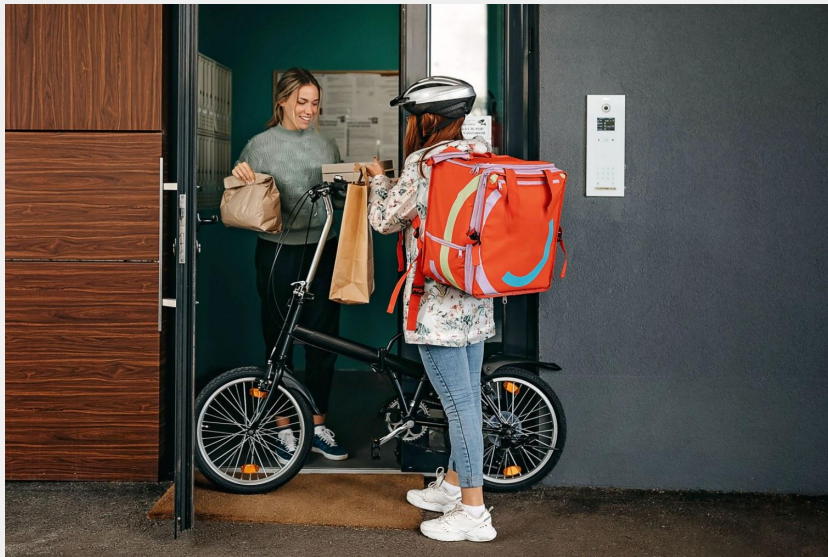
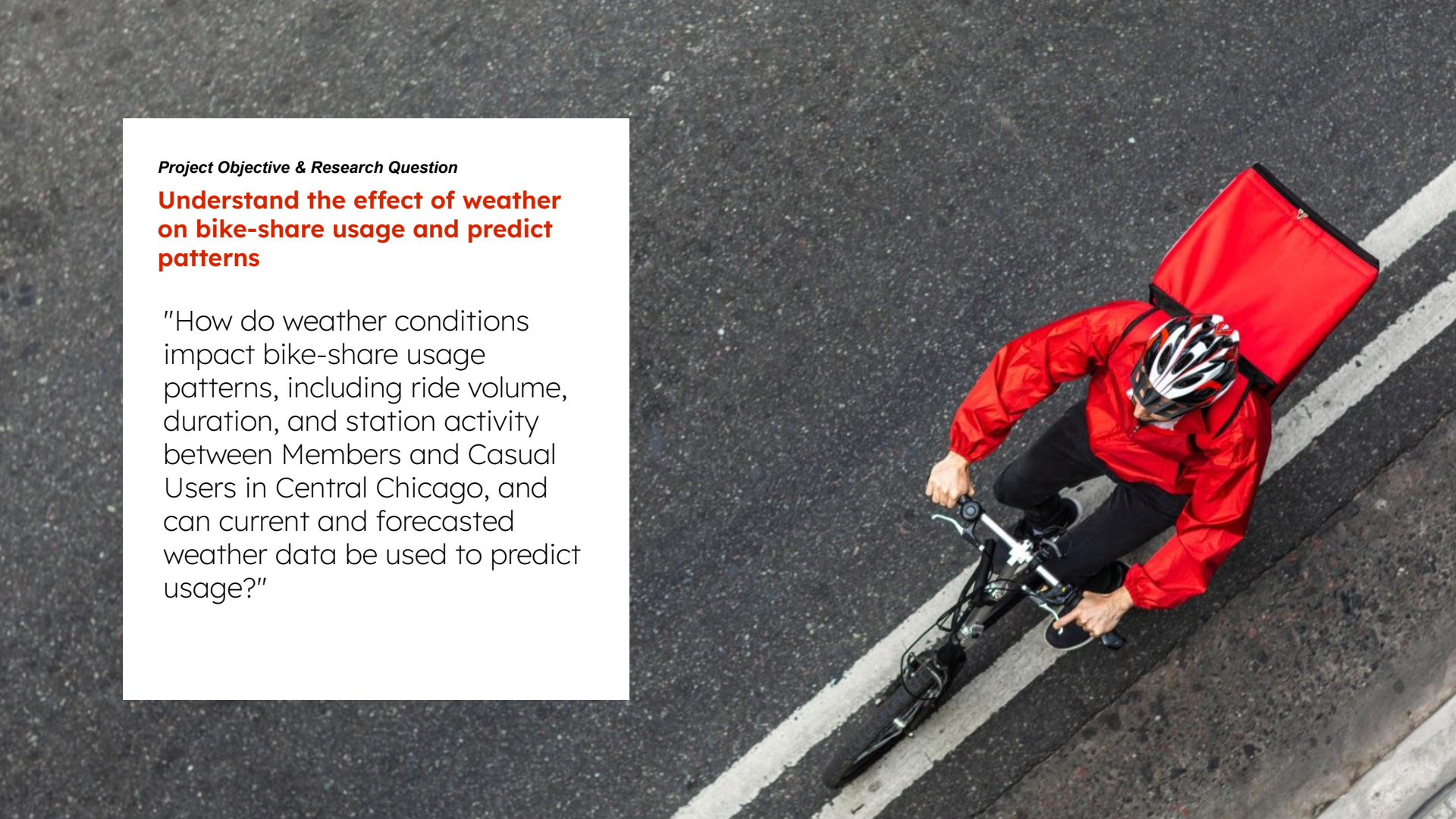
How Weather Conditions Impact Bike-Share Usage Patterns in Central Chicago

A Data-Driven Analysis



Lovecy Thomas Jitesh Makan Sean Schallberger



Project Objective & Research Question

Understand the effect of weather on bike-share usage and predict patterns

"How do weather conditions impact bike-share usage patterns, including ride volume, duration, and station activity between Members and Casual Users in Central Chicago, and can current and forecasted weather data be used to predict usage?"

Supporting Questions

1. How Does the Weather (Type, Temp, Humidity, etc.) Impact Ride Volume?
2. What Temporal Trends Emerge Across Weather Conditions?
3. How Do Different User Types Respond to Weather?
4. How Do Weather Variables Correlate with Overall Ridership?

Data Collection, Integration, and Limitations

Data Collection

Monthly Usage Data from Divvy Bike Share Chicago x 2020-2023 (Kaggle)

Historical Bulk Weather Data of the City of Chicago from OpenWeatherMap.com

Live Weather API

HIGHLIGHTS

Data Cleanup and Integration

Process:

Divvy Bike Share

- A For loop
  - Removing Irrelevant and Bad Data Columns
  - Added Metrics
  - Merging Monthly Data

Incorporating Weather Data

- Inner Merge datasets by timestamp

Known Limitations

Bike Share Data

	ride_id	start_day	start_hour	start_year	t
0	782CEA3C6968D2A6	2020-04-01	0	2020	0 days
1	07F785C9DDA3404C	2020-04-01	0	2020	0 days
2	1FD159E93F7BAFA1	2020-04-01	0	2020	0 day
3	091D47E4F0FC5022	2020-04-01	0	2020	0 day
4	643593E85E46A45C	2020-04-01	0	2020	0 days
...	...	...	...	...	
9813892	6D855DB843848DB3	2023-11-30	23	2023	0 day
9813893	447027EB102601BE	2023-11-30	23	2023	0 day
9813894	993257B9E439A2DD	2023-11-30	23	2023	0 day
9813895	9B518D5122FD7D72	2023-11-30	23	2023	0 days
9813896	C4C352D0A2C1A450	2023-11-30	23	2023	0 day

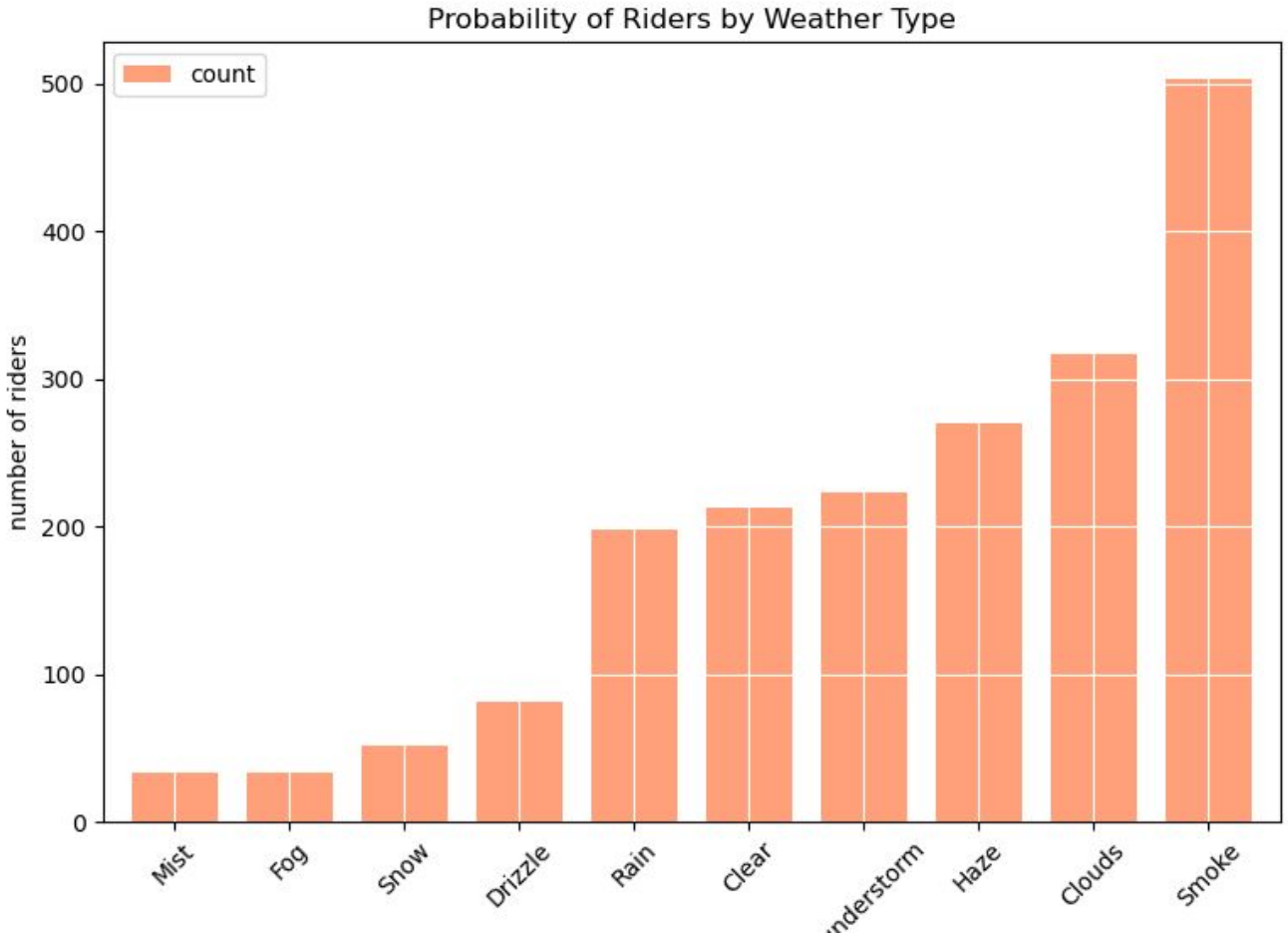
Weather Data

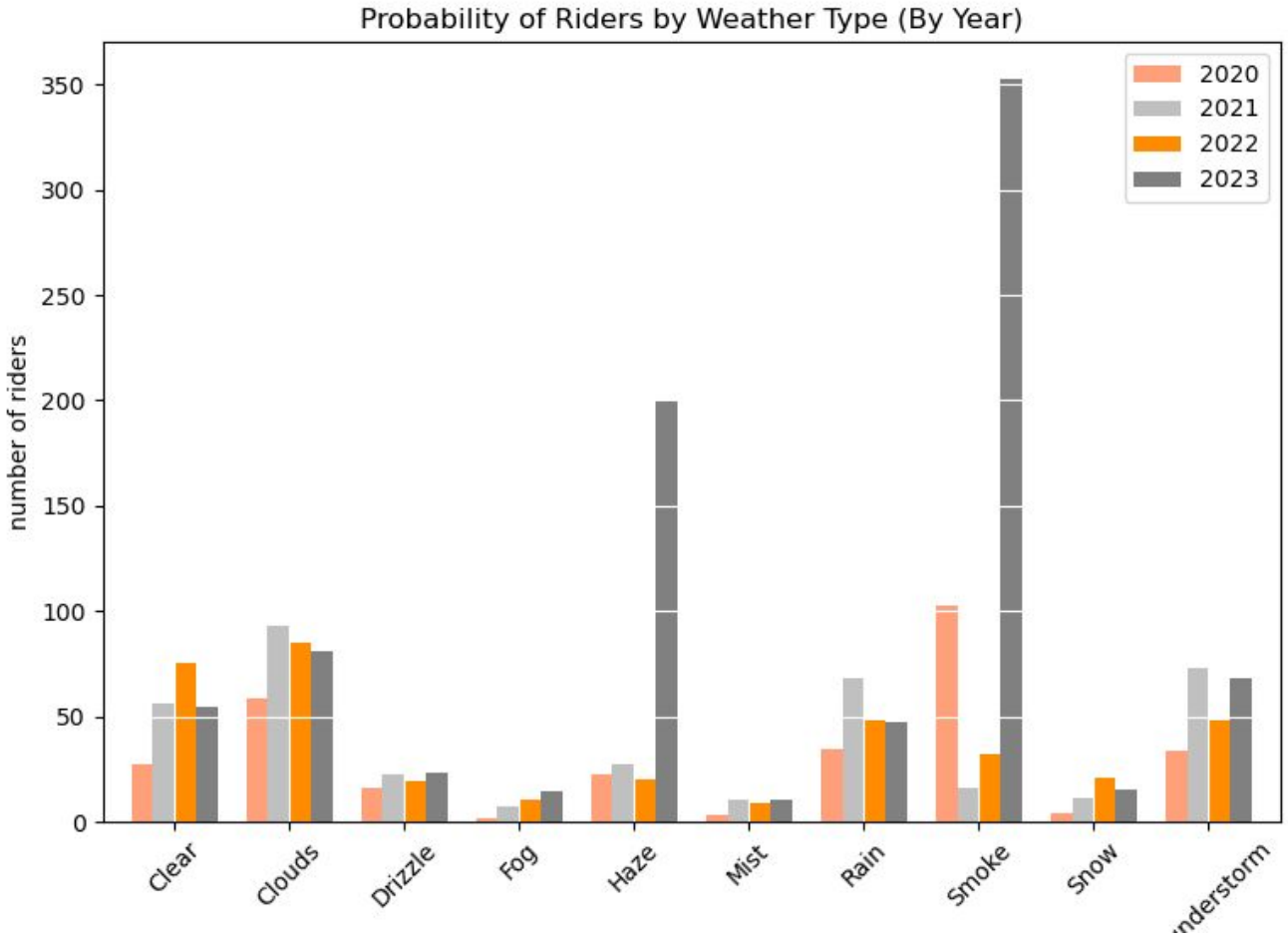
	start_day	start_hour	temp	dew_point	feels_like	temp_min	ten
0	2020-01-01	0	-2.08	-5.63	-9.08	-2.31	
1	2020-01-01	1	-1.99	-5.23	-8.99	-2.23	
2	2020-01-01	2	-1.87	-4.96	-8.87	-2.23	
3	2020-01-01	3	-1.90	-4.55	-8.90	-2.79	
4	2020-01-01	4	-2.18	-4.67	-9.18	-2.78	
...	...	...	...	...	...	...	
37232	2023-12-31	19	0.72	-1.19	-5.23	0.00	
37234	2023-12-31	20	0.63	-1.70	-5.17	0.00	
37236	2023-12-31	21	0.88	-1.19	-4.85	0.53	
37238	2023-12-31	22	0.77	-1.15	-4.38	-0.03	
37241	2023-12-31	23	0.43	-1.17	-4.81	-0.03	

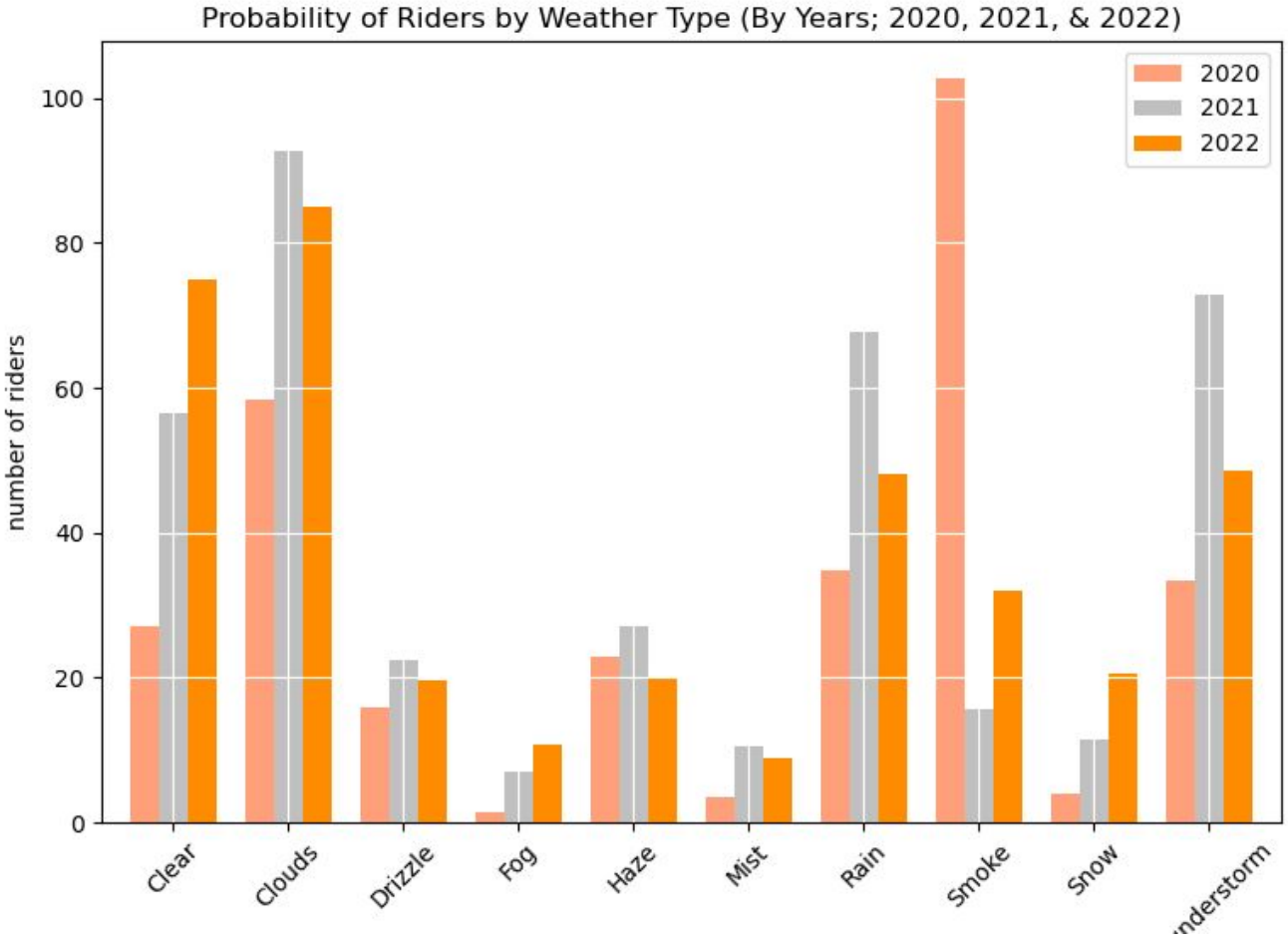
Resulting Data

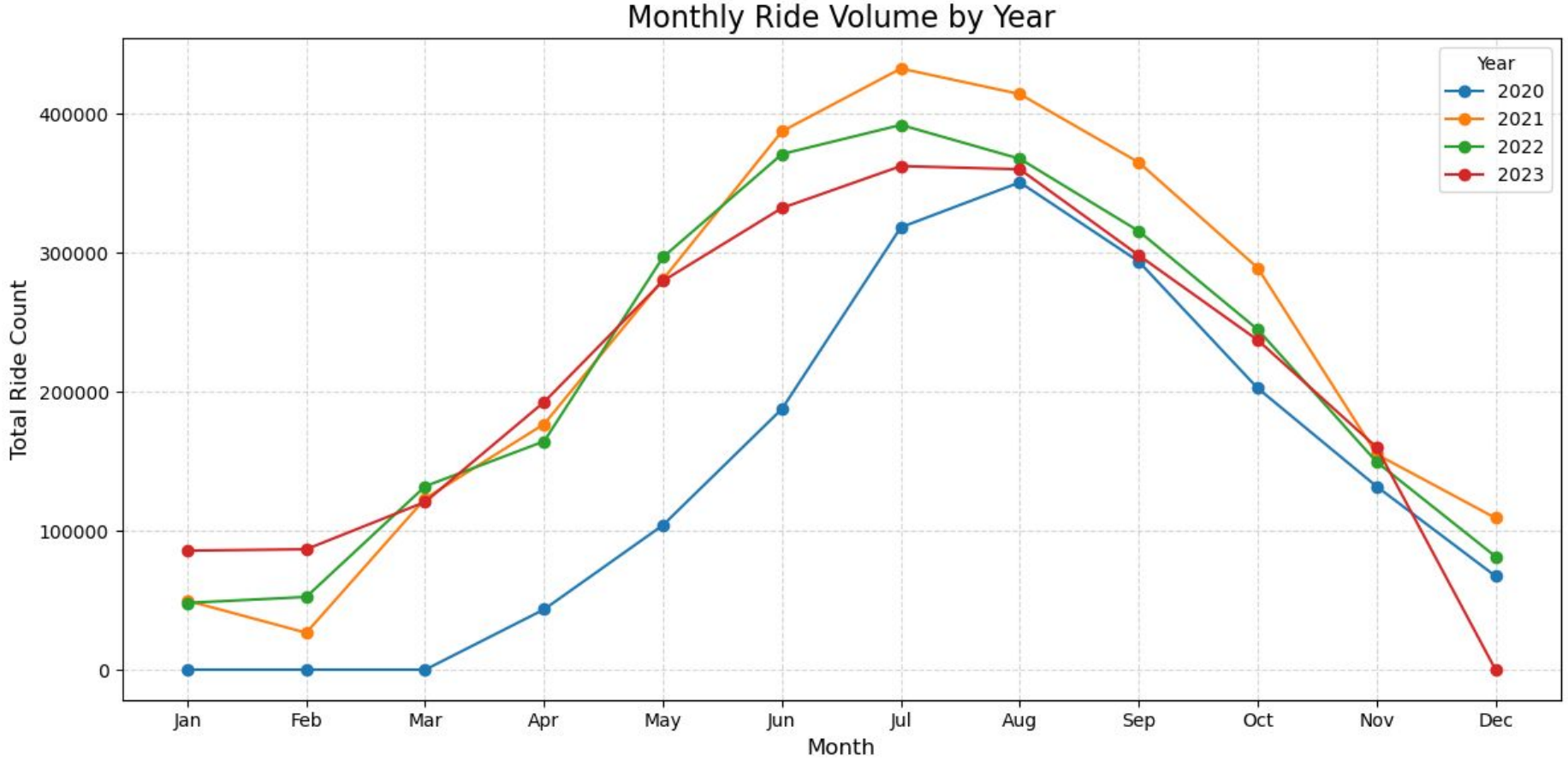
	ride_id	start_day	start_hour	start_year	trip_le
0	782CEA3C6968D2A6	2020-04-01	0	2020	0 days 00:0
1	07F785C9DDA3404C	2020-04-01	0	2020	0 days 00:0
2	1FD159E93F7BAFA1	2020-04-01	0	2020	0 days 00:0
3	091D47E4F0FC5022	2020-04-01	0	2020	0 days 00:0
4	643593E85E46A45C	2020-04-01	0	2020	0 days 00:0
...	...	...	...	...	
9813892	6D855DB843848DB3	2023-11-30	23	2023	0 days 00:1
9813893	447027EB102601BE	2023-11-30	23	2023	0 days 00:3
9813894	993257B9E439A2DD	2023-11-30	23	2023	0 days 00:0
9813895	9B518D5122FD7D72	2023-11-30	23	2023	0 days 00:0
9813896	C4C352D0A2C1A450	2023-11-30	23	2023	0 days 00:0

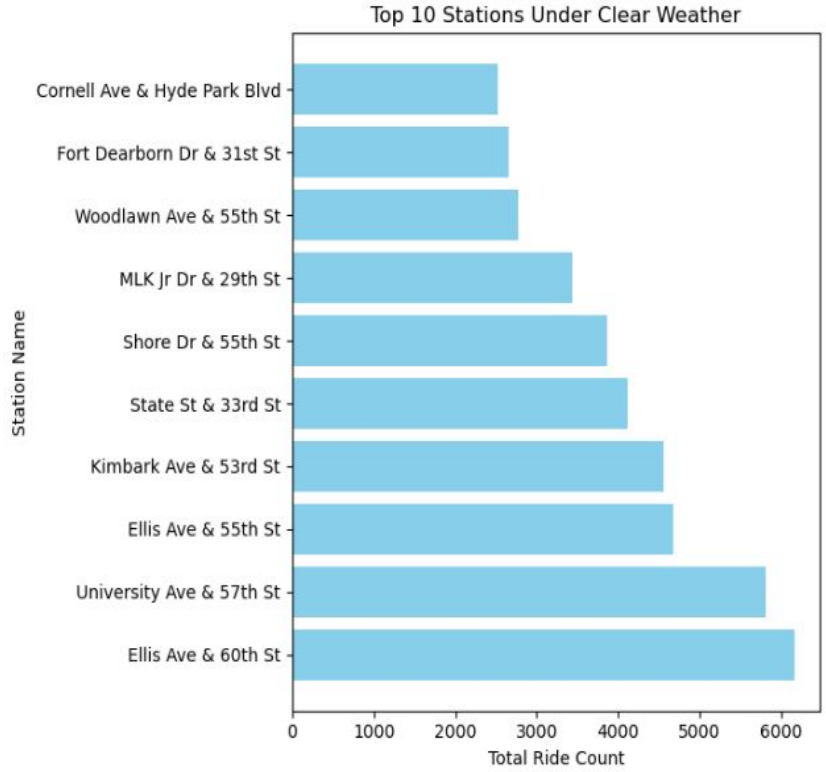
Usage Trends by Weather Type

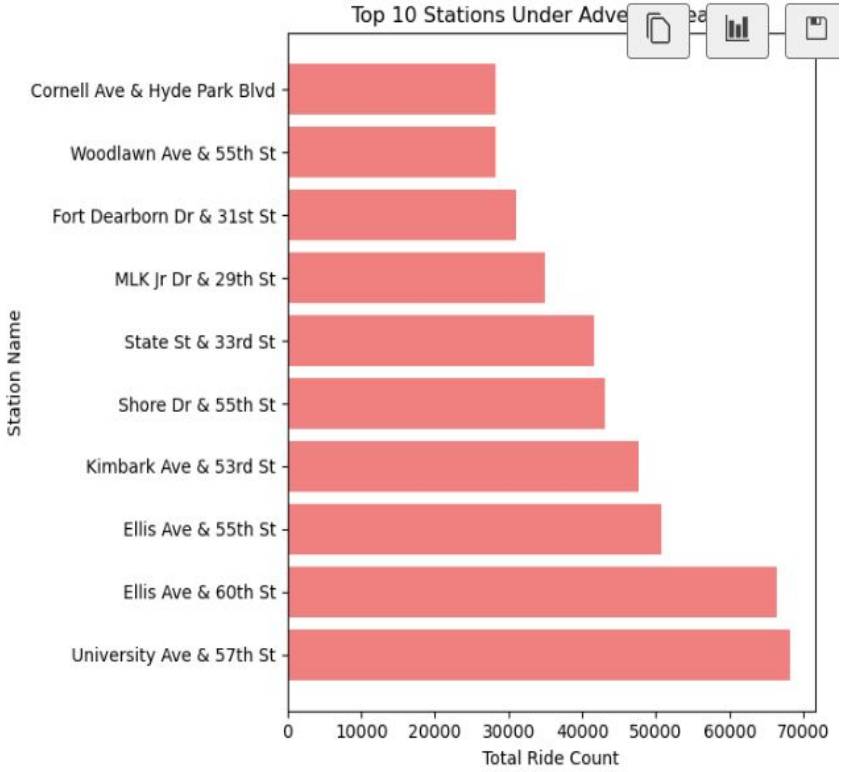

Probability of Riders by Weather Type
count
number of riders
0
100
200
300
400
500
Mist
Fog
Snow
Drizzle
Rain
Clear
nderstorm
Haze
Clouds
Smoke


Probability of Riders by Weather Type (By Year)
number of riders
0
50
100
150
200
250
300
350
2020
2021
2022
2023
Clear
Clouds
Drizzle
Fog
Haze
Mist
Rain
Smoke
Snow

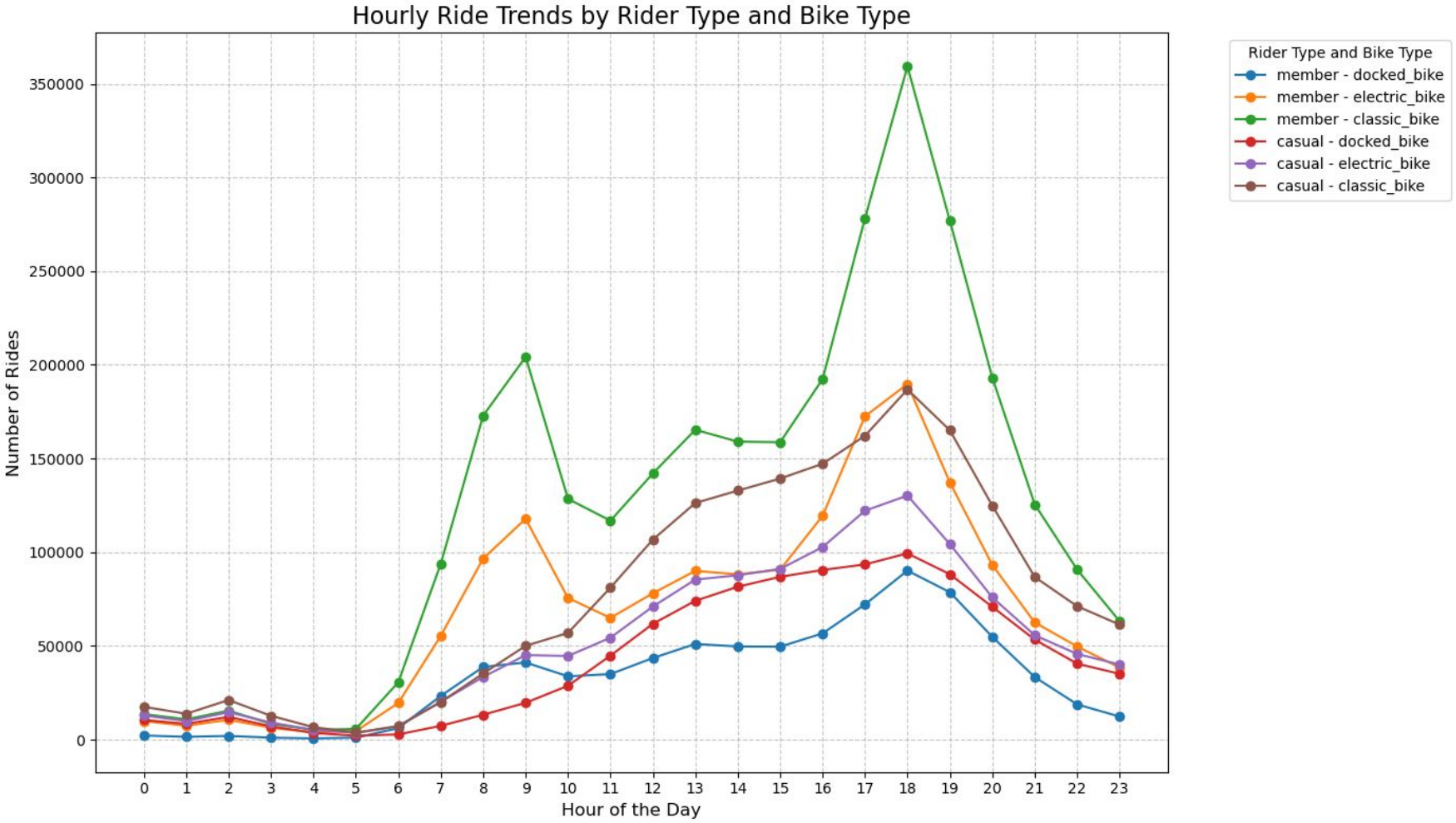

Probability of Riders by Weather Type (By Years; 2020, 2021, & 2022)
number of riders
0
20
40
60
80
100
2020
2021
2022
Clear
Clouds
Drizzle
Fog
Haze
Mist
Rain
Smoke
Snow

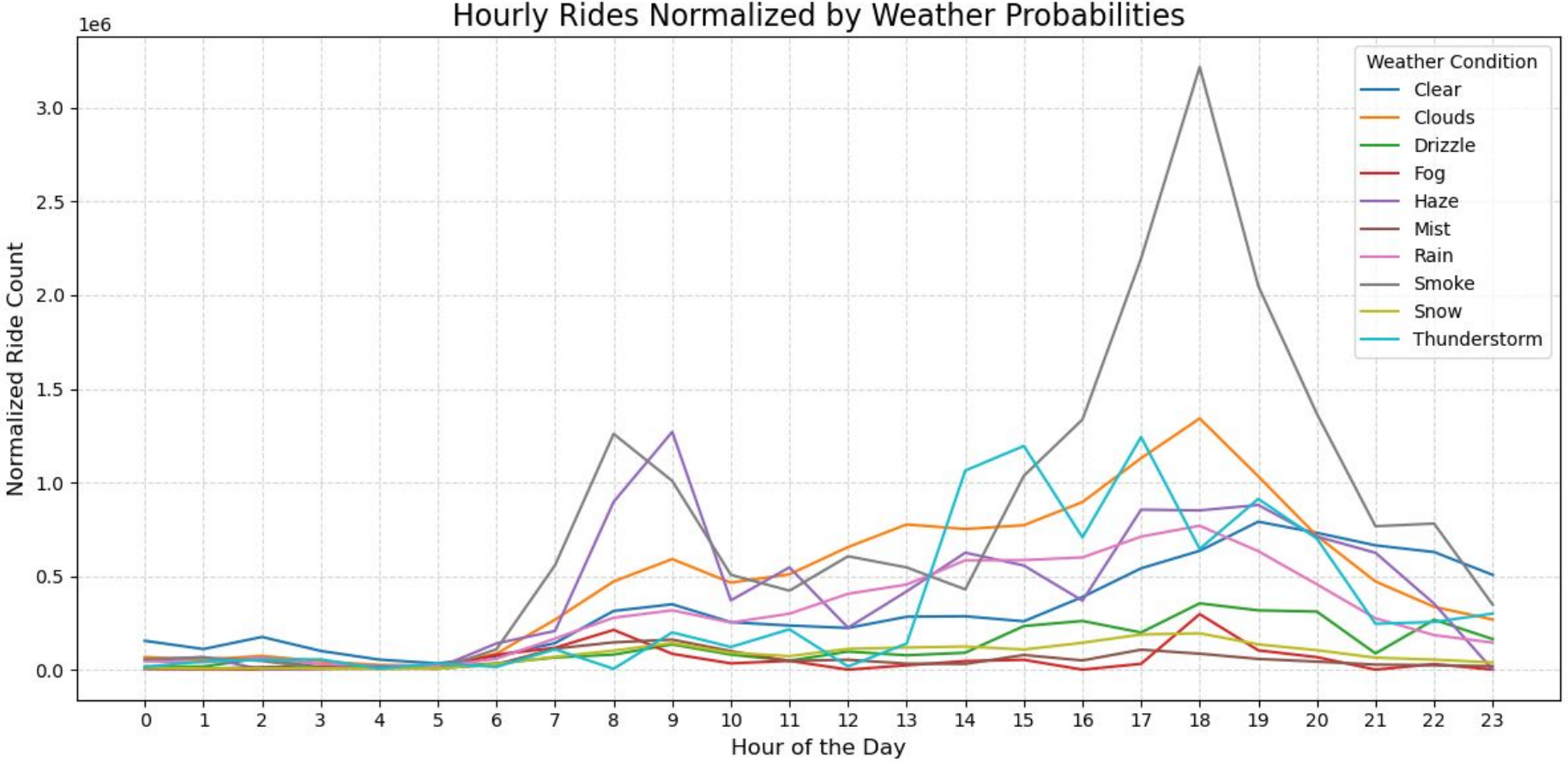

Monthly Ride Volume by Year
Year
2020
2021
2022
2023
Total Ride Count
0
100000
200000
300000
400000
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month


Top 10 Stations Under Clear Weather
Cornell Ave & Hyde Park Blvd
Fort Dearborn Dr & 31st St
Woodlawn Ave & 55th St
MLK Jr Dr & 29th St
Shore Dr & 55th St
State St & 33rd St
Kimbark Ave & 53rd St
Ellis Ave & 55th St
University Ave & 57th St
Ellis Ave & 60th St
Station Name
0
1000
2000
3000
4000
5000
6000
Total Ride Count

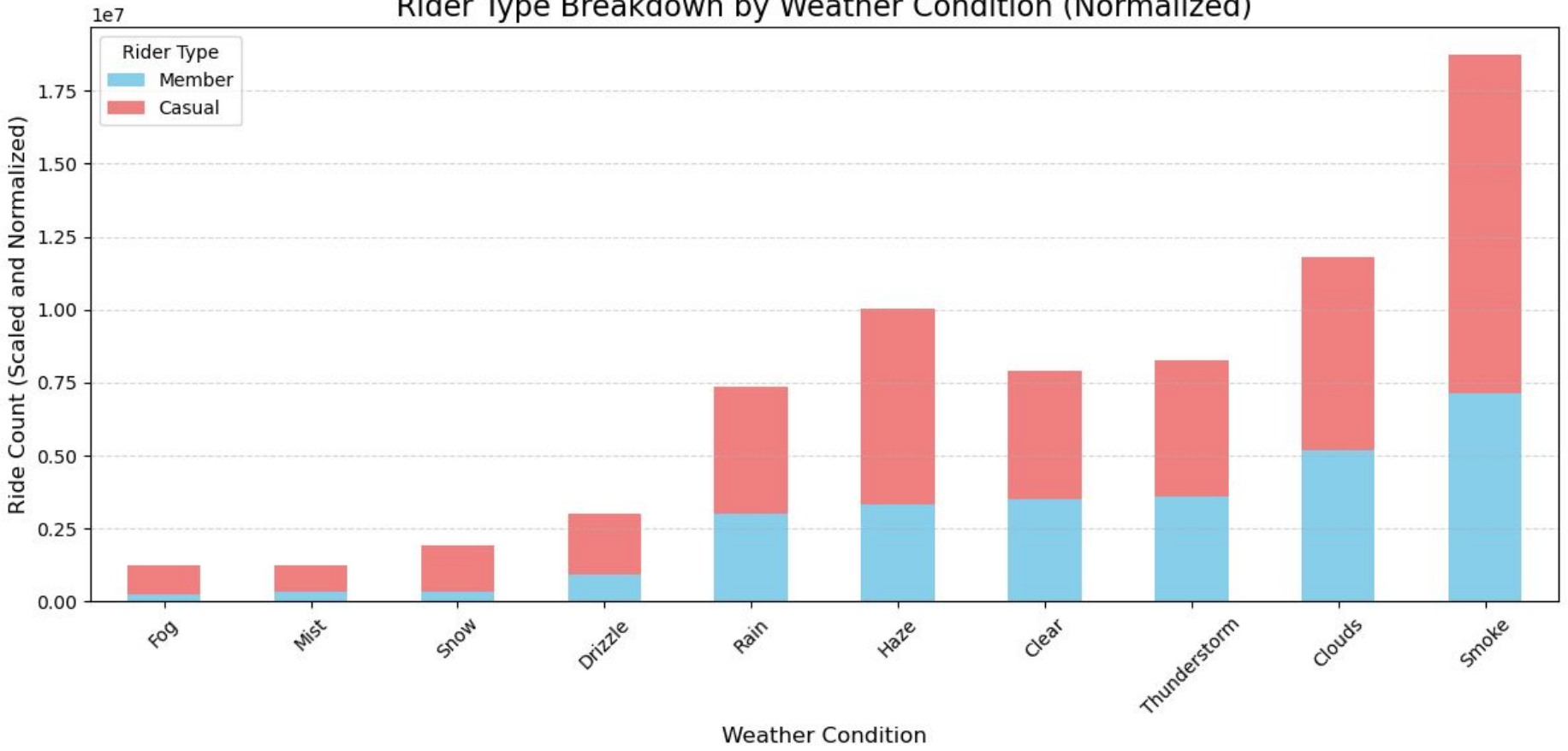

Top 10 Stations Under Adve
Cornell Ave & Hyde Park Blvd
Woodlawn Ave & 55th St
Fort Dearborn Dr & 31st St
MLK Jr Dr & 29th St
State St & 33rd St
Shore Dr & 55th St
Kimbark Ave & 53rd St
Ellis Ave & 55th St
Ellis Ave & 60th St
University Ave & 57th St
Station Name
0
10000
20000
30000
40000
50000
60000
70000
Total Ride Count

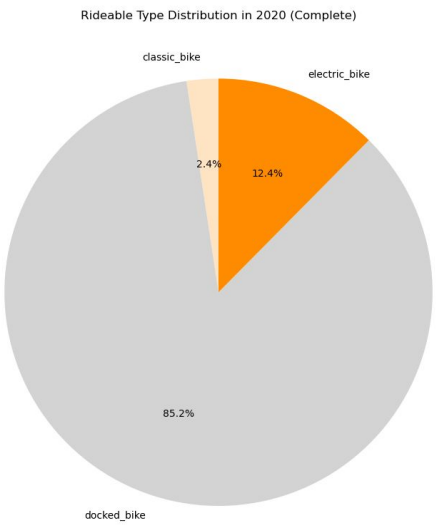
Usage Trends by Time

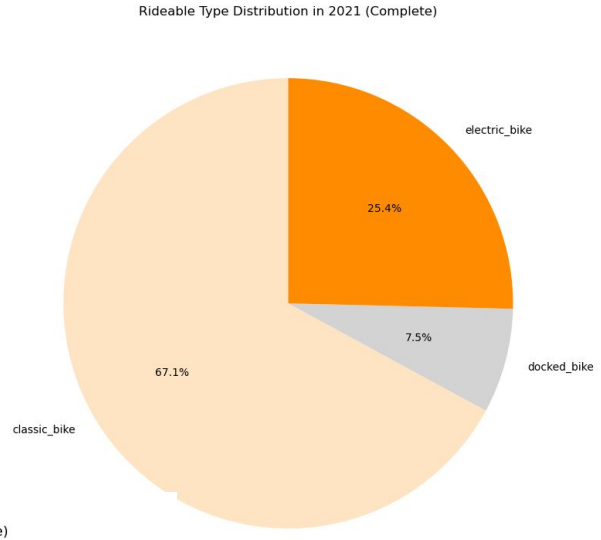

Hourly Ride Trends by Rider Type and Bike Type
Number of Rides
Hour of the Day
0
50000
100000
150000
200000
250000
300000
350000
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Rider Type and Bike Type
member - docked_bike
member - electric_bike
member - classic_bike
casual - docked_bike
casual - electric_bike
casual - classic_bike

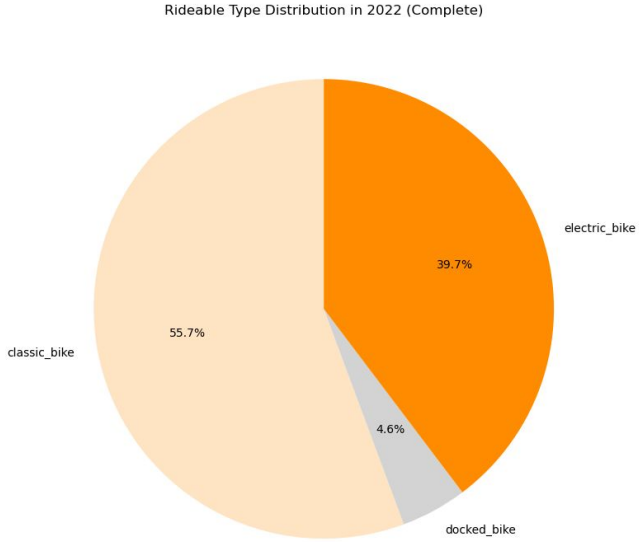

Hourly Rides Normalized by Weather Probabilities
1e6
Normalized Ride Count
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour of the Day
Weather Condition
Clear
Clouds
Drizzle
Fog
Haze
Mist
Rain
Smoke
Snow
Thunderstorm

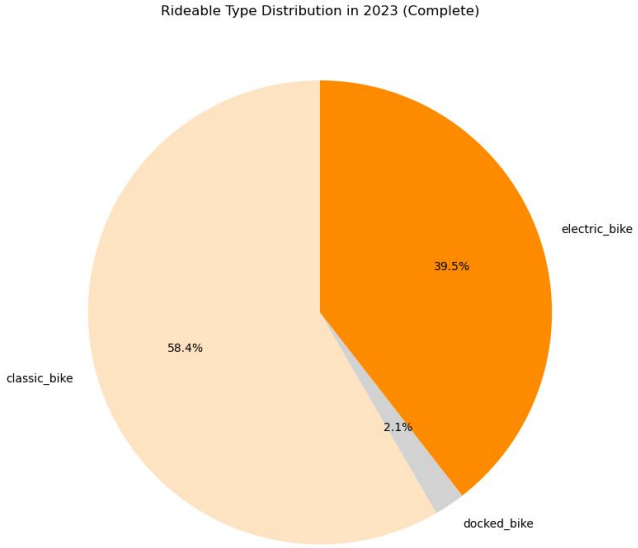
Rider Type Preferences

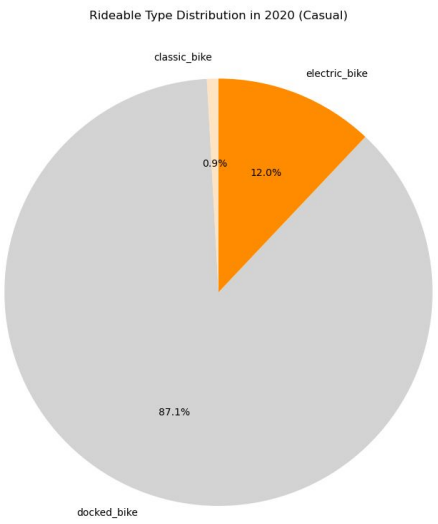

Rider Type Breakdown by Weather Condition (Normalized)
1e7
Rider Type
Member
Casual
Ride Count (Scaled and Normalized)
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
Fog
Mist
Snow
Drizzle
Rain
Haze
Clear
Thunderstorm
Clouds
Smoke
Weather Condition

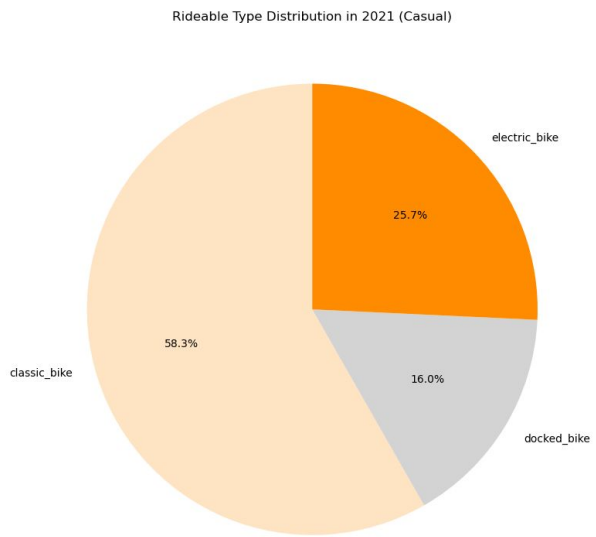

Rideable Type Distribution in 2020 (Complete)
classic_bike
electric_bike
2.4%
12.4%
85.2%
docked_bike

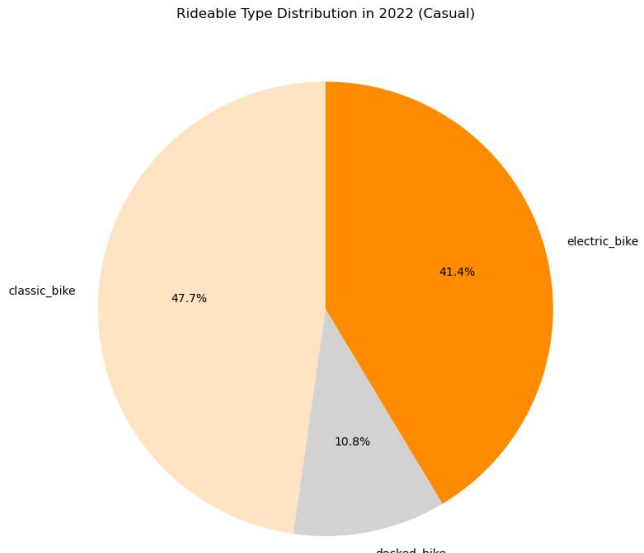

Rideable Type Distribution in 2021 (Complete)
electric_bike
25.4%
7.5%
docked_bike
67.1%
classic_bike

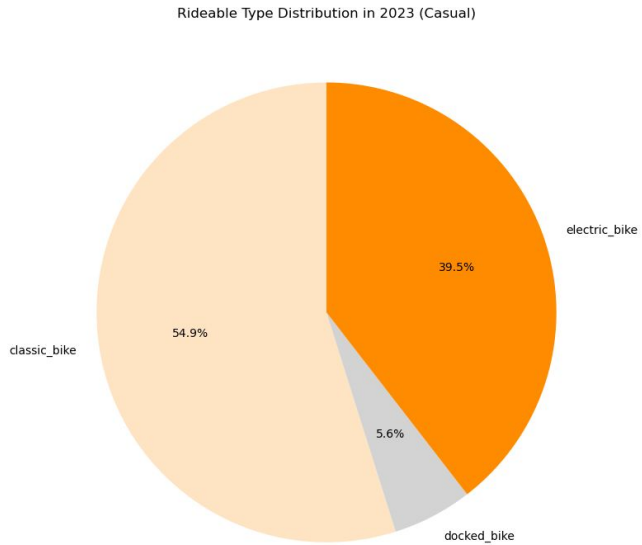

Rideable Type Distribution in 2022 (Complete)
electric_bike
39.7%
55.7%
classic_bike
4.6%
docked_bike

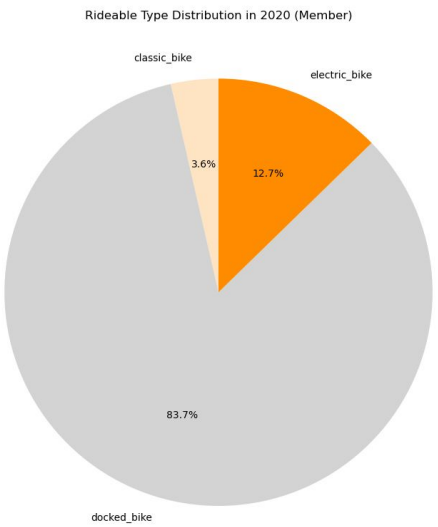

Rideable Type Distribution in 2023 (Complete)
electric_bike
39.5%
58.4%
classic_bike
2.1%
docked_bike

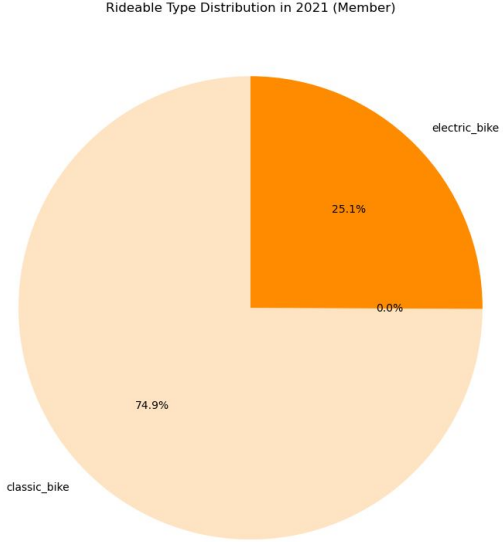

Rideable Type Distribution in 2020 (Casual)
classic_bike
electric_bike
0.9%
12.0%
87.1%
docked_bike

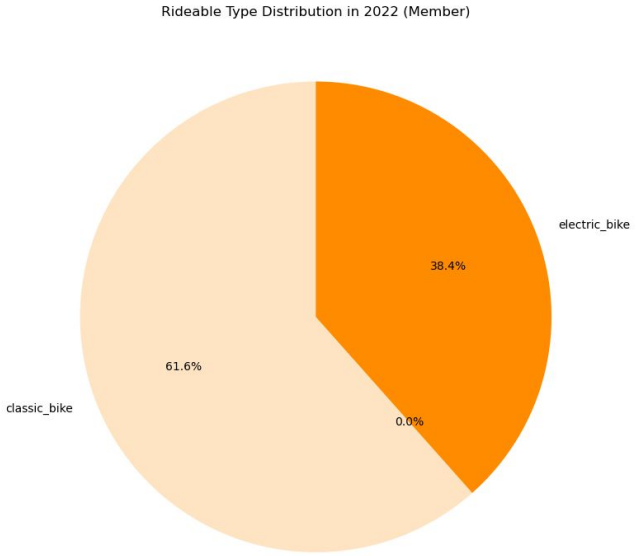

Rideable Type Distribution in 2021 (Casual)
electric_bike
25.7%
58.3%
classic_bike
16.0%
docked_bike

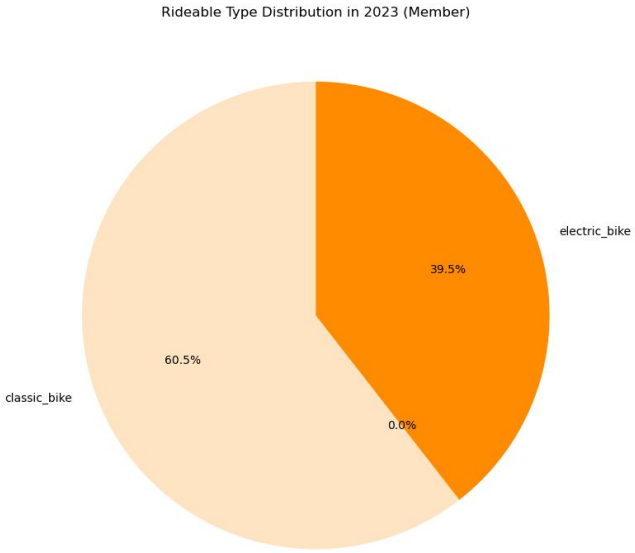

Rideable Type Distribution in 2022 (Casual)
electric_bike
41.4%
classic_bike
47.7%
10.8%


Rideable Type Distribution in 2023 (Casual)
electric_bike
39.5%
classic_bike
54.9%
5.6%
docked_bike

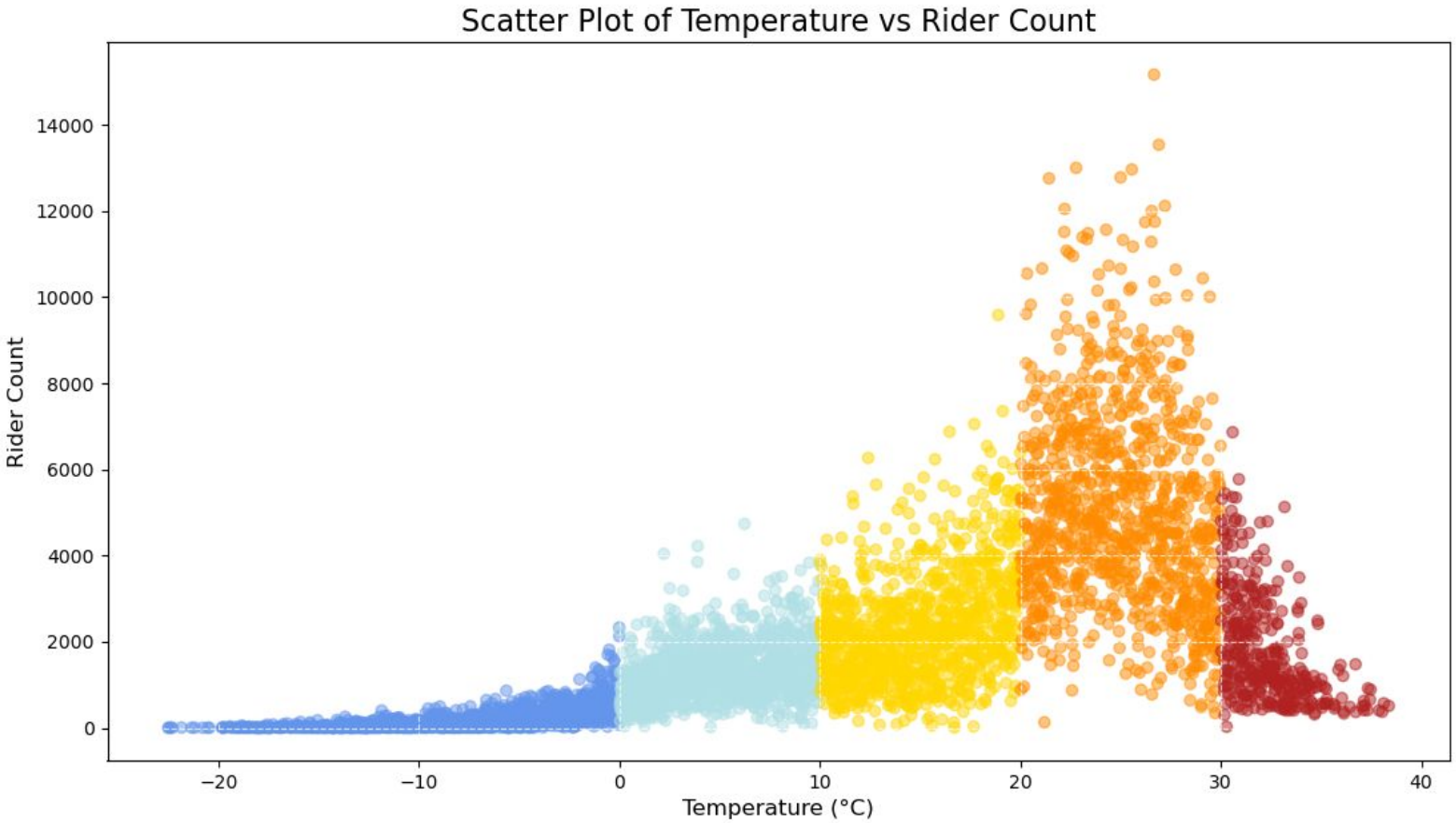

Rideable Type Distribution in 2020 (Member)
classic_bike
electric_bike
3.6%
12.7%
83.7%
docked_bike


Rideable Type Distribution in 2021 (Member)
electric_bike
25.1%
0.0%
74.9%
classic_bike

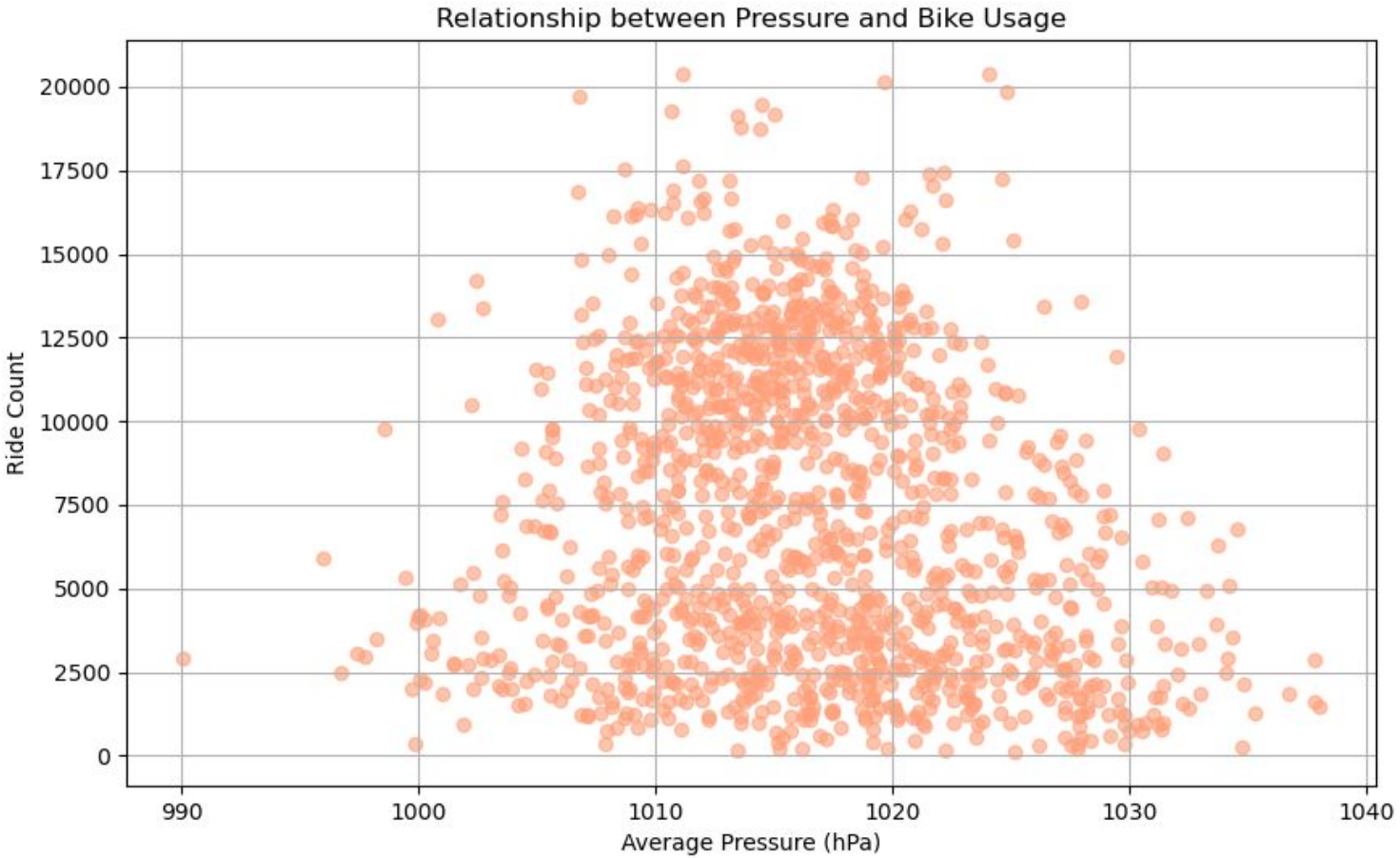

Rideable Type Distribution in 2022 (Member)
electric_bike
38.4%
61.6%
classic_bike
0.0%


Rideable Type Distribution in 2023 (Member)
electric_bike
39.5%
60.5%
classic_bike
0.0%

Usage Trends by Temperature

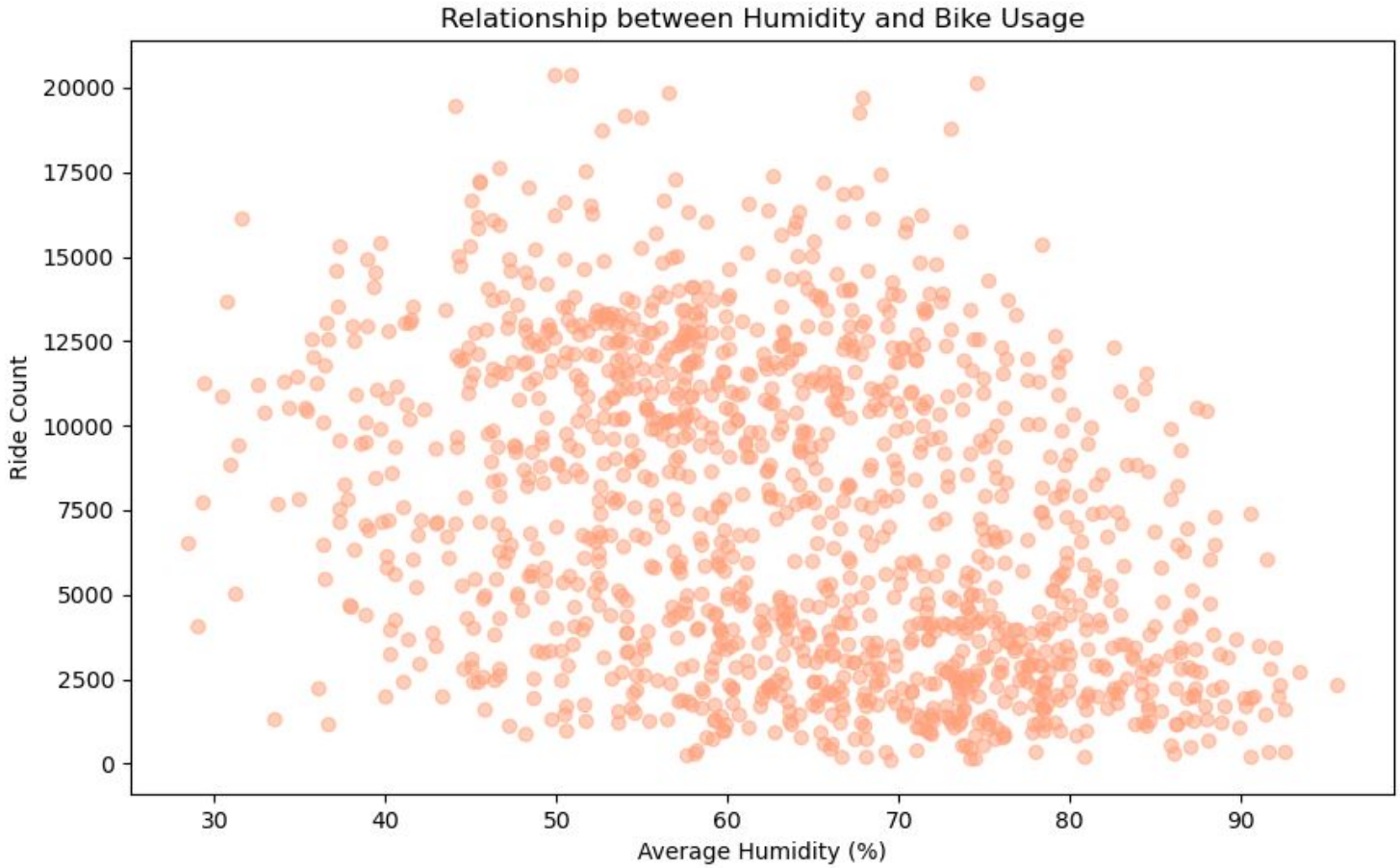

Scatter Plot of Temperature vs Rider Count
Rider Count
14000
12000
10000
8000
6000
4000
2000
0
−20
−10
0
10
20
30
40
Temperature (°C)

Usage Trends by Pressure



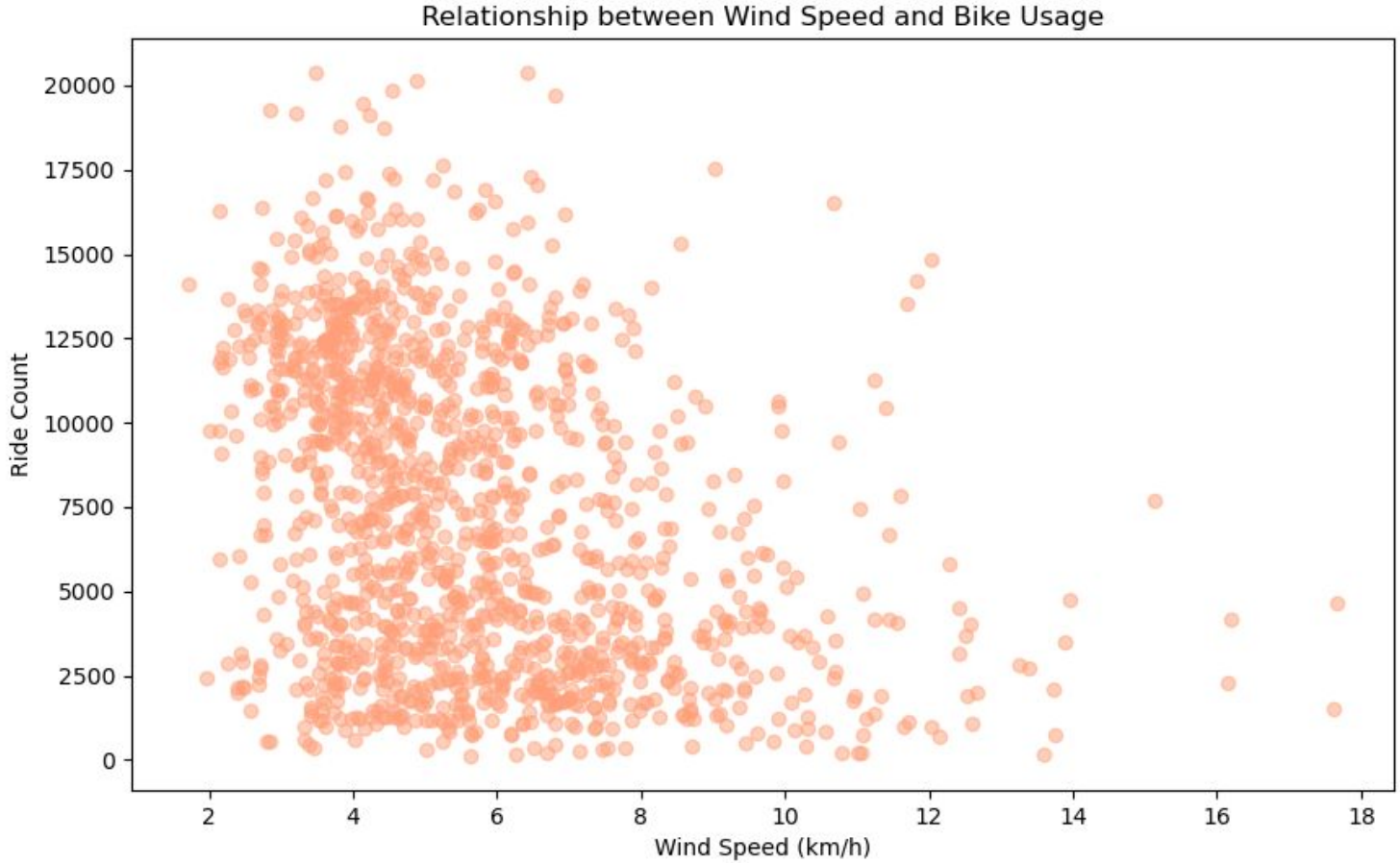
Correlation between pressure and bike usage: -0.15982607636106538
T-statistic: 5.675373785077928, P-value: 1.695332623938162e-08

Usage Trends by Humidity




```
humidity_level
Low       9491.721311
Medium    8374.440821
High      5135.859375
Name: total_rides, dtype: float64
ANOVA F-statistic: 89.9906553200607, P-value: 2.1804968466732907e-37
```

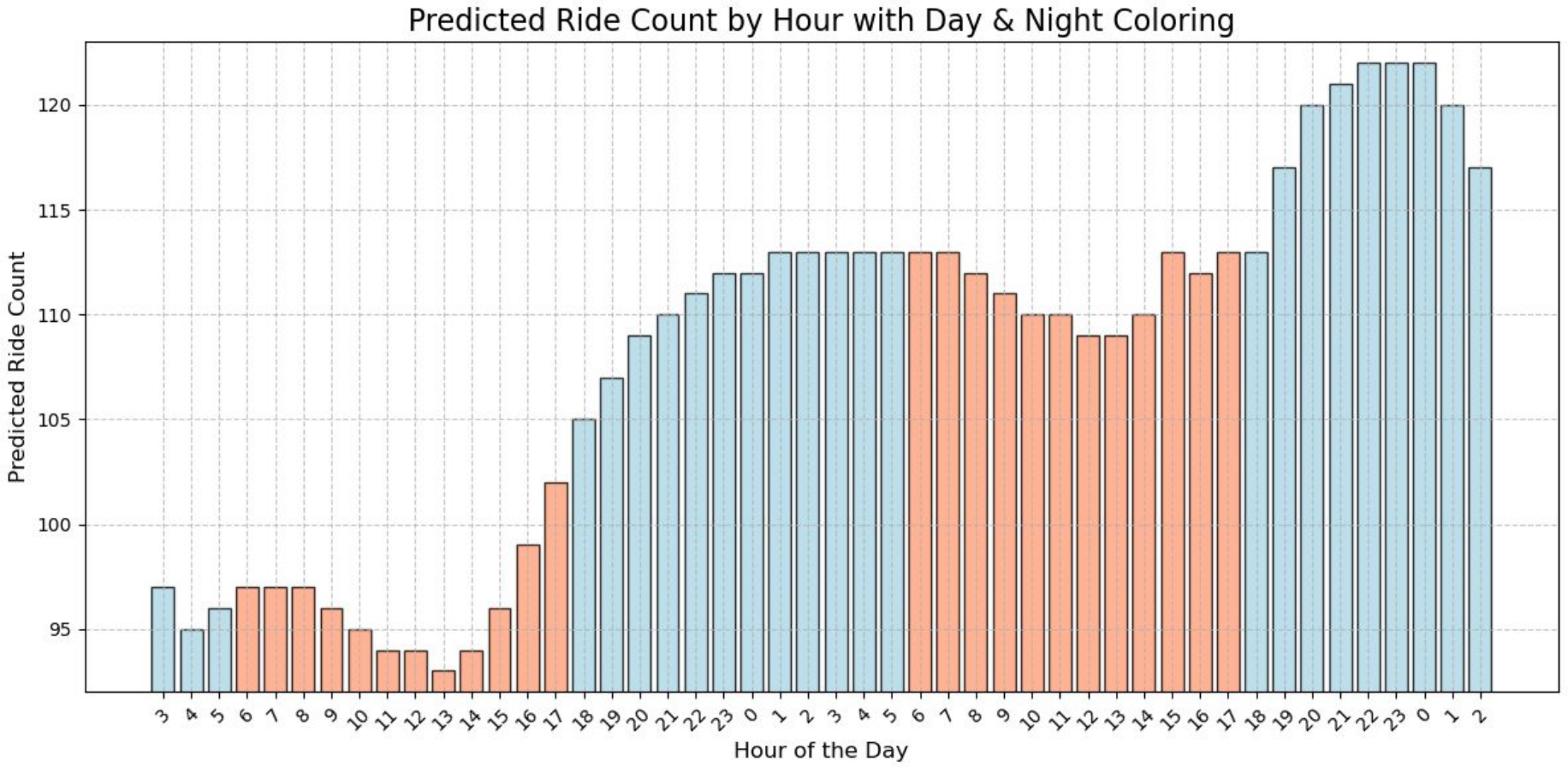
Usage Trends by Wind Speed



Correlation between wind speed and bike usage: -0.3446805515371327

API Work and Predictions

Metric	Datetime	feels_like_Value	humidity_Value	pressure_Value	temp_Value	temp_max_Value	temp_min_Value
0	2024-12-12 04:00:00	34	157	119	34	103	114
1	2024-12-12 05:00:00	35	167	119	35	103	114
2	2024-12-12 06:00:00	34	174	120	34	103	114
3	2024-12-12 07:00:00	31	184	121	30	103	114
4	2024-12-12 08:00:00	27	191	121	25	103	114


Predicted Ride Count by Hour with Day & Night Coloring
Predicted Ride Count
120
115
110
105
100
95
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 0 1 2
Hour of the Day

Conclusion and Recommendations

4

Questions?