

UK Road Safety Intelligence Dashboard

2017–2020 Insights for Predictive Policy and Prevention

This advanced analytics project applies clustering, forecasting (SARIMA), association rule mining, and network analysis to uncover key patterns in UK road traffic accidents and recommend data-driven safety interventions.

What's Inside This Project

Time Patterns

Technique: Peak-hour & weekday visuals
Purpose: Identify high-risk periods for road accidents.

Geographic Clustering

Technique: K-Means, KDE heatmaps
Purpose: Map local hotspots to prioritize urban safety interventions.

Motorcycle Safety Focus

Technique: Engine size × crash timing analysis
Purpose: Target high-risk rider groups with tailored interventions.

Severity Rules Mining

Technique: Apriori association rule mining
Purpose: Trigger context-aware alerts (e.g., snow + darkness).

Forecasting

Technique: SARIMA, ARIMA, Prophet
Purpose: Predict future risks for proactive resource planning.

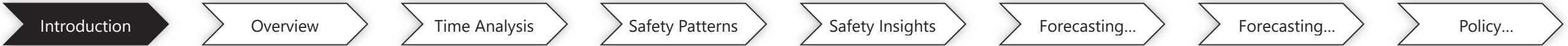
Social Network Analysis

Technique: SNA using centrality and modularity (Leiden)
Purpose: Identify key influencers and community structures.

Model Performance Evaluation

Technique: RMSE & Interval Coverage metrics
Purpose: Inform strategic model adoption (e.g., SARIMA for accuracy).

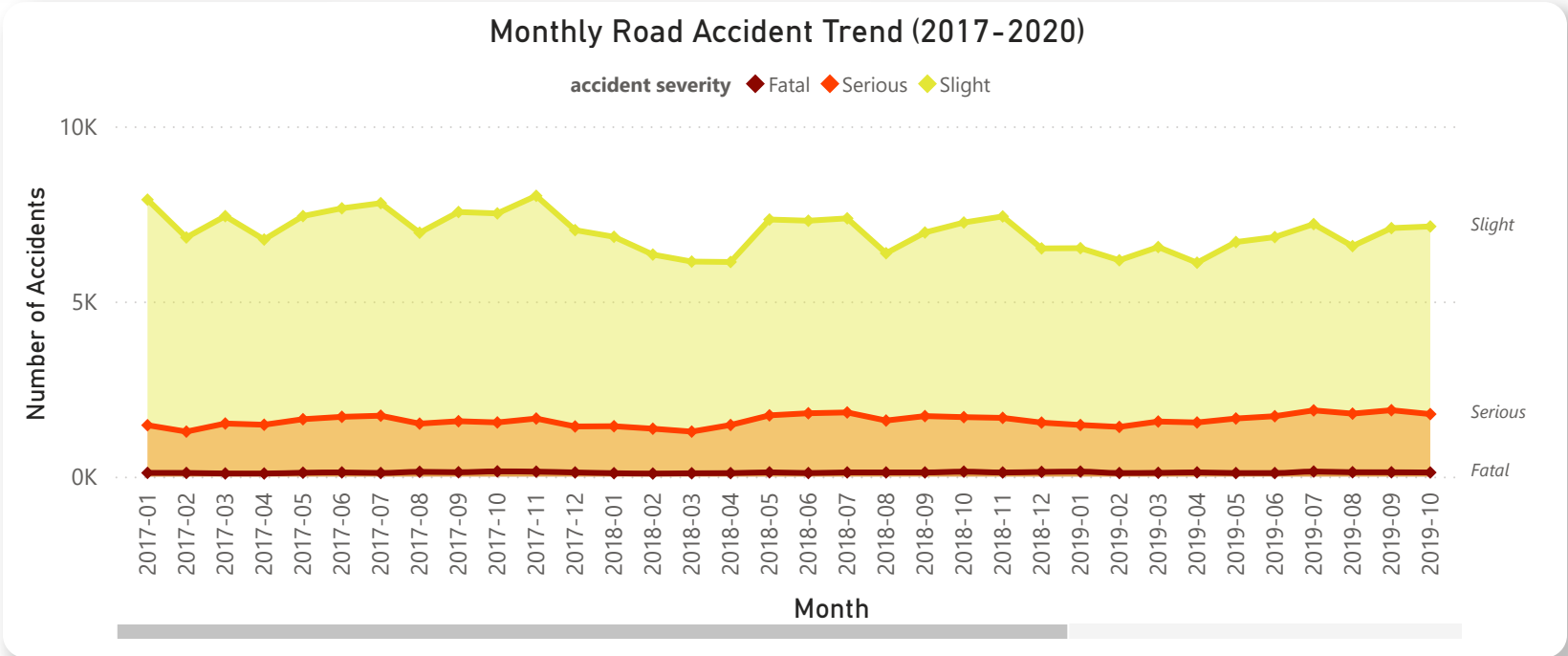
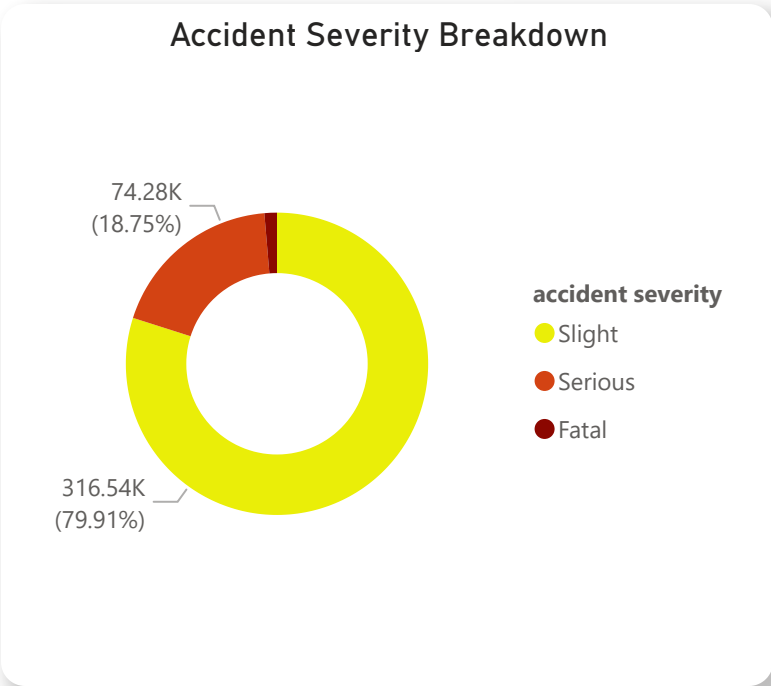
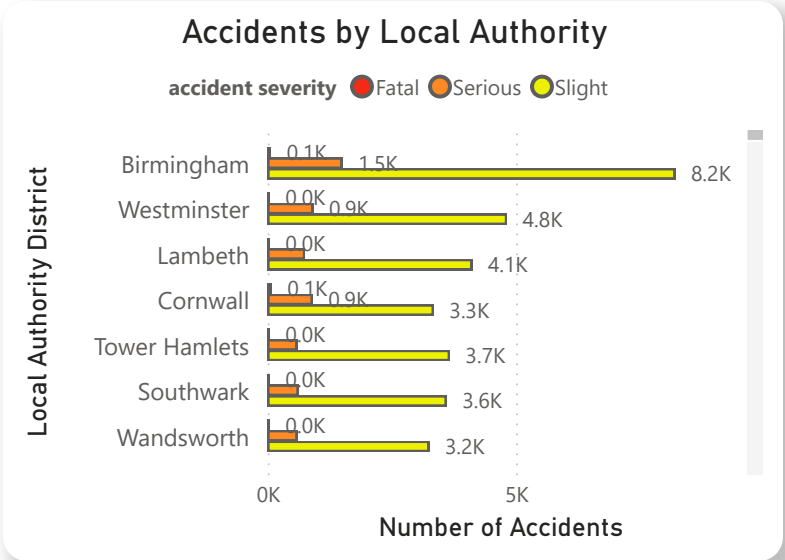
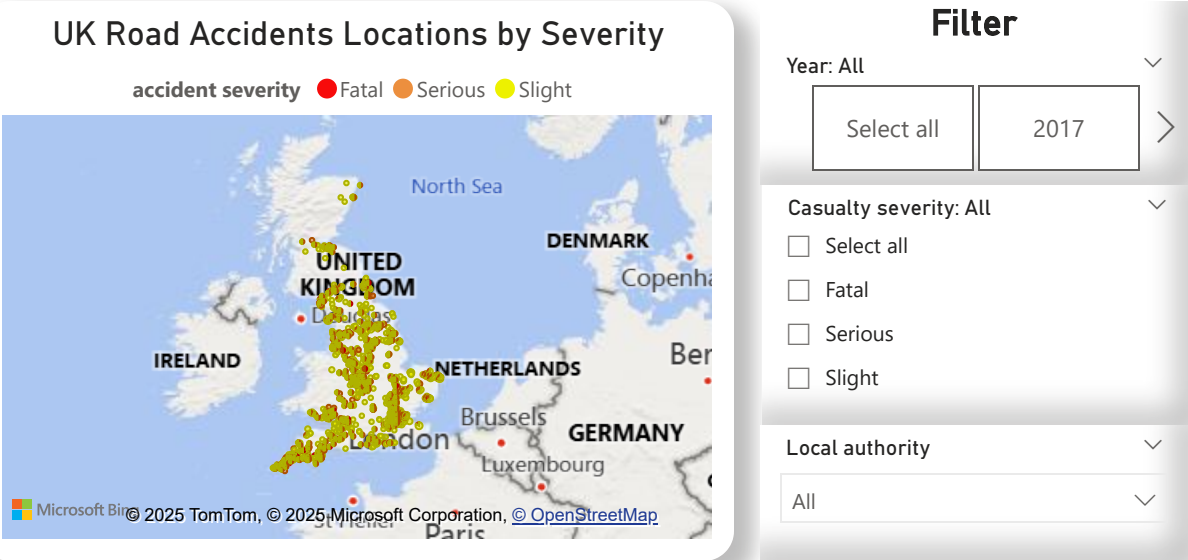
► Explore Dashboards



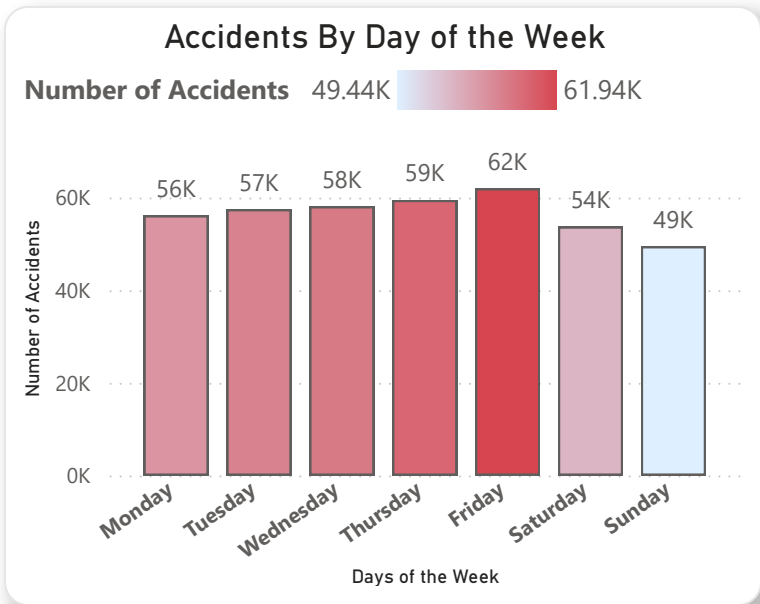
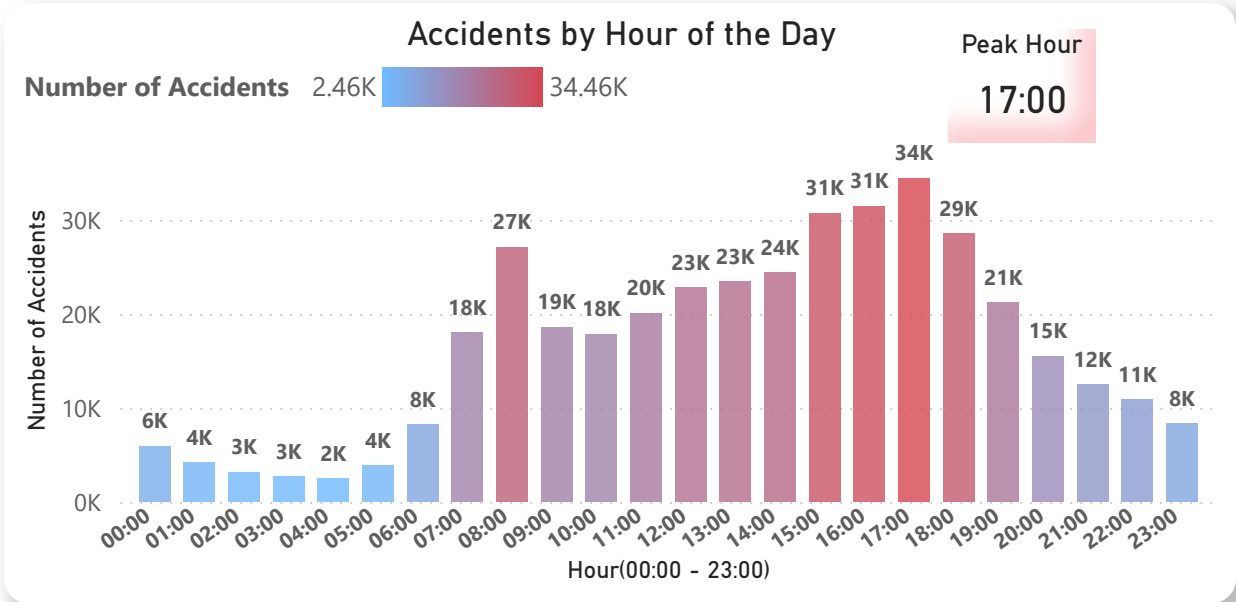
*Project by Joseph Yusuff | MSc Artificial Intelligence & Data Science | 2025
Built with Python (Jupyter), Power BI, and advanced data mining techniques*

UK Road Traffic Overview & Severity Analysis (2017-2020)

396K
Total Accidents



When Do Road Accidents Happen? A Time-Based Analysis



Filter

Year: All

Select all 2017

Month

All

Casualty severity: All

☐ Select all

☐ Fatal

☐ Serious

☐ Slight

Local authority

All

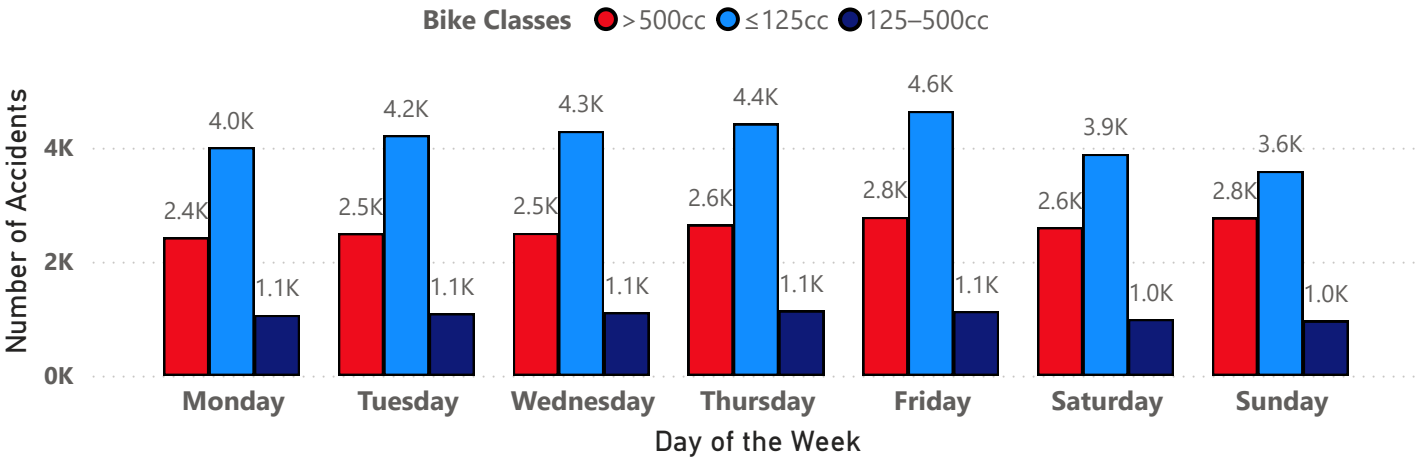
| Peak Casualty Hour 17:00 | Heatmap of Casualties by hour + weekday | | | | | | | |
|-----------------------------|---|---------|-----------|----------|--------|----------|--------|--------|
| | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday | Sunday | Total |
| Hour of the day | | | | | | | | |
| 00:00 | 1221 | 1023 | 1069 | 1045 | 1266 | 1871 | 2044 | 9539 |
| 01:00 | 817 | 734 | 659 | 783 | 818 | 1355 | 1560 | 6726 |
| 02:00 | 635 | 517 | 563 | 589 | 574 | 994 | 1228 | 5100 |
| 03:00 | 498 | 473 | 428 | 461 | 544 | 835 | 1016 | 4255 |
| 04:00 | 461 | 435 | 477 | 448 | 450 | 750 | 790 | 3811 |
| 05:00 | 837 | 698 | 815 | 807 | 817 | 770 | 890 | 5634 |
| 06:00 | 1792 | 1921 | 1763 | 1856 | 1712 | 1245 | 1148 | 11437 |
| 07:00 | 4149 | 4074 | 4292 | 4154 | 3808 | 2310 | 2124 | 24911 |
| 08:00 | 6000 | 6278 | 6632 | 6610 | 6112 | 3527 | 3185 | 38344 |
| 09:00 | 3982 | 4234 | 4086 | 4239 | 4136 | 3350 | 2857 | 26884 |
| 10:00 | 3656 | 3795 | 3755 | 3980 | 4045 | 4158 | 3631 | 27020 |
| 11:00 | 4203 | 4250 | 4253 | 4263 | 4677 | 4828 | 4267 | 30741 |
| 12:00 | 4890 | 4689 | 4665 | 4722 | 5222 | 5542 | 5167 | 34897 |
| 13:00 | 5077 | 4828 | 4877 | 4876 | 5619 | 5559 | 5400 | 36236 |
| 14:00 | 5230 | 5234 | 5239 | 5311 | 6016 | 5467 | 5265 | 37762 |
| 15:00 | 6880 | 6659 | 6932 | 6893 | 7753 | 5964 | 6058 | 47139 |
| 16:00 | 7173 | 7031 | 7240 | 7595 | 7729 | 6111 | 5822 | 48701 |
| 17:00 | 7597 | 8165 | 7787 | 8038 | 8059 | 6310 | 5992 | 51948 |
| 18:00 | 6072 | 6420 | 6288 | 6694 | 6712 | 5669 | 5025 | 42880 |
| 19:00 | 4252 | 4564 | 4554 | 4913 | 5066 | 4776 | 4116 | 32241 |
| 20:00 | 3110 | 3306 | 3303 | 3530 | 3779 | 3692 | 3211 | 23931 |
| 21:00 | 2516 | 2617 | 2670 | 2743 | 3135 | 3059 | 2640 | 19380 |
| 22:00 | 2137 | 2336 | 2310 | 2536 | 2864 | 2903 | 2238 | 17324 |
| 23:00 | 1465 | 1614 | 1684 | 1719 | 2573 | 2575 | 1687 | 13317 |
| Total | 84650 | 85895 | 86341 | 88805 | 93486 | 83620 | 77361 | 600158 |

Motorcycle Safety Patterns: Time and Engine Size Insights (2017–2020)

Total Motorcycle
Accidents

53K

Motorcycle Accidents by Day and Engine Size



Filter

Year: All

Select all

2017

Month

All

Casualty severity: All

☐ Select all

☐ Fatal

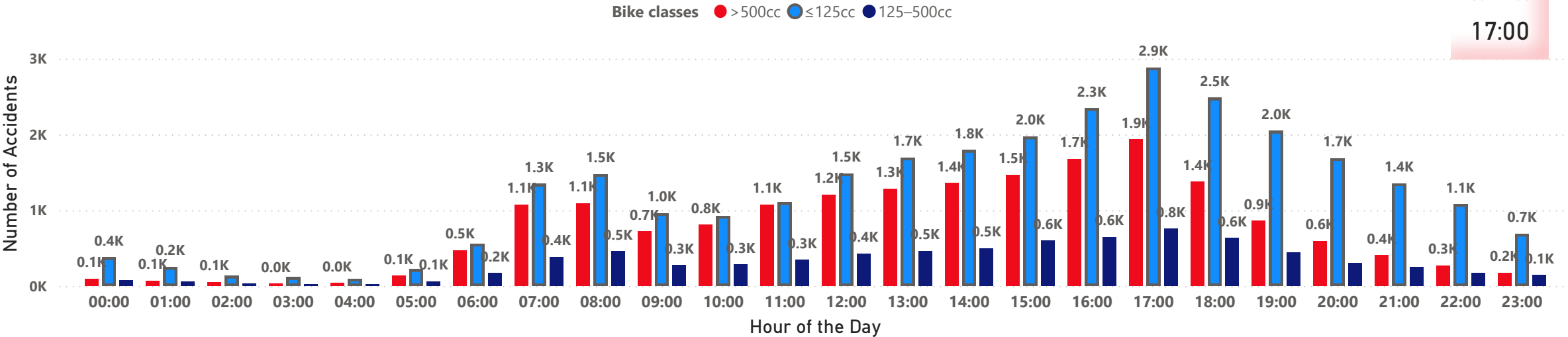
☐ Serious

☐ Slight

Local authority

All

Motorcycle Accidents by Hour and Engine Size

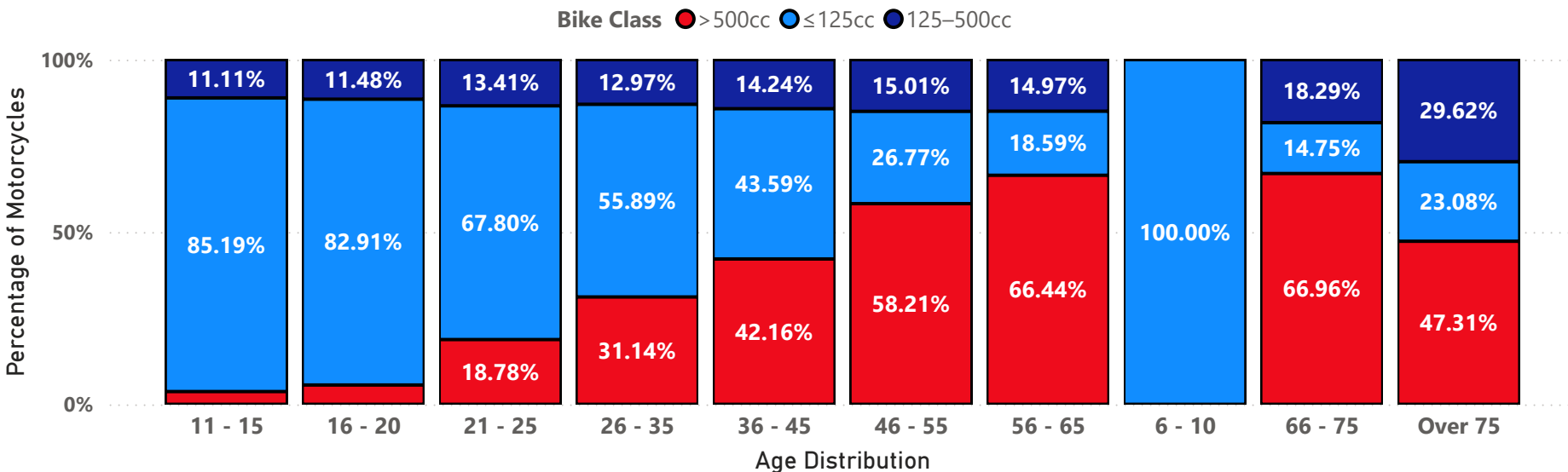


Peak Hour

17:00

Rider Demographics and Crash Conditions: Motorcycle Safety Insights

Rider Age Distribution by Motorcycle Class



Filter

Year: All

Select all

2017

Month

All

Casualty severity: All

☐ Select all

☐ Fatal

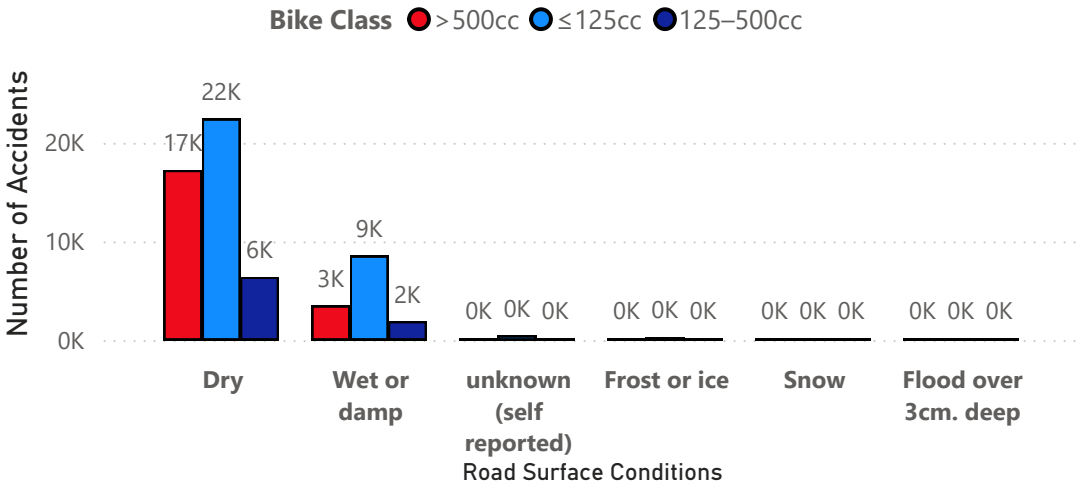
☐ Serious

☐ Slight

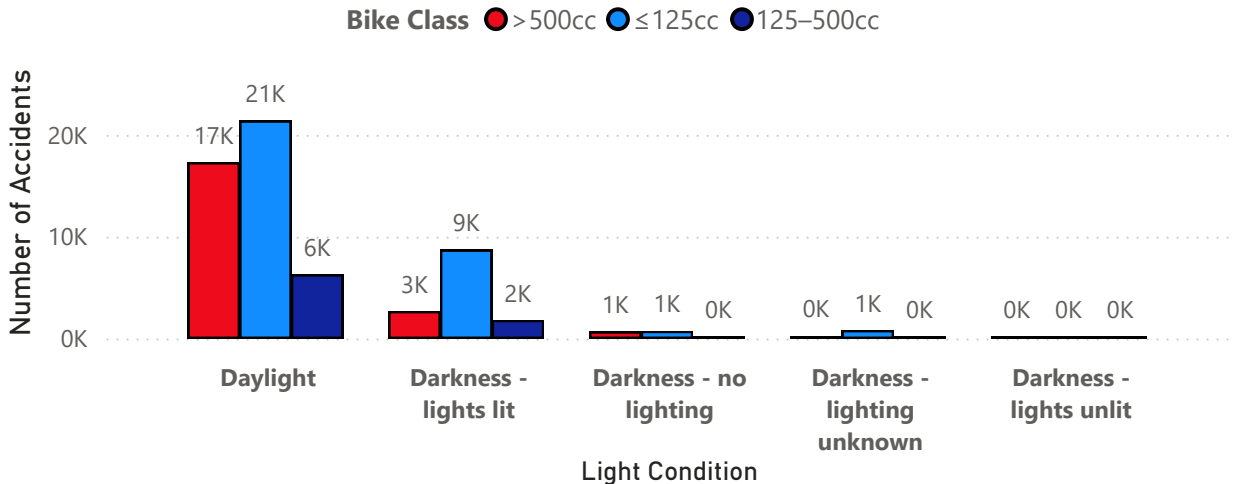
Local authority

All

Accident Distribution by Road Surface and Bike Class



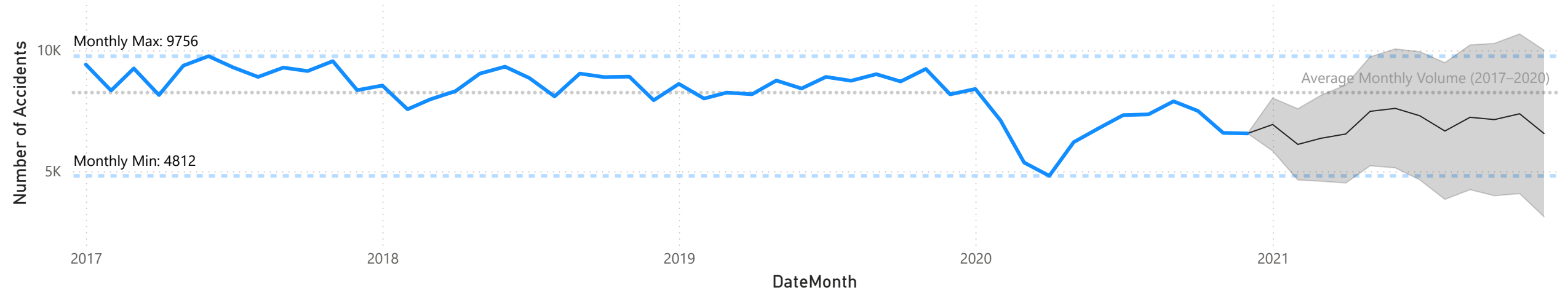
Motorcycle Accidents by Light Condition and Bike Class



Forecasting Future Collisions: Monthly Risk Projections (2020–2021)

Trends modeled from 2017–2020 data using 12-month seasonal patterns. Forecasts guide proactive safety planning for local districts.


Forecast of Monthly Road Accidents (2020–2021)



Note: Forecast based on monthly trend patterns from 2017–2020. Seasonality assumes 12-month cycles. Accuracy decreases beyond 6–12 months.

Filter: Local Authority

All

 **Insight Summary:** In the UK, the peak monthly accident count was 9,756, with an average of 8,252 accidents per month from 2017 to 2020.

9756

Peak Monthly Accidents

4812

Monthly Minimum Recorded

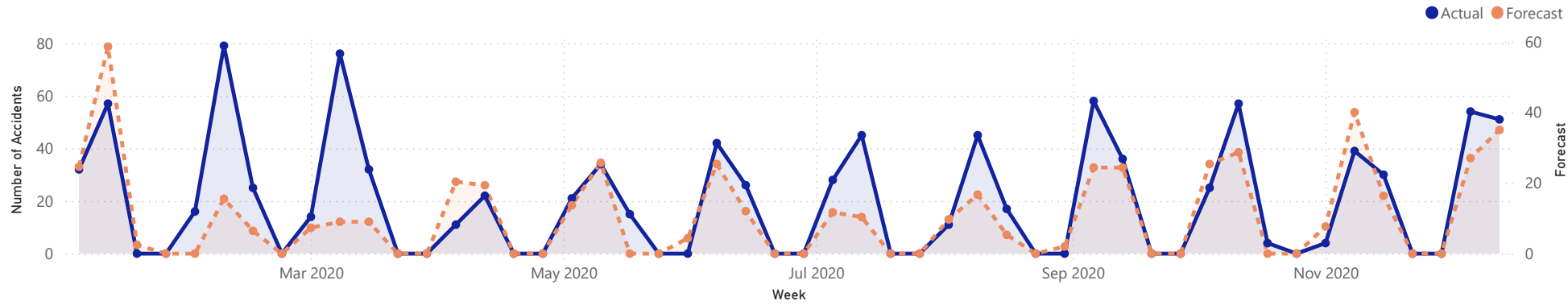
8252

Average Monthly Volume (Historic)

Which Forecasting Model Performs Best for Road Safety?

Regional Model Forecast Accuracy Evaluation for 2020 UK Traffic Incidents using RMSE and Coverage – ARIMA vs SARIMA vs Prophet

Forecast Accuracy for Greater Manchester using SARIMA



Note: Forecasts are weekly predictions for 2020 only, based on 2017–2019 data. Accuracy may vary by region.

Select Region

- ☒ Greater Manchester
- ☐ Metropolitan Police
- ☐ West Yorkshire

Select Model

- ☐ ARIMA
- ☐ PROPHET
- ☒ SARIMA

Select Metric

- ☐ Coverage
- ☐ RMSE

RMSE for Greater Manchester using SARIMA

18.10 accidents/wk

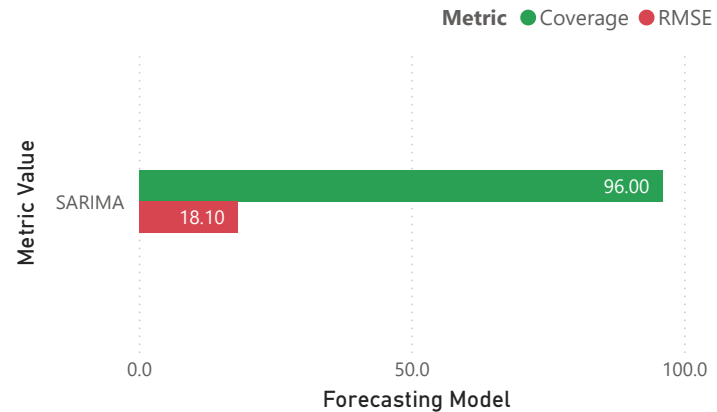
RMSE

Coverage for Greater Manchester using SARIMA

96.00 %

Coverage

RMSE and Coverage for Greater Manchester using SARIMA



Strategic Road Safety Policy Recommendations (2020+)

Targeted Actionable Insights from Forecasting, Clustering, and Network Analysis of the UK Road Traffic Study (2017–2020)

TEMPORAL INTERVENTION SECTION

Insight:

Accidents peak at **8:00 AM and 5:00 PM**, aligning with rush hours. There is also an unexpected rise in **weekend accidents**, particularly **Sunday evenings**.

Recommendation:

- Deploy **targeted police patrols and public awareness campaigns** during weekday rush hours and Sunday evenings.
- Consider **variable signage** or speed enforcement for **commuter windows**.

GEOGRAPHIC CLUSTERS SECTION

Insight:

Cluster analysis (K Means/Q5) revealed **dense accident zones** in Kingston upon Hull's urban center (e.g., Cluster 0), forming consistent spatial patterns.

Recommendation:

- Allocate funding for **road safety upgrades, speed calming, and zoning redesign** in high-risk local authority districts.
- Prioritize **Cluster 0** zones for infrastructure audits.

SEVERITY-AWARE RULES SECTION

Insight:

Association rule mining shows that **accident severity increases sharply** in combinations such as: **Darkness + Snow + Evening → Serious/Fatal**

Recommendation:

- Implement **real-time contextual warnings** on digital signs.
- Trigger **dynamic alerts** during adverse combinations (e.g., snowy nights).

MOTORCYCLE SAFETY PROFILE

Insight:

Motorcycles with engines **>500cc** show **higher crash risk** at peak traffic hours and poor light conditions. Age groups **21–35** dominate rider crashes.

Recommendation:

- Tighten licensing/training for higher-cc bikes.
- Deploy **demographic-specific safety campaigns** (e.g., targeted ads to 21–35 age range).
- Improve **visibility infrastructure** (painted lanes, adaptive lighting).

EVIDENCE-BASED MODEL CHOICE

Insight:

SARIMA yielded **best overall performance** in both RMSE and interval coverage across 3 regions. Prophet was less reliable in metro areas (e.g., London).

Recommendation:

- Adopt **SARIMA** as the **preferred forecasting model** for national road safety systems.
- Continue monitoring emerging models, but **prioritize reliability over novelty**.

FORECASTING & LOGISTICS PLANNING

Insight:

SARIMA models accurately forecast weekly road accidents per region, with over **90% interval coverage**. Weekly forecast trends aligned with actuals in Greater Manchester, West Yorkshire, and London.

Recommendation:

- Integrate **SARIMA forecasts** into emergency services planning.
- Use **weekly accident projections** to optimize:
 1. Ambulance deployment
 2. Traffic officer shifts
 3. Emergency response unit readiness

Data-Driven Safety Policy Summary

Use clustering to **localize interventions**, forecasting to **plan response**, and severity rule mining to **prevent high-impact crashes**.