IDENTIFYING THE BEST TRADING STRATEGY BASED ON SENTIMENT ANALYSIS FOR TATAMOTORS

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Contents

1. Objective

To identify the best investment strategy by performing sentiment analysis on the outlook of "Tatamotors Stock" for the following periods:

- Pre- Covid (Q3 2019 Results) – Tatamotors Q3 2019 result date is "30/01/2020"
- Post-Covid (Q1 2020 Results) - Tatamotors Q1 2020 result date is "31/07/2020"

The focus of this project is to identify the efficient algorithm to predict the employees' intention to exit from an organisation which may be further utilised to create an easy to understand & easy to use "UI (User Interface)" that can populate important KPIs (Key Performance Indicators) with just click of a button.

2. Methodology

The study is divided into two categories of – "Pre Covid Period" & "Post Covid Period".

Same methodology (explained in following sections) is followed for both the categories.

Methodology Architecture

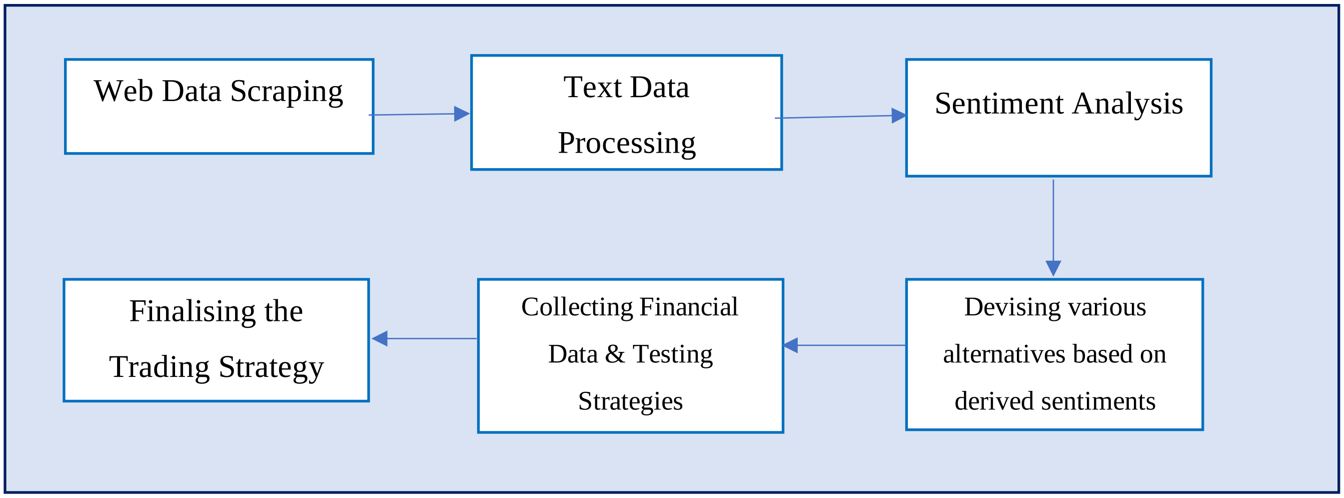


Figure 1 - Project Methodology Architecture

2.1 Web Data Scraping-

To identify the general market sentiments, I have scraped the twitter textual data related to "Tata Motors" for the following period:

Category	Quarter Results	Results Announcement Date	Twitter Data Date Range	Days (in number)
Pre Covid	Q3 for FY 2019	30/01/2020	20/01/2020 to 29/01/2020	10
Post Covid	Q1 for FY 2020	31/07/2020	21/07/2020 to 30/07/2020	10

The news archieve data was not available through the open source methods. Hence, I have used twitter data which was scraped by using Python's "snscrape library".

2.2 Text Data Preprocessing

1. Collected data was loaded in the pandas data frame
2. Converted the content in lower case
3. Removed URLs from the text
4. Removed special characters like "@,#,$,etc." from the text
5. Tokenized (splitting into individual words) the text data

6. Removed English stopwords (words that holds no contextual meaning in the text)
7. User defined stopwords are also removed (bcause getting words related to cars is expected – vehicle, EV, motor,etc.)
8. Removed Punctuation
9. Extracted adjectives from the tweets which later used for sentiments

```python
# Defining my NLTK stop words and my user-defined stop words
stop_words = list(stopwords.words('english'))
user_stop_words = ['2020', 'year', 'many', 'much', 'electric', 'next', 'motor', 'tata', 'hadnt',
                   'havent', 'hasnt', 'isnt', 'shouldnt', 'couldnt', 'wasnt', 'werent','new',
                   'mustnt', ''', '...', '..', '.', '.....', '....', 'been…', 'one', 'two','launch',
                   'three', 'four', 'five', 'six', 'seven', 'eight', 'nine', 'ten', 'aht','car',
                   've', 'next','variant','automatic','last','affordable','full']
alphabets = list(string.ascii_lowercase)
stop_words = stop_words + user_stop_words + alphabets
word_list = words.words()  # all words in English language
```

```python
tweets_df['Processed_Tweets'] = tweets_df['Text'].apply(preprocessTweets)
```

```python
# Apply getAdjectives function to the new 'Processed Tweets' column to generate a new column called 'Tweets_Adjectives'
tweets_df['Tweets_Adjectives'] = tweets_df['Processed_Tweets'].apply(getAdjectives)
```

```python
    unpunctuated_words = [char for char in filtered_words if char not in string.punctuation]
    unpunctuated_words = ' '.join(unpunctuated_words)
```

```python
# function to return words to their base form using Lemmatizer
def preprocessTweetsSentiments(tweet):
    tweet_tokens = word_tokenize(tweet)
    lemmatizer = WordNetLemmatizer() # initiate an object WordNetLemmatizer Class
    lemma_words = [lemmatizer.lemmatize(w) for w in tweet_tokens]
    return " ".join(lemma_words)
```

```python
            if tag == "JJ"]  # pos_tag module in NLTK library
    return " ".join(tweet)  # join words with a space in between them
```

10. Applied word lemmitizer to get root word
11. Sample output:
    - ✓ Pre-covid Period

	Text	Processed_Tweets	Tweets_Adjectives	Tweets_Sentiments
0	@BosePratap @TataMotors_Cars Congrat...	congratulation		congratulation
1	$TSLA market cap increase in after h...	market cap increase trading total ma...	total	market cap increase trading total ma...
2	™ "Electric vehicle race picks up m...	vehicle race momentum		vehicle race momentum
3	@TataMotors \n I want to repair of TA...	want repair safari strome guinea pro...	want strome	want repair safari strome guinea pro...
4	Tata Nexon Electric launched at ₹1.4...	follow		follow

    - ✓ Post-covid Period

	Text	Processed_Tweets	Tweets_Adjectives	Tweets_Sentiments
0	1000 Driven Tata Altroz XZ(P) faces ...	driven oil pump issue service center...		driven oil pump issue service center...
1	@RNTata2000 hi sai, one question and...	hi sai question may idea make low co...	sai low	hi sai question may idea make low co...
2	@AmarpreetKale @TataCompanies @TataS...	great visionary iron man	great visionary	great visionary iron man
3	@NtokozoKhomoo @TataMotors Mara ai,...	ka di		ka di
4	@ND_Moche @TataMotors 🆘			

12. Corpus created from "Tweets_Adjectives" with space sperator.

13. Created function to generate the blue colour for the Word Cloud

14. Initiated the Twitter word cloud object

```python
# Extract all tweets into one long string with each word separate with a "space"
tweets_long_string = tweets_df['Tweets_Adjectives'].tolist()
tweets_long_string = " ".join(tweets_long_string)
```

```python
# Create function to generate the blue colour for the Word Cloud

def blue_color_func(word, font_size, position, orientation, random_state=None,**kwargs):
    return "hsl(210, 100%%, %d%%)" % random.randint(50, 70)
```

```python
# Instantiate the Twitter word cloud object
twitter_wc = WordCloud(background_color='white', max_words=1500)

# generate the word cloud
twitter_wc.generate(tweets_long_string)

# display the word cloud
fig = plt.figure()
fig.set_figwidth(14)  # set width
fig.set_figheight(18)  # set height

plt.imshow(twitter_wc.recolor(color_func=blue_color_func, random_state=3),
           interpolation="bilinear")
plt.axis('off')
plt.show()
```

15. Generated & Display the word cloud

- ✓ Pre Covid

✓ Post Covid

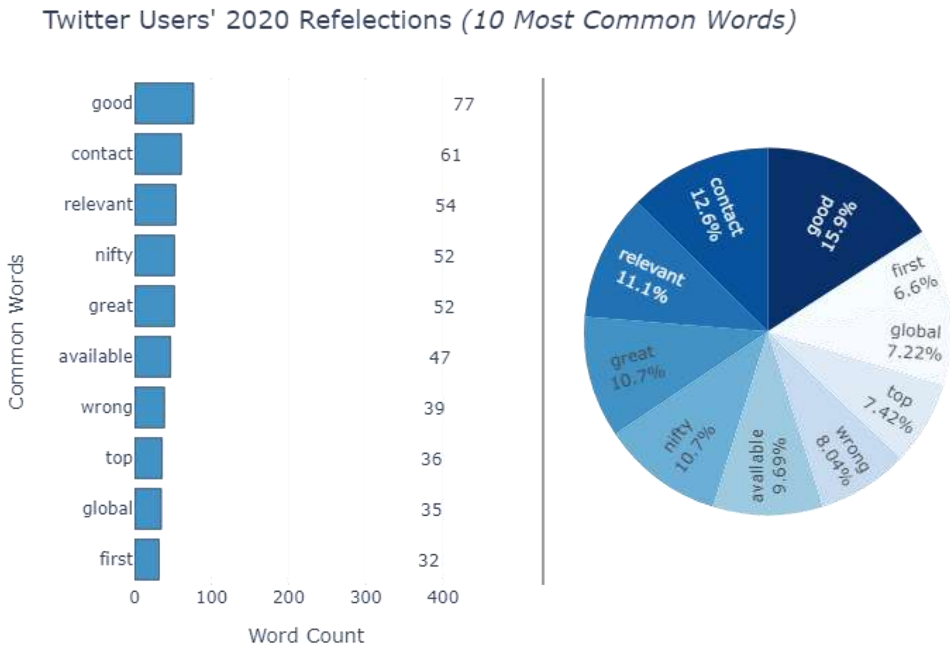
16. Displaying top words from the word cloud

```python
# Combine all words into a list
tweets_long_string = tweets_df['Tweets_Adjectives'].tolist()
tweets_list=[]
for item in tweets_long_string:
    item = item.split()
    for i in item:
        tweets_list.append(i)
```

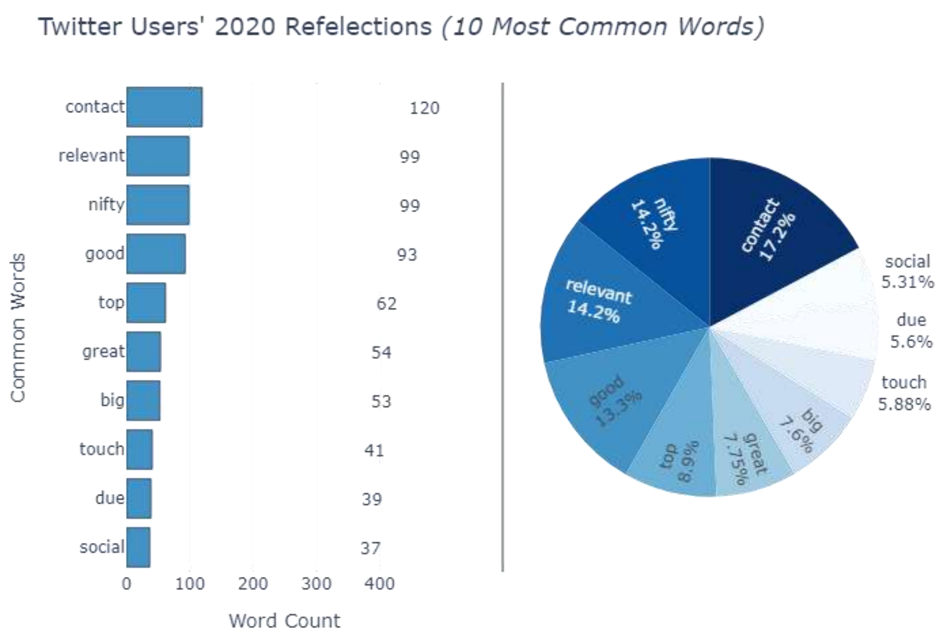
```python
# Use the Built-in Python Collections module to determine Word frequency
from collections import Counter
counts = Counter(tweets_list)
df = pd.DataFrame.from_dict(counts, orient='index').reset_index()
df.columns = ['Words', 'Count']
df.sort_values(by='Count', ascending=False, inplace=True)
```

	Words	Count
8	good	77
17	contact	61
19	relevant	54
81	great	52
24	nifty	52
60	available	47
130	wrong	39
51	top	36
22	global	35
20	first	32

✓ Pre Covid



✓ Post Covid



2.3 Sentiment Analysis

1. Using "TextBlob" module to identify sentiment polarity score

```
# Create function to obtain Subjectivity Score
def getSubjectivity(tweet):
    return TextBlob(tweet).sentiment.subjectivity

# Create function to obtain Polarity Score
def getPolarity(tweet):
    return TextBlob(tweet).sentiment.polarity

# Create function to obtain Sentiment category
def getSentimentTextBlob(polarity):
    if polarity < 0:
        return "Negative"
    elif polarity == 0:
        return "Neutral"
    else:
        return "Positive"
```

2. Summarising the sentiments

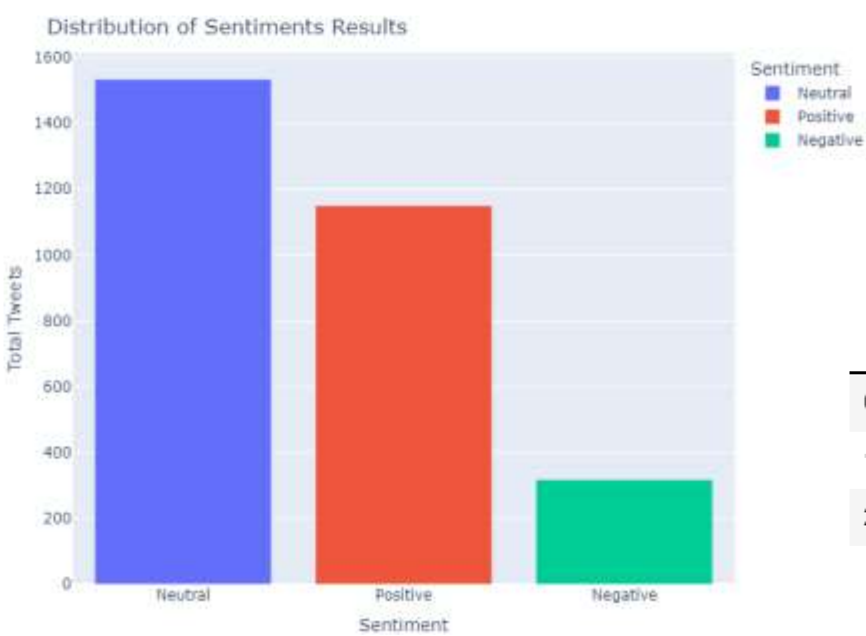
```
# Apply all functions above to respective columns
tweets_df['Subjectivity']=tweets_df['Tweets_Sentiments'].apply(getSubjectivity)
tweets_df['Polarity']=tweets_df['Tweets_Sentiments'].apply(getPolarity)
tweets_df['Sentiment']=tweets_df['Polarity'].apply(getSentimentTextBlob)
```

```
# See quick results of the Sentiment Analysis
tweets_df['Sentiment'].value_counts()
```

```
Neutral     1534
Positive    1150
Negative     317
Name: Sentiment, dtype: int64
```

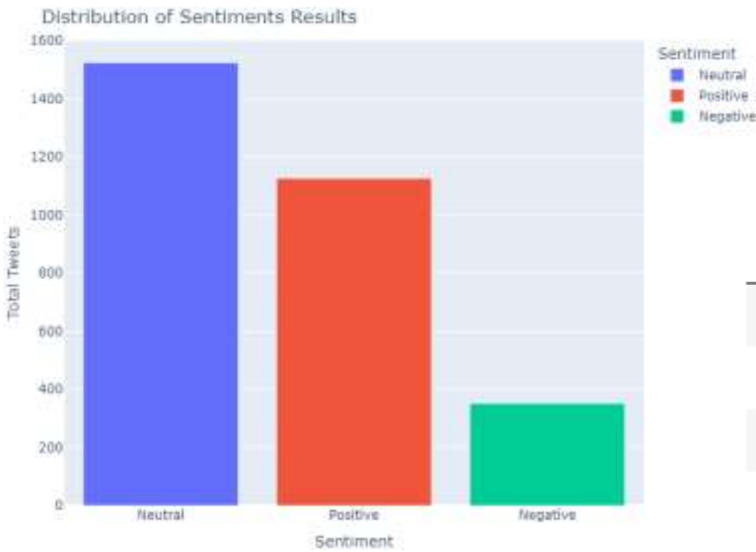
```
# Create dataframe for Count of Sentiment Categories
bar_chart = tweets_df['Sentiment'].value_counts().rename_axis('Sentiment').to_frame('Total Tweets').reset_index()
```

3. Identifying the sentiments:
   - ✓ **Pre Covid Period:**



	Sentiment	Total Tweets
0	Neutral	1534
1	Positive	1150
2	Negative	317

✓ **Post-Covid Period:**



	Sentiment	Total Tweets
0	Neutral	1524
1	Positive	1126
2	Negative	351

2.4 Devising Possible Strategies -

1. Pre Covid Period

[Case - I]:
* Purchase stock on Q3 2019 Result announcement day
* Hold it for next 10 days then sell it
* compare the 10 days tata return with 10 days market return & 10 years average return
* Also compare the outcome with the historical return

[Case - II]:
* Sell the stock on Q3 2019 Result announcement day
* wait for next 10 days then buy back
* calculate return
* Also compare the outcome with the historical return

2. Post Covid Period

[Case - I]:
* Purchase stock on Q1 2020 Result announcement day
* Hold it for next 10 days then sell it
* compare the 10 days tata return with 10 days market return & 10 years average return

* Also compare the outcome with the historical return

[Case - II]:
* Sell the stock on Q1 2020 Result announcement day
* wait for next 10 days then buy back
* calculate return
* Also compare the outcome with the historical return

2.5 Testing Possible Strategies (Assumption: for all types of return calculations, I have used Adjusted Closing Price) -

2.5.1. Pre Covid Period

3. Validating sentiments from financial data during that period

1. Collected "Tatamotors Stock Price" data for 10 days (excluding weekends) before the Q3(2019) announcement

```
#fetching Data

stock = 'TATAMOTORS.NS'
start = '2020-01-16'
end = '2020-01-30'
df = pdr.get_data_yahoo(stock, start, end)

[*********************100%***********************]  1 of 1 completed

df
```

Date	Open	High	Low	Close	Adj Close	Volume
2020-01-16	199.500000	200.600006	196.899994	197.550003	197.550003	28118140
2020-01-17	197.250000	199.449997	195.699997	197.300003	197.300003	18204088
2020-01-20	198.000000	201.449997	194.300003	195.000000	195.000000	28976013

2. Chcecked the price movement

3. 10 Days prices were reflecting growing sentiment in favour for tatamotors

4. Calculating 10 Year Period Return prior to sentiments

1. Data fetching

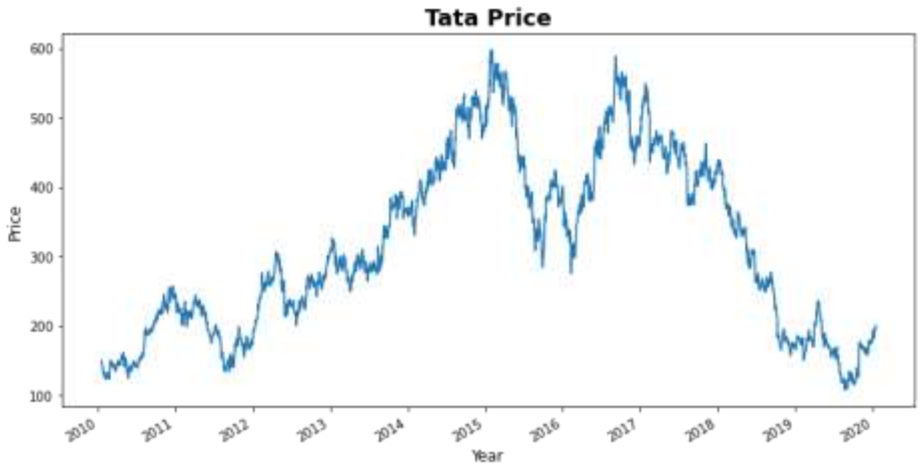
```
stock = 'TATAMOTORS.NS'
start = '2010-01-16'
end = '2020-01-16'
df_10 = pdr.get_data_yahoo(stock, start, end)
```

```
[*********************100%***********************]  1 of 1 completed
```

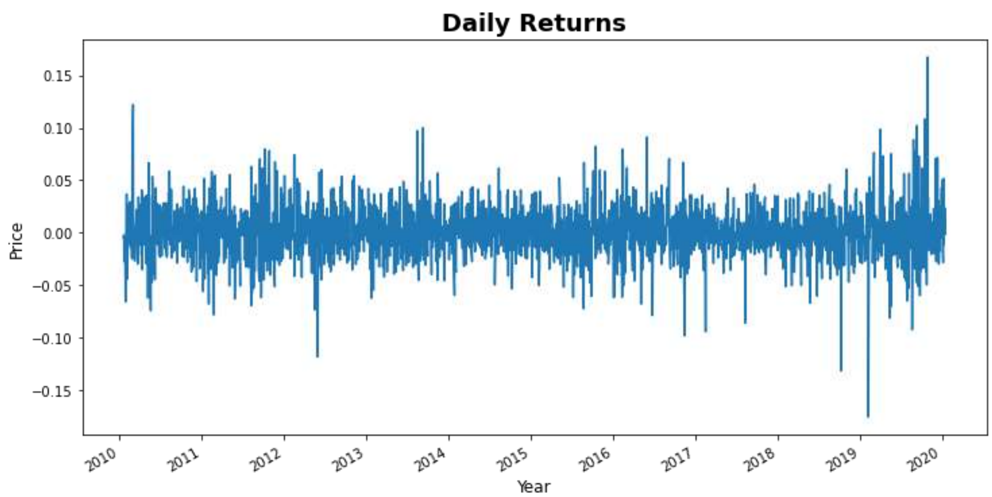
```
df_10.head()
```

Date	Open	High	Low	Close	Adj Close	Volume
2010-01-18	157.045532	161.012970	155.383362	160.449020	150.250122	18756613
2010-01-19	160.874466	162.022156	158.707703	159.627838	149.481110	11559642
2010-01-20	160.280823	160.755737	158.114075	159.281540	149.156845	10185363
2010-01-21	158.242691	159.024307	154.403870	154.888657	145.043182	9291983
2010-01-22	150.861862	155.828583	149.199677	153.958633	144.172272	12698513

2. Plotting Prices



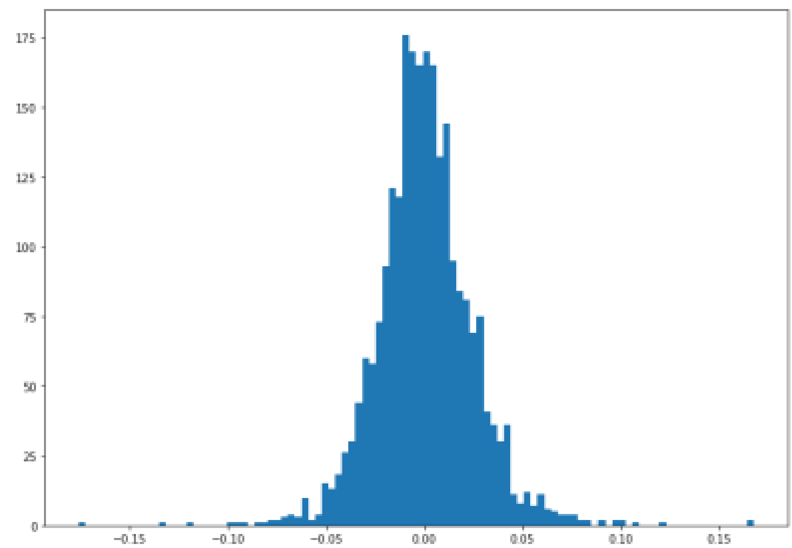
3. Daily Returns plot (highly volatile & mean reversing pattern is observed)



4. Daily Return Histogram
5. Important Statistics

	Open	High	Low	Close	Adj Close	Volume	Log_Returns	Daily_Returns	cumluative_return
count	2463.000000	2463.000000	2463.000000	2463.000000	2463.000000	2.463000e+03	2462.000000	2462.000000	2462.000000
mean	319.118188	323.643771	314.051573	318.664292	315.909616	1.285835e+07	0.000117	0.000425	2.103006
std	124.334269	125.372289	122.973737	124.077697	126.045454	1.243713e+07	0.024836	0.024869	0.838780
min	108.900002	111.599998	106.000000	107.699997	107.699997	0.000000e+00	-0.193375	-0.175827	0.716805
25%	208.133072	212.025810	204.640030	208.602531	201.364990	6.146748e+06	-0.013703	-0.013610	1.340878
50%	298.349884	304.681976	292.759857	298.152008	295.440979	9.181680e+06	-0.000508	-0.000508	1.967023
75%	423.750000	428.849991	418.300003	423.149994	422.699997	1.475572e+07	0.013513	0.013604	2.813476
max	600.212097	605.901123	589.873047	598.134399	597.892273	1.844356e+08	0.154924	0.167569	3.979313

10 years return are 0.4%



- **Purchased stock on quarter results announcement day & Analysed for 10 Days**
  1. Return analysed for 10 days period (excluding weekends) - **from '30/01/2020' to '12/02/2020'**

2. Data Fetching, calculating Daily Return & Cumulative Return

Date	Open	High	Low	Close	Adj Close	Volume	Daily_Returns	cumluative_return
2020-01-30	190.949997	192.550003	184.250000	186.199997	186.199997	70900581	NaN	NaN
2020-01-31	186.300003	188.350006	175.949997	176.600006	176.600006	75621897	-0.051557	0.948443
2020-02-03	163.500000	168.300003	159.550003	163.850006	163.850006	66616190	-0.072197	0.879968
2020-02-04	166.550003	168.600006	161.199997	165.699997	165.699997	49034642	0.011291	0.889903
2020-02-05	167.399994	184.949997	166.600006	183.750000	183.750000	92982265	0.108932	0.986842
2020-02-06	182.000000	183.399994	175.750000	178.850006	178.850006	61821140	-0.026667	0.960526
2020-02-07	177.399994	178.149994	173.000000	173.600006	173.600006	45195760	-0.029354	0.932331
2020-02-10	173.199997	173.199997	168.000000	168.899994	168.899994	33279372	-0.027074	0.907089
2020-02-11	171.850006	175.149994	168.399994	169.750000	169.750000	42868276	0.005033	0.911654
2020-02-12	173.000000	173.300003	169.000000	170.949997	170.949997	34621395	0.007069	0.918099

- INR 1 invested on 30_jan_2020 fallen to INR 0.92

3. Two Strategy Returns

✓ Strategy 1

```
# Return on holding the stock
# Purchased at 186 on 30_Jan_2020 & sold at INR 170.94 on 13_Feb_2020
holding_return = (170.949997-186.199997)/186.199997*100
print(holding_return)
```

```
-8.19011828448096
```

- we're making loss of 8.2%

✓ Strategy 2

```
#Short Selling Return (assuming '0' transaction cost)
#Sold at INR 186.199 on 30_Jan_2020 & Re-Purchased at at INR 170.94 on 13_Feb_2020

buy_back_return = (186.199-170.94)/170.94*100
print(buy_back_return)
```

```
8.926523926523936
```

- We are making 8.92% of profit

- **Purchased Nifty 50 on quarter results announcement day & Analysed for 10 Days**

Date							
2020-01-30	12147.750000	12150.299805	12010.599609	12035.799805	12035.799805	538100	NaN
2020-01-31	12100.400391	12103.549805	11945.849609	11962.099609	11962.099609	771300	-0.006123
2020-02-03	11627.450195	11749.849609	11614.500000	11707.900391	11707.900391	669800	-0.021250
2020-02-04	11786.250000	11986.150391	11783.400391	11979.650391	11979.650391	560400	0.023211
2020-02-05	12005.849609	12098.150391	11953.349609	12089.150391	12089.150391	758000	0.009141
2020-02-06	12120.000000	12160.599609	12084.650391	12137.950195	12137.950195	565100	0.004037
2020-02-07	12151.150391	12154.700195	12073.950195	12098.349609	12098.349609	473500	-0.003263
2020-02-10	12102.349609	12103.549805	11990.750000	12031.500000	12031.500000	524700	-0.005526
2020-02-11	12108.400391	12172.299805	12099.000000	12107.900391	12107.900391	480000	0.006350
2020-02-12	12151.000000	12231.750000	12144.299805	12201.200195	12201.200195	411700	0.007706

```
holding_return_mkt = (12201.200195-12035.799805)/12035.799805*100
print(holding_return_mkt)
```

```
1.3742367992136846
```

- market gave 1.4% return

- **Pre-Covid Strategy Evaluation**

Pre-Covid Strategy Summary:

10 Year Return = 0.04% ; 10 Days Tata Return = -8.2% ; 10 Days Nifty 50 Return = 1.4%

Case - I: Abnormal Profit/Loss on holding 'TATAMOTORS' = -8.2%-1.4% = -9.6%. 10 Years returns yielded better result that using 'sentiment driven holding strategy'

Case - II: Abnormal Profit/Loss on short selling 'TATAMOTORS' = 8.9%-1.4% = 7.5%

Best Pre-covid Strategy : Short when market sentiment is bullish and purchase it after holding for a shorter duration.

Best strategy abnornal return on Tatamotors = 7.5%

2.5.2. Post Covid Period

1. Validating sentiments from financial data during that period

1. Collected "Tatamotors Stock Price" data for 10 days (excluding weekends) before the Q31(2020) announcement

```
#fetching Data
```

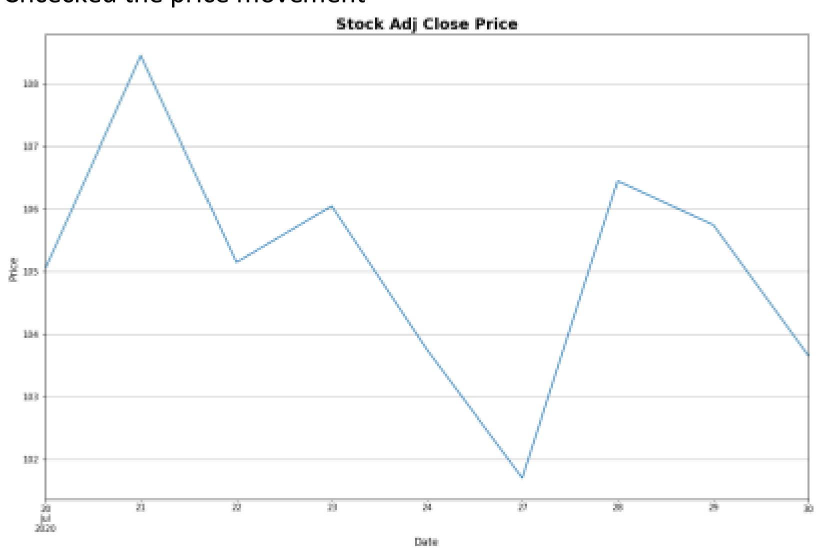
```
stock = 'TATAMOTORS.NS'
start = '2020-07-18'
end = '2020-07-31'
df_post = pdr.get_data_yahoo(stock, start, end)
```

```
[*********************100%***********************]  1 of 1 completed
```

```
df_post
```

Date	Open	High	Low	Close	Adj Close	Volume
2020-07-20	106.349998	106.349998	103.849998	105.050003	105.050003	39786731
2020-07-21	106.000000	109.699997	105.500000	108.449997	108.449997	66008143

2. Chcecked the price movement



3. 10 Days prices were not reflecting growing sentiment correctly for tatamotors for Q1 2020

2. Calculating 10 Year Period Return prior to sentiments

1. Data fetching

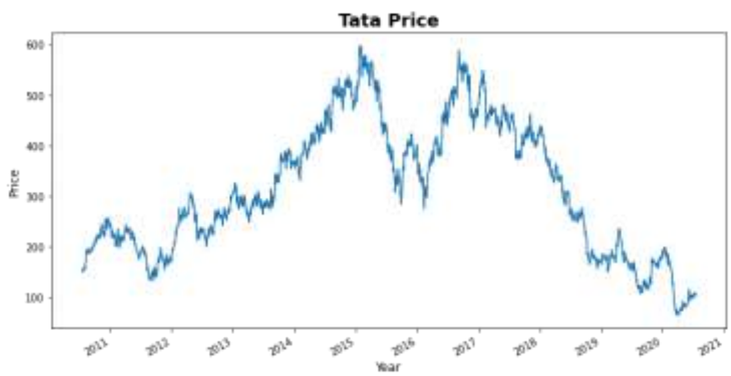
```
stock = 'TATAMOTORS.NS'
start = '2010-07-18'
end = '2020-07-18'
df_10_post = pdr.get_data_yahoo(stock, start, end)
```

```
[*********************100%***********************]  1 of 1 completed
```

```
df_10_post.head()
```

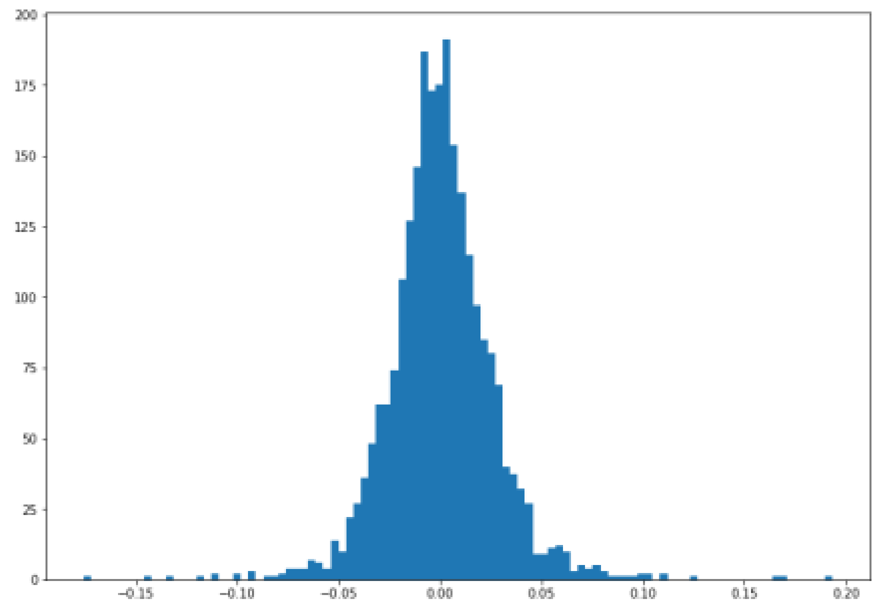
Date	Open	High	Low	Close	Adj Close	Volume
2010-07-19	163.644745	165.010101	162.487167	163.308350	152.927689	9332836
2010-07-20	164.040497	164.832016	160.082947	160.884354	150.657761	8860549
2010-07-21	161.863846	163.427078	161.547241	162.328857	152.010452	9242644
2010-07-22	162.061722	166.217148	161.270218	165.623520	155.095688	13248283
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

2. Plotting Prices



3. Daily Returns plot (highly volatile & mean reversing pattern is observed)

4. Daily Return Histogram



5. Important Statistics

	Open	High	Low	Close	Adj Close	Volume	Daily_Returns	cumiluative_return
count	2463.000000	2463.000000	2463.000000	2463.000000	2463.000000	2.463000e+03	2462.000000	2462.000000
mean	317.113977	321.640536	312.029806	316.626515	314.356613	1.511727e+07	0.000195	2.056019
std	127.596548	128.637718	126.247767	127.382675	128.628916	1.858984e+07	0.026198	0.841011
min	66.500000	66.900002	63.500000	65.300003	65.300003	0.000000e+00	-0.175827	0.426999
25%	208.133072	212.025810	204.640030	208.602531	201.364983	6.146748e+06	-0.013935	1.317401
50%	296.349884	304.681976	292.759857	298.152008	295.440948	9.207354e+06	-0.000508	1.932583
75%	423.750000	428.849991	418.300003	423.149994	422.699997	1.525352e+07	0.013770	2.764215
max	600.212097	606.901123	589.873047	598.134399	597.892273	2.154767e+08	0.193218	3.909640

- 0% is the 10 year average return

10 years return are 0%

- **Purchased stock on quarter results announcement day & Analysed for 10 Days**

  1. Return analysed for 10 days period (excluding weekends) - **from '31/07/2020' to '14/08/2020'**

2. Data Fetching, calculating Daily Return & Cumulative Return

```
df_strategy_post
```

Date	Open	High	Low	Close	Adj Close	Volume	Daily_Returns	cumluative_return
2020-07-31	104.000000	105.400002	102.300003	104.650002	104.650002	33809018	NaN	NaN
2020-08-03	103.000000	114.400002	102.900002	113.050003	113.050003	194765344	0.080268	1.080268
2020-08-04	112.949997	115.099998	110.800003	111.449997	111.449997	95906477	-0.014153	1.064978
2020-08-05	112.400002	117.650002	112.000000	115.400002	115.400002	99371050	0.035442	1.102723
2020-08-06	116.199997	117.699997	115.500000	116.800003	116.800003	60092530	0.012132	1.116101
2020-08-07	117.000000	119.699997	116.000000	119.099998	119.099998	56489390	0.019692	1.138079
2020-08-10	119.949997	124.699997	119.699997	123.849998	123.849998	71093810	0.039882	1.183469
2020-08-11	125.000000	125.800003	121.400002	122.300003	122.300003	50224665	-0.012515	1.168657
2020-08-12	121.000000	126.400002	120.599998	125.349998	125.349998	50713617	0.024939	1.197802
2020-08-13	126.099998	131.899994	124.400002	131.149994	131.149994	95489249	0.046270	1.253225

- INR 1 invested on 31_jan_2021 grew to INR 1.25

- **Two Strategy Returns**
  - ✓ Strategy 1

```
# Return on holding the stock
# Purchased at 104.65 on 31_Jul_2020 & sold at INR 131.14 on 13_AuG_2020
holding_return_post = (131.14-104.65)/104.65*100
print(holding_return_post)
```

```
25.312947921643552
```

- we're making profit of 25%

  - ✓ Strategy 2

```
#Short Selling Return (assuming '0' transaction cost)
#Sold at INR 104.65 on 31_Jul_2020 & Re-Purchased at at INR 131.14 on 13_AuG_2020

buy_back_return_post = (104.65-131.14)/131.14*100
print(buy_back_return_post)
```

```
-20.19978648772303
```

- We are making loss of 20%

- **Purchased Nifty 50 on quarter results announcement day & Analysed for 10 Days**

Date	Open	High	Low	Close	Adj Close	Volume	Daily_Returns
2020-07-31	11139.500000	11150.400391	11026.650391	11073.450195	11073.450195	642600	NaN
2020-08-03	11057.549805	11058.049805	10882.250000	10891.599609	10891.599609	680900	-0.016422
2020-08-04	10946.650391	11112.250000	10908.099609	11095.250000	11095.250000	625700	0.018698
2020-08-05	11155.750000	11225.650391	11064.049805	11101.650391	11101.650391	667600	0.000577
2020-08-06	11185.700195	11256.799805	11127.299805	11200.150391	11200.150391	600400	0.008873
2020-08-07	11186.650391	11231.900391	11142.049805	11214.049805	11214.049805	452600	0.001241
2020-08-10	11270.250000	11337.299805	11238.000000	11270.150391	11270.150391	492000	0.005003
2020-08-11	11322.250000	11373.599609	11299.150391	11322.500000	11322.500000	586100	0.004645
2020-08-12	11289.000000	11322.000000	11242.650391	11308.400391	11308.400391	609900	-0.001245
2020-08-13	11334.849609	11359.299805	11269.950195	11300.450195	11300.450195	562400	-0.000703

```
holding_return_mkt_post = (11300-11073)/11073*100
print(holding_return_mkt_post)
```

```
2.05003160841687
```

- market gave 2% return

- **Post-Covid Strategy Evaluation**

Pre-Covid Strategy Summary:

10 Year Return = 0% ; 10 Days Tata Return = 25% ;10 Days Return on short selling = -20%; 10 Days Nifty 50 Return = 2%

Case - I: Abnormal Profit/Loss on holding 'TATAMOTORS' = 25%-2% = 23%.

Case - II: Abnormal Profit/Loss on short selling 'TATAMOTORS' = -20%-2% = -22%

Best Post-covid Strategy : Buy when market sentiment is bullish and later sell it after holding for a shorter duration.

Best strategy abnornal return on Tatamotors = 23%

3. Finalising the trading strategy & conclusion

As an investor, we should reap the benefit of “Busllish” sentiment to get the maximum abnormal return. However, the findings were different for the pre & post covid period. This strategy is not showing any return in pre covid bcause the general market sentiments (**market risk)** were bearish about most of the stocks bcause of the economic slowdown since covid spread.

Period	Chosen Strategy	Abnormal Profit	Remark
Pre Covid	Buy on result day & sell on 10^{th} day	-9.6%	Strategy failed due to increased market risk because of covid led slowdown
Post Covid	Buy on result day & sell on 10^{th} day	23%	Normal Economic Condition