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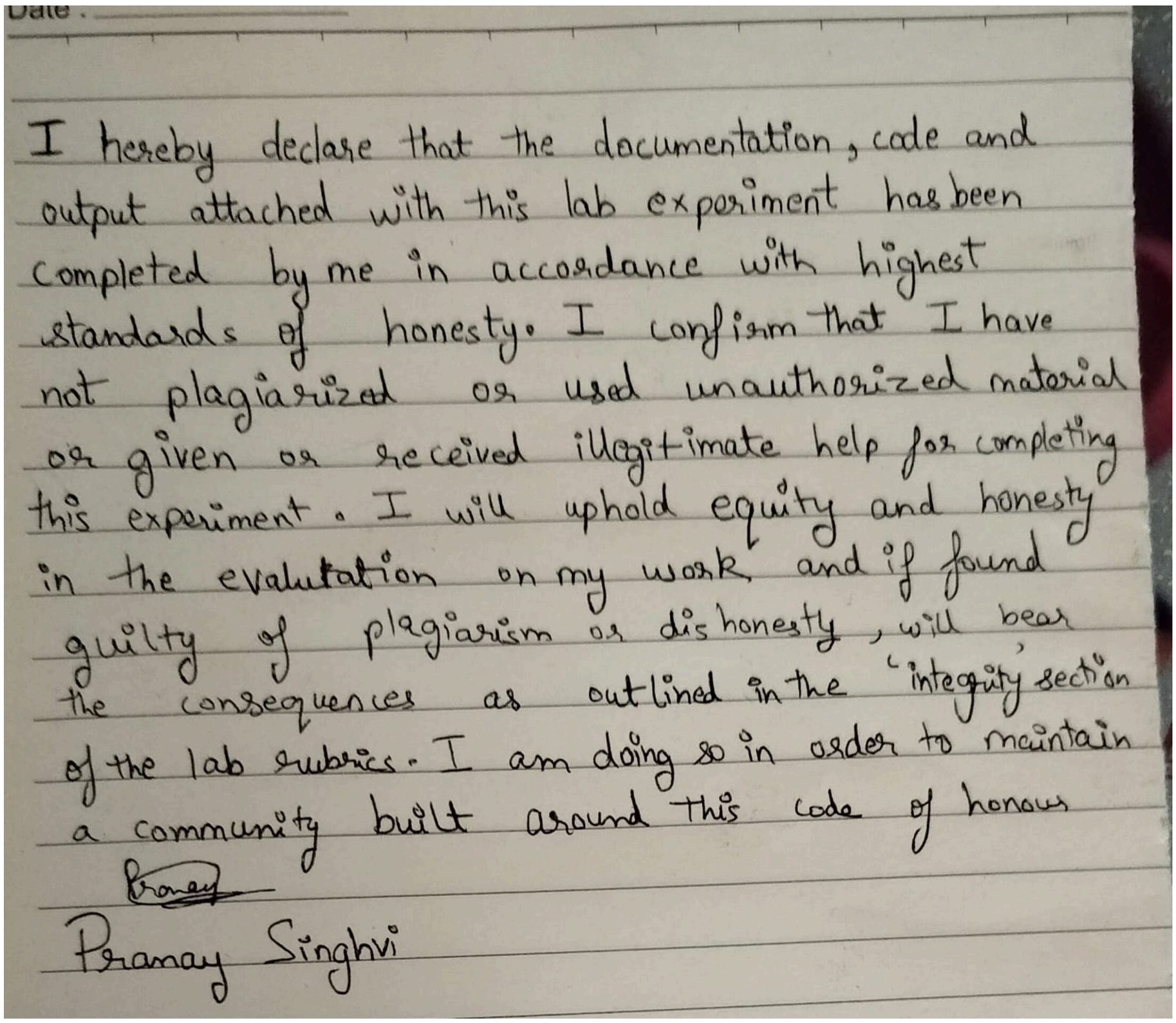
Experiment 9

HONOR PLEDGE	

Date :

I hereby declare that the documentation, code and output attached with this lab experiment has been completed by me in accordance with highest standards of honesty. I confirm that I have not plagiarized or used unauthorized material or given or received illegitimate help for completing this experiment. I will uphold equity and honesty in the evaluation on my work and if found guilty of plagiarism or dishonesty, will bear the consequences as outlined in the 'integrity section of the lab rubrics. I am doing so in order to maintain a community built around this code of honour

Pranay

Pranay Singhvi

PROBLEM STATEMENT	**Sentiment Analysis on Social Media Data** 1. Select one of the social media channels you would like to analyze the data of - Twitter, Instagram, Reddit, YouTube 2. Select value/s for relevant attributes like 'author', 'topic', 'mention', #tag', 'country' etc. to narrow down the scope of what you would like to analyze. 3. Fetch the narrowed down data across a specific time window using python libraries. This time-window would allow to compare and contrast sentiments across different times and for different events that occur during the time-window. 4. Process the text and do sentiment analysis on it using relevant libraries (Twitter lexicon would require a more specialized library) 5. Plot the results and state your analysis of the results.
CASE STUDY	"The Tesla Stock" Elon Musk Tesla Tesla is an American company revolutionizing the automotive industry with its electric vehicles known for long range, sleek designs, and cutting-edge technology. Beyond cars, Tesla also produces innovative energy solutions like solar panels and home battery storage systems, all with the mission of accelerating the world's shift to sustainable energy. **Datasets:** Tesla Data 2014-2021 Elon Musk Tweets 2017-2022

1. Importing Libraries & Datasets

In [ ]:
```
import numpy as np
import pandas as pd
import seaborn as sns
import calendar
from textblob import TextBlob
import matplotlib.pyplot as plt
from matplotlib.pyplot import pie
import matplotlib.dates as mdates
import warnings
warnings.filterwarnings('ignore')

# read csv file
df_doge = pd.read_csv("TSLA.csv")
df1 = pd.read_csv('Elon 2017-2018.csv')
df2 = pd.read_csv('Elon 2018-2019.csv')
df3 = pd.read_csv('Elon 2019-2020.csv')
df4 = pd.read_csv('Elon 2020-2021.csv')
df5 = pd.read_csv('Elon 2021-2022.csv')
```

In [ ]:
```
pip install textblob
```

```
Requirement already satisfied: textblob in /Users/pranaysinghvi/Library/CloudStorage/OneDrive-Personal/SPIT College/3)Class/Semester 6/3)BAP/1)Experiments/ven-bap/lib/python3.12/site-packages (0.18.0.post0)
Requirement already satisfied: nltk>=3.8 in /Users/pranaysinghvi/Library/CloudStorage/OneDrive-Personal/SPIT College/3)Class/Semester 6/3)BAP/1)Experiments/ven-bap/lib/python3.12/site-packages (from textblob) (3.8.1)
Requirement already satisfied: click in /Users/pranaysinghvi/Library/CloudStorage/OneDrive-Personal/SPIT College/3)Class/Semester 6/3)BAP/1)Experiments/ven-bap/lib/python3.12/site-packages (from nltk>=3.8->textblob) (8.1.7)
Requirement already satisfied: joblib in /Users/pranaysinghvi/Library/CloudStorage/OneDrive-Personal/SPIT College/3)Class/Semester 6/3)BAP/1)Experiments/ven-bap/lib/python3.12/site-packages (from nltk>=3.8->textblob) (1.3.2)
Requirement already satisfied: regex>=2021.8.3 in /Users/pranaysinghvi/Library/CloudStorage/OneDrive-Personal/SPIT College/3)Class/Semester 6/3)BAP/1)Experiments/ven-bap/lib/python3.12/site-packages (from nltk>=3.8->textblob) (2023.12.25)
Requirement already satisfied: tqdm in /Users/pranaysinghvi/Library/CloudStorage/OneDrive-Personal/SPIT College/3)Class/Semester 6/3)BAP/1)Experiments/ven-bap/lib/python3.12/site-packages (from nltk>=3.8->textblob) (4.66.1)
Note: you may need to restart the kernel to use updated packages.
```

2. Preprocessing the Data

In [ ]:
```
df_doge = df_doge.drop(columns=["Adj Close"])  # identical with column 'Close'
df_doge["Date"] = pd.to_datetime(df_doge["Date"])

df_doge["Year"] = df_doge["Date"].dt.year
df_doge["Month_Num"] = df_doge["Date"].dt.month
df_doge["Month"] = df_doge["Month_Num"].apply(lambda x: calendar.month_abbr[x])

df_doge["YYYYMM"] = pd.to_datetime(df_doge["Date"], format="%Y%m", errors="coerce")
df_doge["YYYYMM"] = pd.to_datetime(df_doge["Date"]).dt.strftime("%Y%m")

df_doge["Close_log"] = np.log(df_doge["Close"])
df_doge["Return"] = df_doge["Close"] / df_doge["Open"][0] - 1
```

In [ ]:
```
# combine all dataframes
df = pd.concat([df1, df2, df3, df4, df5])

# find tweets which contain 'doge'
df = df[df["Tweet"].str.contains("tesla", case=False)]
df = df.reset_index(drop=True)
df = df[["Date", "Tweet"]]
df["YYYY"] = pd.to_datetime(df["Date"], format="%Y", errors="coerce")
df["YYYY"] = pd.to_datetime(df["Date"]).dt.strftime("%Y")
df.to_csv("Elon_Tsla.csv", index=False)
```

In [ ]:
```
df = pd.read_csv("Elon_Tsla.csv")
print(df.shape[0], "tweets found containing 'doge'")
df.head()
```

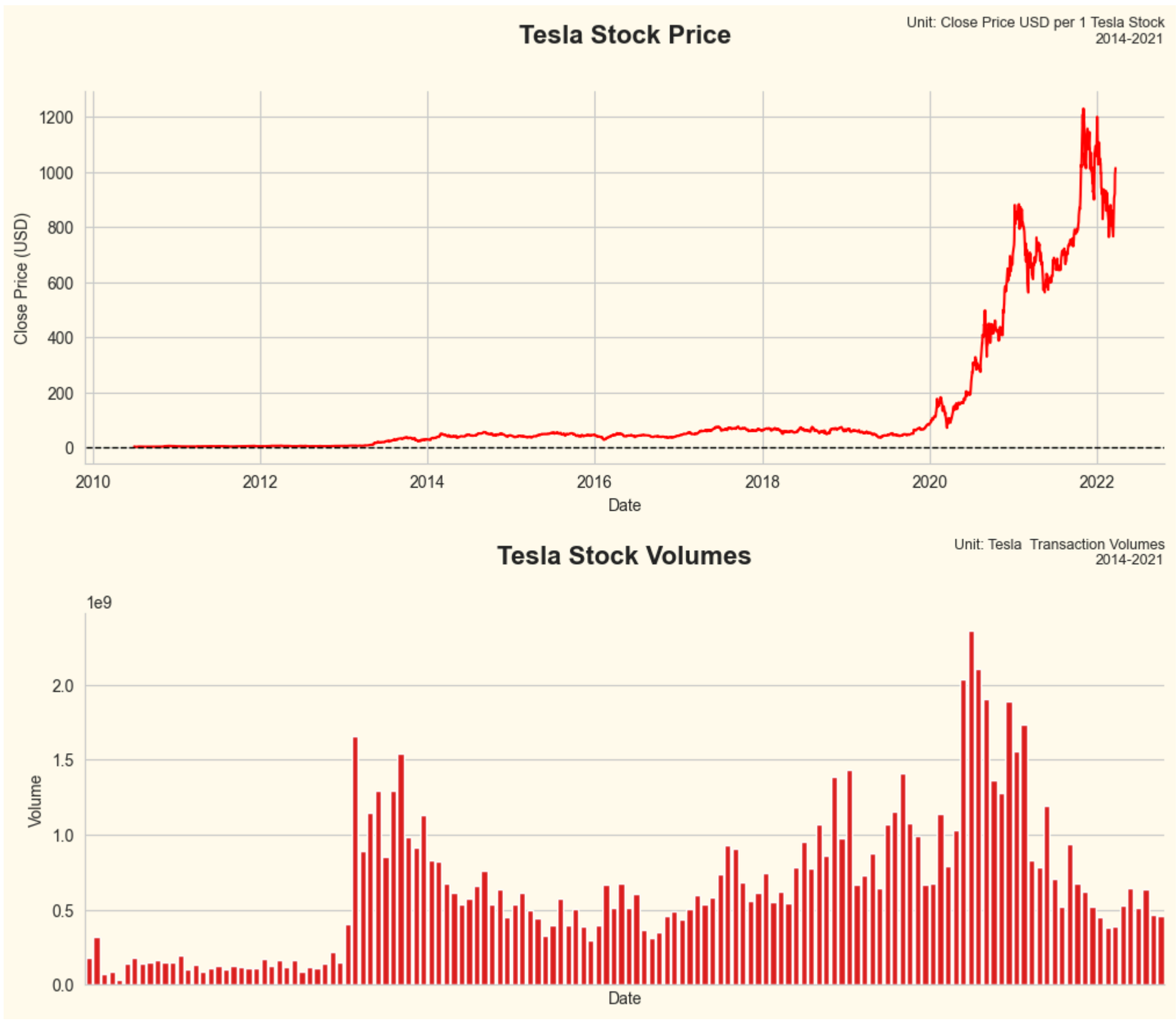
```
2469 tweets found containing 'doge'
```

Out[ ]:

	Date	Tweet	YYYY
0	2017-12-27 00:32:57+00:00	@neilsiegel @Tesla Coming very soon	2017
1	2017-12-26 18:57:03+00:00	@Jason @Tesla Sure	2017
2	2017-12-26 17:46:29+00:00	Wanted again to send a note of deep gratitude ...	2017
3	2017-12-23 23:57:50+00:00	When you get the new Tesla software update, go...	2017
4	2017-12-21 15:34:15+00:00	Glad to see that Tesla owners are having a goo...	2017

It was confirmed that the price and sales volumes of Tesla cars have risen significantly from 2010. This is due to the fact that Elon Musk has been promoting Tesla heavily on social media. The following graph shows the price and sales volume of Tesla cars from 2014 to 2021.

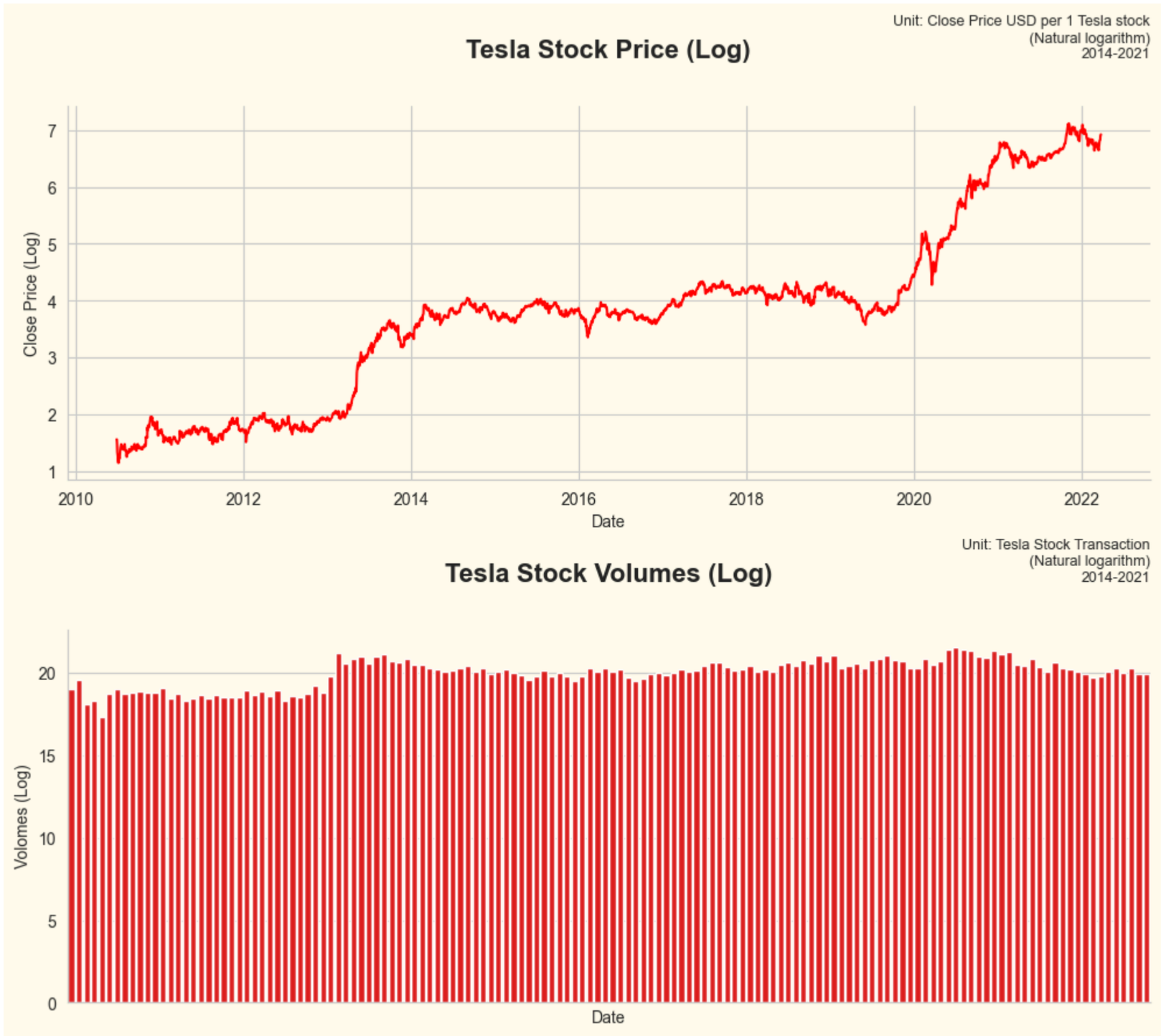
In [ ]:
```
df_hm = pd.pivot_table(df_doge, values="Volume", index=["Year", "Month_Num"], aggfunc=np.sum)
df_hm.reset_index(level=0, inplace=True)
df_hm.reset_index(level=0, inplace=True)
df_hm["Date"] = pd.to_datetime(
    (df_hm.Year * 100 + df_hm.Month_Num).apply(str), format="%Y%m"
).dt.strftime("%Y%m")
df_hm["Volume_log"] = np.log(df_hm["Volume"])

fig = plt.figure(figsize=(12, 10))
fig.tight_layout()
fig.subplots_adjust(hspace=0.4)
fig.patch.set_facecolor("#FFFCEC")
fig.patch.set_alpha(1.0)

ax1 = plt.subplot(2, 1, 1)
ax1 = sns.lineplot(data=df_doge, x="Date", y="Close", color="red")
ax1.patch.set_facecolor("#FFFCEC")
ax1.patch.set_alpha(1.0)

ax1 = plt.gca().spines["right"].set_visible(False)
ax1 = plt.gca().spines["top"].set_visible(False)
ax1 = plt.gca().spines["left"].set_visible(True)
ax1 = plt.gca().spines["bottom"].set_visible(True)

ax1 = plt.ylabel("Close Price (USD)")
ax1 = plt.axhline(0, 8, 0, color="black", linestyle="--", linewidth="1")
ax1 = plt.title(
    "Unit: Close Price USD per 1 Tesla Stock\n2014-2021", fontsize=9, loc="right"
)
ax1 = plt.title(
    "Tesla Stock Price", fontsize=16, fontweight="heavy", loc="center", pad=30
)

ax2 = plt.subplot(2, 1, 2)
ax2 = sns.barplot(x="Date", y="Volume", data=df_hm, color="red")
ax2.patch.set_facecolor("#FFFCEC")
ax2.patch.set_alpha(1.0)

ax2 = plt.gca().spines["right"].set_visible(False)
ax2 = plt.gca().spines["top"].set_visible(False)
ax2 = plt.gca().spines["left"].set_visible(True)
ax2 = plt.gca().spines["bottom"].set_visible(True)
ax2 = plt.xticks([])

ax2 = plt.title(
    "Unit: Tesla  Transaction Volumes\n2014-2021", fontsize=9, loc="right"
)
ax2 = plt.title(
    "Tesla Stock Volumes", fontsize=16, fontweight="heavy", loc="center", pad=30
)
```



I analyzed the trend more closely by taking the natural logarithm of the price and volume of Tesla Stock Price. The following graph shows the price and volume of Tesla Stock from 2014 to 2021. In this case, it was confirmed that **there was a significant price increase in 2017, although not as much as the increase in 2021.**

In [ ]:
```
fig = plt.figure(figsize=(12, 10))
fig.tight_layout()
fig.subplots_adjust(hspace=0.4)
fig.patch.set_facecolor("#FFFCEC")
fig.patch.set_alpha(1.0)

ax1 = plt.subplot(2, 1, 1)
ax1 = sns.lineplot(data=df_doge, x="Date", y="Close_log", color="red")
ax1.patch.set_facecolor("#FFFCEC")
ax1.patch.set_alpha(1.0)

ax1 = plt.gca().spines["right"].set_visible(False)
ax1 = plt.gca().spines["top"].set_visible(False)
ax1 = plt.gca().spines["left"].set_visible(True)
ax1 = plt.gca().spines["bottom"].set_visible(True)

ax1 = plt.ylabel("Close Price (Log)")
```

```
ax1 = plt.annotate(
    "1st Boom Up",
    xy=(pd.to_datetime("2017-02-25"), -8.3),
    xytext=(pd.to_datetime("2016-03-10"), -4),
    arrowprops=dict(arrowstyle="->", connectionstyle="arc3", facecolor="black"),
)
ax1 = plt.annotate(
    "2nd Boom Up",
    xy=(pd.to_datetime("2020-10-25"), -5.8),
    xytext=(pd.to_datetime("2019-09-10"), -2),
    arrowprops=dict(arrowstyle="->", connectionstyle="arc3", facecolor="black"),
)

ax1 = plt.title(
    "Unit: Close Price USD per 1 Tesla stock\n(Natural logarithm)\n2014-2021",
    fontsize=9,
    loc="right",
)
ax1 = plt.title(
    "Tesla Stock Price (Log)", fontsize=16, fontweight="heavy", loc="center", pad=30
)
# semi-colon for hide text before graph output
ax2 = plt.subplot(2, 1, 2)
ax2 = sns.barplot(x="Date", y="Volume_log", data=df_hm, color="red")
ax2.patch.set_facecolor("#FFFCEC")
ax2.patch.set_alpha(1.0)

ax2 = plt.gca().spines["right"].set_visible(False)
ax2 = plt.gca().spines["top"].set_visible(False)
ax2 = plt.gca().spines["left"].set_visible(True)
ax2 = plt.gca().spines["bottom"].set_visible(True)
ax2 = plt.xticks([])

ax2 = plt.ylabel("Volomes (Log)")

ax2 = plt.title(
    "Unit: Tesla Stock Transaction\n(Natural logarithm)\n2014-2021",
    fontsize=9,
    loc="right",
)
ax2 = plt.title(
    "Tesla Stock Volumes (Log)", fontsize=16, fontweight="heavy", loc="center", pad=30
)
# semi-colon for hide text before graph output
```



3. Sentiment Analysis of Elon Musk's Tweets on Dogecoin

In [ ]:
```
def get_sentiment(tweet):
    analysis = TextBlob(tweet)
    if analysis.sentiment.polarity > 0:
        return "pos"
    elif analysis.sentiment.polarity == 0:
        return "neu"
    else:
        return "neg"
```

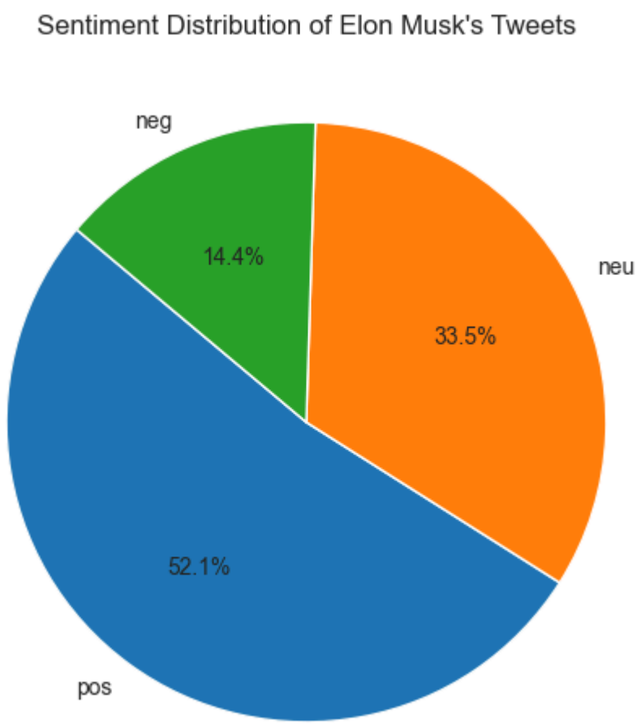
In [ ]:
```
df["sentiment"] = df["Tweet"].apply(get_sentiment)
df.to_csv("Elon_Tsla.csv", index=False)
df = pd.read_csv("Elon_Tsla.csv")
df.head()
```

Out[ ]:

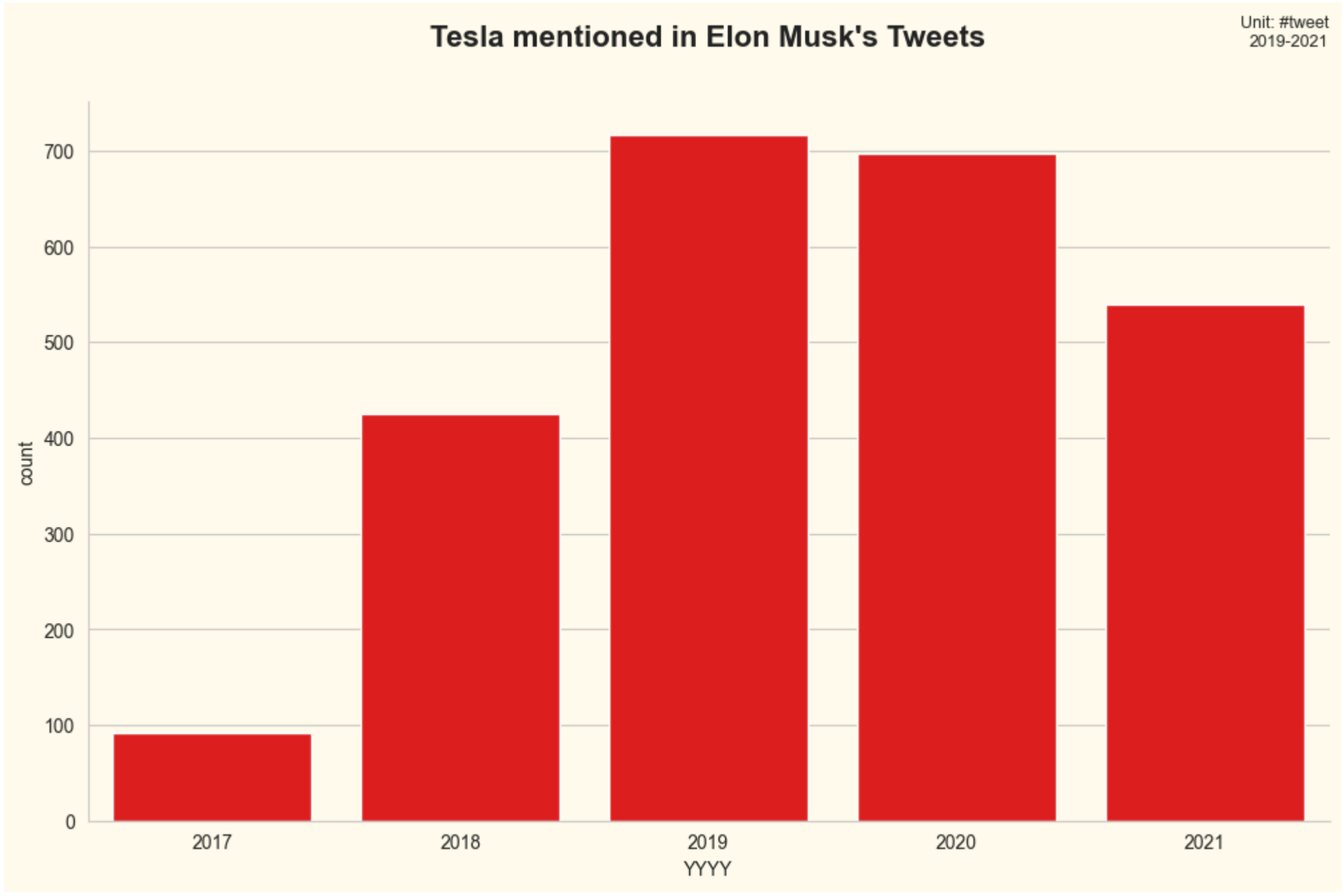
	Date	Tweet	YYYY	sentiment
0	2017-12-27 00:32:57+00:00	@neilsiegel @Tesla Coming very soon	2017	pos
1	2017-12-26 18:57:03+00:00	@Jason @Tesla Sure	2017	pos
2	2017-12-26 17:46:29+00:00	Wanted again to send a note of deep gratitude ...	2017	pos
3	2017-12-23 23:57:50+00:00	When you get the new Tesla software update, go...	2017	pos
4	2017-12-21 15:34:15+00:00	Glad to see that Tesla owners are having a goo...	2017	pos

The sentiment analysis of Elon Musk's tweets on Tesla was conducted using the **TextBlob** library. The following graph shows the sentiment of Elon Musk's tweets on Tesla from 2017 to 2022.
His tweets were mostly positive, or neutral but these tweets had a **significant impact on the price** and volume of Tesla.

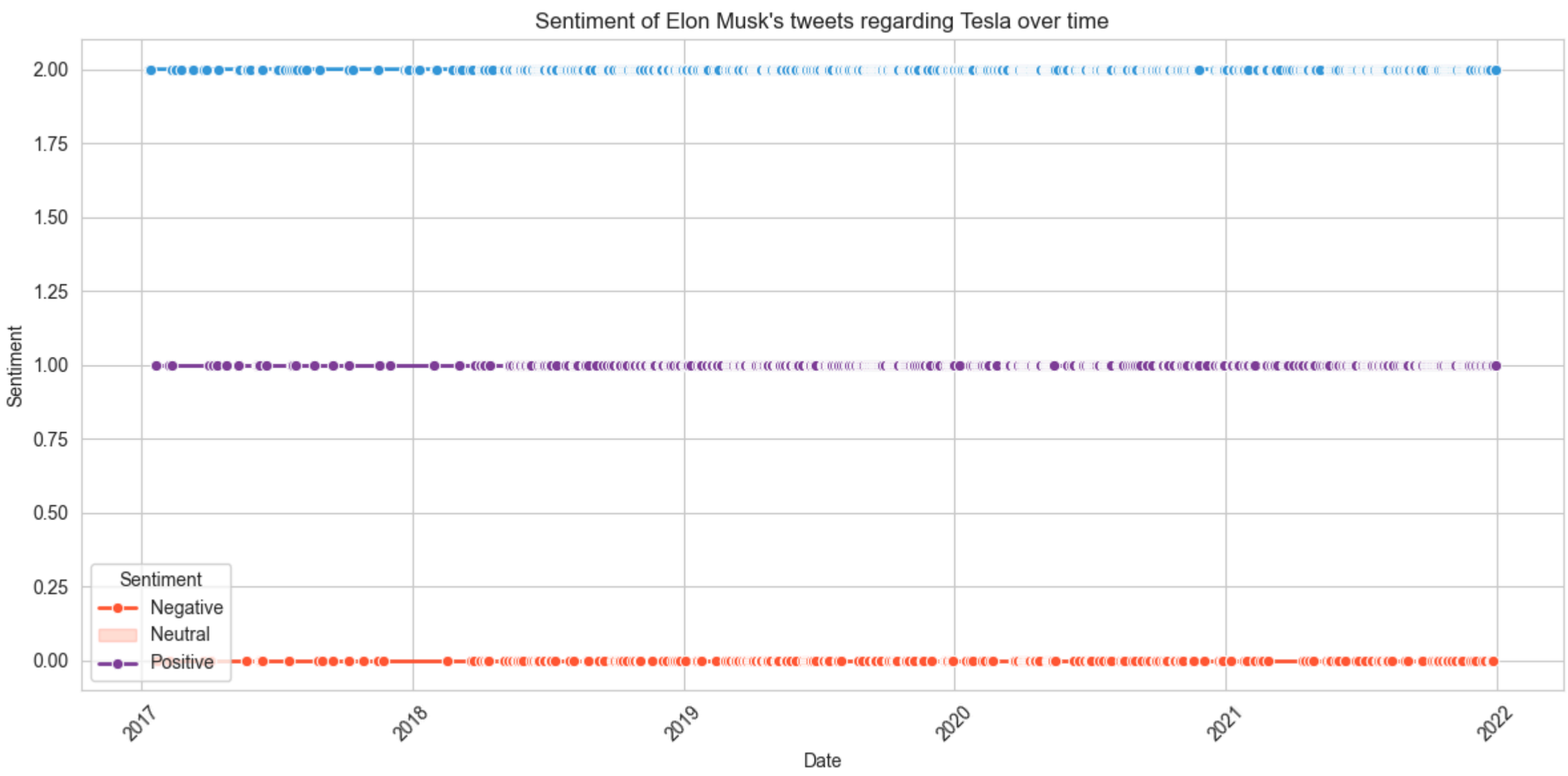
In [ ]:
```
# Sentiment distribution
sentiment_counts = df["sentiment"].value_counts()
plt.figure(figsize=(6, 6))
pie(sentiment_counts, labels=sentiment_counts.index, autopct="%1.1f%%", startangle=140)
plt.title("Sentiment Distribution of Elon Musk's Tweets")
plt.show()
```



In [ ]:
```
fig = plt.figure(figsize=(12, 7))
fig.patch.set_facecolor("#FFFCEC")
fig.patch.set_alpha(1.0)

ax2 = sns.countplot(x="YYYY", data=df, color="red")
ax2.patch.set_facecolor("#FFFCEC")
ax2.patch.set_alpha(1.0)

ax2 = plt.gca().spines["right"].set_visible(False)
ax2 = plt.gca().spines["top"].set_visible(False)
ax2 = plt.gca().spines["left"].set_visible(True)
ax2 = plt.gca().spines["bottom"].set_visible(True)

ax2 = plt.title("Unit: #tweet\n2019-2021", fontsize=9, loc="right")
ax2 = plt.title(
    "Tesla mentioned in Elon Musk's Tweets",
    fontsize=16,
    fontweight="heavy",
    loc="center",
    pad=30,
)
```



In [ ]:
```python
# Map sentiment labels to numeric values for legend
sentiment_mapping = {"neg": 0, "neu": 1, "pos": 2}
df["sentiment_numeric"] = df["sentiment"].map(sentiment_mapping)
df["Date"] = pd.to_datetime(df["Date"])

# Plot the sentiment of Elon Musk's tweets regarding Dogecoin over time
sns.set_style("whitegrid")
custom_palette = {0: "#FF5733", 1: "#7D3C98", 2: "#3498DB"}

# Create line plot
plt.figure(figsize=(12, 6))
sns.lineplot(
    data=df,
    x="Date",
    y="sentiment_numeric",
    marker="o",
    hue="sentiment_numeric",
    palette=custom_palette,
    linewidth=2,
)
plt.xlabel("Date")
plt.ylabel("Sentiment")
plt.title("Sentiment of Elon Musk's tweets regarding Tesla over time")
plt.xticks(rotation=45)
plt.legend(["Negative", "Neutral", "Positive"], title="Sentiment")
plt.tight_layout()
plt.show()
```



CONCLUSION	In this experiment we learned how to perform sentiment analysis on social media data. We analyzed the trend of Tesla Stock Price and sentiment of Elon Musk's tweets on Tesla. We also learned how to fetch data from Twitter and perform sentiment analysis on it.