

Project Title

Group NO: 31

Team MEMBERS and Student IDS

(Paste the Link to your website here)

2025

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# 1 Introduction

## Background and Motivation

The Bureau of Infrastructure and Transport Research Economics (BITRE) collects and publishes Australia-wide **road safety enforcement statistics** each year. These datasets, available through the [BITRE Road Safety Enforcement Data Portal](https://catalogue.data.infrastructure.gov.au/dataset/road-safety-enforcement-data?utm_source=chatgpt.com), include details from 2008–2024 on **speeding infringements**, **mobile phone offences**, **drug tests**, **seatbelt non-compliance**, and **unlicensed driving**.

Our project focuses on the **Speeding Enforcement Dashboard**, which uses the Police enforcement fines 2024 dataset. Speeding remains one of the major causes of road fatalities and serious injuries in Australia, and understanding enforcement trends is critical for effective road safety policy and public awareness.

However, the current BITRE dashboard has several limitations:

* **Limited interactivity:** Users cannot easily filter by detection method or jurisdiction.
* **Lack of proportional context:** Data is shown as raw counts, without accounting for population or licence base.
* **Inconsistent trend visualisation:** Comparing time-series trends (e.g., pre- and post-COVID) requires manual interpretation.

The main audience includes **policy makers, road safety researchers, and the general public** who want clearer insights into national enforcement patterns and their safety implications.

A screenshot of a computer

AI-generated content may be incorrect.

Figure 1: …

**User tasks enabled by our new visualisation:**

1. Compare speeding fines per 10 000 licences across jurisdictions.
2. Explore enforcement trends between 2008–2024.
3. Filter by detection method (camera vs police-issued).
4. Analyse changes during the COVID-19 period (2019–2021).
5. Identify enforcement intensity trends and possible data anomalies.

## Visualisation Purpose

This visualisation aims to transform BITRE’s static speeding enforcement data into an **interactive, comparative dashboard** that helps users interpret enforcement behaviour and its variations among Australian states and territories.

**Research Questions**

1. Which jurisdiction records the highest speeding fines per 10 000 licences?
2. How did enforcement levels change during the COVID-19 period (2019–2021)?
3. Are camera-issued offences increasing faster than police-issued offences?
4. Which jurisdictions show the largest yearly fluctuations in speeding fines?
5. What national trends exist in enforcement levels from 2008–2024?

**Expected Benefits**

* Helps **policy makers** target enforcement and awareness programs.
* Enhances **transparency** and accountability in national road safety data.
* Encourages **data-driven decision making** using open government datasets.
* Raises **public awareness** about speeding enforcement levels.

# 2 Data

## 2.1 Data Source and Governance

**Original Data Source**

Data is sourced from the **Department of Infrastructure, Transport, Regional Development, Communications and the Arts (DITRDCA)** through its agency, the **Bureau of Infrastructure and Transport Research Economics (BITRE)**.

Official dataset link:  
👉 [https://catalogue.data.infrastructure.gov.au/dataset/road-safety-enforcement-data](https://catalogue.data.infrastructure.gov.au/dataset/road-safety-enforcement-data?utm_source=chatgpt.com)

BITRE works with all state and territory police forces and revenue agencies to collect annual enforcement data.

Participating agencies include:

* NSW Police Force & NSW Revenue
* Victoria Police
* Queensland Police Service
* South Australia Police
* Western Australia Police Force
* Tasmania Police
* Northern Territory Police
* Australian Federal Police / Access Canberra

**Table 1: Dataset Summary**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Dataset | Records | Key Attributes | Time Period | Source | Update Frequency |
| Police enforcement fines 2024 | ≈ 35 000 | Year, Jurisdiction, Offence Type, Detection Method, Fine Count | 2008–2024 | BITRE | Annual |
| Police enforcement positive drug tests 2024 | ≈ 3 000 | Year, Jurisdiction, Positive Rate, Detection Method, Age Group | 2008–2024 | BITRE | Annual |
| Police enforcement positive breath tests 2024 | ≈ 3 000 | Year, Jurisdiction, Positive Count, Detection Method | 2008–2024 | BITRE | Annual |

**Data Governance**

**Data Collection Process:**  
BITRE consolidates enforcement data provided annually by each state and territory. Some agencies report both police-issued and camera-issued fines, while others have separate authorities managing camera detections (e.g., Access Canberra for ACT). Data is cleaned, validated, and harmonised before national publication.

**Data Quality Assessment:**  
The 2024 dataset is comprehensive but includes limitations such as missing values for specific years or states (e.g., incomplete ACT or Victorian data during industrial action). Data since 2023 includes **monthly granularity, age group, detection method, and remoteness** fields, improving accuracy

Road safety enforcement data di…

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**Security, Privacy, and Ethics:**  
The datasets contain **no personal or identifiable information** — all data are aggregated by jurisdiction, offence type, and time period. Usage complies with **Australia’s Open Government Data Policy** and Swinburne University ethical standards. Responsible usage is acknowledged in accordance with BITRE’s open-data licence.

**Table 2: Research Questions and Data Support**

|  |  |  |  |
| --- | --- | --- | --- |
| Research Question | Relevant Dataset(s) | Key Attributes / Variables | How the Data Supports the Question |
| 1. Which jurisdiction records the highest fines per 10 000 licences? | police\_enforcement\_2024\_fines.csv | Year, Jurisdiction, Fines, Licences | Enables per-capita comparisons between states and territories. |
| 2. How did speeding enforcement change during COVID-19 (2019–2021)? | police\_enforcement\_2024\_fines.csv | Year, Jurisdiction, Fines | Allows temporal analysis of enforcement decline or increase. |
| 3. Are camera-issued offences increasing faster than police-issued? | police\_enforcement\_2024\_fines.csv | Detection Method, Fines | Supports trend comparison of detection methods over time. |
| 4. Which states show the largest enforcement fluctuations? | police\_enforcement\_2024\_fines.csv | Jurisdiction, Year, Fines | Enables variability and standard deviation analysis. |
| 5. Is there a national trend toward stricter speeding enforcement? | police\_enforcement\_2024\_fines.csv + drug\_tests.csv | Year, Jurisdiction, Fines, Positive Rate | Cross-comparison between enforcement and testing metrics. |

## 2.2 Data Processing and Analysis

### 2.2.1 Key attributes and data types

* List key attributes and their data types (categorical, ordinal, interval, ratio/quantitative)

Table 3: …

|  |  |  |  |
| --- | --- | --- | --- |
| **Key Attribute** | **Data Type** | **Measurement Type** | **Short Description** |
| Jurisdiction | String | Categorical | State or territory |
| Detection Method | String | Categorical | Camera or police-issued |
| Fines | Number (double0 | Quantitative | Number of fines issued |
| Year | Number (integer) | Interval | Year of enforcement |
|  |  |  |  |
|  |  |  |  |

### 2.2.2 Data Processing

* Describe the data cleaning process (in KNIME), including:
  + Handling missing values
  + Removing duplicates
  + Normalisation, transformation, and derived variables
  + Calculated derived metrics (e.g. “Fines per 10,000 licenses”)
* Data filtering and joining datasets

Table 4: …

|  |  |  |
| --- | --- | --- |
| **KNIME Node Used** | **Purpose** | **Output** |
| *Missing Value* node | To detect and fill or remove missing values from numeric or categorical columns. | Replaced missing offence counts with “0” or excluded incomplete jurisdiction-year rows. |
| *Math Formula* / *GroupBy* node | To create new calculated columns such as rates or totals. | Derived metric: Fines per 10,000 licences = (Total Fines / Number of Licences) × 10,000. |
| *Row Filter* / *Rule-based Row Filter* | To select only relevant offences or years for visualisation. | Filtered data to 2010–2024 for selected dashboard category (e.g., Drug Tests). |
| *Joiner* node / *Concatenate* node | To combine multiple datasets (e.g., fines and drug tests) into one table for comparison. | Merged datasets using common keys (Year, Jurisdiction) to create a unified dataset for analysis. |
|  |  |  |
|  |  |  |
|  |  |  |

* Include a screenshot of the KNIME workflow for data processing

A diagram of a string manipulation

AI-generated content may be incorrect.

Figure 2: …(Example)

## 2.3 Data Exploration

* Conduct exploratory data analysis using KNIME.
* Provide summary statistics (basic descriptive statistics) and data visualisations to understand patterns and outliers
* Include a screenshot of the KNIME workflow for data cleaning

Table 5: …

|  |  |  |
| --- | --- | --- |
| **KNIME Node Used** | **Purpose of the Node** | **Example Output / Description** |
| Statistics | Generates basic descriptive statistics (mean, min, max, standard deviation). | Summary table showing average fines and test counts per year. |
| Data Explorer | Provides an overview of column distributions, missing values, and outliers. | Identifies missing *Jurisdiction* values or abnormal *Positive Rates*. |
| GroupBy | Aggregates data to calculate totals or averages per category. | Summarises total fines by *Year* and *Jurisdiction*. |
| Box Plot | Detects outliers and visualises data spread. | Visualises high fine counts in NT compared to other states. |
| Bar Chart | Displays category comparisons. | Shows number of fines per offence type. |
| Line Plot | Shows trends over time. | Plots fines or tests from 2008–2024. |
|  |  |  |
|  |  |  |

A diagram of a string manipulation

AI-generated content may be incorrect.

Figure 3: …(Example only)

* Discuss initial observations (a summary of what you discovered)
* **Reflection:**
  + What insights or anomalies did you find?
  + Which variables are most relevant to your research questions?
  + Any challenges (e.g., missing data or inconsistent reporting)?

Table 6: …

|  |  |  |  |
| --- | --- | --- | --- |
| **Research Question** | **Key Findings from KNIME EDA** | **Initial Observations / Insights** | **Charts Produced in KNIME** |
| 1. Which jurisdiction records the highest fines per 10,000 licences? | KNIME *GroupBy* node shows NT and WA have highest fines per capita; ACT lowest. | Jurisdictional variation is clear — possible link to enforcement intensity. | Bar chart of total fines by jurisdiction |
| Q2 |  |  |  |
| Q3 |  |  |  |
| Q4 |  |  |  |
| Q5 |  |  |  |

# 3 Visualisation Design

This section should include:

## Website Design

* Create a wireframe of your webpage layout, showing:
  + Navigation structure
  + Placement of headings, text, and charts
  + Provide a wireframe using tools like Figma, Miro, PowerPoint (or a hand-drawn sketch).
  + Describe the planned structure and user flow of the website in paragraphs

A screenshot of a computer

AI-generated content may be incorrect.

Figure 4: …

* Design a storyboard explaining how users will interact with your D3.js website.
  + Describe the user journey (what they click, what changes on screen).
  + **Example Storyboard:** A user selects “Victoria” from the dropdown → line chart updates to show speeding trends from 2010–2024 → hovering over 2020 shows note “COVID-19 travel restrictions.”

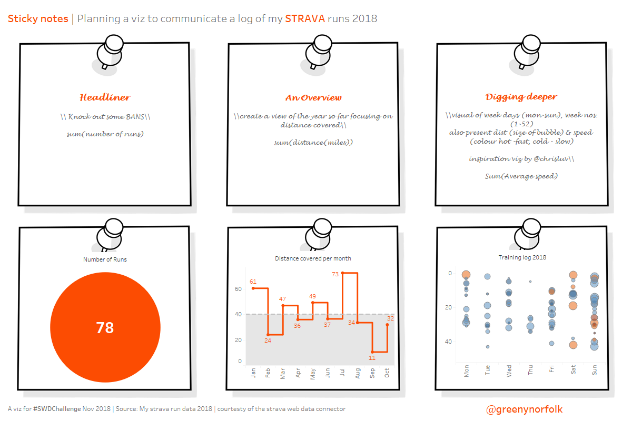


Figure 5

## 3.2 Visualisation Design

* Explain the chart types chosen (e.g., bar, scatter, line, area, Sankey, parallel coordinates etc) and why they are appropriate.

Table 7: …

|  |  |  |  |
| --- | --- | --- | --- |
| **Research Question** | **Chart Type** | **Why It’s Appropriate** | **Data Type Represented** |
| 1. Jurisdiction with highest fines per 10,000 licences | Bar Chart | Clearly compares discrete categories (states/territories). | Categorical (Jurisdiction) + Quantitative (Fines per 10,000) |
| 1. Jurisdiction with highest fines per 10,000 licences | Choropleth Map | Shows geographical variation of fines effectively. | Spatial (Jurisdiction) + Quantitative (Rate) |
| Q2 |  |  |  |
| Q2 |  |  |  |
| Q3 |  |  |  |
| Q4 |  |  |  |
| Q5 |  |  |  |

* Discuss adherence to good design principles, including:
  + Graphical integrity (avoiding misleading charts)
  + Accessibility (colourblind and web-friendly palettes, font size)
  + Scalability (responsiveness across different screen sizes)
* Explain how graphical elements (colour, shape, size, annotations) are used to represent differences effectively.
* Justify colour choices, labelling, and layout decisions.
* Describe how you will use annotations and tooltips enhance user understanding.

## 3.3 Interaction Design

* Describe interactive features (e.g., zooming, filtering, tooltips, animations) and their role in improving user experience.
* Provide a table of interactions, explaining:
  + The interaction method (hover, click, drag, etc.)
  + The expected user behaviour and response

Table 8: …

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Interaction Feature** | **Interaction Method (User Action)** | **System Response / Behaviour** | **Linked Research Question(s)** | **Purpose and User Experience Benefit** |
| Tooltip on Hover | Hover over bar, line, or map point | Displays a popup showing details (e.g., year, jurisdiction, fines, detection method, or positive rate). | Q1 – Jurisdiction with highest fines; Q4 – Positive drug test rates | Provides “details on demand” without cluttering visuals; helps compare fine or test rates precisely. |
| Dropdown Filter | Select jurisdiction or offence type from a dropdown menu | Updates all charts to display selected category only. | Q1, Q2, Q3 – Compare jurisdictions and enforcement types | Enables focused comparison; users can easily switch between states or offence types. |
| Time Slider / Brush | Drag or select a time range on timeline | Filters charts to show selected years only. | Q2 – COVID-19 (2020–2021) impact on enforcement | Allows users to isolate and examine specific periods (e.g., lockdown years) for temporal analysis. |
| Animated Transitions | Automatic when filters or time slider change | Smoothly updates charts to reflect new data. | All questions | Preserves context and helps users track changes during interaction. |
|  |  |  |  |  |

# 4 Iteration and Validation

## 4.1 Testing and refinements

* Describe the iterative process of testing and improving the visualisation
* Include feedback received (from peers, users, or instructors) and how changes were made in response
* Provide before-and-after comparisons using screenshots/sketches
* Discuss any adjustments made to design due to programming issues
* Discuss accessibility features of design/programming

Table 9: Iteration Plan (example)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Week** | **Focus / Iteration Stage** | **Deliverables / Outputs** | **Feedback Target** | **Feedback Received & Improvements Planned** |
| Week 9 | Project Planning & Setup | Selected BITRE topic, defined 5 research questions, created initial wireframe and storyboard. | Tutor | (To be filled after Week 9 stand-up) |
| Week 10 | Initial Design *(Prototype 1)* | KNIME analysis results, wireframe updates, draft D3.js chart layout. | Tutor | Tutor suggested improving chart alignment and label readability. Plan to adjust font size and add chart titles. |
| Week 11 | Refined Design *(Prototype 2)* | Interactive charts, improved colour scheme and accessibility features. | Peer & Tutor | Feedback to add tooltips and consistent colour palette. Plan to implement hover tooltips in D3.js and standardise chart colours. |
| Week 12 | Final Design *(Prototype 3)* | Completed D3.js dashboard, full interactivity, usability test results. | Final Tutor Review | Feedback to simplify navigation and legend clarity. Plan to redesign header and legend elements using D3.js SVG. |

Table 10: Iteration Documentation Summary (Example)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Iteration / Week** | **Screenshot (Insert Image)** | **Feedback Received** | **Changes Made** | **Reflection / What Improved** |
| Iteration 1 – Week 10 | (Insert image of Prototype 1 here) | “Improve chart alignment and label readability.” | Adjusted font size, added chart titles, improved layout spacing. | Layout now clearer and easier to read. Font hierarchy enhances data interpretation. |
| Iteration 2 – Week 11 | (Insert image of Prototype 2 here) | “Add tooltip interaction and consistent colour scheme.” | Implemented hover tooltips in D3.js, applied consistent blue-orange palette. | Increased interactivity and readability. Charts now visually coherent. |
| Iteration 3 – Week 12 | (Insert image of Prototype 3 here) | “Simplify navigation bar and improve legend clarity.” | Redesigned navigation bar and legend using D3.js SVG. Adjusted alignment for smaller screens. | Navigation now smoother; legends are more intuitive, improving storytelling flow. |

## 4.2 Usability evlauation

* Conduct a usability evaluation
* After the final iteration:
  + Conduct a short usability test with 3–5 participants.
  + Provide 2–3 test tasks (e.g., identify highest offence rate, compare states).
  + Collect feedback and summarise findings.
* Include:
  + Participant details (anonymised)
  + Method used (observation, think-aloud, etc.)
  + Summary of key findings and adjustments made (reflection.

Table 11: Participant Summary (Example)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Participant ID** | **Background** | **Familiarity with Data Visualisations** | **Device Used** | **Testing Method** |
| P1 | Postgraduate student in Data Science | High | Laptop (Windows) | Think-Aloud Observation |
| P2 | Undergraduate in Business Analytics | Medium | Laptop (Mac) | Observation and Notes |

Table 12: Usability Test Tasks and Methods

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Task ID** | **Test Task Description** | **Purpose of the Task** | **Method Used** | **Success Criteria** |
| T1 | Identify which jurisdiction had the highest fines per 10,000 licences in 2024. | Test the clarity of comparative charts (bar/choropleth). | Observation + Think-Aloud | Participant can locate and interpret correct data within 30 seconds. |
| T2 | Compare speeding offences before and during COVID-19 (2019–2021). | Assess how well users can filter and understand time-series data. | Think-Aloud | Participant uses slider or filter to isolate time range and explains trend. |
|  |  |  |  |  |
|  |  |  |  |  |

Table 13: Summary of Key Findings and Adjustments

|  |  |  |  |
| --- | --- | --- | --- |
| **Issue / Observation** | **User Feedback** | **Adjustment / Improvement Made** | **Impact on Usability** |
| Tooltip text was small on tablet view. | P3 reported difficulty reading tooltip text. | Increased tooltip font size and added background opacity for contrast. | Improved readability on mobile and tablet. |
| Legend not easily understood. | P2 and P4 found legend colours ambiguous for “Camera” vs “Police”. | Added labels and consistent colour scheme across charts. | Enhanced clarity and colour association. |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

# 5 Conclusion and Future Improvements

* Summarise what your visualisation revealed about the chosen topic.
* Reflect on challenges and lessons learned (data, design, interactivity).
* Suggest future improvements, such as:
  + Adding real-time BITRE API data
  + Integrating accident/fatality data
  + Applying predictive analytics

# References

References consulted (blogs, books, academic papers, discussion/help forums - for both design and programming)

# Appendices

* Gen AI Declaration (how AI tools were used)
* Usability evaluation test materials (notes and screenshots)
* Notes/data collected in usability evaluation (if used)
* KNIME workflow screenshot (if any)