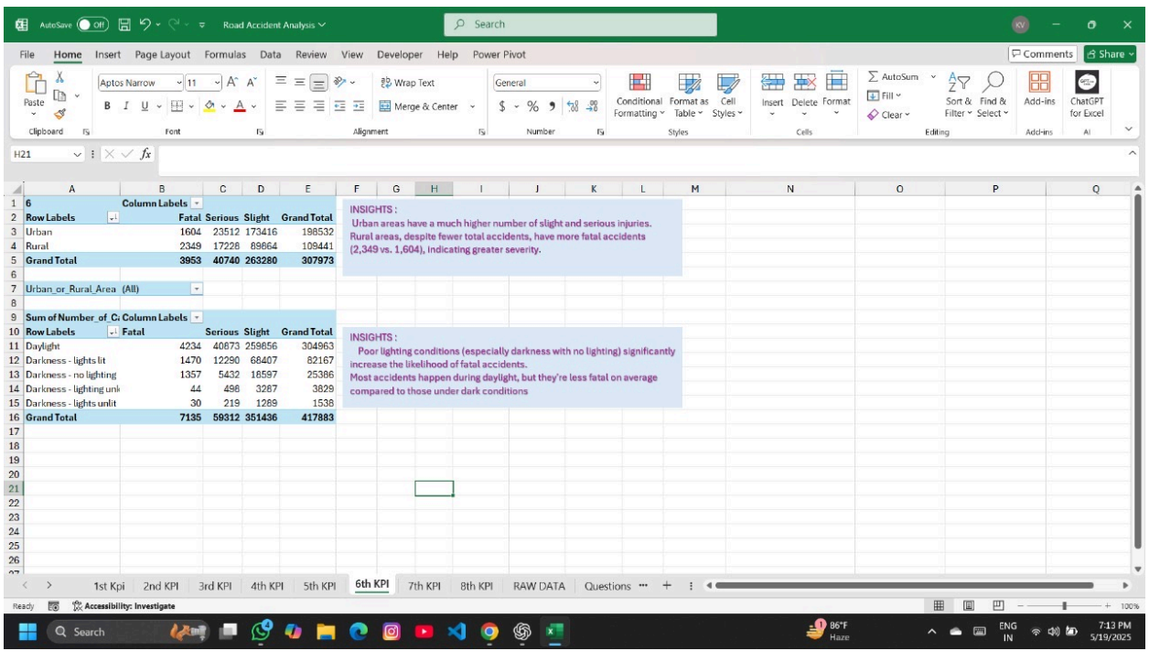
For Future Research:

- Add driver demographics
- Analyze accident density with road usage frequency
- Explore machine learning for risk prediction

Appendices

- A. Excel Pivot Table Screenshots





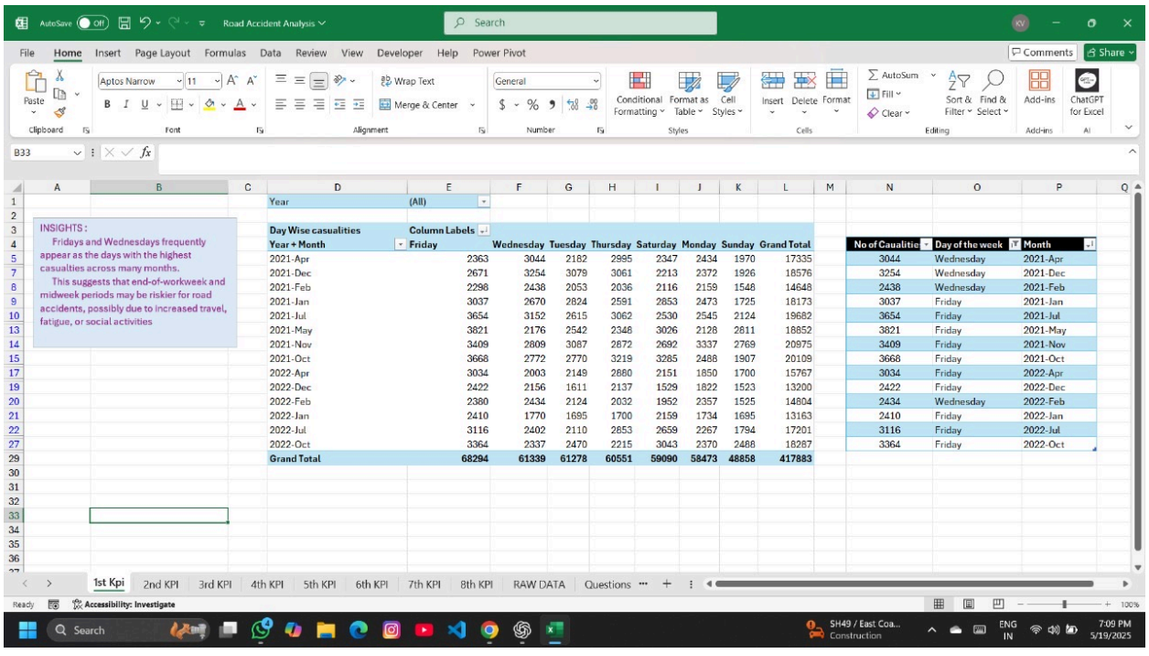
6	Column Labels			
Row Labels	Fatal	Serious	Slight	Grand Total
Urban	1604	23512	173416	198532
Rural	2349	17228	89864	109441
Grand Total	3953	40740	263280	307973

Urban_or_Rural_Area (All)

Sum of Number_of_Ca	Column Labels			
Row Labels	Fatal	Serious	Slight	Grand Total
Daylight	4234	40873	259856	304963
Darkness - lights lit	1470	12290	68407	82167
Darkness - no lighting	1357	5432	18597	25386
Darkness - lighting unk	44	496	3287	3829
Darkness - lights unlit	30	219	1269	1538
Grand Total	7135	59312	351436	417883

INSIGHTS :
Urban areas have a much higher number of slight and serious injuries.
Rural areas, despite fewer total accidents, have more fatal accidents (2,349 vs. 1,604), indicating greater severity.

INSIGHTS :
Poor lighting conditions (especially darkness with no lighting) significantly increase the likelihood of fatal accidents.
Most accidents happen during daylight, but they're less fatal on average compared to those under dark conditions

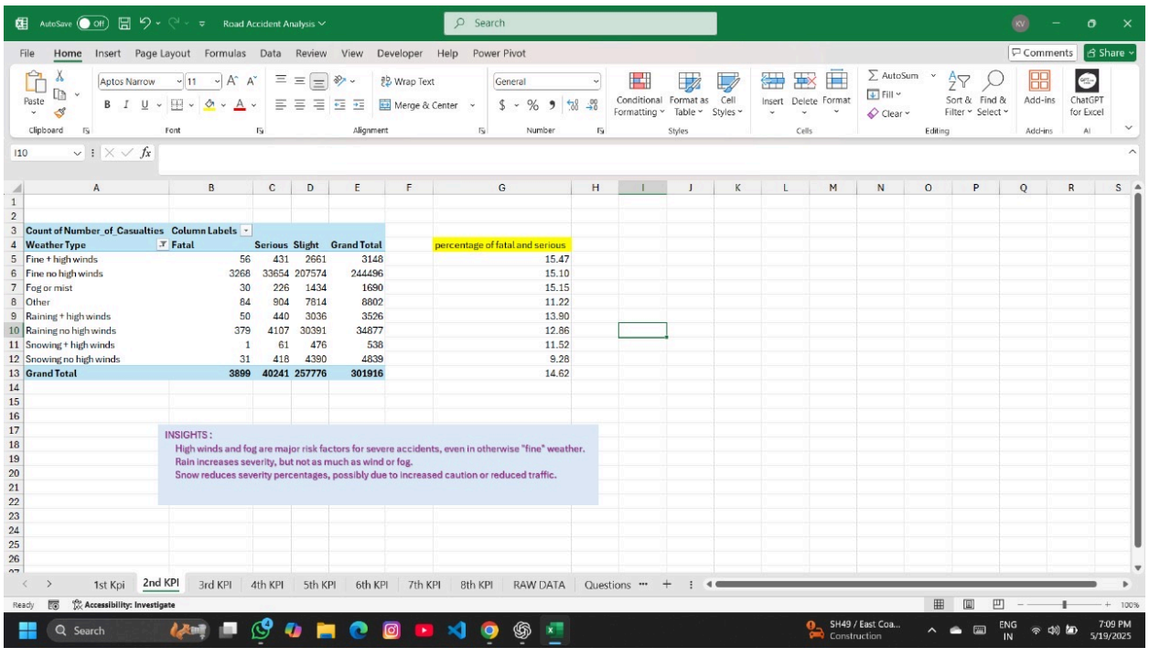


INSIGHTS :
Fridays and Wednesdays frequently appear as the days with the highest casualties across many months.
This suggests that end-of-workweek and midweek periods may be riskier for road accidents, possibly due to increased travel, fatigue, or social activities

Year (All)

Day Wise casualties	Column Labels							
Year + Month	Friday	Wednesday	Tuesday	Thursday	Saturday	Monday	Sunday	Grand Total
2021-Apr	2363	3044	2182	2995	2347	2434	1970	17335
2021-Dec	2671	3254	3079	3061	2213	2372	1926	18576
2021-Feb	2298	2438	2053	2036	2116	2159	1548	14648
2021-Jan	3037	2670	2824	2591	2853	2473	1725	18173
2021-Jul	3654	3152	2615	3062	2530	2545	2124	19682
2021-May	3821	2176	2542	2348	3026	2128	2611	18852
2021-Nov	3409	2809	3087	2872	2692	3337	2769	20975
2021-Oct	3668	2772	2770	3219	3285	2488	1907	20109
2022-Apr	3034	2003	2149	2880	2151	1850	1700	15767
2022-Dec	2422	2156	1611	2137	1529	1822	1523	13200
2022-Feb	2380	2434	2124	2032	1952	2357	1525	14804
2022-Jan	2410	1770	1695	1700	2159	1734	1695	13163
2022-Jul	3116	2402	2110	2853	2659	2267	1794	17201
2022-Oct	3364	2337	2470	2215	3043	2370	2488	18287
Grand Total	68294	61339	61278	60551	59090	58473	48858	417883

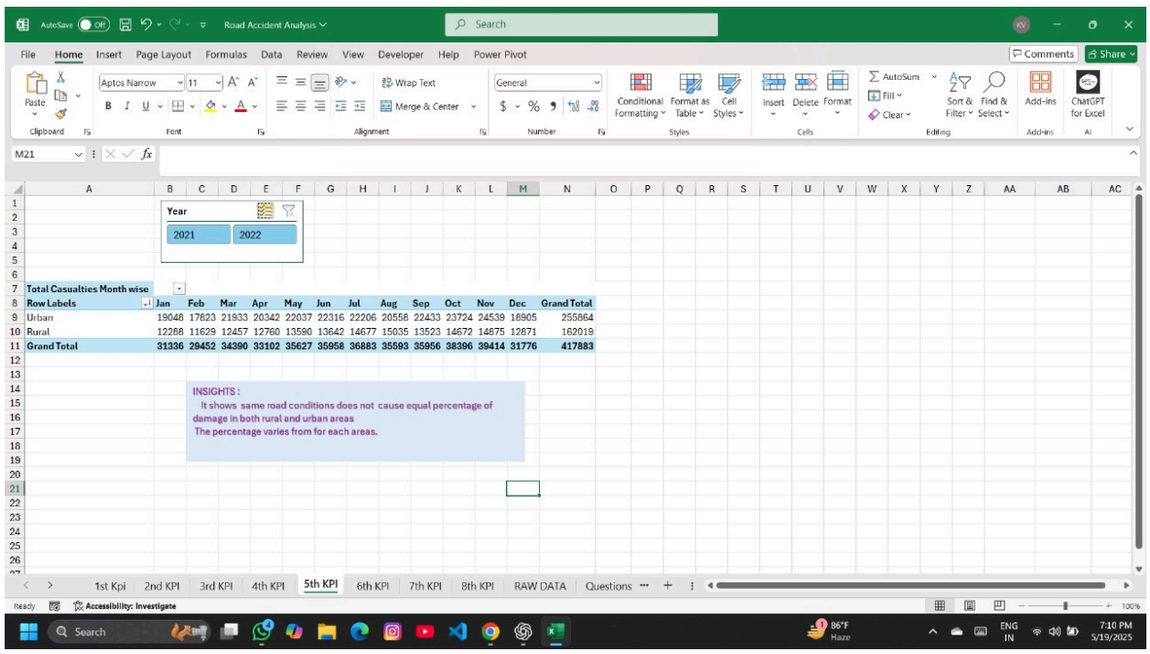
No of Caualitie	Day of the week	Month
3044	Wednesday	2021-Apr
3254	Wednesday	2021-Dec
2438	Wednesday	2021-Feb
3037	Friday	2021-Jan
3654	Friday	2021-Jul
3821	Friday	2021-May
3409	Friday	2021-Nov
3668	Friday	2021-Oct
3034	Friday	2022-Apr
2422	Friday	2022-Dec
2434	Wednesday	2022-Feb
2410	Friday	2022-Jan
3116	Friday	2022-Jul
3364	Friday	2022-Oct



Count of Number_of_Casualties	Column Labels			
Weather Type	Fatal	Serious	Slight	Grand Total
Fine + high winds	56	431	2661	3148
Fine no high winds	3268	33654	207574	244496
Fog or mist	30	226	1434	1690
Other	84	904	7814	8802
Raining + high winds	50	440	3036	3526
Raining no high winds	379	4107	30391	34877
Snowing + high winds	1	61	476	538
Snowing no high winds	31	418	4390	4839
Grand Total	3899	40241	257776	301916

percentage of fatal and serious
15.47
15.10
15.15
11.22
13.90
12.86
11.52
9.28
14.62

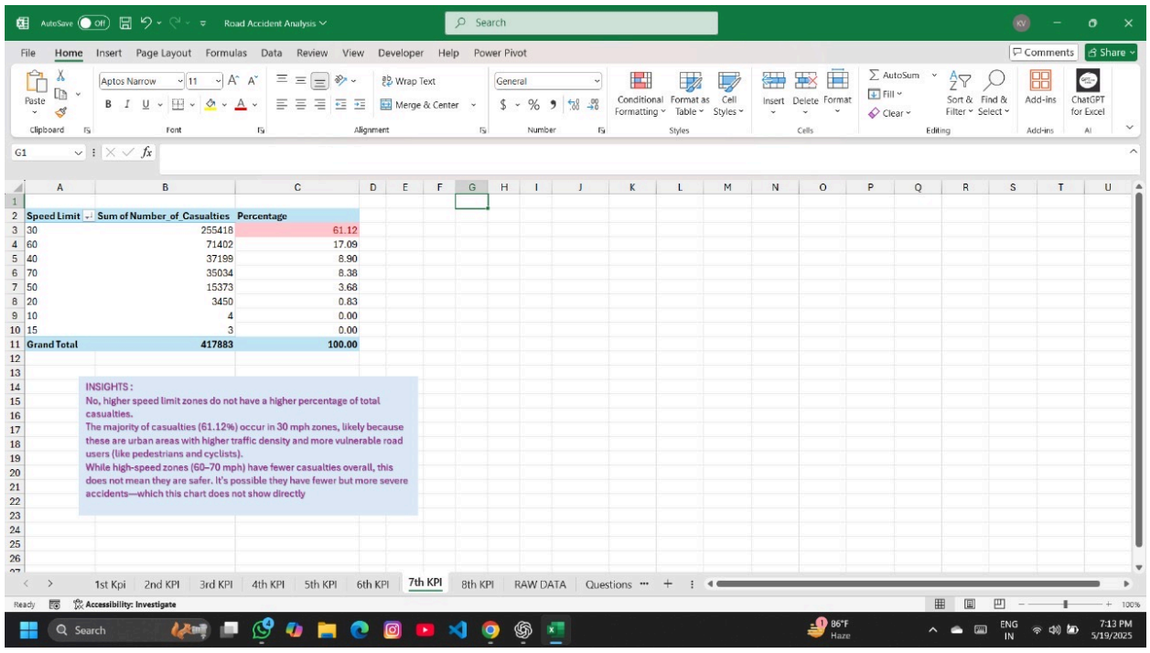
INSIGHTS :
High winds and fog are major risk factors for severe accidents, even in otherwise "fine" weather.
Rain increases severity, but not as much as wind or fog.
Snow reduces severity percentages, possibly due to increased caution or reduced traffic.



Year: 2021, 2022

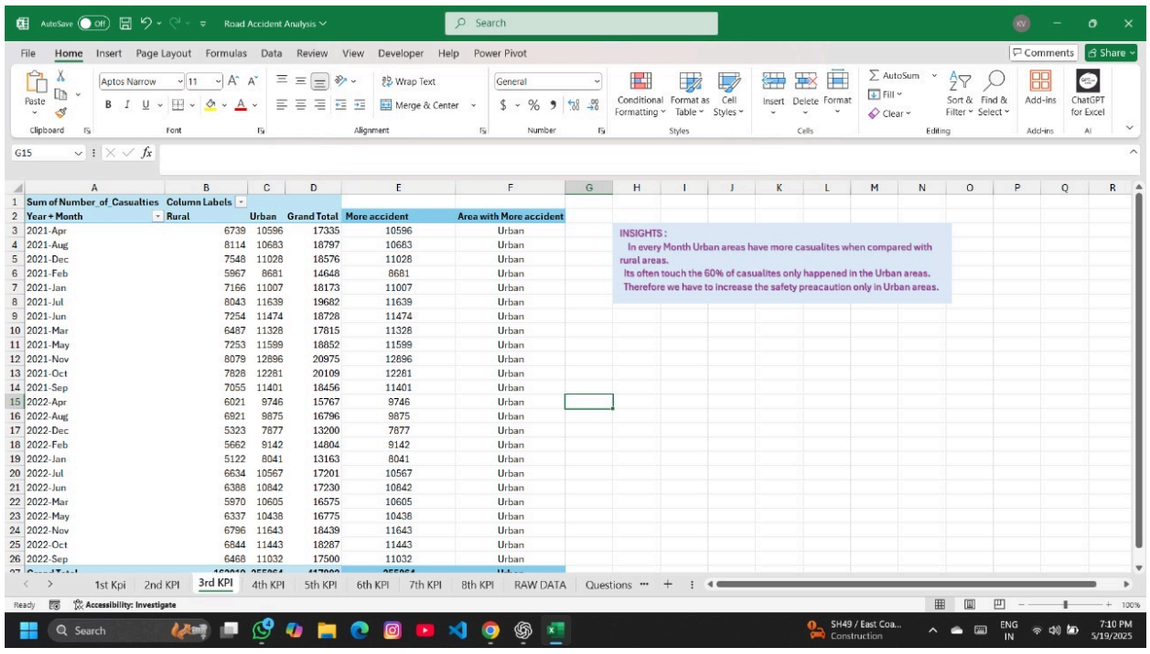
Total Casualties Month wise													
Row Labels	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Grand Total
Urban	19048	17823	21933	20342	22037	22316	22206	20556	22433	23724	24539	16905	255864
Rural	12288	11629	12457	12760	13590	13642	14677	15035	13523	14672	14875	12871	162019
Grand Total	**31336**	**29452**	**34390**	**33102**	**35627**	**35958**	**36883**	**35593**	**35956**	**38396**	**39414**	**31776**	**417883**

INSIGHTS :
It shows same road conditions does not cause equal percentage of damage in both rural and urban areas
The percentage varies from for each areas.



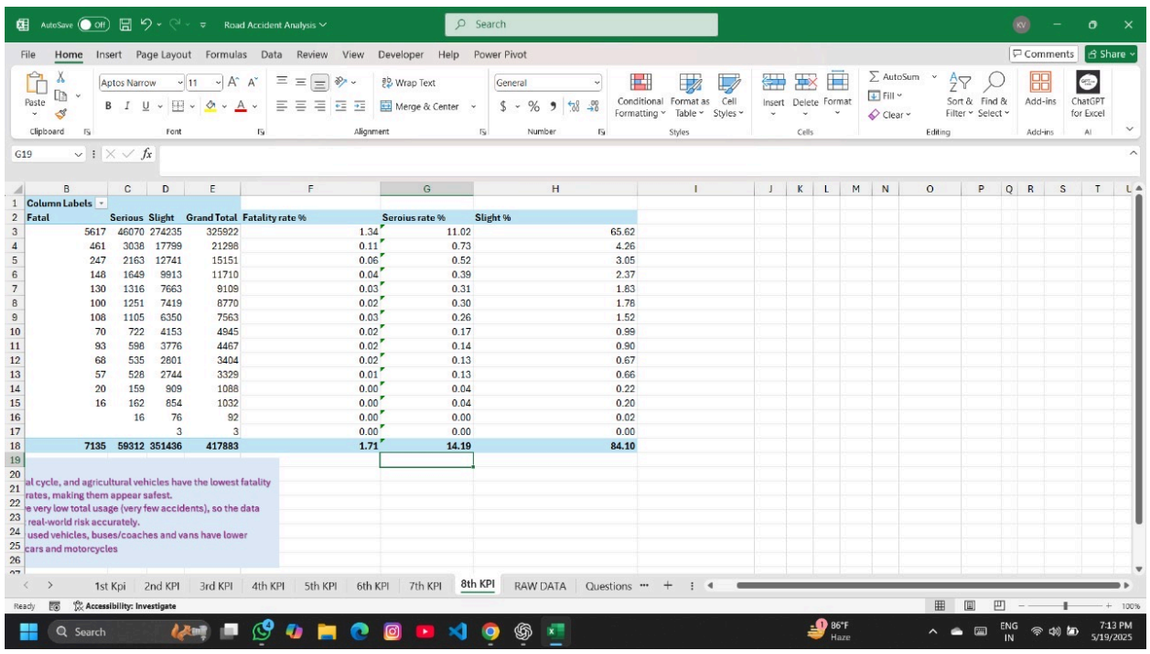
Speed Limit	Sum of Number_of_Casualties	Percentage
30	255418	61.12
60	71402	17.09
40	37199	8.90
70	35034	8.38
50	15373	3.68
20	3450	0.83
10	4	0.00
15	3	0.00
Grand Total	**417883**	**100.00**

INSIGHTS :
No, higher speed limit zones do not have a higher percentage of total casualties.
The majority of casualties (61.12%) occur in 30 mph zones, likely because these are urban areas with higher traffic density and more vulnerable road users (like pedestrians and cyclists).
While high-speed zones (60–70 mph) have fewer casualties overall, this does not mean they are safer. It's possible they have fewer but more severe accidents—which this chart does not show directly



Sum of Number_of_Casualties	Column Labels				
Year + Month	Rural	Urban	Grand Total	More accident	Area with More accident
2021-Apr	6739	10596	17335	10596	Urban
2021-Aug	8114	10683	18797	10683	Urban
2021-Dec	7548	11028	18576	11028	Urban
2021-Feb	5967	8681	14648	8681	Urban
2021-Jan	7166	11007	18173	11007	Urban
2021-Jul	8043	11639	19682	11639	Urban
2021-Jun	7254	11474	18728	11474	Urban
2021-Mar	6487	11328	17815	11328	Urban
2021-May	7253	11599	18852	11599	Urban
2021-Nov	8079	12896	20975	12896	Urban
2021-Oct	7828	12281	20109	12281	Urban
2021-Sep	7055	11401	18456	11401	Urban
2022-Apr	6021	9746	15767	9746	Urban
2022-Aug	6921	9875	16796	9875	Urban
2022-Dec	5323	7877	13200	7877	Urban
2022-Feb	5662	9142	14804	9142	Urban
2022-Jan	5122	8041	13163	8041	Urban
2022-Jul	6634	10567	17201	10567	Urban
2022-Jun	6388	10842	17230	10842	Urban
2022-Mar	5970	10605	16575	10605	Urban
2022-May	6337	10438	16775	10438	Urban
2022-Nov	6796	11643	18439	11643	Urban
2022-Oct	6844	11443	18287	11443	Urban
2022-Sep	6468	11032	17500	11032	Urban

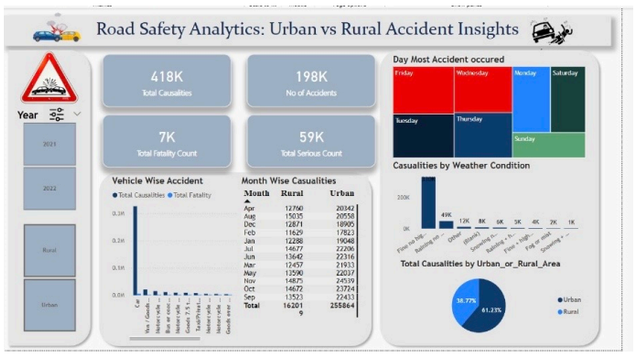
INSIGHTS :
In every Month Urban areas have more casualites when compared with rural areas.
Its often touch the 60% of casualites only happened in the Urban areas.
Therefore we have to increase the safety preacaution only in Urban areas.



Column Labels						
Fatal	Serious	Slight	Grand Total	Fatality rate %	Seroius rate %	Slight %
5617	46070	274235	325922	1.34	11.02	65.62
461	3038	17799	21298	0.11	0.73	4.26
247	2163	12741	15151	0.06	0.52	3.05
148	1649	9913	11710	0.04	0.39	2.37
130	1316	7663	9109	0.03	0.31	1.83
100	1251	7419	8770	0.02	0.30	1.78
108	1105	6350	7563	0.03	0.26	1.52
70	722	4153	4945	0.02	0.17	0.99
93	598	3776	4467	0.02	0.14	0.90
68	535	2601	3404	0.02	0.13	0.67
57	528	2744	3329	0.01	0.13	0.66
20	159	909	1088	0.00	0.04	0.22
16	162	854	1032	0.00	0.04	0.20
	16	76	92	0.00	0.00	0.02
		3	3	0.00	0.00	0.00
7135	59312	351436	417883	1.71	14.19	84.10

al cycle, and agricultural vehicles have the lowest fatality rates, making them appear safest.
e very low total usage (very few accidents), so the data real-world risk accurately.
used vehicles, buses/coaches and vans have lower cars and motorcycles

- PowerBi Visualisation Screenshot



Revision History :

Date	Author	Description
2025-05-19	Kathirvel	Initial Draft Completed
2025-05-20	Kathirvel	Added Appendix and revison history
2025-05-21	Kathirvel	Final review and formatting

Conclusion:

This project provides a comprehensive analysis of road accident patterns, highlighting critical risk factors such as vehicle type, environmental conditions, and temporal trends. The findings underscore the urgent need for targeted interventions, particularly in urban 30 mph zones and poorly lit rural roads. By focusing on high-risk days and improving infrastructure in vulnerable areas, policymakers and stakeholders can significantly reduce accident frequency and severity. The insights derived from this analysis offer a strong foundation for future research and policy development. Continued data collection and in-depth study of demographic and behavioral

factors will further enhance road safety strategies. Ultimately, the implementation of these recommendations can contribute to safer roads and the preservation of countless lives.

Contact for Further Information:

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