Public Tableau Dashboard

DECLARATION OF THE USE OF AI

1. **Code to remove duplicates and missing values**
2. **Code to bind the excel files into one single file**
3. **Code to create find out the total of specific columns for different excel files**
4. **Code to arrange the total of the columns into a dataframe and assign months.**
5. **How can I publish tableau with multiple data source**
6. **How to add layers to a map in tableau**
7. **What is the step by step to create a data connection in tableau with two data sources**

Abstract

The bike-sharing service Divvy offers a combination between sustainability and fitness to the environment of Chicago with the aim to positively affect this area. This paper aims to explore how this positive effect can increase through answering a business problem, “How can Divvy Bikes Chicago leverage tools such as seasonal trends in ridership and preferences of station placement to optimise membership conversions and retention strategies?”. The business question will be answered with a combination of a data analysis with data retrieved from Divvy, which includes different diagrams, graphs and models and a literature review. As a result of answering the business question, the paper could contribute to boost Divvy’s positive effect by increasing the company’s output.

Introduction

Divvy bikes is a bike-sharing company based in Chicago with thousands of bikes and hundreds of bike stations. Divvy allows users to use their bikes casually or with a membership. To use their bikes casually, Divvy charges their users an unlock fee and an additional fee per minute the bike is used. Users with a membership have unlimited free of charge bike rides for 45 minutes and must pay an additional fee per minute after the 45 minutes are over.

In a recent study conducted by Faghih-Imani & Eluru (2015) regarding Divvy, trends in memberships and casual users were analysed. They found that members and casual users differ in elasticity regarding the use of the bike-sharing service with members being more inclined to use the service to commute throughout the year and casual users wanting to use the service recreationally. Therefore, the bike-sharing service is most popular for casual users in warmer months and or during the weekends, implying seasonality for casual users Faghih-Imani & Eluru (2015). Next to seasonality, Faghih-Imani & Elurru concluded that the preference for the number of stations and their respective capacity differs between members and casual users, suggesting that members typically prefer more stations and casual users prefer a higher capacity of bicycles at the most popular stations. Results from another study regarding the company CityCycle in Australia suggests a similar finding regarding the usage patterns of members. Their regular users seemed to recommend an increase in docking stations across suburban areas and more integration with public transport Fishman, et al (2012). On the contrary, casual users want to use

the service recreationally and want to visit the most popular spots. Typically, this results in casual users preferring a higher capacity at these stations, because there are only a few that are of interest to them. The preference for type of bike, classic or electrical, could also be relevant to Divvy to increase output or to decide which type of stations should be increased or decreased.

Based on these results, it is safe to assume that if the bike sharing service is looking to increase their output, it should focus on member conversion and retention since the number of members are more constant through the year. This might be achieved through station allocation, focus on bike type and it might be beneficial to introduce monetary incentives in the less popular months. There is a gap in the literature regarding the placement of new stations in less populated areas or monetary incentives to attract new members for the Divvy service in Chicago, setting the stage for the business problem which will be explored in this paper. The business problem is: “How can Divvy Bikes Chicago leverage tools such as seasonal trends in ridership and preferences of station placement to optimise membership conversions and retention strategies?”.

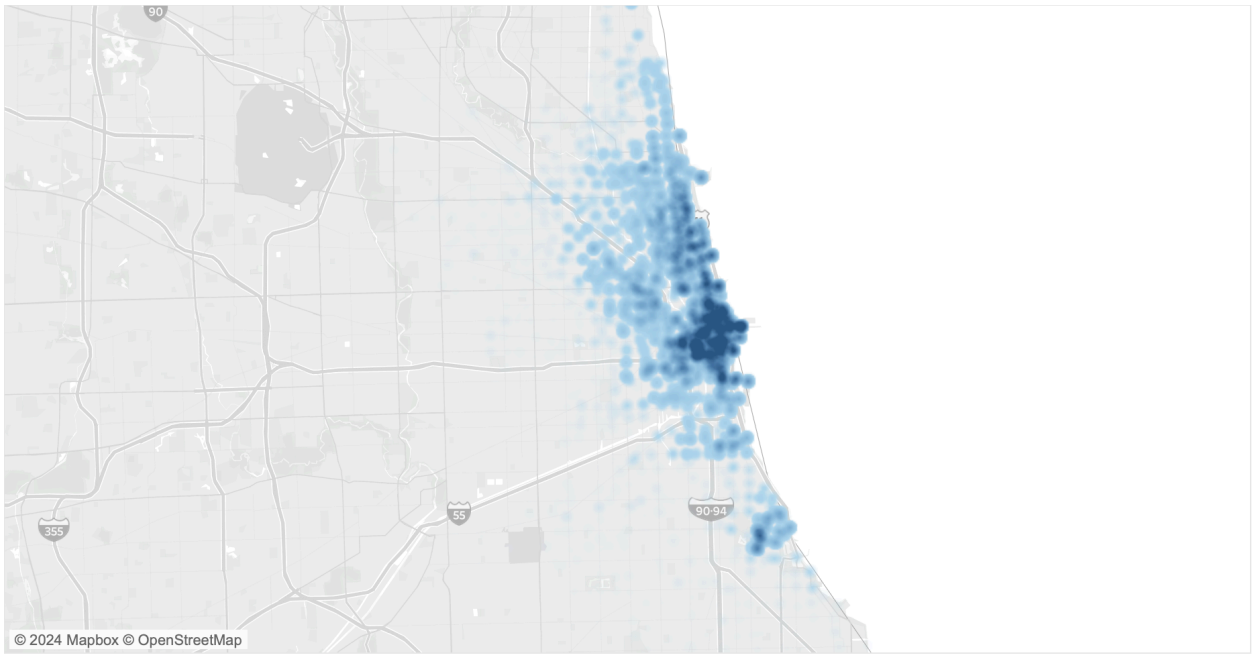
Data Source

Chicago's Divvy bikes system, a program of Chicago Department of Transportation(CDOT), is one of the largest bike share systems in the United States alongside many others managed by Lyft across multiple states. In an effort to focus on air pollution reduction, economic stability and alternatives to relieve traffic congestion, Divvy Bikes promote an easy way to travel within the city both for tourism, regular commuters and using the platform as a social engagement through means of single rides, day passes, memberships or a Lyft Pink Premium option (Divvy Bikes, n.d.).

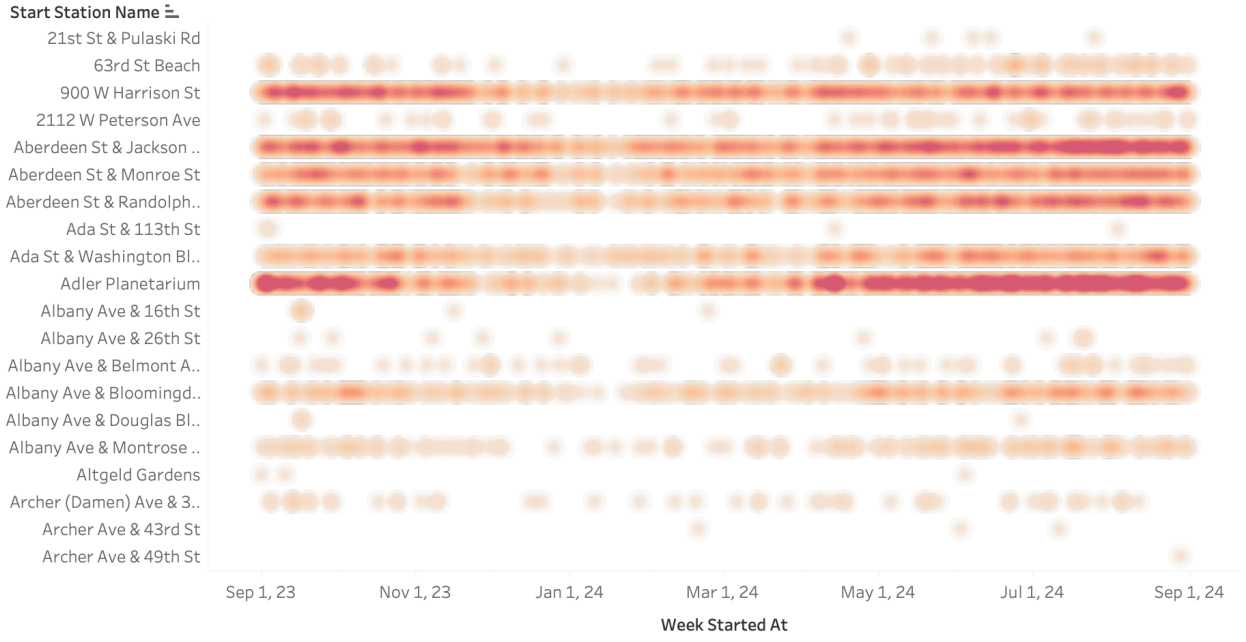
The dataset used, spans across a 12 month period (09/2023- 08/2024) and includes trip details such as, starting and ending location from the bike sharing program, as seen in the figure below. Importantly, the dataset includes geographical information to display the distribution of trip details across latitudes and longitudes in the city of Chicago, and most recently the expansion to the Evanston suburb (Divvy Bikes, n.d.). Unique trip identifiers account for 419,784 data points applied in the below research highlighting membership details.

The size and scale of Chicago is a noteworthy mention, as it's the third largest city in the United states, accounting for a population of approximately 2.6 million persons (U.S. Census Bureau, 2023). Annually, the windy city also receives approximately 2.1 million visitors (Office of Governor JB Pritzker, 2023). Within this population, the city accounts for a rather large urban city centre, where daily 1% of people choose to use biking as a transportation option, 86.7% utilising personal vehicles and 1.4% travelling by public transportation (Federal Highway Administration, 2022).

Figure 1, *Density trends and map of Chicago*



Map based on Longitude (generated) and Latitude (generated). Details are shown for Ride Id.



Descriptive Analysis

The data includes riding patterns of casual riders and members who pay subscriptions every year. The data also contains information on the type of bikes used in the form of classic and electrical bikes. Moreover, the start and end station of the rides taken with their respective longitude and latitude locations are available as well. After careful observation, missing values, duplicates and outliers were removed to structure the dataset for analysis. Considering the volume and therefore the computational difficulties of the large dataset, the dataset was reduced in size. The original dataset had over 5,000,000 observations spreading over 12 months. The data was reduced by sampling 10% of the observations of each month and these samples were subsequently merged into one dataframe. Both the descriptive statistics of the original dataset and the reduced sampling of the dataset were immensely similar, making a bias increase unlikely. The descriptive statistics of the smaller dataset can be observed in the below table 1.

Table 1: *Descriptive statistics of relevant variables*

Variables	Observations	Mean	Std. Dev.	Min	Max
Rideable type	419,783	0.330	0.470	0	1
Member_casual	419,783	0.646	0.478	0	1

Where for rideable type, the 1 indicates an electric bike and a 0 a normal bike. For member_casual, a 1 indicates a member and a 0 indicates a casual user. The amount of stations in the dataset is 1,351.

Figure 2: *Trends observed in the riding patterns of Casual versus Member riders*

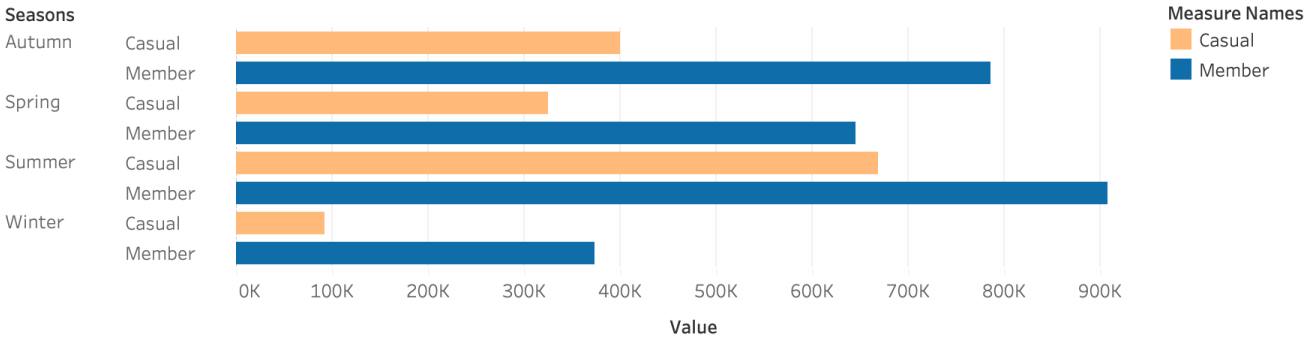


Figure 2 shows the distribution of casual and member users across the four seasons. We can see that summer and autumn are the most popular seasons and that spring and winter are less popular seasons. Where the winter season is significantly less popular than the other seasons.

Figure 3: *Trends observed in the type of bike chosen by the riders over the seasons*

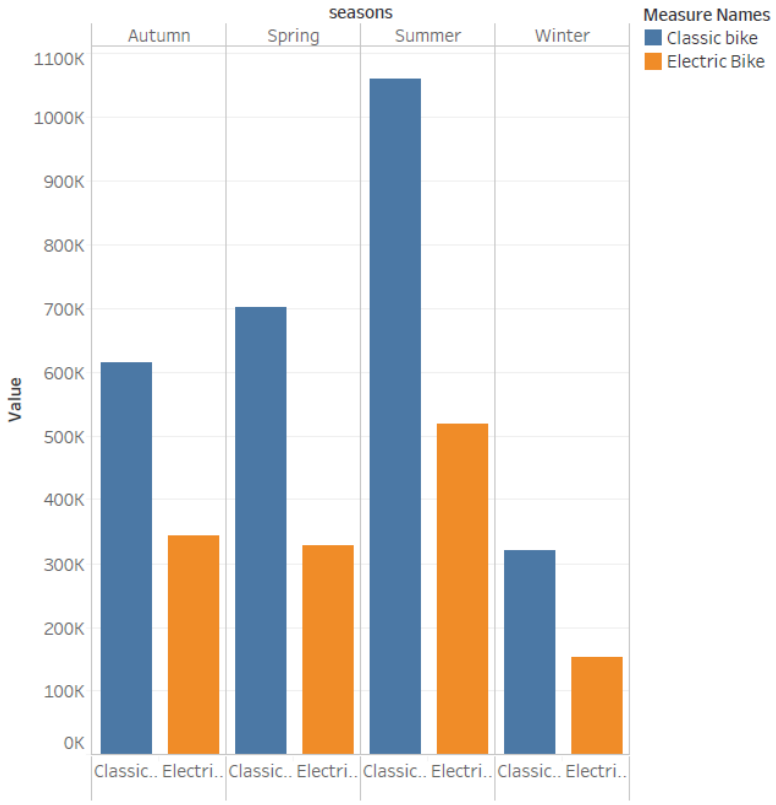
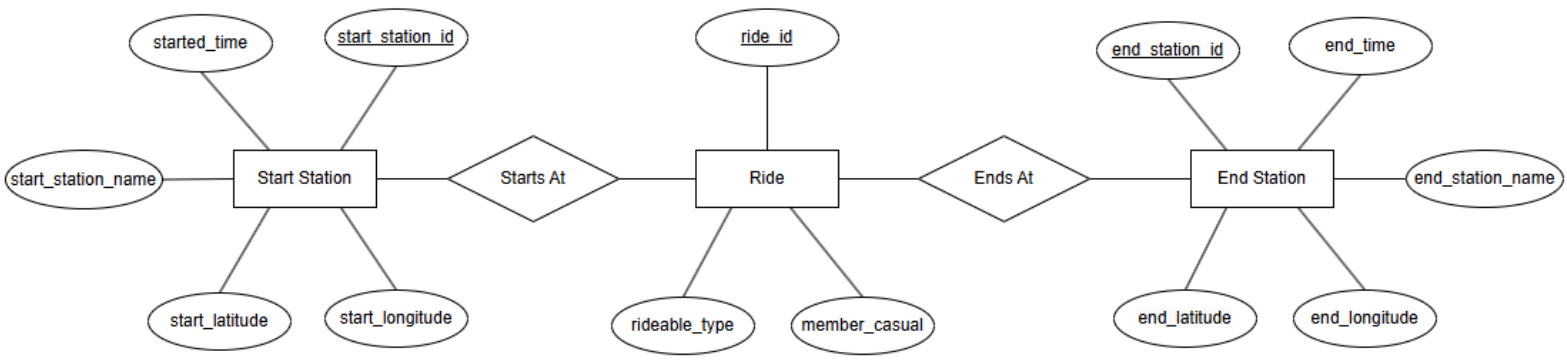


Figure 3 shows the trends on the types of bikes chosen by the rider for his journey over the four seasons. After observing figure 3, one can conclude that the classic bike is more popular than the electric bike besides the autumn season. The absolute gap between the two types is most accentuated for the summer season.

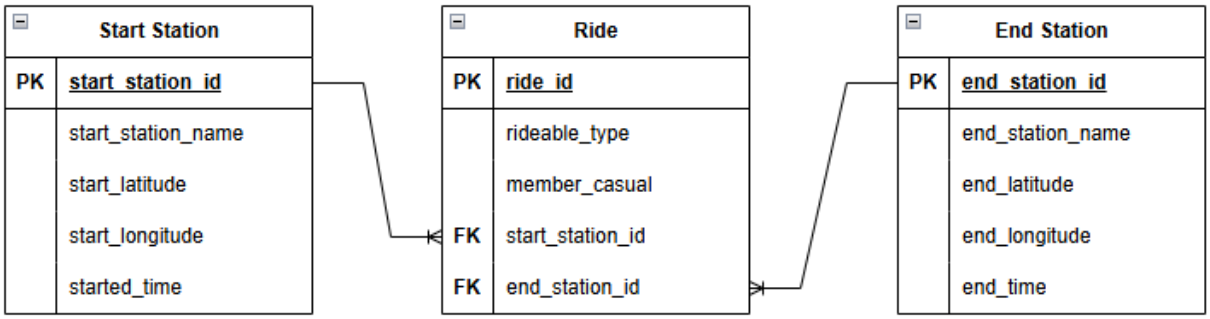
Entity-Relationship Diagram



An entity-relationship diagram (ERD) was created to represent the data structure of Divvy Bikes. The main part of the ERD is the *Ride* entity, which uniquely identifies each ride with a *ride_id*. The ERD includes attributes such as *rideable_type* to specify the type of bike used and *member_casual* to differentiate between members and casual users. Furthermore, the *Start Station* and *End Station* entities store detailed information about each station. The *Ride* entity has two key relationships: “Starts At” and “Ends At”, this structure ensures that every ride can be precisely connected to its start and end stations.

By separating station data, we can easily analyse key metrics like the most popular stations, usage rates and peak times, offering Divvy insights to optimise operational strategies and enhance the user experience.

Logical Database Model



In our logical database model, the primary key of the *Ride* table is *ride_id*, which uniquely identifies each ride. It also includes two foreign keys: *start_station_id* and *end_station_id*, which connect to the primary keys of the *Start Station* and *End Station* tables, respectively. These foreign keys allow each ride to be accurately linked to its start and end stations. The *Start Station* table's primary key is *start_station_id*, uniquely identifying each starting station, while the *End Station* table's primary key is *end_station_id*, uniquely identifying each ending station.

Discussion

Seasonal Patterns and Membership Conversion

Through our analysis on Divvy's data we can see changes in the number of casual riders and members throughout the year, where the warmer seasons on average have both more casual riders and members compared to the colder seasons. In figure 2, one can observe that the number of members is consistently significantly higher than the number of casual riders. This difference in the type of ridership is the most accentuated in the winter season. The elasticity trend observed from our data analysis is in alignment with the studies of Gebhart and Noland (2014) and Faghih-Imani & Eluru (2015).

This finding creates the opportunity for Divvy to use the found seasonality as a tool to increase the total membership. Firstly, Fishman (2016) emphasises that convenience and accessibility are strong motivators in bikeshare, especially during high-demand months. To tap into this demand, Divvy can utilise targeted promotions, such as limited-time summer passes or discounted seasonal memberships.

In addition to utilising the existing popularity of the service as a tool to convert casual riders into members for the popular summer and spring seasons, it can also be used as a tool to create demand in the spring and especially the winter seasons. Regular winter maintenance, such as keeping docking stations clear of snow and ice, can make winter riding more appealing by increasing convenience. Fishman (2016) highlights this importance of reliability and convenience in bikeshare retention, and Shaheen et al. (2014) suggest that “reliability assurance strategies,” including improved maintenance and dock availability, are crucial for sustaining member usage through colder months. Additionally, implementing winter membership bundles for a reduced fee, could increase demand with a monetary incentive.

Usage of ride type

After observing figure 2, one can conclude that classic bikes are the preferred bikes. The data shows that more than half of riding usage is concentrated on classic bikes. In the case of long distance or high frequency use, the battery of an electric bike can be depleted quickly, and finding a charging station to charge the bike is often a time-consuming and inconvenient task. This limitation may affect the user's riding plan, so many people prefer to choose a classic bike that is not limited by the battery to ensure the continuity and convenience of the journey. In cold or bad weather, the use of electric bikes is more restricted, and riders may not be willing to brave the cold weather to find a charging station.

Therefore, prioritising classic bikes and its stations could be a better strategy to attract and retain more users. The maintenance of classic bikes and the stations would also be less costly compared to electric bikes, because of the extra equipment and labour needed for the electric bikes (DeMaio, 2009).

Docking station allocation in relation to membership retention

After exploring opportunities in membership conversion, the general preference for the classic bike sets the stage for the other tool Divvy can use to increase membership retention, which is station allocation. In figure 1, the density map of the stations in Chicago is presented. This figure shows us how there are opportunities to increase the number of stations in certain areas around the city centre. Increasing these stations in areas with low station numbers could be beneficial for membership retention, especially throughout the winter season. Fishman, et al(2012) found that members prefer a higher number of stations as opposed to casual riders who prefer a higher capacity for bikes in the stations. The popularity of the classic bikes is beneficial for the costs correlated with increasing the number of stations, because classic bikes and the respective stations, as stated above, are less costly.

Conclusion

To summarise, using tools such as seasonality, monetary incentives and station allocation could all contribute in solving the business problem; “How can Divvy Bikes Chicago leverage tools such as seasonal trends in ridership and preferences of station placement to optimise membership conversions and retention strategies?”. Monetary incentives could be used to leverage the summer popularity to increase output and to create demand during the winter season where the popularity of the sharing service is at its lowest. These monetary incentives could be beneficial for the conversion rate.

The finding that users overall prefer the casual bike type over the electric bike could help Divvy with station allocation and maintenance allocation. Focusing more on the maintenance of casual stations is not only less costly, but also maintains the stations of the preferred bikes. Additionally, Divvy should consider increasing the overall number of stations, as that is what members typically prefer over bike station capacity. By increasing the stations, Divvy might keep a higher number of members in the less popular seasons like the winter, thereby benefiting the retention rate.

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