Migration Waves: Mapping Australia's Human Tapestry

Website Link: https://mercury.swin.edu.au/cos30045/s103512168/Code/home.html

COS30045 Data Visualisation: Project Process Book (Group 4)

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1. _Introduction_

1.1 _Background and Motivation_

Migration is the movement of people from one place to another, usually across political or geographical borders. This migration may be temporary or permanent, voluntary or compelled, and may be prompted by a variety of factors, such as economic opportunities, the desire to reunite with family members, or the desire to escape persecution or war. With each passing day, the phenomenon of migration maintains its prominence on the agenda. It is a complex and multifaceted phenomenon that has a profound impact on societies worldwide.

Understanding migration patterns and trends is crucial for policymakers, researchers, and the general public to make informed decisions and develop effective strategies. In the initial stages of our project, we intended to focus on global migration, selecting random countries to showcase migration in a broader context. However, after careful consideration and analysis, we decided to shift our focus solely to Australia and explore migration within its different states over a specific period.

Australia, known for its diverse cultural landscape, has experienced significant migration flows throughout its history. By narrowing our scope to Australia, we aimed to delve deeper into the complexities of migration within the country, including both international and domestic migration. This approach allowed us to capture a more comprehensive and detailed picture of migration patterns within the Australian context.

Users of this visualization will include a diverse range of individuals and groups with an interest in migration dynamics in Australia. The potential audience comprises policymakers, researchers, academics, journalists, educators, and even the general public. Each user group will have distinct tasks and objectives when engaging with the visualization.

Policymakers and government officials will benefit from this visualization as it provides them with valuable insights into the movement of populations within different states. Understanding the patterns and trends of migration can assist in formulating evidence-based policies, addressing regional disparities, and planning for infrastructure and resource allocation.

Researchers and academics will find this visualization valuable for studying the impact of migration on various aspects, such as socio-economic factors, cultural integration, labor market

dynamics, and regional development. It allows them to uncover patterns, identify correlations, and develop a comprehensive understanding of migration phenomena within the country.

Educators can incorporate this visualization into their curricula to educate students about migration patterns and dynamics in Australia. By visualizing the data, students can grasp the nuances of migration within different states, fostering critical thinking and encouraging discussions around social, economic, and cultural implications.

For the general public, this visualization serves as an accessible platform to explore and engage with migration data. It raises awareness about the diverse factors influencing migration, promotes empathy towards migrants, and enables individuals to better understand the complex processes at play within their own country.

The importance of this visualization lies in its ability to distill complex migration data into intuitive visual representations. By presenting the information in a visually compelling and interactive format, it becomes more accessible and engaging to a wide range of users. It allows for exploration, analysis, and discovery of migration patterns, facilitating evidence-based decision-making, informed discussions, and fostering a better understanding of migration dynamics within Australia.

1.2 *Visualisation Purpose*

The completed visualization project focusing on migration in Australia serves the purpose of providing users with a comprehensive understanding of the migration patterns and trends within different states of Australia over a certain period. By employing visualizations that showcase the number of people entering and departing from various states, along with the distribution of different visa classes and their impact on population growth, the project aims to address several key questions and achieve specific objectives. The following are the questions that users will be able to answer with the visualization:

1. How does migration vary across different states of Australia over a certain period?
2. Which states of Australia are experiencing higher levels of immigration and which ones are witnessing more emigration?
3. How does migration in Australia vary by visa class?
4. Which visa classes are contributing the most to the migration flow within different states?
5. How does migration contribute to population growth in different states of Australia?
6. Are there any specific time periods during which migration has significantly increased or decreased within certain states?

Possible Benefits of the Completed Visualization:

- **Enhanced Understanding:** Users will gain a deeper understanding of migration dynamics within Australia, particularly within different states, which can aid in policymaking, research, and analysis.
- **Geographical Insight:** By visualizing migration on a map, users can easily grasp the geographical distribution of migrants and identify regions with higher or lower migration rates.
- **Comparative Analysis:** The visualization allows users to compare migration patterns across states, enabling them to identify disparities, similarities, and factors driving migration.
- **Policy Evaluation:** Policymakers and stakeholders can assess the effectiveness of migration policies by analyzing the visualized data and understanding their impact on specific states.
- **Population Planning:** The visualization provides valuable insights into population growth resulting from migration, aiding in urban planning, resource allocation, and infrastructure development.
- **Identification of Trends:** Users can identify recurring migration patterns, such as seasonal migration or shifts in migration preferences over time, enabling them to anticipate and respond to future trends.
- **Informative Presentations:** The visualizations can be utilized for educational purposes, presentations, or reports, effectively conveying complex migration data in an accessible and visually engaging manner.

Overall, the completed visualization project offers valuable insights into migration patterns within different states of Australia, empowering users to answer key questions, make informed decisions, and gain a comprehensive understanding of the topic.

1.3 Project Schedule

Week5: Planning of the features and visualization of the website and researching different data sources and collecting relevant datasets.

Week6: Processing and finalizing the datasets

Week7: Allocating tasks for Design Process Book and started working on it.

Week8: Creating website (HTML, CSS)

Week9: Start working on the visualization(D3)

Week10: Demonstrating the first draft of the design process book and website.

Week11: Finalising datasets, Visualisations and report.

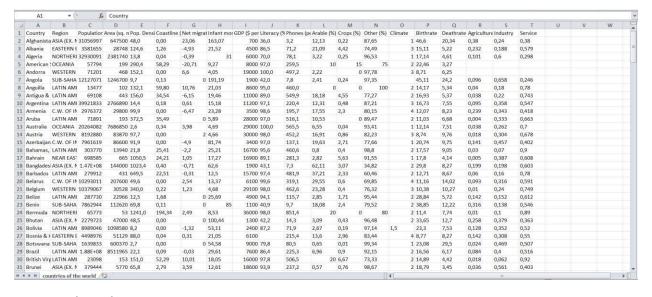**Week12:** Finishing design process book and Website.

2. Data

2.1. Data Source (Proposal)

The data we proposed for our visualisation project in this report came from a variety of sources. These sources include the World Statistics dataset from the World Bank, the Countries of the World dataset, and the Migration & Population Density dataset accessible on Kaggle. These databases were chosen because of the volume of data they contain on global migration trends.

It's crucial to remember that we just proposed these datasets for research and analysis; we make no claims about the reliability of the data or any particular source. However, we thought that these datasets offer a thorough and varied view of the subject and offer special insights into how migration affects various facets of life around the world.

Dataset:

- https://www.kaggle.com/datasets/mutindafestus/world-statistics-dataset-from-world-bank
- https://www.kaggle.com/datasets/fernandol/countries-of-the-world
- https://www.kaggle.com/datasets/eliasdabbas/migration-data-worldbank-1960-2018)
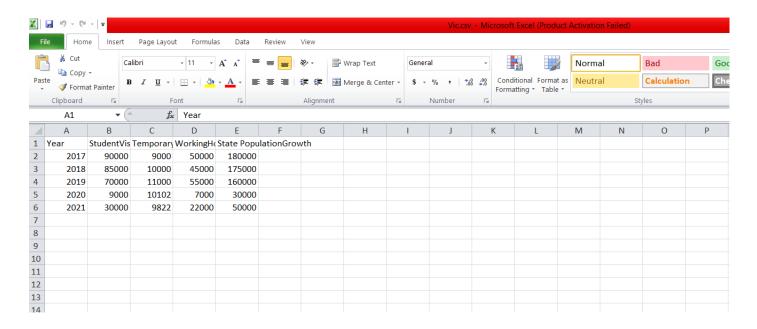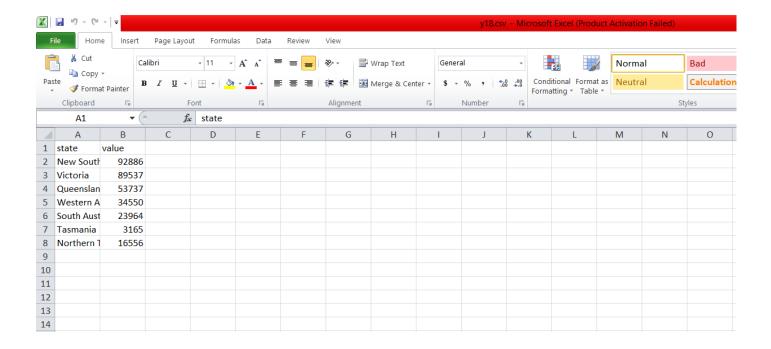

2.2 Data Source (Final)

Our proposal aimed to visualize world migration, specifically focusing on selected countries and exploring the impact of migration in those regions. However, after careful consideration and in order to provide a more focused and comprehensive analysis, we have modified our concept to concentrate solely on migration within Australia.

The data used in this visualization project on migration in the context of Australia has been sourced from the Scanlon Foundation Research Institute (SFRI). SFRI is a reputable research institution that focuses on understanding the dynamics of social cohesion, population diversity, and the experiences of migrants in Australia. We have utilized datasets spanning from 2017 to 2021, ensuring the inclusion of the most recent and relevant information. These datasets offer valuable insights into migration patterns and trends, allowing us to accurately represent the flow of individuals entering and leaving the country during the specified time period.

Dataset:

- https://www.abs.gov.au/statistics/people/population/national-state-and-territory-population/latest-release
- https://www.abs.gov.au/statistics/people/population/national-state-and-territory-population/latest-release
- https://www.abs.gov.au/statistics/people/population/migration-australia/latest-release
- https://www.abs.gov.au/statistics/people/population/national-state-and-territory-population/mar-2022/310102.xlsx
- https://data.gov.au/data/dataset/historical-migration-statistics
- https://data.gov.au/dataset/ds-dga-ab245863-4dea-4661-a334-71ee15937130/details?q
- https://data.gov.au/dataset/ds-dga-324aa4f7-46bb-4d56-bc2d-772333a2317e/details?q
- https://data.gov.au/dataset/ds-dga-602f74a0-a588-4dea-ae28-0fe123cbb182/details?q
- https://data.gov.au/dataset/ds-dga-2515b21d-0dba-4810-afd4-ac8dd92e873e/details?q
- https://data.gov.au/dataset/ds-dga-c957d829-4f9b-4213-a0c2-8cbeb9a03ffb/details?q

Year	StudentVisa	Temporary	WorkingHoliday	State PopulationGrowth
2017	90000	9000	50000	180000
2018	85000	10000	45000	175000
2019	70000	11000	55000	160000
2020	9000	10102	7000	30000
2021	30000	9822	22000	50000

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	state	value													
2	New South	92886													
3	Victoria	89537													
4	Queenslan	53737													
5	Western A	34550													
6	South Aust	23964													
7	Tasmania	3165													
8	Northern T	16556													
9															
10															
11															
12															
13															
14															

2.3 Data Processing

This project's data processing phase included numerous processes to guarantee that the data was appropriately processed for usage in the final website.

To begin, we removed any unnecessary data properties from the original Excel workbook in order to make it more manageable and easier to deal with. This allowed us to focus on the important data points while preventing user overload by presenting them with an overwhelming number of charts.

Next, we chose recent year duration to examine recent changes in various factors due to migration. This method assisted us in identifying and emphasising the most important trends

and changes that occurred in recent years, and in presenting them in a clear and succinct manner.

To guarantee that the website loaded quickly and efficiently, we also decided to reduce the datasets to smaller CSV files. This contributed to faster website load times and simplified data processing for D3.

Overall, the project's data processing phase was crucial in ensuring that the data was appropriately processed for usage in the final website.

```
DataVisFinal > Code > ▦ y17.csv
1    state,value
2    New South Wales,94928
3    Victoria,87132
4    Queensland,50637
5    Western Australia,35702
6    South Australia,25103
7    Tasmania,3242
8    Northern Territory,20571
9
```

3. Project Requirements

3.1 Must-Have Features (Proposal)

There are certain aspects that need to be included in the visualisations to ensure that viewers can understand the topic being represented with ease. The graphs should include the following components:

- **Title:** To help users easily comprehend the data, the visualisations should have a suitable title. These titles must also be constant in order for the site map to be simple and quick to navigate.

- **Axis:** The dependent and independent variables, which are plotted using the X and Y axis in the visualisations, must be made clear to the user. Marks are used on graphs to show scale for continuous variables and to denote the units that are being used (e.g., a mark denotes a year).

- **Legend:** Legends are crucial for enabling users to comprehend the chart they are watching since they help users remember the various colours on the chart. They also declutter cluttered charts by localising and streamlining the labels.

- **Colours:** Colours are an essential component of visual representations because they can help users understand the meaning and impact of a situation.

- **Brief explanation:** Some viewers won't be able to read or understand the data being displayed in certain projects or visualisations. It would therefore be best if we could quickly outline the context of the visualisation.

- **Interactivity:** Users need to be able to look through several data sets to determine which ones are more relevant to them. Users could choose to look at data that is particular to their own state or compare states with comparable populations. Smooth transitions will also improve the visual appeal of the charts.

3.2 Must-Have Features (Final)

All charts contain titles, axis, and legends, which are crucial communicative components that help the user understand what they are viewing. In addition, color is employed to inform the viewer and improve the charts' aesthetic appeal. A brief summary is provided for each chart to assist and inform the user. Although it is currently possible to focus on, explore, and switch between different states, interactivity was a difficult aspect of development and was difficult to implement. It would have been preferable to include more on the website with more time and experience.

3.3 Optional

The following features will be included in the project if they are useful and there is time for development:

1) **Using website buttons:** Users should be able to choose which charts they want to display or hide using website buttons. They will also be necessary for navigation and interaction.

2) **Mouseover effect:** For example, each condition would be highlighted with a black outline when the mouse is hovered over it, allowing users to see the condition they are in as well as the exact amount of energy expended by fuel type in that condition. This is done to make the user experience interactive and help with informational delivery.

Users can navigate between buttons on the page's top-level main menu. As a result, users may navigate between sections and interact with different website functions without feeling overrun by the layout or their available alternatives. Mouseover effects have been used to show the user to specific values and help them to view which components they are currently viewing.

4. Visualisation Design (Proposal)
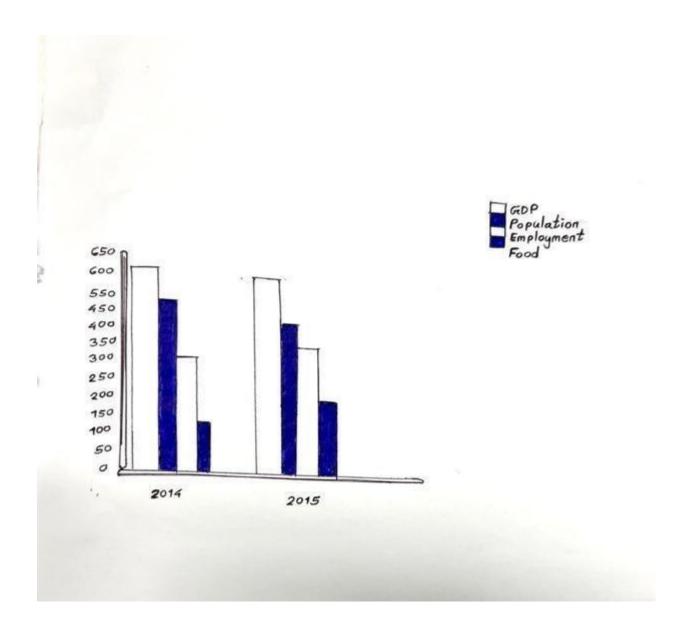
4.1 Multiple Bar Chart

Fig- Draft Multiple Bar Chart – featuring colors & layout

We will show in the visualisation a multiple bar chart that illustrates the effects of migration between the years 2014 and 2018. Users can learn a lot about countries most impacted by migration and the effects linked with it by looking at the data displayed in the graphic.

We gathered extensive information on migration trends from reliable international sources and performed a thorough analysis to develop the multiple bar chart. Key indicators were included in the dataset. We were able to give a comparative analysis of the effects of migration on various countries over a five-year period by gathering and combining this information.

Each bar represents a specific aspect, while the height of the bar represents the magnitude of the impact caused by migration. Users can compare the effects of migration between particular countries using the chart. Users can identify nations that experienced a similar amount of migration effect by visually comparing the relative heights of the bars and making insightful comparisons.
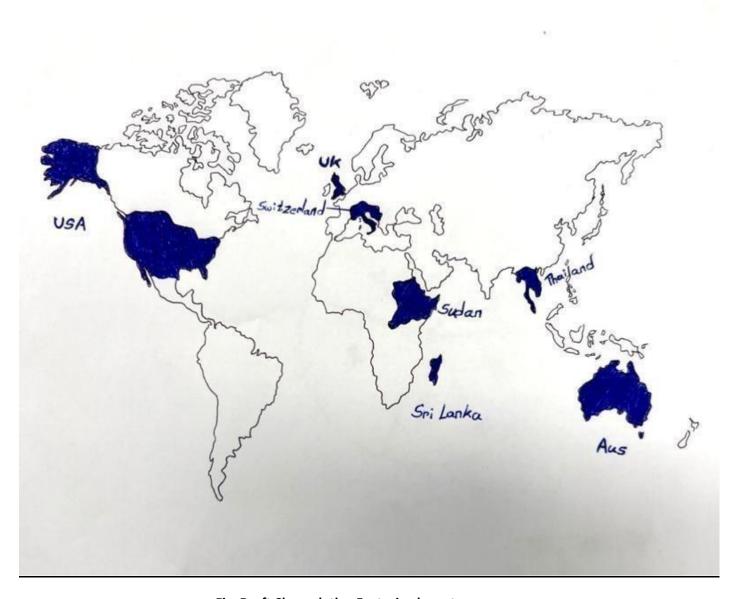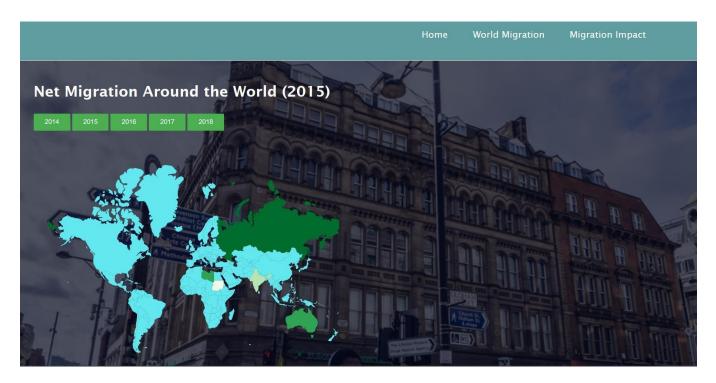
4.2 Choropleth Map

Fig: Draft Choropleth – Featuring layout

In order to visualise global net migration trends, we will use an interactive choropleth map. The colour pattern that will be used in the map will depict the levels of net migration, with lighter hues denoting lower net migration and darker hues denoting more net migration. In

order to make it easier for the audience to understand the information being displayed, the map will also feature state labels and net migration values. Users will have the option to switch between different years, making it easier to track changes in net migration over time. By giving net migration a visual depiction, population movement trends can be more easily understood.

5. Visualisation Design (Progress)

5.1 Choropleth Map

The visualization consists of a heatmap that allows users to explore migration trends for different countries over the years 2014 to 2018. Users can hover over specific countries to obtain detailed information about their net migration values. This report will outline the design, functionality, and benefits of the heatmap visualization.

Design and Functionality:

The heatmap visualization presents an intuitive and interactive interface for users to explore net migration trends across countries and years. The following design and functionality elements have been incorporated.

Heatmap Representation:

The heatmap utilizes a color gradient to represent the net migration values. The color spectrum is chosen to reflect the magnitude of migration, with warmer colors indicating higher net immigration and cooler colors representing lower net emigration.

Year Selection:

Users can select a specific year within the range of 2014-2018 to view net migration data for that particular period. This feature enables the identification of migration patterns and changes over time.

Hover Interaction:

Users can hover over individual countries on the heatmap to reveal detailed information about their net migration values.

Country Comparison:

The visualization allows users to compare net migration trends between multiple countries by selecting them simultaneously. This feature enables the identification of relative migration patterns and facilitates a deeper understanding of the data.

9.2 Multiple Bar Chart

The visualization focuses on the years 2014 to 2018 and allows users to explore and compare selected countries, representing both developed and underdeveloped nations. By analyzing these trends, we aim to provide valuable insights into the impact of migration on different countries' socioeconomic indicators.

The visualization component of this report consists of multiple bar charts, each illustrating the effects of migration on a specific aspect. The selected aspects include:

GDP: This bar chart visualizes the changes in GDP (Gross Domestic Product) for each selected country between 2014 and 2018. The bars represent the GDP values, allowing users to compare the growth or decline in economic performance resulting from migration.

Population Growth: This visualization showcases the population growth rates of the chosen countries over the same period. By comparing the bar heights, users can identify the influence of migration on population dynamics.

Land Area: The bar chart for land area demonstrates any changes in the size of the selected countries due to migration. Users can examine whether migration has had any impact on land availability or land-use patterns.

Job Opportunities: This visualization presents the effects of migration on job opportunities within each selected country. The bars indicate changes in employment rates or job creation, offering insights into the relationship between migration and workforce dynamics.

6. Visualisation Design (Final)

6.1 Multiple Bar Chart

The visualisation presents a multiple bar chart depicting the influx of individuals belonging to three different visa classes who have entered various states of Australia. Additionally, it showcases the corresponding population growth resulting from this migration phenomenon. The chart spans the years 2017 to 2021 and employs the x-axis to represent the timeline, while the y-axis illustrates the numerical values. The visualisation effectively combines the use of colors, bar charts, and data tooltips to present complex data in a visually appealing and easily interpretable manner. When hovering over a specific bar, the color of that particular bar changes and users can view the exact numerical value along with the name of that particular bar type..

The primary objective of this visualisation is to enable users to identify and compare the number of people entering Australia across the specified time period. By utilizing the bar chart format, it offers a clear visual representation of the data, making it effortless to discern any trends, patterns, or variations in the migration and population growth across different visa classes and years.
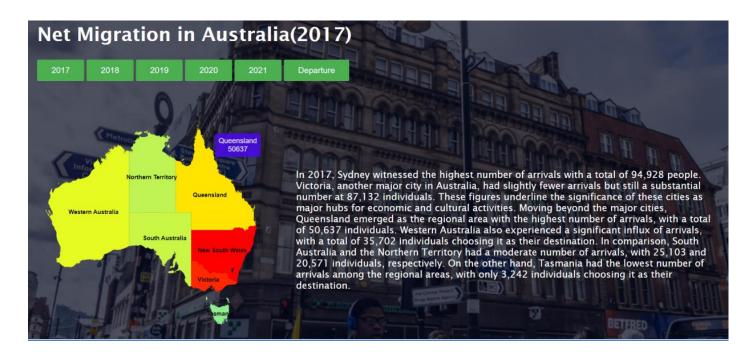
6.2. Multiple Line Chart

The visualisation presents a comparative analysis of the number of departures from different states across Australia over a five-year period, from 2017 to 2021. The x-axis represents the years from 2017 to 2021, allowing viewers to observe changes over time. The y-axis represents the number of departures, indicating the scale of population movement from each state. The chart employs different colors for each state, enabling easy visual distinction between the lines representing individual states.

Markers have been integrated into the visualisation, enhancing its interactivity. When hovering over a specific point on a line, users can view the exact numerical value associated with that particular year and state. This feature enables users to obtain precise information on the number of departures from each state and facilitates more detailed analysis. By leveraging this visualisation, viewers can quickly discern patterns of population movement and identify states that experience significant fluctuations in departures over the examined period.
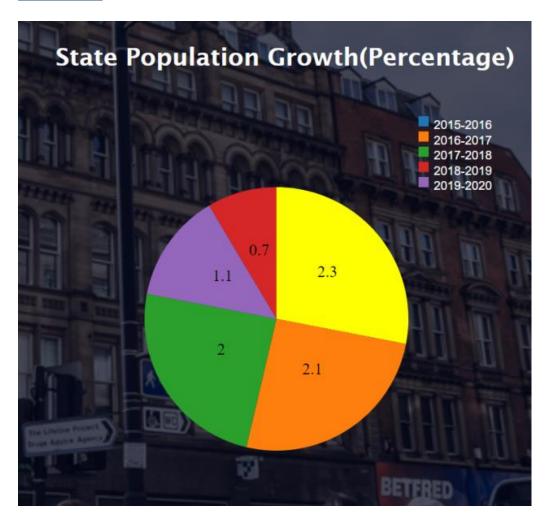
6.3 Choropleth Map

The Choropleth Map Visualisation showcases the number of people who arrived in various states of Australia between the years 2017 and 2021. The map effectively represents this data by saturating each state with a color gradient, where darker hues represent higher numbers of arrivals, while lighter shades indicate lower numbers.

Upon interacting with the visualisation, users can hover their mouse cursor over each state, triggering a blue outline to highlight the selected state. This interactive feature provides users with detailed information about the precise number of people who entered that particular state.

The visualisation offers a comprehensive and intuitive way to compare the influx of people across different Australian states over the specified time period. By visually encoding the data in the form of colors, users can quickly identify states with higher or lower numbers of arrivals, enabling them to draw meaningful insights.

6.4 Pie Chart

The pie chart visualization represents the number of people who arrived in a specific state of Australia from the years 2017 to 2021. Each year is distinguished by a different color, allowing for easy identification of each year's contribution to the overall population growth. The chart displays the percentage growth of the population attributed to different visa classes over the specified period. By utilizing data tooltips, the visualization enhances usability by providing additional information when a user hovers over a specific segment. The purpose of this visualization is to enable a comparison of the population growth in that particular state over the specified time frame.

7. *Validation*

The purpose of this validation was to assess the website's ability to convey the complex data sets, as well as user interaction and comprehension of the visual representations offered. The testing process intended to identify potential issues users might encounter while navigating the website and interpreting the visualisations, with the intention of improving the overall user experience.

Objectives:

- **The principal goals of usability testing were to:**

1. Assess the user's ability to navigate both websites and comprehend the presented visualisations. The map visualisation, line chart, and multiple bar chart's simplicity of comprehension piqued our interest.
2. Determine whether users were able to interact with the visualisations to obtain insights. For example, their ability to correctly identify migration trends and discern state-by-state population growth.
3. Assess user contentment with the website's overall design, layout, and usability. This entailed analysing aesthetic features, loading periods, and intuitive design.
4. To collect user feedback regarding their experience with the website, including any problems they encountered, suggestions for development, and features they found particularly useful or enjoyable.

By achieving these objectives, the testing sought to pinpoint areas for development to improve the user experience, provide design information for upcoming updates, and eventually make the website a useful and user-friendly resource for comprehending Australian migration statistics.

- **Methodology:**

Usability testing was conducted using a mixed-methods approach, combining qualitative observations and quantitative measurements to obtain a thorough understanding of how users interact with the website. Participants were given a specified amount of time to complete the tasks as part of the physical testing procedure. They were given a link to the website's homepage. Participants were encouraged to 'think aloud' as they navigated the website and completed the tasks for the purposes of qualitative feedback and capturing their thought processes.

- **The concentration of the tests was on the website's two primary sections:**

Participants were tasked with navigating the map visualisation depicting arrivals in various Australian states and the line chart visualisation depicting departures from these states on Page 1. The tasks included identifying the states with the highest and lowest arrivals based on the colour gradients in various years, the states with the highest and lowest departures based on the lines of the chart, and the interpretation of the data visualisations.

For page 2 participants were tasked with comprehending and interacting with a visualisation depicting various visa classes and consequent population growth in each state. The tasks consisted of identifying the

most popular visa class in a particular state and describing the effect of visa holders on population growth. Participants were asked to assess the ease of navigation, the clarity of the visualisations, and their overall satisfaction with the website for both pages. They were also encouraged to provide any feedback or suggestions for the site's enhancement.

All quantitative data and qualitative responses were collected, anonymized, and prepared for analysis following the conclusion of the study. A total of 4 participants participated in the usability testing, bringing a variety of experiences and perspectives.

- **Participants Demographic:**

In this usability test, a total of four participants were involved, all of whom were students aged between 18 and 24. Each of these individuals identified themselves as highly competent in navigating the web and using digital tools.

When it comes to familiarity with the subject matter, there was a division among the participants. Two of them had prior knowledge and experience with migration data and trends. The remaining participants, while comfortable with digital tools, had no previous experience or understanding of migration trends or data.

- **Test Tasks:**

Participants were asked to complete a series of tasks that reflect real-world actions users might take when visiting "Migration Waves: Mapping Australia's Human Tapestry". These tasks were designed to assess the usability and effectiveness of the site's navigation and data visualizations. Here are the tasks assigned to the participants:

Task 1: Map Visualization Navigation

Participants were asked to navigate the map visualization on Page 1, identifying the states with the highest and lowest numbers of arrivals for a specific year, for example, 2017.

Task 2: Line Chart Interpretation

On the same page, participants were tasked with interpreting the line chart visualization, identifying the trend of people departing from a particular state (e.g., Victoria) from 2017 to 2021.

Task 3: Visa Class Analysis

On Page 2, participants were asked to identify the most popular visa class in a specific state based on the visualization provided.

Task 4: Population Growth Impact

Also on Page 2, participants were tasked with assessing and commenting on the impact of different visa classes on the population growth in a selected state by using the data shown in the pie chart.

Task 5: Overall Site Navigation and Feedback

Finally, participants were asked to navigate freely around the website, noting any difficulties they encountered and suggesting possible improvements. They were also asked to provide feedback on the overall design, layout, and clarity of visualizations on the website.

- **Findings:**

Map Visualization Navigation:

Our test participants showcased a strong understanding of the map visualization - each individual was able to correctly identify the states with the most and least arrivals for the specific year. Feedback on the map's interactive capabilities was largely positive, with users expressing appreciation for the hover feature that clarified the exact figures.

Line Chart Interpretation:

The line chart visualization successfully communicated the trend of departures from the specified state over the years. However, a few participants experienced difficulty with the mouse-hover feature, which could impact the ease of interpreting the data.

Suggestion for Improvement:

An enhancement to the smoothness of the mouse-hover feature could further facilitate data interpretation for users.

Visa Class Analysis:

All participants were able to accurately pinpoint the most prevalent visa class, indicating a strong comprehension of the presented data.

Impact on Population Growth:

The task related to assessing the impact of different visa classes on population growth was successfully completed by all participants. They accurately identified whether the population growth for different visa classes was increasing or decreasing.

Task 7: General Navigation and User Feedback

- **Analysis:**

Participants found it straightforward to navigate the website overall, commending its user-friendly and intuitive design. The clear layout and smooth transitions between sections were well-received.

However, some users expressed concerns regarding the number of visa classes represented. They suggested that including a greater variety of visa classes could improve the accuracy of the population impact analysis.

When it came to the visualizations, participants were pleased with the clarity and informativeness of the graphics. The interactivity of the features was appreciated as it allowed for more engaging and accessible data exploration. Nonetheless, previously mentioned improvements, like enhancing the hover function in the line chart, were reiterated as areas for potential enhancement to further elevate user experience.

- **Conclusion:**

In conclusion, the usability test provided insightful feedback to the website. Participants demonstrated a solid grasp of the data presented via the site's visuals. It was determined that the map visualisation and visual representation of various visa classes were particularly effective. However, the test also revealed some potential development areas. Enhancing the mouseover feature on the line chart and incorporating a broader range of visa classes were two of the most prominent suggestions derived from the feedback. The implementation of these modifications could enhance the user experience and guarantee more accurate data representation. Participants found the site to be intuitive and user-friendly on average, confirming the design's overall success. They were able to easily navigate the website, demonstrating the site's effective layout and transitions.

8. Conclusion

In conclusion, our team embarked on a fascinating visualisation project focused on the topic of migration in the context of Australia. Initially, we had planned to work on world migration, but we ultimately decided to narrow our scope and concentrate solely on Australia. By delving into the various migrations occurring within different states of Australia over a specific period, we aimed to provide a comprehensive and insightful visual representation of this complex phenomenon.

Our process book serves as a comprehensive record of our journey throughout this project. Within its pages, we detailed the data sources we utilized, the steps we took to process the data, and the project requirements we established at the outset. We also extensively documented our visualisation design choices and the reasoning behind them, ensuring transparency and clarity in our decision-making process. Lastly, we outlined our rigorous validation process, emphasizing our commitment to delivering accurate

and reliable insights.

In summary, our visualization project on migration in the context of Australia has allowed us to delve into the intricate patterns of migration within different states of the country. By employing interactive maps, highlighting visa classes, and exploring population growth, we have provided viewers with a comprehensive understanding of the complex dynamics of migration within Australia. Through our process book, we have documented our research journey, laying the groundwork for future projects in the field of migration visualization.

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