Bart Data Analysis

Intro

In the past 15 years, the Bay Area Rapid Transit (BART) system, the mass transit system that joins San Francisco and Contra Costa County, has been subject to many factors of change; most notably, the rise in ridesharing apps, Uber and Lyft, as well as the Covid-10 pandemic and its lasting impact.

The purpose of this paper is to:

1. Investigate overall trends in BART ridership leading up to the pandemic.
2. Show the impact the pandemic on ridership.
3. Chart the commute patterns to SF Downtown, a hub of corporate and retail activity, to understand the larger implications of Covid-19 on commerce and recommend city planning changes.

Although this paper is accessible to everyone, the primary audiences of this project are the BART Board of Directors, the SF Planning Commision, and the SF Downtown Merchant Association.

BART Background

BART started service in 1972 and has grown to 50 station across five counties. It joins San Francisco International Airport, Oakland International Airport, with San Francisco Downtown, and Oakland Downtown. Currently, BART operates from 5am-12am. Although its most popular destinations are SF Downtown, it connects outer San Francisco and Contra Costa County suburbs to the metropolis.

Since BART is a civic project, it relies on regional and state funding to maintain the operational costs. The pandemic has impacted BART Riderships and they are currently relying on its $1.6 billion emergency federal funds to subsidize operational costs. More information on BART here.

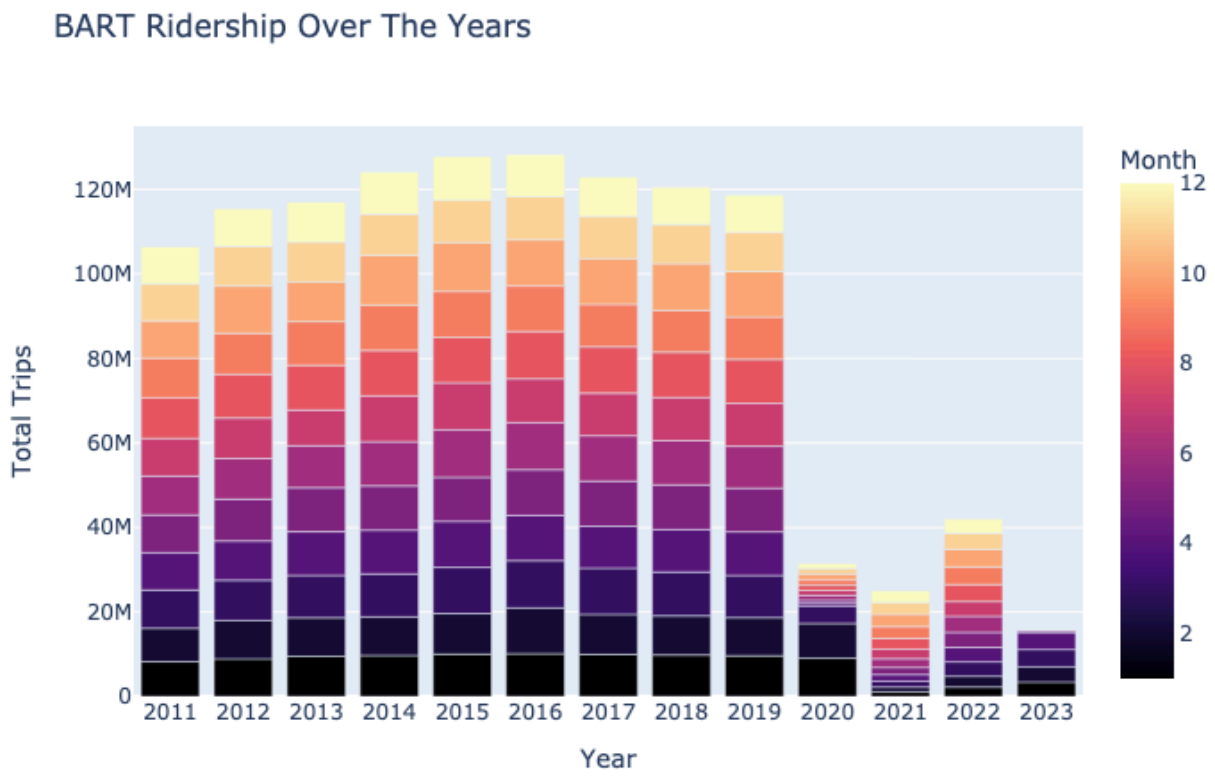
Project Scope and Methodology

The following analysis is based on a single dataset, procured from Kaggle. Its author is BART. The data tracks the bart ticket scans as a rider travels a trip. The rider scans at their origin station, and once again, at their destination station. The data summarizes the total trips per hour per unique combination of origin and destination station.

The data encapsulates all rider data from January 1st, 2011 to April 30th, 2023.

A station map, showing BARTs routes is provided for reference. Downtown SF is defined as the four stations Embarcadero (EMBR), Montgomery St. (MONT), Powell St. (POWL), and Civic Center (CIVC).

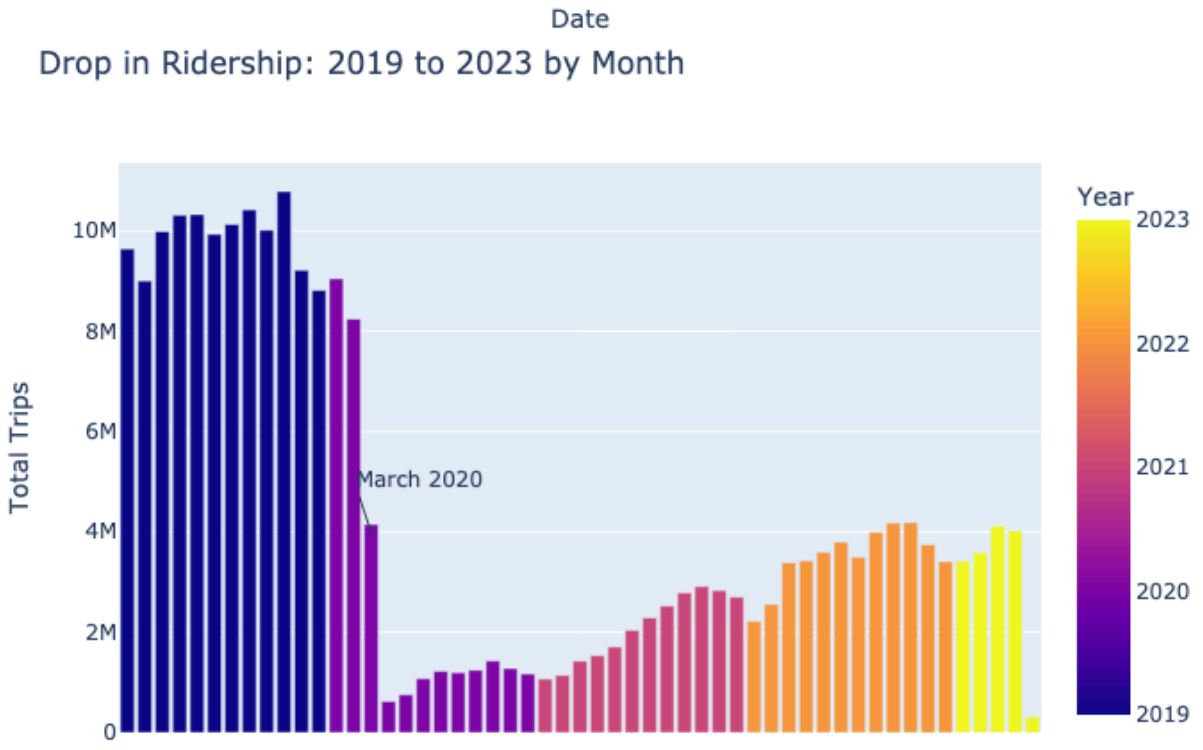
2011- 2023 Ridership: Rideshare Growth and Covic



From 2011 to 2019, before the pandemic, BART averaged 120 millions rides a year, peaking in 2016 at 128 million, steadily decreasing by 7.4% in 2019. During this stretch of time, Uber and Lyft ridesharing apps launched their fleets and grew in revenue year over year.

It is possible that the decrease in 2016 to 2019 is a result of riders switching from BART to rideshare apps, although the extent of the impact would need to be further studied. Nevertheless, 2019 ridership exceeds that of 2013 and prior.

In March 2020, ridership dropped drastically. This correlates to the COVID-19 shelter in place ordinance effective March 16th, 2020.



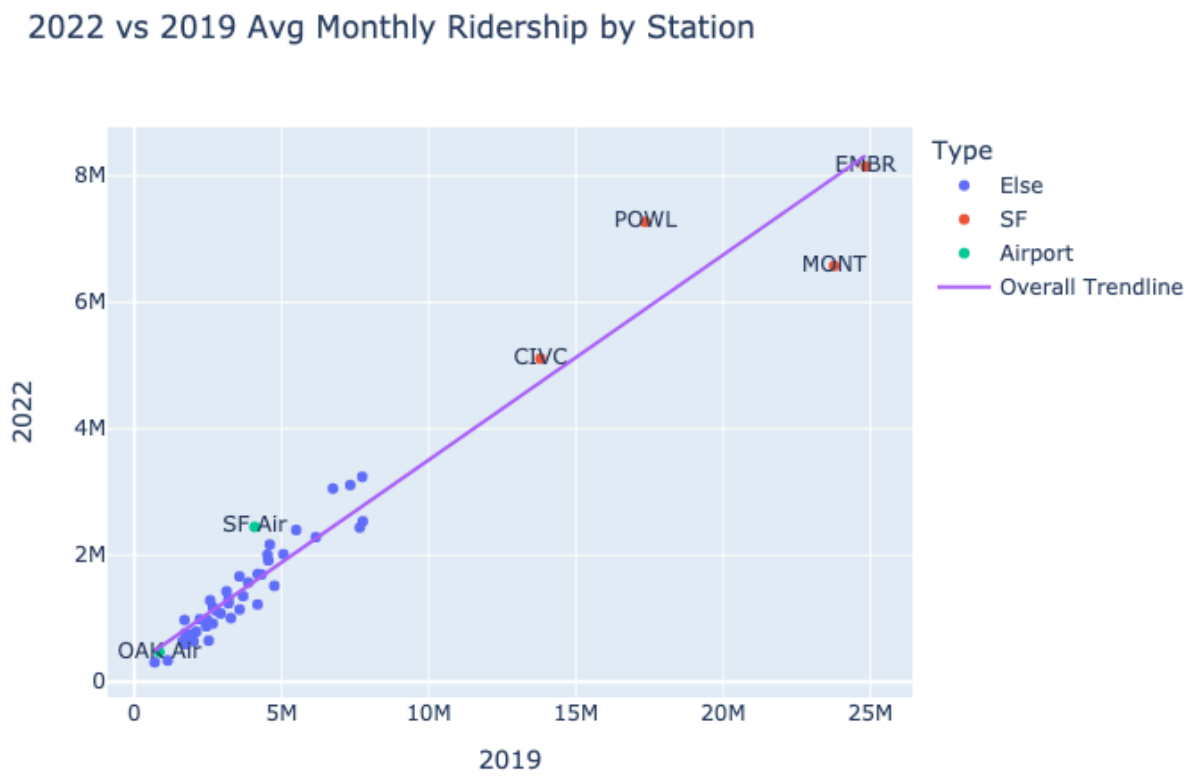
In the above figure, 2020 monthly ridership dropped from 8 million to less than 1 million in just a couple months. April 2020 marks the lowest total trips in the 2011-2023 timeframe; 2021 totals the lowest yearly trip count at 20.87% of pre-pandemic yearly mean (2011-2019).

Since then, BART ridership has grown in waves, with each year's peak around September, coinciding with the end of summer and back to school. Ridership shows signs of continued growth as numbers have not plateaued.

Despite this growth, there are many questions that remain: When will growth level out? Will ridership return equally for each station? What are the lasting impacts of shelter in place? What can the city do to foster growth?

*Please note: 2023 data is incomplete but indicates steady year over year growth coming out of the pandemic.

BART Rebound in the Pandemic



The above figure compares the total monthly riders per station in 2019 vs 2022. We are using 2019 data to represent pre-pandemic ridership, and 2022 data to represent our most up to date snapshot.

On average the bounceback rate, defined as the percent 2022 of 2019, is around 32%, which is depicted by the purple line. On average stations are 32% as busy as they were prior to the pandemic.

The four red dots, representing SF Downtown, have the highest volumes of all stations. EMBR and CIVC have bounceback rates close to stations average, while POWL shows a higher rate (41.78%) and MONT a lower (27.66%). In fact, despite being the second busiest stations, MONT has the second lowest bounceback rate and a large impact on ART's overall rebound.

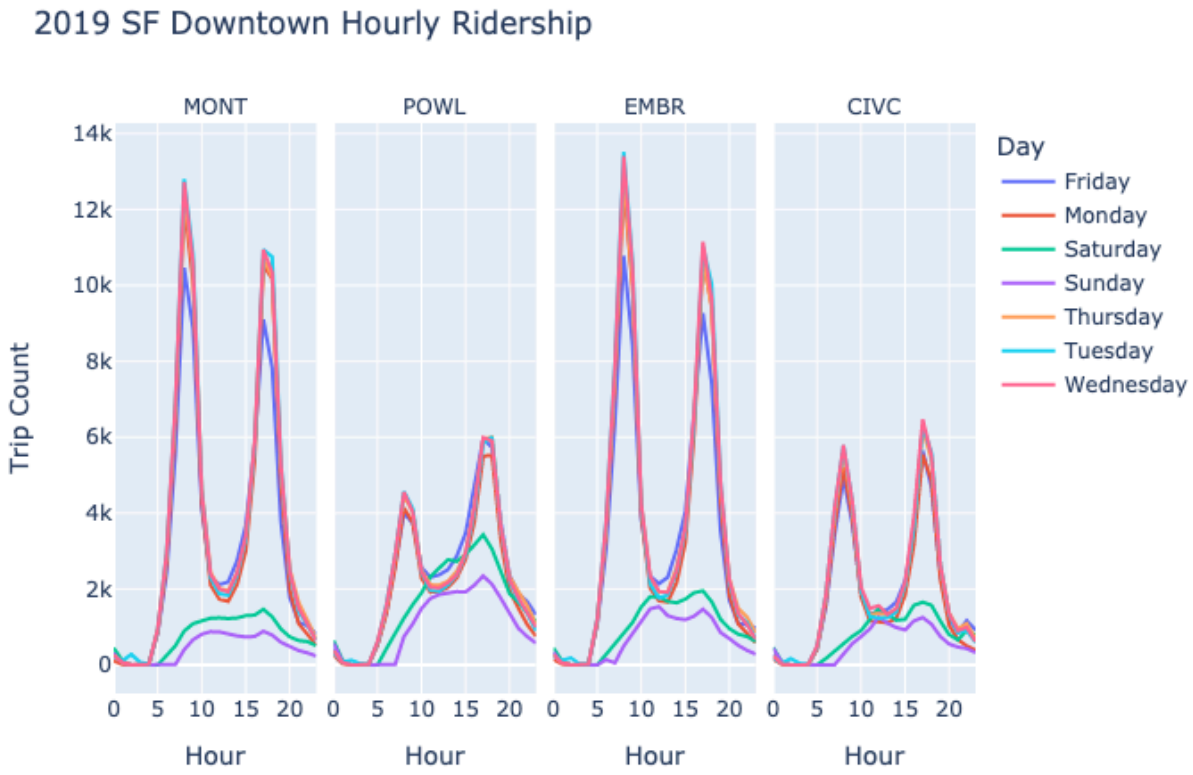
Other stations of note: The stations that have higher than average bounceback rates are airports and end of the line suburban stations. These higher rates could be attributed to fewer transportation options: a lack of rideshare, prohibitively expensive fares, and a lack of buses. In addition, these stations do not have high ridership in general, so people living near those stations may also be driving or not traveling into central areas as frequently.

Covid Impact on SF Down Commute Patterns: Work From Home and Retail

SF Downtown stations are the busiest station and make up 33.6% of total trips in 2019. In 2022, this percentage decreased to 30.2%.

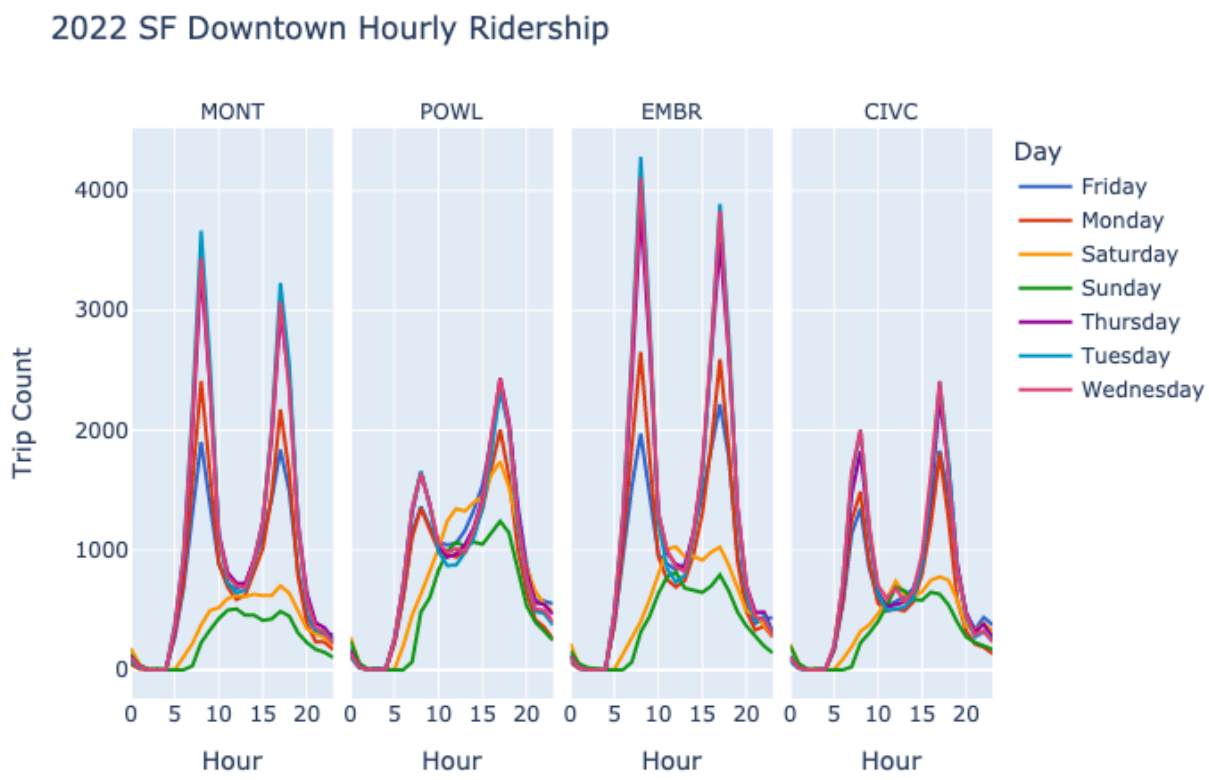
A deep dive into ridership by hour by day examines changes in commute patterns.
At this point, it is helpful to define these stations and their neighboring commercial uses:

- EMBR - Surrounded by Financial District, Google Corporate, and waterfront retail, visited by tourists.
- MONT - Surrounded by Corporate Offices.
- POWL - Surrounded by major shopping malls and hotels.
- CIVC - Surrounded by City Hall and City Departments.



The 2019 Figure shows two distinct travel patterns, weekday and weekend. Weekdays follow the same pattern and magnitude. They have two distinct peaks, 8am and 5pm. For MONT and EMBR, Fridays are 81.25% of other weekdays.

On weekends, Saturday is slightly busier, but shows a broad curve, with peak travel times between 3-5pm, representative of commercial and recreational activity. POWL shows the greatest weekend activity consistent with being close to downtown retail.



The 2022 Figure shows the same two commute trends, now with more variance by day. This is most visible for MONT and EMBR, the two stations with corporate offices. There is now a clear rank of ridership by day: Tuesday the busiest, and Friday and Monday being the slowest.

Friday ridership is at 47% and 51% of Tuesdays during peak morning commute for EMBR and MONT respectively. Less than half of commuters are using BART to come to work on Friday.

The lower numbers reflect a changing work from home policy for computer based work. While lower ridership shows that fewer people are commuting downtown, the variance in the curves show a work from home policy that allows employees to come to work three days a week: Tuesday, Wednesday, Thursday.

CIVC center, the hub for city services, also shows lower commute on Monday and Friday but not to the same degree (Friday is 67% of Tuesday at peak hours). Unlike EMBR and POWL areas, these are city services and organizations and may be subject to a more uniform work policy. In

addition, city work requires more interfacing in person, as compared to tech and corporate web based jobs.

POWL station weekend activity is a compelling point of interest. From the scatterplot above, remember that POWL bounceback rate from 2019 to 2022 is higher than average (41% vs 32%). Saturday visibly exceeds the weekday activity at noon. In fact, in 2019, weekends represented 19% of total trips, and in 2020 that increased to 23%.

Summary and Discussion

Over the past decade, BART Ridership tells the story of San Francisco Bay Area transportation and commuter habits as rideshare apps launched and the pandemic changed the way we travel and gather.

When Covid-19 and the first shelter in place ordinance in March 2020 took effect, BART ridership plummeted to less than 20% of its former ridership. Through the pandemic, BART has provided a consistent service, despite drastically lowered populations. During this time, BART has been supported by federal emergency disaster relief funds to maintain operations.

Since March 2020, ridership has growth month over month and as of April 30th, 2023, aggregate ridership has grown to around 39.48% of pre pandemic numbers. Ridership continues to grow, but may not return in full due to lasting changes from the pandemic.

Stations have come back to around 32% of their 2019 numbers, but not all equally. Most notably, Montgomery Station, the second highest station lags at 27% of its 2019 volume. This dip is indicative of changing Monday and Friday commute numbers.

During the pandemic many corporate offices adopted a remote work model, some transitioning back to in office work as time continued. Many provided hybrid models where employees came in three days a week, Tuesday, Wednesday, and Thursday. If these policies continue, which is likely, commute numbers will not return to pre pandemic numbers in full and will level off at a lower number.

In addition to these work models, many corporations have chosen to vacate their office buildings entirely. Salesforce has reduced their occupancy in their own Salesforce tower. Google recently announced that it will not renew its lease in SF Downtown. With employers leaving SF Downtown, BART ridership is at risk of waning.

Given these changes, it is imperative to start envisioning what SF Downtown could look like in the next ten years.

As shown in the POWL station data, commute to the area is actually higher than average. When motivated by retail, recreation, and leisure, riders will continue to visit these areas. Meanwhile, the pandemic has been challenging for retailers as well. As a result, many larger stores have

closed including Uniqlo, Forever 21, the Westfield Mall, and now Macy's. These brands sell their products online, so it is not imperative to maintain physical spaces to continue to sell their products.

With many offices and retailers closing, and a shift towards remote work takes effect, there are two main callouts:

1. BART ridership may not return to its former volume, reducing overall revenues for its busiest stations.
2. SF Downtown is at risk of losing its vibrancy, and its role as a hub for retail, tourism, and recreation.

In order to secure ridership numbers for BART and to maintain a vibrant downtown, SF City should plan for a SF Downtown that is more retail and recreation than corporate offices, proportionately.

SF City should focus on creating SF Downtown as a destination for in person experiences that cannot be duplicated remotely. Some possible recommendations include:

- Ensure that empty storefronts are filled, even temporarily, with installations or short term leases that engage foot traffic.
- Create commercial streets that are pedestrian only (closed to vehicles) and promote a more immersive retail and leisure experience.
- Center SF Downtown as a destination for dining and events. Event days are recommended for Fridays 5pm-7pm (to encourage weekday commuters to come in Friday), and Saturday and Sunday from 12pm-6pm.
- Work with food establishments in corporate dense areas to offer lower priced lunch options as a way to attract daily commuters back to the area.
- Remove blockers for small business and restaurants to open these larger spaces, possibly by working with building owners and merchants association to open food halls or shared spaces in which small business can afford to open.

Further Research

Given the costly strategies recommended to promote SF Downtown vibrancy, its is necessary to conduct further research to support these findings.

At a minimum, it is recommended to:

1. Analyze rideshare data (Uber and Lyft), to understand the impact of rideshare on commute patterns and support or refute daily commute patterns to SF Downtown.
2. Analyze SF Muni data (bus) to support or refute daily commute patterns to SF Downtown.
3. Randomized street surveys to understand riders' motivations for visiting the SF Downton area (work and retail), and understand their views on potential revitalization efforts.