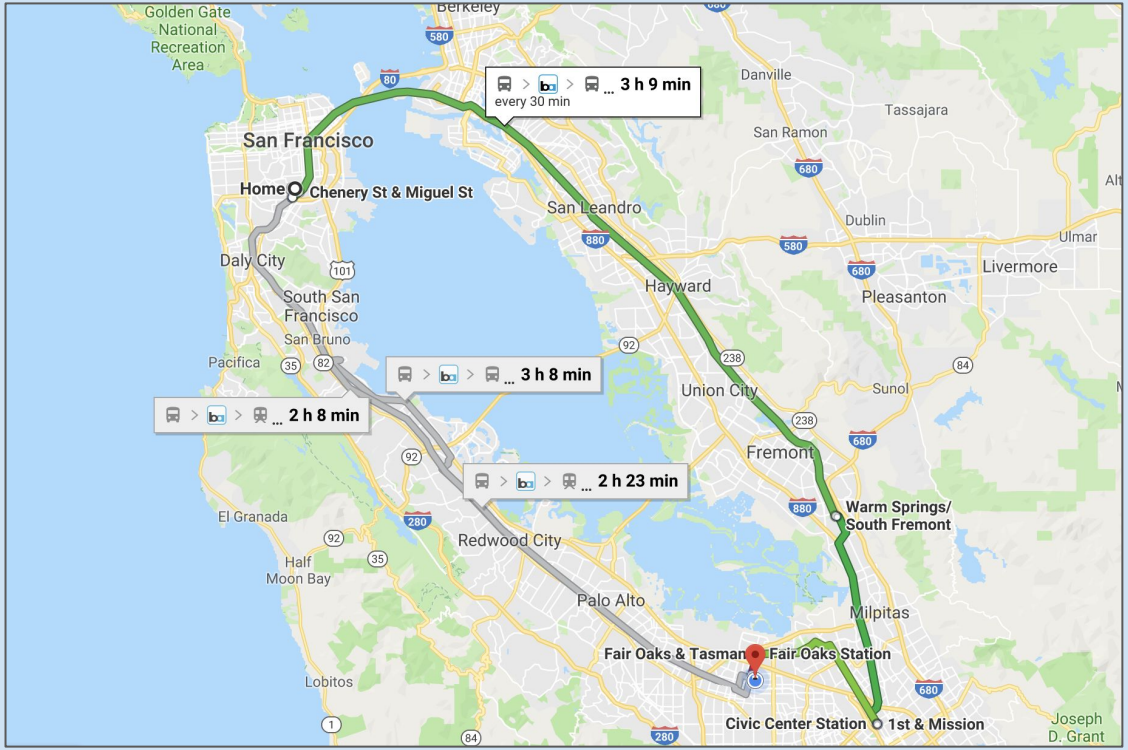
Making BART GREAT *for once*…

An evaluation of the Bay Area Rapid Transit compared to top world metros

Project Team:
Eric
Mana
Rohan
Matt

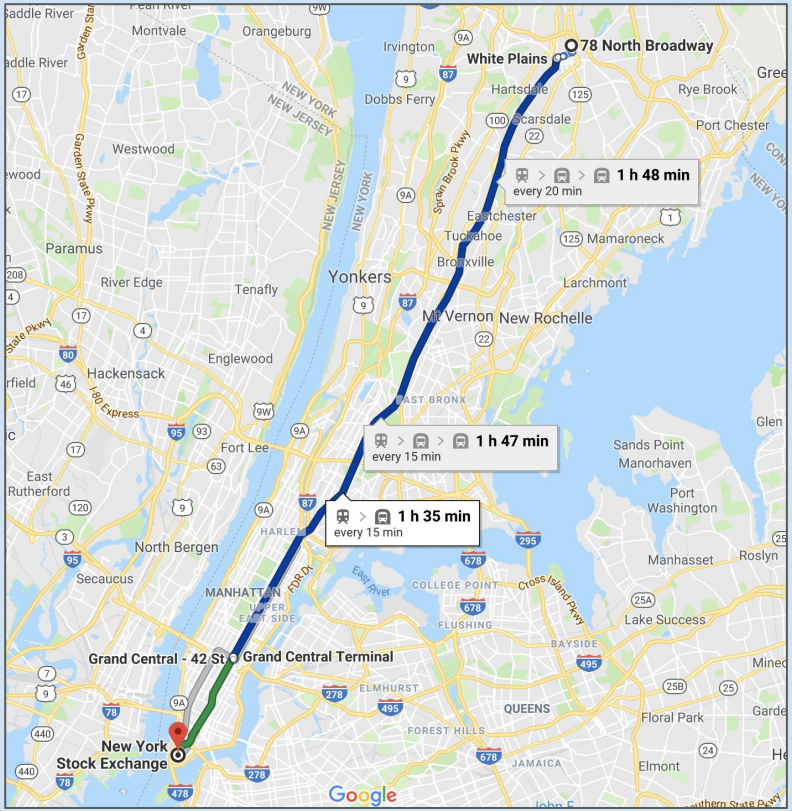
Me

New Job, New commute



My friend Phil

His commute



Presentation Outline

- Background/Executive Summary
- Research Questions to Answer
- Data sources/cleaning
- Objectives with visual outputs
- Challenges/Limitations with Analysis
- Reject/DNR Null hypothesis
- Summary of findings
- Recommendations
- Sources

Research Questions to Answer

1. How many destinations does BART serve compared to other metro systems?
2. What is the total track length that BART offers compared to the other metro systems?
3. BART Customer Satisfaction - How satisfied? What are top complaint categories?
4. Operating cost per passenger per mile comparison?
5. Explore metro population compared to total city population

BART = Bay Area Rapid Transport

- Does not cover the entire bay area
- Not rapidly transport

Data Sources/Cleaning

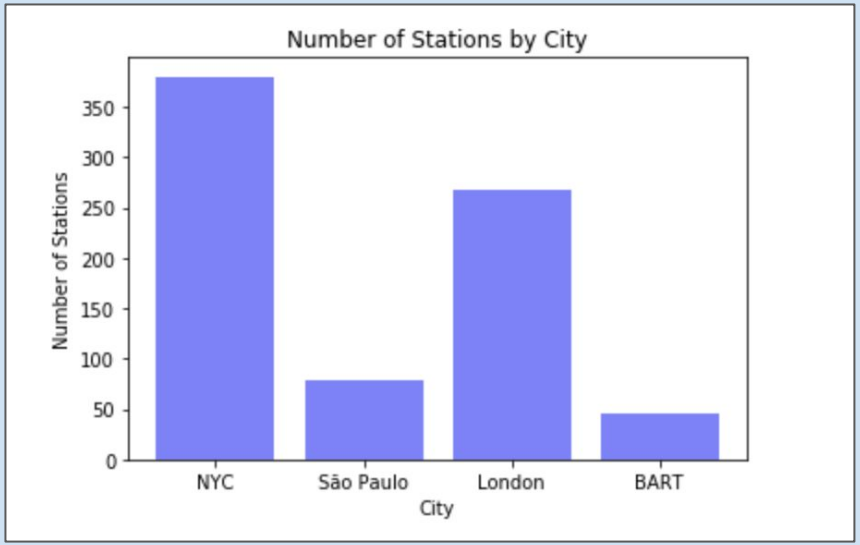
In [4]:
```
#NYC subway data
#bring csv into pandas dataframe
nyc_metro_file = os.path.join('nyc-metro-data', 'stops.csv')
with open(nyc_metro_file, newline='') as metro_holder:
    nyc_metro = csv.reader(metro_holder, delimiter=',')
    nyc_metro_headers = next(nyc_metro)
    nyc_metro_data = pd.DataFrame([row for row in nyc_metro])
#cleaning nyc data
nyc_metro_data = nyc_metro_data.rename(columns={0: nyc_metro_headers[0],
                                                1: nyc_metro_headers[1],
                                                2: nyc_metro_headers[2],
                                                3: nyc_metro_headers[3],
                                                4: nyc_metro_headers[4],
                                                5: nyc_metro_headers[5],
                                                6: nyc_metro_headers[6],
                                                7: nyc_metro_headers[7],
                                                8: nyc_metro_headers[8],
                                                9: nyc_metro_headers[9]})
nyc_metro_data = nyc_metro_data.drop(columns=['stop_code', 'stop_desc', 'zone_id', 'stop_url'])
#nyc_metro_data.head()
nyc_station_total = len(nyc_metro_data.stop_name.value_counts())
print(f'The NYC subway has {nyc_station_total} stations.')
```

```
The NYC subway has 380 stations.
```

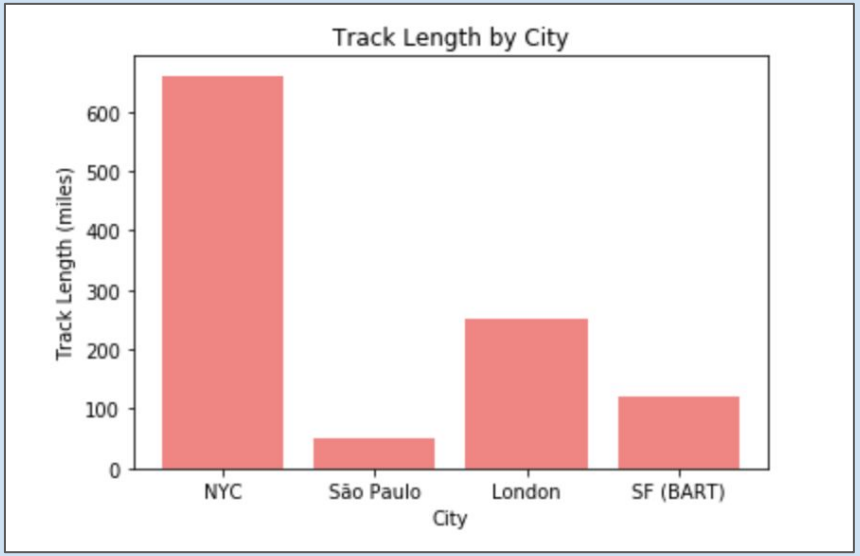
In [7]:
```
# London tube fares 2019
tube_fares_2019 = {"Zones Traveled": ["Zone 1", "Zone 1 & 2", "Zone 1 To 3", "Zone 1 To 4",
                                      "Zone 1 To 5", "Zone 1 To 6", "Zone 2 To 6"],
                   "Single Journey Ticket Adult": [4.90, 4.90, 4.90, 5.90, 5.90, 6.00, 5.90],
                   "Single Journey Ticket Child": [2.40, 2.40, 2.40, 2.90, 2.90, 3.00, 2.90],
                   "Oyster Card Peak": [2.40, 2.90, 3.30, 3.90, 4.70, 5.10, 4.40],
                   "Oyster Card Off Peak": [2.40, 2.40, 2.80, 2.80, 3.10, 3.10, 3.00]}

def poundToDollar(pound):
    dollar = pound * 1.23
    return round(dollar, 2)

for d in range(0, len(tube_fares_2019["Single Journey Ticket Adult"])):
    tube_fares_2019["Single Journey Ticket Adult"][d] = poundToDollar(tube_fares_2019["Single Journey Ticket Adult"][d])

for d in range(0, len(tube_fares_2019["Single Journey Ticket Child"])):
    tube_fares_2019["Single Journey Ticket Child"][d] = poundToDollar(tube_fares_2019["Single Journey Ticket Child"][d])

for d in range(0, len(tube_fares_2019["Oyster Card Peak"])):
    tube_fares_2019["Oyster Card Peak"][d] = poundToDollar(tube_fares_2019["Oyster Card Peak"][d])

for d in range(0, len(tube_fares_2019["Oyster Card Off Peak"])):
    tube_fares_2019["Oyster Card Off Peak"][d] = poundToDollar(tube_fares_2019["Oyster Card Off Peak"][d])

tube_fares_2019 = pd.DataFrame(tube_fares_2019)
tube_fares_2019
```

Analysis with Visual Summary

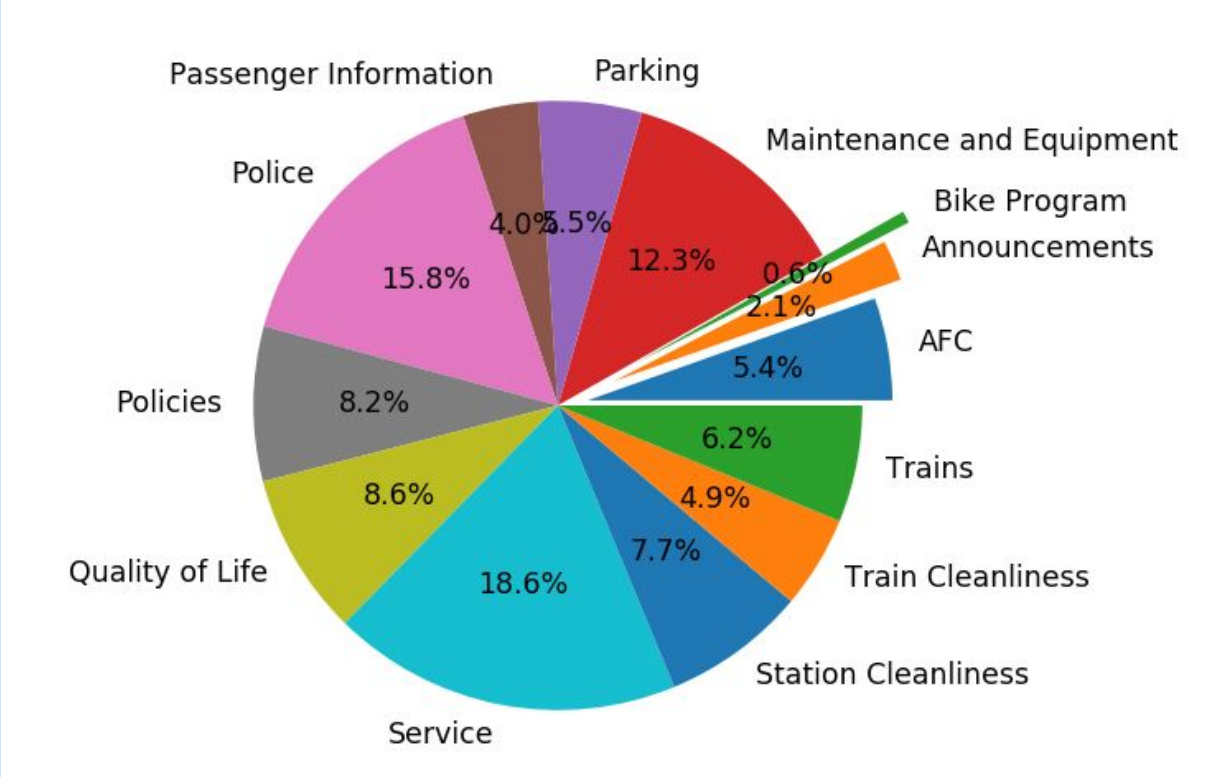
How many destinations does BART serve compared to other metro systems?



What is the total track length that BART offers compared to the other metro systems?



BART Customer Complaints - Snapshot Q1-Q2 2018

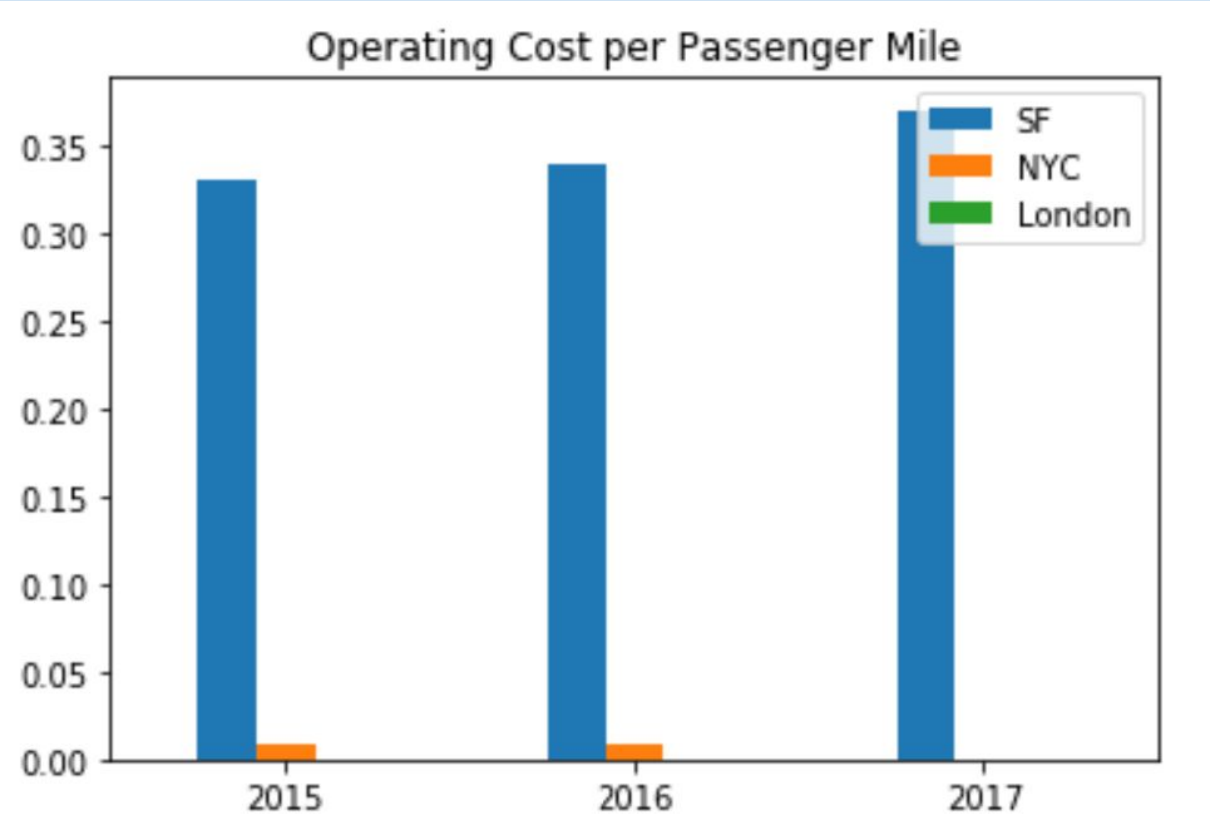


*AFC - Automatic Fare Collection

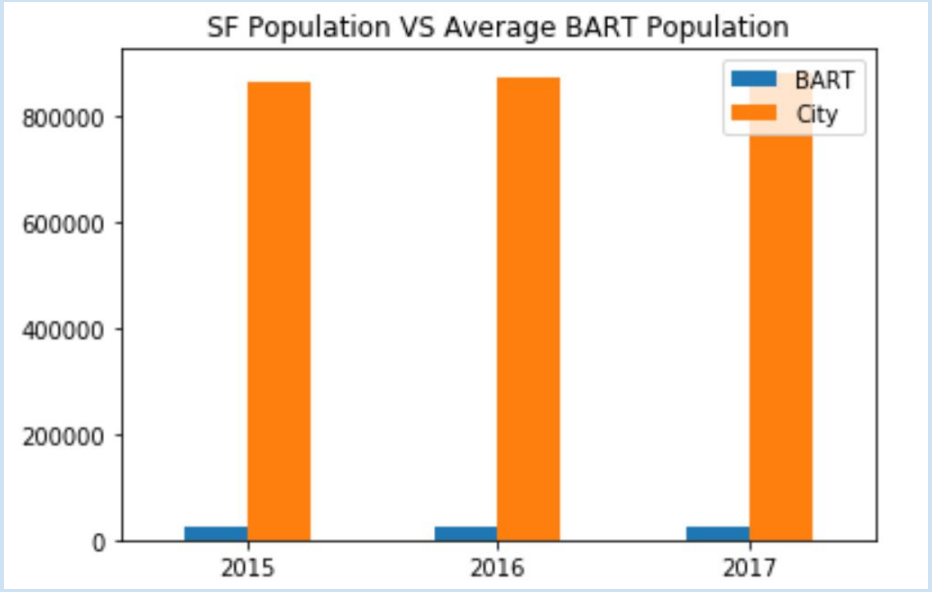
BART Customer Satisfaction Survey Results

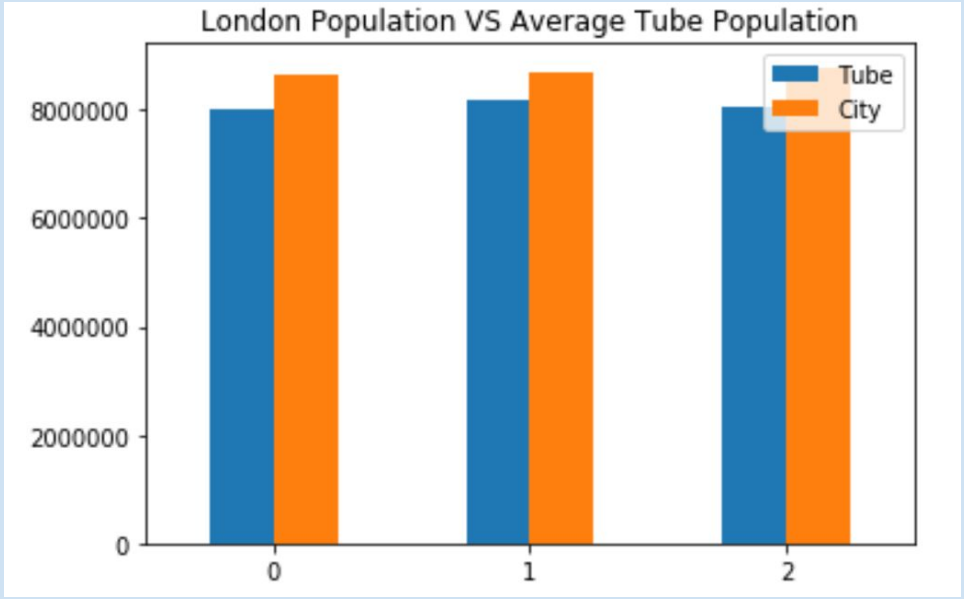
Year	Very Satisfied	Somewhat Satisfied	Neutral	Somewhat Dissatisfied	Very Dissatisfied	Missing	Very or Somewhat Satisfied
2008	42%	41%	10%	4%	1%	0%	84%
2010	36%	46%	12%	5%	1%	0%	82%
2012	40%	44%	11%	4%	1%	0%	84%
2014	28%	46%	15%	8%	2%	1%	74%
2016	24%	45%	17%	11%	3%	0%	69%
2018	16%	40%	22%	15%	6%	0%	56%

Operating Costs



City Population VS Average Metro Population





Challenges/Limitations with Analysis

Data Collection

- Incomplete/Lack of Data
- Time tables didn’t line always line up for comparing data
- Proper Sourcing for 3rd party data

Data Analysis

- Reformatting complex files - time consuming
- Merging creating errors on Github
- Collaborating with different time schedules/time-zones to complete analysis

Summary of Findings

H_0 = BART is the worst subway system in our sample

Poor data availability and lack of historical data has forced us to focus on fundamental, linear issues within metro systems. With larger data sets, t-test's and even ANOVA tests could be run to check the significance of our comparisons.
BART is proven to be extremely inefficient in all categories sampled.

1. How many destinations does BART serve compared to other metro systems? Fewest of all comparison cities
2. What is the total track length that BART offers compared to the other metro systems? Least track length compared to other metros sampled
3. BART Customer Satisfaction - How satisfied? What are top complaint categories?
4. Operating cost per passenger per mile comparison? Highest cost per passenger per mile in our sampled metros
5. Explore metro population compared to total city population - BART had the lowest usage percentage by population compared to other sampled metro cities

Recommendations

- More stations/lines
- Increase efficiency per rider
- Better police presence and services
- Explore data sharing for best practices from other metro institutions
- Increase marketing campaign efforts to educate public on use of BART
- Incentive users to use BART and give tax incentives to commuter supported companies offering benefits to employees
- Propose exploratory study on upgrading the structure and design of BART to modernize design and efficiency of layout
- In 2013, BART conducted a thorough study on
    - https://www.bart.gov/sites/default/files/docs/BART%20SCOA%20Final%20Report%20June%202013.pdf

A key service strategy objective is to reduce unproductive service miles as much as possible

Recommendations directly from BART Survey 2013

In 2013, BART conducted a thorough study on

- https://www.bart.gov/sites/default/files/docs/BART%20SCOA%20Final%20Report%20June%202013.pdf

System investment - grow membership
Maximize load capacity
Access to stations - landuse and forecast ridership
A key service strategy objective is to reduce unproductive service miles as much as possible

Recommendations directly from BART Survey 2013 cont’d

The main service strategies that had been considered are:

- Express and Limited-Stop Service
- Skip-Stop Service
- Zone-Based Service
- Short Line Service
- Coupling
- Timed Transfers
- Schedule Optimization
- Differentiation Between Services
- Service Reconfiguration

Sources

1. https://www.kaggle.com/citylines/city-lines
2. BART Rider Reports
3. BART Open Data
4. https://www.kaggle.com/thiagodsd/sao-paulo-metro
5. https://www.kaggle.com/new-york-state/nys-metropolitan-transport-authority-mta-data
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7. https://data.cityofnewyork.us/browse?Dataset-Information_Agency=Metropolitan+Transportation+Authority+%28MTA%29
8. http://www.metro.sp.gov.br/en/pdf/sustainability-report-2015.pdf (Sao Paulo Survey)
9. https://www.metrotransit.org/data/sites/1/media/blog/metro-transit-rider-survey-2014---final.pdf (Sao Paulo Survey)
10. https://developer.transportapi.com/documentation/tube-information (Wait times for London)
11. https://www.londontoolkit.com/briefing/underground.htm
12. http://content.tfl.gov.uk/tfl-annual-report-and-statement-of-accounts-2018-19.pdf
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