London School of Economics

Data Analytics Career Accelerator

Thoughtworks Employer Project

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Prefix

OptimalRouteInitiative_Group6_LSE_Notebook_1 – London Data Cleaning and initial EDA

OptimalRouteInitiative_Group6_LSE_Notebook_2 – Infrastructure, Accidents, and Bike Share

OptimalRouteInitiative_Group6_LSE_Notebook_3 – Parking/Theft, Demographics, Case Study

OptimalRouteInitiative_Group6_LSE_Accidents_Dashboard

OptimalRouteInitiative_Group6_LSE_Infrastructure_Dashboard

Complete overview of data utilised in this report can be found in Appendix Table 1

Contents

Business Scenario

In 2018, the Mayor of London launched the Transport Strategy to transform urban mobility and reduce car dependence. The Mayor of London set priorities for improving cycling infrastructure and promotion, including street improvements, safety measures, and accessibility for all demographics.

Analytical Approach

This analysis evaluates the impact of infrastructure improvements on cycling behaviour, ascertaining key demographics for increase in cycling engagement, targeting boroughs to invest with cycling infrastructure, and actionable recommendations in increase in cycle uptake. The project is divided into six subprojects, addressing key questions:

1. How does cycling infrastructure development impact cyclist numbers?
2. Which areas have the highest accident risks?
3. What influences cycle hire usage, and how can marketing boost uptake?
4. Is cycle parking meeting demand at key locations?
5. What demographics use cycling, and what are the barriers to increased uptake?
6. What are New York City's cycling strategies, and how can they inform London's?

Data Description and Wrangling

The three London *datasets (1-3)* were wrangled and concatenated. Boroughs were pinpointed by merging with *dataset 4* allowing for focussed analysis. Due to inconsistent data collection, a dataset with common survey months for each borough, excluding 2020 data, was used. Inconsistent bike counts were managed by grouping data by date and borough, calculating mean cycles. For normalisation, yearly data per borough summed total bikes.

Analysis by Subproject

1. Infrastructure

A linear regression model (Notebook 2, Figure-I1) was used to examine the correlation between cycle lane coverage percentage (*dataset-5*) and cyclist numbers. The 'Cycle lane coverage %' coefficient was significant (p=0.017), indicating a substantial impact on cyclists. The *datasets (5-9)* provide detailed information on cycle lanes in London boroughs, with street attributes represented as Boolean values, which was then used to calculate the percentage of lanes with each attribute (Table-2). The decision tree (Figure-I2) splits data based on features related to street attributes, the top node – the percentage of contraflow lanes, was chosen as a major factor.

Clustering analysis was done using *datasets (5-12)* and segmented boroughs into groups for targeted infrastructure developments and cycling promotion campaigns, with the optimal number of clusters determined to be five (Figure-I3, Table-3). Key infrastructure factors are visualised in the Infrastructure Dashboard.

2. Accidents

On *database 12*, accidents are categorised into slight, serious, and fatal (Figure-A1). All severity levels were combined to better understand overall trends.

To account for varying bike numbers and their impact on accident likelihood, the accident rate was calculated by dividing the number of accidents by the average number of bikes. A trend of accidents peaking in 2018, followed by a decline in 2019, was noticed (Figure-A2). However, this trend lacked statistical significance, so the average accident rate was used for further analysis.

The MLR model for inner London, using these and other features (notebook_2_cell_93), has an R^2=0.72. For outer London, the best model includes different features (notebook_2_cell_78), and single improvements have a lower impact on accident rates.

To explore accident rates by severity and boroughs, and to examine their relationship with bike numbers and linear regressions, consult dashboards 1, 2, and 3 for detailed insights. Please refer to: 'OptimalRouteInitiative_Group6_LSE_Accidents_Dashboard'.

3. Bike Sharing

Data *(database 1-2, 4)* were aggregated by month/year to determine and visualise trends. The proportion of hire bikes was calculated, revealing significant insights into the distribution of usage across London boroughs (Figure-B1). *Databases 13-16:* Data on member and casual hires was summarised to show yearly totals and trends (Figure-B2). Statistically significant rise was found in memberships (using linear regression and t-tests), however, normality tests (Shapiro-Wilk, D'Agostino-Pearson K2) and a low r-squared indicated potential heteroscedasticity, requiring future investigation (Figure-B3). London's bike share schemes had consistent membership growth, suggesting a transition from casual to regular cyclists.

4. Case Study

To analyse cycling uptake in New York, data from reports [26], surveys [23, 24, 25], and studies were gathered. Quantitative analysis focussed on infrastructure growth, financial investments, and cycling activity increases. Timelines, network expansions, and safety measures, particularly e-bike fatalities, were examined. Qualitative analysis assessed community engagement programmes, comparing pre- and post-intervention cycling behaviour. Further, analysis of New York evaluated integration with other transport modes and demographic trends. This approach provided comprehensive insights into the effectiveness of cycling initiatives and strategies for enhancing cycling uptake in urban centres.

5. Parking

Three-step process identified boroughs in need: *datasets (17-18)* classified and binned for infrastructure needs (Low-demand < 17, Medium 17-35, High > 35) – 29 low-demand boroughs (Figure-P1). Analysis of secure locations revealed 7 boroughs lacking infrastructure. Further, *dataset 19* was used to analyse the number of stolen bikes.

6. Demographics

Dataset-20 was analysed to depict regular cycling habits by borough, using cycling participation 2022 and average yearly growth rates 2016-2022 (Figure-D1, D2). Plotting these with the median of cycling participation and the zero-growth line of average growth 2016-2022 four segments were found: Low, Emerging, Stagnant/Decreasing, and Growing cycling boroughs (Figure-D3). Demographics of cycling were analysed based on *datasets 21-22* and several sources [15-17]. Gender cycle share was calculated using *datasets 3, 4* aggregating by gender, month and borough.

Key findings

1. **Infrastructure**. There is a positive correlation between cycle lane coverage and the number of cyclists. Contraflow lanes are a key factor in urban cycling infrastructure. Cycling infrastructure plans can address the unique needs of each borough identified in clustering analysis. Clusters 0, 3, and 4 exhibit advanced cycling infrastructure with focus on cyclist safety. Clusters 1,2, characterised by ample space and lower immediate demand, require implementation of traffic calming measures to address cyclists' safety.
2. **Accidents**. The 15 boroughs with the highest accident rates were found to be in outer London (Figure-A3), In inner boroughs, a moderate positive correlation was observed

between accident rates and shared lanes and traffic volumes and a negative correlation with segregated and contraflow lanes (Figure-A4). Conversely, no significant correlation was observed between accident rates and these features in outer London boroughs (Figure-A5).

3. **Parking.** London has 23,757 parking locations, but most lack proper infrastructure, leading to poor quality. 99.2% are insecure, and 96.6% lack key features like bike hangars (Figure-P2). Seven boroughs have no secure locations (Figure-P3). A pattern emerged when comparing boroughs with and without secure parking, notably in Kensington & Chelsea amongst 8 others needing more quality parking (Figure-P4). Bike theft was analysed (Figure-P5), and linked with lack of secure park, based on that Hackney and Kensington & Chelsea show a high need for secure parking (Figure-P6).
4. **Bike sharing.** A steady increase in member hires was observed, particularly peaking during the COVID-19 pandemic. Casual hires remained relatively stable; the drop in 2023 correlates with competition entering the market, plus a price increase. Overall hire consistency of around 60% indicates a shift towards regular, committed users (Figure-B2).
5. **Case study.** New York saw a substantial increase in cyclists due to significant investments in cycling infrastructure, such as over 1,500 miles of bike lanes and the Citi Bike programme, which facilitated 610,000 daily trips. The city's Vision Zero safety measures reduced accidents, although e-bike fatalities highlighted the need for specific safety regulations. Despite these efforts, 2023 was the deadliest year for cyclists since 1999 (Figure-C1), emphasising ongoing safety challenges.
6. **Demographics**. Women and residents of outer London are underrepresented among cyclists, representing a significant potential for increased cycling uptake (Figure-D4). Women constitute 15% of road cyclists while representing 51.6% of the London population, with only 33% of cycling trips made by women (Figure-D5).

Recommendations

1. Infrastructure. Implement targeted infrastructure improvements and cycling promotion campaigns in identified borough clusters to enhance cycling uptake. Expand the network of contraflow lanes and cycle bypasses to enhance connectivity within neighbouring areas. Shift focus from shared lanes to more segregated lanes. In both inner and outer London, expand the use of speed cushions and other traffic calming measures to create safer environments for cyclists.

2. Accidents. Focus on enhancing cycling infrastructure and promoting cyclist safety education campaigns in outer London boroughs. Our model estimates the impact of infrastructure improvements on accident rates by borough (Figure-A5). For example, a 10% increase in contraflow lanes in Croydon could reduce accidents by 5%.

3. Bike Sharing. Leverage low car ownership and expand bike share programmes to make cycling more accessible and affordable, especially for commuters and underserved communities (like low-income neighbourhoods) through extended concessions. Enhance the programme, ensuring seamless integration with public transport. Survey users and leverage data for continuous improvement. Draw inspiration from successful programmes like NYC's Citi Bike and local initiatives like Cycle Sisters London.

4. Case Study. New York integrated cycling with public transportation, increasing accessibility and convenience. This shows that tailored strategies in infrastructure, community programmes, and safety policies can effectively promote urban cycling, aligning with environmental and health goals. NYC's e-bike experience shows London needs clear safety regulations and education for e-riders.

5. Parking. Improve the security and quality features of parking locations, prioritising level of demand and security need, catering to commuters and leisure cyclists alike.

6. Demographics. Target boroughs to boost women's cycling were identified as those below the median cycling participation line (Figure-D5).

Conclusion

By implementing these targeted recommendations, London can significantly increase cycling uptake across identified demographics. A data-driven approach, focussing on infrastructure improvements, safety enhancements, and accessibility measures, will create a more attractive and secure cycling environment for all Londoners. This shift towards cycling will contribute to reduced car dependence, and a more sustainable urban mobility system.

Appendix

Data limitations and further analysis

1. For inner and outer London, data was only collected during spring and summer, lacking year-round accuracy, which makes it difficult to reach the clear conclusions of the cycling engagement in these areas.
2. The lack of historical data on both the proportion of the number of cyclists and the corresponding infrastructure developments in each borough has made it challenging to train a predictive model that can accurately forecast future trends.
3. Further research and data collection are necessary to assess the progress made since the introduction of the Mayor's of London Transport strategy, as the metrics (like the number of cycling journeys or the number of residents living within 400 metres of a Cycleway) used in the report are not clearly defined.

Tables

Table 1. Datasets Utilised in the Analysis

	Database Name	Data Source	Description
1	Central London	Thoughtworks	Area-based cycle counts from TfL cycling monitoring programme
2	Inner London	Thoughtworks	Area-based cycle counts from TfL cycling monitoring programme
3	Outer London	Thoughtworks	Area-based cycle counts from TfL cycling monitoring programme
4	Bike sites	Thoughtworks	Survey location characteristics
5	Cycle lane coverage in percent	Healthy streets scorecards	Absolute length of protected cycle track as % of total borough road length for each borough, 2021
6	cycle_lane_track	TfL database	Types of cycle lanes
7	Traffic_calming	TfL database	Types of traffic calming measures
8	Crossing	TfL database	Types of crossings
9	Types of signals	TfL database	Types of signals
10	Car Traffic Flows	Department for Transport	Traffic volume(km) for all vehicles by borough
11	London Santander Cycle Stations	Santander Cycles Map	Docking stations for all operational Santander Cycles in London
12	AccidentsAPI	TfL API	Data retrieved from 2015 to 2019, filtered for PedalCycles
13	Santander Quarterly Performance Reports	TfL	Members vs casual bike hires from 2017 to 2024
14	TfL Cycle Hire Performance Reports	TfL API	Santander Cycles performance
15	London Datastore	London Datastore	Total number of hires of the Santander Cycle Hire Scheme, by day, month and year. Retrieved data to test against quarterly performance
16	TfL Journey Data Extracts	TfL	Retrieved data for 2017 and 2023 for Cycle Hire, and eBikes
17	CyclePark	https://api.tfl.gov.uk/Place/Type/CyclePark	Data from 2021-09-05
18	CyclePark	https://www.bicycleassociation.org.uk/wp-content/uploads/2021/06/05132-Cycle-Parking-and-Security-Standards-June-2021-REV-5.pdf	
19	Bike thefts	Metropolitan Police	
20	Participation in cycling by borough	Department for Transport	Proportion of adults who cycle, by purpose, frequency, and local authority, England, November 2015 to November 2022
21	Travel in London 2023	TfL	Travel in London 2023 active travel trends data (travel-in-london-2023-active-travel-trends-

			data-acc.xlsx), demographic aspects of cycling
22	Demographic statistics	https://www.ons.gov.uk/census	Office of National Statistics (ONS)
23	Bicycle Counts	Thoughtworks	Area based bicycle counts from New York City Dept Of Transportation
24	2023 NY CItiBike TripData	https://citibikenyc.com/system-data	Monthly counts of NYC CitiBike usage
25	Bicycle Routes	Thoughtworks	Detailed data on bicycle routes in New York City boroughs.
26	Bike Fatalities	New York Times	A report on the number of cycling fatalities in NYC

Table 2. Example of the Street Attributes Dataframe (Transposed)

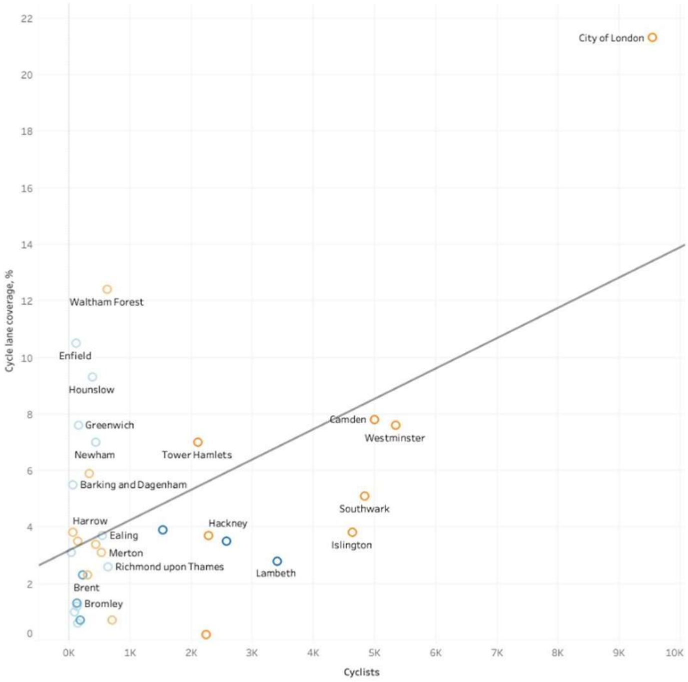
Street Attribute / Borough	Barking and Dagenham	Barnet	...
Segregated Lane	4.65	8.49	...
Shared Lane	36.23	76.83	...
Priority Lane	15.06	1.15	...
Contraflow Lane	2.57	1.61	...
Cycle Bypass	0.12	-	...
Cycle Signal Head	-	-	...
Two Stage Turn	-	-	...
Signal-Controlled Crossing	98.11	62.5	...
Pedestrian-Only Crossing	-	4.17	...
Raised Crossing	2.4	2.65	...
Speed Cushions	7.34	5.04	...
Traffic Calming Measures	0.52	3.98	...

Table 3. Clustering Analysis

Cluster	Borough
0 – Progressive Urban Mobility Hub	Hammersmith and Fulham, Lambeth, Wandsworth
1 – Developing Cycling	Barking and Dagenham, Bexley, Croydon, Ealing, Enfield, Greenwich, Havering, Hounslow, Newham, Redbridge, Richmond upon Thames
2 – Suburban Cycling	Barnet, Bromley, Hillingdon
3 – Emerging Cycling	Brent, Haringey, Harrow, Kingston upon Thames, Lewisham, Merton, Sutton, Waltham Forest
4 – Advanced Cycling Hub	Camden, City of London, Hackney, Islington, Kensington and Chelsea, Southwark, Tower Hamlets, Westminster

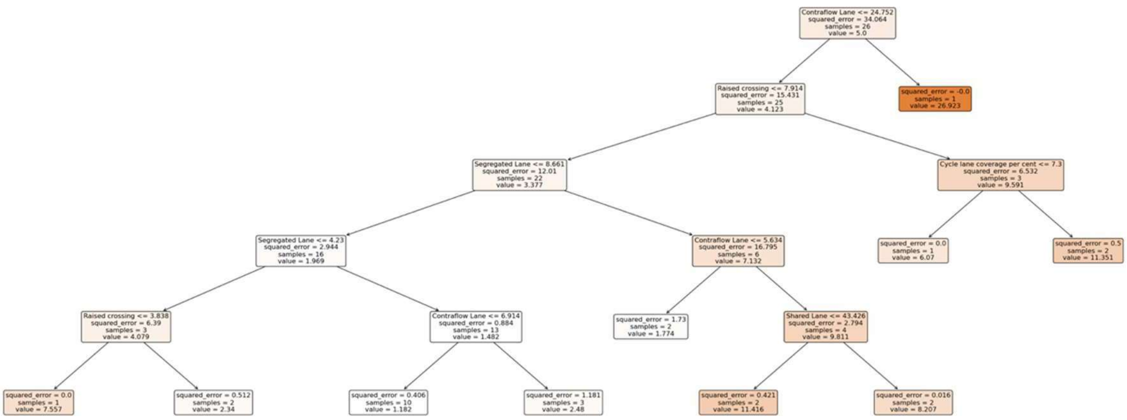
Visualisations

Figure I1. Regression Model – The cycle lane coverage vs number of cyclists.



There is a positive correlation between cycle lane coverage and the number of cyclists. As lane length increases, the total number of cycles also tends to increase. However, the R-squared value of 0.166 suggests that only 16.6% of cyclist variability is explained. City of London and Camden – high numbers of cyclists and high cycle lane coverage. Waltham Forest and Enfield higher than expected cycle lane coverage relative to cyclist numbers. Westminster – cycle lane coverage is less than might be expected given the number of cyclists.

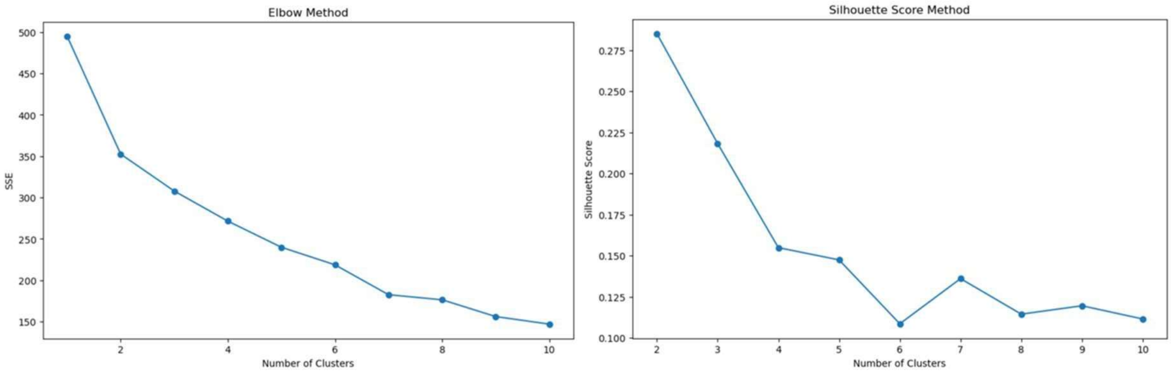
Figure I2. The decision tree model of the street attributes.



The model first considers whether the percentage of contraflow lanes (lanes allowing cyclists to travel in the opposite direction of vehicular traffic in a one-way street) is less than or equal to 24.752%. The positioning of contraflow lanes as the primary decision criterion underscores their importance in urban cycling infrastructure. That potentially enhance connectivity and safety for cyclists. There may be an opportunity to significantly increase cyclist numbers by expanding these lanes. This could involve converting existing lanes into contraflow lanes or introducing new contraflow pathways.

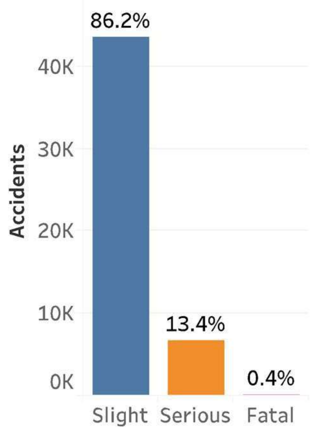
Figure I3.

Choosing the number of clusters. The Elbow and Silhouette methods.



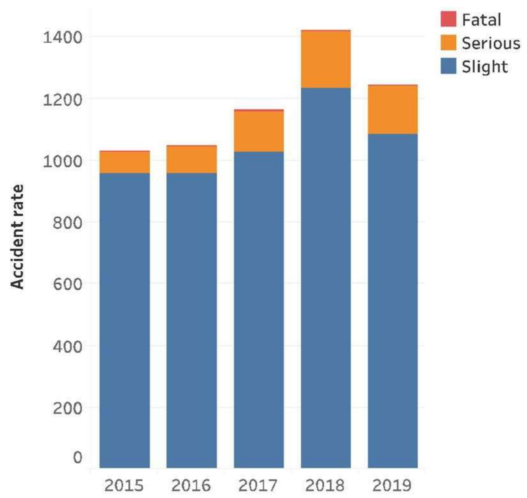
The ‘elbow’ point appears around 4 to 5 clusters. This suggests that additional clusters beyond this point do not significantly improve the compactness of the clusters, thus 4-5 clusters might be optimal from this perspective. The elbow method shows diminishing returns on SSE improvement beyond 5 clusters, and the silhouette score stabilises somewhat around 5 clusters although it is lower than at 2 clusters.

Figure A1



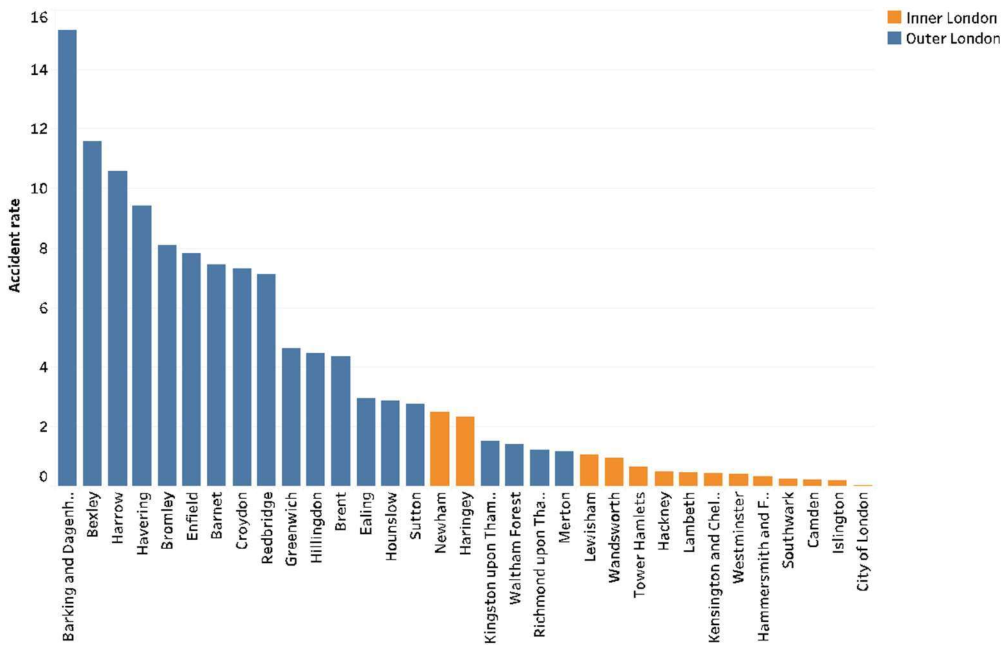
This bar chart shows the severity of traffic accidents. Most (86%) are slight, with serious (13%) and fatal (0.4%) accidents being much less frequent.

Figure A2



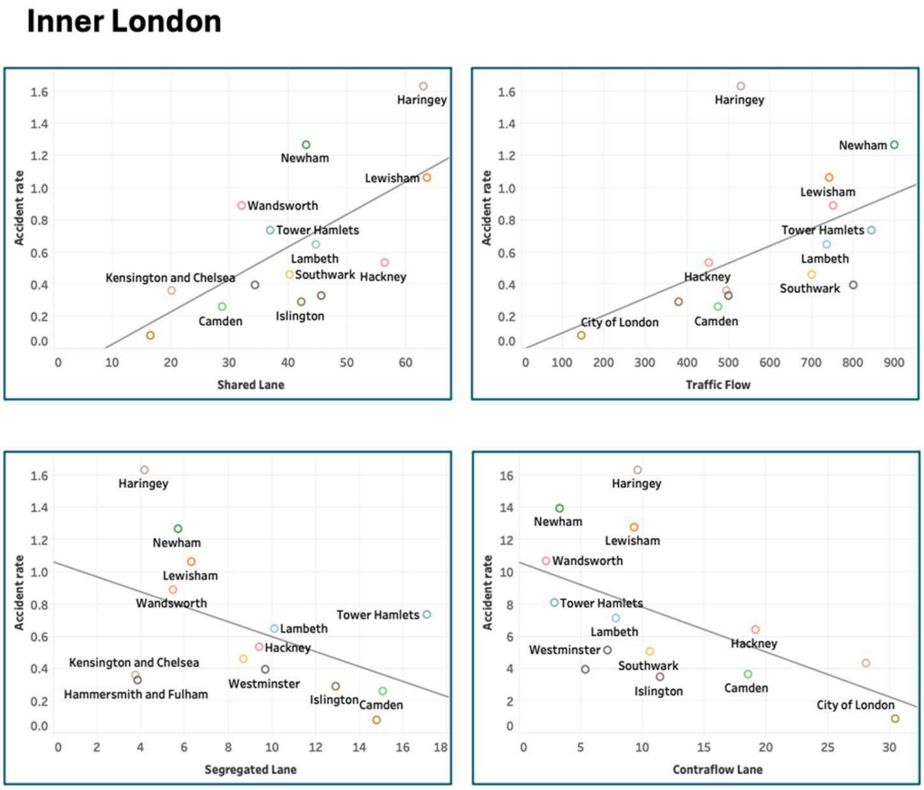
This chart shows the distribution of traffic accidents across different years, categorised by their severity (Fatal, Serious, Slight). Each bar represents the total number of accidents for a specific year. A trend of accidents increasing and peaking in 2018, followed by a decline in 2019, was noticed.

Figure A3



The 15 boroughs with the highest accident rates were found to be in Outer London**.**

Figure A4.



In inner boroughs, a moderate positive correlation was identified between accident rates and shared lanes (R^2=0.32) and traffic volumes (R^2=0.17), and a negative correlation with segregated (R^2=0.23) and contraflow (R^2=0.16) lanes.

Figure A5.

In outer boroughs, no correlation was identified between accident rates and shared lanes (R^2=0.007), traffic volumes (R^2=0.04), and segregated (R^2=0.007). A negative weak correlation was found with contraflow (R^2=0.12) lanes.

Figure A6.

Two MLR were done separately for inner and outer London.

Since the dependent variable (accident rate) is a ratio, interpreting coefficients directly as 'increase' or 'decrease' is not appropriate. Instead, we can interpret the coefficients in terms of percentage changes using elasticity, which measures the percentage change in one variable in response to a one percent change in another. The table shows the elasticity of each feature in each borough.

Results from MLR

x_inner = df_inner[['Segregated Lane', 'Traffic', 'Shared Lane', 'Contraflow Lane', 'Mean Total cycles', 'Protected', 'Raised crossing']]

Borough	Segregated Lane	Contraflow Lane	Shared Lane
Camden	-1.61	-0.81	1.04
City of London	-1.58	-1.33	0.60
Hackney	-1.00	-0.84	2.05
Hammersmith and Fulham	-0.41	-0.23	1.66
Haringey	-0.45	-0.42	2.29
Islington	-1.38	-0.50	1.54
Kensington and Chelsea	-0.40	-1.23	0.73
Lambeth	-1.08	-0.34	1.63
Lewisham	-0.67	-0.41	2.31
Newham	-0.61	-0.14	1.56
Southwark	-0.93	-0.46	1.46
Tower Hamlets	-1.83	-0.12	1.34
Wandsworth	-0.59	-0.09	1.17
Westminster	-1.04	-0.31	1.25

x_outer = df_outer.drop(['Accident rate', 'Borough', 'Region', 'Shared Lane', 'Traffic calming measures', 'Cycle Bypass'], axis=1)

Borough	Segregated Lane	Contraflow Lane	Signal-Controlled Crossing	Raised Crossing	Speed Cushions
Barking & Dagenham	-0.44	-0.11	-1.83	-0.26	-0.25
Barnet	-0.80	-0.07	-1.17	-0.29	-0.17
Bexley	-1.09	-0.03	-1.11	-0.68	-0.74
Brent	-0.04	-0.08	-1.48	-0.43	-1.67
Bromley	-0.65	-0.03	-0.65	-0.60	-0.67
Croydon	-0.43	-0.47	-1.14	-0.32	-1.14
Ealing	-0.51	-0.25	-1.50	-0.38	-0.54
Enfield	-0.59	-0.02	-1.20	-0.76	-1.15
Greenwich	-0.66	-0.16	-1.44	-0.73	-0.52
Harrow	-0.43	-0.02	-1.15	-0.39	-1.63
Havering	-0.43	-0.02	-1.67	-0.46	-0.74
Hillingdon	-0.81	-0.03	-0.92	-0.81	-0.16
Hounslow	-1.03	-0.13	-1.58	-0.51	-0.63
Kingston upon Thames	-1.32	-0.15	-1.27	-0.35	-0.60
Merton	-0.71	-0.15	-1.37	-0.58	-0.89
Redbridge	-0.41	-0.14	-1.46	-0.24	-0.48
Richmond upon Thames	-0.34	-0.06	-1.59	-0.29	-0.64
Sutton	-0.80	-0.21	-1.39	-0.45	-0.83
Waltham Forest	-0.52	-0.39	-0.92	-0.73	-0.61

Figure B1.

The bar chart of Proportions of Hire Bikes by Borough shows the areas with the highest and lowest hire bike usage, informing where to focus expansion efforts. The distribution of hire bikes is heavily skewed towards central London boroughs. Increasing hire bike availability and promoting cycling in these lower-proportion, outer areas can enhance overall cycling uptake in London, aligning with the Mayor's strategy to improve urban mobility.

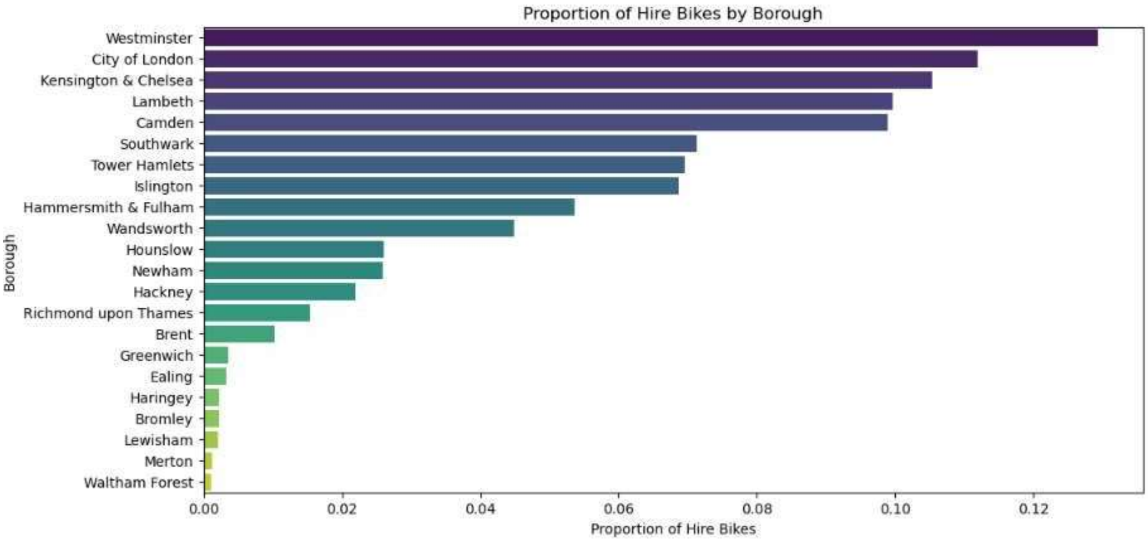


Figure B2.

Bar chart of members and casual hire usage, showing steady increase in member hires, with peaks during Covid. Casual hires remained relatively stable; the noticeable drop in 2023 correlates with competition entering the market, plus a price increase. Rates must be kept competitive to prevent customer loss. Overall hire consistency indicates a shift towards regular, committed users. A bar plot with dual axes depicts yearly totals and the changing ratio between member and casual ridership from 2017 to 2023 (Figure B2).

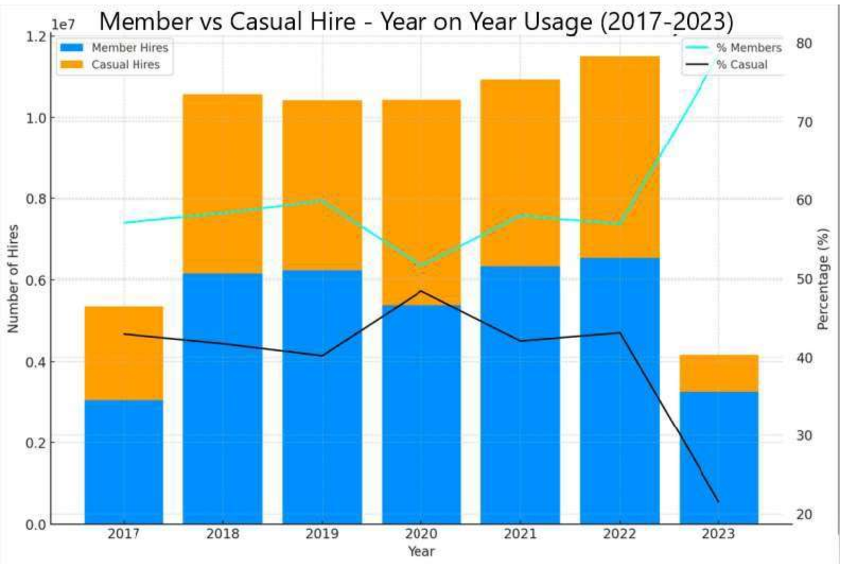


Figure B3.

New Member Statistics. A linear regression model was fitted to identify trends over time. Residual analysis and normality tests were performed to validate the model. The residuals plot for the linear regression model indicated some heteroscedasticity, suggesting the model does not fully capture the relationship between time and new memberships. Normality tests (Shapiro-Wilk and D'Agostino-Pearson) were performed to test validity of the model's assumptions. Findings from stats and residuals highlight the need for further analysis refinement.

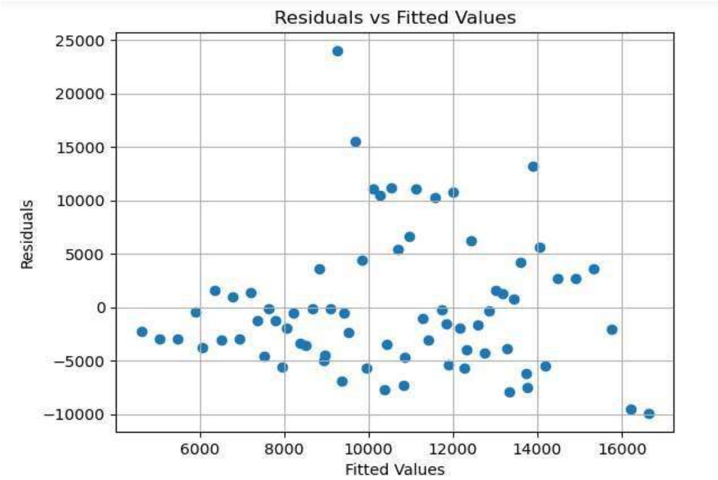


Figure C1.

The chart displays cycling fatalities in New York City from 2008 to 2024, categorised by traditional bicycles and e-bikes. Deaths involving e-bikes start appearing in the data from 2016 onward, indicating a recent increase in e-bike usage or reporting. A significant increase in total cycling fatalities in 2024 compared to previous years, with a notable spike in deaths associated with traditional bicycles.

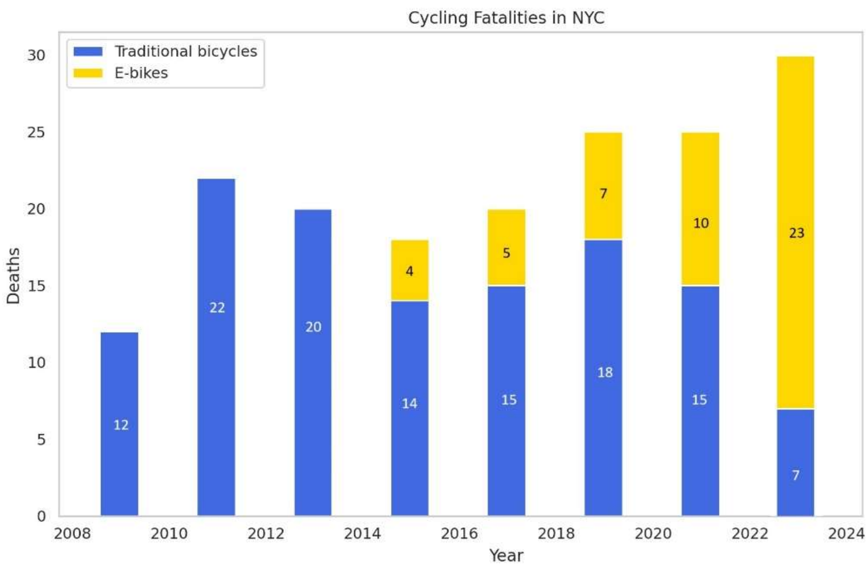


Figure P1.

The chart represents the number of locations per borough, categorised by high and medium demand. A notable number of high demand locations include Camden, Hackney Southwark and Westminster. A balanced distribution between high and medium demand locations, such as Greenwich and Islington. Some boroughs like Bexley, Sutton, and Barking & Dagenham have a much lower number of locations, indicating either smaller size, lower population density, and less cycling activity.

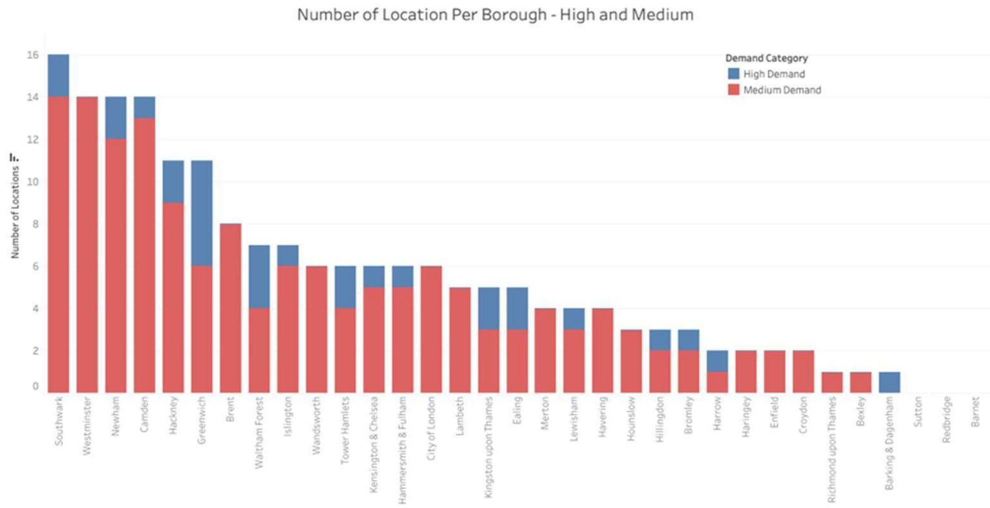


Figure P2.

1. Quality of Parking locations: Poor

- Secure [Level of Quality]
  - Mode: False with 23,558 out 23,758 = 99.2%
- BikeHangar [Level of Quality]
  - Mode: False 22,827 out of 23,758 = 96.1%
  - Describe confined structure to store bicycle
- Carriageway [Level of Quality/ aka segretate lanes of cyclists]
  - Mode: False 22,980 out of 23,758 = 96.7%
  - Describe road type
- Covered [Level of Quality]
  - Mode: False 22,554 out of 23,758 = 94.9%
  - Describe feature in parking location within the space
- Locker [Level of Quality]
  - Mode: False 23,501 out of 23,758 = 98.9%
  - Describe feature in parking location within the space

2. 7 Boroughs without a single secure location:

  - Barnet
  - Bexley
  - Ealing
  - Enfield
  - Harrow
  - Kensington & Chelsea
  - Sutton

Figure P3.

```
7 Boroughs without a single secure location:
 - Barnet
 - Bexley
 - Ealing
 - Enfield
 - Harrow
 - Kensington & Chelsea
 - Sutton

8 boroughs consist of 52% of data set
 - Hackney                  0.096477
 - Camden                   0.164751
 - Westminster              0.232226
 - Southwark                0.295829
 - Hammersmith & Fulham     0.358968
 - Lambeth                  0.419119
 - Islington                0.471566
 - Kensington & Chelsea     0.522457
```

Figure P4.

```
Borough with secure location ranked by demand:
- Southwark
- Westminster
- Camden
- Hackney

Borough without  secure location ranked by demand:
- Kensington & Chelsea
- Ealing
- Harrow
- Enfield
- Bexley
```

Figure P5.

```
1. Bike theft trends:
   - 2020 peak
   - 2021 above the avg per year (please refer to point 3)
2. Total bike stolen: 103036
   - Avg per year: 103036/5 = 20607.2 (allow to determine which year
   where above the weighted center)
3. Total theft per year:
   - 2018 = 19569.0
   - 2019 = 20090.0
   - 2020 = 23859.0
   - 2021 = 21173.0
   - 2022 = 18345.0
4. Avg theft per borough out 32 :
   - 2018 = 612
   - 2019 = 628
   - 2020 = 746
   - 2021 = 662
   - 2022 = 573 (covid)
```

Figure P6.

The graph shows the average bike thefts per borough. Hackney, Tower Hamlets, Southwark, Westminster, and Camden each having roughly between 1400 and 1800 average bike thefts, indicating these are high-risk areas. Boroughs like Islington, Lambeth have moderate levels of bike theft. Barking and Dagenham, Sutton, Harrow, and Havering show the lowest average theft.

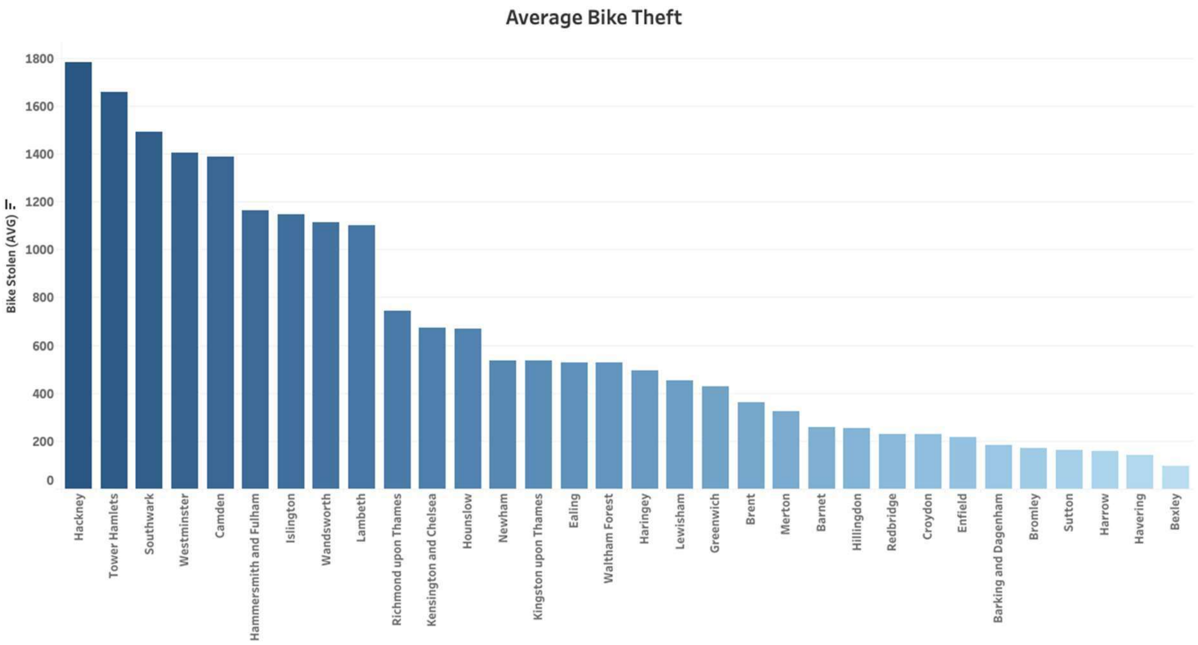


Figure D1. (next page)

The graph shows the average yearly growth rate (2016-2022) of cycling participation (cycled at least once a week) in London boroughs. Brent residents significantly changed their regular cycling habits with the highest average yearly increase of 11.2% in cycling uptake at least once a week leading the growth rate in London on the top of chart.

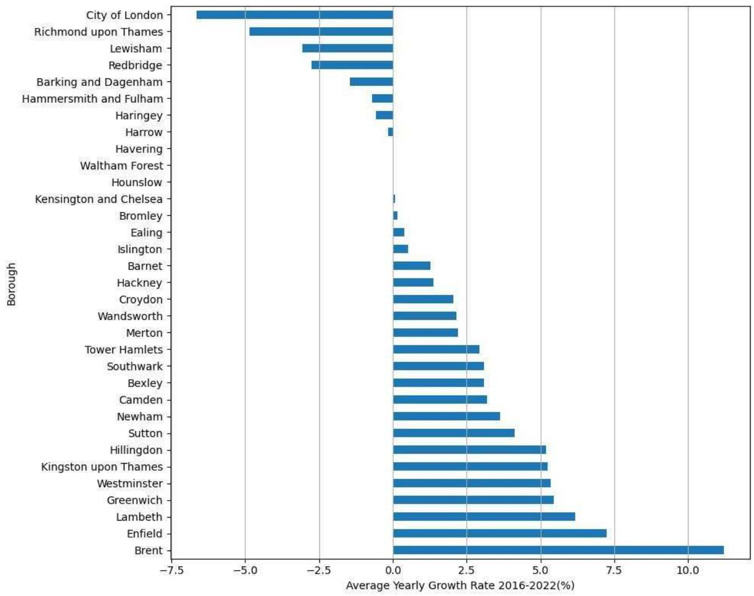


Figure D2.

The bar chart illustrates the proportion of adults who cycle at least once a week in various London boroughs as of 2022, with a red line indicating the median percentage, which is 10.5%. Hackney, Southwark and Hammersmith and Fulham tops the list with over 25% of adults cycling at least once a week. Outer London boroughs have significantly lower cycling participation rates then Inner London boroughs.

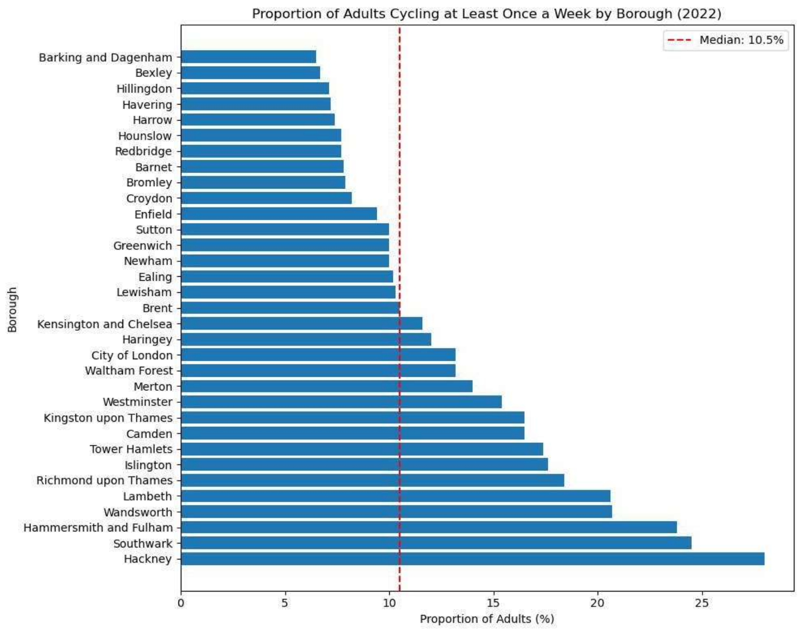


Figure D3.

The scatter plot shows the proportion of adults cycling at least once a week in 2022 for various London boroughs, plotted against the average growth rate in cycling activity from 2016 to 2022. Growing Cycling - boroughs with above-median cycling rates and a positive growth rate in cycling activity. Stagnating/Decreasing Cycling - high proportions of cyclists but show negative growth rates. Emerging Cycling - below-median cycling rates but have shown positive growth, indicating that cycling is becoming more popular in these areas. Low Cycling - low proportions of cycling and negative or negligible growth rates.

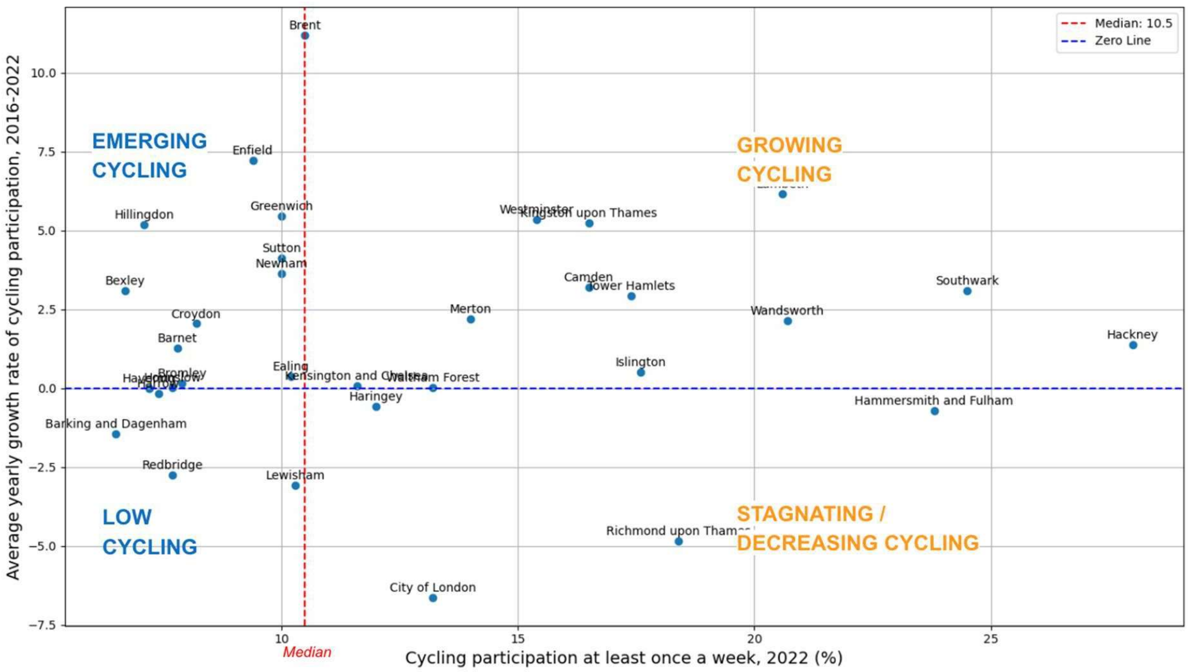
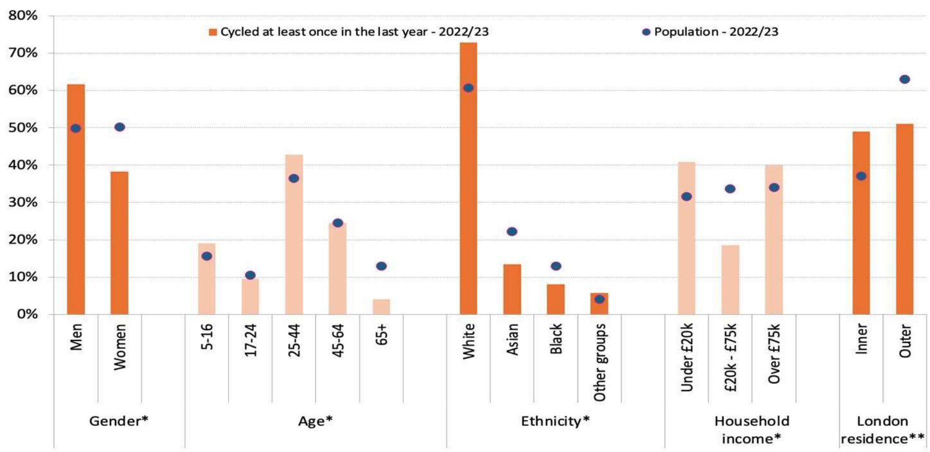
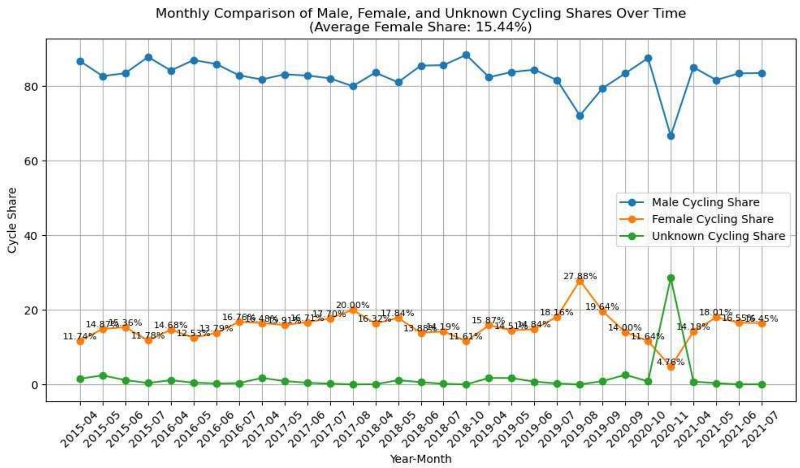


Figure D4.



The chart displays various demographics and their cycling activity in London for 2022/23. A higher percentage of men cycled at least once last year compared to women. The 17-24 age group shows the highest percentage of cycling participation. The youngest (5-16) and the oldest (65+) age groups have the lowest cycling participation. The White demographic has the highest percentage of individuals who cycled at least once last year. Households with an income over £75k show much higher cycling participation than those under £20k, indicating that income levels may influence the ability to access cycling or the desire to use it as a mode of transport. Residents of Inner London cycle significantly more than those in Outer London.

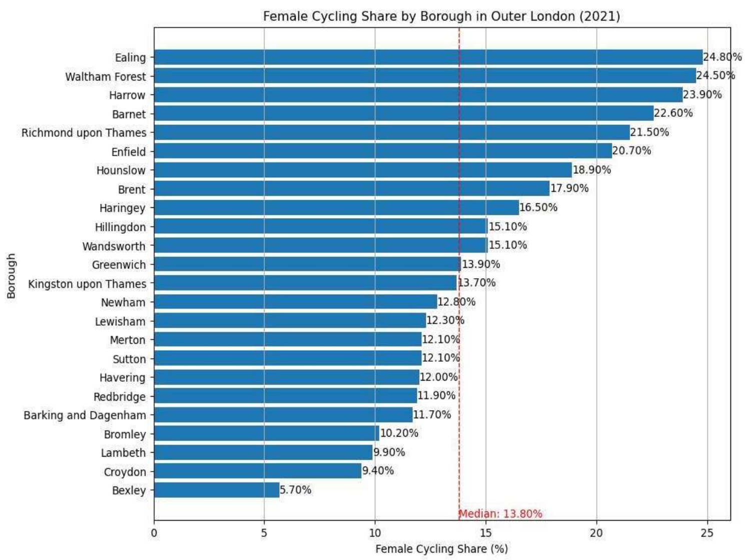
Figure D5.



The line graph shows the monthly comparison of male, female shares in cycling participation over time from May 2015 to July 2017 on the streets of Outer London. The average female share of cycling during this period is indicated as 15.44%.

Figure D6.

The proportion of female cycling participation by borough in Outer London for the year 2021. Ealing, Waltham Forest and Harrow also show strong female participation. Lambeth, Croydon, and especially Bexley, which has the lowest at 5.70%, indicate significantly lower levels of female cycling participation.



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