# UK Road Traffic Accident Analysis

Comprehensive statistical analysis of 307,973 road traffic incidents across the United Kingdom during 2021-2022, delivering actionable insights for evidence-based road safety policy and resource optimization.

# The Challenge: Unstructured Data, Critical Stakes

Road accidents remain a critical public safety concern across the UK, with multiple factors such as weather conditions, road surface quality, speed limits, and traffic controls influencing accident severity. However, raw accident data often exists in fragmented, unstructured formats, making it extraordinarily difficult for stakeholders to derive actionable insights or implement targeted interventions.

This project transforms 307,973 recorded incidents spanning 2021-2022 into meaningful intelligence that can guide policy decisions, improve safety interventions, and ultimately save lives. By converting complex datasets into interactive visualizations and statistical insights, we enable transport planners and policymakers to make evidence-based decisions grounded in comprehensive analysis rather than intuition.

# Why Data-Driven Analysis Matters

## Evidence Over Intuition

Traditional road safety approaches rely on limited anecdotal evidence. Comprehensive statistical analysis identifies specific risk factors, temporal patterns, and geographical hotspots requiring targeted interventions, ensuring safety resources are allocated based on empirical evidence.

## Quantifying Challenges

By measuring night-time driving risks, vehicle-type vulnerabilities, and road-type dangers, we develop targeted solutions addressing root causes rather than symptoms. Statistical quantification transforms vague concerns into actionable priorities.

## Policy Development

Statistical insights provide policymakers with concrete evidence supporting new safety regulations, speed limit adjustments, and infrastructure improvements. Evidence-based policy development demonstrably improves road safety outcomes across all demographics.

# Dataset Scope and Coverage

## Comprehensive Coverage

**Source:** UK Department for Transport Road Safety Data

**Time Period:** 2021-2022

**Total Records:** 307,973 accident incidents

**Geographic Scope:** United Kingdom road network

## Key Variables Analyzed

- Number of casualties per incident
- Vehicles involved in collisions
- Speed limits at accident locations
- Road types and classifications
- Temporal patterns (time, day, season)
- Weather and surface conditions

# Project Objectives

## 01

### Statistical Analysis

Analyze descriptive statistics for casualties, vehicles involved, and speed limits across UK road accidents to establish baseline metrics and identify outliers.

## 02

### Temporal Patterns

Identify temporal patterns and trends in accident data between 2021-2022 to understand seasonal, weekly, and hourly risk variations.

## 03

### Interactive Dashboards

Create interactive dashboards for stakeholder visualization and decision-making, enabling dynamic exploration of complex accident patterns.

## 04

### Actionable Recommendations
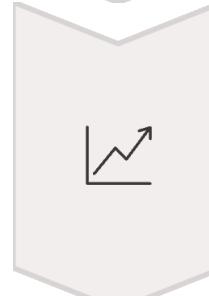
Develop data-driven recommendations for road safety improvements, targeting the highest-impact interventions for resource optimization.

# Methodology: From Raw Data to Insights
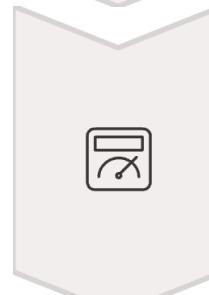
### Data Cleaning & Validation

Verified completeness and accuracy of 307,973 accident records. Handled missing values, standardized categorical variables, and removed duplicates to ensure data integrity.
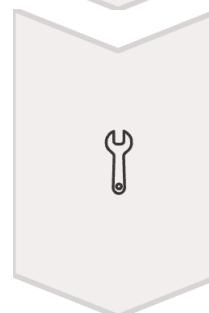
### Statistical Analysis

Conducted comprehensive descriptive statistics, distribution analysis, temporal trend examination, and correlation studies to identify significant patterns.

### Dashboard Development

Created interactive visualizations with KPI displays, multi-dimensional filtering, and user-friendly navigation for stakeholder exploration.

### Tools & Technologies

Leveraged Python, R, Tableau/Power BI, Pandas, NumPy, and SQL for comprehensive data processing, statistical modeling, and visualization.

# Dashboard Overview

Interactive dashboard providing comprehensive visualization of UK road traffic accident data, enabling stakeholders to explore patterns, filter by multiple dimensions, and extract actionable insights for evidence-based decision-making and policy development.

# Statistical Summary: Key Metrics

## 307,973
### Total Incidents
Recorded accidents across the UK during 2021-2022 analysis period

## 1.36
### Average Casualties
Mean casualties per incident, with median and mode of 1

## 1.83
### Vehicles Involved
Average vehicles per accident, predominantly single and two-vehicle collisions

## 38.87
### Mean Speed Limit
Average mph at accident locations, indicating moderate-speed environments

# Casualty and Vehicle Distribution Analysis

## Casualty Patterns

The majority of accidents result in single casualties, with an average of 1.36 per incident. While most collisions are relatively minor, extreme cases exist—the maximum recorded incident involved 48 casualties. High kurtosis in the distribution indicates that such multi-casualty events are statistically rare outliers.
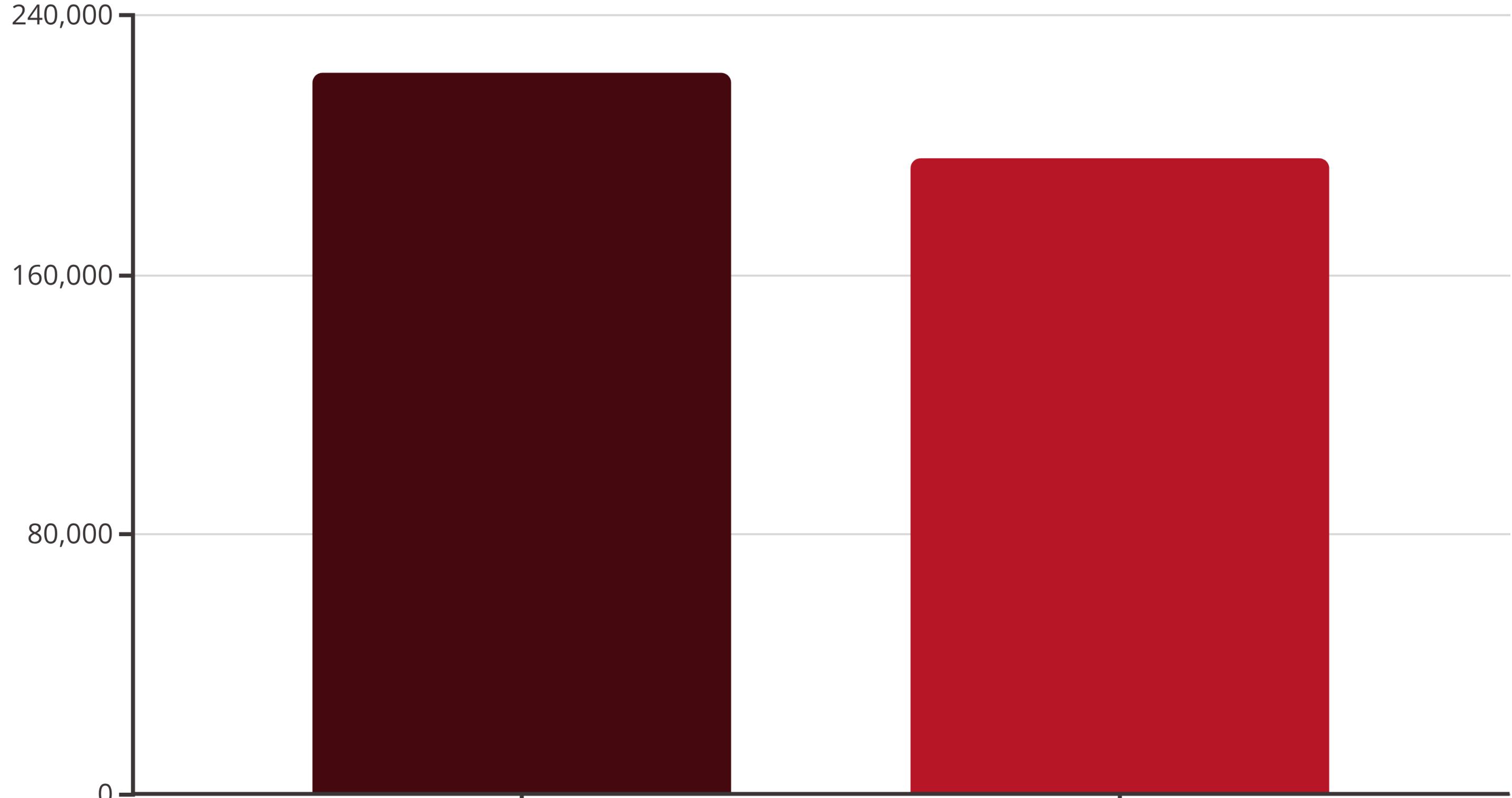
**Key Insight:** Single-casualty accidents dominate, but extreme cases highlight the need for comprehensive safety measures across all road types and conditions.

## Vehicle Involvement

With an average of 1.83 vehicles per accident, the data confirms most incidents are single or two-vehicle collisions. The distribution is highly skewed toward these common scenarios, while extremely rare cases involving up to 32 vehicles represent statistical outliers occurring infrequently.

**Key Insight:** Chain-reaction accidents exist but are exceptional; most safety interventions should target single and two-vehicle collision scenarios.

## Temporal Trends: Year-Over-Year Improvement

# Weekly Patterns: Weekday vs. Weekend Risk



## Weekday Casualties

Monday through Friday demonstrate significantly higher casualty numbers, driven by increased commuter and work-related traffic. These peak risk periods represent higher exposure levels as millions of workers travel during rush hours.

## Weekend Patterns

Saturday and Sunday show relatively lower accident rates, reflecting reduced commuter traffic volumes. Weekend travel tends to be more discretionary and distributed throughout the day rather than concentrated during peak periods.

**Strategic Recommendation:** Targeted weekday safety interventions—particularly during morning and evening rush hours—may yield the most significant benefits in reducing overall casualty numbers.

# Speed Limit and Road Design Insights

The mean speed limit of 38.87 mph across accident locations, with distribution showing positive skewness toward lower speed limits, reveals a critical insight: accidents frequently occur in moderate-speed environments rather than high-speed motorways.

Speed limits in the dataset range from 10 mph to 60 mph, with lower speed limit roads being more prevalent. This pattern suggests that urban and suburban road design factors—including intersection design, visibility, pedestrian crossings, and traffic density—may be as critical as speed management in accident prevention.

Key Finding: Most accidents don't happen on motorways but in complex urban and suburban environments where multiple factors intersect.

# Recommendations: Night-Time and Road Type Safety

## Enhanced Night Visibility

Create comprehensive awareness campaigns about reduced visibility risks during night-time driving. Enhance street lighting infrastructure in high-accident zones and implement reflective road markings. Develop targeted driver education programs focusing on night-time driving techniques and hazard recognition to address elevated risk periods.

## Road-Specific Interventions

Prioritize safety improvements on single carriageways showing higher casualty rates. Conduct detailed engineering reviews of road design and speed limits for high-casualty road types. Implement road-type specific safety measures and develop specialized maintenance schedules based on identified statistical patterns.

# Recommendations: Vehicle Safety and Urban Focus

### Vehicle Technology Focus

With cars accounting for nearly 80% of casualties, focus on advanced safety technologies and driver assistance systems (ADAS). Develop targeted interventions for motorcyclists showing disproportionate casualty rates and create vehicle-type specific safety campaigns.

### Urban Safety Measures

Implement enhanced safety measures in urban areas where accident density is highest. Develop smart traffic management systems for urban environments and create comprehensive pedestrian and cyclist safety programs for high-risk urban segments.

### Rural Road Strategies

Develop specialized safety strategies for rural roads based on unique risk profiles. Improve infrastructure and signage in rural areas with higher accident severity and implement design standards accounting for different traffic patterns and emergency response challenges.

# Moving Forward: Continuous Improvement

## Evidence-Based Allocation

Allocate safety resources based on statistical risk profiles, prioritizing interventions with highest casualty reduction potential

## Continuous Monitoring

Establish regular review mechanisms using statistical analysis to track intervention effectiveness over time

## Automated Reporting

Create automated reporting systems and KPIs for continuous safety monitoring and stakeholder communication

## Predictive Analytics

Implement predictive analytics to identify emerging risk patterns before they escalate into major safety concerns

This comprehensive analysis of 307,973 UK road traffic incidents demonstrates the power of data-driven approaches to road safety. The 12% reduction in casualties from 2021 to 2022 proves that evidence-based interventions work. By continuing to leverage statistical insights, interactive dashboards, and targeted recommendations, transportation authorities can optimize resource allocation and save lives across the UK road network.