

Bike Share Toronto Data Analysis & Predictions with Machine Learning & Power BI



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Introduction



Bike Share Toronto is a public bicycle-sharing system serving the city of Toronto, Canada. It is operated by the Toronto Parking Authority and aims to promote sustainable urban mobility by providing an affordable, eco-friendly transportation alternative.

Launched: 2011

Operator: Toronto Parking Authority

Stations: Over **625 docking stations** across the city

Bicycles Available: More than **7,000 bikes**

Service Area: Covers downtown Toronto and expanding suburban areas

Pricing: Includes pay-as-you-go, monthly, and annual membership plans

Technology: Features GPS tracking, mobile app integration, and real-time bike availability updates



Key Challenges & Objectives



Issue

Toronto's Bikeshare system has growing demand but lacks an optimized approach for demand forecasting.



Significance

Helps city planners, bikeshare operators, and policy makers optimize services.



Objectives

Analyze user trends, predict future demand, and visualize key insights.

Key Questions:

Which stations are **busiest**? What are **peak hours**? Can we **predict demand**?



Methodology (Data & Tools Used)



Data Source

- Ridership Data
- Station Information

Tools & Techniques

- Python
- Power BI
- Google Colab

Visualization

- Power BI
- Seaborn/Matplotlib

Machine Learning

- Machine Learning Algorithm
- Encoding Techniques
- Feature Scaling & Selection

Feature Engineering

- Time-Based Features
- Station & Demand Features
- User Behavior Features



Station Demand Forecasting



Goal: Predict trip demand for better inventory management & station optimization.

Algorithm Used: **LightGBM** (Light Gradient Boosting Machine)

Model Accuracy: $R^2 = 0.70$, RMSE = **3.89%**

Feature Importance: Starting station, starting hour of the day, starting month, day of the week

	start_station_id	start_hour	start_day_of_week	start_month	rfg_predictions	xgb_predictions	lgb_predictions
0	7211	7	2	9	4.0	1.0	2.0
1	7276	12	6	10	2.0	1.0	2.0
2	7297	11	3	10	2.0	1.0	2.0
3	7200	7	4	2	4.0	5.0	6.0
4	7076	5	2	1	60.0	39.0	56.0
5	7151	0	5	5	3.0	3.0	3.0





User Classification & Predictions

Goal: Predict trip demand for better inventory management & station optimization.

Algorithm Used: **Random Forest Classifier**

Model Accuracy: Accuracy = **96.08%**, F1 Score = **0.9796**

Feature Importance: Trip Duration, Starting Station, Ending Station, Hour of the Day, Day of the Week, Starting Month

User Type Segmentation:

- **Casual Users:** Prefer weekends, longer trips, and leisure-oriented routes.
- **Annual Members:** Ride on weekdays, shorter trips, and use bikes for daily commutes.

	duration_minutes	start_station_id	end_station_id	start_hour	start_day_of_week	start_month	logreg_predictions	rf_predictions	xgb_predictions
0	647	7042	7082	21	2	10	0	0	0
1	75	7284	7139	4	0	8	0	0	0
2	856	7207	7003	19	2	12	0	0	0
3	325	7094	7020	10	2	4	0	0	1



Station Clustering & Classification



Goal: Group stations based on demand patterns to optimize bike redistribution and infrastructure planning

Algorithm Used: K-Means Clustering

Feature Importance: Total rides per station, proximity to transit hubs, peak hour demand, seasonal variation in demand

Clusters Name: Downtown Core (**142**), West End (**73**), Uptown (**63**), East End (**55**), East York (**26**)

Potential Cluster Categories:

- **High-Demand Stations** (Frequent rentals/returns, e.g., downtown hubs)
- **Moderate-Demand Stations** (Balanced inflow and outflow)
- **Low-Demand Stations** (Used occasionally, mostly off-peak hours)





Yearly Overview Dashboard (2018)



Filters



1.93M

Total Trips

31.09M

Minutes spend Biking

359

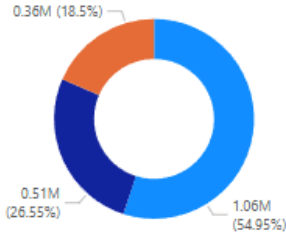
Total Stations

16.08

Average Trip Duration (minutes)

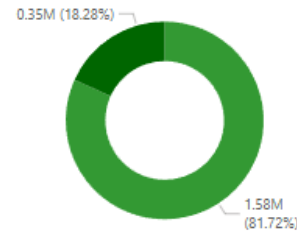
Total Trips by Time Category

Off Peak Evening Rush Morning Rush

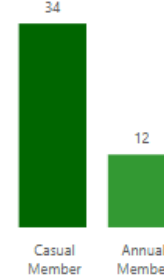


Total Trips by Membership Type

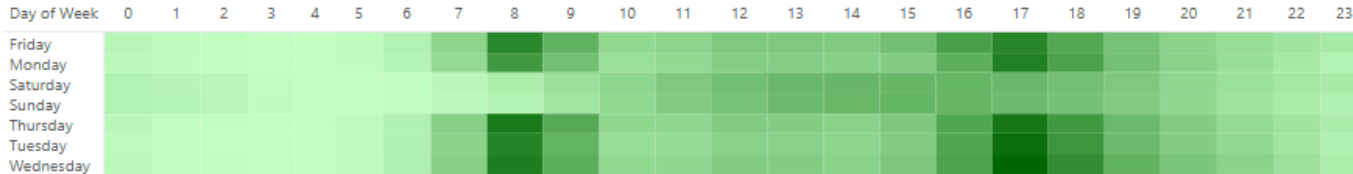
Annual Member Casual Member



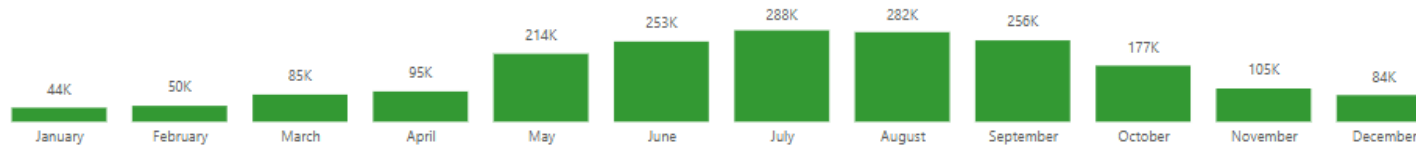
Average Trip Duration (mins) by Membership Type



Trips by Day of Week and Hour of Day



Trips by Month



BikeShare Toronto Dashboards, Yearly Overview Dashboard

Live data

Data updated on 25-01-16, 9:13 p.m.



HUMBER



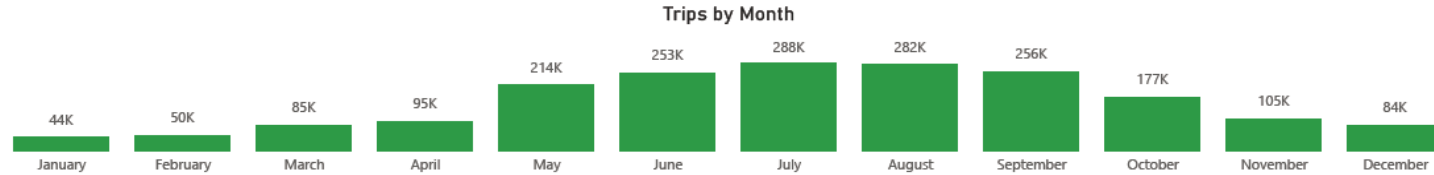
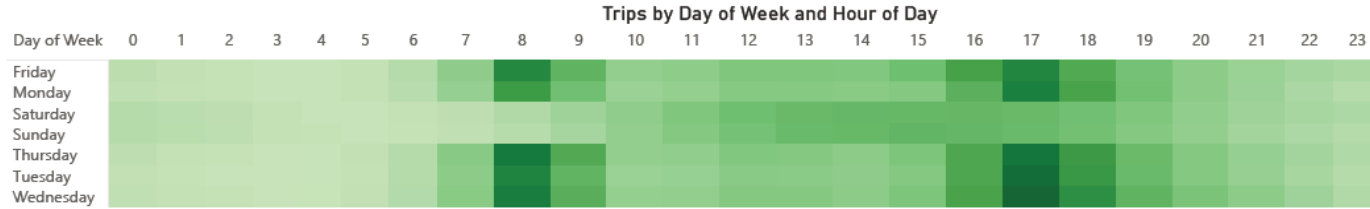
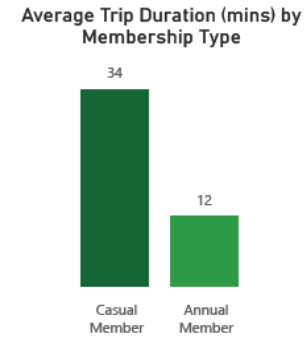
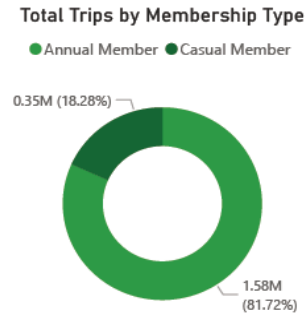
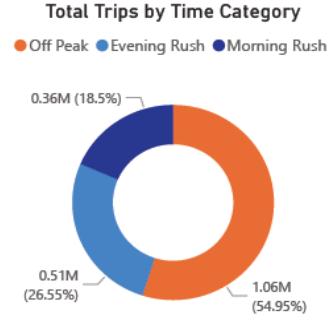
Yearly Overview Dashboard

1.93M
Total Trips

31.09M
Minutes spend Biking

359
Total Stations

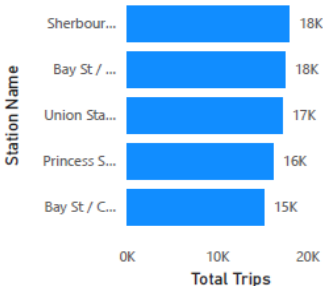
16.08
Average Trip Duration (minutes)



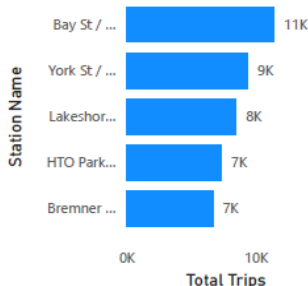


User Behaviour Dashboard

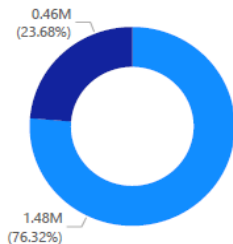
Top 5 Stations for Annual Members



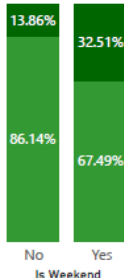
Top 5 Stations for Casual Members



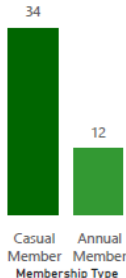
Total Trips Weekday vs. Weekend



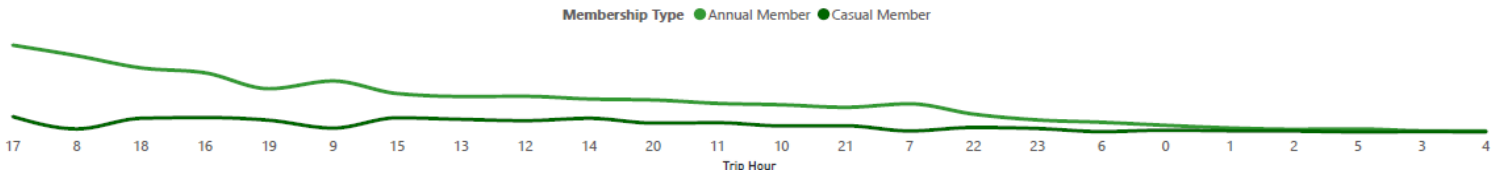
Weekend vs. Weekday Trips



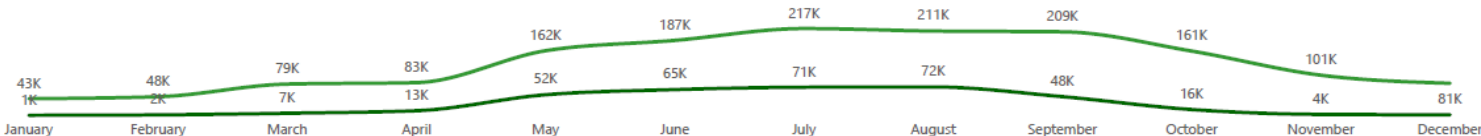
Average Trip Duration by Membership Type



Trips by Hour of Day



Trips by Month





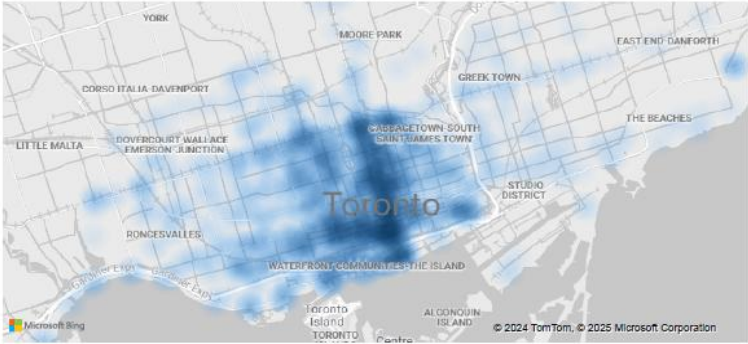
Station Popularity Dashboard

Top 10 Stations by Arrival



City of Toronto, Province of Ontario, Esri Canada, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, I... Powered by Esri

Total Trips by Station Location



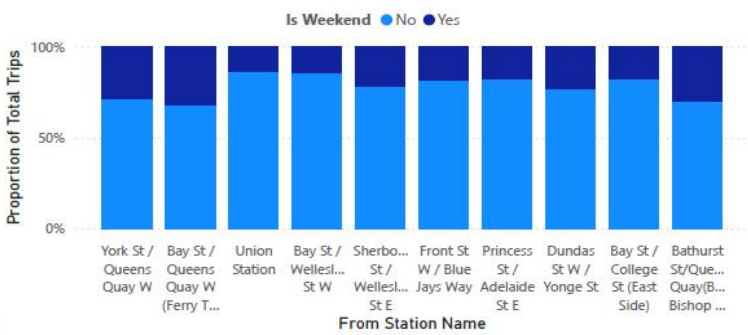
Microsoft Bing © 2024 TomTom, © 2025 Microsoft Corporation

Top 10 Stations by Departure



City of Toronto, Province of Ontario, Esri Canada, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, I... Powered by Esri

Trips by Station (Weekday vs Weekend)



Project Resources & Data Sources



Ridership Data:

<https://open.toronto.ca/dataset/bike-share-toronto-ridership-data/>

Station Info Data:

https://tor.publicbikesystem.net/ube/gbfs/v1/en/station_information

Project Folder:

https://drive.google.com/drive/folders/1kU3_DJn3UNOTw2EQle_JFQ_fbSdcoPjS

Detailed Report:

https://www.linkedin.com/posts/mohit-rathod_bike-share-toronto-prediction-and-classification-activity-7262117039157178368-GvsM

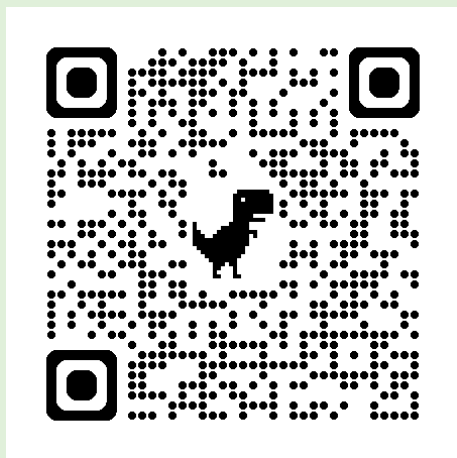




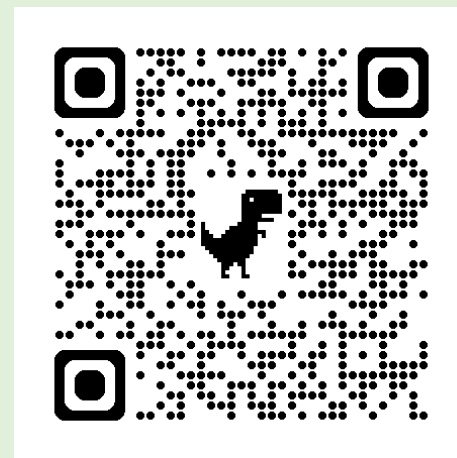
Thank You!

Do you have any questions?

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Maven Analytics Portfolio



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