Cyclistic bike-share analysis case study

Background

About the company

In 2016, Cyclistic launched a successful bike-share offering. Since then, the program has grown to a fleet of 5,824 bicycles that are geotracked and locked into a network of 692 stations across Chicago. The bikes can be unlocked from one station and returned to any other station in the system anytime.

Until now, Cyclistic’s marketing strategy relied on building general awareness and appealing to broad consumer segments. One approach that helped make these things possible was the flexibility of its pricing plans: single-ride passes, full-day passes, and annual memberships. Customers who purchase single-ride or full-day passes are referred to as casual riders. Customers who purchase annual memberships are Cyclistic members.

Cyclistic’s finance analysts have concluded that annual members are much more profitable than casual riders. Although the pricing flexibility helps Cyclistic attract more customers, Moreno believes that maximizing the number of annual members will be key to future growth. Rather than creating a marketing campaign that targets all-new customers, Moreno believes there is a very good chance to convert casual riders into members. She notes that casual riders are already aware of the Cyclistic program and have chosen Cyclistic for their mobility needs.

Moreno has set a clear goal: Design marketing strategies aimed at converting casual riders into annual members. In order to do that, however, the marketing analyst team needs to better understand how annual members and casual riders differ, why casual riders would buy a membership, and how digital media could affect their marketing tactics. Moreno and her team are interested in analyzing the Cyclistic historical bike trip data to identify trends.

Ask

Business Problem

Design marketing strategies aimed at converting casual riders into annual members.

Three questions will guide the future marketing program:

1. How do annual members and casual riders use Cyclistic bikes differently?
2. Why would casual riders buy Cyclistic annual memberships?
3. How can Cyclistic use digital media to influence casual riders to become members?

Assignment

Answer the question: How do annual members and casual riders use Cyclistic bikes differently? Produce a report with the following deliverables:

1. A clear statement of the business task
2. A description of all data sources used
3. Documentation of any cleaning or manipulation of data
4. A summary of your analysis
5. Supporting visualizations and key findings
6. Your top three recommendations based on your analysis

Data Preparation Notes

Using the last 12 months of trip data in dataset (date range 202205-202304 as indicated in file names)

The data that we will be using is Cyclistic's historical trip data from last 12 months (202205-202304). The data has been made available by Motivate International Inc. on this link under this license.

Note that one file name 202209-divvy-publictripdata.csv had a name discrepancy - all other files were named in the format yyyymm-divvy-tripdata.csv.

ROCCC approach is used to determine the credibility of the data

- Reliable – It is complete and accurate and it represents all bike rides taken in the city of Chicago for the selected duration of our analysis.
- Original - The data is made available by Motivate International Inc. which operates the city of Chicago's Divvy bicycle sharing service which is powered by Lyft.
- Comprehensive - the data includes all information about ride details including starting time, ending time, station name, station ID, type of membership and many more.
- Current – It is up-to-date as it includes data until end of May 2021
- Cited - The data is cited and is available under Data License Agreement.

Data Processing Notes

Tools

- MBP M1Max 64GB
- DB Browser for SqlLite
- SqlLite3
- VS Code (IDE with extensions including Data Wrangler)
- Jupyter Notebook

Data Staging/Cleaning

- Created an empty SqlLite database and imported each of the 12 CSV files into separate tables indentified by YYYYMM in table name
- Created a view that combined all tables into a single table - compared row counts to validate
- Added additional columns to support analysis
  - ride_duration_secs
  - ride_duration_mins
  - season (Spring, Summer, Fall, Winter) using meteorological seasons
  - day_number (1-7)
  - weekday (Monday..Sunday)
- Noticed ride_durations with negative values; assumed started_at and ended_at enties were reversed so used abs() in duration calculation; also noticed zero values
- Rideable types have three values fpr casual but only two for members; the type "docked_bike" is unique. There should be only the two types. To fix this anomaly, I counted docked_bikes as classic bikes because the choices were in line with member choices.

Analysis

`Given the available and derived/calculated data what could this data tells us about how members and casual riders use Cyclistic bikes differently?`

- What types of bikes are used members and casual riders?

- How do ride durations compare?
- How do ride counts compare?
- How do the temporal aspects compare (month, day of week, time of day, season)?
- What stations are most frequently used by each type of rider?

It might have been interesting to examine ride distances but although the data includes a start and end lat and long, that is not enough information to calculate actual distance travelled.

In [ ]:

```
# %pip install ipython-sql
#Introduces a %sql (or %%sql) magic.
# Connect to a database, using SQLAlchemy URL connect strings, then issue SQL commands within IPython or IPython Notebook.
%load_ext sql
#data tables in sqlite db including a consolidated table with all data; data enhancements are contained in views to ensure original data integrity
%sql sqlite://///Users/dinorusso/PyDev/Coursera_Case_Study_1/Cyclistic_Trip_Data/DB/cyclistic_v5.db
```

In [ ]:

```
# peek at the data contained in the last view - v7 as a dataframe
result = %sql select * from v7
df = result.DataFrame()
df.head()
```

```
* sqlite://///Users/dinorusso/PyDev/Coursera_Case_Study_1/Cyclistic_Trip_Data/DB/cyclistic_v5.db
Done.
```

Out[ ]:

	ride_id	rideable_type	started_at	ended_at	start_station_name	start_station_id	end_station_name	end_station_id	start_lat	start_lng	...	ride_duration_mins	season	day_number
0	EC2DE40644C6B0F4	classic_bike	2022-05-23 23:06:58	2022-05-23 23:40:19	Wabash Ave & Grand Ave	TA1307000117	Halsted St & Roscoe St	TA1309000025	41.891466	-87.626761	...	33.0	Spring	1
1	1C31AD03897EE385	classic_bike	2022-05-11 08:53:28	2022-05-11 09:31:22	DuSable Lake Shore Dr & Monroe St	13300	Field Blvd & South Water St	15534	41.880958	-87.616743	...	38.0	Spring	3
2	1542FBEC830415CF	classic_bike	2022-05-26 18:36:28	2022-05-26 18:58:18	Clinton St & Madison St	TA1305000032	Wood St & Milwaukee Ave	13221	41.882242	-87.641066	...	22.0	Spring	4
3	6FF59852924528F8	classic_bike	2022-05-10 07:30:07	2022-05-10 07:38:49	Clinton St & Madison St	TA1305000032	Clark St & Randolph St	TA1305000030	41.882242	-87.641066	...	9.0	Spring	2
4	483C52CAAE12E3AC	classic_bike	2022-05-10 17:31:56	2022-05-10 17:36:57	Clinton St & Madison St	TA1305000032	Morgan St & Lake St	TA1306000015	41.882242	-87.641066	...	5.0	Spring	2

5 rows × 24 columns

In [ ]:

```
df.describe()
```

Out[ ]:

	start_lat	start_lng	end_lat	end_lng	ride_duration_secs	ride_duration_mins	day_number	season_number	is_member_ride	is_casual_ride	member_ride_duration_mins	ca
count	5.859061e+06	5.859061e+06	5.853088e+06	5.853088e+06	5.859061e+06	5.859061e+06	5.859061e+06	5.859061e+06	5.859061e+06	5.859061e+06	5.859061e+06	
mean	4.190262e+01	-8.764770e+01	4.190284e+01	-8.764778e+01	1.136401e+03	1.893804e+01	3.107713e+00	2.855357e+00	5.974940e-01	4.025060e-01	7.469428e+00	
std	4.581984e-02	2.865640e-02	6.717431e-02	1.064370e-01	1.045984e+04	1.743318e+02	2.001841e+00	9.279801e-01	4.904028e-01	4.904028e-01	2.328518e+01	
min	4.164000e+01	-8.784000e+01	0.000000e+00	-8.814000e+01	0.000000e+00	0.000000e+00	0.000000e+00	1.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	
25%	4.188103e+01	-8.766140e+01	4.188103e+01	-8.766150e+01	3.390000e+02	6.000000e+00	1.000000e+00	2.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	
50%	4.190000e+01	-8.764414e+01	4.190000e+01	-8.764434e+01	5.990000e+02	1.000000e+01	3.000000e+00	3.000000e+00	1.000000e+00	0.000000e+00	4.000000e+00	
75%	4.193000e+01	-8.762980e+01	4.193000e+01	-8.762991e+01	1.075000e+03	1.800000e+01	5.000000e+00	4.000000e+00	1.000000e+00	1.000000e+00	1.000000e+01	
max	4.207000e+01	-8.752000e+01	4.237000e+01	0.000000e+00	2.483235e+06	4.138700e+04	6.000000e+00	4.000000e+00	1.000000e+00	1.000000e+00	1.035300e+04	

Quick Stats across all rides

In [ ]:

```
# for context - how many of each rider type rides do we have
df['member_casual'].value_counts()
```

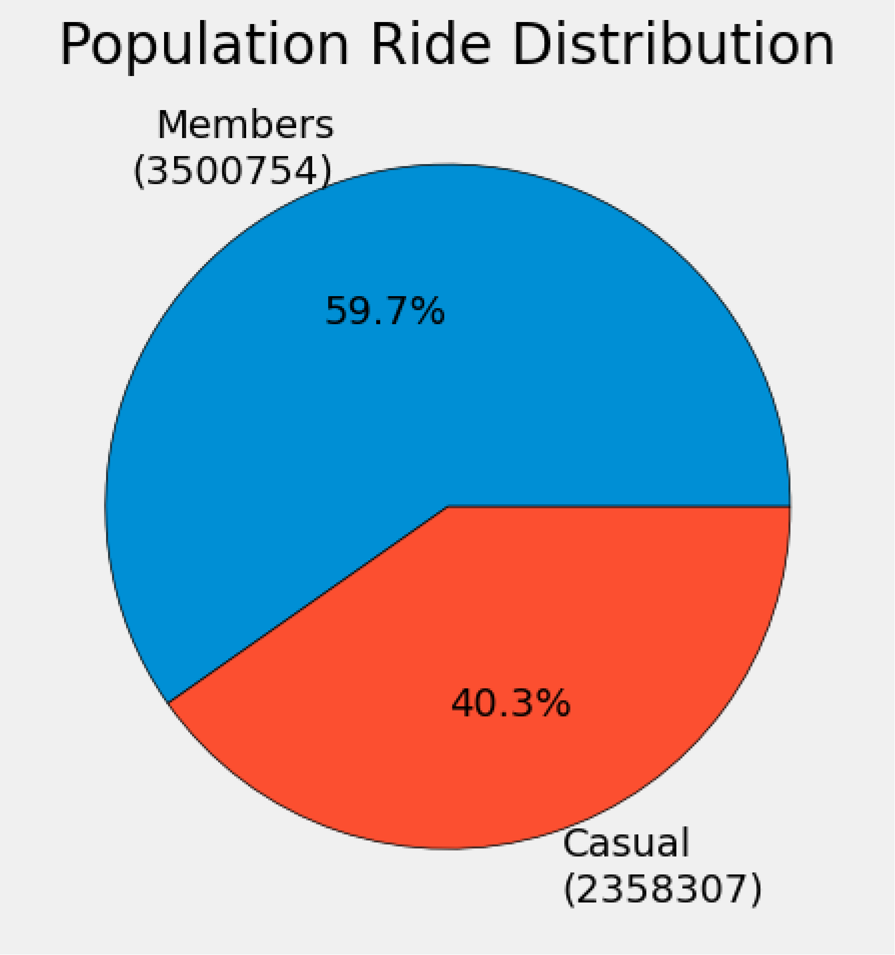
Out[ ]:

```
member_casual
member    3500754
casual    2358307
Name: count, dtype: int64
```

In [ ]:

```
# create viz as a pie chart

from matplotlib import  pyplot as plt
plt.style.use("fivethirtyeight")
labels = ['Members\n(' + str(df['member_casual'].value_counts()[0]) +')', 'Casual\n(' + str(df['member_casual'].value_counts()[1]) + ')']
plt.rcParams["figure.figsize"] = (10,5)
plt.pie(df['member_casual'].value_counts(), labels = labels,
        autopct='%1.1f%%',
        wedgeprops={'edgecolor':'black'} )
plt.title("Population Ride Distribution")
plt.tight_layout()
plt.rcParams["figure.figsize"] = (10,5)
plt.show()
```



What types of bikes are used by riders?

In [ ]:

```
# lets take a look at rideable_type (bike type) members vs casual
df_biketypes = df[['member_casual','bike_type' ]]

import pandas as pd
pivot = pd.crosstab(df_biketypes['member_casual'],
                    df_biketypes['bike_type'],
                    values=df_biketypes['bike_type'],
                    aggfunc='count').fillna(0)
pivot.head(20)
```

Out[ ]:

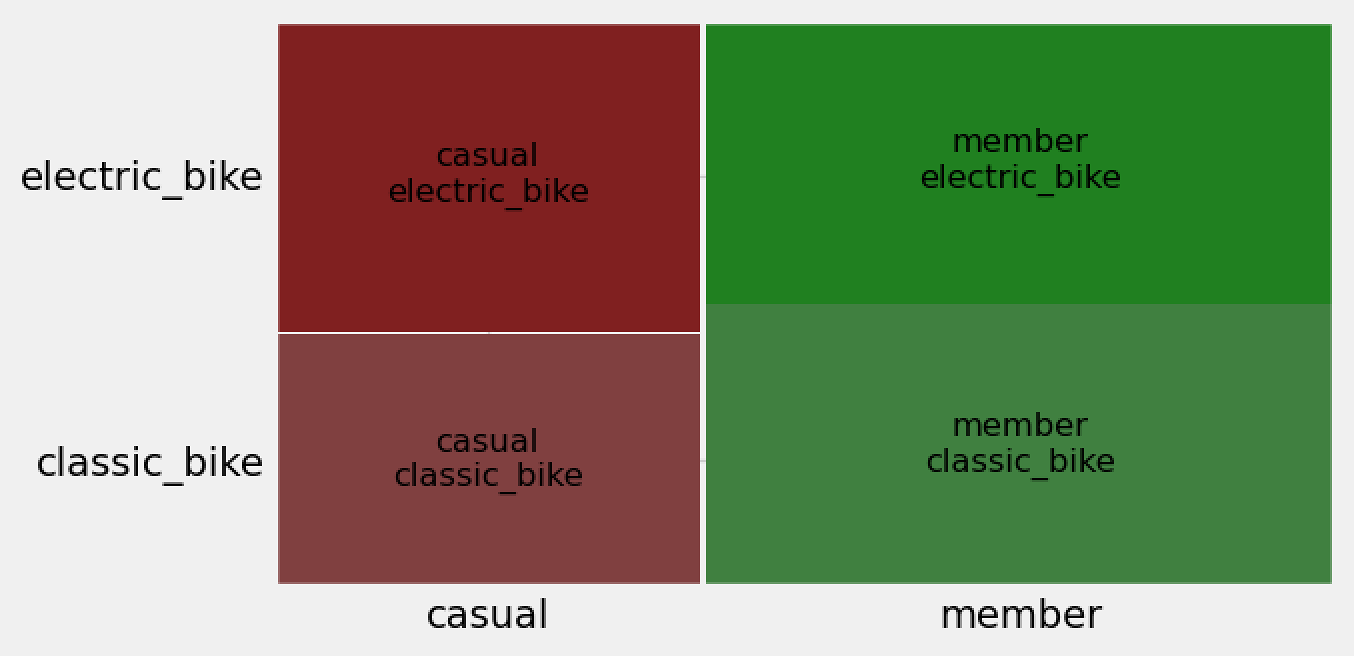
bike_type	classic_bike	electric_bike
member_casual		
casual	1061764	1296543
member	1751339	1749415

In [ ]:

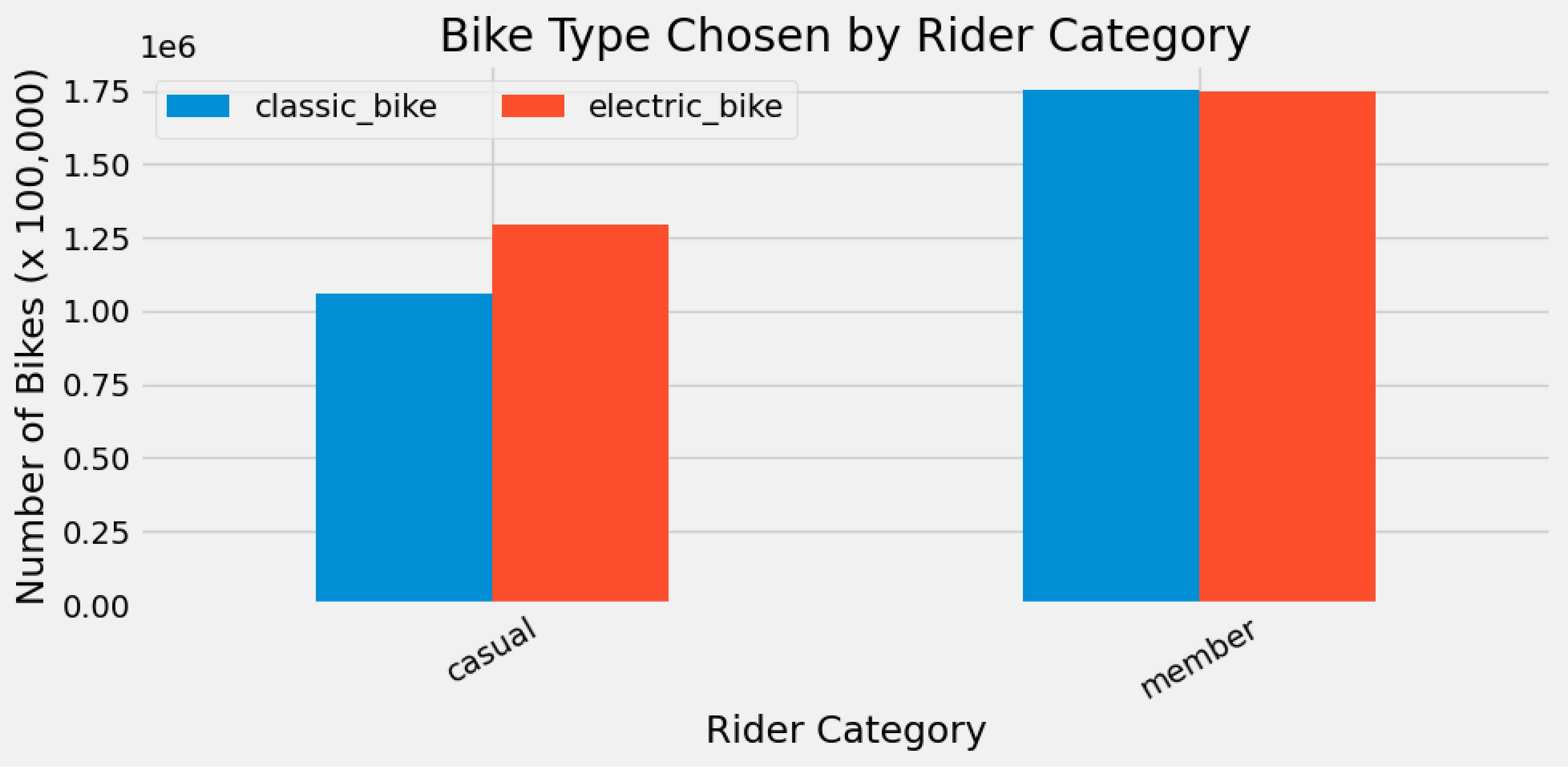
```
import numpy as np
import matplotlib.pyplot as plt
from statsmodels.graphics.mosaicplot import mosaic
from itertools import product

plt.rcParams["figure.figsize"] = [7.00, 3.50]
plt.rcParams["figure.autolayout"] = True
mosaic(pivot.stack(), axes_label=True)
```

```
Out[ ]: (<Figure size 700x350 with 3 Axes>,
         {('casual', 'classic_bike'): (0.0,
           0.0,
           0.4005034474556988,
           0.44872722035362583),
          ('casual', 'electric_bike'): (0.0,
           0.4520494794898385,
           0.4005034474556988,
           0.5479505205101615),
          ('member', 'classic_bike'): (0.4054785718338083,
           0.0,
           0.5945214281661918,
           0.49861275542544387),
          ('member', 'electric_bike'): (0.4054785718338083,
           0.5019350145616565,
           0.5945214281661918,
           0.49806498543834343)})
```



```
In [ ]: # I was not satisfied that the mosaic plot was clear enough so created a bar chart
        ax = pivot.plot(kind="bar",figsize=(10,5), title="Bike Type Chosen by Rider Category").legend(loc='upper left', ncol=2)
        plt.xlabel("Rider Category")
        plt.ylabel("Number of Bikes (x 100,000)")
        plt.xticks(rotation=30, horizontalalignment="center")
        plt.tight_layout()
```



No real insight. Looks like both rider type choose bikes similarly (i.e. not a large preference between classic and electric).

What about temporal distinctions?

What about day of week distinction?

Day of Week

In [ ]:

```
# note that queries were tested in DB Browser for Sqlite in advance
# these queries were design to return data that could be plotted without additional manipulation as much as possible
sql_statement = f"""select
        weekday,
        sum(is_member_classic_bike_ride) as classic_member,
        sum(is_casual_classic_bike_ride) as classic_casual,
        sum(is_member_electric_bike_ride) as electric_member,
        sum(is_casual_electric_bike_ride) as electric_casual
from
(
select weekday, day_number,
case
        when bike_type == "classic_bike"  and  is_member_ride == True then True
        else False
end as is_member_classic_bike_ride,
case
        when bike_type == "classic_bike"  and is_casual_ride == True then True
        else False
end as is_casual_classic_bike_ride,
case
        when bike_type == "electric_bike"  and  is_member_ride == True then True
        else False
end as is_member_electric_bike_ride,
case
        when bike_type == "electric_bike"  and is_casual_ride == True then True
        else False
end as is_casual_electric_bike_ride
from v7

)
group by weekday
order by day_number"""

result = %sql {sql_statement}
```

```
 * sqlite://///Users/dinorusso/PyDev/Coursera_Case_Study_1/Cyclistic_Trip_Data/DB/cyclistic_v5.db
Done.
```

In [ ]:

```
df_bikes_dow = result.DataFrame()
df_bikes_dow.head(7)
```

Out[ ]:

	weekday	classic_member	classic_casual	electric_member	electric_casual
0	Sunday	204975	190659	197106	198177
1	Monday	247527	123114	237037	152638
2	Tuesday	276353	115676	268049	156987
3	Wednesday	276971	117915	279945	166660
4	Thursday	275780	134739	285104	183732
5	Friday	242510	151057	254966	199027
6	Saturday	227223	228604	227208	239322

In [ ]:

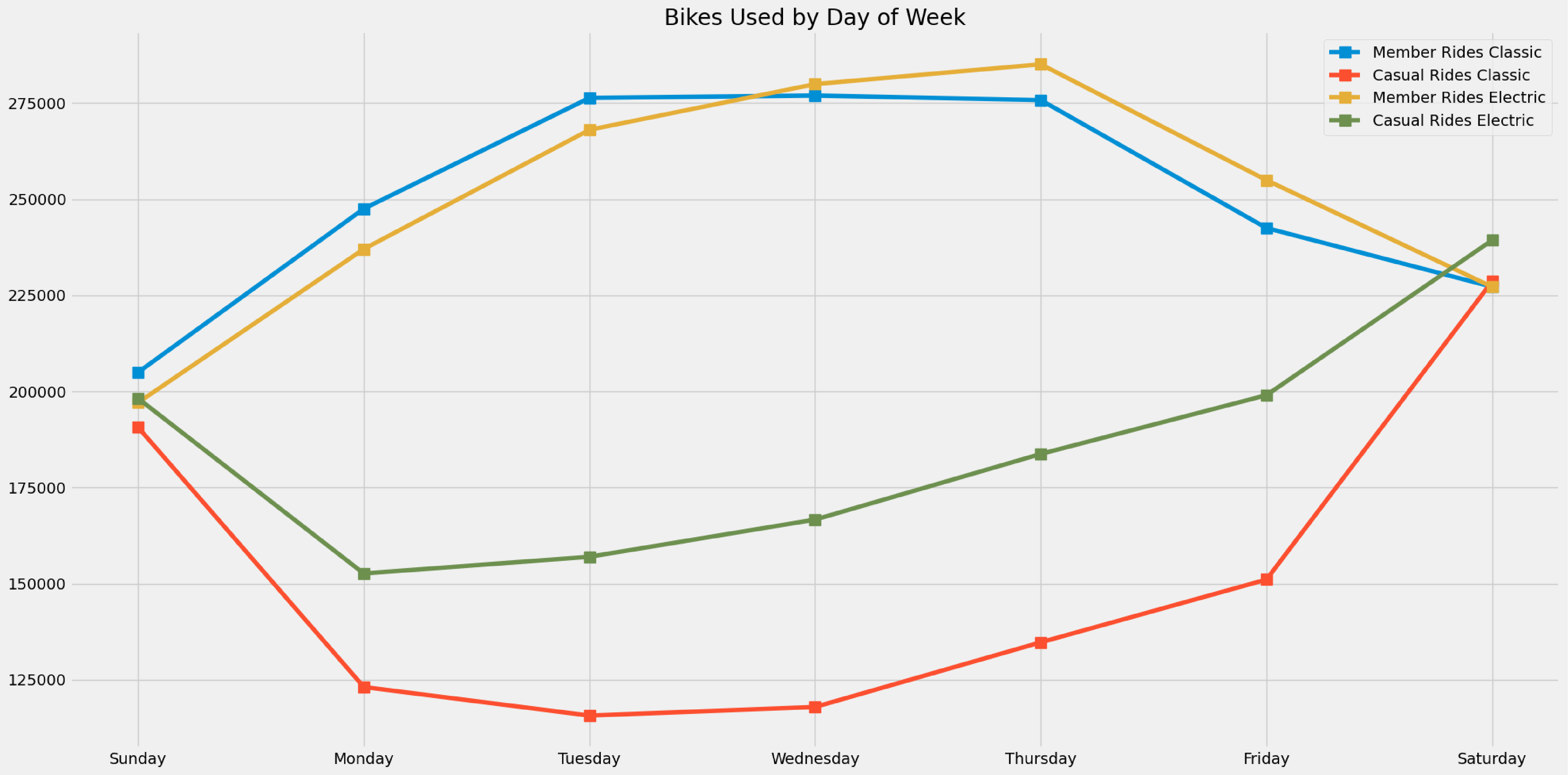
```
weekdays = df_bikes_dow['weekday']
c_mem = df_bikes_dow['classic_member']
c_cas = df_bikes_dow['classic_casual']
e_mem = df_bikes_dow['electric_member']
e_cas = df_bikes_dow['electric_casual']
plt.tight_layout()
plt.rcParams["figure.figsize"] = (10,5)
plt.plot(weekdays,c_mem, marker='s',markersize = 10, label = "Member Rides Classic")
plt.plot(weekdays,c_cas,  marker='s',markersize = 10,label = "Casual Rides Classic")
plt.plot(weekdays,e_mem, marker='s',markersize = 10, label = "Member Rides Electric")
plt.plot(weekdays,e_cas,  marker='s',markersize = 10,label = "Casual Rides Electric")

plt.legend()


plt.title("Bikes Used by Day of Week")
```

Out[ ]:

```
Text(0.5, 1.0, 'Bikes Used by Day of Week')
```



It appears that casual riders tend to prefer electric bikes over classic bikes especially on weekdays.
Members tend to rent more classic bikes until midweek where they start to prefer electric bikes. **Perhaps they are getting tired!**

Monthly

```
In [ ]: sql_statement = f"""select
               YYMM,
               sum(is_member_classic_bike_ride) as classic_member,
               sum(is_casual_classic_bike_ride) as classic_casual,
               sum(is_member_electric_bike_ride) as electric_member,
               sum(is_casual_electric_bike_ride) as electric_casual
        from
```

```
(
select substr(started_at, 1, 7) as YYMM,
case
        when bike_type == "classic_bike"  and  is_member_ride == True then True
        else False
end as is_member_classic_bike_ride,
case
        when bike_type == "classic_bike"  and is_casual_ride == True then True
        else False
end as is_casual_classic_bike_ride,
case
        when bike_type == "electric_bike"  and  is_member_ride == True then True
        else False
end as is_member_electric_bike_ride,
case
        when bike_type == "electric_bike"  and is_casual_ride == True then True
        else False
end as is_casual_electric_bike_ride
from v7
)
group by YYMM
order by YYMM"""

result = %sql {sql_statement}
df_bikes_mon = result.DataFrame()
df_bikes_mon.head(12)
```

```
 * sqlite://///Users/dinorusso/PyDev/Coursera_Case_Study_1/Cyclistic_Trip_Data/DB/cyclistic_v5.db
Done.
```

Out[ ]:

	YYMM	classic_member	classic_casual	electric_member	electric_casual
0	2022-05	197971	152484	156472	127931
1	2022-06	236664	200636	163489	168415
2	2022-07	217078	187150	200355	218905
3	2022-08	215415	154958	211593	203966
4	2022-09	200767	125201	203875	171496
5	2022-10	151992	74182	197704	134807
6	2022-11	111549	38938	125414	61834
7	2022-12	60698	14577	76214	30317
8	2023-01	76385	15647	73908	24361
9	2023-02	74354	17729	73075	25287
10	2023-03	87627	22476	108850	39725
11	2023-04	120839	57786	158466	89499

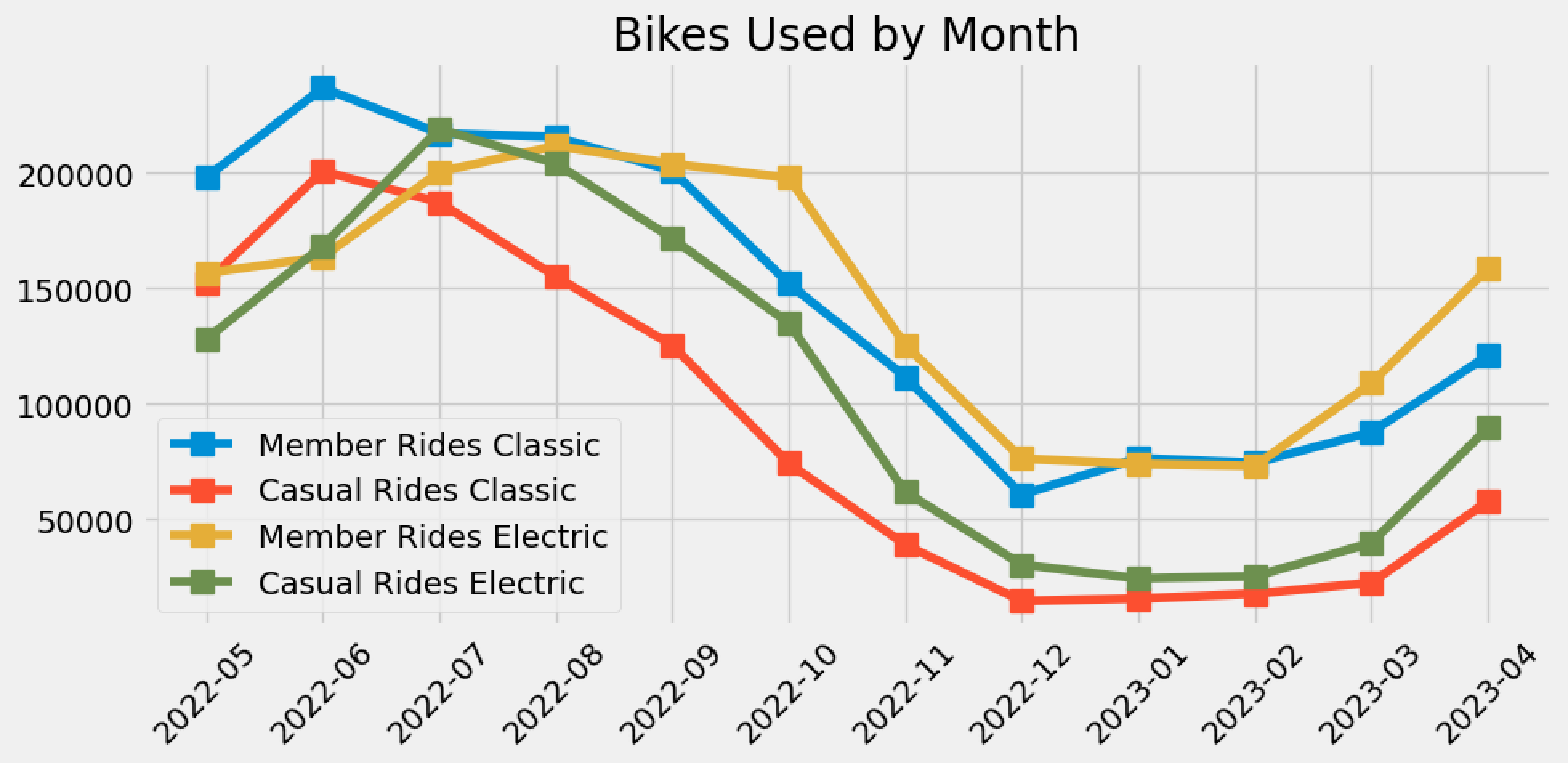
In [ ]:

```
#plot results
months = df_bikes_mon['YYMM']
c_mem = df_bikes_mon['classic_member']
```

```
c_cas = df_bikes_mon['classic_casual']
e_mem = df_bikes_mon['electric_member']
e_cas = df_bikes_mon['electric_casual']
plt.tight_layout()
plt.rcParams["figure.figsize"] = (10,5)
plt.plot(months,c_mem, marker='s',markersize = 10, label = "Member Rides Classic")
plt.plot(months,c_cas,  marker='s',markersize = 10,label = "Casual Rides Classic")
plt.plot(months,e_mem, marker='s',markersize = 10, label = "Member Rides Electric")
plt.plot(months,e_cas,  marker='s',markersize = 10,label = "Casual Rides Electric")
plt.xticks(rotation = 45)
plt.legend()


plt.title("Bikes Used by Month")
```

```
Out[ ]: Text(0.5, 1.0, 'Bikes Used by Month')
```



Seasonal

Note that meteorilogical seasons were calculated and added to the data based on the timestamp of "started_at" field - also an ordinal was added "season_number" to allow for a logical ordering

```
In [ ]: #seasonal?
        sql_statement = f"""select
                season,
                sum(is_member_classic_bike_ride) as classic_member,
                sum(is_casual_classic_bike_ride) as classic_casual,
                sum(is_member_electric_bike_ride) as electric_member,
                sum(is_casual_electric_bike_ride) as electric_casual
        from
        (
        select season, season_number,
        case
                when bike_type == "classic_bike"  and  is_member_ride == True then True
                else False
        end as is_member_classic_bike_ride,
        case
                when bike_type == "classic_bike"  and is_casual_ride == True then True
                else False
        end as is_casual_classic_bike_ride,
        case
                when bike_type == "electric_bike"  and  is_member_ride == True then True
                else False
        end as is_member_electric_bike_ride,
        case
                when bike_type == "electric_bike"  and is_casual_ride == True then True
                else False
        end as is_casual_electric_bike_ride
        from v7

        )
        group by season
        order by season_number"""
        result = %sql {sql_statement}
        df_bikes_season = result.DataFrame()
        df_bikes_season.head(4)
```

```
 * sqlite://///Users/dinorusso/PyDev/Coursera_Case_Study_1/Cyclistic_Trip_Data/DB/cyclistic_v5.db
Done.
```

Out[ ]:

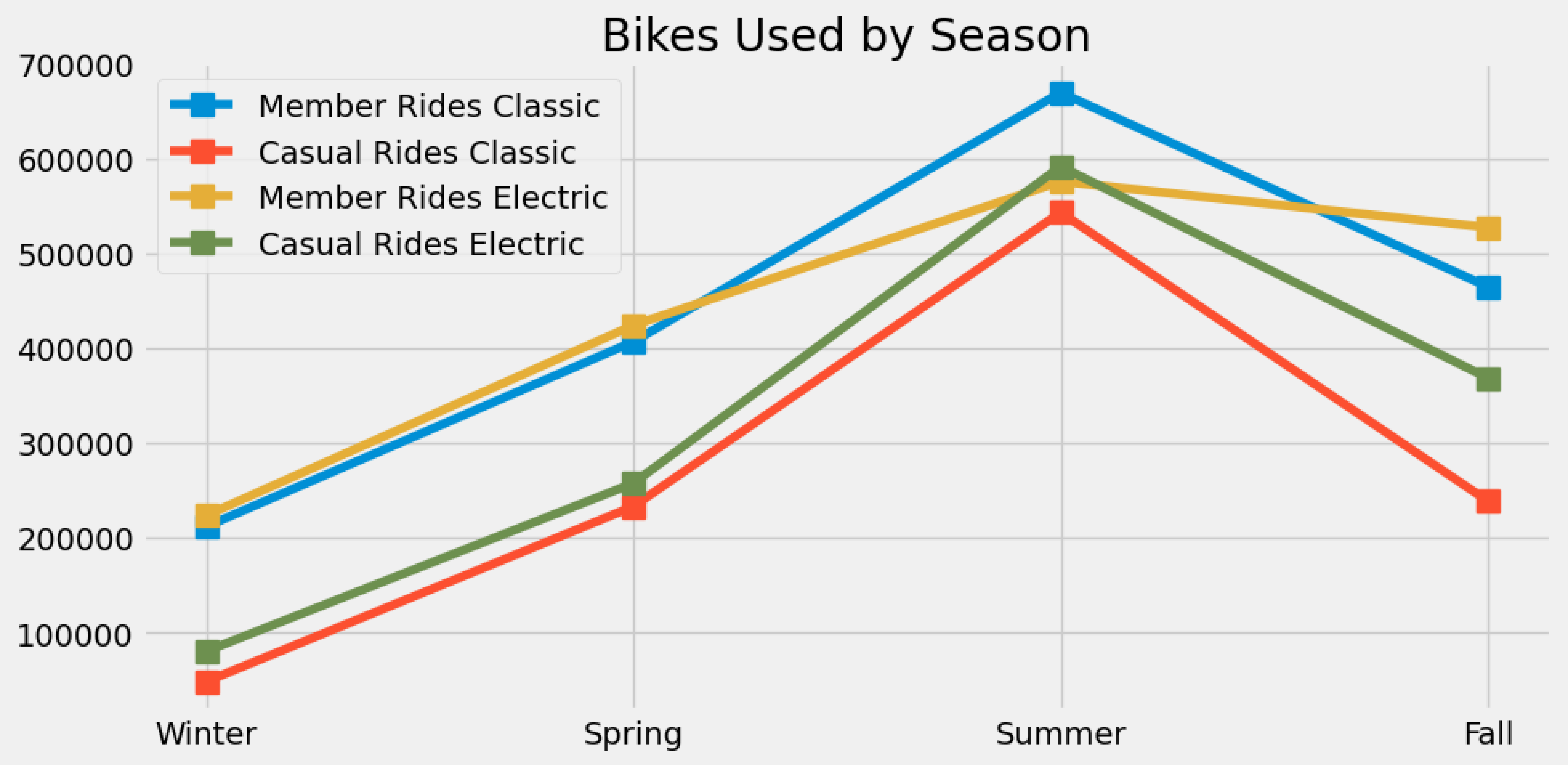
	season	classic_member	classic_casual	electric_member	electric_casual
0	Winter	211437	47953	223197	79965
1	Spring	406437	232746	423788	257155
2	Summer	669157	542744	575437	591286
3	Fall	464308	238321	526993	368137

In [ ]:

```
#plot results
seasons = df_bikes_season['season']
c_mem = df_bikes_season['classic_member']
c_cas = df_bikes_season['classic_casual']
e_mem = df_bikes_season['electric_member']
e_cas = df_bikes_season['electric_casual']
plt.tight_layout()
plt.rcParams["figure.figsize"] = (10,5)
plt.plot(seasons,c_mem, marker='s',markersize = 10, label = "Member Rides Classic")
plt.plot(seasons,c_cas,  marker='s',markersize = 10,label = "Casual Rides Classic")
plt.plot(seasons,e_mem, marker='s',markersize = 10, label = "Member Rides Electric")
plt.plot(seasons,e_cas,  marker='s',markersize = 10,label = "Casual Rides Electric")

plt.legend()
plt.title("Bikes Used by Season")
```

```
Out[ ]: Text(0.5, 1.0, 'Bikes Used by Season')
```



Let's compare ride frequency by riders by season and day of week

Part II - Ride Frequency

```
In [ ]: result = %sql SELECT  weekday, count(member_casual) as all_rides, sum(is_member_ride) as member_rides, sum(is_casual_ride) as casual_rides from v7 group by weekday order by v7.day_
        df_rides_dow = result.DataFrame()
        df_rides_dow.head(7)
```

```
 * sqlite:////Users/dinorusso/PyDev/Coursera_Case_Study_1/Cyclistic_Trip_Data/DB/cyclistic_v5.db
Done.
```

Out[ ]:

	weekday	all_rides	member_rides	casual_rides
0	Sunday	790917	402081	388836
1	Monday	760316	484564	275752
2	Tuesday	817065	544402	272663
3	Wednesday	841491	556916	284575
4	Thursday	879355	560884	318471
5	Friday	847560	497476	350084
6	Saturday	922357	454431	467926

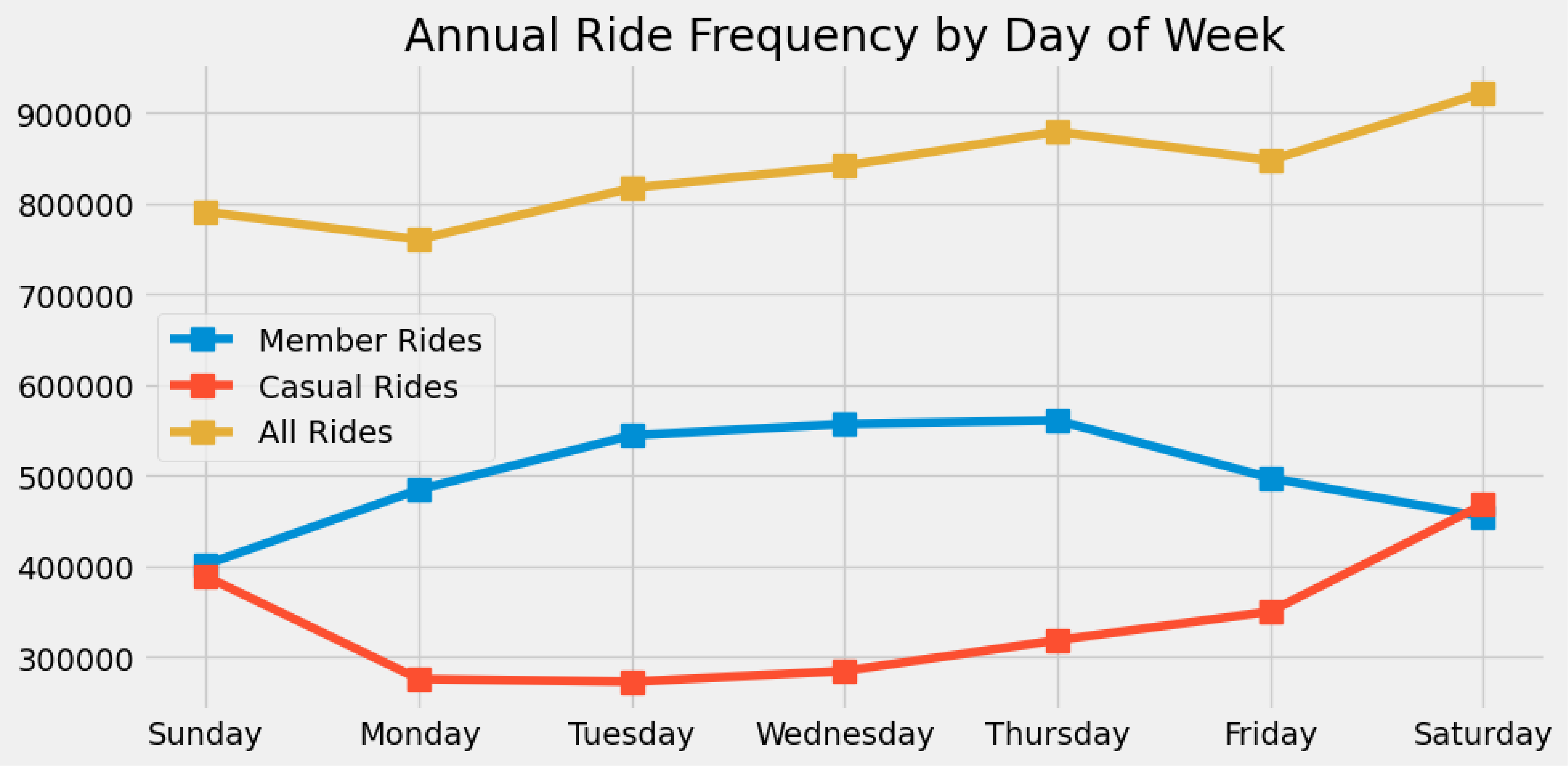
In [ ]:

```
weekdays = df_rides_dow['weekday']
all_rides = df_rides_dow['all_rides']
member_rides = df_rides_dow['member_rides']
casual_rides = df_rides_dow['casual_rides']
plt.tight_layout()
plt.rcParams["figure.figsize"] = (10,5)
plt.plot(weekdays,member_rides, marker='s',markersize = 10, label = "Member Rides")
plt.plot(weekdays,casual_rides,  marker='s',markersize = 10,label = "Casual Rides")
plt.plot(weekdays,all_rides,  marker='s',markersize = 10,label = "All Rides")
plt.legend()


plt.title("Annual Ride Frequency by Day of Week")
```

Out[ ]:

```
Text(0.5, 1.0, 'Annual Ride Frequency by Day of Week')
```



Ride Frequency by Day of the Week

This chart indicates the differences between rider types depending on day of the week.

- Members and casual rider ride in about the same frequency on weekend days (Saturday and Sunday)
- Casual rider frequency drops off significantly on Monday and starts rampingup on Friday
- Member rider frequency increases significantly on Monday and starts declining on Friday

```
In [ ]: result = %sql SELECT  substr(started_at, 1, 7) as YYYY_MM, count(member_casual) as all_rides, sum(is_member_ride) as member_rides, sum(is_casual_ride) as casual_rides from v7 group
        df_rides_month = result.DataFrame()
        df_rides_month.head(12)
```

```
 * sqlite://///Users/dinorusso/PyDev/Coursera_Case_Study_1/Cyclistic_Trip_Data/DB/cyclistic_v5.db
Done.
```

Out[ ]:

	YYYY_MM	all_rides	member_rides	casual_rides
0	2022-05	634858	354443	280415
1	2022-06	769204	400153	369051
2	2022-07	823488	417433	406055
3	2022-08	785932	427008	358924
4	2022-09	701339	404642	296697
5	2022-10	558685	349696	208989
6	2022-11	337735	236963	100772
7	2022-12	181806	136912	44894
8	2023-01	190301	150293	40008
9	2023-02	190445	147429	43016
10	2023-03	258678	196477	62201
11	2023-04	426590	279305	147285

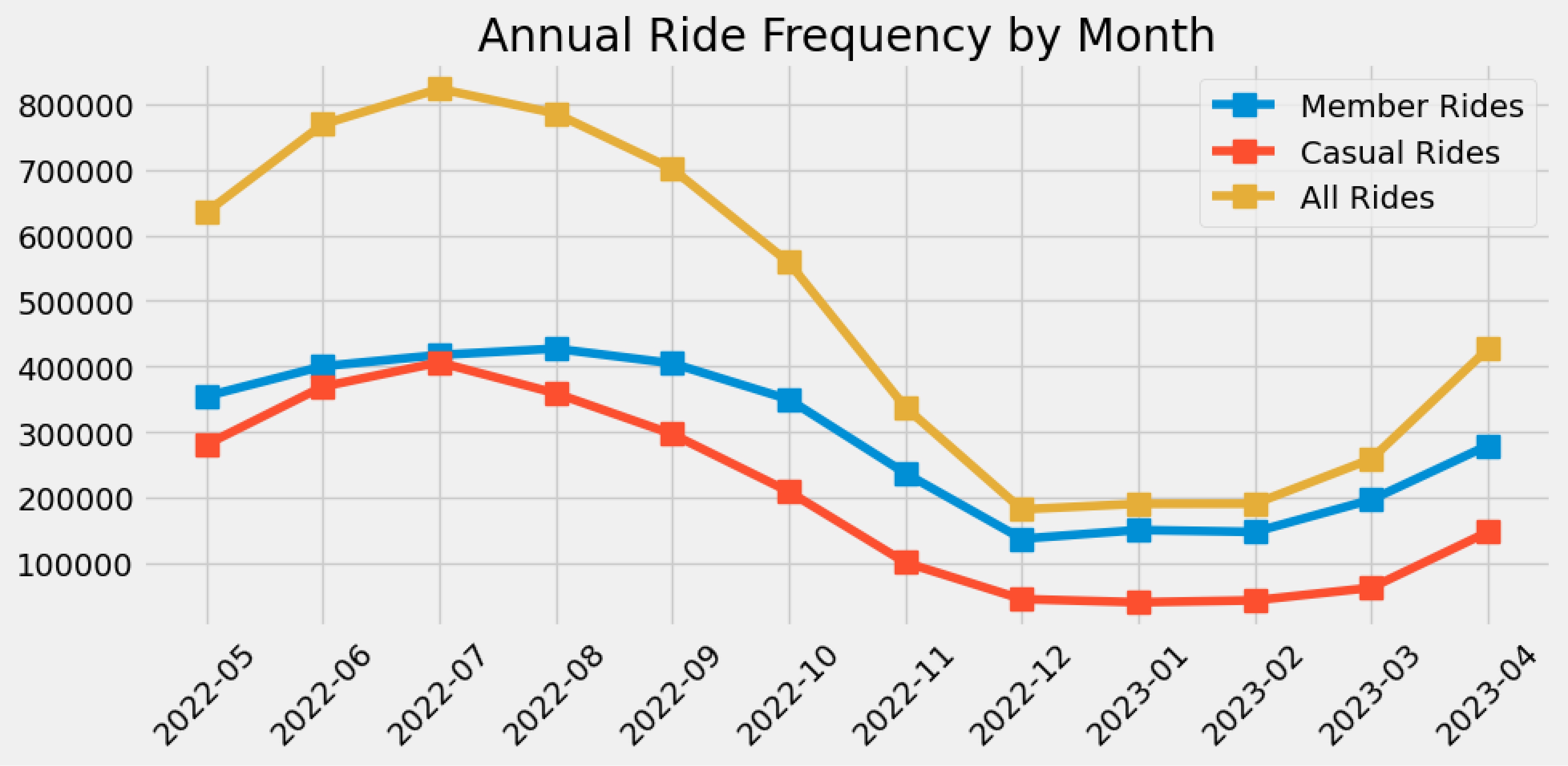
In [ ]:

```
months = df_rides_month['YYYY_MM']
all_rides = df_rides_month['all_rides']
member_rides = df_rides_month['member_rides']
casual_rides = df_rides_month['casual_rides']
plt.tight_layout()
plt.rcParams["figure.figsize"] = (10,5)
plt.plot(months,member_rides, marker='s',markersize = 10, label = "Member Rides")
plt.plot(months,casual_rides,  marker='s',markersize = 10,label = "Casual Rides")
plt.plot(months,all_rides,  marker='s',markersize = 10,label = "All Rides")
plt.xticks(rotation = 45)
plt.legend()


plt.title("Annual Ride Frequency by Month")
```

Out[ ]:

```
Text(0.5, 1.0, 'Annual Ride Frequency by Month')
```



```
In [ ]: #ride frequency by Time of Day (Hour) based on Start Time
        result = %sql select substr(started_at, 11, 3) as start_hour, count(ride_id) as all_rides, sum(is_casual_ride) as casual_rides, sum(is_member_ride) as member_rides from v7 group by
        df_rides_hour = result.DataFrame()
        df_rides_hour.head(24)
```

```
 * sqlite://///Users/dinorusso/PyDev/Coursera_Case_Study_1/Cyclistic_Trip_Data/DB/cyclistic_v5.db
Done.
```

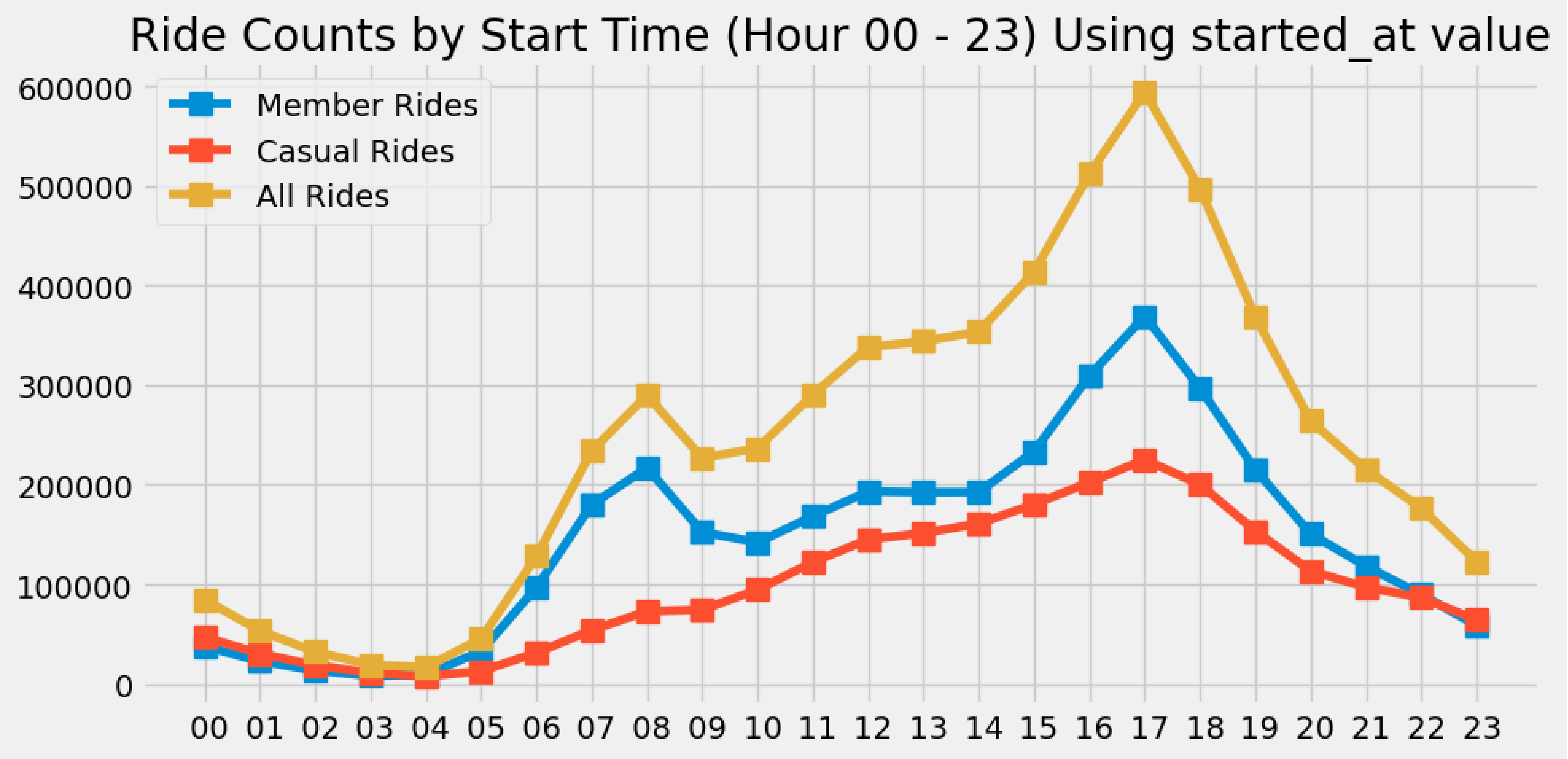
Out[ ]:

	start_hour	all_rides	casual_rides	member_rides
0	00	84680	47113	37567
1	01	53348	30410	22938
2	02	32284	18802	13482
3	03	19254	11007	8247
4	04	16767	7680	9087
5	05	45567	12848	32719
6	06	128101	31240	96861
7	07	234060	54059	180001
8	08	289834	72823	217011
9	09	226857	74458	152399
10	10	236714	94619	142095
11	11	290600	122314	168286
12	12	338362	145066	193296
13	13	343947	151462	192485
14	14	353675	161060	192615
15	15	413789	180325	233464
16	16	511917	202483	309434
17	17	594525	225217	369308
18	18	497210	200178	297032
19	19	368658	153534	215124
20	20	264072	113439	150633
21	21	215456	97208	118248
22	22	176437	86600	89837
23	23	122947	64362	58585

In [ ]:

```
hours = df_rides_hour['start_hour']
all_rides = df_rides_hour['all_rides']
member_rides = df_rides_hour['member_rides']
casual_rides = df_rides_hour['casual_rides']
plt.tight_layout()
plt.rcParams["figure.figsize"] = (10,5)
plt.plot(hours,member_rides, marker='s',markersize = 10, label = "Member Rides")
plt.plot(hours,casual_rides,  marker='s',markersize = 10,label = "Casual Rides")
plt.plot(hours,all_rides,  marker='s',markersize = 10,label = "All Rides")
plt.legend()
plt.title("Ride Counts by Start Time (Hour 00 - 23) Using started_at value")
```

```
Out[ ]: Text(0.5, 1.0, 'Ride Counts by Start Time (Hour 00 - 23) Using started_at value')
```



Member rides increase dramatically starting at 5:00 AM to 8:00 am; they increase again between 3:00 PM and 7:00PM (likely peak commute times work) Casual rides volume is less appears to be less influenced by TOD by highest number of starts are between 10:00 AM and 7:00 PM

Part II - Ride Duration

```
In [ ]: result = %sql  SELECT  weekday,round(avg(NULLIF(ride_duration_mins,0))) as all_rides,round(avg(NULLIF(member_ride_duration_mins, 0))) as member_rides,round(avg(NULLIF(casual_ride_d
        df_ride_durations_dow = result.DataFrame()
        df_ride_durations_dow.head(7)
```

```
 * sqlite://///Users/dinorusso/PyDev/Coursera_Case_Study_1/Cyclistic_Trip_Data/DB/cyclistic_v5.db
Done.
```

Out[ ]:

	weekday	all_rides	member_rides	casual_rides
0	Sunday	24.0	14.0	34.0
1	Monday	18.0	12.0	29.0
2	Tuesday	17.0	12.0	26.0
3	Wednesday	16.0	12.0	25.0
4	Thursday	17.0	12.0	25.0
5	Friday	19.0	13.0	28.0
6	Saturday	24.0	14.0	33.0

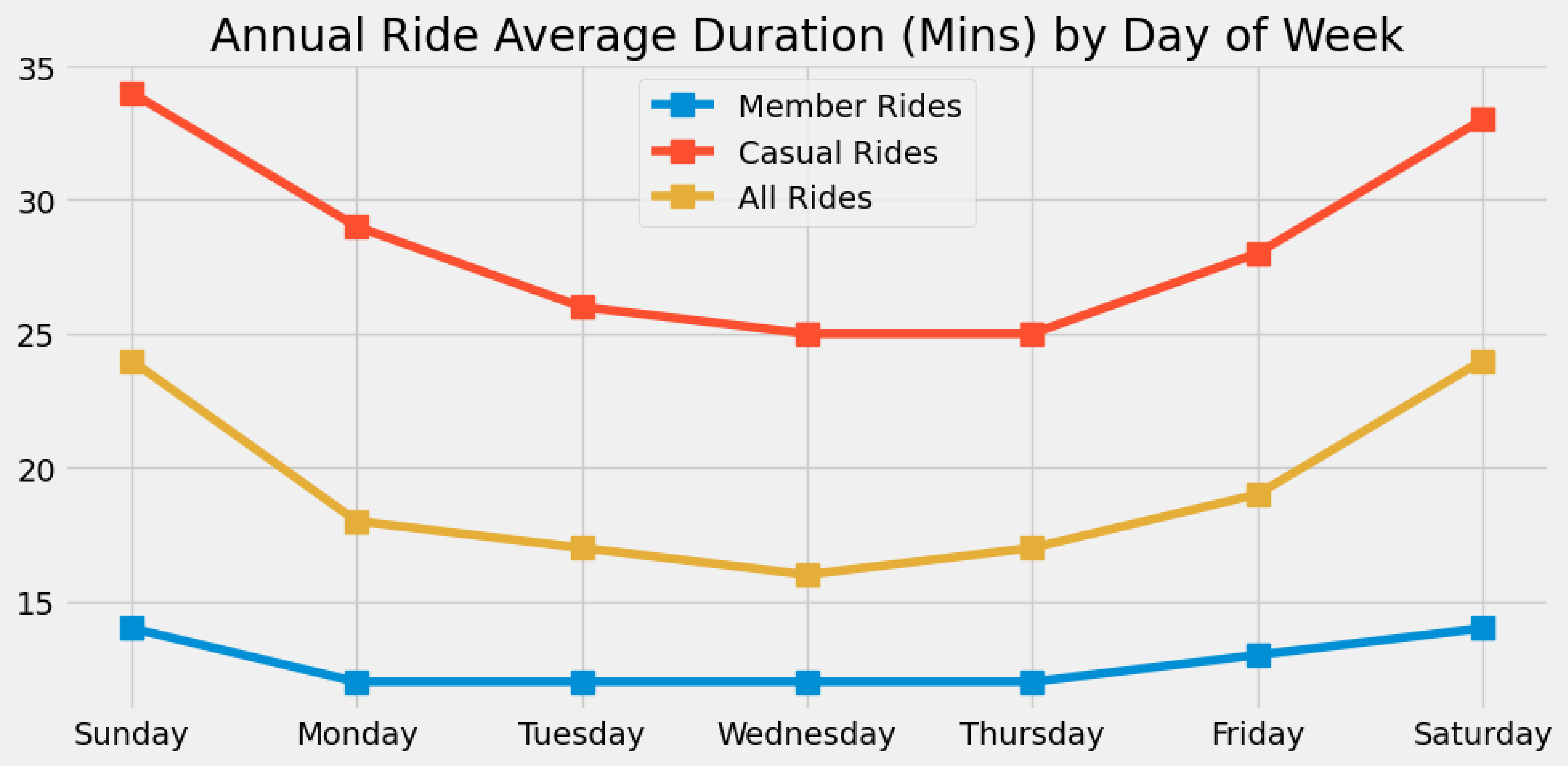
In [ ]:

```
weekdays = df_ride_durations_dow['weekday']
all_rides = df_ride_durations_dow['all_rides']
member_rides = df_ride_durations_dow['member_rides']
casual_rides = df_ride_durations_dow['casual_rides']
plt.tight_layout()
plt.rcParams["figure.figsize"] = (10,5)
plt.plot(weekdays,member_rides, marker='s',markersize = 10, label = "Member Rides")
plt.plot(weekdays,casual_rides,  marker='s',markersize = 10,label = "Casual Rides")
plt.plot(weekdays,all_rides,  marker='s',markersize = 10,label = "All Rides")
plt.legend()


plt.title("Annual Ride Average Duration (Mins) by Day of Week")
```

Out[ ]:

```
Text(0.5, 1.0, 'Annual Ride Average Duration (Mins) by Day of Week')
```



This chart indicates the differences between rider average ride durations depending on day of the week.

- Member rider average durations are relatively flat with a minor increase on weekend; durations are half as long as casual riders
- Casual riders tend to have twice as long rides as compared to members

```
In [ ]: result = %sql  SELECT substr(v7.started_at, 1, 7) as YYYY_MM,round(avg(NULLIF(ride_duration_mins,0))) as all_rides, round(avg(NULLIF(member_ride_duration_mins, 0))) as member_rides
        df_rides_yymm = result.DataFrame()
        df_rides_yymm.head(12)
```

```
 * sqlite://///Users/dinorusso/PyDev/Coursera_Case_Study_1/Cyclistic_Trip_Data/DB/cyclistic_v5.db
Done.
```

Out[ ]:

	YYYY_MM	all_rides	member_rides	casual_rides
0	2022-05	21.0	14.0	31.0
1	2022-06	23.0	14.0	33.0
2	2022-07	22.0	14.0	30.0
3	2022-08	21.0	14.0	30.0
4	2022-09	20.0	13.0	28.0
5	2022-10	18.0	12.0	27.0
6	2022-11	14.0	11.0	22.0
7	2022-12	14.0	11.0	23.0
8	2023-01	13.0	11.0	23.0
9	2023-02	14.0	11.0	24.0
10	2023-03	13.0	11.0	22.0
11	2023-04	18.0	12.0	28.0

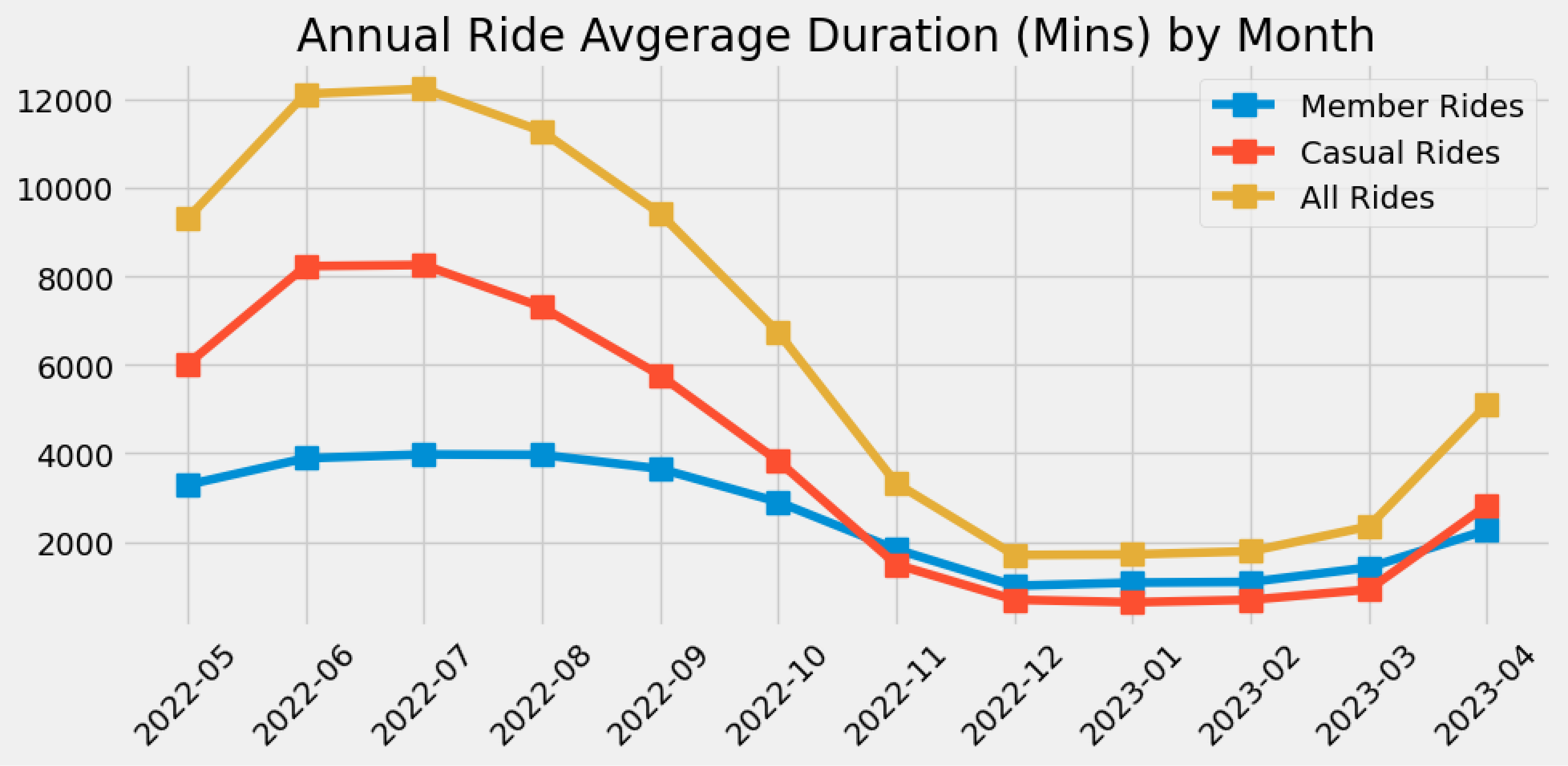
In [ ]:

```python
months = df_rides_yymm['YYYY_MM']
all_rides = df_rides_yymm['all_rides']
member_rides = df_rides_yymm['member_rides']
casual_rides = df_rides_yymm['casual_rides']
plt.tight_layout()
plt.rcParams["figure.figsize"] = (10,5)
plt.plot(months,member_rides, marker='s',markersize = 10, label = "Member Rides")
plt.plot(months,casual_rides,  marker='s',markersize = 10,label = "Casual Rides")
plt.plot(months,all_rides,  marker='s',markersize = 10,label = "All Rides")
plt.xticks(rotation = 45)
plt.legend()


plt.title("Annual Ride Avgerage Duration (Mins) by Month")
```

Out[ ]:

```
Text(0.5, 1.0, 'Annual Ride Avgerage Duration (Mins) by Month')
```



This chart indicates the differences between rider average ride durations depending on month.

- Member rider average durations are relatively flat with a minor decrease in colder months; durations are under 15 mins avg
- Casual riders average durations rise in April and begin a slow decline in Aug; November thru March avg ride durations are relatively flat but still almost 2x members

```
In [ ]: result = %sql  SELECT  weekday,round(sum(ride_duration_mins)) as all_rides,round(sum(member_ride_duration_mins)) as member_rides,round(sum(casual_ride_duration_mins)) as casual_rid
        df_ride_durations_dow = result.DataFrame()
        df_ride_durations_dow.head(7)
```

```
 * sqlite://///Users/dinorusso/PyDev/Coursera_Case_Study_1/Cyclistic_Trip_Data/DB/cyclistic_v5.db
Done.
```

Out[ ]:

	weekday	all_rides	member_rides	casual_rides
0	Sunday	18558887.0	5557686.0	13001201.0
1	Monday	13624991.0	5803098.0	7821893.0
2	Tuesday	13413398.0	6505317.0	6908081.0
3	Wednesday	13510168.0	6631702.0	6878466.0
4	Thursday	14651546.0	6786105.0	7865441.0
5	Friday	15783304.0	6150068.0	9633236.0
6	Saturday	21416832.0	6329859.0	15086973.0

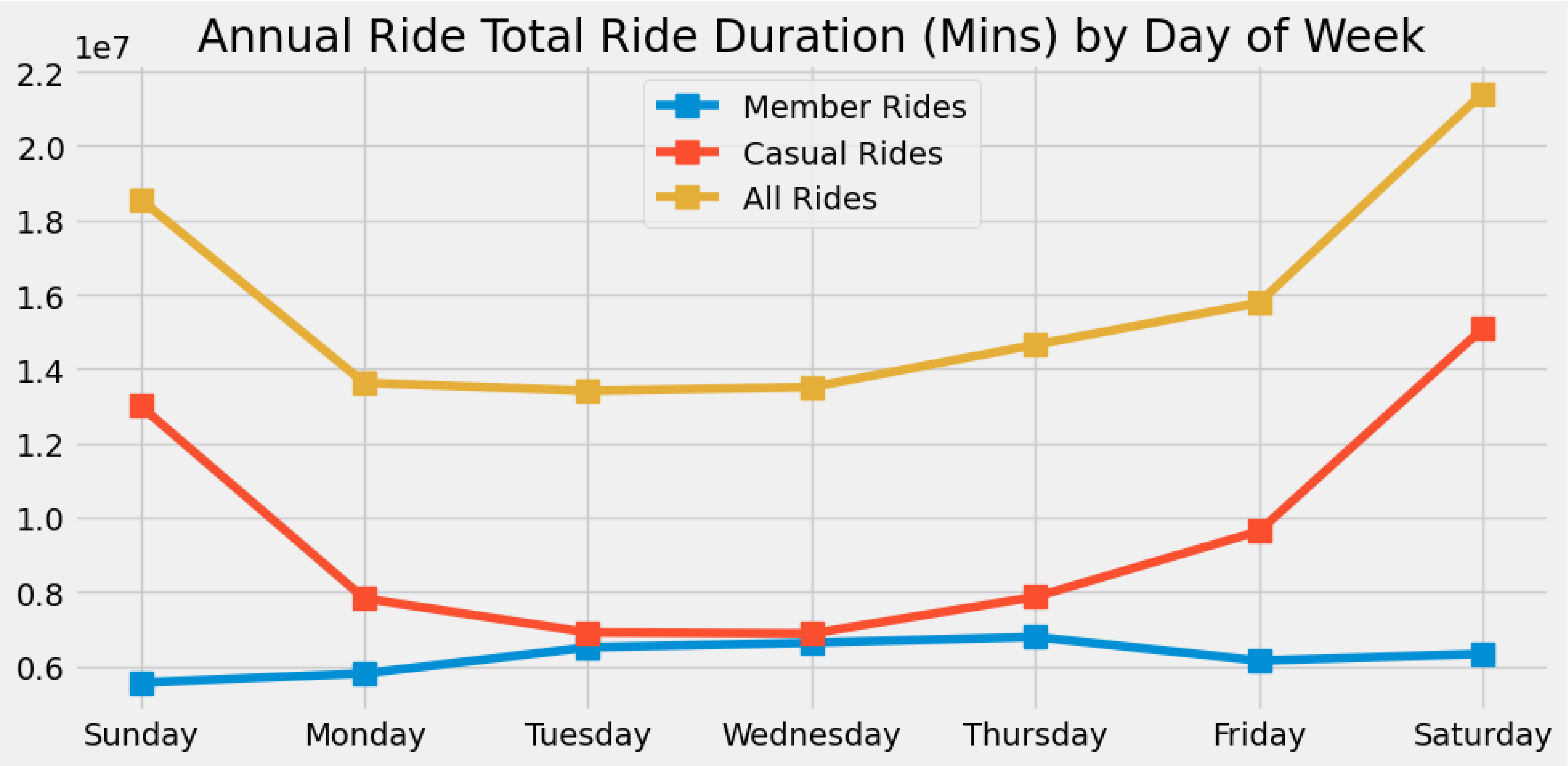
In [ ]:

```
weekdays = df_ride_durations_dow['weekday']
all_rides = df_ride_durations_dow['all_rides']
member_rides = df_ride_durations_dow['member_rides']
casual_rides = df_ride_durations_dow['casual_rides']
plt.tight_layout()
plt.rcParams["figure.figsize"] = (10,5)
plt.plot(weekdays,member_rides, marker='s',markersize = 10, label = "Member Rides")
plt.plot(weekdays,casual_rides,  marker='s',markersize = 10,label = "Casual Rides")
plt.plot(weekdays,all_rides,  marker='s',markersize = 10,label = "All Rides")
plt.legend()


plt.title("Annual Ride Total Ride Duration (Mins) by Day of Week")
```

Out[ ]:

```
Text(0.5, 1.0, 'Annual Ride Total Ride Duration (Mins) by Day of Week')
```



This chart indicates the differences between total member vs casual total minutes of rides by day of the week.

- Member rider total durations are relatively flat and significantly less than casual total durations.
- Casual riders average durations rise in April and begin a slow decline in Aug; November thru March avg ride durations are relatively flat but still almost 2x members

In [ ]:

```
result = %sql  SELECT substr(v7.started_at, 1, 7) as YYYY_MM,round(sum(ride_duration_mins)) as all_rides, round(sum(member_ride_duration_mins)) as member_rides,round(sum(casual_rid
df_rides_yymm = result.DataFrame()
df_rides_yymm.head(12)
```

```
 * sqlite://///Users/dinorusso/PyDev/Coursera_Case_Study_1/Cyclistic_Trip_Data/DB/cyclistic_v5.db
Done.
```

Out[ ]:

	YYYY_MM	all_rides	member_rides	casual_rides
0	2022-05	13393004.0	4737144.0	8655860.0
1	2022-06	17447862.0	5601450.0	11846412.0
2	2022-07	17613708.0	5725897.0	11887811.0
3	2022-08	16234371.0	5714599.0	10519772.0
4	2022-09	13562518.0	5259890.0	8302628.0
5	2022-10	9695848.0	4181572.0	5514276.0
6	2022-11	4784420.0	2637752.0	2146668.0
7	2022-12	2454438.0	1453926.0	1000512.0
8	2023-01	2473348.0	1556669.0	916679.0
9	2023-02	2576408.0	1578844.0	997564.0
10	2023-03	3382365.0	2050706.0	1331659.0
11	2023-04	7340836.0	3265386.0	4075450.0

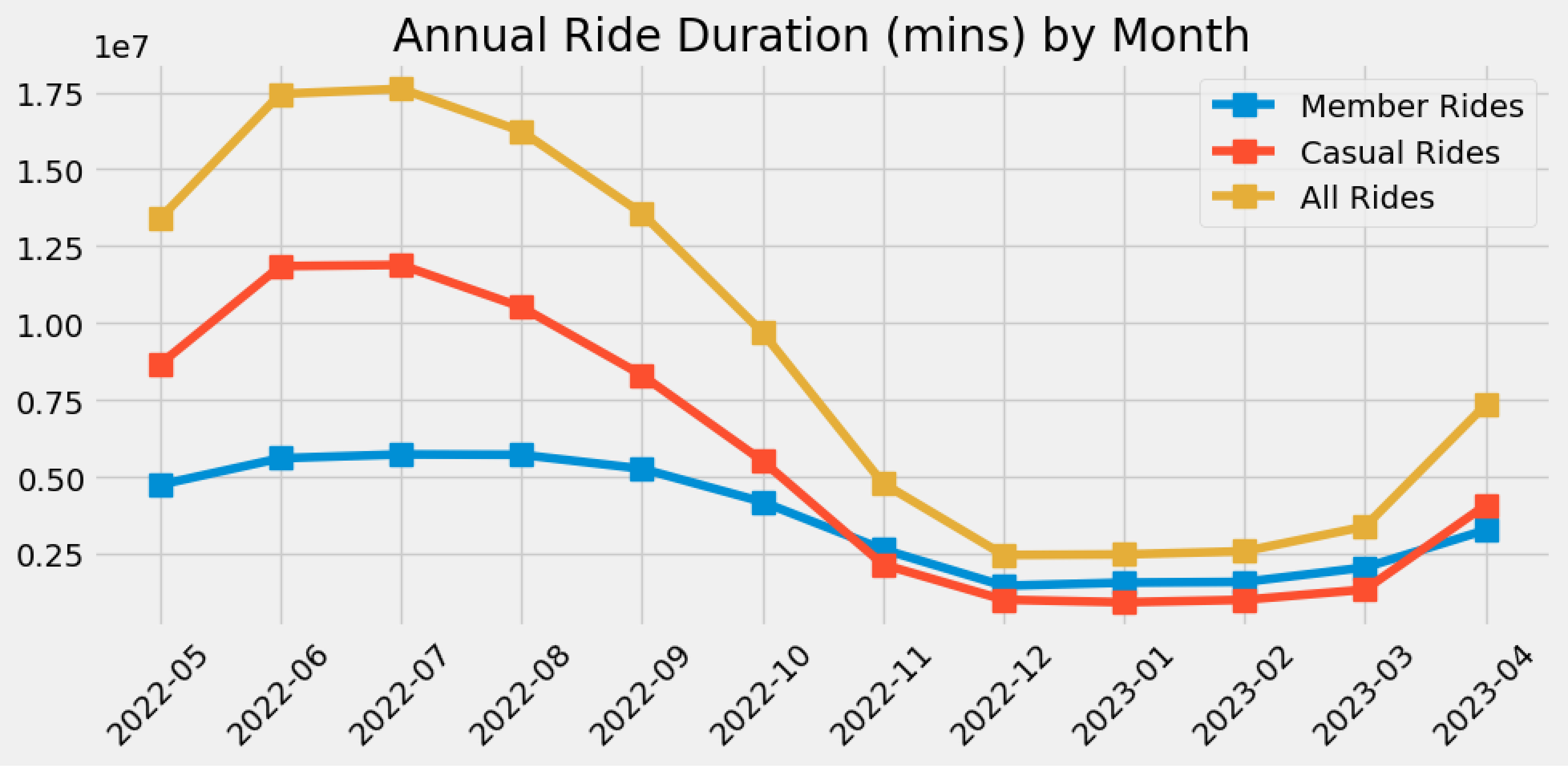
In [ ]:

```python
months = df_rides_yymm['YYYY_MM']
all_rides = df_rides_yymm['all_rides']
member_rides = df_rides_yymm['member_rides']
casual_rides = df_rides_yymm['casual_rides']
plt.tight_layout()
plt.rcParams["figure.figsize"] = (10,5)
plt.plot(months,member_rides, marker='s',markersize = 10, label = "Member Rides")
plt.plot(months,casual_rides,  marker='s',markersize = 10,label = "Casual Rides")
plt.plot(months,all_rides,  marker='s',markersize = 10,label = "All Rides")
plt.xticks(rotation = 45)
plt.legend()


plt.title("Annual Ride Duration (mins) by Month")
```

Out[ ]:

```
Text(0.5, 1.0, 'Annual Ride Duration (mins) by Month')
```



This chart indicates the differences between total member vs casual total minutes of rides by month.

- Member rider total durations slightly exceed casual total durations in Nov - Mar.
- Casual riders total durations rise in April and outpace member rider total durations through October with peaks in June and July

```
In [ ]: result = %sql  SELECT substr(v7.started_at, 1, 7) as YYYY_MM,round(sum(ride_duration_mins)/1440) as all_rides, round(sum(member_ride_duration_mins)/1440) as member_rides,round(sum(
        df_rides_yymm = result.DataFrame()
        df_rides_yymm.head(12)
```

```
 * sqlite://///Users/dinorusso/PyDev/Coursera_Case_Study_1/Cyclistic_Trip_Data/DB/cyclistic_v5.db
Done.
```

Out[ ]:

	YYYY_MM	all_rides	member_rides	casual_rides
0	2022-05	9301.0	3290.0	6011.0
1	2022-06	12117.0	3890.0	8227.0
2	2022-07	12232.0	3976.0	8255.0
3	2022-08	11274.0	3968.0	7305.0
4	2022-09	9418.0	3653.0	5766.0
5	2022-10	6733.0	2904.0	3829.0
6	2022-11	3323.0	1832.0	1491.0
7	2022-12	1704.0	1010.0	695.0
8	2023-01	1718.0	1081.0	637.0
9	2023-02	1789.0	1096.0	693.0
10	2023-03	2349.0	1424.0	925.0
11	2023-04	5098.0	2268.0	2830.0

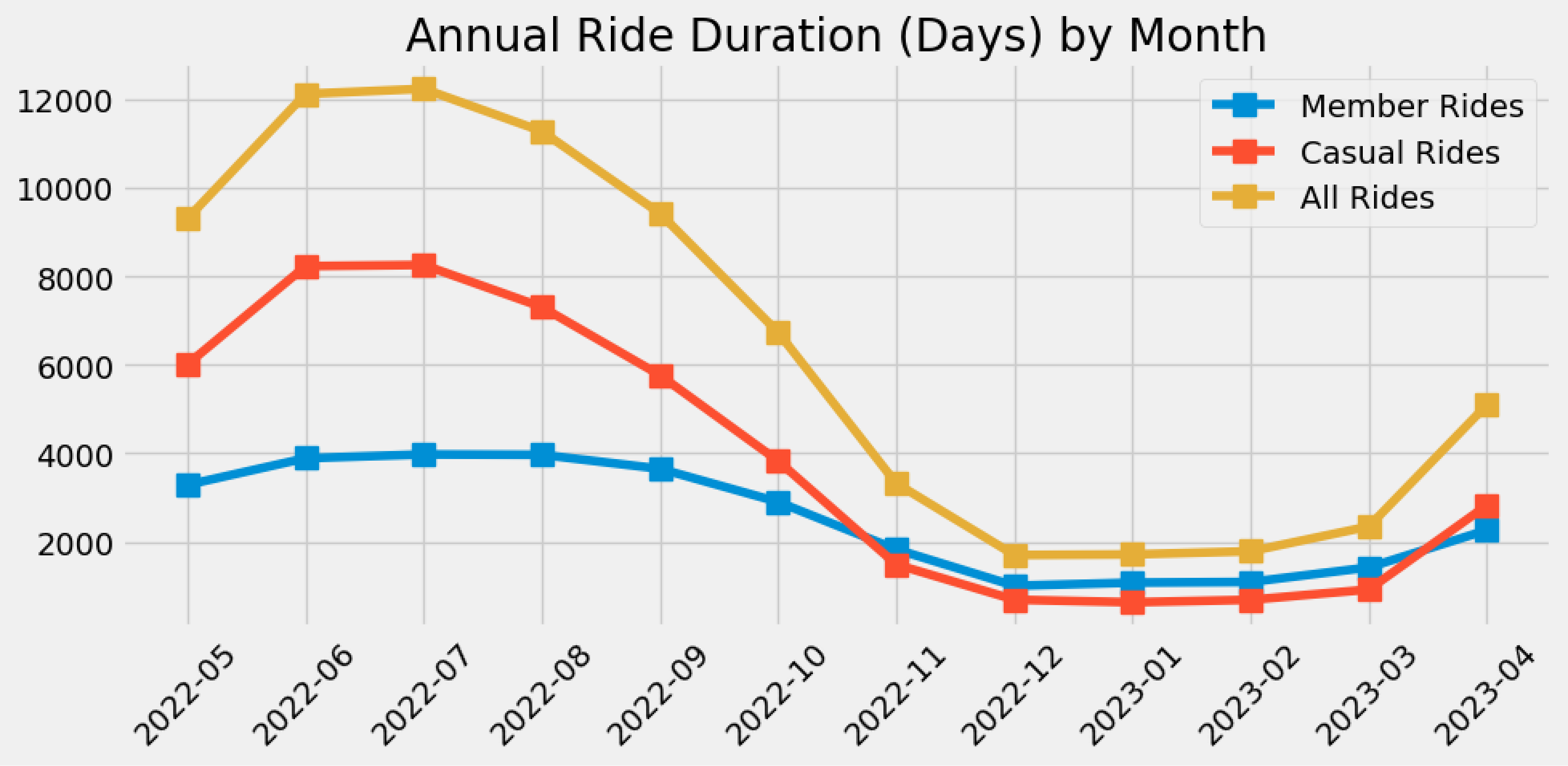
In [ ]:

```
months = df_rides_yymm['YYYY_MM']
all_rides = df_rides_yymm['all_rides']
member_rides = df_rides_yymm['member_rides']
casual_rides = df_rides_yymm['casual_rides']
plt.tight_layout()
plt.rcParams["figure.figsize"] = (10,5)
plt.plot(months,member_rides, marker='s',markersize = 10, label = "Member Rides")
plt.plot(months,casual_rides,  marker='s',markersize = 10,label = "Casual Rides")
plt.plot(months,all_rides,  marker='s',markersize = 10,label = "All Rides")
plt.xticks(rotation = 45)
plt.legend()


plt.title("Annual Ride Duration (Days) by Month")
```

Out[ ]:

```
Text(0.5, 1.0, 'Annual Ride Duration (Days) by Month')
```



This chart indicates the differences between total member vs casual total days of rides durations by month.

- Member rider total durations slightly exceed casual total durations in Nov - Mar.
- Casual riders total durations rise in April and outpace member rider total durations through October with peaks in June and July

```
In [ ]: result = %sql  SELECT  weekday,round(sum(ride_duration_mins)/1440) as all_rides,round(sum(member_ride_duration_mins)/1440) as member_rides,round(sum(casual_ride_duration_mins)/1440
        df_ride_durations_dow = result.DataFrame()
        df_ride_durations_dow.head(7)
```

```
 * sqlite://///Users/dinorusso/PyDev/Coursera_Case_Study_1/Cyclistic_Trip_Data/DB/cyclistic_v5.db
Done.
```

Out[ ]:

	weekday	all_rides	member_rides	casual_rides
0	Sunday	12888.0	3860.0	9029.0
1	Monday	9462.0	4030.0	5432.0
2	Tuesday	9315.0	4518.0	4797.0
3	Wednesday	9382.0	4605.0	4777.0
4	Thursday	10175.0	4713.0	5462.0
5	Friday	10961.0	4271.0	6690.0
6	Saturday	14873.0	4396.0	10477.0

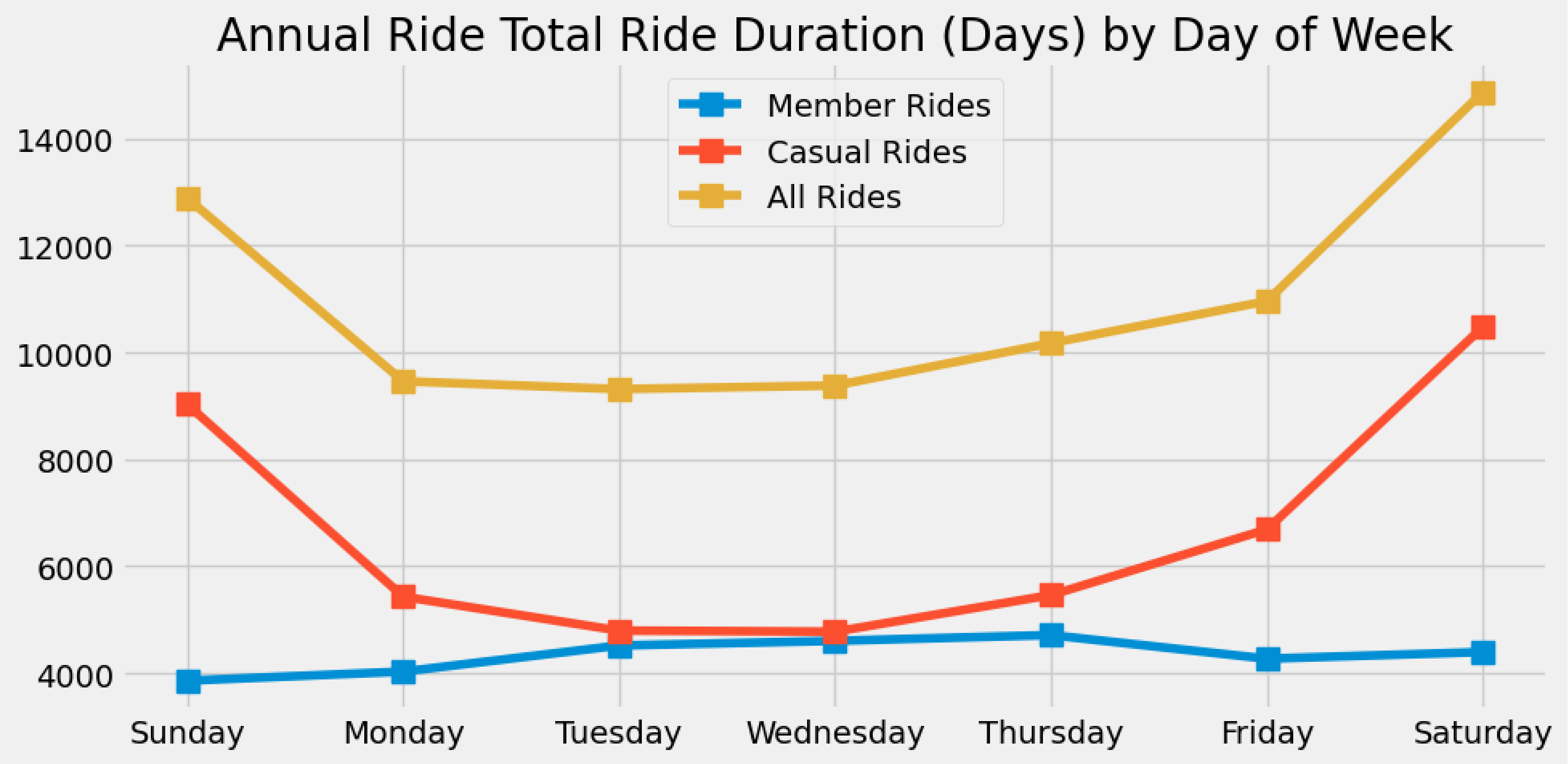
In [ ]:

```
weekdays = df_ride_durations_dow['weekday']
all_rides = df_ride_durations_dow['all_rides']
member_rides = df_ride_durations_dow['member_rides']
casual_rides = df_ride_durations_dow['casual_rides']
plt.tight_layout()
plt.rcParams["figure.figsize"] = (10,5)
plt.plot(weekdays,member_rides, marker='s',markersize = 10, label = "Member Rides")
plt.plot(weekdays,casual_rides,  marker='s',markersize = 10,label = "Casual Rides")
plt.plot(weekdays,all_rides,  marker='s',markersize = 10,label = "All Rides")
plt.legend()


plt.title("Annual Ride Total Ride Duration (Days) by Day of Week")
```

Out[ ]:

```
Text(0.5, 1.0, 'Annual Ride Total Ride Duration (Days) by Day of Week')
```



This chart indicates the differences between total member vs casual total days of rides by day of the week.

- Member rider total durations are relatively flat and significantly less than casual total durations.
- Casual riders average durations rise in April and begin a slow decline in Aug; November thru March avg ride durations are relatively flat but still almost 2x members