

# Trump Twitter Analysis

Group 14: MDS 522 : Members:  
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Analyzing the **realDonaldTrump\_in\_office.csv** from  
[https://github.com/MarkHershey/CompleteTrumpTweetsArchive/blob/master/datarealDonaldTrump\\_in\\_office.csv](https://github.com/MarkHershey/CompleteTrumpTweetsArchive/blob/master/datarealDonaldTrump_in_office.csv)

## Summary

Here we are analyzing Tweets published by Donald Trump during his first presidency, specifically how the time of day or season affect the frequency of the tweets. Additionally, we did sentiment analysis using a VADER for classification to determine the frequency of positive, negative and neutral tweets. Finally, using a combination of CountVectorizer and Logistic Regression, we used WordCloud visualization to determine the most frequent positive and negative words.

## Introduction

Twitter (also known as X) is one of the world's most popular social media platforms, where users can share short messages (texts, videos, photos) known as tweets. In April 2025, the Pew Research Center did a study and found that on average active users published 157 tweets per month, which is around 5 tweets per day. At the beginning of his first presidency, Donald Trump followed the average, posting about 5.7 times per day. However towards the second half of 2020, his posting rate grew to around 34.8 times per day. On June 5 2020, he went as far as tweeting or retweeting 200 messages in a single day. With so much data, we thought it would be interesting to consider what could affect his frequency of posting. The president uses the platform mostly to disparage those he perceives as threats (people, companies, countries...), with more than half of his tweets between January 2017 and October 2019 being used to attack something or someone. Another interesting question to consider would be to determine the frequency of positive and negative tweets throughout his presidency. In this report, we will start by considering different factors (time of day or season) that might have an impact on the frequency of the tweets, then we will classify the tweets into positive, negative or neutral to determine the most frequent sentiment expressed in his posts.

Data

The dataset we are using contains all tweets published (includes deleted tweets) published by Donald Trump during his first presidency between 20 Jan 2017 and 08 Jan 2021. It contains 5 columns (ID, Time, Tweet URL, Tweet Text) and each row represents a tweet. For the initial EDA and data processing we ended up having to drop around 1/2 of the rows to stop unconventional characters at the end of the tweet string from tripping up pandas. After a visual review we noticed that these problem rows were quite evenly distributed (every 2-3 rows) and that this wouldn't be too much of an issue to get started.

All of the data and rows have now been recovered. All numbers and values have been updated and applied to the analysis and put through further validation processes.

## Analysis

Part 1: Does the time of day/period of the year affect the frequency of the tweets?

With the president posting 34.8 times per day it is interesting to consider whether the time of day or even the period of the year affects the frequency of his tweets. Before our analysis, we believed that the frequency of tweets would be highest during the daytime and night-time. These assumptions were proven wrong as the numbers show that the most frequent time of day for tweets was the overnight period.

```
In [1]: import pandas as pd
import altair as alt
import requests
import pandera.pandas as pa
from pandera.pandas import Column, DataFrameSchema

def load_clean_trump_csv(url): # chatGPT assistance to constr
    resp = requests.get(url) # download the csv text from
    resp.raise_for_status() # raise if 4xx/5xx
    lines = resp.text.splitlines()

    rows = []

    for i, line in enumerate(lines, start=1):
        line = line.rstrip("\n\r")
        if not line.strip():
            continue # skip empty lines

        parts = line.split(",")

        if i == 1: # skip header row
```

```

        continue

    if len(parts) < 4:                                     # if fewer than
        continue

    id_val = parts[0].strip()                               # the first 3
    time_val = parts[1].strip()
    url_val = parts[2].strip()
    tweet_text = ",".join(parts[3:]).strip()

    rows.append((id_val, time_val, url_val, tweet_text))

df = pd.DataFrame(rows, columns=["ID", "Time", "Tweet URL", "Tweet Text"])
return df

```

url = "https://raw.githubusercontent.com/MarkHershey/CompleteTrumpTweetsArchived/master/trump\_tweets.csv"

tweets = load\_clean\_trump\_csv(url)

tweets.columns = tweets.columns.str.strip()

#print(tweets.columns)

tweets["Date & Time"] = pd.to\_datetime(tweets["Time"], errors="coerce")

tweets = tweets.drop(columns=["ID", "Tweet URL", "Time"])

print(tweets.shape)

tweets.head(10)

(23075, 2)

Out[1]:

		Tweet Text	Date & Time
0	"It all begins today! I will see you at 11:00 ...	2017-01-20 06:31:00	
1	"Today we are not merely transferring power fr...	2017-01-20 11:51:00	
2	"power from Washington, D.C. and giving it bac...	2017-01-20 11:51:00	
3	"What truly matters is not which party control...	2017-01-20 11:52:00	
4	"January 20th 2017, will be remembered as the ...	2017-01-20 11:53:00	
5	"The forgotten men and women of our country wi...	2017-01-20 11:54:00	
6	"We will bring back our jobs. We will bring ba...	2017-01-20 11:54:00	
7	"We will follow two simple rules: BUY AMERICAN...	2017-01-20 11:55:00	
8	"It is time to remember that...https://www.fac...	2017-01-20 11:58:00	
9	"So to all Americans, in every city near and f...	2017-01-20 12:00:00	

## DATA VALIDATION: Pandera

In [2]: schema = DataFrameSchema(  
{  
 "Date & Time": Column(pa.DateTime, nullable=False, coerce=True),  
 "Tweet Text": str,  
 "ID": int,  
 "Time": str,  
 "Tweet URL": str  
})

```

        "Tweet Text": Column(pa.String, nullable=False),
    }
)

tweets_valid = schema.validate(tweets)

```

- The initial data filtering by time of day visualized in the bar chart shows that the highest frequency of tweets occurs during the evening period between 4:01 pm - 12:00 am (as mentioned above) with a total of 8825 analyzed tweets. The second most frequent tweet period occurred during the overnight period between 12:01 am - 8:00 am with a total of 7881 analyzed tweets, with the time of day resulting in the least frequent amount of tweets actually being the daytime period between 8:01am-4:00pm with a total of 6369 analyzed tweets. Perhaps this is because Trump is most busy during the day (golfing?) and cannot tend to tweets.

```
In [3]: tweets = tweets.set_index("Date & Time") #
```

```

daytime = tweets.between_time("08:01", "16:00")
evening = tweets.between_time("16:01", "00:00")
overnight = tweets.between_time("00:01", "08:00")

print(f"The number of tweets in the 'Daytime' category is: {len(daytime)}")
print(f"The number of tweets in the 'Evening' category is: {len(evening)}")
print(f"The number of tweets in the 'Overnight' category is: {len(overnight)}")

print("Just by the distribution of tweets it is surprisingly evenly spread;")

```

The number of tweets in the 'Daytime' category is: 6369  
The number of tweets in the 'Evening' category is: 8825  
The number of tweets in the 'Overnight' category is: 7881  
Just by the distribution of tweets it is surprisingly evenly spread; with the most tweets happening in the evening.

```
In [4]: tweet_time = pd.DataFrame({
    "Time": ["daytime", "evening", "overnight"],
    "Count": [len(daytime), len(evening), len(overnight)]
})

tweet_time
```

```
Out[4]:   Time  Count
          0  daytime  6369
          1  evening  8825
          2  overnight  7881
```

Figure 1: Number of tweets published by time of day (daytime: 8:01 am - 4:00 pm, evening: 4:01 pm - 12:00 am, overnight: 12:01 am - 8:00 am )

- The seasonal filtering of the tweets returned the results of the most frequent amount of tweets being in the summer with 6747 analyzed tweets, with the autumn being the second busiets season for tweets resulting in 6401 analysed tweets, followed by the spring recording 5543 analyzed tweets, and lastly the winter being the least busy season for tweets recording a number of 4384 tweets. This falls inline with inutitive assumptions about mood and activity as the summer is usually the busiest with longer days (daylight) and nicer weather, then the fall slowly tapers off into the winter season being the shortest days for daylight and the most restricting weather.

```
In [5]: tw = pd.Series(tweets.index.strftime('%m-%d'), index=tweets.index)      # Change the date format to month-day

spring = tweets.loc[tw.between('04-01', '06-30')]                                # April
summer = tweets.loc[tw.between('07-01', '09-30')]                                # July 1
autumn = tweets.loc[tw.between('10-01', '12-31')]                                # October
winter = tweets.loc[tw.between('01-01', '03-31')]                                # January

print(f"The number of tweets in the 'Spring' category is: {len(spring)}")
print(f"The number of tweets in the 'Summer' category is: {len(summer)}")
print(f"The number of tweets in the 'Autumn' category is: {len(autumn)}")
print(f"The number of tweets in the 'Winter' category is: {len(winter)}")
print("")
print("Judging by the distribution of tweets throughout the seasons, the frequency decays in the winter and spring and peaks in the summer")
```

The number of tweets in the 'Spring' category is: 5543  
The number of tweets in the 'Summer' category is: 6747  
The number of tweets in the 'Autumn' category is: 6401  
The number of tweets in the 'Winter' category is: 4384

Judging by the distribution of tweets throughout the seasons, the frequency decays in the winter and spring and peaks in the summer

```
In [6]: tweet_season = pd.DataFrame({
    "Season": ["Spring", "Summer", "Autumn", "Winter"],
    "Count": [len(spring), len(summer), len(autumn), len(winter)]
})

tweet_season
```

Out[6]:

	Season	Count
0	Spring	5543
1	Summer	6747
2	Autumn	6401
3	Winter	4384

Figure 2: Number of tweets published by season (Spring: April 1st - June 30th, Summer: July 1st - September 30th, Autumn: October 1st - December 31st, Winter: January 1st -

March 31st)

Creating the time of day frequency charts:

```
In [7]: time_bars = alt.Chart(tweet_time).mark_bar(color="#f00808").encode(
    y = "Time:N",
    x = "Count:Q",
).properties(
    title="Trump's Tweet Frequency by Time of Day",
    width=500,
    height=350)

#time_bars
```

```
In [8]: label_df = pd.DataFrame({
    "Time": ["daytime", "evening", "overnight"],
    "range": ["8:01am–4:00pm", "4:01pm–12:00am", "12:01am–8:00am"],
    "Count": tweet_time["Count"].values
})
```

```
In [9]: range_text = (
    alt.Chart(label_df)
    .mark_text(
        align="center",
        baseline="middle",
        color="white",
        fontSize=16,
        dx=-80
    )
    .encode(
        y="Time:N",
        x="Count:Q",
        text="range:N"
    )
)

#time_bars + range_text
```

```
In [10]: count_text = alt.Chart(label_df).mark_text(
    align="left",
    baseline="middle",
    dx=5,
    color="black",
    fontSize=14
).encode(
    y="Time:N",
    x="Count:Q",
    text="Count:Q"
)

tweet_times = time_bars + range_text + count_text
#tweet_times
```

```
In [11]: final_time_of_day_chart = (time_bars + range_text + count_text).properties(p  
final_time_of_day_chart
```

Out[11]:

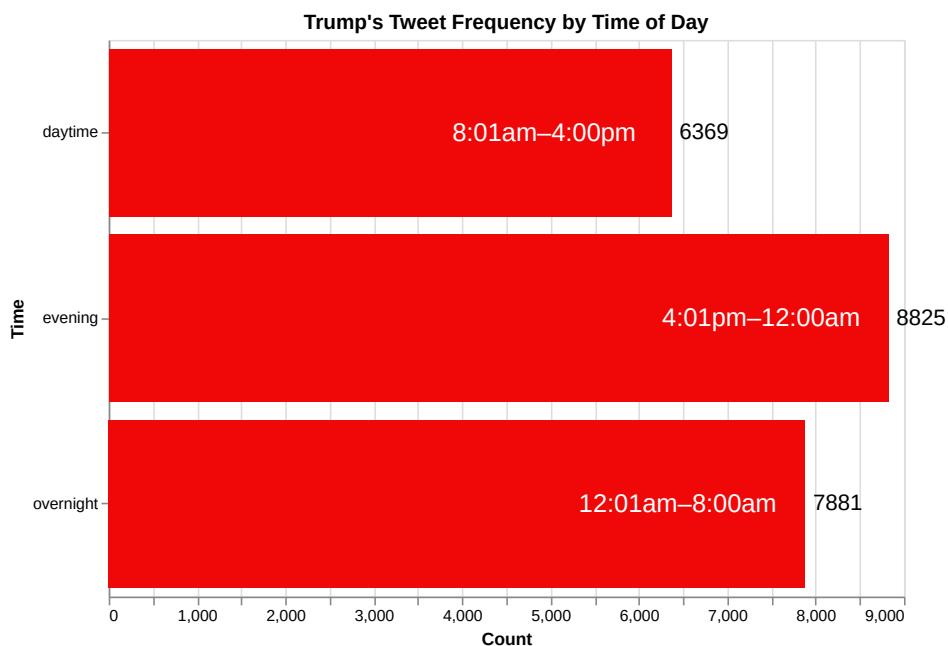


Figure 3: Trump's Tweet Frequency by Time of Day

Creating the seasonal frequency charts:

```
In [12]: season_bars = alt.Chart(tweet_season).mark_bar(color="#f00808").encode(  
    x="Count:Q",  
    y=alt.Y("Season:N", sort=["Spring", "Summer", "Autumn", "Winter"])  
).properties(  
    title="Trump's Tweet Frequency by Season",  
    width=500,  
    height=350)  
  
#season_bars
```

```
In [13]: season_label_df = pd.DataFrame({  
    "Season": ["Spring", "Summer", "Autumn", "Winter"],  
    "range": ["April 1st - June 30th", "July 1st – Sept 30th", "Oct 1st – Dec 31st"],  
    "Count": tweet_season["Count"].values  
})  
#season_label_df
```

```
In [14]: season_range_text = alt.Chart(season_label_df).mark_text(  
    align="center",  
    baseline="middle",  
    color="white",  
    fontSize=16,  
    dx=-90  
).encode(  
    y=alt.Y("Season:N", sort=["Spring", "Summer", "Autumn", "Winter"]),  
    x="Count:Q",  
    text="range"
```

```

        text="range:N"
    )

#season_bars + season_range_text

```

```
In [15]: season_count_text = alt.Chart(season_label_df).mark_text(
    align="left",
    baseline="middle",
    dx=5,
    color="black",
    font_size=14
).encode(
    y=alt.Y("Season:N", sort=["Spring", "Summer", "Autumn", "Winter"]),
    x="Count:Q",
    text="Count:Q"
)

tweet_seasons = season_bars + season_range_text + season_count_text
#tweet_seasons
```

```
In [16]: final_season_chart = (season_bars + season_range_text + season_count_text).properties(
    width=800
)
final_season_chart
```

Out[16]:

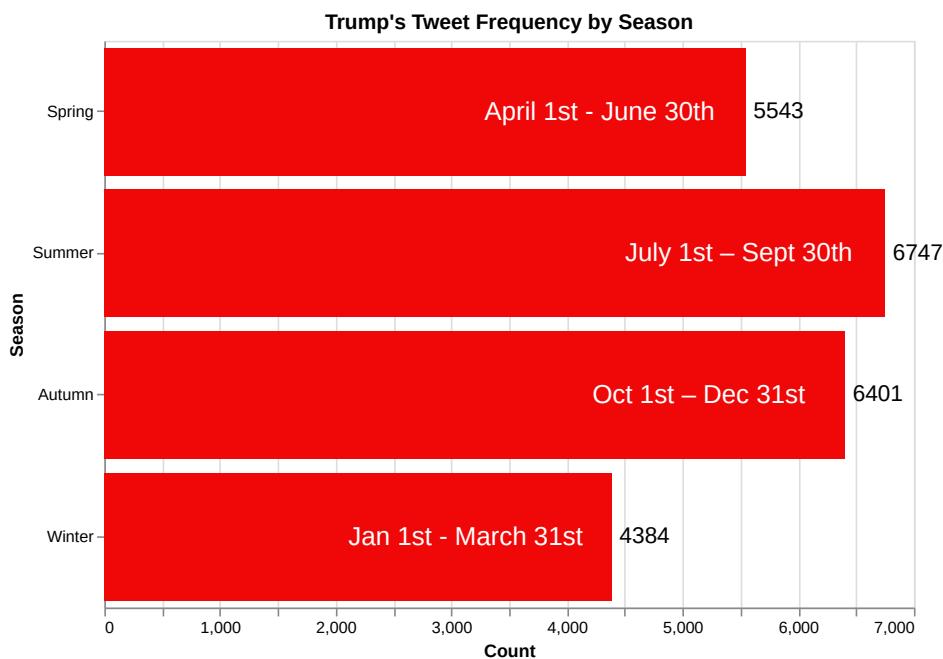


Figure 4: Trump's Tweet Frequency by Season

Visualizing our results we see that there is no major difference in posting frequency given the time of day, but there is a difference for different seasons.

```
In [17]: tweet_charts = (tweet_seasons | tweet_times).properties(padding={"right": 50})
tweet_charts
```

Out[17]:

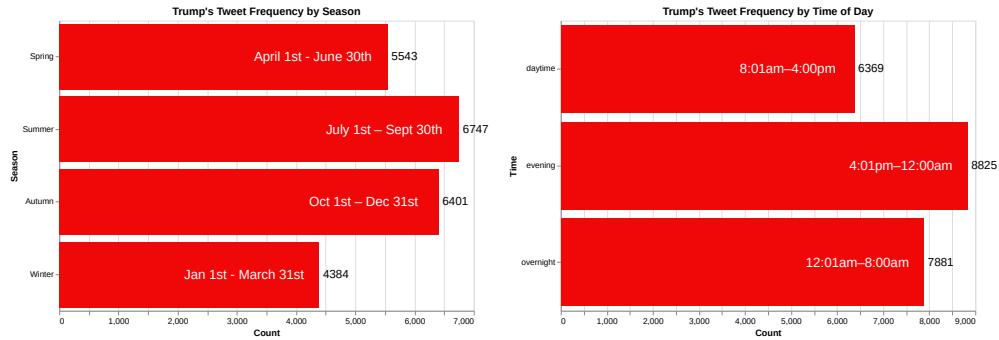


Figure 5: Trump's Tweet Frequency by Time of Day and Season

## Part 2: How many tweets are positive vs negative? (2 classification methods)

When we think of the tweets posted by the president, we tend to think mostly of those where he criticizes or attacks others. However, is this a real representation of the sentiments of his tweets? In this part we will use two different sentiment analysis models to determine the frequency of positive, negative and neutral tweets.

### Method 1:

We use a simple sentiment analysis model (VADER) to classify each tweet as positive, negative, or neutral, and then compare the counts, this methodological inspiration is from ChatGPT.

In [18]:

```
#import nltk
from vaderSentiment.vaderSentiment import SentimentIntensityAnalyzer
sia = SentimentIntensityAnalyzer()
```

In [19]:

```
tweets_q2 = tweets.copy()
tweets_q2["Tweet Text"] = tweets_q2["Tweet Text"].fillna("").astype(str)

tweets_q2["sentiment_score"] = tweets_q2["Tweet Text"].apply(
    lambda t: sia.polarity_scores(t)["compound"]
)

def score_to_label(score, pos_threshold=0.05, neg_threshold=-0.05):
    if score >= pos_threshold:
        return "positive"
    elif score <= neg_threshold:
        return "negative"
    else:
        return "neutral"

tweets_q2["sentiment_label"] = tweets_q2["sentiment_score"].apply(score_to_label)

tweets_q2[["Tweet Text", "sentiment_score", "sentiment_label"]].head(10)
```

Out[19]:

Date & Time	Tweet Text	sentiment_score	sentiment_label
<b>Date &amp; Time</b>			
2017-01-20 06:31:00	"It all begins today! I will see you at 11:00 ...	0.0000	neutral
2017-01-20 11:51:00	"Today we are not merely transferring power fr...	0.2144	positive
2017-01-20 11:51:00	"power from Washington, D.C. and giving it bac...	0.3400	positive
2017-01-20 11:52:00	"What truly matters is not which party control...	0.0954	positive
2017-01-20 11:53:00	"January 20th 2017, will be remembered as the ...	0.0000	neutral
2017-01-20 11:54:00	"The forgotten men and women of our country wi...	-0.6124	negative
2017-01-20 11:54:00	"We will bring back our jobs. We will bring ba...	0.7345	positive
2017-01-20 11:55:00	"We will follow two simple rules: BUY AMERICAN...	0.0000	neutral
2017-01-20 11:58:00	"It is time to remember that... <a href="https://www.fac...">https://www.fac...</a>	0.0000	neutral
2017-01-20 12:00:00	"So to all Americans, in every city near and f...	0.0000	neutral

In [20]:

```
sentiment_counts = (
    tweets_q2
        .groupby("sentiment_label")
        .size()
        .reset_index(name="Count")
        .rename(columns={"sentiment_label": "Sentiment"})
)

sentiment_counts
```

Out[20]:

	Sentiment	Count
0	negative	6838
1	neutral	4404
2	positive	11833

Figure 6: Number of tweets per sentiment (negative, neutral, positive)

Using the VADER sentiment analyzer the tweets were classified as either positive, neutral, or negative. At first, we believed that the tweets were likely more negative than positive, but in fact the tweets were classified as far more positive than negative, almost doubling the negatively classified tweets. The tweets classified as 'neutral' fall almost directly in between the tweets classified as positive and negative. The actual context and literal meaning of the tweets was not analyzed, nor the accuracy of the classification at this point, so there is certainly going to be a margin of error and some 'false positives' etc as the positivity is quite often a self directed compliment of sorts.

```
In [21]: sentiment_chart = (
    alt.Chart(sentiment_counts)
    .mark_bar()
    .encode(
        x=alt.X("Sentiment:N", sort=["positive", "neutral", "negative"]),
        y=alt.Y("Count:Q"),
        tooltip=["Sentiment", "Count"]
    )
    .properties(
        title="Number of Positive, Neutral, and Negative Tweets"
    )
)

sentiment_chart
```

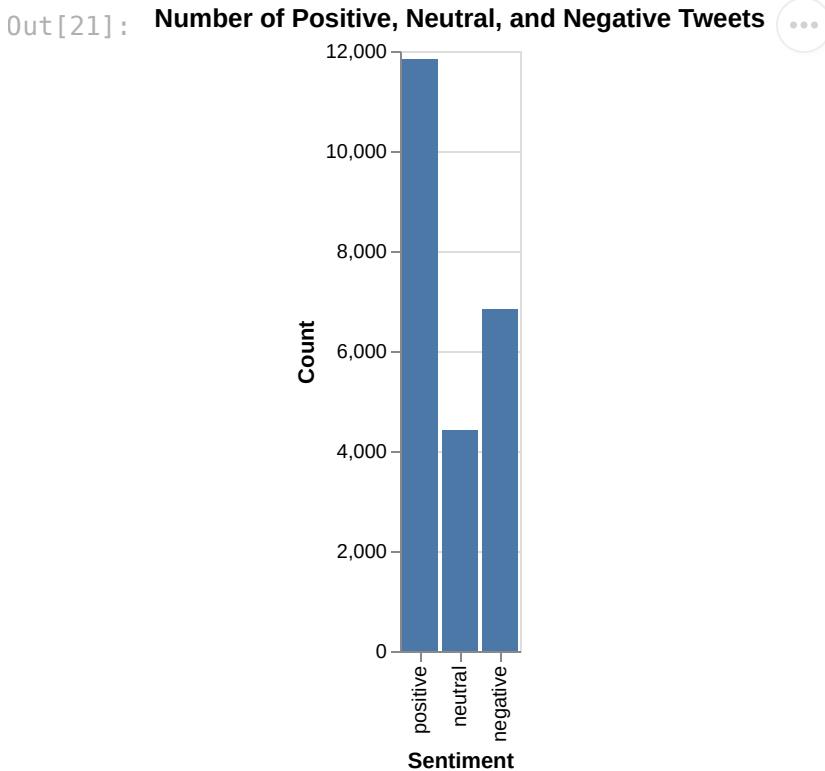


Figure 7: Chart Comparing the Number of Positive, Neutral, and Negative Tweets

### Method 2:

Using a CountVectorizer and Logistic Regression, combining with a Wordcloud

visualization to determine the most frequent words in the positive and negative tweets. Syntax and bug fixing credited to ChatGPT 5.1

```
In [22]: import re
from collections import Counter
from wordcloud import WordCloud
import matplotlib.pyplot as plt
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split

positive_words = set("""good great amazing fantastic tremendous strong win w
happy proud respect love best positive incredible honored grateful huge strc

negative_words = set("""bad terrible horrible weak fail failure disaster sac
worst negative unfair hate disgrace stupid dishonest democrat biden obama de

stopwords = set("""the a an and of to in is it this that for on with be as b
you your my our their they we i he she his her him them rt s all t just now

# -----
# 1. Helper functions
# -----


def simple_tokenize(text: str):
    """Lowercase everything, remove URLs and non letters, then split."""
    text = text.lower()
    text = re.sub(r"http\S+", "", text)           # remove URLs
    text = re.sub(r"[^a-zA-Z\s]", " ", text)       # keep letters and spaces
    return text.split()

def weak_label(text: str):
    """Use positive and negative lexicons to create weak labels for training
    if not isinstance(text, str):
        return None
    tokens = simple_tokenize(text)
    pos_hits = sum(1 for w in tokens if w in positive_words)
    neg_hits = sum(1 for w in tokens if w in negative_words)
    if pos_hits > neg_hits:
        return "positive"
    elif neg_hits > pos_hits:
        return "negative"
    else:
        return None # ambiguous, skip from training

# -----
# 2. Create weak labels for a subset of tweets
# -----


tweets["weak_label"] = tweets["Tweet Text"].apply(weak_label)
train_df = tweets.dropna(subset=["weak_label"]).copy()

print("Number of weak labeled tweets:", len(train_df))
print(train_df["weak_label"].value_counts())
```

```

# -----
# 3. Train a simple ML model using CountVectorizer
# -----


X_train, X_test, y_train, y_test = train_test_split(
    train_df["Tweet Text"],
    train_df["weak_label"],
    test_size=0.2,
    random_state=42,
    stratify=train_df["weak_label"]
)

vectorizer = CountVectorizer(stop_words=list(stopwords), min_df=3)
X_train_vec = vectorizer.fit_transform(X_train.fillna(""))
X_test_vec = vectorizer.transform(X_test.fillna(""))

clf = LogisticRegression(max_iter=2000)
clf.fit(X_train_vec, y_train)

print("Validation accuracy (weak labels):", clf.score(X_test_vec, y_test))

# -----
# 4. Predict sentiment for all tweets (positive vs negative)
# -----


all_X = vectorizer.transform(tweets["Tweet Text"].fillna(""))
tweets["Sentiment"] = clf.predict(all_X)

print(tweets["Sentiment"].value_counts())


# -----
# 5. Answer the question "What are the most frequent words in the positive and negative tweets"
# -----


pos_text = " ".join(tweets[tweets["Sentiment"] == "positive"]["Tweet Text"])
neg_text = " ".join(tweets[tweets["Sentiment"] == "negative"]["Tweet Text"])

pos_tokens = [w for w in simple_tokenize(pos_text) if w not in stopwords]
neg_tokens = [w for w in simple_tokenize(neg_text) if w not in stopwords]

top_pos = Counter(pos_tokens).most_common(20)
top_neg = Counter(neg_tokens).most_common(20)

top_pos_df = pd.DataFrame(top_pos, columns=["word", "count"])
top_neg_df = pd.DataFrame(top_neg, columns=["word", "count"])

print("\nMost frequent words in positive tweets:")
print(top_pos_df)

print("\nMost frequent words in negative tweets:")
print(top_neg_df)

# -----
# 6. Wordcloud
# -----

```

```
pos_wc = WordCloud(  
    width=900,  
    height=500,  
    background_color="white"  
) .generate(" ".join(pos_tokens))  
  
plt.figure(figsize=(10, 5))  
plt.imshow(pos_wc, interpolation="bilinear")  
plt.axis("off")  
plt.title("Positive Tweets Word Cloud")  
plt.show()  
  
neg_wc = WordCloud(  
    width=900,  
    height=500,  
    background_color="white"  
) .generate(" ".join(neg_tokens))  
  
plt.figure(figsize=(10, 5))  
plt.imshow(neg_wc, interpolation="bilinear")  
plt.axis("off")  
plt.title("Negative Tweets Word Cloud")  
plt.show()
```

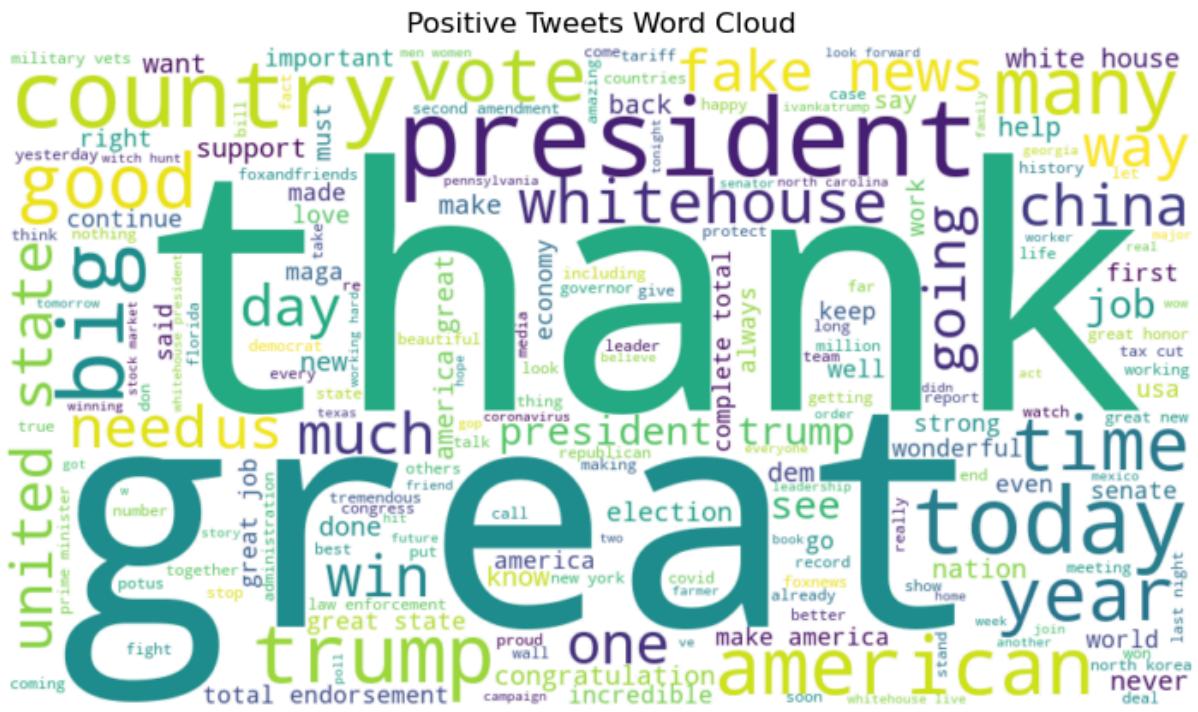
```
Number of weak labeled tweets: 10136
weak_label
positive    6067
negative    4069
Name: count, dtype: int64
Validation accuracy (weak labels): 0.9990138067061144
Sentiment
positive    16013
negative    7062
Name: count, dtype: int64
```

Most frequent words in positive tweets:

	word	count
0	great	3590
1	president	1882
2	thank	1538
3	trump	1398
4	big	1174
5	america	1026
6	today	954
7	country	932
8	new	893
9	no	847
10	news	840
11	american	814
12	get	802
13	out	761
14	good	739
15	whitehouse	723
16	up	723
17	many	693
18	been	677
19	there	641

Most frequent words in negative tweets:

	word	count
0	democrats	1602
1	trump	1084
2	president	1058
3	biden	1011
4	no	993
5	fake	743
6	joe	723
7	news	694
8	would	652
9	out	640
10	up	617
11	never	594
12	been	585
13	than	579
14	media	573
15	there	531
16	obama	529
17	election	524
18	country	519
19	want	518



## Negative Tweets Word Cloud

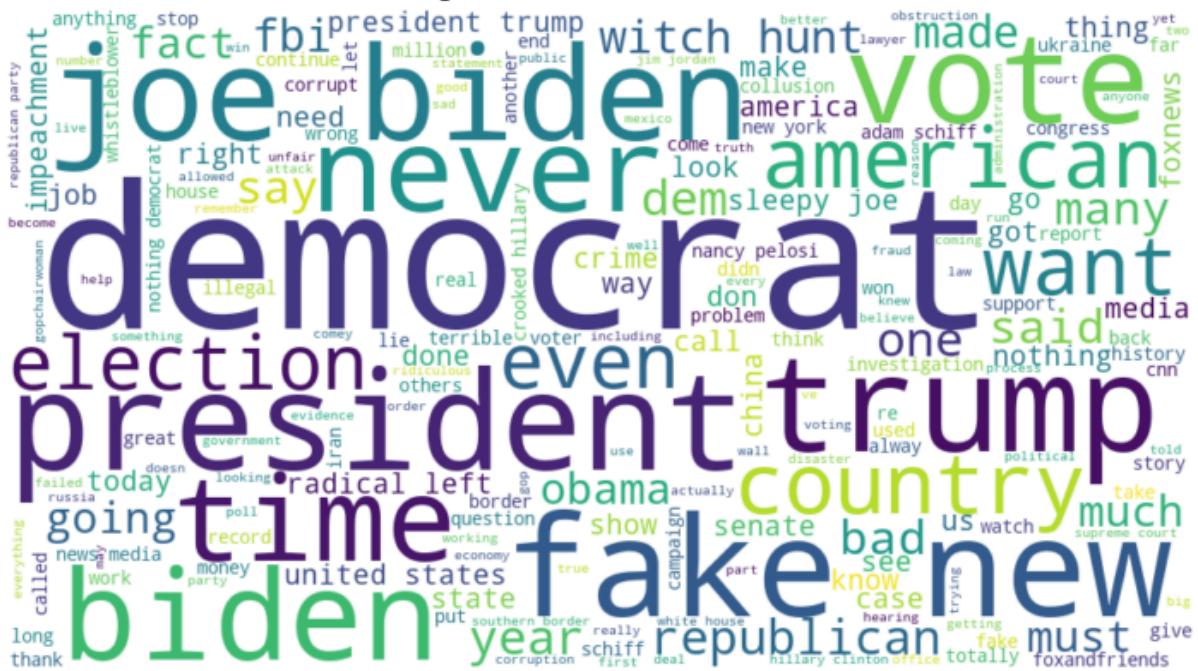


Figure 8a: Table with the number of weak labeled tweets

Figure 8b: Table with the number of tweets per sentiment (positive or negative)

Figure 8c: Table of the most frequent words used in positive tweets

Figure 8d: Word cloud of the positive tweets

Figure 8e: Word cloud of the negative tweets

The second classifier method used to analyze the tweets was utilizing the CountVectorizer() to classify sets as positive words, negative words and some stop words unique to this dataset. The overall positive VS negative tweet counts are skewed

in the opposite direction as the 'neutral' category here is somewhat added to the positively classified category. The results of the most frequent words are not very surprising to anyone who has followed American news at all in the last 10 years with the positive tweets containing words of praise and common phrases used by Trump, as well as his own name. The most frequent words appearing in the negative tweets could also be somewhat assumed as they contain words of the opposing political parties and leaders as well as other common phrases and words that one would hear often in a news report of Trump lashing out over twitter or a speech. A somewhat interesting note is that the word 'Trump' appears frequently in both positive and negative classifications, but could be rationalized by the fact that Trump often speaks about himself in the third person. A great visual indicator of these word frequencies is the word clouds for the respective most frequent positive and negatively classified words.

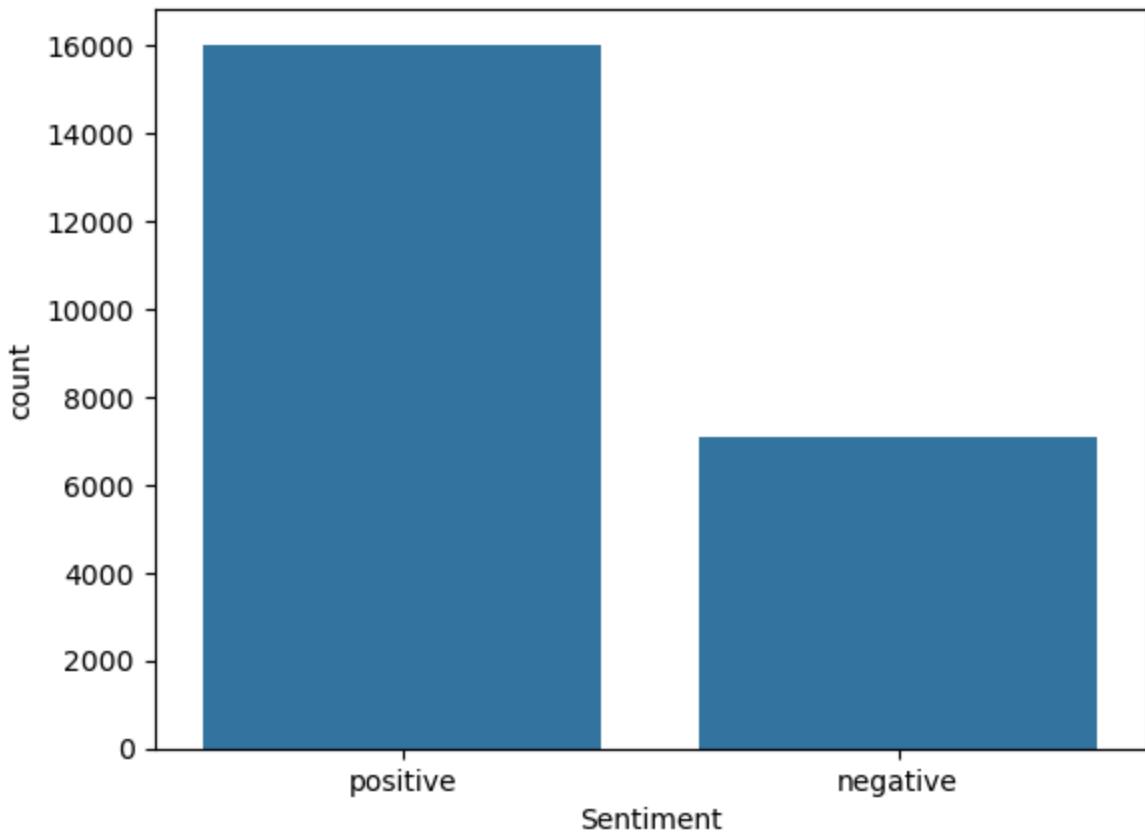
### ~DATA VALIDATION 2: Sentiment Analysis

Target/response variable follows expected distribution validation:

For this question, since the dataset we used did not have a "target" column, we had to try using different methods in order to find the "sentiment" of the tweets (this has been discussed with Instructor Sky Sheng and she gave us the go ahead. As the graphs/values of the check for using CountVectorizer and Logistic Regression below suggest, we do see a skewness towards positive tweets, which can be surprising to many people. This is partly due to neutral tweets are lumped together with positive tweets. However, since this dataset is about Trump's tweets while he was in office, those tweets could be positive because he was the "powerful man" back then.

```
In [23]: # -----
# Data validation related to target
#
# -----
import seaborn as sns
#
# 1. Distribution of Sentiment Graph
#
sns.countplot(data=tweets, x="Sentiment")
plt.title("Distribution of Sentiment Labels")
plt.show()
#
# -----
# 2. Distribution of Sentiment Proportion
#
print(tweets["Sentiment"].value_counts(normalize=True))
#
# -----
# 3. Time-based Distribution of Sentiment Graph
#
tweets.resample("ME")["Sentiment"].value_counts().unstack().plot(kind="bar",
plt.title("Sentiment over time (monthly)")
plt.show()
```

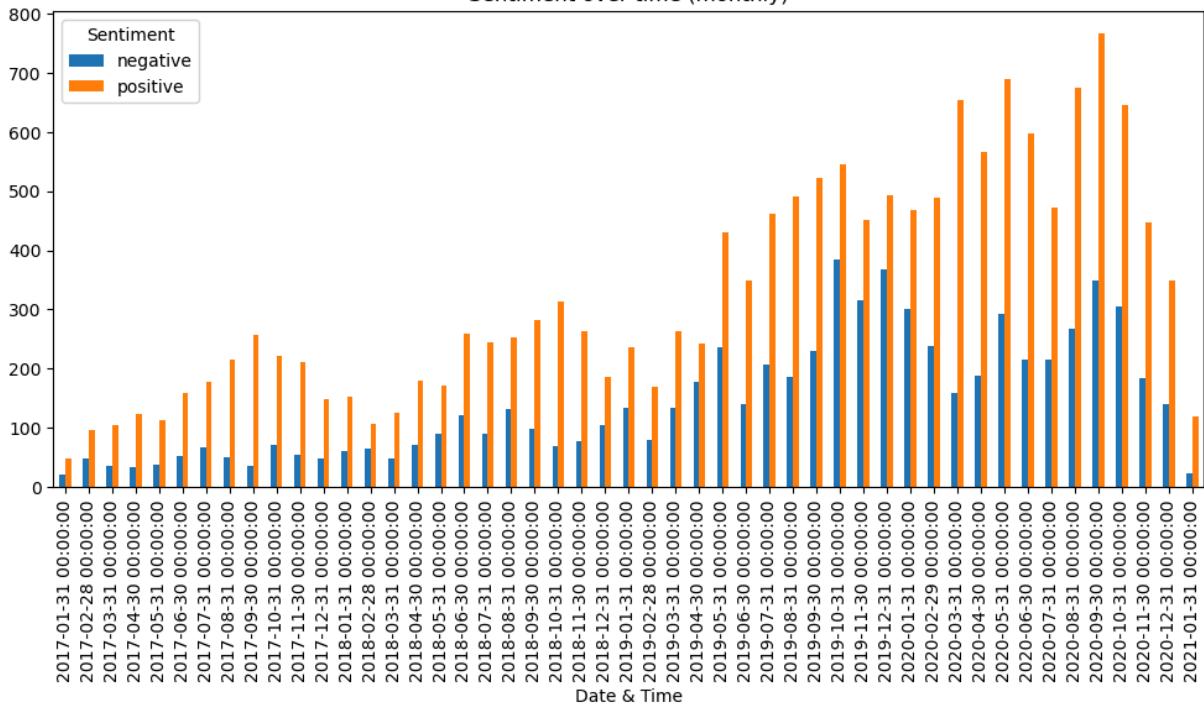
## Distribution of Sentiment Labels



Sentiment

```
positive    0.693954
negative    0.306046
Name: proportion, dtype: float64
```

Sentiment over time (monthly)



In [ ]:

Figure 9a: Graph with the distribution of sentiment labels

Figure 9b: Proportion of sentiment labels values

Figure 9c: Graph with the distribution of sentiment labels over time

### ~ DATA VALIDATION 3: Correlation

#### No anomalous correlations between target/response variable and features/explanatory variables validation:

For this question, again since the dataset we used did not have a "target" column, we tried our best to validate what was done. We can see that negative tweets has a higher mean length compared to positive tweets. However, there is no real correlation between time of day (even though negative tweets seem to appear slightly later in the day) or day of the week. In the wordclouds above, we do not see a clear intersection of words both appearing frequently in positive tweets and negative tweets which shows that our classification is working quite well. Last but not least, the model probability distribution graph shows that the model confidently picked up positive and negative tweets while still showing uncertainty for ambiguous cases, which is expected for a simple classifier trained on weak, lexicon-based labels.

```
In [24]: # -----
# Data validation related to target pt.2
# -----



# -----
# 1. Numeric correlations
# -----
tweets["length"] = tweets["Tweet Text"].str.len()
print(tweets.groupby("Sentiment")["length"].describe())
# -----

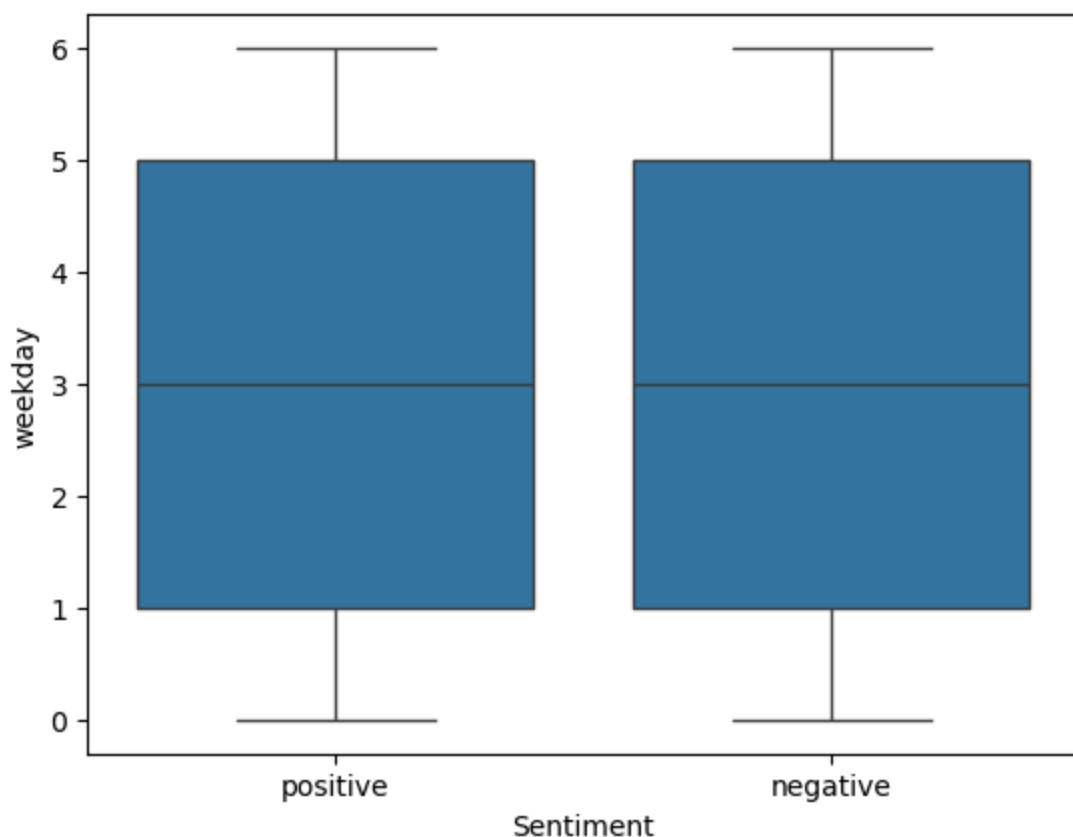
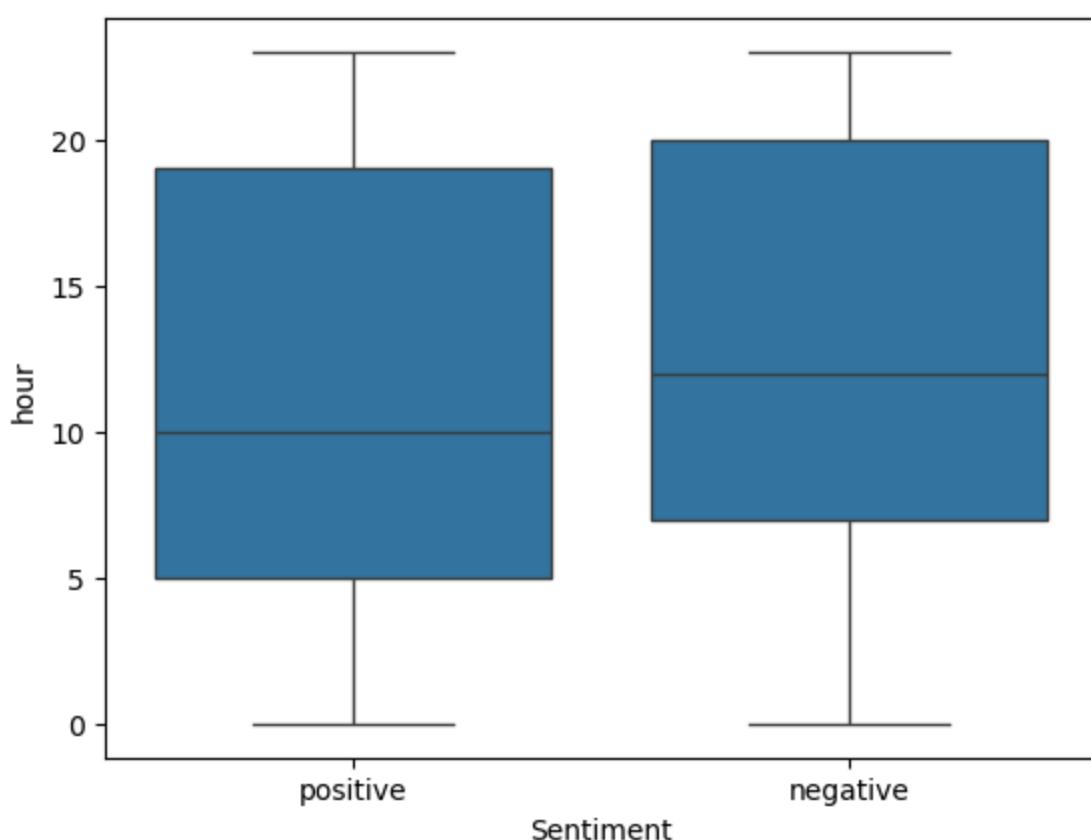


# 2. Categorical correlations (hour of day, weekday)
# -----
tweets["hour"] = tweets.index.hour
tweets["weekday"] = tweets.index.dayofweek
sns.boxplot(data=tweets, x="Sentiment", y="hour")
plt.show()
sns.boxplot(data=tweets, x="Sentiment", y="weekday")
plt.show()
# -----



# 3. Model probability checks
# -----
probs = clf.predict_proba(vectorizer.transform(tweets["Tweet Text"]))
tweets["pos_prob"] = probs[:, 1]
sns.histplot(tweets["pos_prob"])
plt.title("Prediction Probability Distribution")
plt.show()
```

Sentiment	count	mean	std	min	25%	50%	75%	max
negative	7062.0	216.426366	73.957397	16.0	147.0	237.0	281.0	365.0
positive	16013.0	157.345157	91.493712	6.0	77.0	142.0	247.0	433.0



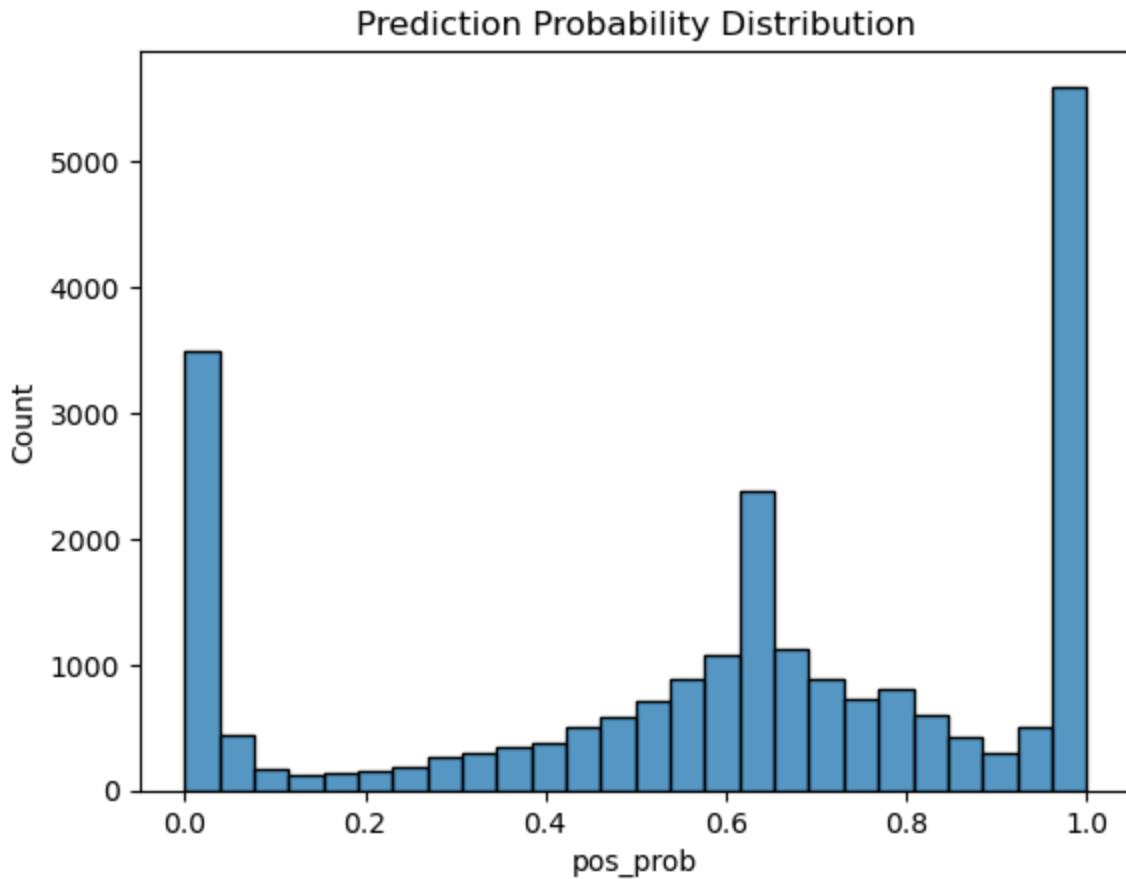


Figure 10a: Tweet length stats according to sentiments

Figure 10b: Distribution graphs for time of day and day of the week related to sentiments

Figure 10c: Model prediction probability distribution graph

## Correct category levels

### Checking for string mismatches

```
In [26]: # Using pandera
import pandera.pandas as pa
from deepchecks.tabular.checks import StringMismatch

schema = pa.DataFrameSchema(
    {
        "Sentiment": pa.Column(str,
                               pa.Check.isin(["positive", "negative"], error=""),
        "weak_label": pa.Column(str, pa.Check.isin(["positive", "negative"],
    }

)
schema.validate(tweets, lazy=True)
```

Out[26]:

Tweet Text weak\_label Sentiment length hour weekday pc

Date & Time	Tweet Text	weak_label	Sentiment	length	hour	weekday	pc
2017-01-20 06:31:00	"It all begins today! I will see you at 11:00 ...	None	positive	114	6	4	0.
2017-01-20 11:51:00	"Today we are not merely transferring power fr...	None	negative	140	11	4	0.
2017-01-20 11:51:00	"power from Washington, D.C. and giving it bac...	None	positive	95	11	4	0.
2017-01-20 11:52:00	"What truly matters is not which party control...	None	negative	120	11	4	0.
2017-01-20 11:53:00	"January 20th 2017, will be remembered as the ...	None	positive	101	11	4	0.
...	...	...	...	...	...	...	...
2021-01-07 04:13:00	"I am asking for everyone at the U.S. Capitol ...	positive	positive	191	4	3	0.
2021-01-07 05:17:00	"https://t.co/Pm2PKV0Fp3"	None	positive	25	5	3	0.
2021-01-08 08:10:00	"https://t.co/csX07ZVWGe"	None	positive	25	8	4	0.
2021-01-08 22:46:00	"The 75,000,000 great American Patriots who vo...	positive	positive	228	22	4	0.
2021-01-08 23:44:00	"To all of those who have asked, I will not be...	None	positive	90	23	4	0.

23075 rows × 7 columns

In [27]:

```
# Using deepchecks
from deepchecks.tabular import Dataset

dataset = Dataset(tweets.drop('Tweet Text', axis=1), label="Sentiment", cat_f
result = StringMismatch().run(dataset)
result.show()
```

```
/home/uba/miniforge3/envs/522_proj/lib/python3.11/site-packages/deepchecks/tabular/dataset.py:236: UserWarning:
```

```
Dataframe index has duplicate indexes, setting index to [0,1...,n-1].
```

```
VBox(children=(HTML(value='<h4><b>String Mismatch</b></h4>'), HTML(value='<p>Detect different variants of stri...'))
```

## Checking for single values

```
In [28]: from deepchecks.tabular.checks import IsSingleValue
sv = IsSingleValue()
sv.run(dataset)
```

```
VBox(children=(HTML(value='<h4><b>Single Value in Column</b></h4>'), HTML(value='<p>Check if there are columns...'))
```

## No anomalous correlations between features/explanatory variables

Using the deepchecks package to check the correlation. Since we are using bag of words it makes sense that the correlation between feature and label will be high (which is why we set the threshold to 0.95).

For feature/feature, we can check if the date time has high feature correlation if we turn Date & Time column into categorical features.

```
In [29]: from deepchecks.tabular import Dataset
from deepchecks.tabular.checks.data_integrity import FeatureFeatureCorrelation
from deepchecks.tabular.checks import FeatureLabelCorrelation

trump_tweet_ds = Dataset(tweets.reset_index().drop(columns='weak_label'), la
```

```
In [31]: # Checking feature label correlation
check_feat_lab_corr = FeatureLabelCorrelation().add_condition_feature_pps_le
check_feat_lab_corr_result = check_feat_lab_corr.run(dataset=trump_tweet_ds)

if not check_feat_lab_corr_result.passed_conditions():
    raise ValueError("Feature-Label correlation exceeds the maximum acceptab

# Checking feature feature correlation
check_feat_feat_corr = FeatureFeatureCorrelation().add_condition_max_number_
check_feat_feat_corr_result = check_feat_feat_corr.run(dataset=trump_tweet_c

if not check_feat_feat_corr_result.passed_conditions():
    raise ValueError("Feature-feature correlation exceeds the maximum accept

# ValueError works as expected
```

```
-----  
ValueError                                     Traceback (most recent call last)  
Cell In[31], line 6  
      3     check_feat_lab_corr_result = check_feat_lab_corr.run(dataset=trump_tweet_ds)  
      5     if not check_feat_lab_corr_result.passed_conditions():  
----> 6         raise ValueError("Feature-Label correlation exceeds the maximum  
acceptable threshold.")  
      8 # Checking feature feature correlation  
      9 check_feat_feat_corr = FeatureFeatureCorrelation().add_condition_max  
_number_of_pairs_above_threshold(threshold = 0.8, n_pairs = 0)  
  
ValueError: Feature-Label correlation exceeds the maximum acceptable threshold.
```

```
In [32]: # Creating functions to turn datetime into categorical features  
def season(date):  
    if 4 <= date.month <=6:  
        return 'spring'  
    elif 7 <= date.month <=9:  
        return 'spring'  
    elif 10 <= date.month <=12:  
        return 'autumn'  
    else:  
        return 'winter'  
  
def daytime(date):  
    if pd.Timestamp('08:01').time() <= date.time() <= pd.Timestamp('16:00').time():  
        return 'daytime'  
    elif pd.Timestamp('16:01').time() <= date.time() <= pd.Timestamp('00:00').time():  
        return 'evening'  
    else:  
        return 'overnight'
```

```
In [33]: # Creating functions to turn Tweet Text into categorical features  
def avg_word_length(text):  
    average = 0  
    for word in text.split():  
        average += len(word)  
    return round(average/len(text.split()),1)  
  
def punctuation_count(text):  
    count = 0  
    for char in text:  
        if not char.isalnum() and not char.isspace():  
            count+=1  
    return count
```

```
In [34]: dates_tweets = tweets.reset_index()  
dates_tweets['year']=dates_tweets['Date & Time'].dt.year  
dates_tweets['month']=dates_tweets['Date & Time'].dt.month  
dates_tweets['day']=dates_tweets['Date & Time'].dt.day  
dates_tweets['season']=dates_tweets['Date & Time'].apply(season)  
dates_tweets['time_of_day']=dates_tweets['Date & Time'].apply(daytime)
```

```

dates_tweets['character_count']=dates_tweets['Tweet Text'].apply(len)
dates_tweets['avg_word_length']=dates_tweets['Tweet Text'].apply(avg_word_length)
dates_tweets['word_count']=dates_tweets['Tweet Text'].apply(lambda x:len(x.split()))
dates_tweets['punctuation_count']=dates_tweets['Tweet Text'].apply(punctuation_count)
dates_tweets.drop(columns=['weak_label','Date & Time','Tweet Text'])

```

Out[34]:

	Sentiment	length	hour	weekday	pos_prob	year	month	day	season	time
0	positive	114	6	4	0.695553	2017	1	20	winter	o
1	negative	140	11	4	0.301445	2017	1	20	winter	o
2	positive	95	11	4	0.591566	2017	1	20	winter	o
3	negative	120	11	4	0.429320	2017	1	20	winter	o
4	positive	101	11	4	0.801022	2017	1	20	winter	o
...	...	...	...	...	...	...	...	...	...	...
23070	positive	191	4	3	0.999798	2021	1	7	winter	o
23071	positive	25	5	3	0.643497	2021	1	7	winter	o
23072	positive	25	8	4	0.643497	2021	1	8	winter	o
23073	positive	228	22	4	0.999971	2021	1	8	winter	o
23074	positive	90	23	4	0.623647	2021	1	8	winter	o

23075 rows × 14 columns

In [36]:

```

# Checking feature feature correlation

date_time_ds = Dataset(dates_tweets, label = 'Sentiment', cat_features=['year', 'month', 'day', 'hour', 'weekday'])
check_feat_feat_corr = FeatureFeatureCorrelation().add_condition_max_number_of_features(10)
check_feat_feat_corr_result = check_feat_feat_corr.run(dataset=date_time_ds)

if not check_feat_feat_corr_result.passed_conditions():
    raise ValueError("Feature-feature correlation exceeds the maximum acceptable threshold.")

# ValueError works as expected

```

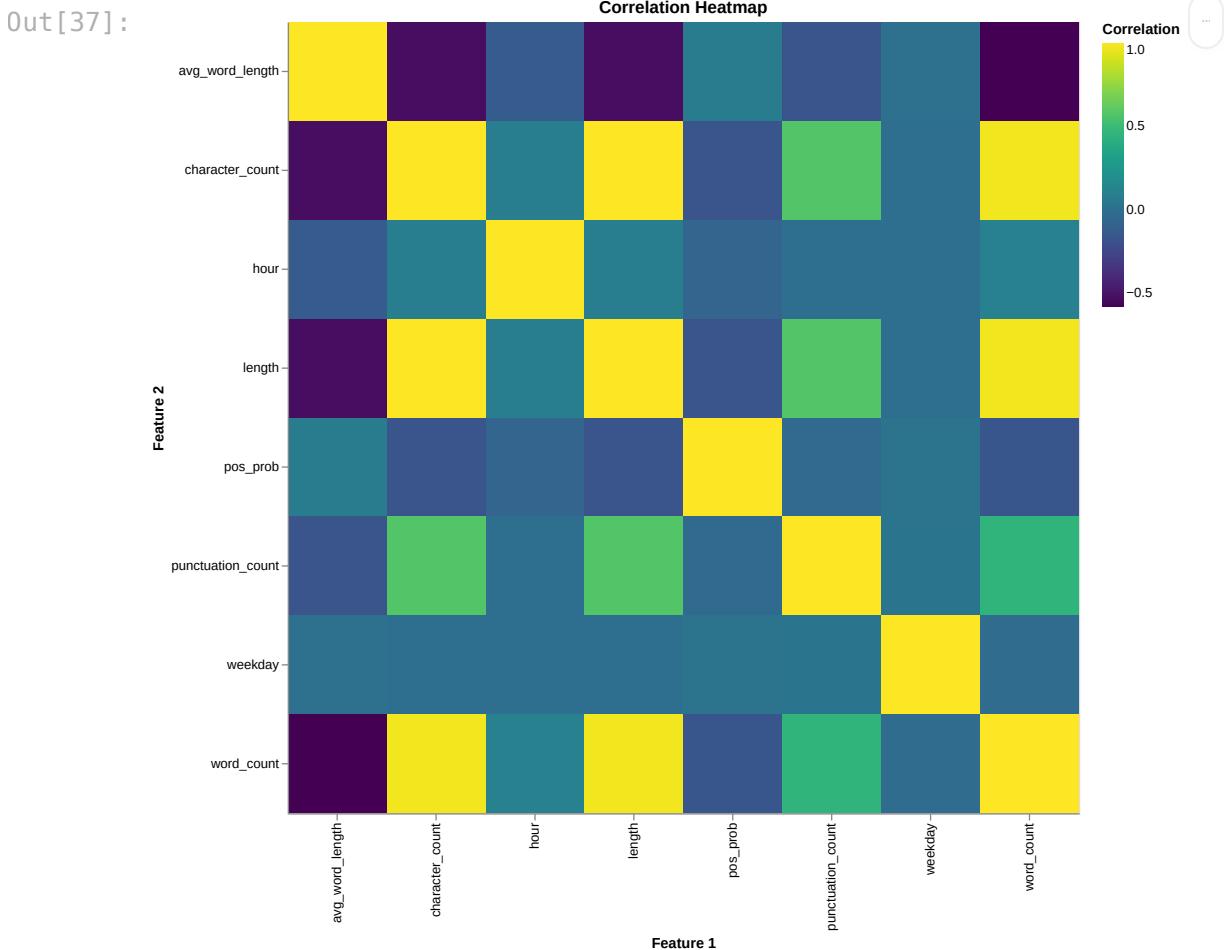
-----

ValueError Traceback (most recent call last)  
Cell In[36], line 8  
 5 check\_feat\_feat\_corr\_result = check\_feat\_feat\_corr.run(dataset=date\_time\_ds)  
 6 7 if not check\_feat\_feat\_corr\_result.passed\_conditions():  
----> 8 8 raise ValueError("Feature-feature correlation exceeds the maximum acceptable threshold.")  
 9 10 # ValueError works as expected

ValueError: Feature-feature correlation exceeds the maximum acceptable threshold.

```
In [37]: correlation_matrix = dates_tweets.drop(columns=['weak_label', 'Date & Time', ''])
correlation_long = correlation_matrix.reset_index().melt(id_vars='index')
correlation_long.columns = ['Feature 1', 'Feature 2', 'Correlation']

alt.Chart(correlation_long).mark_rect().encode(
    x='Feature 1:Q',
    y='Feature 2:Q',
    color=alt.Color('Correlation:Q', scale=alt.Scale(scheme='viridis')),
    tooltip=['Feature 1', 'Feature 2', 'Correlation']
).properties(
    width=600,
    height=600,
    title="Correlation Heatmap"
)
```



## Correct data types in each column

To ensure that our dataset is clean and ready for downstream analysis, we first verify that each column has the correct data type. Since our dataset contains text, sentiment labels, and a timestamp index, incorrect types (such as strings for dates) could break the analysis or produce misleading results. Below, we inspect and correct data types as needed.

```
In [38]: print("Column data types:")
print(tweets.dtypes)

# Check whether datetime exists either as a column OR as index
if isinstance(tweets.index, pd.DatetimeIndex):
    print("\nDatetime index detected – dates are correctly parsed as index.")
else:
    if "Date" in tweets.columns:
        print("\n'Date' column exists – check first few values:")
        print(tweets["Date"].head())
    else:
        print("\nNo datetime information found (neither column nor index).")
```

```
Column data types:
Tweet Text      object
weak_label     object
Sentiment      object
length         int64
hour           int32
weekday        int32
pos_prob       float64
dtype: object
```

```
Datetime index detected – dates are correctly parsed as index.
```

## No duplicates observations

We checked for duplicated rows using DataFrame.duplicated(). The dataset contains no duplicate entries, meaning each tweet represents a unique observation.

```
In [39]: dup_count = tweets.duplicated().sum()
print(f"Number of duplicated rows: {dup_count}")

# If duplicates exist, remove them
if dup_count > 0:
    tweets = tweets.drop_duplicates()
    print("Duplicates removed.")
else:
    print("No duplicate observations found.")
```

```
Number of duplicated rows: 51
Duplicates removed.
```

## No outlier or anomalous values

We examined tweet length distribution using descriptive statistics, a boxplot, and the IQR (1.5×IQR rule). 0 number of extreme values were detected, and they are reasonable for tweet text length (there's 280 characters limits).

```
In [40]: tweets["length"] = tweets["Tweet Text"].str.len()

print("Length descriptive statistics:")
print(tweets["length"].describe())
```

```

# Boxplot to visualize outliers
sns.boxplot(data=tweets, x="length")
plt.title("Outlier Check – Tweet Length")
plt.show()

# Using IQR rule to detect outliers
Q1 = tweets["length"].quantile(0.25)
Q3 = tweets["length"].quantile(0.75)
IQR = Q3 - Q1
lower_bound = Q1 - 1.5 * IQR
upper_bound = Q3 + 1.5 * IQR

outliers = tweets[(tweets["length"] < lower_bound) | (tweets["length"] > upper_bound)]
print(f"Number of detected outliers: {outliers.shape[0]}")

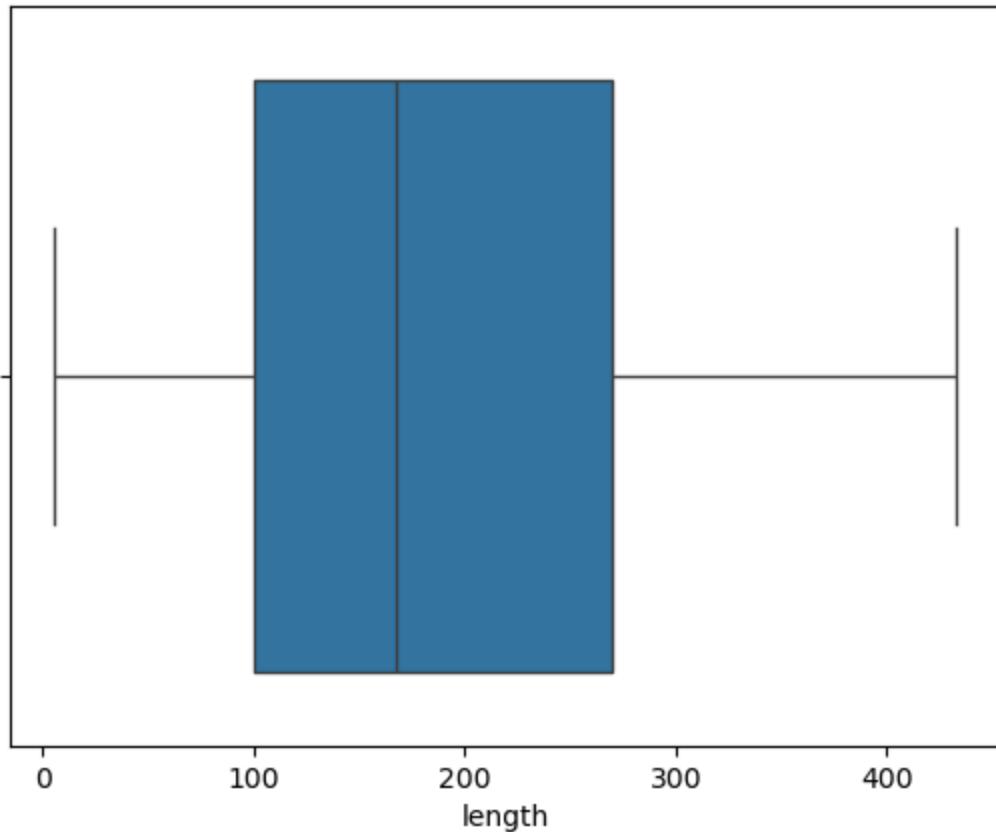
```

Length descriptive statistics:

count	23024.000000
mean	175.489663
std	90.647064
min	6.000000
25%	100.000000
50%	168.000000
75%	270.000000
max	433.000000

Name: length, dtype: float64

Outlier Check — Tweet Length



Number of detected outliers: 0

## Results

Within this report we considered multiple aspects of the tweets. Firstly we determined that Donald Trump's most productive time and season for posting was overnight during the summer. Then we determined that, contrary to what we originally believed, most of his tweets are actually positively connotated. Now, as mentioned above, our sentiment classification methods might not be a faithful representation of the sentiment of the tweets, as the models do not consider intricacies (sarcasm, neutral tweets added to positive class) that can change the sentiment of the message.

## References

Gottfried, J., Park, E., & Nolan, H. (n.d.). Americans' Social Media Use 2025 Growing shares of U.S. adults say they are using Instagram, TikTok, WhatsApp and Reddit, but YouTube still rises to the top FOR MEDIA OR OTHER INQUIRIES. Retrieved November 21, 2025, from [https://www.pewresearch.org/wp-content/uploads/sites/20/2025/11/PI\\_2025.11.20\\_Social-Media-Use\\_REPORT.pdf](https://www.pewresearch.org/wp-content/uploads/sites/20/2025/11/PI_2025.11.20_Social-Media-Use_REPORT.pdf)

McCarthy, N. (2021, January 11). Infographic: End Of The Road For Trump's Twitter Account. Statista Daily Data; Statista. <https://www.statista.com/chart/19561/total-number-of-tweets-from-donald-trump/?srltid=AfmBOorYyvrCIBJxWCwAxW5yYEI6cPXzdh-oMfRfAPfoXrcdpIEA3fy>

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In [ ]: