CS506 Bus Transit Performance Team D -

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Problem Motivation

Public transportation plays a crucial role in the quality of life for residents in Massachusetts and the Greater Boston area. However, how confident can we be that the quality of service is equal for all reachable areas? With such a substantial impact on resident day-to-day life, it is necessary to quantify how “fair” Boston’s public transportation is, and which areas perceive better/worse quality of service.

Project Goal

We explored key questions such as: How does the quality of public transportation services vary across different neighborhoods? Are there discernible disparities in service frequency, reliability, and accessibility? How do factors such as income levels, racial demographic, and geographic location correlate with the perceived quality of public transportation?

Extension Project: Focused on how Demographic Factors play a role in Bus Ridership/Accessibility.

Data Collection and Cleaning

Collected Data from the https://mbta-massdot.opendata.arcgis.com/ website. The following 5 Datasets were used for analysis:

1. Boston Census Dataset
2. Boston Neighbourhood Demographics
3. Bus Reliability
4. Bus Ridership by Time Period, Season, Route Line, and Stop
5. Wheelchair/Accessibility

In addition, data from the https://api-v3.mbta.com/ api was utilized to obtain bus level information such as "vehicle_number", "route_id" and the bus stops each particular bus would visit along with their coordinates.

Division of Work

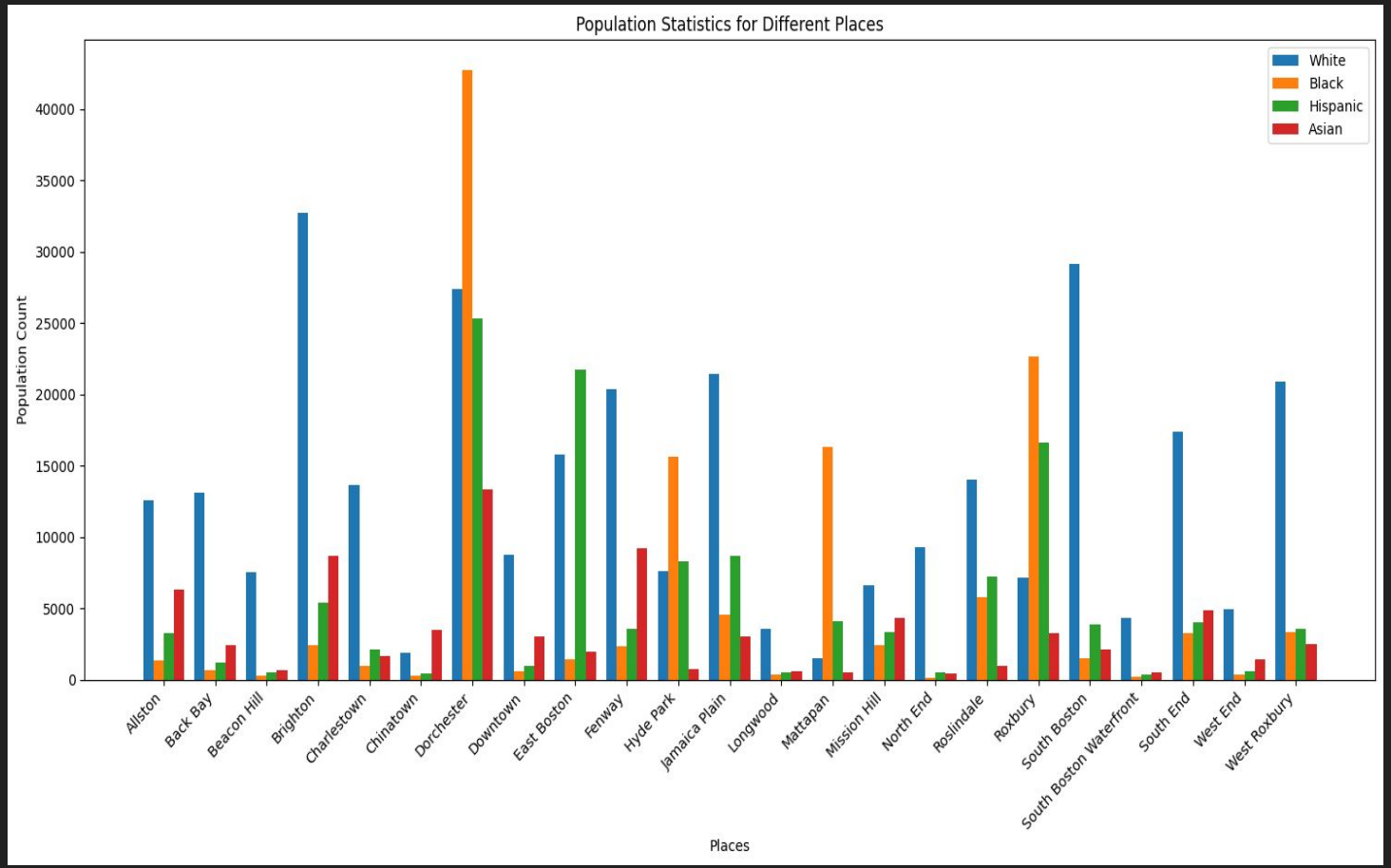
- Rishven and Haoxiang - Data preprocessing, base questions 1, 2, extension project
- Xavier and Ketan - Data collection, cleaning, preprocessing, base questions 1, 2, 3, 5, extension project
- James - Data preprocessing, extension project, presentation and slides

Base Questions:

1. What are the end-to-end travel times for different bus routes
2. Are there disparities in the service levels of different routes? (which lines are late more often than others)
3. What are the population sizes and characteristics of the communities serviced by different bus routes (e.g. race, ethnicity, age, people with disabilities/ vulnerabilities)?
4. If there are service level disparities, are there differences in the characteristics of the people most impacted?
5. Which routes are better/worse, differences in quality of service by class/race, contributing variables, ect.

Extension Project: Demographic Factors on Bus Ridership/Accessibility

Extension Project: Demographic Factors on Bus Ridership (Race)

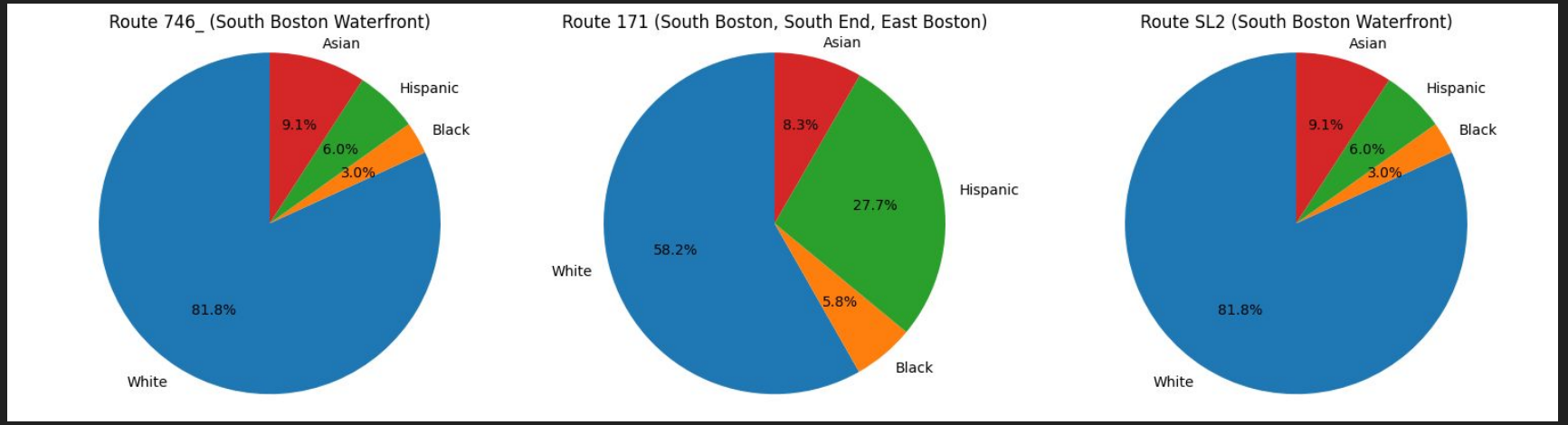


Neighborhoods sorted based on wheelchair accessibility:

Charlestown
East Boston
Downtown
Brighton
Hyde Park
Allston
Dorchester
Mattapan
Back Bay
West End
Fenway
West Roxbury
South End
Jamaica Plain
Chinatown
South Boston
South Boston
Waterfront
Mission Hill
North End
Longwood
Beacon Hill
Roxbury
Roslindale

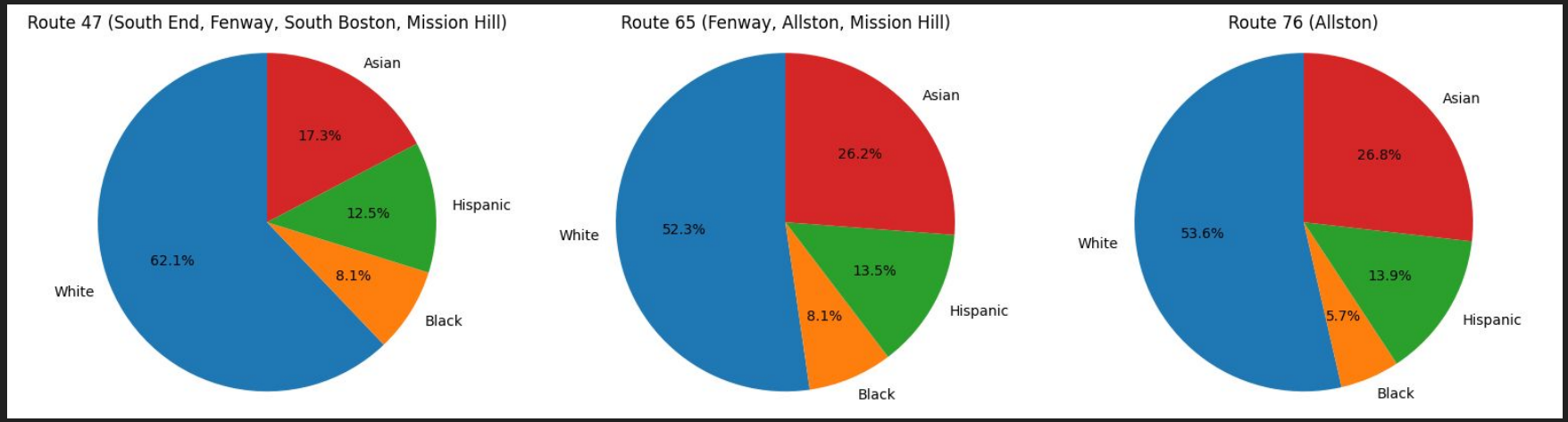
Extension Project: Demographic Factors on Bus Ridership (Race)

Top 3 Least Late Routes



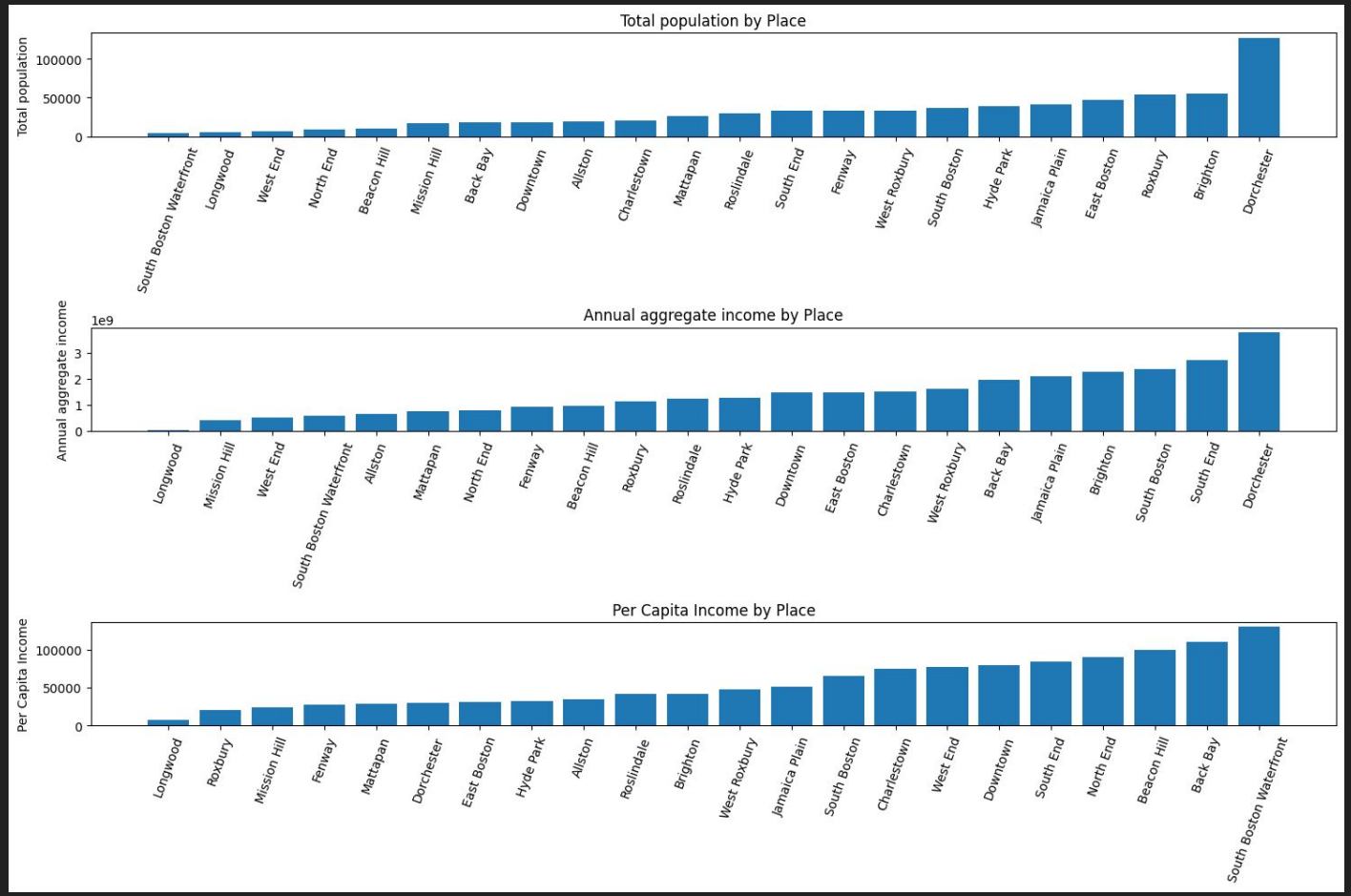
Extension Project: Demographic Factors on Bus Ridership (Race)

Top 3 Most Late Routes



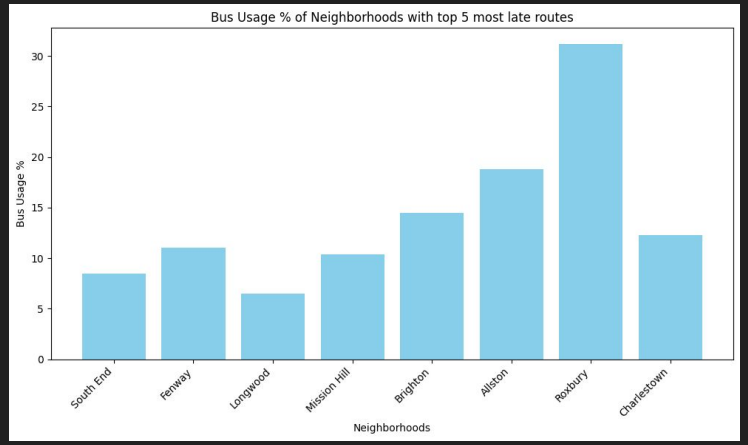
Extension Project: Raw Analysis of Incomes

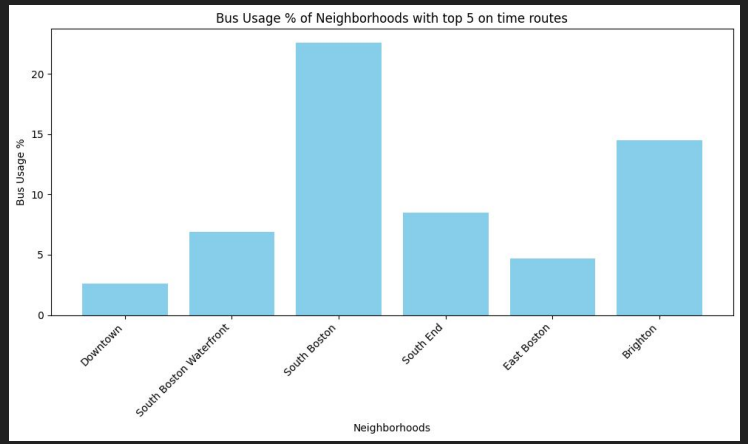
- To better understand what is causing Per Capita Income to be high or low
- South Boston Waterfront has very less population.
- Can draw new conclusions based on this information - Outliers, etc.



Extension Project: Demographic Factors on Bus Ridership (% Bus Users)

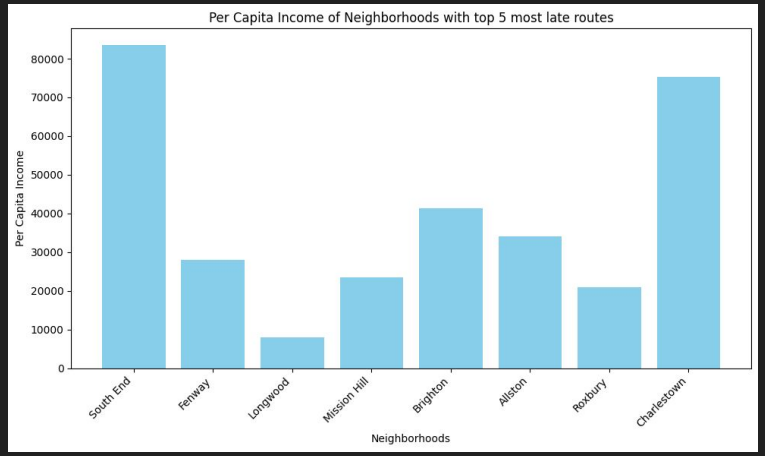
Place	num_stops	Bus
Roxbury	130.0	31.2
South Boston	144.0	22.6
Mattapan	715.0	20.0
Dorchester	487.0	19.6
Allston	507.0	18.8
Brighton	730.0	14.5
Charlestown	876.0	12.3
Hyde Park	375.0	12.1
Fenway	66.0	11.0
Mission Hill	78.0	10.4
Jamaica Plain	66.0	9.9
Roslindale	104.0	9.4
South End	85.0	8.5
South Boston Waterfront	28.0	6.9
West Roxbury	234.0	6.7
Longwood	40.0	6.5
East Boston	1229.0	4.7
West End	12.0	3.0
Back Bay	49.0	2.9
Downtown	26.0	2.6
Beacon Hill	7.0	2.2
North End	12.0	0.9

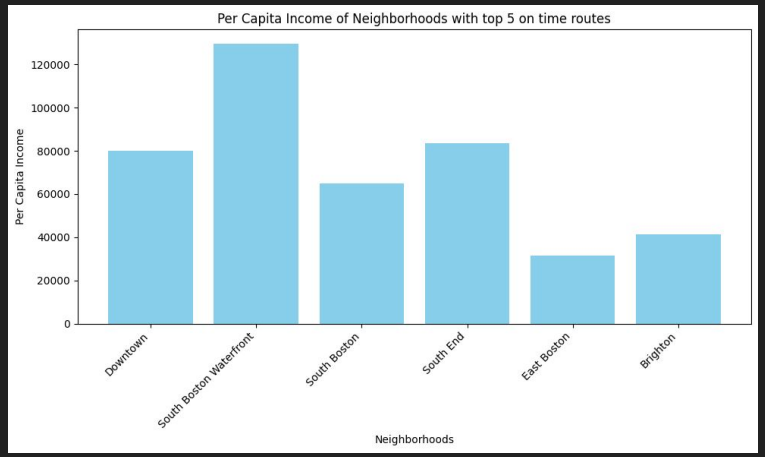




Extension Project: Demographic Factors on Bus Ridership (Per Capita Income)

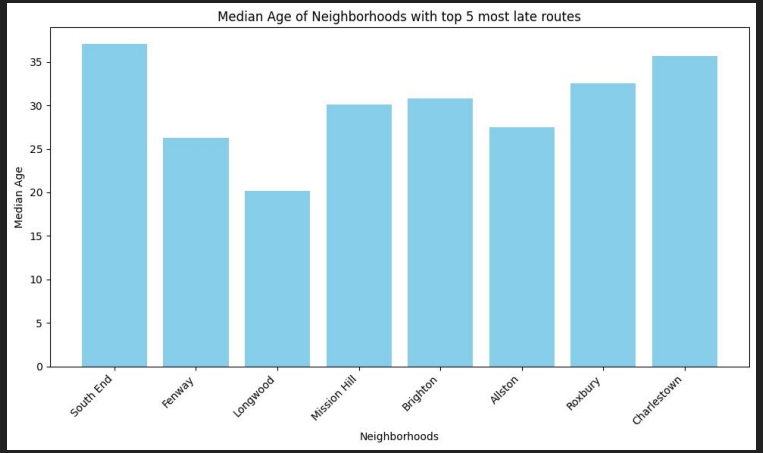
Place	num_stops	Income
South Boston Waterfront	28	129651.0
Back Bay	49	110677.0
Beacon Hill	7	100005.0
North End	12	89696.0
South End	85	83609.0
Downtown	26	80057.0
West End	12	77069.0
Charlestown	876	75339.0
South Boston	144	64745.0
Jamaica Plain	66	51655.0
West Roxbury	234	47836.0
Brighton	730	41261.0
Roslindale	104	41252.0
Allston	507	34149.0
Hyde Park	375	32744.0
East Boston	1229	31473.0
Dorchester	487	29767.0
Mattapan	715	28356.0
Fenway	66	28021.0
Mission Hill	78	23446.0
Roxbury	130	20978.0
Longwood	40	7975.0

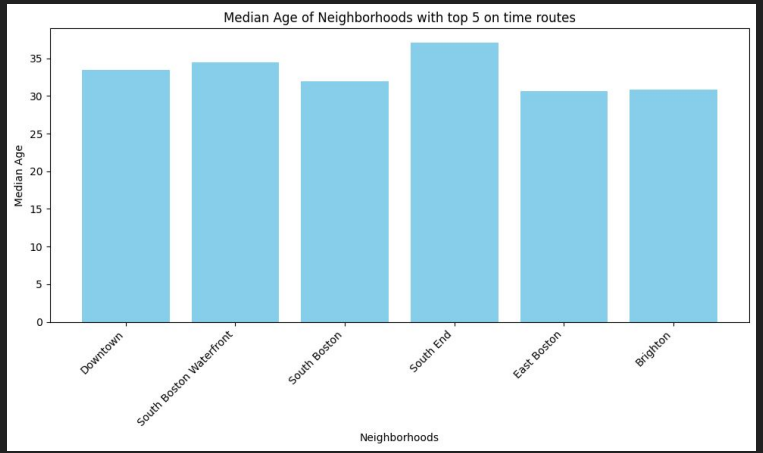




Extension Project: Demographic Factors on Bus Ridership (Age)

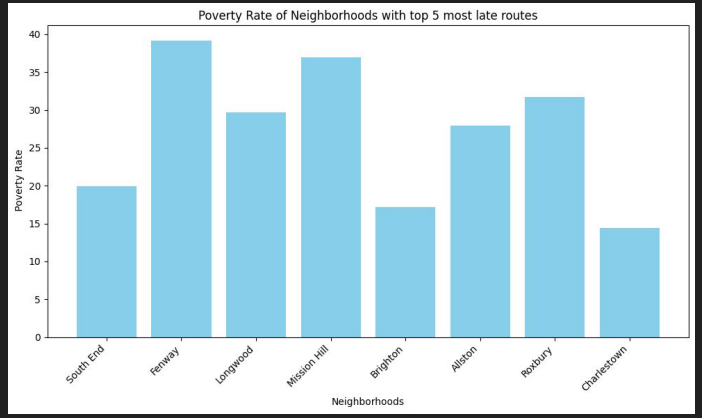
Place	num_stops	Median Age
West Roxbury	234	42.8
Roslindale	104	39.8
Hyde Park	375	39.4
West End	12	37.8
South End	85	37.1
Mattapan	715	36.7
Charlestown	876	35.7
Jamaica Plain	66	34.8
South Boston Waterfront	28	34.5
Downtown	26	33.5
Dorchester	487	33.4
Roxbury	130	32.5
South Boston	144	31.9
North End	12	31.1
Brighton	730	30.8
East Boston	1229	30.6
Mission Hill	78	30.1
Allston	507	27.5
Fenway	66	26.3
Longwood	40	20.2

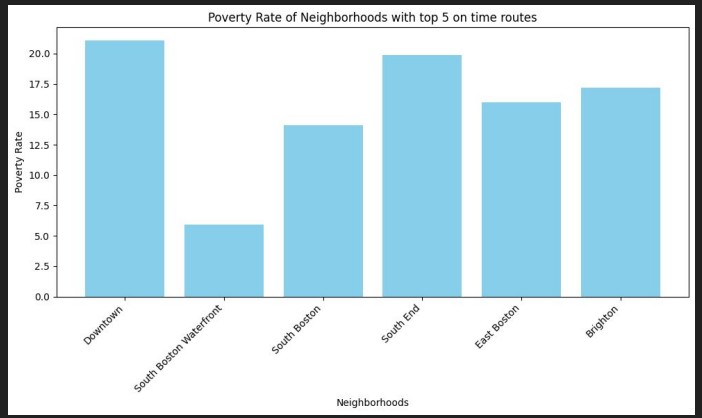




Extension Project: Demographic Factors on Bus Ridership (Poverty Rate)

Place	num_stops	Poverty Rate
Fenway	66	39.2
Mission Hill	78	37.0
Roxbury	130	31.7
Longwood	40	29.7
Allston	507	27.9
Dorchester	487	22.2
Downtown	26	21.1
Mattapan	715	20.1
South End	85	19.9
Brighton	730	17.2
East Boston	1229	16.0
Hyde Park	375	14.9
Charlestown	876	14.4
South Boston	144	14.1
West End	12	14.0
Jamaica Plain	66	12.8
Back Bay	49	11.9
Roslindale	104	9.8
North End	12	8.0
Beacon Hill	7	6.4
West Roxbury	234	6.3
South Boston Waterfront	28	5.9





Reflection on Progress So far

Progress:

- We have done exploratory analysis for demographic factors include race, age, income, poverty rate, etc to explore how they correlate to the accessibility of Bus ridership for citizens in different region of boston.

Insights from Dataset:

- There evidently is a larger population of Black, Asian, and Hispanic people In communities that experience more lateness.
- The lateness heat map shows a high concentration of delayed stops running across Commonwealth, Fenway, Roxbury, Mission Hill, and Chinatown.
- Commonwealth, Fenway, and Mission Hill are college hubs. .
- However, looking into Roxbury and Chinatown should yield more information.
- Not only does Roxbury have a higher minority population, it also has less bus stops as its neighboring communities that are predominantly white.
- This trend is apparent across Boston area when we examine the plot “Number of Bus Stops vs. Demographic”.
- Chinatown and neighboring districts within the heart of the city experience constant congestion. As a result, bus delays are more frequent. Recently in 2022, the MBTA decided to not include Chinatown in the Orange Line Shuttle Route, which affects the lives of many people who depend on shuttles to travel to and from Chinatown & Tufts.
- Looking at this data the people of South Boston, Roxbury, Dorchester, Mattapan, Chelsea, Revere, East Somerville and Lynn are feeling the brunt of unreliable service. We notice that a majority of people in these community do not own personal vehicles, and thus rely on public transportation (e.g. the bus) in the absence of rapid transit.

Next Steps:

- We can explore more about the household type of families in different region of Boston which correlate with Bus ridership of people. In addition, we could try to find how the racial group distribute in downtown area specifically since it is the center-area of city which could lead to more representative observations.

The End

Individual Contribution:

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