COS30045 – Data Visualisation

Visualisation Design Book

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Contents

1 Introduction

1.1 Background and Motivation (Han)

The Bureau of Infrastructure and Transport Research Economics (BITRE) has been publishing Australian transport information since 1970. They have collected data on how road safety laws are enforced (like fines for using mobile phones, speeding, and drug testing) since 2008. However, in 2023, they started collecting more specific information about this enforcement. On Road Safety Enforcement data, it is stated that the BITRE has updated more detailed data where available including monthly granularity, age groups, remote areas and detection methods used (Bureau of Infrastructure and Transport Research Economics, 2024).

Their current Police Enforcement Dashboard does not show this new level of detail. For this project, we will create one or more ways to see and interact with this data. These visual tools should allow users to explore parts of the data with the latest information. Our team will focus in refine the mobile phone dashboard and process data related to mobile phones violations while driving.

Target Audiences (Serena)

To ensure our project product is useful to the users, we first identified the key target users and their purposes in exploring this data. Here are the target audience groups of the dashboard:

The young drivers and students: According to *The Medical Journal of Australia*, individuals aged 17–25 exhibit higher rates of mobile phone use while driving compared to older age groups. This increasing usage is associated with a greater rate of collisions and near-misses among this population. It emphasises the need for targeted interventions aimed at younger drivers to mitigate the risks associated with mobile phone use while driving. Questions they might ask: “Which states issue the most fines for mobile phone use?”, “Are camera-detected fines replacing police-issued fines?”

Filters by age group and fine type (camera vs. police-issued). These features help raise awareness and support educational campaigns targeting this high-risk group.

General public: Benefits by gaining awareness of penalties and risks, with questions such as “How many fines are issued in my state?” or “Is phone use while driving increasing?” The dashboard supports both analysis and public education.

Simple visual summaries of fine counts by state and year

Tooltip explanations and infographics explaining penalties and risks

Government officials and Policymakers: Policymakers and law enforcement need accurate data to evaluate enforcement methods like mobile phone detection cameras and shape safety strategies. Their focus is on outcomes, asking questions like “Are cameras effective?” or “Do all states use the same tech?”.

Filters is used to across different jurisdictions. This enables informed decisions on legislation and resource allocation.

Transport safety analyst: They study behavioural patterns and risk factors related to road safety. This dashboard provides them with valuable insights into trends in mobile phone-related enforcement, allowing them to investigate questions such as, “Are mobile phone offences increasing in certain states?” or “What enforcement methods are linked to lower offence rates?”

Filter is used to custom time.

Commented [HN1]: What time?

Educators and academic researchers: Researchers in road safety and behavioural science use data to uncover patterns and test hypotheses. Questions they might explore include “*What socio-demographic factors correlate with mobile phone use while driving?”*, *“Has policy implementation led to statistically significant changes in behaviour?”*.

Filter feature for variables like age, location, and fine type.

- Explain the importance of the visualisation. What problem does it address? (Serena)

The visualisation addresses the issue of mobile phone use while driving, which is a growing concern, particularly among young drivers aged 17–25. This dashboard combines critical enforcement data in one location, making it clear and easy to analyse. It helps overcome difficulties such as lack of public awareness, restricted access to enforcement statistics across states, and the difficulty in analysing the impact of enforcement measures over time. Overall, it supports safer driving behaviours, evidence-based legislation, and public education.

- Describe the key tasks users will perform using this visualisation.

1. Young drivers and students: They can use it to explore which states issue the most fines, understand the difference between police-issued and camera-detected fines, and become more aware of the risks associated with mobile phone use.

2. General public: They use it to check how many fines are issued in their state and observing trends over time, helping them stay informed and adjust their behaviour accordingly.

3. Government officials and Policymakers: They use to evaluate the effectiveness of camera enforcement, compare strategies across jurisdictions, and identify areas for improved policy and resource allocation

4. Transport safety analyst: They use to study behavioural trends, identify enforcement patterns, and correlate data to better understand risk factors.

5. Educators and academic researchers: They can apply filters to analyse specific groups, download data for deeper research, and develop materials to teach or present findings related to road safety.

Sample of Communication

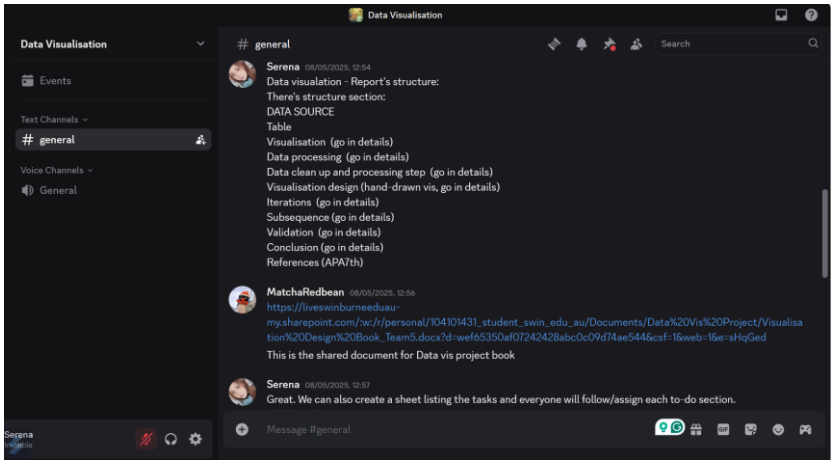


Figure 1:

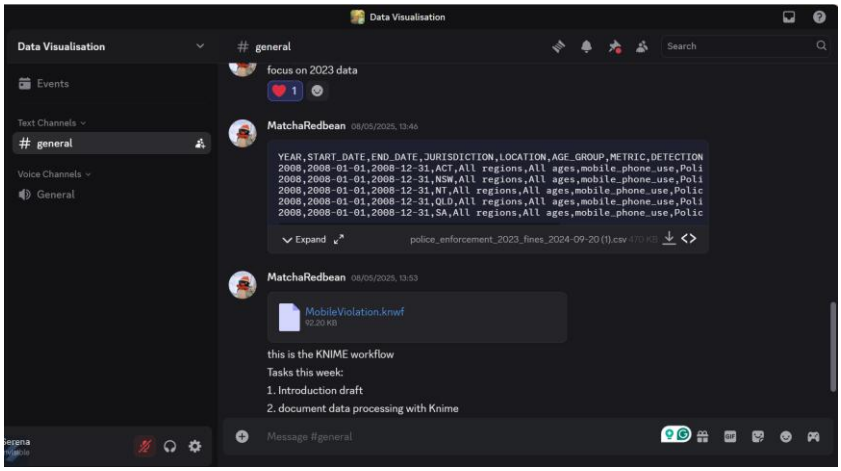


Figure 2:

1.2 Visualisation Purpose

- Define the specific questions users should be able to answer or what you are trying to achieve by making the visualisation
- List the benefits of the completed visualisation, explaining its impact on decision-making.

The visualisation can be used as an educational resource and a tool for assessing the effectiveness of enforcement strategies and policy implementation.

2 Data

2.1 Data Source and Governance

- Identify the original data source(s) and provide links where applicable.

https://www.bitre.gov.au/sites/default/files/documents/police_enforcement_2023_fines_2024-09-20.csv

- Include a brief data summary table (e.g., number of records, key attributes, update frequency)
    - Have 5017 records
    - Key attributes:
        - Year
        - Start_date, end_date
        - Jurisdiction
        - Location
        - Age_group
        - Metrics (mobile_phone_use)
        - Detection_method
        - Fines
        - Arrests
        - charges
- Discuss data governance, including:
    - Data collection process
    - Data quality assessment
    - Security, privacy, and ethical considerations
- Demonstrate how the data supports answering the questions from Section 1.2

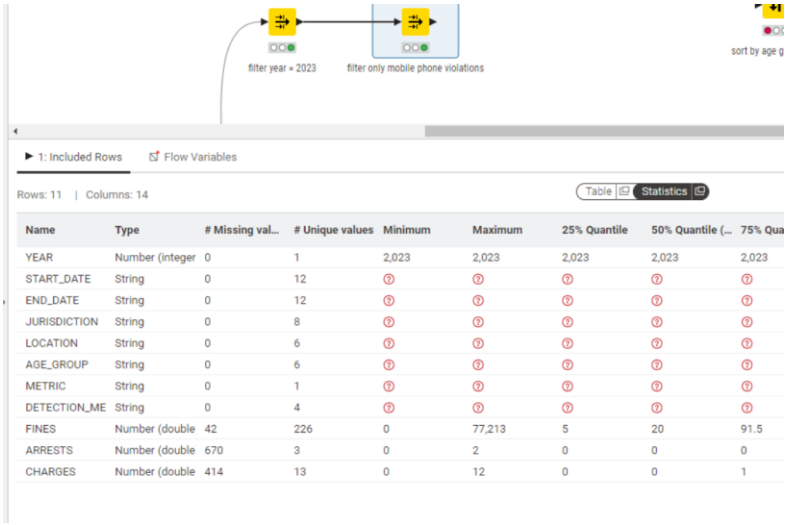
2.2 Data Processing and Analysis

We are using KNIME to process the data.

Step 1: Import the data using CSV Reader

Step 2: Filter only mobile phone violations in year 2023 with Row Filter (year = 2023, metric = “mobile_phone_use”

Step 3: Check statistics view to see if the data has missing values. For these missing values, it might be because the data was not recorded, or the methods were not applicable in some states. We decided to replace them with 0 (for arithmetic calculations) and add a note for users to know that the metrics are not available in some regions to avoid misleading.



Name	Type	# Missing val...	# Unique values	Minimum	Maximum	25% Quantile	50% Quantile (...	75% Qua
YEAR	Number (integer	0	1	2,023	2,023	2,023	2,023	2,023
START_DATE	String	0	12					
END_DATE	String	0	12					
JURISDICTION	String	0	8					
LOCATION	String	0	6					
AGE_GROUP	String	0	6					
METRIC	String	0	1					
DETECTION_ME	String	0	4					
FINES	Number (double	42	226	0	77,213	5	20	91.5
ARRESTS	Number (double	670	3	0	2	0	0	0
CHARGES	Number (double	414	13	0	12	0	0	1

Figure 3:

- List key attributes and their data types (categorical, ordinal, interval, ratio/quantitative)
- Describe the data cleaning process, including:
    - Handling missing values
    - Removing duplicates
    - Normalisation, transformation, and derived variables
    - Data filtering and joining datasets
- Include a screenshot of the KNIME workflow and append the .knfw file to the submission

2.3 Data Exploration

- Conduct exploratory data analysis using KNIME or other tools.
- Provide summary statistics and data visualisations to understand patterns and outliers
- Discuss initial observations and any challenges encountered

3 Visualisation Design

This section should include:

3.1 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).

Figure: Figma prototype

Create a storyboard showing how users will interact with your website and data visualisation to answer their question or achieve your purpose

3.2 Visualisation Design

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

Our dashboard use bar charts and lines charts with these button filters on the main dashboard. These choices are purposefully designed in accordance with industry standards for data visualisation which ensure accessibility for different group of users.

1. Bar chart (for comparisons):
   - **Benefit:** Ideal for visualising the “Fine counts by state and year”. It clearly compares the number of fines with the bars for each state and years, so users can quickly identify which states issues more fines or observe yearly variations especially 2023. This directly addresses questions from the ‘general public’ ("How many fines are issued in my state?") and young drivers ("Which states issue the most fines for mobile phone use?")

- **Enhancements:** Tooltips will be used to provide specific fine counts and context regarding penalties, supporting public awareness and understanding.

2. Line chart (avoid many category values):
   - **Benefit:** Perfect for displaying “Whether phone use while driving is increasing”. It is a good choice for illustrating trends and changes in data over time. By plotting fine counts against time (years), users can easily recognise trend, detect fluctuations, and understands the broader progression of mobile phone use while driving. This is crucial for policymakers asking the effectiveness of cameras and transport safety analysts investigating "Are mobile phone offences increasing in certain states?"
   - **Enhancements:** Interactive tooltips will provide detailed explanations of risks associated with increasing trends, supporting educational campaigns and public understanding.

- Discuss adherence to good design principles, including:
    - Graphical integrity (avoiding misleading charts)

  - **Clear baselines:** All bar charts will originate from a zero baseline to accurately represent quantities and avoid exaggerating differences.
  - **Consistent scales:** Y-axes across similar charts will maintain consistent scales where appropriate to allow for direct comparisons.
  - **Appropriate chart types:** The choice of bar charts for comparisons and line charts to avoid many category values promotes graphical integrity by using the most suitable visualisation for the data.
  - **Transparent data presentation:** We will clearly label axes, provide unit details, and include data sources to ensure transparency and avoid misleading charts.
    - Accessibility (colourblind and web-friendly palettes, font size)

  - **Colour:** We will use a colourblind-friendly palette to make the friendly interface.
  - **Font size:** A font size of 12-13px for body text and larger for headings will be used.
  - Interactive elements: Focus states for interactive elements (Eg: Filters, tooltips)
    - Scalability (responsiveness across different screen sizes)

- **Responsive Layout:** The dashboard – user story will be designed with a responsive layout using D3, histogram,... which ensure that the charts and accompanying information adapt gracefully to various screen sizes.
- Explain how graphical elements (colour, shape, size, annotations) are used to represent differences effectively.

- Different colours will be used to distinguish between different categories, such as "camera-detected fines" versus "police-issued fines," or individual states on a bar chart.

- Justify colour choices, labelling, and layout decisions.
  - **Readability:** High contrast between text and background colours will be maintained for optimal readability. We choose the 'blue' colour scheme which aligns well with Australian Government-related themes.
  - **Consistency:** Consistent colour schemes will be applied across similar charts to avoid confusion.

- Describe how you will use annotations and tooltips enhance user understanding.
  - Annotations will mark significant policy changes, legislative introductions, or public awareness campaigns directly on the charts. It also can draw attention to specific comparisons.
  - Tooltips will provide precise numerical values when hovering over data points.

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3.3Interaction Design

- Describe interactive features (e.g., zooming, filtering, tooltips, animations) and their role in improving user experience.
  - **Filtering:** This is the most important interactive feature, allowing users to segment and focus on specific subsets of the data. For young drivers and students, filtering by age group and fine type (camera vs. police-issued) helps them understand patterns relevant to their demographic. Furthermore, government officials and policymakers' can filter across different jurisdictions to compare enforcement methods, while transport safety analysts and researchers can apply filters for custom time ranges and variables like age, location, and fine type to test hypotheses and uncover specific trends. Filters reduce cognitive load by presenting only relevant information, preventing data overload.
    Scaler/Slider filter:
  - **Tooltip:** This is also the most crucial interactive feature. Because when users hover over a bar in a bar chart or a point on a line chart, a tooltip will appear, displaying information (e.g., associated penalties for a specific fine type), or numerical values (e.g., exact fine

counts). This is especially useful for the general public who find out answers to "How many fines are issued in my state?" and for educators who need to explain specific data points.

- Provide a table of interactions, explaining:
    - The interaction method (hover, click, drag, etc.)
    - The expected user behaviour and response

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

4.2 Usability evaluation

- Conduct a usability evaluation

5 Conclusion and Future Improvements

Summarise key findings of project and lessons learnt.

Identification of possible future improvements.

References

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

Bureau of Infrastructure and Transport Research Economics. (2024). *Road safety enforcement data*. Australian Government. https://www.bitre.gov.au/publications/2024/road-safety-enforcement-data

Appendices

Gen AI Declaration

Usability evaluation test materials (if used)

Notes/data collected in usability evaluation (if used)