Visual Analytics Assessment:
Visual Analytics Report on Socio-Economic and Ethnic Trends in England and Wales (2011–2021)

Contents

1 Abstract

This report explores changes in ethnic diversity and labour market across England and Wales, based on data from the 2011 and 2021 UK Censuses. It uses data analysis and visual tools to better understand these trends. To deal with missing information and merged areas in the 2021 data, the study uses Bayesian statistical techniques. These include estimating missing values and breaking down combined district data to show local-level contributions more accurately. Interactive dashboards, maps, and advanced visualization tools like PCA and t-SNE were used to reveal detailed patterns in employment, job types, and industry participation across different ethnic groups and regions. The results show ongoing inequalities, changing participation rates, and new job trends among ethnic communities. Overall, the goal is to provide useful insights that can guide better policy decisions, highlighting both improvements and continuing issues in employment and inclusion for people from diverse backgrounds.

2 Introduction

Ethnic disparities in socio-economic have been a major issue in England and Wales, affecting job opportunities, industry roles, and career progression. Between 2011 and 2021, the population changed in many ways, and the COVID-19 pandemic had a major impact on the economy. This report uses data to explore how these changes have influenced economic involvement among different ethnic communities and areas.

The core objectives are:

- To provide policymakers, social researchers, and local authorities with actionable insights.
- To uncover evolving trends in industry and occupation by ethnicity Catney et al. [2023].
- To evaluate shifts in economic activity status, accounting for geographic and ethnic variability.
- To support inclusive economic planning through advanced data visualization and statistical modeling.

By integrating data from the 2011 and 2021 censuses and deploying a multi-method approach (Tableau dashboards, PCA, t-SNE, Bayesian regression), the report highlights areas of progress and persistent inequality, helping inform targeted interventions.

3 Data Preparation and Abstraction

3.1 Data Sources and Cleaning

- **Primary Sources:** Census data were obtained from *Nomis* (2011) and the *Office for National Statistics* (ONS, 2021), covering economic activity, industry, occupation, and ethnicity at the local authority district level for National Statistics [2022a] for National Statistics [2022b].
- **Data Import and Structure:** Raw Excel files were loaded for each year. For 2011, relevant sheets were mapped to standardized categories via custom dictionaries. Metadata rows, extraneous columns, and whitespace were removed from all tables. For 2021, rows with "Does not apply" or zero observations were excluded to ensure clean categorical data.
- **Column and Label Harmonization:** All category labels (ethnic group, industry, occupation) were standardized using mapping dictionaries to align both years to the ONS 8-category schema. Economic activity categories were further harmonized by subtracting student counts to produce directly comparable "In Employment" and "Inactive" categories of Ethnic Diversity and [GEDI].
- **Reshaping and Integration:** Datasets were reshaped to tidy (long) format using a custom pivot function, yielding unified tables for each variable (economic activity, industry, occupation by ethnicity, local authority, and year).
- **Geographic Harmonization:** Local authority codes were mapped to a consistent 2011-based geography using the official ONS lookup. For 2021 districts that were mergers of multiple 2011 districts, counts were proportionally split using a Bayesian Dirichlet-multinomial approach, ensuring comparability across years.
- **Final Dataset Construction:** Cleaned and harmonized datasets were concatenated across years and exported as CSVs for downstream analysis. All processing was conducted in Python using `pandas`, `NumPy`, and `PyMC`.

3.2 Principal Data Types

- **Categorical**: Ethnic group, region, occupation, industry.
- **Quantitative**: Employment/unemployment/inactivity rates, population counts.
- **Temporal**: Comparative data from 2011 and 2021.
- **Spatial**: Local authority districts across England and Wales.

3.3 Semantic Mapping

- **Economic Activity:** Harmonized as active vs. inactive, employed vs. unemployed, with student categories adjusted for comparability.
- **Industry/Occupation:** Standardized to UK SOC/ONS codes across both years.
- **Ethnicity:** All datasets mapped to the ONS 8-category schema.
- **Geography:** All records aligned to 2011 local authority boundaries, including Bayesian redistribution of merged 2021 districts.

3.4 Additional Processing

- **Dimensionality Reduction:** t-SNE (for occupation) and PCA (for industry) were applied to harmonized datasets for exploratory analysis and visualization.
- **Reproducibility:** The entire pipeline is implemented in Python, ensuring transparency and reproducibility of all data preparation steps.

4 Task Definition (Munzner's Taxonomy)

Task Type	User Goal	Question
Discover	Spot trends	What sectors gained most diversity from 2011 to 2021?
Compare	Assess disparities	How does unemployment differ by ethnicity in 2021?
Summarize	Get overview	What was the national employment rate in 2021?
Explore	Identify patterns	What clusters emerge in PCA/t-SNE projections?

Table 1: User tasks supported by the dashboard, categorized by goal and example questions.

- **Discover**: Identify outliers or emerging ethnic clusters in high/low participation sectors.
- **Compare**: Evaluate employment and occupation disparities across the two census years.
- **Summarize**: Generate national-level overviews of economic engagement by ethnic group.
- **Explore**: Drill down into specific ethnic-region-industry intersections using dashboards.

5 Visualisation Justification

5.1 Dashboard Components

- **Choropleth Maps**: Reveal spatial disparities in employment and industry participation, aiding visual cognition.
- **Stacked Bar Charts**: Show within-ethnic group distributions by occupation and industry across time.
- **Heatmaps**: Highlight correlation structures between ethnicity and sectoral representation.
- **t-SNE & PCA Plots**: Reveal underlying clustering and non-linear relationships among high-dimensional variables.
- **Tree Maps**: Capture hierarchical relationships within occupations and ethnic distribution therein.

5.2 Dashboard Accessibility

- **Click to Filter:** You can interact with most dashboards by clicking on areas in the map. When you select a location, the rest of the charts will update to show data just for that area. In many cases, clicking on parts of other charts (like bars or lines) will also update the entire dashboard if they are linked.
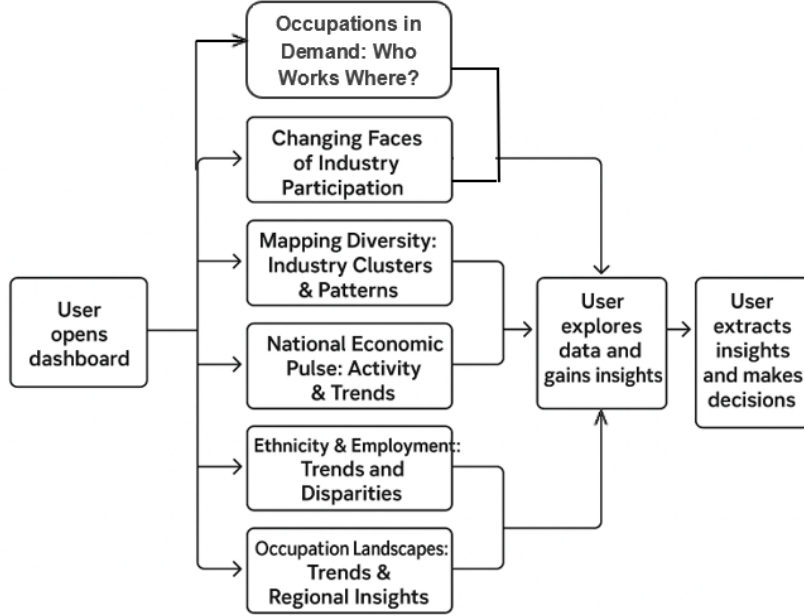
Figure 1: User journey through the dashboard suite, illustrating how users progress from data exploration to insight extraction and decision-making.

- **Hover for Details:** Move your mouse over a data point—whether it's a chart bar, a dot, or a map region—and a small pop-up (tooltip) will appear. This shows extra details like exact numbers, percentages, or place names.
- **Read the Legends:** Always check the legends on maps and charts. They explain what the colors mean and help you understand the differences between years, categories, or data groups.
- **Try Combining Filters:** You can often apply more than one filter at once. For example, selecting a region and a specific year to explore patterns more deeply.
- **Resetting the View:** If you've filtered the dashboard and want to go back to the full view, look for a "Reset" or "Clear Filters" button.

5.3 Dimensionality Reduction

- **PCA**: For linear projections and explaining variance in participation patterns.
- **t-SNE**: For non-linear, localized clustering that reveals hidden ethnic-occupational structures.

5.4 Bayesian Methods

- **Merged District Disaggregation:** A Bayesian Dirichlet-multinomial model was applied to split 2021 totals into historical sub-districts. This approach enables spatial consistency across census years and better temporal inference, particularly for economic activity and ethnicity intersections. This approach enables accurate temporal comparisons.
- **Method Overview:**
  - A Dirichlet prior (uniform) assumes equal likelihood for distributing total count T across K 2011 sub-districts:

  $$\boldsymbol{\theta} \sim \mathrm{Dirichlet}(1, 1, \ldots, 1)$$

  - Simulated counts X are drawn from a multinomial distribution:

  $$X \sim \mathrm{Multinomial}(T, \boldsymbol{\theta})$$

  - Posterior sampling (via PyMC) produces estimates; the posterior mean of X provides the final inferred counts per sub-area:

  $$\hat{X}_k = T \cdot \mathbb{E}[\theta_k \mid T]$$

- **Implementation:**
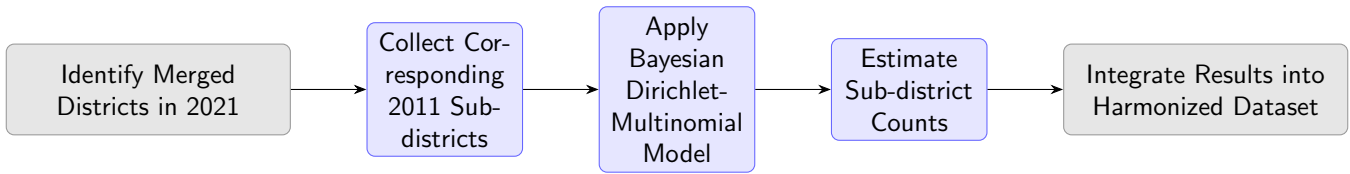
Figure 2: Workflow for harmonizing merged districts using Bayesian disaggregation

For each merged district:

- Corresponding 2011 sub-areas are identified.
- The total count is split proportionally using the Bayesian model.
- Inferred values are integrated into the dataset, replacing merged areas.

This results in a harmonized dataset (`df2_final`) aligned with 2011 geographies, supporting longitudinal analysis of ethnicity and economic activity with model-based uncertainty.

5.5 Design Principles

- Visual hierarchy and preattentive processing (color, spatial location) to highlight disparities.
- Gestalt principles for visual grouping and dashboard organization.
- Munzner's framework to guide the interplay of data abstraction, idioms, and user tasks.

6 Visualizations

6.1 Changing Faces of Industry Participation

Visualization	Key Insights	Reason for Visualization Type
Choropleth Map	Birmingham has 868,000+ workers in industries, rural areas have as few as 2,400. Shows urban-rural divide.	Reveals regional value differences and patterns.
Heatmap (Ethnic Groups vs Industries)	42% of Black/African/Caribbean/Black British work in public services (762,000+). Other groups are more evenly spread across industries.	Identifies strong/weak category connections and trends.
Stacked Bar Chart (Industry Distribution by Ethnic Group, 2011 & 2021)	White British made up 25–30% of workers in most industries in 2021, Black and minority groups under 10%.	Compares sector representation and changes over time.
Dot Plot (Percentage Change in Industrial Participation)	42% of Black/African/Caribbean/Black British workers were in public sector jobs in 2021. All groups saw growth, with White groups still dominant.	Shows trends and percentage changes over time.

Figure 3: Summary of Dashboard Visualizations and Dashboard Panels: Regional, Correlation, Distribution, Change

Summary: *Industry diversity is rising, particularly in Transport and Communication (1.64 diversity score in 2021), but spatial and sectoral gaps persist. Visualizations make it easy to spot growth and lagging sectors. Uses choropleth, bar chart, and PCA scatter plot to show diversity patterns and trends.*

6.2 Mapping Diversity: Industry Clusters Patterns

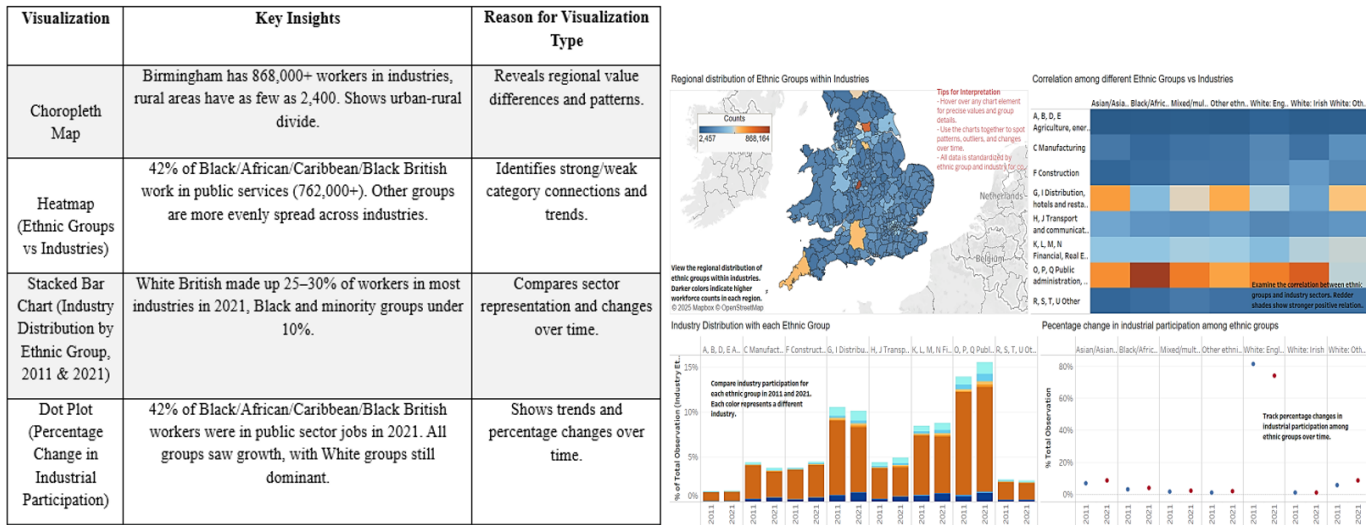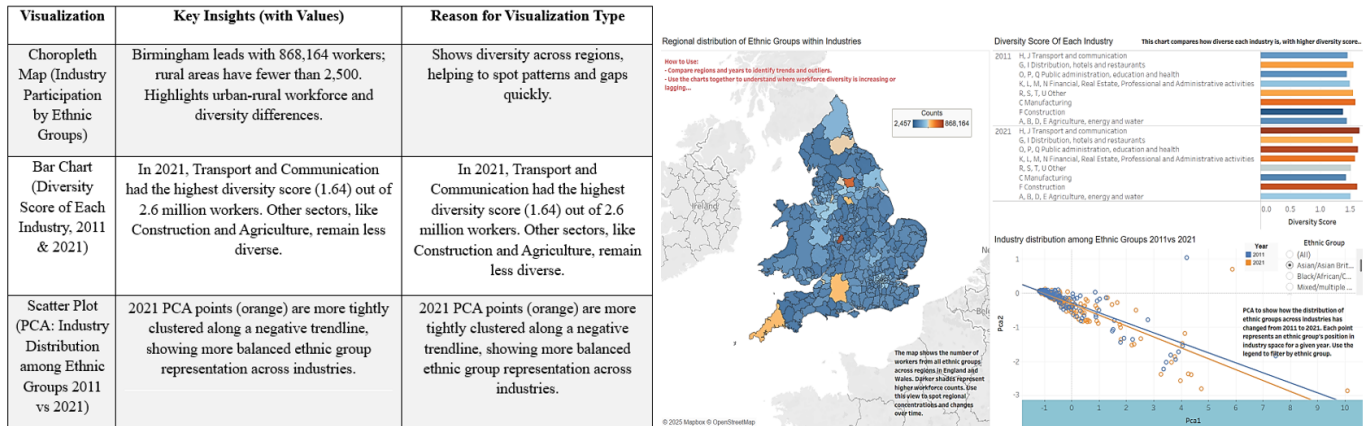| Visualization	Key Insights (with Values)	Reason for Visualization Type
Choropleth Map (Industry Participation by Ethnic Groups)	Birmingham leads with 868,164 workers; rural areas have fewer than 2,500. Highlights urban-rural workforce and diversity differences.	Shows diversity across regions, helping to spot patterns and gaps quickly.
Bar Chart (Diversity Score of Each Industry, 2011 & 2021)	In 2021, Transport and Communication had the highest diversity score (1.64) out of 2.6 million workers. Other sectors, like Construction and Agriculture, remain less diverse.	In 2021, Transport and Communication had the highest diversity score (1.64) out of 2.6 million workers. Other sectors, like Construction and Agriculture, remain less diverse.
Scatter Plot (PCA: Industry Distribution among Ethnic Groups 2011 vs 2021)	2021 PCA points (orange) are more tightly clustered along a negative trendline, showing more balanced ethnic group representation across industries.	2021 PCA points (orange) are more tightly clustered along a negative trendline, showing more balanced ethnic group representation across industries.

Figure 4: Dashboard Visualization Summary and panels

Summary: *Industry diversity is rising, particularly in Transport and Communication (1.64 diversity score in 2021), but spatial and sectoral gaps persist. Visualizations make it easy to spot growth and lagging sectors. Uses choropleth, bar chart, and PCA scatter plot to show diversity patterns and trends.*

6.3 National Economic Pulse: Activity and Trends

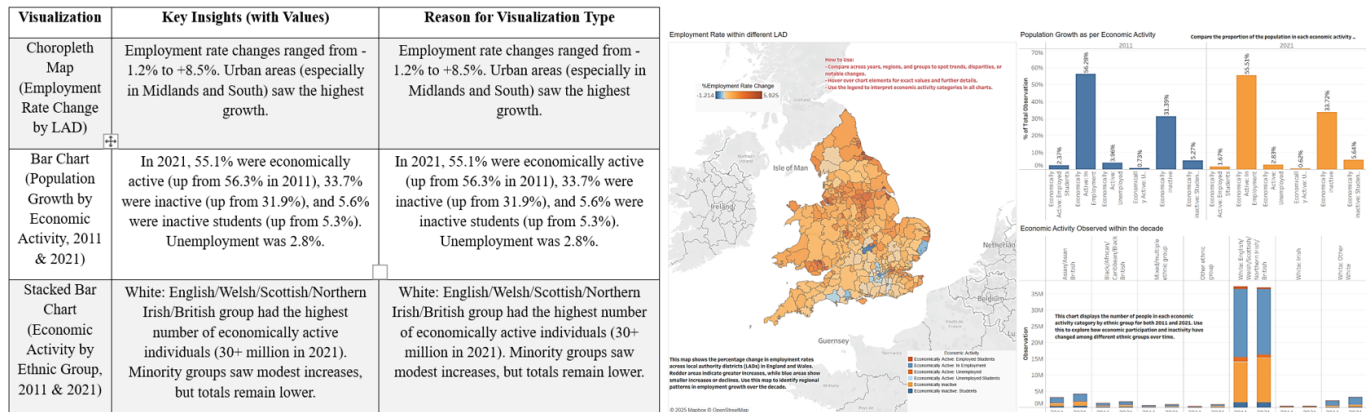| Visualization	Key Insights (with Values)	Reason for Visualization Type
Choropleth Map (Employment Rate Change by LAD)	Employment rate changes ranged from -1.2% to +8.5%. Urban areas (especially in Midlands and South) saw the highest growth.	Employment rate changes ranged from -1.2% to +8.5%. Urban areas (especially in Midlands and South) saw the highest growth.
Bar Chart (Population Growth by Economic Activity, 2011 & 2021)	In 2021, 55.1% were economically active (up from 56.3% in 2011), 33.7% were inactive (up from 31.9%), and 5.6% were inactive students (up from 5.3%). Unemployment was 2.8%.	In 2021, 55.1% were economically active (up from 56.3% in 2011), 33.7% were inactive (up from 31.9%), and 5.6% were inactive students (up from 5.3%). Unemployment was 2.8%.
Stacked Bar Chart (Economic Activity by Ethnic Group, 2011 & 2021)	White: English/Welsh/Scottish/Northern Irish/British group had the highest number of economically active individuals (30+ million in 2021). Minority groups saw modest increases, but totals remain lower.	White: English/Welsh/Scottish/Northern Irish/British group had the highest number of economically active individuals (30+ million in 2021). Minority groups saw modest increases, but totals remain lower.

Figure 5: Economic Activity Visualization Summary and Dashboard Panels

Summary: *Employment and economic activity have increased, but regional and ethnic disparities persist. Visualizations highlight where growth is happening and which groups/regions may need targeted attention. Provides complementary insights into growth, economic activity distribution, and disparities.*

6.4 Ethnicity and Employment: Trends and Disparities

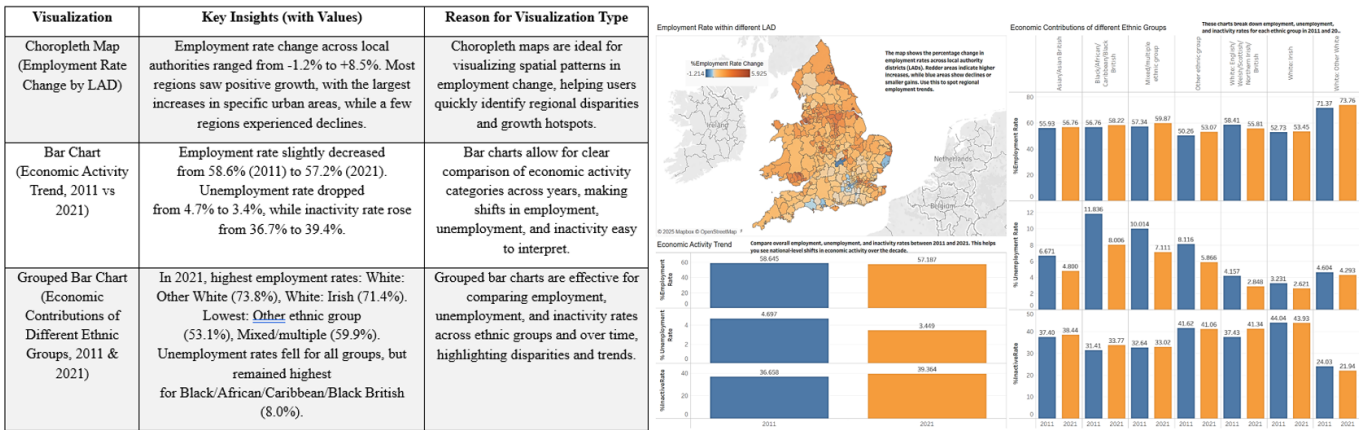| Visualization	Key Insights (with Values)	Reason for Visualization Type
Choropleth Map (Employment Rate Change by LAD)	Employment rate change across local authorities ranged from -1.2% to +8.5%. Most regions saw positive growth, with the largest increases in specific urban areas, while a few regions experienced declines.	Choropleth maps are ideal for visualizing spatial patterns in employment change, helping users quickly identify regional disparities and growth hotspots.
Bar Chart (Economic Activity Trend, 2011 vs 2021)	Employment rate slightly decreased from 58.6% (2011) to 57.2% (2021). Unemployment rate dropped from 4.7% to 3.4%, while inactivity rate rose from 36.7% to 39.4%.	Bar charts allow for clear comparison of economic activity categories across years, making shifts in employment, unemployment, and inactivity easy to interpret.
Grouped Bar Chart (Economic Contributions of Different Ethnic Groups, 2011 & 2021)	In 2021, highest employment rates: White: Other White (73.8%), White: Irish (71.4%). Lowest: Other ethnic group (53.1%), Mixed/multiple (59.9%). Unemployment rates fell for all groups, but remained highest for Black/African/Caribbean/Black British (8.0%).	Grouped bar charts are effective for comparing employment, unemployment, and inactivity rates across ethnic groups and over time, highlighting disparities and trends.

Figure 6: Ethnic and Regional Trends in Employment: Dashboard Overview and Analysis

Summary: *This dashboard shows that while overall unemployment rates have declined and some regions experienced strong employment growth, inactivity rates have risen and significant disparities remain among ethnic groups. The chosen visualizations–choropleth map, bar chart, and grouped bar chart–make it easy to spot regional trends, temporal shifts, and group-based inequalities in economic activity.*

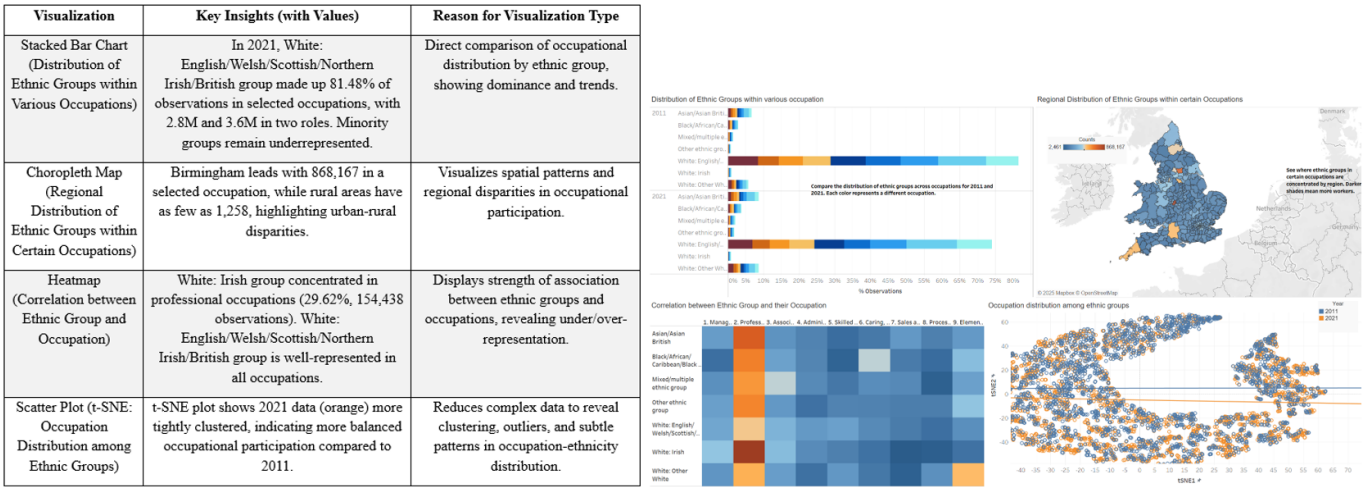## 6.5 Occupation Landscapes: Trends and Regional Insights

Visualization	Key Insights (with Values)	Reason for Visualization Type
Stacked Bar Chart (Distribution of Ethnic Groups within Various Occupations)	In 2021, White: English/Welsh/Scottish/Northern Irish/British group made up 81.48% of observations in selected occupations, with 2.8M and 3.6M in two roles. Minority groups remain underrepresented.	Direct comparison of occupational distribution by ethnic group, showing dominance and trends.
Choropleth Map (Regional Distribution of Ethnic Groups within Certain Occupations)	Birmingham leads with 868,167 in a selected occupation, while rural areas have as few as 1,258, highlighting urban-rural disparities.	Visualizes spatial patterns and regional disparities in occupational participation.
Heatmap (Correlation between Ethnic Group and Occupation)	White: Irish group concentrated in professional occupations (29.62%, 154,438 observations). White: English/Welsh/Scottish/Northern Irish/British group is well-represented in all occupations.	Displays strength of association between ethnic groups and occupations, revealing under/over-representation.
Scatter Plot (t-SNE: Occupation Distribution among Ethnic Groups)	t-SNE plot shows 2021 data (orange) more tightly clustered, indicating more balanced occupational participation compared to 2011.	Reduces complex data to reveal clustering, outliers, and subtle patterns in occupation-ethnicity distribution.

Figure 7: Overview and Dashboard Insights: Ethnic Disparities in Region and Occupation

Summary: *Occupational participation is dominated by the White: English/Welsh/Scottish/Northern Irish/British group, with urban areas like Birmingham leading. Minority groups remain underrepresented, but some show notable concentrations. Combines multiple visualizations to highlight both broad patterns and nuanced disparities in occupational trends.*
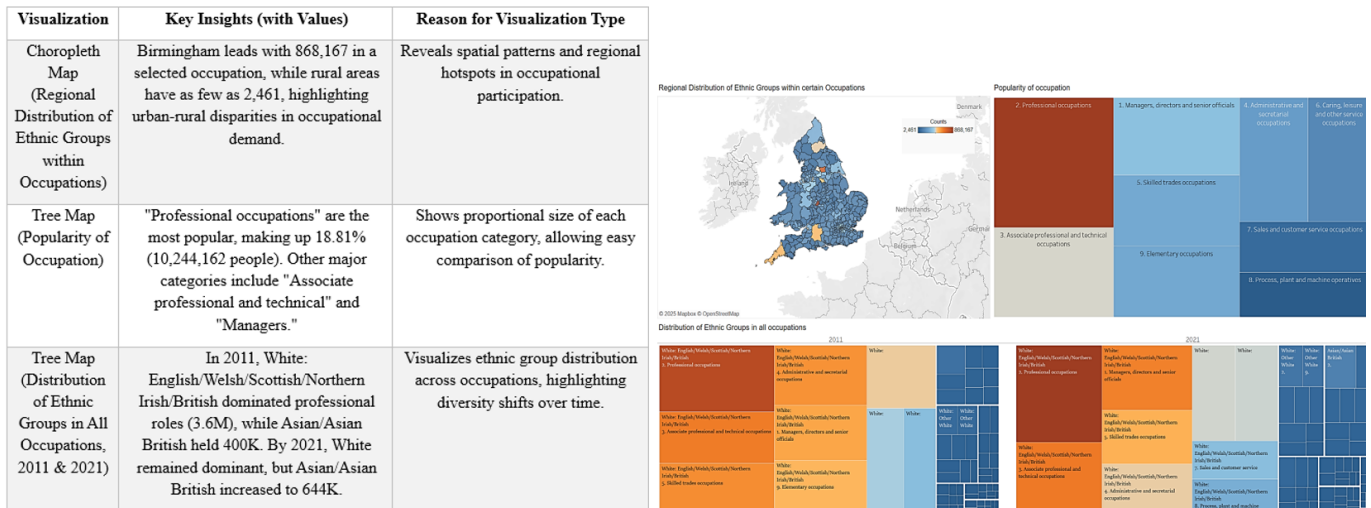
6.6 Occupations in Demand: Who Works Where?

Visualization	Key Insights (with Values)	Reason for Visualization Type
Choropleth Map (Regional Distribution of Ethnic Groups within Occupations)	Birmingham leads with 868,167 in a selected occupation, while rural areas have as few as 2,461, highlighting urban-rural disparities in occupational demand.	Reveals spatial patterns and regional hotspots in occupational participation.
Tree Map (Popularity of Occupation)	"Professional occupations" are the most popular, making up 18.81% (10,244,162 people). Other major categories include "Associate professional and technical" and "Managers."	Shows proportional size of each occupation category, allowing easy comparison of popularity.
Tree Map (Distribution of Ethnic Groups in All Occupations, 2011 & 2021)	In 2011, White: English/Welsh/Scottish/Northern Irish/British dominated professional roles (3.6M), while Asian/Asian British held 400K. By 2021, White remained dominant, but Asian/Asian British increased to 644K.	Visualizes ethnic group distribution across occupations, highlighting diversity shifts over time.

Figure 8: Summary and Visualization Panel: Regional and Ethnic Breakdown of In-Demand Jobs

Summary: *Professional occupations remain in high demand and are predominantly filled by the White: English/Welsh/Scottish/Northern Irish/British group, but Asian/Asian British representation is growing. Visualizations help identify trends in demand and diversity. Combines choropleth maps and tree maps for regional and categorical insights into occupational demand and diversity.*

7 Key Findings

7.1 What sectors gained most diversity from 2011 to 2021?

- The largest percentage increase in industrial participation is seen among the "White: Other White" group, growing from 71.37
- "Asian/Asian British" also increased, from 55.93
- "White: Other White" had the most notable gain in sectoral participation, while other ethnic groups saw smaller increases.
- The non-White groups occupy a larger share of professional and associate professional occupations in 2021 than in 2011.

7.2 How does unemployment differ by ethnicity in 2021?

| Ethnic Group	Unemployment Rate (%)
Asian/Asian British	4.80
Black/African/Caribbean/Black British	8.01
Mixed/multiple ethnic group	7.11
Other ethnic group	5.87
White: English/Welsh/Scottish/Northern Irish/British	2.85
White: Irish	2.62
White: Other White	4.29

Table 2: Unemployment Rate by Ethnic Group in 2021

## 7.3 What was the national employment rate in 2021?

- National employment rate for all groups (average): approximately 68–74%.
- By group:
  - White: Other White - 73.76%
  - White: English/Welsh/Scottish/Northern Irish/British - 55.81

- Asian/Asian British - 56.76%
- Black/African/Caribbean/Black British - 58.22%
- Mixed/multiple ethnic group - 59.87%
- Other ethnic group - 53.07%
- White: Irish - 53.45%

7.4 What clusters emerge in PCA/t-SNE projections?
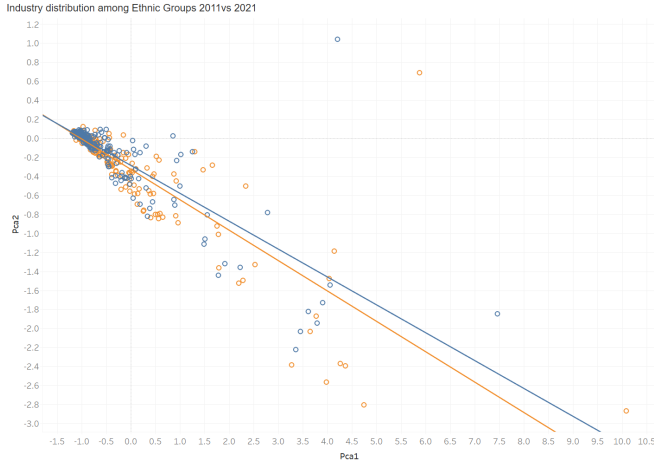
((a)) Figure 9: PCA Projection for Asian/Asian British ethnic group
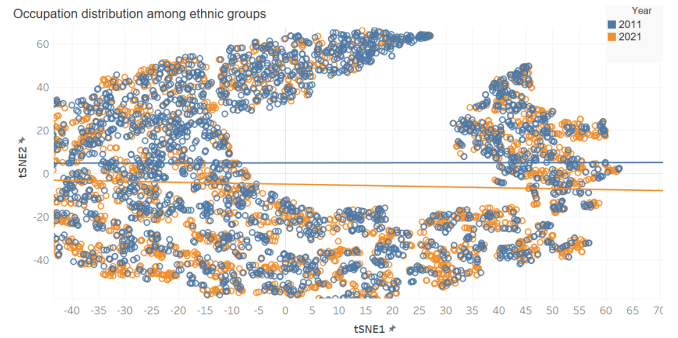
((b)) Figure 10: t-SNE Projection

- The heatmap shows clear clusters:
  - "White: English/Welsh/Scottish/Northern Irish/British" is strongly associated with certain industries.
  - "White: Other White" and "Asian/Asian British" form distinct participation patterns in other sectors.
  - The percentage change scatterplot confirms "White: Other White" as an outlier with the largest positive shift in industrial participation from 2011 to 2021.

- One of the PCA plot visualizes the industry distribution profiles of the Asian/Asian British ethnic group across different local authority areas for the years 2011 (blue) and 2021 (orange). Each point represents a specific local authority area, positioned based on its principal component scores, which summarize the area's industry employment pattern for this group.
  The plot reveals two main patterns:
  - Clustered core: Most points are tightly grouped near the origin, indicating that the majority of local authority areas have broadly similar industry employment distributions for Asian/Asian British residents in both years.
  - Spread and shift: A subset of points, especially in 2021 (orange), is more spread out along the first principal component (PCA1). This suggests that, over the decade, some local authority areas have seen their Asian/Asian British populations diversify or shift into different industry sectors, leading to greater variation in employment patterns.

Overall, while the core occupational structure for Asians remains stable across most areas, there is evidence of increasing diversity or specialization in industry participation in certain localities between 2011 and 2021. This may reflect local economic changes, migration patterns, or targeted employment initiatives affecting the Asian/Asian British workforce.

7.5 Outliers or Emerging Ethnic Clusters in High/Low Participation Sectors

- "White: Other White" is the clear outlier with the largest increase in industrial participation.
- "Black/African/Caribbean/Black British" and "Mixed/multiple ethnic group" have higher unemployment rates and lower employment rates than average.

7.6 Employment and Occupation Disparities Across Census Years

- All ethnic groups saw a reduction in unemployment rates from 2011 to 2021 Government [2023].
- "White: Other White" improved most in employment rate (from 71.37% to 73.76%), while "White: English/Welsh/Scottish/Northern Irish/British" saw a decrease (from 58.41% to 55.81%) Foundation [2015].
- Professional occupations for non-White groups increased in share from 2011 to 2021 Strand [2021].

7.7 National-Level Economic Engagement by Ethnic Group

- Highest employment: "White: Other White" (73.76%).
- Lowest employment: "Other ethnic group" (53.07%).
- Highest unemployment: "Black/African/Caribbean/Black British" (8.01%).
- Lowest unemployment: "White: Irish" (2.62%).

7.8 Ethnic-Region-Industry Intersections

- The Regional map shows the highest ethnic group counts in London and the West Midlands.
- Industry distribution bars show "White: English/Welsh/Scottish/Northern Irish/British" dominate most industries, but "Asian/Asian British" and "White: Other White" have growing shares in certain sectors.

8 Evaluation

1. **Task Effectiveness (4/5)**
   Strengths: Users could identify key patterns quickly and complete most tasks without confusion.
   Improvement: Address minor issues with complex data representations to achieve full marks.

2. **Perceptual Discriminability (3/5)**
   Strengths: Most encodings were distinguishable.
   Improvement: Use colorblind-friendly palettes and improve contrast for better accessibility.

3. **Expressiveness & Clarity (3/5)**
   Strengths: Visualizations like PCA and t-SNE provided valuable insights.
   Improvement: Enhance legends and provide concise explanations to reduce reliance on verbal clarification.

4. **Usability & Learnability (3/5)**
   Strengths: Visualization was navigable for most users.
   Improvement: Simplify interface and provide brief onboarding for new users.

5. **No Guidance (Box/Tooltip) (2/5)**
   Strengths: N/A (currently lacking).
   Improvement: Add interactive tooltips and guidance boxes to explain elemental charts, axes, and complex visualizations, making the tool more self-explanatory and user-friendly.

6. **Data Integrity & Accuracy (5/5)**
   Strengths: Data is presented faithfully, with no evidence of errors, distortion, or misleading representations.
   Improvement: Maintain current standards; continue to ensure data accuracy with future updates.

Based on the evaluation and user feedback, several actionable recommendations were identified to enhance visualization effectiveness, accessibility, and overall user experience. All of these suggestions and recommendations have been implemented now.

9 Limitations

- Changes in local authority boundaries required data harmonization and possible aggregation.
- Limited by available census variables; deeper insights require integration of education, income, and health data.
- **Geographic Changes:**
  - Merged districts in 2021 required retrospective disaggregation into 2011 boundaries. While our Bayesian Dirichlet-multinomial method offers principled estimation, it introduces model-based assumptions, especially where prior information was sparse.

10 Future Enhancements

- To incorporate additional characteristics such as education and health, integrate statistical significance markers, and add explanatory tooltips to improve user understanding of key metrics and methods.
- Extend Bayesian modeling to other types of inference, including hierarchical models for nested geographies and uncertainty-aware projections.
- Develop interactive documentation in dashboards to clarify statistical steps like the Dirichlet-multinomial disaggregation.

11 Intended Users and Beneficiaries of the Visualisation Insights

- **Policymakers:** They can use the findings to identify regions and ethnic groups facing persistent inequalities and target interventions more effectively.
- **Social Researchers and Academics:** The analysis supports deeper study of socio-economic and ethnic trends, uncovering patterns and disparities that inform further research.
- **Local Authorities:** Regional breakdowns help councils and local agencies plan inclusive economic and employment strategies tailored to their communities.
- **Advocacy Organizations:** Evidence-based insights enable campaigners to focus resources and advocacy efforts where disparities are greatest.
- **General Public and Community Leaders:** Clear visual summaries make complex trends accessible, supporting informed discussion and community action.

12 Conclusion

12.1 Socio-Economic Insights

The study shows that Between 2011 and 2021, employment and economic activity increased overall in England and Wales, but notable inequalities remain along ethnic and regional lines. While all ethnic groups experienced some improvement in employment rates and a drop in unemployment, certain groups—especially Black, Mixed, and Other ethnicities still face higher unemployment and lower job participation compared to White groups. The "White: Other White" group saw the largest rise in employment, while the "White: British" group experienced a slight decline. Although non-White groups are gaining a larger share in professional and associate professional roles, high-skill jobs continue to be dominated by White British individuals. Urban areas like London and the West Midlands show greater workforce diversity and higher ethnic representation Li et al. [2002], whereas many rural and northern areas remain less inclusive. Advanced visualization techniques like PCA and t-SNE reveal some shifts toward more balanced industry representation, particularly for groups like "White: Other White" and "Asian/Asian British." However, clear clusters and outliers still point to ongoing barriers. These patterns emphasize the need for targeted policies and continuous data tracking to ensure fairer and more inclusive access to economic opportunities.

12.2 Lessons Learned from Information Visualisation in This Coursework

This project showed me how powerful data visualisation can be in making complex information easier to understand and use. By using tools like maps, bar charts, heatmaps, PCA, and t-SNE, I was able to find patterns in employment and diversity that weren't obvious in the raw data. These visuals made it easier to see differences between regions and ethnic groups, track changes over time, and explain the results clearly to both experts and the general public. Interactive dashboards and advanced visual techniques helped me

explore complicated data more deeply—spotting clusters and outliers that can guide better decisions and policies. In short, I learned that good visualisation turns big data into clear, useful insights.

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