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Bixi Data Analysis

Introduction

BIXI Montréal is a non-profit organization created in 2014 by the city of Montreal to manage its bike-sharing system. The BIXI network has more than 9,600 bikes (7,270 regular BIXIs, 2,395 electric BIXIs) and almost 800 stations spread out across the areas of Montreal, Laval, Longueuil, Westmount, Ville Mont-Royal and Montréal- Est (Bixi coverage map[1]).

The objective of this report is to gain a high-level understanding of:

- Characteristics of Bixi bikes usage and the factors that influence it and popular stations.

- Analysis of Bixi non-members' revenue.

- Overall business growth.

The analysis was done based on 8.584.166 trips done during the years 2016 and 2017, this information is available in the Open Data Portal at Bixi Montreal[2].

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[1] Bixi Coverage Map: https://secure.bixi.com/map/

[2] Open Data Portal at Bixi Montreal: https://www.bixi.com/en/open-data

Analysis

Bixi bikes usage

- ***Trips and seasons:*** In 2016, were reported 3.917.401 trips, compared to 2017 with 4.666.765 trips. Graph 1. is broken by month the number of trips, evidencing how the tendency varies greatly throughout the year as a consequence of the association between weather seasons and the conditions of service usage, it is not a surprise that the number of trips reached a peak in the summer months.

Monthly number of trips 2016 - 2017
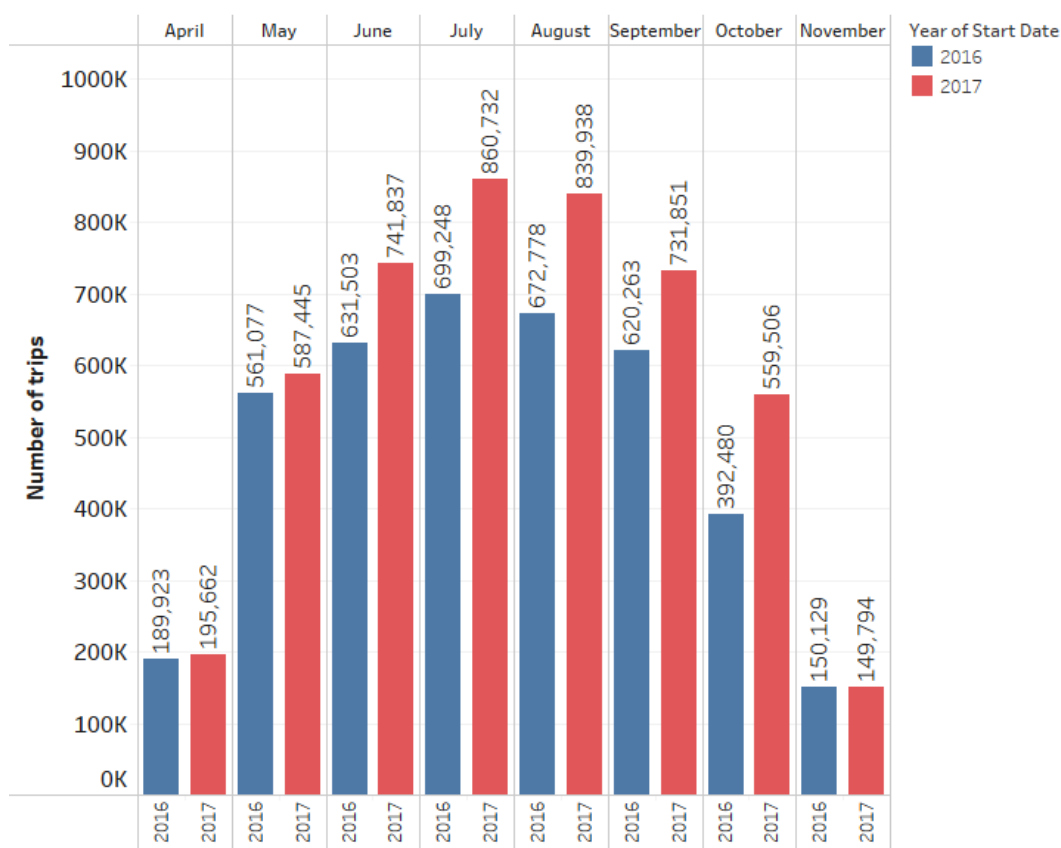
Graph 1.

- ***Membership:*** Graph 2. shows customers with membership represented the biggest proportion of total trips in 2017 (2016 distribution followed a quite similar pattern). At least 70% of total trips were made by members every month. Additionally, it is possible to say that customers with membership have a high level of usage throughout the year, while non-members made more trips in the summer season.

Percentage of trips done by customers according to membership status
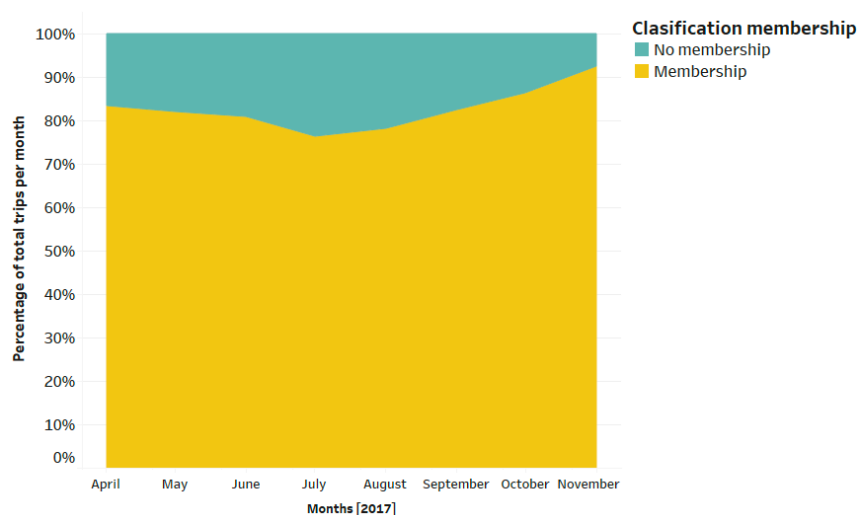
Graph 2.

- ***Stations:*** The most popular station is 6100: 'Mackay / de Maisonneuve', between 2016 and 2017 this station reported 97.150 started trips and 99.128 ended trips. This station is presumably located in an important spot like the downtown of the city or in a tourist spot.

'Mackay / de Maisonneuve' Number of trips vs day time
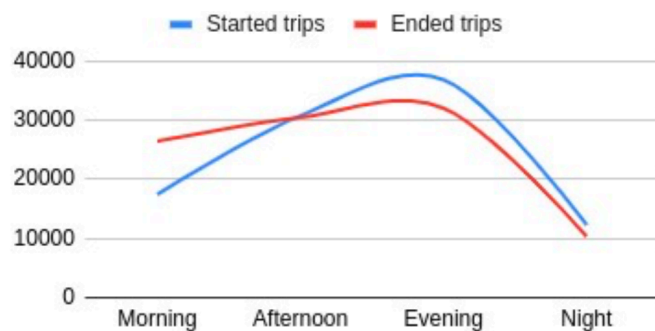
Graph 3.

- **'Mackay / de Maisonneuve':** the dynamic of trips throughout the day in this station could be explained by a mix of two kinds of populations:

  - Local population like students, workers or people that live in the place: that could explain the high number of trips during all day starting early in the morning (in the morning many people that live there go out and some others arrive to work in the area), the local population also explain why the station has trips even a night.

  - Tourist visitors that visit the place in major quantity during the morning and afternoon hours, that area could have locals or spots of interest for visitors or customers.

Most popular stations by number of trips and membership status
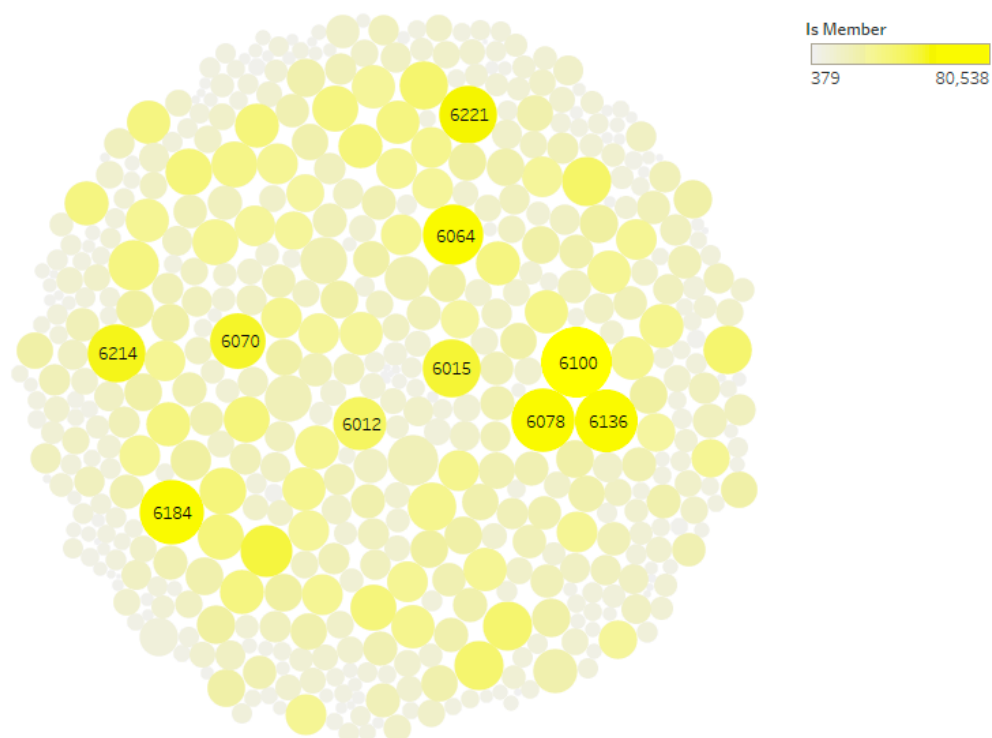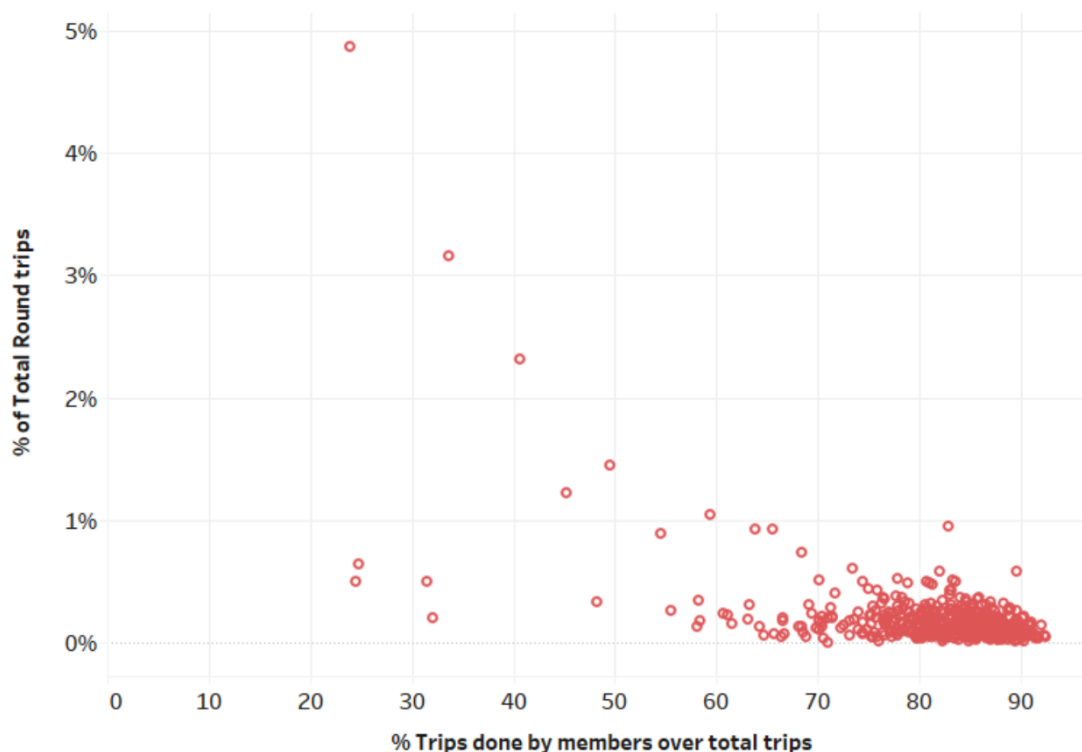

Graph 4.
The intensity of the yellow colour means that in the most popular stations, the biggest number of trips are done by customers with membership.

- **Percentage of round trips and percentage of member trips by station:** The distribution represents how the major number of stations were grouped in the area with a higher percentage of trips by membership customers and a lower percentage of round trips. On the contrary, stations with a higher percentage of round trips were also stations with less usage by membership customers, then customers without membership were more likely to do round trips and use stations in the city outskirts.

**Relation between Round trips per station in membership customer group**

Graph 5.

- *Round trips:* the percentage of round trips over the total trips started in each station vary between 10 and 30%. It is expected to find stations with a high fraction of round trips in stations located in areas with circuits that start and end in the same place, for example, Bixi stations in parks, subway stations or in areas with few additional Bixi stations in the periphery.

- ***Distribution of all trips by duration in minutes:*** 5 minutes trips were the most frequent trips. This representation also contrasts the behaviour pattern between members and non-members regarding trip length. In distribution, the tail was founded especially for non-membership customers. Live/working close to areas with a high number of stations could favour customers to have the membership, long trips were associated with stations in the outskirts of the city (see map graphic).

Trips distributed according to length in minutes and discriminated by membership status
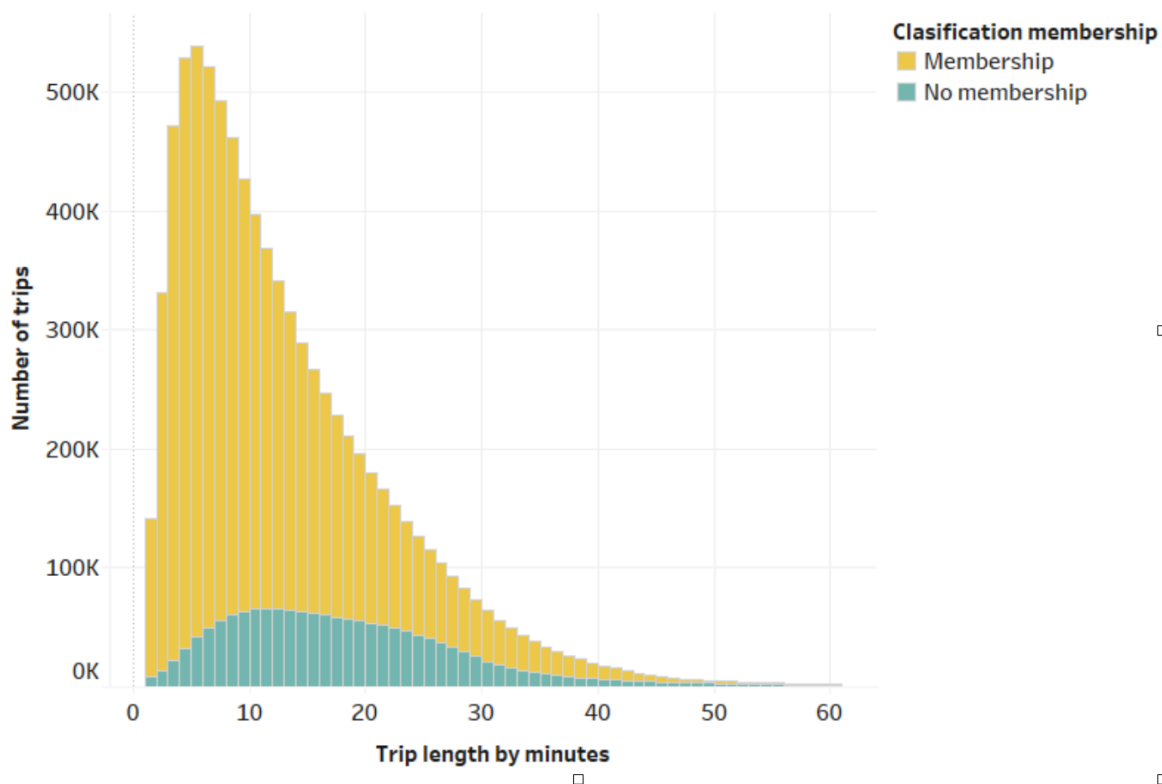
Graph 6.

Bixi non-members' revenue

The analysis in this section was done to get a better understanding of the revenue generated by infrequent users who make single, shorter trips an hour long or less.

The pricing model for single trips:

$2.99 flat rate for each trip that is 30 minutes or less

$4.79 ($2.99 + $1.80) for trips greater than 30 minutes, up to 45 minutes in length

$7.79 ($2.99 + $1.80 + $3) for trips greater than 45 minutes, up to 60 minutes

*** It was assumed every non-member trip is a single trip.**

Calculated field to get the revenue generated by the pricing model and 3.2 Total dollar amounts and relative percentage of revenue from single trips up to an hour in length

Non-members' Revenue distribution by the time of trips

Ranges of trips time per minutes	Number of trips	Revenue for nonmembers trips	Total Revenue for nonmembers trips in percent..
Trips <= 30 min * $2.99	1,403,829	$4,197,449	81.32%
Trips > 30 <= 45 min * $4.79	136,536	$654,007	12.67%
Trips > 45 up to 60 * $7.79	39,801	$310,050	6.01%
Grand Total	1,580,166	$5,161,506	100.00%

Table 1.

The total amount of flat rate revenue for each hour and each day of the week.
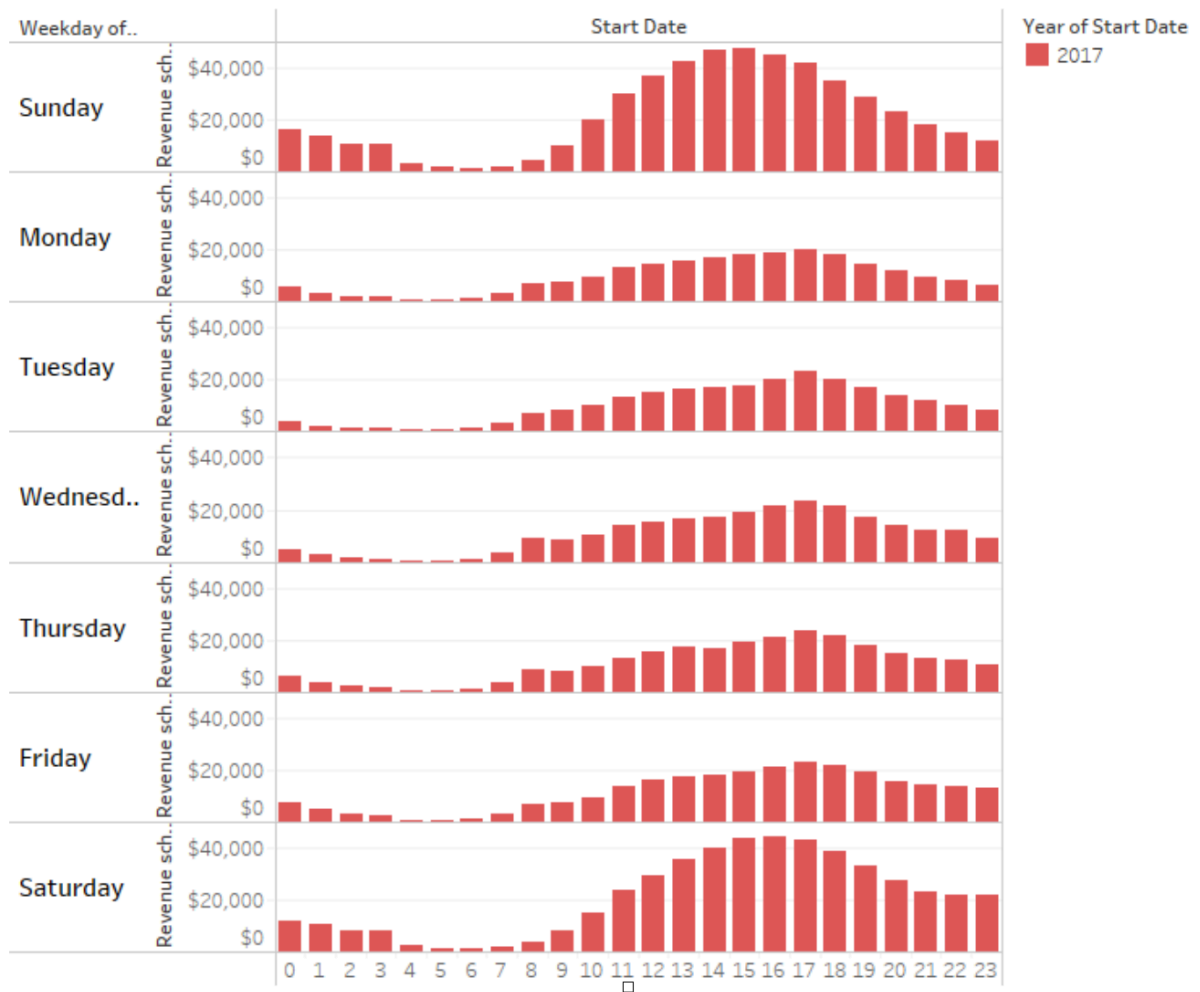
Graph 7.

During the weekend the revenue was considerably higher, Monday to Friday the average revenue is close to $20.000, while during the weekend the revenue is almost double of that reaching the amount of $40.000 per day.

Overall business grown

During 2016 and 2017 the total amount of population in Gran Montreal (Montreal Metropolitan Area) rounded to 4.100.000 people (Montreal population trend[3]) with a growth Rate of 0.83%. Whereas, the number of trips between 2016 and 2017 increased 19%. These results do not rule out the influence of the grown population with the Bixi grown but taken together, these results suggest that the service has the chance to grow to obtain more customers from the population that already lives in the city, this group of customers it is also more likely to have memberships.

The findings indicate that the highest number of trips corresponds with the group with memberships. A reasonable approach to increase the number of memberships is to launch a special promotion that incentive people to have a membership. Regarding this proposal, it is recommendable launch the offer finishing the month of March, when customers are about to have 8 months ahead to enjoy the service.

From a different point of view, during summer the number of trips for non-members increased, possibly associated with the increased number of tourists in the city. Considering the constant increment in the percentage of occupancy of hotel establishments in Montreal tourism statistics[4], it is recommendable to launch strategies that attract the tourists' interest in the service.

Finally, the findings from this analysis could suggest that the location of the station has a significant effect on the number of trips, due to that it is suggested to revise the city transformation to evaluate new possible spots to expand the service with new stations in areas that share characteristics with the most popular stations.

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[3] Montreal population trend: https://www.macrotrends.net/cities/20384/montreal/population

[4] Montreal tourism statistics: https://toolkit.mtl.org/en/studies-reports-and-statistics

Conclusions

○ The number of trips between 2016 and 2017 increased by 19%

○ Time of year and membership status are intertwined and influenced greatly by how people use Bixi bikes.

○ A reasonable approach to increase the Bixi trips is to launch a special promotion that incentive people to have a membership during the first months of the year.

○ Customers without membership were more likely to do round trips, longer trips and use stations in the city outskirts.

○ The revenue generated by infrequent users who make single, shorter trips an hour long or less is considerably higher on weekends.

The database was manipulated with the programs:
- MySQL Server and Workbench Version 8.0.21
- Tableau Desktop Version 2021.4.2.