Bixi Deliverable 2

Providing further information through a more extensive analysis will provide each department within the Bixi organization to gather more meaningful insight from the dataset provided. This report seeks to provide a greater understanding and actionable recommendations based on the following points specifically:

- What overall value can be gathered when analyzing the data in 2016 and 2017 specifically;
- How can the organization better leverage the service's usage between members and non-members as well as whether trips begin and end at the same station;
- What key patterns can be utililzed to further increase the organization's revenues;
- What additional factors can be considered to further capitalize on the locations in which the service is being used.

Data and Methodology

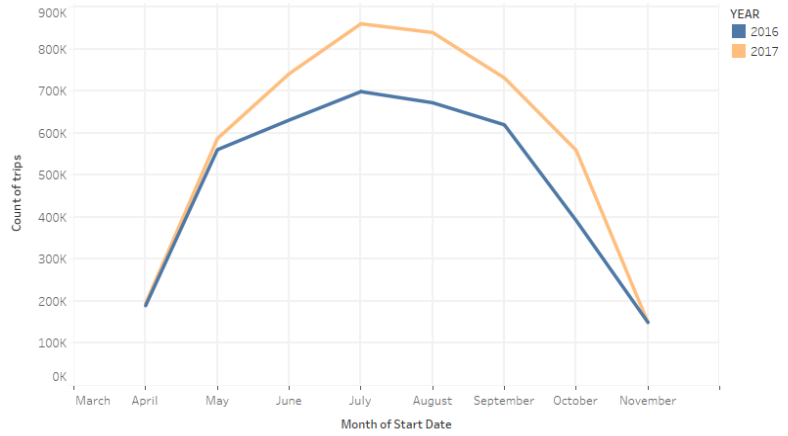
The findings of this report were primarily derived from the use and analysis of visualizations sourced from the original dataset provided from the Bixi organization's open data portal. The data is based on the information gathered by individual trips around the city of Montreal and observes behaviour for both member and non-member rentals through the year. It is important to note that only information gathered between the months of April and November were analyzed as the service is not offered in the winter months due to the city's cold weather and snowfall. The varying visualizations highlight specific aspects allowing for further analysis and recommendations based on the information presented.

Results

Question 1

The initial review performed specifically for the Business Intelligence team provided a general understanding of the volume in usage between 2016 and 2017.

Monthly Trips by Year (Fig 1.1)



The trend shows the number of trips in each month for the given years.

Percentage of Monthly Trips per Year (Fig 1.2)

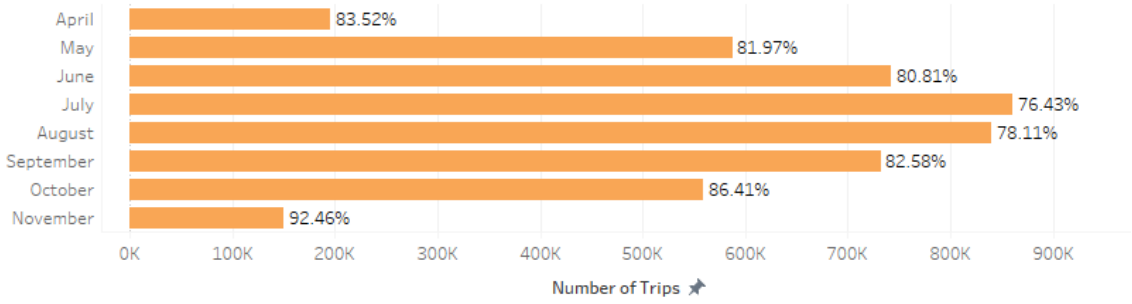
	Start Date	
Month of St..	2016	2017
April	4.85%	4.19%
May	14.32%	12.59%
June	16.12%	15.90%
July	17.85%	18.44%
August	17.17%	18.00%
September	15.83%	15.68%
October	10.02%	11.99%
November	3.83%	3.21%

The table shows the percentage breakdown of annual trips on a monthly basis.

Figure 1.1 above shows a clear rise in usage from 2016 to 2017 with Figure 1.2 reinforcing the increased usage during the summer months given the higher percentage of total trips occurring in July and August. The increase in usage during this specific period can likely be attributed to the warmer summer weather that Montreal experiences.

To better understand the impact of active memberships on the total usage of the Bixi service, the proportion of member trips was measured relative to the total number of trips in 2017 for each month. Per Figure 1.3 below, while the graph itself depicts a greater total number of trips during the summer than for the spring or fall. Further analysis however indicates that the proportion of member to non-member trips decreases in contrast to the rising number of trips. This phenomenon can possibly be explained by the fact that individuals who are not members may be more willing to use the service during periods of warmer weather as an alternative to other methods of transportation; public transportation may be seen as a more uncomfortable means of getting around in the city whereas use of one's own vehicle can be inconvenient due to the reduced parking in certain areas of the city.

Member Percentage of Trips (Fig 1.3)



The total number of member trips for the year 2017 on a monthly basis, indicating the percentage of member trips to the total numbr of trips.

The last point requested for the BI department was for further investigation into which specific stations experience a high number of round trips. This is to say which stations are

used to begin and end a single trip. This may provide specific insight into the areas around these specific stations, but also as to whether or not there is opportunity to set up additional stations within a given proximity.

Highest Percentage of Round Trips by Station (Fig 1.4)

Name	
Métro Jean-Drapeau	30.20%
Métro Angrignon	23.31%
Berlioz / de l'Île des Soeurs	20.43%
LaSalle / 4e avenue	20.06%
Basile-Routhier / Gouin	19.32%
Parc Plage	18.46%
Gare Canora	17.92%
LaSalle / Sénécal	14.73%
Casino de Montréal	14.37%
Quai de la navette fluviale	13.76%

The figure displays the stations with the highest percentage of round trips (the start station is also the end station.)

The specific stations listed in Figure 1.4 are those with the greatest percentage of trips being round trips. As mentioned, the cause for the high number of round trips may be due to lack of available stations nearby, but can also be explained by the attractions in the surrounding area. Many of these stations can actually be found very close to high-tourism areas located specifically near the large rivers that surround Montreal: the St-Lawrence Riverand the Rivières des Prairies. These areas offer scenic bike routes that locals and tourists can enjoy throughout the summer, further reinforcing the fact that Bixi observes a greater number of non-member trips during the summer.

The BI team can therefore use this insight as a determining factor when choosing locations for future Bixi stations. It's recommended they not only be situated close to bodies of water such as the Lachine Canal on the South-Eastern side of the island, but perhaps other areas with scenic routes throughout the city.

Question 2

This section of the report aims to provide further insight for the Marketing team of the Bixi organization to further assist with creating successful campaigns that target opportunity segments of the market. One can expect to observe a negatively correlated relationship between the percentage of trips performed by members and the percentage of round trips at a given station. As previously discussed, round trips tend to occur at stations with tourist attractions in the vicinity. Given that memberships would be held by local residents rather than tourists, it would be logical to assume that a higher proportion of non-members are using the service at stations that see a higher percentage of round trips.

Further to this insight, the following figure is a depiction of the number of trips based on their duration in minutes.

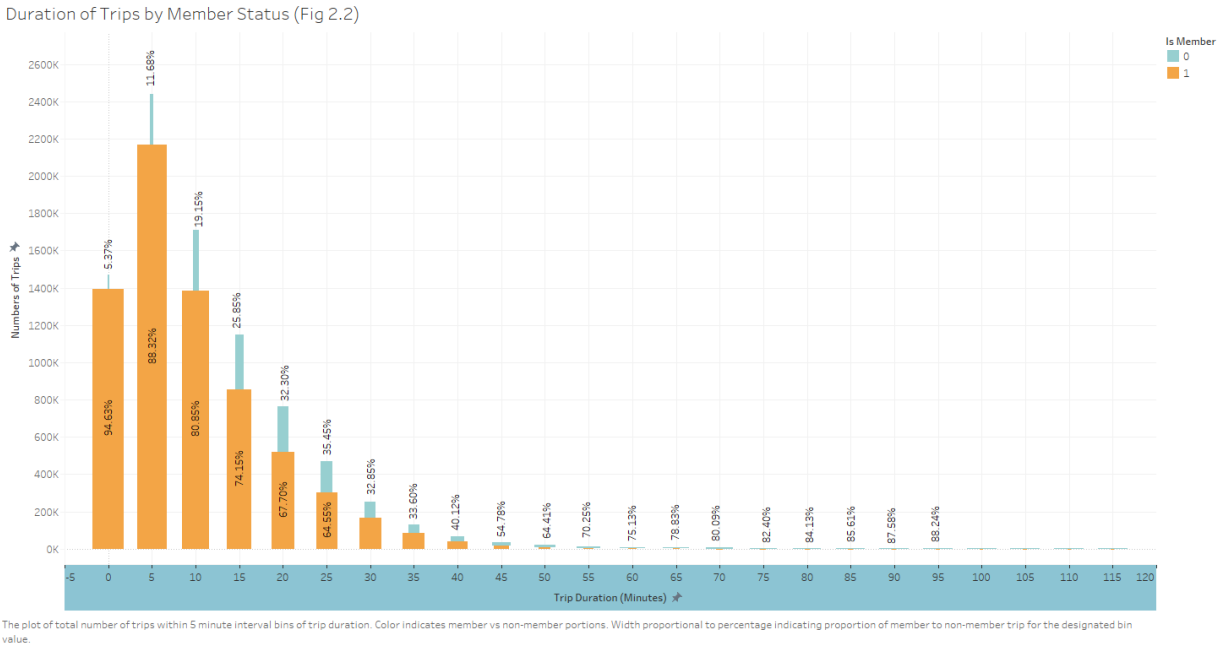
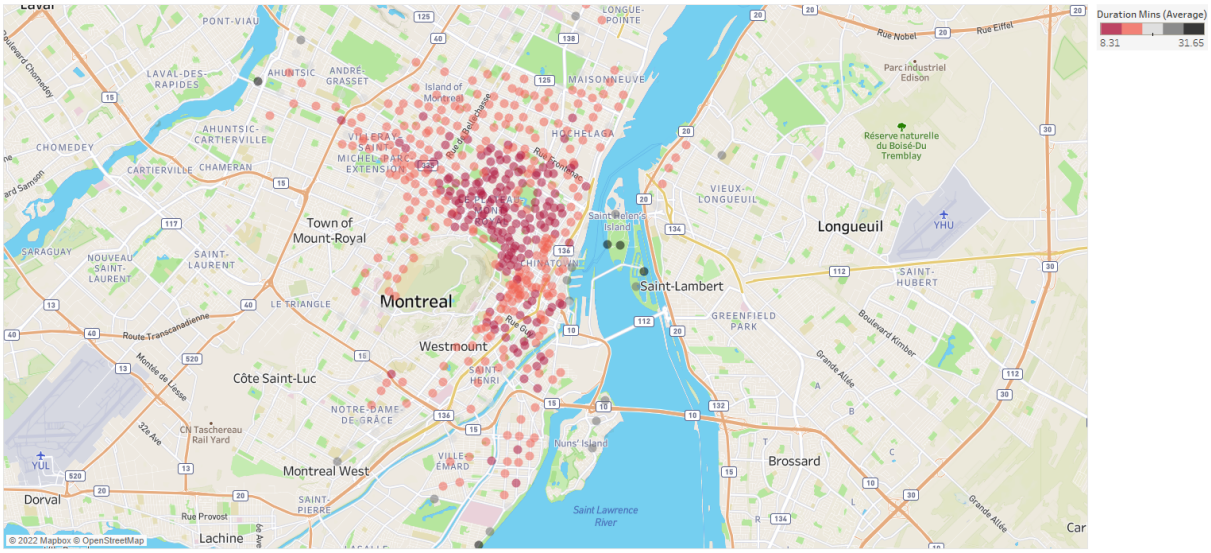


Figure 2.2 above not only shows the number of trips within each 5 minutes interval of trip duration, but it also demonstrates the behaviour of member vs. non-member trips as the length of the trip increases. While the overall number of trips decreases, the proportion of member to non-member trips shifts with the former decreasing as time increases and the latter increasing with the trip's duration. This is likely due to the nature of the trip and the customer's reason for renting the bicycle. Members will likely use the service for a predetermined use such as getting to work or going to a local grocery store whereas non-members have been proven to use the service as a means of entertainment and sightseeing. This reasoning can explain the extended period of time for which they use the service.

This idea is also observed on the following map which indicates the location of all stations on the map as well as the average trip duration represented by the colour of the marker. Figure 2.3 below reveals that several stations such as Métro Jean-Drapeau, Métro Angrignon and Berlioz/de l'Île des Soeurs are all seen to be located near scenic areas of the city. They are also stations on the map indicated to have some of the longest average durations per trip.

Average Trip Duration per Station (Fig 2.3)



Map based on Longitude and Latitude. Colour shows average of duration in minutes. The data is filtered on Station Names.

In contrast to this, many of the points colored with a red hue, indicating a short average trip duration can be found around the Plateau Mont-Royal area, a section of the city known for restaurants, bars and other local markets as well as nearby residential townhouses. It can be expected that many of the trips that start at one of the surrounding stations will likely be shorter as the rider's destination is likely nearby.

The marketing team can further utilize these findings and focus on campaigns specific to the target demographic in the areas discussed as well as similar ones in the rest of the city. Focusing on tourists as the target market in sections of the city with more sight-seeing opportunities while promoting convenient travelling to local residents in areas with increased foot-traffic and business.

Question 3

The final portion of this report aims to assist the Director of Finance maximize on the existing price model by analyzing the different factors that contribute to the organization's revenue generation. The pricing model reviewed focuses on single, non-member trips that are shorter than an hour. It specifically breaks the trips into duration groups of 30 minutes, 30 to 45 minutes and 45 to 60 minutes. The revenue from these trips is then calculated by applying a rate of $2.99, $4.79 and $7.79 respectively. The following table indicates the total revenues generated by each duration group as well as the percentage of each duration group's revenue in proportion to the total revenue generated.

Revenue for Single Trips (Fig 3.1)

Trip Length Bin	Revenue	% of Total Revenue
30 Mins or Less	4,133,971	79.53%
30 to 45 Mins	734,585	14.13%
45 to 60 Mins	329,758	6.34%

Revenue and total % revenue distributed by bin length. Calculated based on pricing model.

As can be seen in Figure 3.1 to the left, the overwhelming majority of the revenue is generated by trips lasting 30 minutes or less. This indicates that of the infrequent riders who use the service, those using it for the shortest periods of time, likely due to some unforeseen reason, tend to do so at a much higher frequency than the combined single trips that last more than 30 minutes. By applying these findings, the finance department of the organization can possibly increase revenues by increasing the flat rate for rides 30 minutes or less to $3.50; this is an increase of just over $0.50 to the individual rider, but a possible 17% increase in revenues.

The following heatmap also displays a clear image of when the majority of these trips occur, potentially explaining the cause behind the high amount of infrequent user volume.

Hourly Revenue Per Weekday (Fig 3.3)

Start Date

Hour of Start Date	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
0	93,617	38,442	34,926	45,693	52,289	64,728	95,818
1	72,137	20,807	15,823	22,371	25,472	36,358	70,543
2	52,893	12,250	9,218	12,710	14,074	22,249	53,515
3	46,755	10,417	7,454	9,275	10,480	17,533	44,817
4	18,903	6,557	5,206	5,983	6,644	8,563	16,469
5	10,845	11,906	13,924	14,693	14,259	13,548	10,549
6	14,681	42,912	53,718	57,408	54,005	44,922	15,210
7	24,180	151,841	190,355	200,471	191,064	152,690	31,918
8	47,882	312,410	371,875	389,394	375,296	299,111	63,532
9	82,949	178,138	207,288	213,477	208,852	181,977	100,584
10	128,035	108,408	121,762	125,529	120,787	118,864	130,905
11	166,199	125,356	143,861	147,625	139,983	144,483	168,765
12	192,643	152,221	177,723	181,065	170,822	176,978	195,731
13	214,530	151,509	171,674	175,668	167,380	179,496	216,243
14	231,187	146,462	156,927	161,992	155,982	172,385	232,299
15	240,560	177,597	187,993	197,932	191,255	209,494	244,809
16	235,618	268,897	313,047	319,975	298,429	299,709	246,481
17	220,216	385,300	456,403	455,506	419,443	361,342	235,980
18	187,901	285,318	331,107	334,512	316,752	275,971	214,437
19	157,059	198,001	228,206	237,971	230,789	211,435	182,599
20	127,547	150,436	178,575	184,567	185,353	165,796	150,316
21	105,930	118,694	148,101	151,850	153,943	139,507	129,658
22	89,826	86,871	111,234	123,885	129,808	119,570	119,848
23	66,809	59,331	77,232	87,371	96,496	111,150	116,242

Revenue: 5,206 – 456,403

Revenue broken down by hour and weekday, color indicates level of revenue generated. Data filtered for duration between 1 and 30 minutes.

Figure 3.3 above shows that the highest amount of revenue is being generated around 8 AM and 5 PM, not surprisingly around the same time most people leave for work and later make their way home. This may explain that the majority of infrequent users whose trips last under 30 minutes are using the service as a means of travelling to and from work. Local residents may likely be using the service as an alternative means of transportation by choice due to favourable weather conditions or due to unforeseen circumstances, but this would be less probable given the previous behaviour displayed by non-members to use the service during the summer months.

The Director of Finance may therefore use the information presented above to increase the flat rate for those customers who use the service during these peak hours of the week or work in conjunction with the marketing department to further promote the membership to non-members.

Question 4

The final section of this report served to provide the operations team with a dashboard which could be utilized to gain insights as required. It provides access to figures previously discussed (Figures 2.3 & 3.1) as well as a table depicting the average duration of trips as well as the average revenue generated for each station.

Average Trip Duration and Revenue by Station (Fig 4.2)

Name	Duration Mins (Aver..	Revenue
Mackay / de Maisonneuve	13	300,025
Métro Mont-Royal (Rivard / du Mon..	11	247,493
Métro Place-des-Arts (de Maisonne..	14	244,130
Métro Laurier (Rivard / Laurier)	10	232,984
Métro Peel (de Maisonneuve / Stanl..	14	223,062
Berri / de Maisonneuve	15	206,084
du Mont-Royal / Clark	11	202,526
Square St-Louis	12	199,051
Milton / University	11	185,893
Métro St-Laurent (de Maisonneuve /..	15	174,609
de la Commune / Place Jacques-Cart..	24	169,115
Marquette / du Mont-Royal	10	161,772
Parc Jeanne Mance (monument à sir..	15	156,737

Duration Mins (Average)andRevenue broken down by Name.The view is filtered on sum of Revenue, which ranges from 155,577 to 300,025.

While only a portion of the dashboard described above, the Figure 4.1 can further be extended to include all stations provided in the dataset to quickly point out their location on Figure 2.3 and further determine whether the surrounding area would be suitable for different marketing campaigns.

Recommendations

Upon consideration of the findings of this report, a final recommendation provided to the Bixi Montreal organization is to focus on marketing campaigns that target a specific demographic in a given section of the city while also focusing on adding new stations to certain areas. One such example would be to add stations in areas of the city known for its inconvenient parking. The Plateau Mont Royal is one such section where, despite the popular restaurant scene and local shops, the area is notorious for being a difficult spot to find any parking. The following image from a local paper, although from 2013, still reflects this fact.

In addition to this, sections of this municipality, as well as other boroughs of the city, are open only to pedestrians between June 1st and September 30th according to an April 15, 2021 article in the local newspaper, the Montreal Gazette. While a significant inconvenience to local residents who commute by public transportation or use of their own vehicle, this provides Bixi with a greater opportunity to focus its resources in the areas of Figure 2.3 above that is densely covered by stations coloured in red.

Conclusion

Based on the findings derived from the dataset provided, this report has provided insight on multiple facets affecting the service's overall usage as well as what specific recommendations can be considered to further increase revenues. By operating in tandem, the departments addressed can use the findings to initiate campaigns that will further increase usage and memberships throughout the city.