Case Study 1: How Does a Bike-Share Navigate Speedy Success?

Project Description

You are a junior data analyst working in the marketing analyst team at Cyclistic, a bike-share company in Chicago. The director of marketing believes the company's future success depends on maximizing the number of annual memberships. Therefore, your team wants to understand how casual riders and annual members use Cyclistic bikes

Data Dictionary

Field	Description
	Trip start day and time
	Trip end day and time
	Trip start station
	Trip end station
	Rider type (Member, Single Ride, and Day Pass)

Data sources used

Divvy Data - The data has been processed to remove trips that are taken by staff as they service and inspect the system; and any trips that were below 60 seconds in length (potentially false starts or users trying to re-dock a bike to ensure it was secure).

Business Task

How do annual members and casual riders use Cyclistic bikes differently?

Why would casual riders buy Cyclistic annual memberships?

How can Cyclistic use digital media to influence casual riders to become members?

Metrics

Assumptions

Data Tasks

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Summary

- Casual riders spent more time in bikes
- Popular spot is Lake Shore Dr & Monroe St
- Classic bikes are most rented
- Docked bikes spent most time cycling
- Saturday has highest count of rented bikes
- Member riders love classic and electric bikes but casual riders prefer docked bikes
- Member riders have been in consistent usage for all days, same for casual riders
- Member riders spent less time biking than casual riders
- Majority of time spent riding whole one week is less than 5000 minutes or 83 hours

Recommendation for Action

Import Libraries

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import random

import statsmodels.api as sm
from statsmodels.formula.api import ols

import datetime
from datetime import datetime, timedelta

import scipy.stats

import pandas_profiling
from pandas_profiling import ProfileReport


%matplotlib inline
#sets the default autosave frequency in seconds
%autosave 60
sns.set_style('dark')
sns.set(font_scale=1.2)

plt.rc('axes', titlesize=12)
plt.rc('axes', labelsize=14)
plt.rc('xtick', labelsize=12)
plt.rc('ytick', labelsize=12)

import warnings
warnings.filterwarnings('ignore')

# Use Folium library to plot values on a map.
#import folium

# Use Feature-Engine library
#import feature_engine
#import feature_engine.missing_data_imputers as mdi
#from feature_engine.outlier_removers import Winsorizer
#from feature_engine import categorical_encoders as ce
#from feature_engine.discretisation import EqualWidthDiscretiser, EqualFrequencyDiscretiser, DecisionTreeDis
#from feature_engine.encoding import OrdinalEncoder

pd.set_option('display.max_columns',None)
#pd.set_option('display.max_rows',None)
pd.set_option('display.width', 1000)
pd.set_option('display.float_format','{:.2f}'.format)

random.seed(0)
np.random.seed(0)
np.set_printoptions(suppress=True)
```

```
Autosaving every 60 seconds
```

Exploratory Data Analysis

In [2]:
```
df = pd.read_csv("202103-divvy-tripdata.csv",parse_dates=['started_at','ended_at'])
```

In [3]:
```
df
```

Out[3]:

	ride_id	rideable_type	started_at	ended_at	start_station_name	start_station_id	end_station_name	end_station_id
0	CFA86D4455AA1030	classic_bike	2021-03-16 08:32:30	2021-03-16 08:36:34	Humboldt Blvd & Armitage Ave	15651	Stave St & Armitage Ave	13266
1	30D9DC61227D1AF3	classic_bike	2021-03-28 01:26:28	2021-03-28 01:36:55	Humboldt Blvd & Armitage Ave	15651	Central Park Ave & Bloomingdale Ave	18017
2	846D87A15682A284	classic_bike	2021-03-11 21:17:29	2021-03-11 21:33:53	Shields Ave & 28th Pl	15443	Halsted St & 35th St	TA1308000043
3	994D05AA75A168F2	classic_bike	2021-03-11 13:26:42	2021-03-11 13:55:41	Winthrop Ave & Lawrence Ave	TA1308000021	Broadway & Sheridan Rd	13323
4	DF7464FBE92D8308	classic_bike	2021-03-21 09:09:37	2021-03-21 09:27:33	Glenwood Ave & Touhy Ave	525	Chicago Ave & Sheridan Rd	E008
...	...	...	...	...	...	...	...	...
228491	9397BDD14798A1BA	docked_bike	2021-03-20 14:58:56	2021-03-20 17:22:47	Michigan Ave & Oak St	13042	New St & Illinois St	TA1306000013
228492	BBBEB8D51AAD40DA	classic_bike	2021-03-02 11:35:10	2021-03-02 11:43:37	Kingsbury St & Kinzie St	KA1503000043	New St & Illinois St	TA1306000013
228493	637FF754DA0BD9E1	classic_bike	2021-03-09 11:07:36	2021-03-09 11:49:11	Michigan Ave & Oak St	13042	Clark St & Berwyn Ave	KA1504000146
228494	F8F43A0B978A7A35	classic_bike	2021-03-01 18:11:57	2021-03-01 18:18:37	Kingsbury St & Kinzie St	KA1503000043	New St & Illinois St	TA1306000013
228495	3AE64EA5BF43CF72	electric_bike	2021-03-26 17:58:14	2021-03-26 18:06:43	NaN	NaN	New St & Illinois St	TA1306000013

228496 rows × 13 columns

In [4]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 228496 entries, 0 to 228495
Data columns (total 13 columns):
 #   Column              Non-Null Count   Dtype
---  ------              --------------   -----
 0   ride_id             228496 non-null  object
 1   rideable_type       228496 non-null  object
 2   started_at          228496 non-null  datetime64[ns]
 3   ended_at            228496 non-null  datetime64[ns]
 4   start_station_name  213648 non-null  object
 5   start_station_id    213648 non-null  object
 6   end_station_name    211769 non-null  object
 7   end_station_id      211769 non-null  object
 8   start_lat           228496 non-null  float64
 9   start_lng           228496 non-null  float64
 10  end_lat             228329 non-null  float64
 11  end_lng             228329 non-null  float64
 12  member_casual       228496 non-null  object
dtypes: datetime64[ns](2), float64(4), object(7)
memory usage: 22.7+ MB
```

In [5]:
```
df.describe(include='all')
```

Out[5]:

	ride_id	rideable_type	started_at	ended_at	start_station_name	start_station_id	end_station_name	end_station_id
count	228496	228496	228496	228496	213648	213648	211769	211769
unique	228496	3	209025	208629	673	673	673	673
top	344E493DA4E38158	classic_bike	2021-03-21 13:41:24	2021-03-29 12:32:25	Lake Shore Dr & Monroe St	13300	Lake Shore Dr & Monroe St	13300
freq	1	152545	5	7	2453	2453	2380	2380
first	NaN	NaN	2021-03-01 00:01:09	2021-03-01 00:06:28	NaN	NaN	NaN	NaN
last	NaN	NaN	2021-03-31 23:59:08	2021-04-06 11:00:11	NaN	NaN	NaN	NaN
mean	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
std	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
min	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
25%	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
50%	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
75%	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
max	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN

In [6]:
```
df.columns
```

Out[6]:
```
Index(['ride_id', 'rideable_type', 'started_at', 'ended_at', 'start_station_name', 'start_station_id', 'end_station_name', 'end_station_id', 'start_lat', 'start_lng', 'end_lat', 'end_lng', 'member_casual'], dtype='object')
```

In [7]:
```
df["time_diff"] = df['ended_at'] - df['started_at']
```

In [8]:
```
df["time_diff"] = df["time_diff"]/np.timedelta64(1,'m') #Convert to minutes
```

In [9]:
```
df.head()
```

Out[9]:

	ride_id	rideable_type	started_at	ended_at	start_station_name	start_station_id	end_station_name	end_station_id	start_lat
0	CFA86D4455AA1030	classic_bike	2021-03-16 08:32:30	2021-03-16 08:36:34	Humboldt Blvd & Armitage Ave	15651	Stave St & Armitage Ave	13266	41.92
1	30D9DC61227D1AF3	classic_bike	2021-03-28 01:26:28	2021-03-28 01:36:55	Humboldt Blvd & Armitage Ave	15651	Central Park Ave & Bloomingdale Ave	18017	41.92
2	846D87A15682A284	classic_bike	2021-03-11 21:17:29	2021-03-11 21:33:53	Shields Ave & 28th Pl	15443	Halsted St & 35th St	TA1308000043	41.84
3	994D05AA75A168F2	classic_bike	2021-03-11 13:26:42	2021-03-11 13:55:41	Winthrop Ave & Lawrence Ave	TA1308000021	Broadway & Sheridan Rd	13323	41.97
4	DF7464FBE92D8308	classic_bike	2021-03-21 09:09:37	2021-03-21 09:27:33	Glenwood Ave & Touhy Ave	525	Chicago Ave & Sheridan Rd	E008	42.01

In [10]:
```
df["weekday"] = df["started_at"].dt.weekday
```

In [11]:
```
df.head() #Return the day of the week as an integer, where Monday is 0 and Sunday is 6
```

Out[11]:

	ride_id	rideable_type	started_at	ended_at	start_station_name	start_station_id	end_station_name	end_station_id	start_lat
0	CFA86D4455AA1030	classic_bike	2021-03-16 08:32:30	2021-03-16 08:36:34	Humboldt Blvd & Armitage Ave	15651	Stave St & Armitage Ave	13266	41.92
1	30D9DC61227D1AF3	classic_bike	2021-03-28 01:26:28	2021-03-28 01:36:55	Humboldt Blvd & Armitage Ave	15651	Central Park Ave & Bloomingdale Ave	18017	41.92
2	846D87A15682A284	classic_bike	2021-03-11 21:17:29	2021-03-11 21:33:53	Shields Ave & 28th Pl	15443	Halsted St & 35th St	TA1308000043	41.84
3	994D05AA75A168F2	classic_bike	2021-03-11 13:26:42	2021-03-11 13:55:41	Winthrop Ave & Lawrence Ave	TA1308000021	Broadway & Sheridan Rd	13323	41.97
4	DF7464FBE92D8308	classic_bike	2021-03-21 09:09:37	2021-03-21 09:27:33	Glenwood Ave & Touhy Ave	525	Chicago Ave & Sheridan Rd	E008	42.01

In [12]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 228496 entries, 0 to 228495
Data columns (total 15 columns):
 #   Column              Non-Null Count   Dtype
---  ------              --------------   -----
 0   ride_id             228496 non-null  object
 1   rideable_type       228496 non-null  object
 2   started_at          228496 non-null  datetime64[ns]
 3   ended_at            228496 non-null  datetime64[ns]
 4   start_station_name  213648 non-null  object
 5   start_station_id    213648 non-null  object
 6   end_station_name    211769 non-null  object
 7   end_station_id      211769 non-null  object
 8   start_lat           228496 non-null  float64
 9   start_lng           228496 non-null  float64
 10  end_lat             228329 non-null  float64
 11  end_lng             228329 non-null  float64
 12  member_casual       228496 non-null  object
 13  time_diff           228496 non-null  float64
 14  weekday             228496 non-null  int64
dtypes: datetime64[ns](2), float64(5), int64(1), object(7)
memory usage: 26.1+ MB
```

Save to CSV

In [13]:
```
#df.to_csv("bike.csv", index=False)
```

In [ ]:

Groupby Function

In [14]:
```
df.groupby("start_station_name")["ride_id"].count().sort_values()
```

Out[14]:
```
start_station_name
Commercial Ave & 100th St          1
N Hampden Ct & W Diversey Ave      1
N Damen Ave & W Wabansia St        1
N Carpenter St & W Lake St         1
Ashland Ave & Garfield Blvd        1
                                ...
Wells St & Elm St               1660
Millennium Park                 1757
Clark St & Elm St               1935
Streeter Dr & Grand Ave         2074
Lake Shore Dr & Monroe St       2453
Name: ride_id, Length: 673, dtype: int64
```

In [15]:
```
df.groupby("end_station_name")["ride_id"].count().sort_values()
```

Out[15]:
```
end_station_name
Bradley Park                    1
Halsted St & 96th St            1
Halsted St & 69th St            1
Halsted St & 59th St            1
Marshfield Ave & 59th St        1
                              ...
Michigan Ave & Oak St        1714
Millennium Park              1869
Clark St & Elm St            1924
Streeter Dr & Grand Ave      2039
Lake Shore Dr & Monroe St    2380
Name: ride_id, Length: 673, dtype: int64
```

In [16]:
```
df.groupby("rideable_type")["ride_id"].count().sort_values()
```

Out[16]:
```
rideable_type
docked_bike       15657
electric_bike     60294
classic_bike     152545
Name: ride_id, dtype: int64
```

In [17]:
```
df.groupby("member_casual")["ride_id"].count().sort_values()
```

Out[17]:
```
member_casual
casual     84033
member    144463
Name: ride_id, dtype: int64
```

In [18]:
```
df.groupby("start_station_name")["time_diff"].mean().sort_values()
```

Out[18]:
```
start_station_name
S Wentworth Ave & W 111th St            2.98
Stewart Ave & 63rd St                   4.28
State St & 76th St                      5.89
Eggleston Ave & 69th St                 5.97
N Sheffield Ave & W Wellington Ave      6.87
                                        ...
Dauphin Ave & 103rd St                413.96
Karlov Ave & Madison St               546.61
Ashland Ave & 66th St                 755.54
Elizabeth St & 92nd St                968.84
East End Ave & 87th St               3869.29
Name: time_diff, Length: 673, dtype: float64
```

In [19]:
```
df.groupby("rideable_type")["time_diff"].mean().sort_values()
```

Out[19]:
```
rideable_type
electric_bike   16.43
classic_bike    19.38
docked_bike     81.64
Name: time_diff, dtype: float64
```

In [20]:
```
df.groupby("member_casual")["time_diff"].mean().sort_values()
```

Out[20]:
```
member_casual
member   13.97
casual   38.16
Name: time_diff, dtype: float64
```

In [ ]:

Pandas-Profiling Reports

In [21]:
```
profile = ProfileReport(df=df, title='Bike Report', minimal=True)
```

In [22]:
```
profile.to_notebook_iframe()
```

Bike Report — Overview — Variables

Overview

Overview — Warnings 11 — Reproduction

Dataset statistics

Number of variables	15
Number of observations	228496
Missing cells	63484
Missing cells (%)	1.9%
Duplicate rows	0
Duplicate rows (%)	0.0%
Total size in memory	26.1 MiB
Average record size in memory	120.0 B

Variable types

CAT	7
NUM	6
DATE	2

Variables

ride_id
Categorical

Distinct	228496
Distinct (%)	100.0%

344E493DA4E38158	1
7F7DCABFF5FB2989	1
E134F6C89E1C4E56	1

In [23]:
```
profile.to_file("bike_report.html")
```

Drop unwanted features

In [24]:
```
df.columns
```

Out[24]:
```
Index(['ride_id', 'rideable_type', 'started_at', 'ended_at', 'start_station_name', 'start_station_id', 'end_station_name', 'end_station_id', 'start_lat', 'start_lng', 'end_lat', 'end_lng', 'member_casual', 'time_diff', 'weekday'], dtype='object')
```

In [25]:
```
df.drop(['ride_id','start_station_id','end_station_id', 'start_lat', 'start_lng', 'end_lat', 'end_lng'],axis
```

In [26]:
```
df.head()
```

Out[26]:

	rideable_type	started_at	ended_at	start_station_name	end_station_name	member_casual	time_diff	weekday
0	classic_bike	2021-03-16 08:32:30	2021-03-16 08:36:34	Humboldt Blvd & Armitage Ave	Stave St & Armitage Ave	casual	4.07	1
1	classic_bike	2021-03-28 01:26:28	2021-03-28 01:36:55	Humboldt Blvd & Armitage Ave	Central Park Ave & Bloomingdale Ave	casual	10.45	6
2	classic_bike	2021-03-11 21:17:29	2021-03-11 21:33:53	Shields Ave & 28th Pl	Halsted St & 35th St	casual	16.40	3
3	classic_bike	2021-03-11 13:26:42	2021-03-11 13:55:41	Winthrop Ave & Lawrence Ave	Broadway & Sheridan Rd	casual	28.98	3
4	classic_bike	2021-03-21 09:09:37	2021-03-21 09:27:33	Glenwood Ave & Touhy Ave	Chicago Ave & Sheridan Rd	casual	17.93	6

Treat Missing Values

In [27]:
```
df.isnull().sum()
```

Out[27]:
```
rideable_type             0
started_at                0
ended_at                  0
start_station_name    14848
end_station_name      16727
member_casual             0
time_diff                 0
weekday                   0
dtype: int64
```

In [28]:
```
df['start_station_name'] = df['start_station_name'].replace(np.nan,"Missing")
```

In [29]:
```
df['end_station_name'] = df['end_station_name'].replace(np.nan,"Missing")
```

In [30]:
```
df.isnull().sum()
```

Out[30]:
```
rideable_type         0
started_at            0
ended_at              0
start_station_name    0
end_station_name      0
member_casual         0
time_diff             0
weekday               0
dtype: int64
```

In [31]:
```
df.describe()
```

Out[31]:

	time_diff	weekday
count	228496.00	228496.00
mean	22.87	3.08
std	154.42	2.10
min	-0.02	0.00
25%	6.83	1.00
50%	12.32	3.00
75%	23.10	5.00
max	31681.65	6.00

Data Visualization

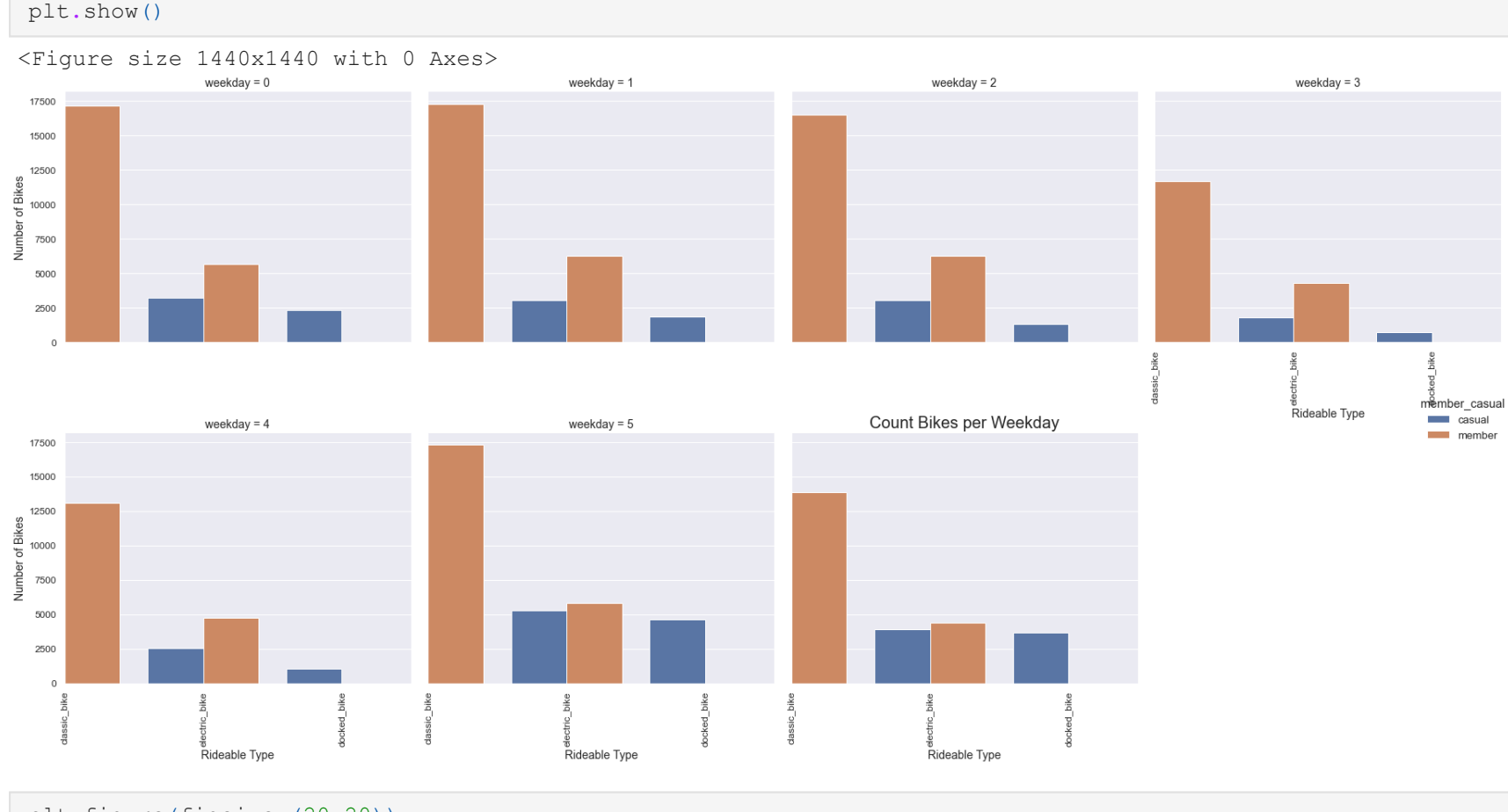
Univariate Data Exploration

In [32]:
```
df.hist(bins=50, figsize=(20,5))
plt.suptitle('Feature Distribution', x=0.5, y=1.02, ha='center', fontsize=20)
plt.tight_layout()
plt.show()
```

In [33]:
```
df.boxplot(figsize=(20,5))
plt.suptitle('BoxPlot', x=0.5, y=1.02, ha='center', fontsize=20)
plt.tight_layout()
plt.show()
```

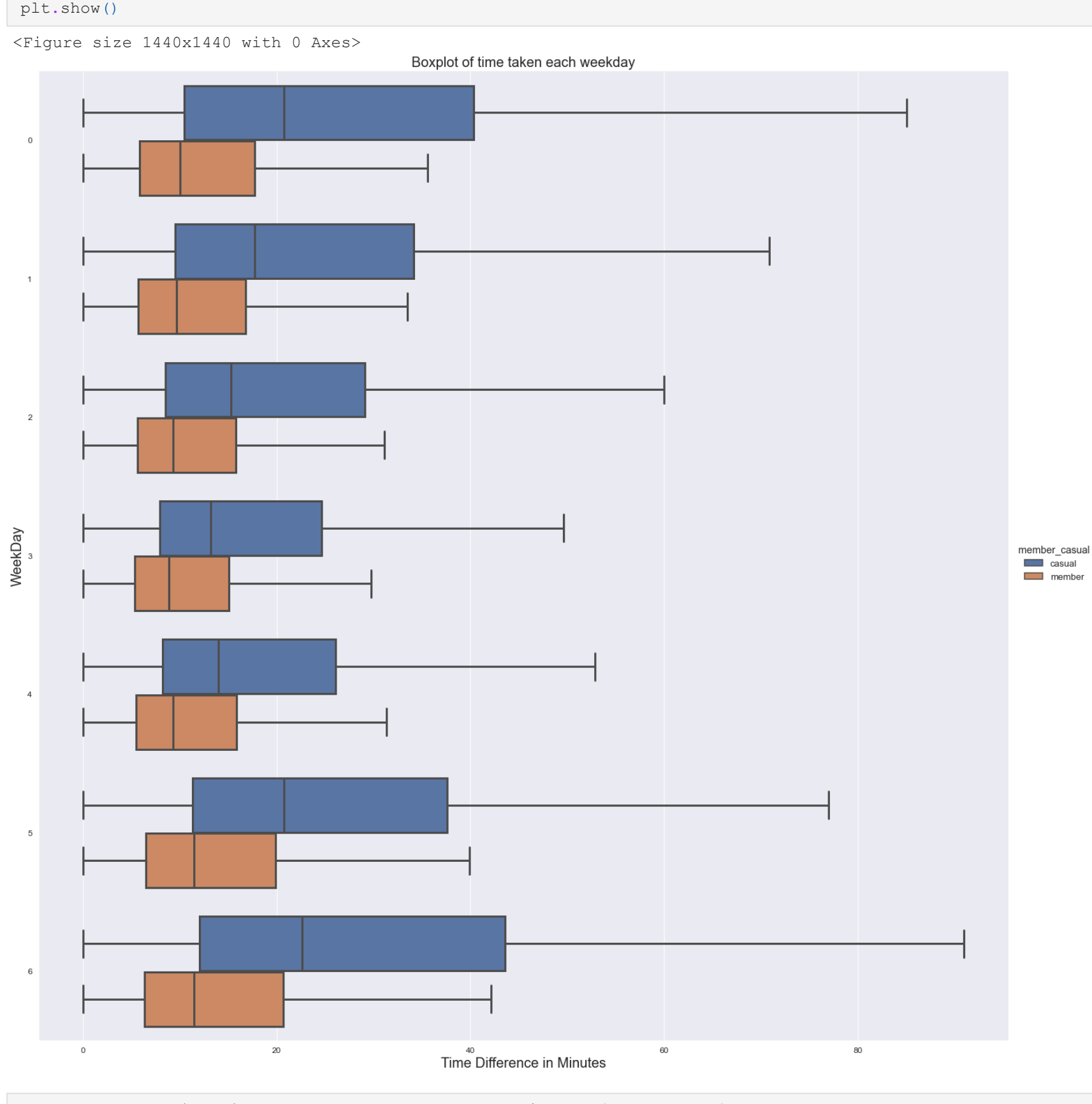
In [34]:
```
plt.figure(figsize=(20,20))


g = sns.catplot(x='rideable_type', hue='member_casual', col = 'weekday', col_wrap=4,
            kind='count', data=df,
            height = 6, aspect = 1)

g.set_xlabels("Rideable Type")
g.set_ylabels("Number of Bikes")
plt.title("Count Bikes per Weekday", size=20)
#g = (g.set_axis_labels("Tip","Total bill(USD)").set(xlim=(0,10),ylim=(0,100)


g.set(xlim=(0,None))
g.set_xticklabels(rotation=90)
plt.tight_layout()
plt.show()
```

```
<Figure size 1440x1440 with 0 Axes>
```

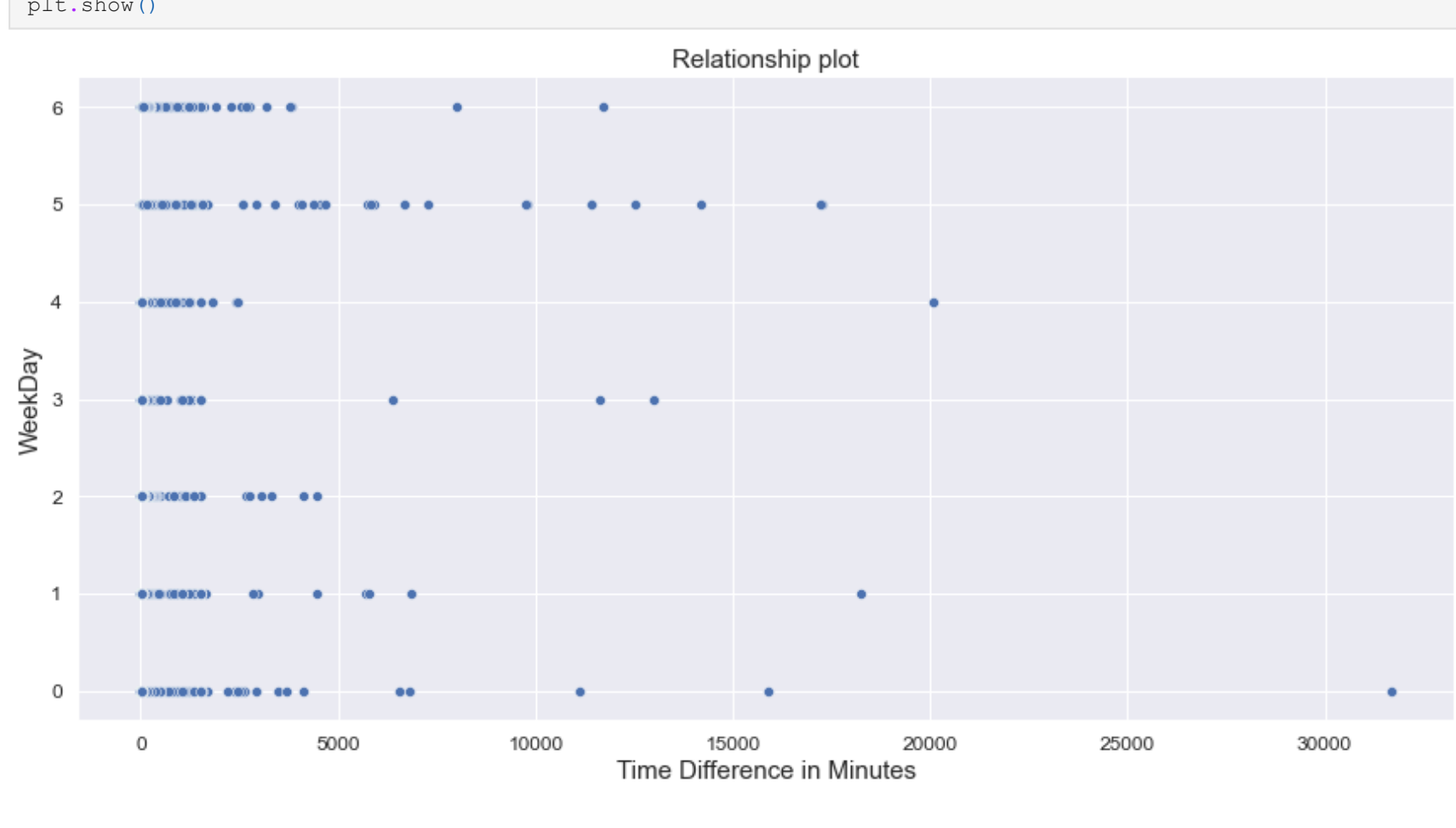


In [35]:
```
plt.figure(figsize=(20,20))

sns.catplot(x="time_diff", y="weekday",

            hue="member_casual", ci=None,

            data=df, color=None, linewidth=3, showfliers = False,

            orient="h", height=20, aspect=1, palette=None,

            kind="box", dodge=True)

plt.xlabel("Time Difference in Minutes", size=20)
plt.ylabel("WeekDay", size=20)

plt.title("Boxplot of time taken each weekday", size=20)

plt.show()
```

```
<Figure size 1440x1440 with 0 Axes>
```

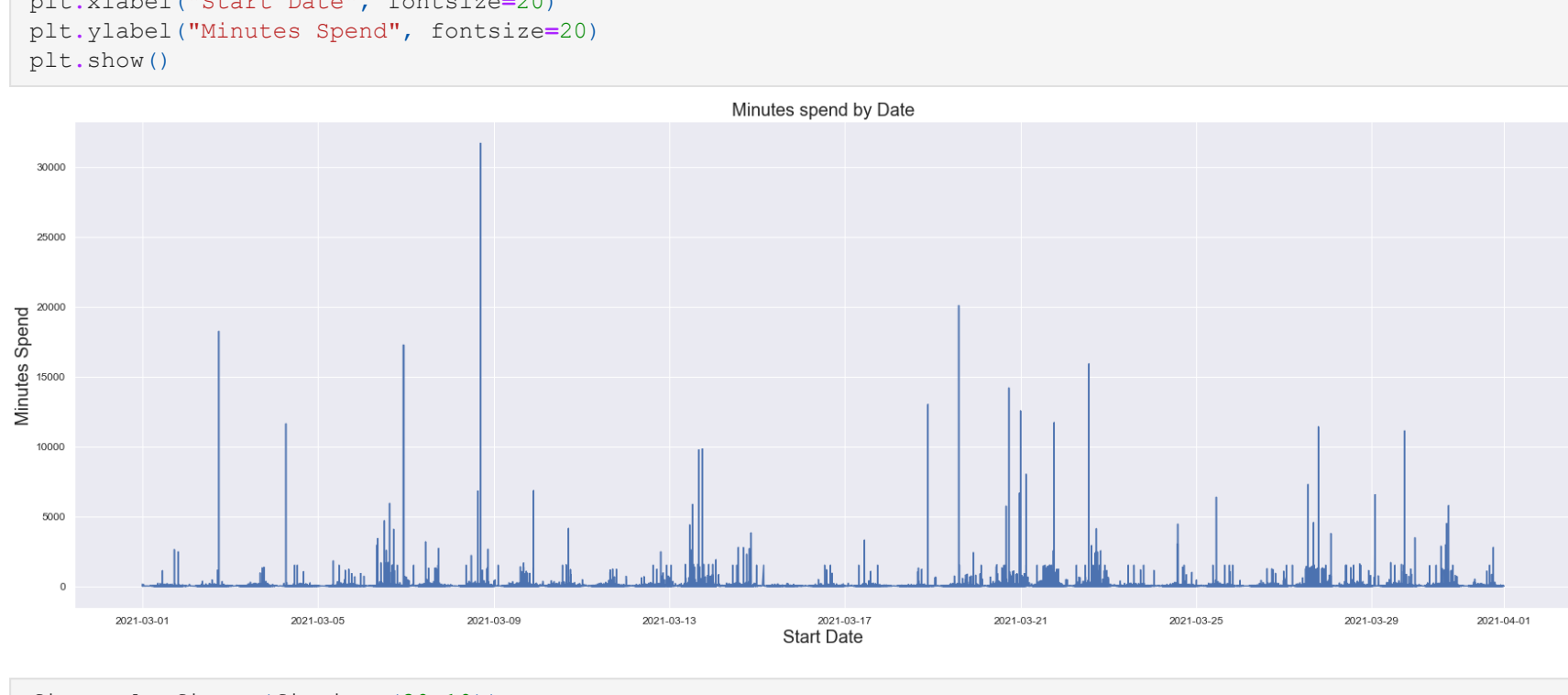


In [36]:
```
sns.relplot(x="time_diff", y="weekday", data=df, height = 6, aspect = 2)

plt.xlabel("Time Difference in Minutes", size=15)
plt.ylabel("WeekDay", size=15)
plt.title("Relationship plot", size=15)
plt.show()
```

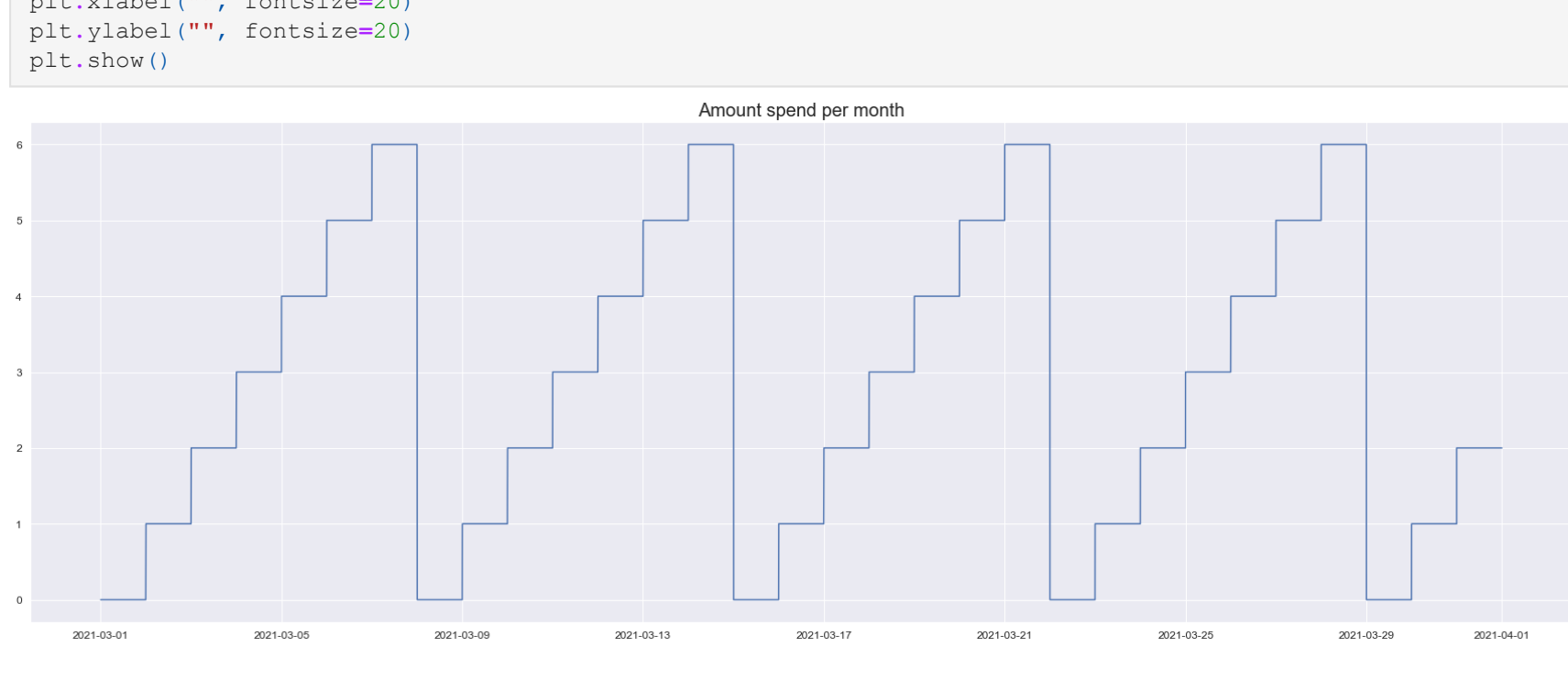


Time-Series Analysis

In [37]:
```
fig = plt.figure(figsize=(30,10))
sns.lineplot(x=df.started_at,y=df.time_diff,data=df, estimator=None)
plt.title("Minutes spend by Date", fontsize=20)
plt.xlabel("Start Date", fontsize=20)
plt.ylabel("Minutes Spend", fontsize=20)
plt.show()
```



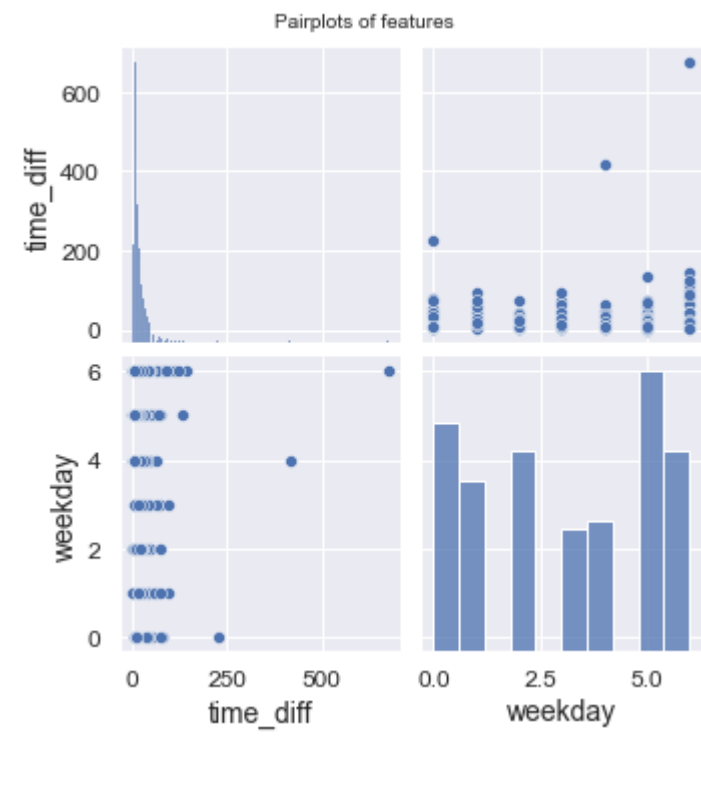
In [38]:
```
fig = plt.figure(figsize=(30,10))
sns.lineplot(x=df.started_at,y=df.weekday, data=df, estimator=None)
plt.title("Amount spend per month", fontsize=20)
plt.xlabel("", fontsize=20)
plt.ylabel("", fontsize=20)
plt.show()
```



Pairplots

In [39]:
```
plt.figure(figsize=(20,20))
sns.pairplot(df.sample(500))
plt.suptitle('Pairplots of features', x=0.5, y=1.02, ha='center', fontsize=10)
plt.show()
```

```
<Figure size 1440x1440 with 0 Axes>
```



Correlation

In [40]:
```
df.corr()
```

Out[40]:

	time_diff	weekday
time_diff	1.00	0.02
weekday	0.02	1.00

In [41]:
```
plt.figure(figsize=(9,5))
sns.heatmap(df.corr(),cmap="coolwarm",annot=True,fmt='.2f',linewidths=2)
plt.title("", fontsize=20)
plt.show()
```