CCDS 322 Final Project Report

Customer Feedback

Group members:

Dania Abdelmonem 2112241

Shatha Al-Qarni 2111884

Nrdeen Ali 2110419

Salma Mohammed 2110956

Introduction:

Our dataset contains reviews covering various services and products such as movies, food, and websites. These reviews are categorized into positive/negative sentiments.

Research/Our Approach:

To make it easier for decision makers to be informed about customers' opinions by analyzing their responses and developing the product to satisfy the customer. Our data is from Kaggle.

The Models We Used:

We used Support Vector Machine (SVM) & Random Forest to compare the results and analysis

Our Goal Is To Answer The Following Questions:

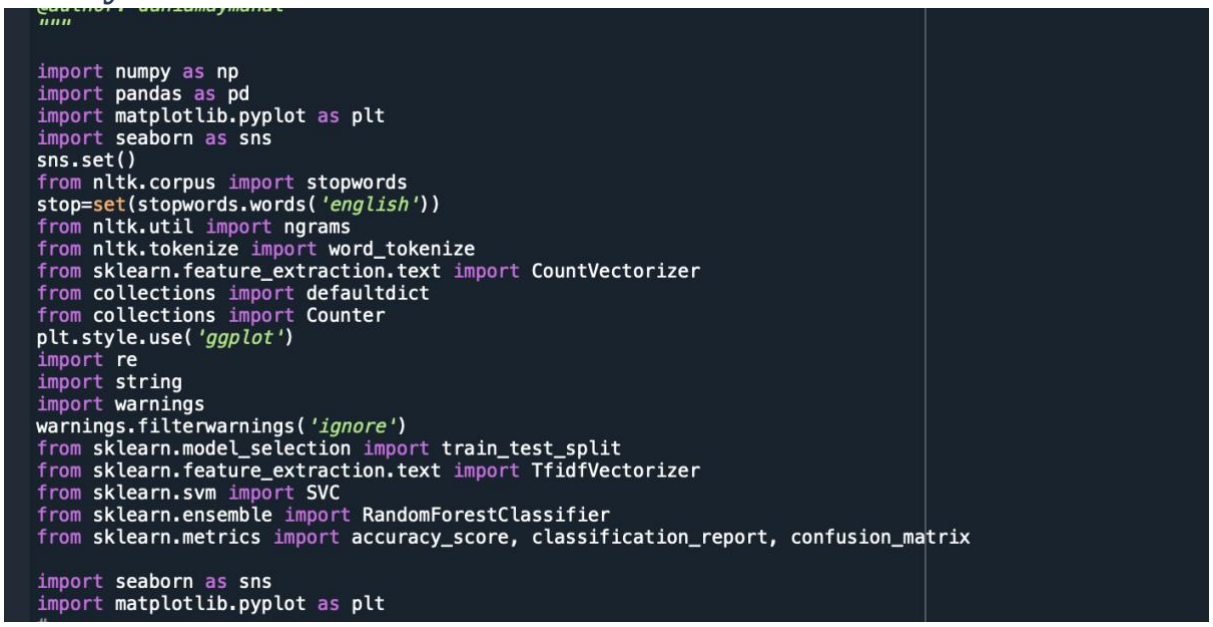
1. **What are the specific words to see if the comment is positive or negative?**

2. Were most comments positive or negative?

3. Is there a comment consisting of a negative/positive part at the same time?

4. Let's say there is a comment that has nothing to do with being positive/negative, how will it be classified?

Analysis and Results: The libraries we used

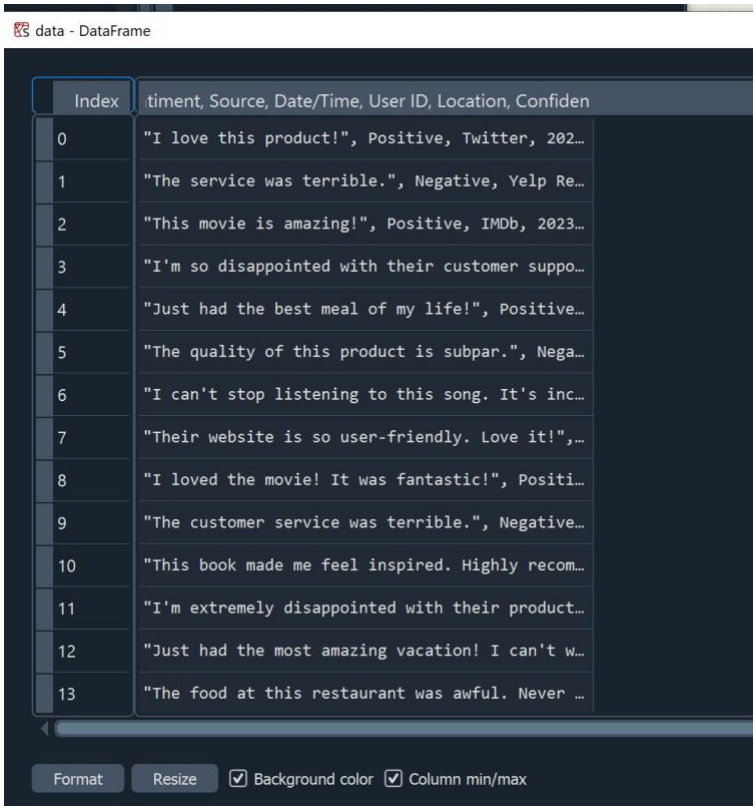


```
"""

import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
sns.set()
from nltk.corpus import stopwords
stop=set(stopwords.words('english'))
from nltk.util import ngrams
from nltk.tokenize import word_tokenize
from sklearn.feature_extraction.text import CountVectorizer
from collections import defaultdict
from collections import Counter
plt.style.use('ggplot')
import re
import string
import warnings
warnings.filterwarnings('ignore')
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.svm import SVC
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score, classification_report, confusion_matrix

import seaborn as sns
import matplotlib.pyplot as plt
```

Data Pre-processing:

This is what our data looks like at first.

```
data=pd.read_csv('sentiment-analysis.csv')
data.head()
```



We then divided the data, putting each in a colomn:

```
#
#loading the data set
data=pd.read_csv('sentiment-analysis.csv')
data.head()
#separating the data into columns
data = data['Text, Sentiment, Source, Date/Time, User ID, Location, Confidence Score'].str.split(', ', expand=True)
data.columns = ['Text', 'Sentiment', 'Source', 'Date/Time', 'User ID', 'Location', 'Confidence Score']
print('There are {} rows and {} columns in data.'.format(data.shape[0], data.shape[1]))

data.head(10)
```

data - DataFrame

Index	Text	Sentiment	Source	Date/Time	User ID	Location	fidence S
0	"I love this product!"	Positive	Twitter	2023-06-15 09:23:14	@user123	New York	0.85
1	"The service was terrible."	Negative	Yelp Reviews	2023-06-15 11:45:32	user456	Los Angeles	0.65
2	"This movie is amazing!"	Positive	IMDb	2023-06-15 14:10:22	moviefan789	London	0.92
3	"I'm so disappointed with their customer suppo…	Negative	Online Forum	2023-06-15 17:35:11	forumuser1	Toronto	0.78
4	"Just had the best meal of my life!"	Positive	TripAdvisor	2023-06-16 08:50:59	foodie22	Paris	0.88
5	"The quality of this product is subpar."	Negative	Amazon Reviews	2023-06-16 10:15:27	shopper123	San Francisco	0.72
6	"I can't stop listening to this song. It's inc…	Positive	Spotify	2023-06-16 13:40:18	musiclover456	Berlin	0.91
7	"Their website is so user-friendly. Love it!"	Positive	Website Testimonial	2023-06-16 16:05:36	testimonialuser1	Sydney	0.87
8	"I loved the movie! It was fantastic!"	Positive	IMDb	2023-07-02 09:12:34	user123	New York	0.92
9	"The customer service was terrible."	Negative	Yelp Reviews	2023-07-02 10:45:21	user456	Los Angeles	0.65
10	"This book made me feel inspired. Highly recom…	Positive	Goodreads	2023-07-02 12:34:56	bookworm789	London	0.88
11	"I'm extremely disappointed with their product…	Negative	Online Store	2023-07-02 15:21:43	shopper789	San Francisco	0.72
12	"Just had the most amazing vacation! I can't w…	Positive	TripAdvisor	2023-07-02 18:01:23	travelenthusiast1	Sydney	0.93
13	"The food at this restaurant was awful. Never …	Negative	Zomato	2023-07-02 20:45:37	foodlover123	Mumbai	0.55
14	"I can't stop listening to this song. It's my …	Positive	Spotify	2023-07-03 09:17:52	musiclover789	Berlin	0.91
15	"Their website is so confusing and poorly desi…	Negative	Website Review	2023-07-03 11:59:18	user789	Toronto	0.68
16	"I had an incredible experience at the theme p…	Positive	Trip Report	2023-07-03 14:40:05	thrillseeker1	Orlando	0.89
17	"The product arrived damaged. Very disappointe…	Negative	Online Store	2023-07-03 17:25:09	buyer123	Chicago	0.76
18	"The concert was absolutely breathtaking. Best…	Positive	Event Review	2023-07-03 20:15:33	musicfan456	Paris	0.95
19	"I had a terrible experience with their custom…	Negative	Online Chat	2023-07-04 08:32:41	user1234	Sydney	0.61
20	"This movie is a masterpiece! I was blown away…	Positive	IMDb	2023-07-04 14:05:27	cinephile789	Los Angeles	0.93
21	"The customer service at this store is top-not…	Positive	Yelp Reviews	2023-07-04 16:35:19	shopper456	New York	0.82
22	"I'm disappointed with the ending of this book…	Negative	Goodreads	2023-07-04 19:18:53	booklover123	London	0.68
23	"The product I received was damaged. Unaccepta…	Negative	Online Store	2023-07-04 21:52:41	buyer789	San Francisco	0.75
24	"Just had the worst flight experience. Delayed…	Negative	Airline Review	2023-07-05 09:10:15	traveler456	Sydney	0.57
25	"The hotel stay was absolutely amazing! Luxury…	Positive	TripAdvisor	2023-07-05 12:30:08	traveladdict1	Paris	0.95
26	"The food at this restaurant was outstanding. …	Positive	Zomato	2023-07-05 15:45:32	foodie789	Mumbai	0.89
27	"This playlist is my go-to for workouts. Energ…	Positive	Spotify	2023-07-05 18:20:17	gymrat123	Berlin	0.91
28	"I had a frustrating experience navigating thr…	Negative	Website Review	2023-07-05 21:05:44	user987	Toronto	0.67
29	"The roller coaster ride was thrilling! Heart-…	Positive	Theme Park Review	2023-07-06 08:48:39	thrillseeker2	Orlando	0.92
30	"The product I ordered never arrived. Terrible…	Negative	Online Store	2023-07-06 11:25:56	customer123	Chicago	0.64

Then we cleaned our data and separated the date&time:

```
#Data Cleaning
data.isnull().sum()
data.dropna(inplace=True)
data.head(10)

#there are some leading and trailing spaces in 'Date/Time' column, so let's trim them
data['Date/Time'] = data['Date/Time'].str.strip()

data[['Date', 'Time']] = data['Date/Time'].str.split(' ', expand=True)

data.drop(columns=['Date/Time'], inplace=True)
data['Date'] = pd.to_datetime(data['Date'])
data['Time'] = pd.to_datetime(data['Time'], format='%H:%M:%S').dt.time
```

data - DataFrame

Index	Text	Sentiment	Source	User ID	Location	fidence S	Date	Time
0	"I love this product!"	Positive	Twitter	@user123	New York	0.85	2023-06-15 00:00:00	09:23:14
1	"The service was terrible."	Negative	Yelp Reviews	user456	Los Angeles	0.65	2023-06-15 00:00:00	11:45:32
2	"This movie is amazing!"	Positive	IMDb	moviefan789	London	0.92	2023-06-15 00:00:00	14:10:22
3	"I'm so disappointed with their customer suppo…	Negative	Online Forum	forumuser1	Toronto	0.78	2023-06-15 00:00:00	17:35:11
4	"Just had the best meal of my life!"	Positive	TripAdvisor	foodie22	Paris	0.88	2023-06-16 00:00:00	08:50:59
5	"The quality of this product is subpar."	Negative	Amazon Reviews	shopper123	San Francisco	0.72	2023-06-16 00:00:00	10:15:27
6	"I can't stop listening to this song. It's inc…	Positive	Spotify	musiclover456	Berlin	0.91	2023-06-16 00:00:00	13:40:18
7	"Their website is so user-friendly. Love it!"	Positive	Website Testimonial	testimonialuser1	Sydney	0.87	2023-06-16 00:00:00	16:05:36
8	"I loved the movie! It was fantastic!"	Positive	IMDb	user123	New York	0.92	2023-07-02 00:00:00	09:12:34
9	"The customer service was terrible."	Negative	Yelp Reviews	user456	Los Angeles	0.65	2023-07-02 00:00:00	10:45:21
10	"This book made me feel inspired. Highly recom…	Positive	Goodreads	bookworm789	London	0.88	2023-07-02 00:00:00	12:34:56
11	"I'm extremely disappointed with their product…	Negative	Online Store	shopper789	San Francisco	0.72	2023-07-02 00:00:00	15:21:43
12	"Just had the most amazing vacation! I can't w…	Positive	TripAdvisor	travelenthusiast1	Sydney	0.93	2023-07-02 00:00:00	18:01:23
13	"The food at this restaurant was awful. Never …	Negative	Zomato	foodlover123	Mumbai	0.55	2023-07-02 00:00:00	20:45:37
14	"I can't stop listening to this song. It's my …	Positive	Spotify	musiclover789	Berlin	0.91	2023-07-03 00:00:00	09:17:52
15	"Their website is so confusing and poorly desi…	Negative	Website Review	user789	Toronto	0.68	2023-07-03 00:00:00	11:59:18
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18	"The concert was absolutely breathtaking. Best…	Positive	Event Review	musicfan456	Paris	0.95	2023-07-03 00:00:00	20:15:33
19	"I had a terrible experience with their custom…	Negative	Online Chat	user1234	Sydney	0.61	2023-07-04 00:00:00	08:32:41
20	"This movie is a masterpiece! I was blown away…	Positive	IMDb	cinephile789	Los Angeles	0.93	2023-07-04 00:00:00	14:05:27
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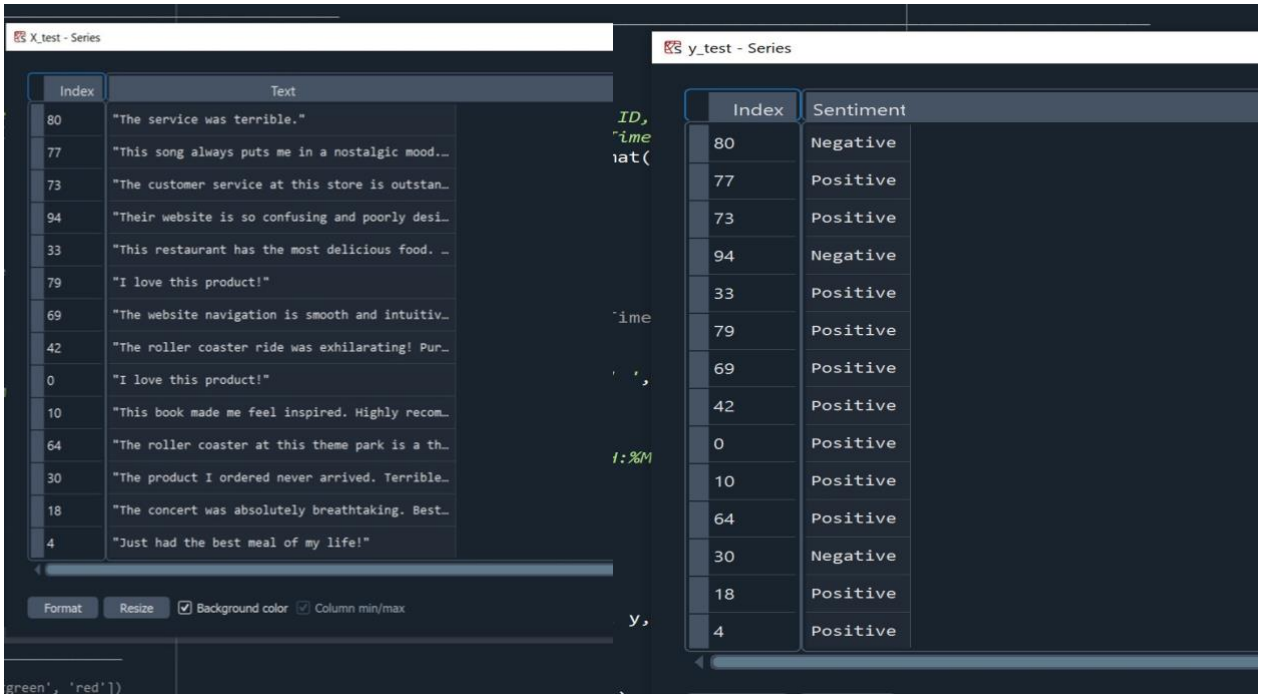
23	"The product I received was damaged. Unaccepta…	Negative	Online Store	buyer789	San Francisco	0.75	2023-07-04 00:00:00	21:52:41
24	"Just had the worst flight experience. Delayed…	Negative	Airline Review	traveler456	Sydney	0.57	2023-07-05 00:00:00	09:10:15
25	"The hotel stay was absolutely amazing! Luxury…	Positive	TripAdvisor	traveladdict1	Paris	0.95	2023-07-05 00:00:00	12:30:08

We then distributed the data, comparing the positive and negative opinions:

```
#Data Distribution
sns.countplot(x='Sentiment', data=data, palette= ['lightgreen', 'red'])
plt.xlabel('Sentiment')
plt.ylabel('Count')
plt.title('Count of Positive and Negative Reviews')
plt.show()
data['Sentiment'] = data['Sentiment'].str.strip()
data['Sentiment'] = data['Sentiment'].str.lower()
fig, axes = plt.subplots(2, 2, figsize=(12, 8))
```

We used 20% of the data randomly as a test set:

```
# Preparing the data
X = data['Text']
y = data['Sentiment']

# Splitting the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Feature extraction using TF-IDF vectorizer
tfidf_vectorizer = TfidfVectorizer(max_features=5000)
X_train_tfidf = tfidf_vectorizer.fit_transform(X_train)
X_test_tfidf = tfidf_vectorizer.transform(X_test)
```



Our SVM Model (kernel is linear):

```
# Support Vector Machine (SVM)
svm_classifier = SVC(kernel='linear', C=1)
svm_classifier.fit(X_train_tfidf, y_train)

# Predictions
svm_predictions = svm_classifier.predict(X_test_tfidf)

# Evaluating SVM
svm_accuracy = accuracy_score(y_test, svm_predictions)
print("SVM Accuracy:", svm_accuracy)
print("\nClassification Report for SVM:\n", classification_report(y_test, svm_predictions))
print("Confusion Matrix for SVM:\n", confusion_matrix(y_test, svm_predictions))
```

```
There are 98 rows and 7 columns in data.
SVM Accuracy: 0.9

Classification Report for SVM:
              precision    recall  f1-score   support

    Negative       0.71      1.00      0.83         5
    Positive       1.00      0.87      0.93        15

    accuracy                           0.90        20
   macro avg       0.86      0.93      0.88        20
weighted avg       0.93      0.90      0.90        20

Confusion Matrix for SVM:
 [[ 5  0]
 [ 2 13]]
```

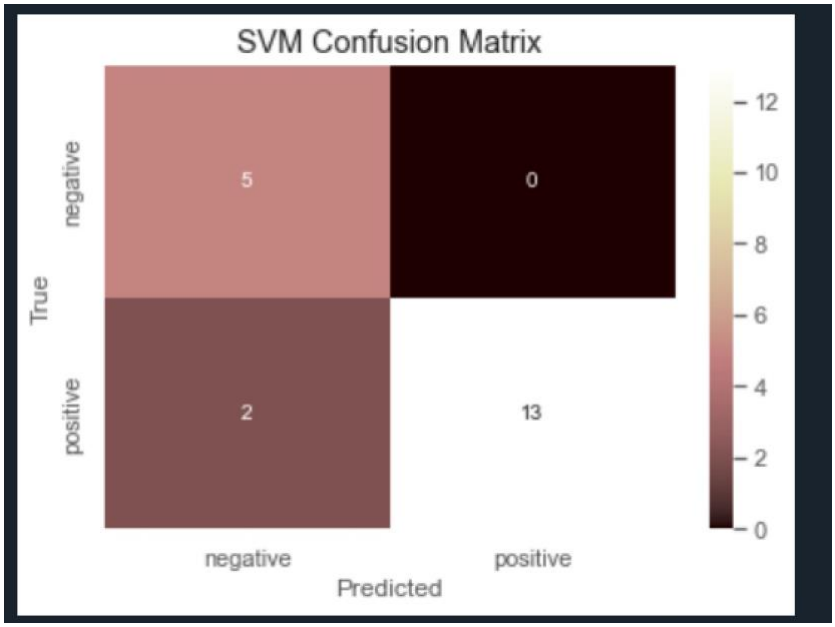
Our Random Forest Model (determined the n_estimators to be 100):

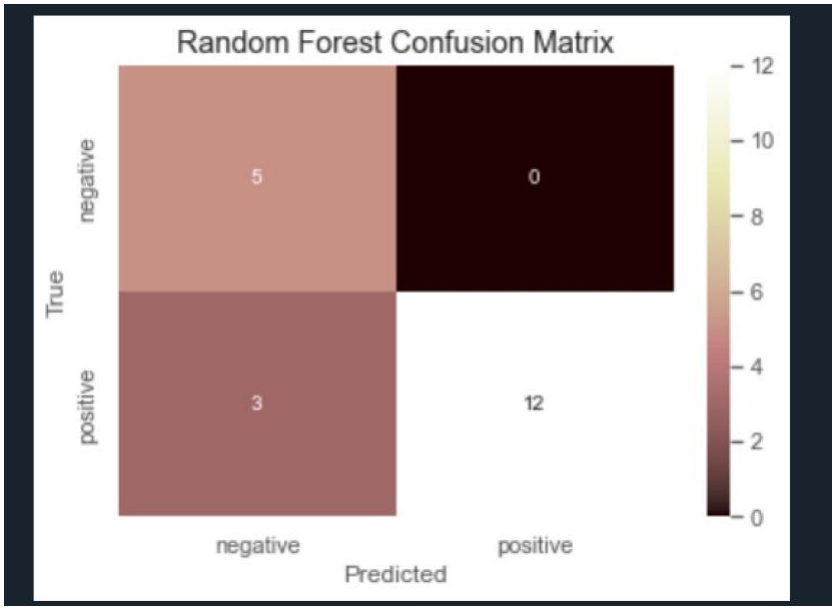
```
# Random Forest
rf_classifier = RandomForestClassifier(n_estimators=100, random_state=42)
rf_classifier.fit(X_train_tfidf, y_train)

# Predictions
rf_predictions = rf_classifier.predict(X_test_tfidf)

# Evaluating Random Forest
rf_accuracy = accuracy_score(y_test, rf_predictions)
print("\nRandom Forest Accuracy:", rf_accuracy)
print("\nClassification Report for Random Forest:\n", classification_report(y_test, rf_predictions))
print("Confusion Matrix for Random Forest:\n", confusion_matrix(y_test, rf_predictions))
```

```
Random Forest Accuracy: 0.85

Classification Report for Random Forest:
              precision    recall  f1-score   support

    Negative       0.62      1.00      0.77         5
    Positive       1.00      0.80      0.89        15

    accuracy                           0.85        20
   macro avg       0.81      0.90      0.83        20
weighted avg       0.91      0.85      0.86        20

Confusion Matrix for Random Forest:
 [[ 5  0]
 [ 3 12]]
```

Confusion Matrix, Correlation Heatmap:

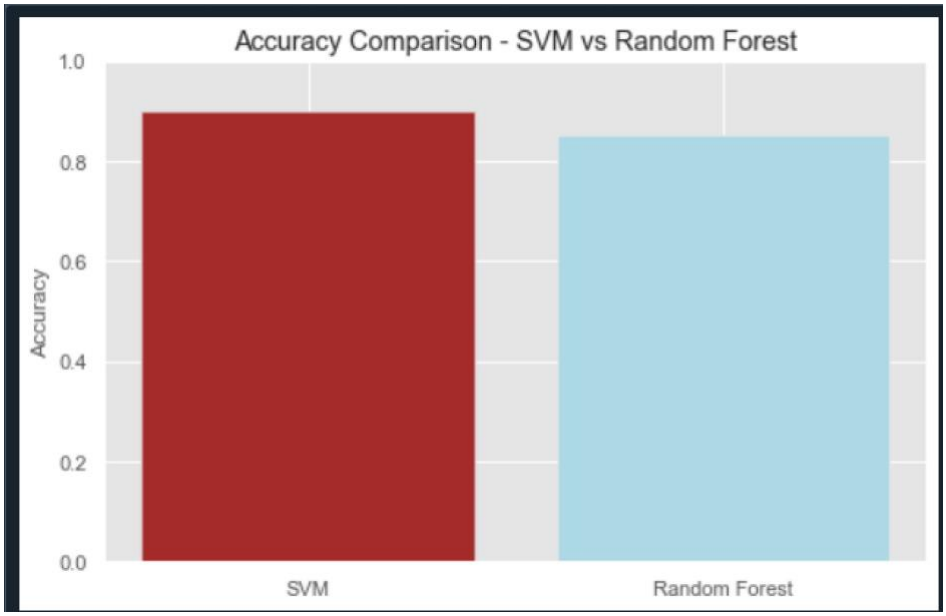
```
# Function to plot confusion matrix
def plot_confusion_matrix(y_true, y_pred, title, labels):
    cm = confusion_matrix(y_true, y_pred)
    plt.figure(figsize=(6, 4))
    sns.heatmap(cm, annot=True, fmt='d', cmap='pink', xticklabels=labels, yticklabels=labels)
    plt.title(title)
    plt.xlabel('Predicted')
    plt.ylabel('True')
    plt.show()

# Plotting Confusion Matrix for SVM
plot_confusion_matrix(y_test, svm_predictions, 'SVM Confusion Matrix', ['negative', 'positive'])

# Plotting Confusion Matrix for Random Forest
plot_confusion_matrix(y_test, rf_predictions, 'Random Forest Confusion Matrix', ['negative', 'positive'])

# Plotting Accuracy Comparison
models = ['SVM', 'Random Forest']
accuracies = [svm_accuracy, rf_accuracy]
```





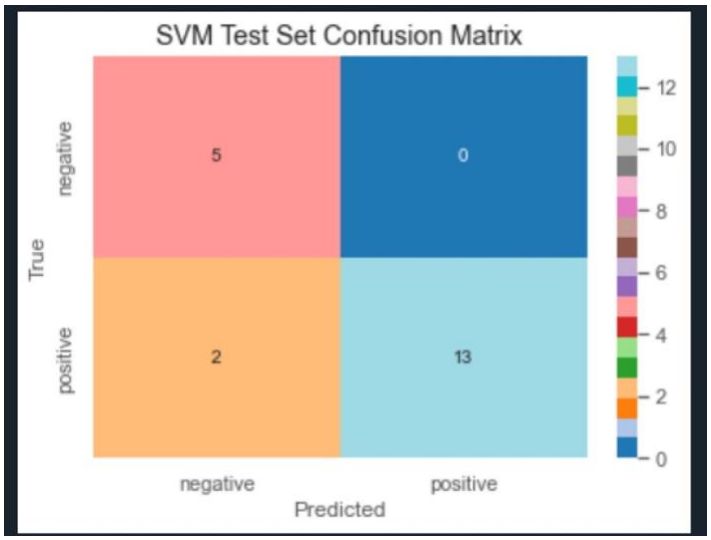
Model Accuracy Comparison:

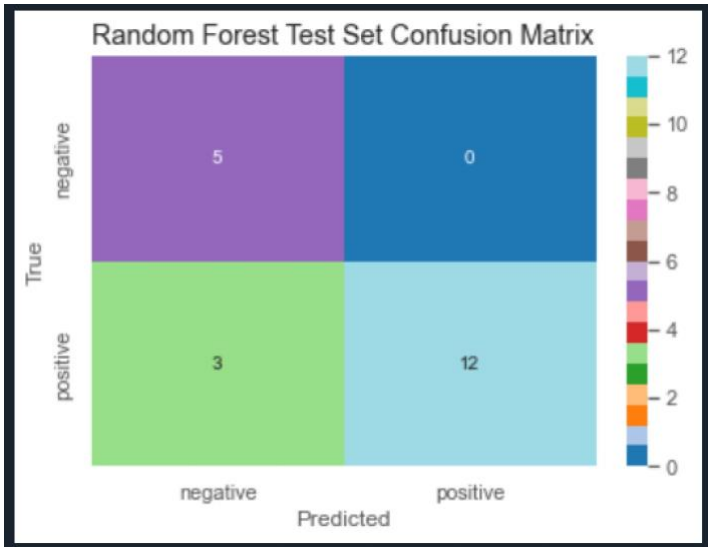
```
# Plotting Accuracy Comparison
models = ['SVM', 'Random Forest']
accuracies = [svm_accuracy, rf_accuracy]

plt.figure(figsize=(8, 5))
plt.bar(models, accuracies, color=['brown', 'lightblue'])
plt.ylabel('Accuracy')
plt.title('Accuracy Comparison - SVM vs Random Forest')
plt.ylim(0, 1)
plt.show()
```

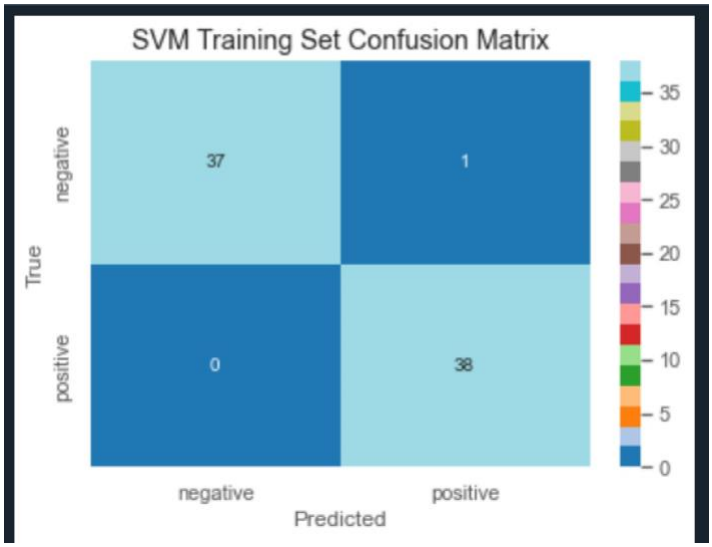


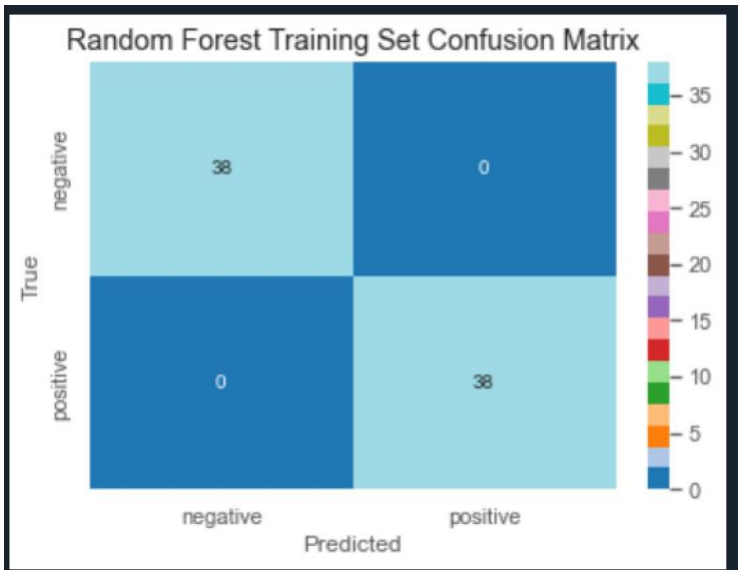
Comparison between Training/Test Set:

```python
# Function to plot confusion matrix
def plot_confusion_matrix(y_true, y_pred, title, labels):
    cm = confusion_matrix(y_true, y_pred)
    plt.figure(figsize=(6, 4))
    sns.heatmap(cm, annot=True, fmt='d', cmap='tab20', xticklabels=labels, yticklabels=labels)
    plt.title(title)
    plt.xlabel('Predicted')
    plt.ylabel('True')
    plt.show()

# Plotting Confusion Matrix for SVM (Test Set)
plot_confusion_matrix(y_test, svm_predictions, 'SVM Test Set Confusion Matrix', ['negative', 'positive'])

# Plotting Confusion Matrix for Random Forest (Test Set)
plot_confusion_matrix(y_test, rf_predictions, 'Random Forest Test Set Confusion Matrix', ['negative', 'positive'])

# Plotting Confusion Matrix for SVM (Training Set)
svm_train_predictions = svm_classifier.predict(X_train_tfidf)
plot_confusion_matrix(y_train, svm_train_predictions, 'SVM Training Set Confusion Matrix', ['negative', 'positive'])

# Plotting Confusion Matrix for Random Forest (Training Set)
rf_train_predictions = rf_classifier.predict(X_train_tfidf)
plot_confusion_matrix(y_train, rf_train_predictions, 'Random Forest Training Set Confusion Matrix', ['negative', 'positive'])

# Plotting Accuracy Comparison
models = ['SVM Test Set', 'Random Forest Test Set', 'SVM Training Set', 'Random Forest Training Set']
accuracies = [accuracy_score(y_test, svm_predictions), accuracy_score(y_test, rf_predictions),
              accuracy_score(y_train, svm_train_predictions), accuracy_score(y_train, rf_train_predictions)]
```

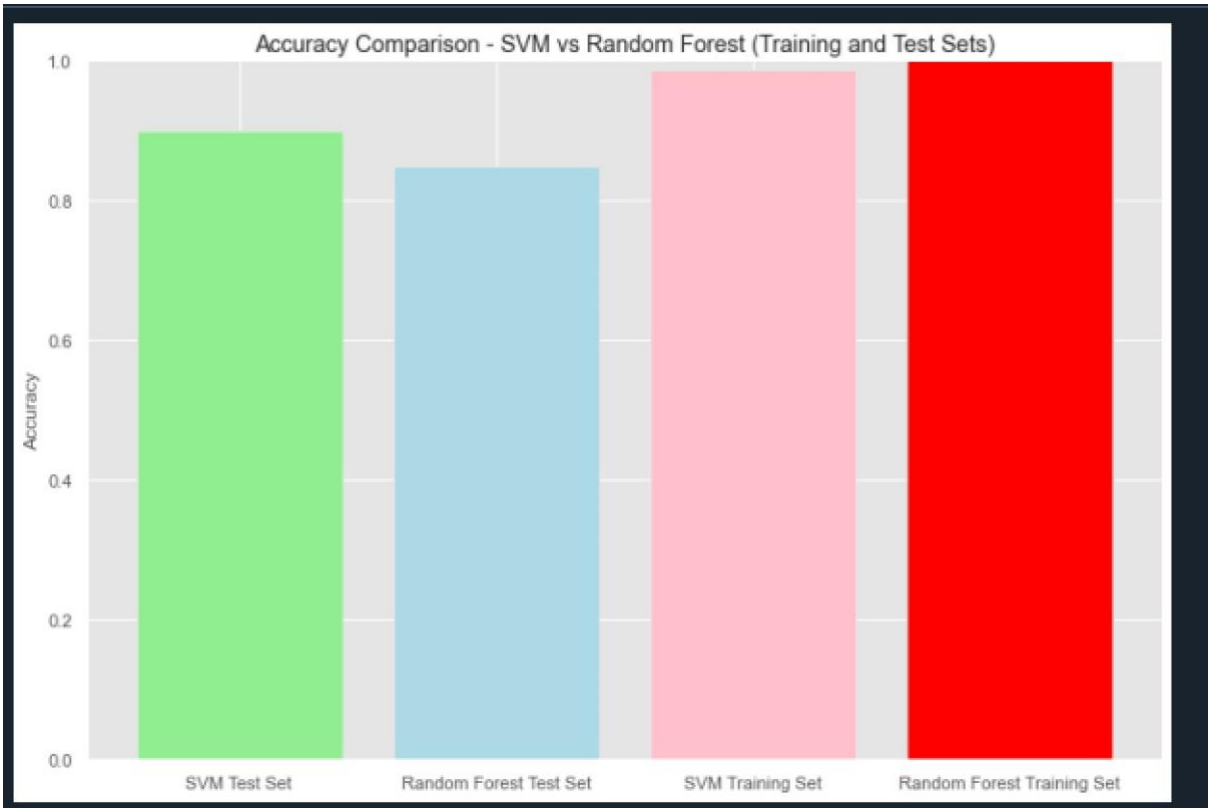



Random Forest Test Set Confusion Matrix
5
0
3
12
negative
positive
True
negative
positive
Predicted
12
10
8
6
4
2
0


SVM Training Set Confusion Matrix
37
1
0
38
negative
positive
True
negative
positive
Predicted
35
30
25
20
15
10
5
0

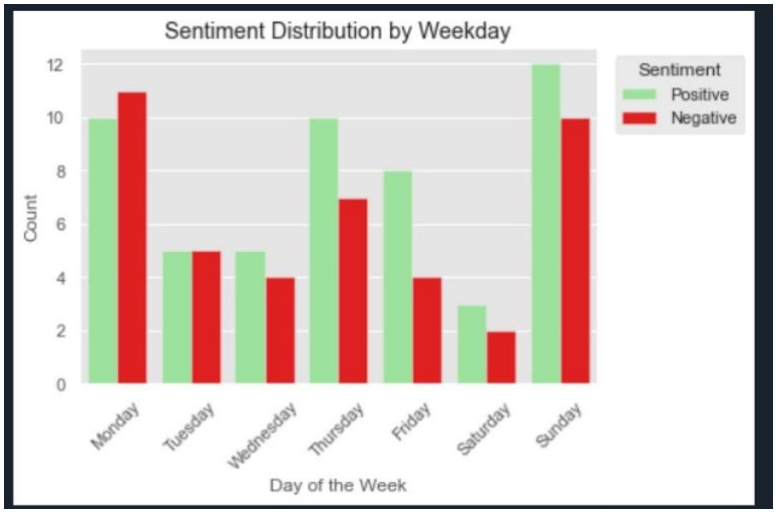

Random Forest Training Set Confusion Matrix
38
0
0
38
negative
positive
True
negative
positive
Predicted
35
30
25
20
15
10
5
0

```
plt.figure(figsize=(12, 8))
plt.bar(models, accuracies, color=['lightgreen', 'lightblue', 'pink', 'red'])
plt.ylabel('Accuracy')
plt.title('Accuracy Comparison - SVM vs Random Forest (Training and Test Sets)')
plt.ylim(0, 1)
plt.show()
```



How many times does each user review? Is it positive or negative?

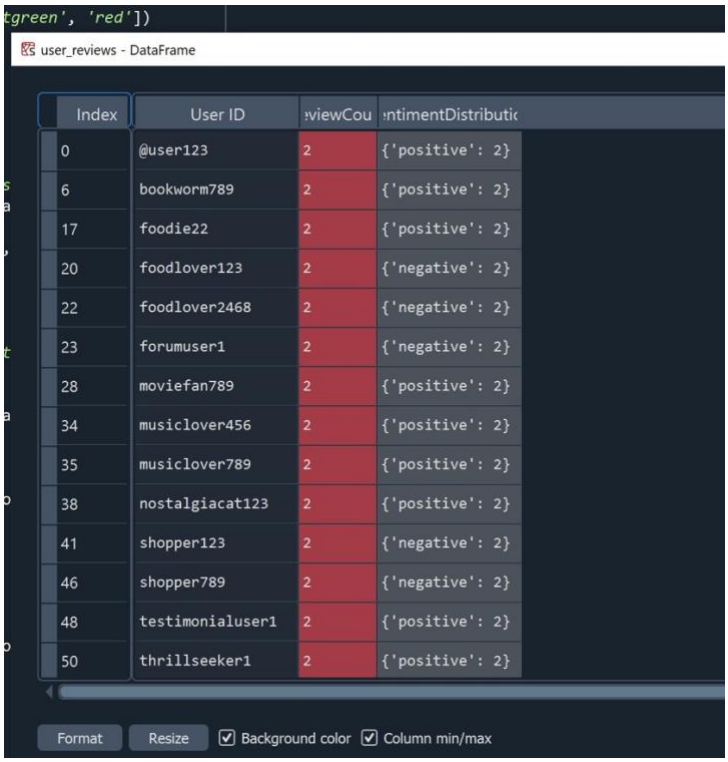
```
#Data Distribution
sns.countplot(x='Sentiment', data=data, palette= ['lightgreen', 'red'])
plt.xlabel('Sentiment')
plt.ylabel('Count')
plt.title('Count of Positive and Negative Reviews')
plt.show()
data['Sentiment'] = data['Sentiment'].str.strip()
data['Sentiment'] = data['Sentiment'].str.lower()
data['DayOfWeek'] = data['Date'].dt.day_name()
custom_order = ['Monday', 'Tuesday', 'Wednesday', 'Thursday', 'Friday', 'Saturday', 'Sunday']
data['DayOfWeek'] = pd.Categorical(data['DayOfWeek'], categories=custom_order, ordered=True)

sns.countplot(x='DayOfWeek', hue='Sentiment', data=data, palette= ['lightgreen', 'red'])

plt.xlabel('Day of the Week')
plt.ylabel('Count')
plt.title('Sentiment Distribution by Weekday')
plt.legend(title='Sentiment', labels=['Positive', 'Negative'], bbox_to_anchor=(1.02, 1), loc='upper left')
plt.xticks(rotation=45)
plt.show()
sns.countplot(y='Source', hue='Sentiment', data=data, palette=['lightgreen', 'red'])
plt.xlabel('Count')
plt.ylabel('Source')
plt.title('Positive and Negative Reviews by Source')
plt.legend(title='Sentiment', loc='center left', bbox_to_anchor=(1, 0.5), labels=['Positive', 'Negative'])
plt.show()

sns.countplot(y='Location', hue='Sentiment', data=data, palette=['lightgreen', 'red'])
plt.xlabel('Count')
plt.ylabel('Source')
plt.title('Positive and Negative Reviews by Location')
plt.legend(title='Sentiment', loc='center left', bbox_to_anchor=(1, 0.5), labels=['Positive', 'Negative'])
plt.show()
```


Sentiment Distribution by Weekday
Sentiment
Positive
Negative
Count
0
2
4
6
8
10
12
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
Day of the Week

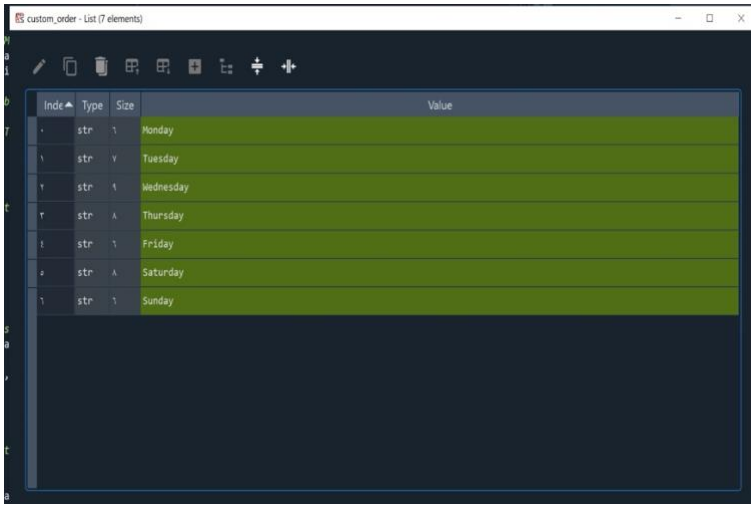

Positive and Negative Reviews by Source
Twitter
Yelp Reviews
IMDb
Online Forum
TripAdvisor
Amazon Reviews
Spotify
Website Testimonial
Goodreads
Online Store
Zomato
Website Review
Trip Report
Event Review
Online Chat
Airline Review
Theme Park Review
Music Review
Retail Store
Online Helpdesk
Gaming Forum
Travel Website
Hotel Review
Food Blog
TV Show Review
Art Review
Travel Blog
Source
Sentiment
Positive
Negative
0
2
4
6
8
10
Count

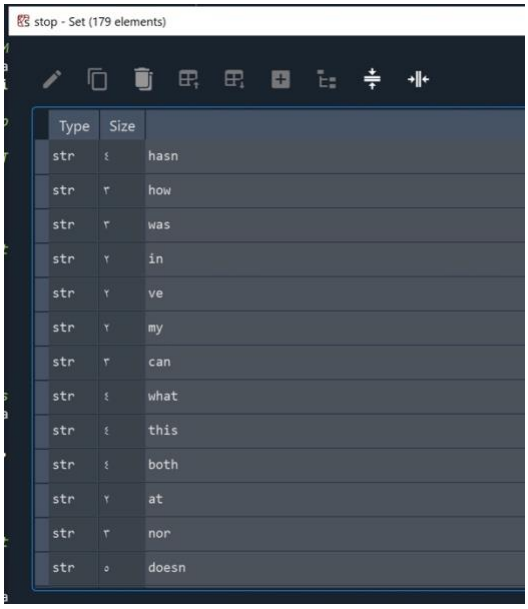

Positive and Negative Reviews by Location
New York
Los Angeles
London
Toronto
Paris
San Francisco
Berlin
Sydney
Mumbai
Orlando
Chicago
Source
Sentiment
Positive
Negative
0
2
4
6
8
10
Count

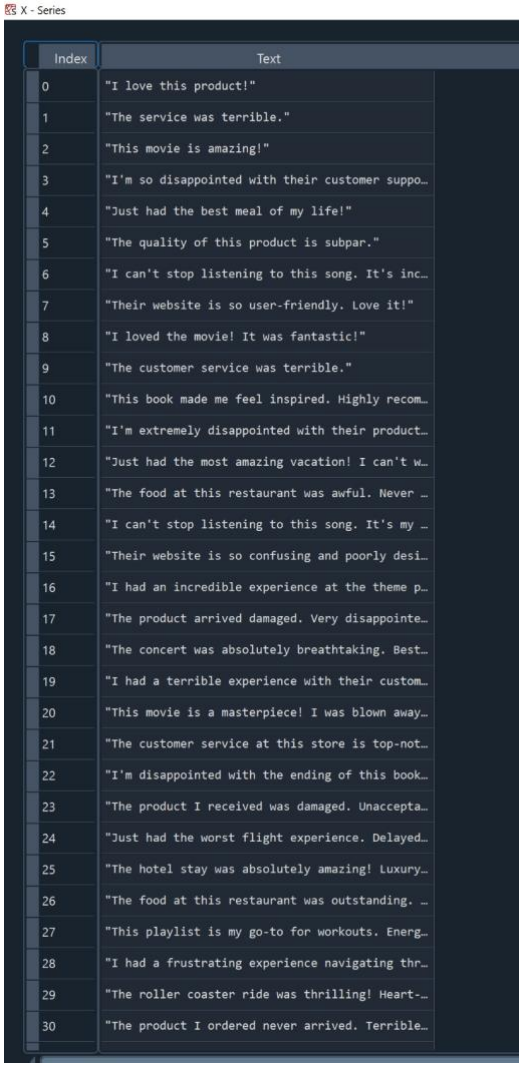
```python
#User Distribution
data.describe()

data['User ID'] = data['User ID'].str.strip()

user_reviews = data.groupby('User ID').agg(
    ReviewCount=('Text', 'count'),
    SentimentDistribution=('Sentiment', lambda x: dict(x.value_counts()))
).reset_index()

user_reviews = user_reviews[user_reviews['ReviewCount'] >= 2]

sentiment_data = pd.DataFrame(user_reviews['SentimentDistribution'].to_list())
sentiment_data.index = user_reviews['User ID']
sentiment_data
data[data['User ID'] == 'user456'][['Text', 'Source']]
```

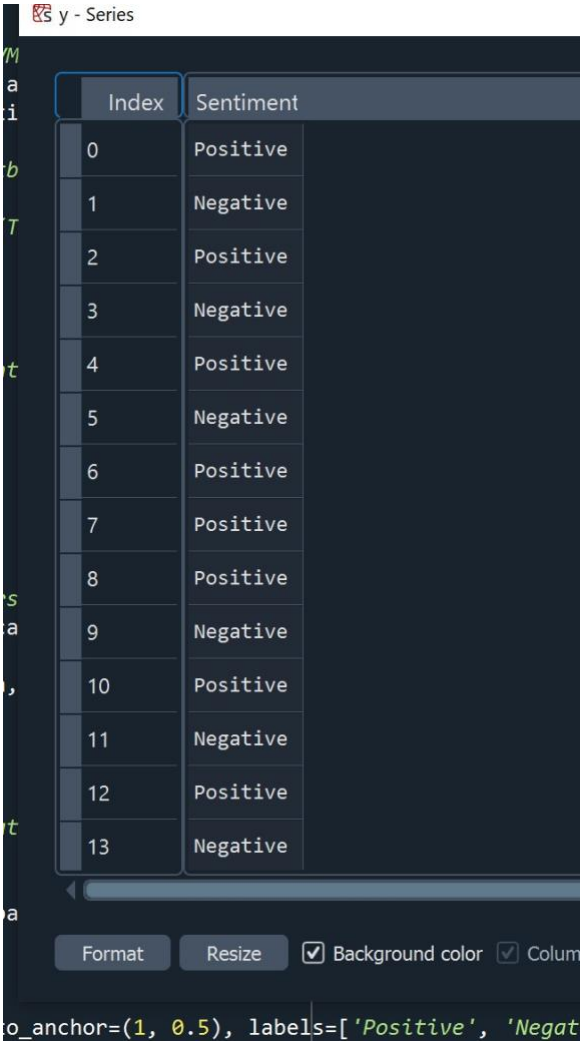


Our Variable Explorer:









Conclusion:

The accuracy using SVM model was 0.9 (90%) and using Random Forest gave us 0.85 (85%). Thus, we can conclude that SVM is the better option for answering our questions.

Our Code:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
sns.set()
from nltk.corpus import stopwords
stop=set(stopwords.words('english'))
from nltk.util import ngrams
from nltk.tokenize import word_tokenize
from sklearn.feature_extraction.text import CountVectorizer
from collections import defaultdict
from collections import Counter
plt.style.use('ggplot')
import re
import string
import warnings
warnings.filterwarnings('ignore')
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.svm import SVC
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score, classification_report, confusion_matrix

import seaborn as sns
import matplotlib.pyplot as plt
#_____________________________________________________________________
#loading the data set
data=pd.read_csv('sentiment-analysis.csv')
data.head()
#separating the data into columns
data = data['Text, Sentiment, Source, Date/Time, User ID, Location, Confidence Score'].str.split(', ', expand=True)
data.columns = ['Text', 'Sentiment', 'Source', 'Date/Time', 'User ID', 'Location', 'Confidence Score']
print('There are {} rows and {} columns in data.'.format(data.shape[0], data.shape[1]))

data.head(10)
#Data Cleaning
data.isnull().sum()
data.dropna(inplace=True)
data.head(10)

#there are some leading and trailing spaces in 'Date/Time' column, so let's trim them
```

```
#there are some leading and trailing spaces in 'Date/Time' column, so let's trim them
data['Date/Time'] = data['Date/Time'].str.strip()

data[['Date', 'Time']] = data['Date/Time'].str.split(' ', expand=True)

data.drop(columns=['Date/Time'], inplace=True)
data['Date'] = pd.to_datetime(data['Date'])
data['Time'] = pd.to_datetime(data['Time'], format='%H:%M:%S').dt.time
#User Distribution
data.describe()

data['User ID'] = data['User ID'].str.strip()

user_reviews = data.groupby('User ID').agg(
    ReviewCount=('Text', 'count'),
    SentimentDistribution=('Sentiment', lambda x: dict(x.value_counts()))
).reset_index()

user_reviews = user_reviews[user_reviews['ReviewCount'] >= 2]

sentiment_data = pd.DataFrame(user_reviews['SentimentDistribution'].to_list())
sentiment_data.index = user_reviews['User ID']
sentiment_data
data[data['User ID'] == 'user456'][['Text', 'Source']]
#ALGORITMS

# Preparing the data
X = data['Text']
y = data['Sentiment']

# Splitting the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Feature extraction using TF-IDF vectorizer
tfidf_vectorizer = TfidfVectorizer(max_features=5000)
X_train_tfidf = tfidf_vectorizer.fit_transform(X_train)
X_test_tfidf = tfidf_vectorizer.transform(X_test)

# Support Vector Machine (SVM)
svm_classifier = SVC(kernel='linear', C=1)
svm_classifier.fit(X_train_tfidf, y_train)

# Predictions
svm_predictions = svm_classifier.predict(X_test_tfidf)

# Evaluating SVM
svm_accuracy = accuracy_score(y_test, svm_predictions)
print("SVM Accuracy:", svm_accuracy)
print("\nClassification Report for SVM:\n", classification_report(y_test, svm_predictions))
```

```python
# Evaluating SVM
svm_accuracy = accuracy_score(y_test, svm_predictions)
print("SVM Accuracy:", svm_accuracy)
print("\nClassification Report for SVM:\n", classification_report(y_test, svm_predictions))
print("Confusion Matrix for SVM:\n", confusion_matrix(y_test, svm_predictions))

# Random Forest
rf_classifier = RandomForestClassifier(n_estimators=100, random_state=42)
rf_classifier.fit(X_train_tfidf, y_train)

# Predictions
rf_predictions = rf_classifier.predict(X_test_tfidf)

# Evaluating Random Forest
rf_accuracy = accuracy_score(y_test, rf_predictions)
print("\nRandom Forest Accuracy:", rf_accuracy)
print("\nClassification Report for Random Forest:\n", classification_report(y_test, rf_predictions))
print("Confusion Matrix for Random Forest:\n", confusion_matrix(y_test, rf_predictions))

#_____________________________plots_____________________________________


# Function to plot confusion matrix
def plot_confusion_matrix(y_true, y_pred, title, labels):
    cm = confusion_matrix(y_true, y_pred)
    plt.figure(figsize=(6, 4))
    sns.heatmap(cm, annot=True, fmt='d', cmap='pink', xticklabels=labels, yticklabels=labels)
    plt.title(title)
    plt.xlabel('Predicted')
    plt.ylabel('True')
    plt.show()

# Plotting Confusion Matrix for SVM
plot_confusion_matrix(y_test, svm_predictions, 'SVM Confusion Matrix', ['negative', 'positive'])

# Plotting Confusion Matrix for Random Forest
plot_confusion_matrix(y_test, rf_predictions, 'Random Forest Confusion Matrix', ['negative', 'positive'])



# Plotting Accuracy Comparison
models = ['SVM', 'Random Forest']
accuracies = [svm_accuracy, rf_accuracy]

plt.figure(figsize=(8, 5))
plt.bar(models, accuracies, color=['brown', 'lightblue'])
plt.ylabel('Accuracy')
plt.title('Accuracy Comparison - SVM vs Random Forest')
plt.ylim(0, 1)
plt.show()
```

```python
    plt.figure(figsize=(8, 5))
    plt.bar(models, accuracies, color=['brown', 'lightblue'])
    plt.ylabel('Accuracy')
    plt.title('Accuracy Comparison - SVM vs Random Forest')
    plt.ylim(0, 1)
    plt.show()
    # Function to plot confusion matrix
    def plot_confusion_matrix(y_true, y_pred, title, labels):
        cm = confusion_matrix(y_true, y_pred)
        plt.figure(figsize=(6, 4))
        sns.heatmap(cm, annot=True, fmt='d', cmap='tab20', xticklabels=labels, yticklabels=labels)
        plt.title(title)
        plt.xlabel('Predicted')
        plt.ylabel('True')
        plt.show()

    # Plotting Confusion Matrix for SVM (Test Set)
    plot_confusion_matrix(y_test, svm_predictions, 'SVM Test Set Confusion Matrix', ['negative', 'positive'])

    # Plotting Confusion Matrix for Random Forest (Test Set)
    plot_confusion_matrix(y_test, rf_predictions, 'Random Forest Test Set Confusion Matrix', ['negative', 'positive'])

    # Plotting Confusion Matrix for SVM (Training Set)
    svm_train_predictions = svm_classifier.predict(X_train_tfidf)
    plot_confusion_matrix(y_train, svm_train_predictions, 'SVM Training Set Confusion Matrix', ['negative', 'positive'])

    # Plotting Confusion Matrix for Random Forest (Training Set)
    rf_train_predictions = rf_classifier.predict(X_train_tfidf)
    plot_confusion_matrix(y_train, rf_train_predictions, 'Random Forest Training Set Confusion Matrix', ['negative', 'positive'])

    # Plotting Accuracy Comparison
    models = ['SVM Test Set', 'Random Forest Test Set', 'SVM Training Set', 'Random Forest Training Set']
    accuracies = [accuracy_score(y_test, svm_predictions), accuracy_score(y_test, rf_predictions),
                  accuracy_score(y_train, svm_train_predictions), accuracy_score(y_train, rf_train_predictions)]
    plt.figure(figsize=(12, 8))
    plt.bar(models, accuracies, color=['lightgreen', 'lightblue', 'pink', 'red'])
    plt.ylabel('Accuracy')
    plt.title('Accuracy Comparison - SVM vs Random Forest (Training and Test Sets)')
    plt.ylim(0, 1)
    plt.show()

    #Data Distribution
    sns.countplot(x='Sentiment', data=data, palette= ['lightgreen', 'red'])
    plt.xlabel('Sentiment')
    plt.ylabel('Count')
    plt.title('Count of Positive and Negative Reviews')
    plt.show()
    data['Sentiment'] = data['Sentiment'].str.strip()
    data['Sentiment'] = data['Sentiment'].str.lower()
```

```
# Plotting Accuracy Comparison
models = ['SVM Test Set', 'Random Forest Test Set', 'SVM Training Set', 'Random Forest Training Set']
accuracies = [accuracy_score(y_test, svm_predictions), accuracy_score(y_test, rf_predictions),
              accuracy_score(y_train, svm_train_predictions), accuracy_score(y_train, rf_train_predictions)]
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plt.bar(models, accuracies, color=['lightgreen', 'lightblue', 'pink', 'red'])
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sns.countplot(x='Sentiment', data=data, palette= ['lightgreen', 'red'])
plt.xlabel('Sentiment')
plt.ylabel('Count')
plt.title('Count of Positive and Negative Reviews')
plt.show()
data['Sentiment'] = data['Sentiment'].str.strip()
data['Sentiment'] = data['Sentiment'].str.lower()
data['DayOfWeek'] = data['Date'].dt.day_name()
custom_order = ['Monday', 'Tuesday', 'Wednesday', 'Thursday', 'Friday', 'Saturday', 'Sunday']
data['DayOfWeek'] = pd.Categorical(data['DayOfWeek'], categories=custom_order, ordered=True)

sns.countplot(x='DayOfWeek', hue='Sentiment', data=data, palette= ['lightgreen', 'red'])

plt.xlabel('Day of the Week')
plt.ylabel('Count')
plt.title('Sentiment Distribution by Weekday')
plt.legend(title='Sentiment', labels=['Positive', 'Negative'], bbox_to_anchor=(1.02, 1), loc='upper left')
plt.xticks(rotation=45)
plt.show()
sns.countplot(y='Source', hue='Sentiment', data=data, palette=['lightgreen', 'red'])
plt.xlabel('Count')
plt.ylabel('Source')
plt.title('Positive and Negative Reviews by Source')
plt.legend(title='Sentiment', loc='center left', bbox_to_anchor=(1, 0.5), labels=['Positive', 'Negative'])
plt.show()

sns.countplot(y='Location', hue='Sentiment', data=data, palette=['lightgreen', 'red'])
plt.xlabel('Count')
plt.ylabel('Source')
plt.title('Positive and Negative Reviews by Location')
plt.legend(title='Sentiment', loc='center left', bbox_to_anchor=(1, 0.5), labels=['Positive', 'Negative'])
plt.show()
```

import numpy as np

import pandas as pd

import matplotlib.pyplot as plt

import seaborn as sns

sns.set()

from nltk.corpus import stopwords

stop=set(stopwords.words('english'))

from nltk.util import ngrams

from nltk.tokenize import word_tokenize

from sklearn.feature_extraction.text import CountVectorizer

from collections import defaultdict

from collections import Counter

plt.style.use('ggplot')

import re

import string

import warnings

warnings.filterwarnings('ignore')

from sklearn.model_selection import train_test_split

from sklearn.feature_extraction.text import TfidfVectorizer

from sklearn.svm import SVC

```
from sklearn.ensemble import RandomForestClassifier

from sklearn.metrics import accuracy_score, classification_report, confusion_matrix


import seaborn as sns

import matplotlib.pyplot as plt

#_____
_____

#loading the data set

data=pd.read_csv('sentiment-analysis.csv')

data.head()

#separating the data into columns

data = data['Text, Sentiment, Source, Date/Time, User ID, Location, Confidence Score'].str.split(', ',
expand=True)

data.columns = ['Text', 'Sentiment', 'Source', 'Date/Time', 'User ID', 'Location', 'Confidence Score']

print('There are {} rows and {} columns in data.'.format(data.shape[0], data.shape[1]))


data.head(10)

#Data Cleaning

data.isnull().sum()

data.dropna(inplace=True)

data.head(10)


#there are some leading and trailing spaces in 'Date/Time' column, so let's trim them

data['Date/Time'] = data['Date/Time'].str.strip()


data[['Date', 'Time']] = data['Date/Time'].str.split(' ', expand=True)


data.drop(columns=['Date/Time'], inplace=True)

data['Date'] = pd.to_datetime(data['Date'])

data['Time'] = pd.to_datetime(data['Time'], format='%H:%M:%S').dt.time

#User Distribution

data.describe()


data['User ID'] = data['User ID'].str.strip()
```

```
user_reviews = data.groupby('User ID').agg(
    ReviewCount=('Text', 'count'),
    SentimentDistribution=('Sentiment', lambda x: dict(x.value_counts()))
).reset_index()

user_reviews = user_reviews[user_reviews['ReviewCount'] >= 2]

sentiment_data = pd.DataFrame(user_reviews['SentimentDistribution'].to_list())
sentiment_data.index = user_reviews['User ID']
sentiment_data
data[data['User ID'] == 'user456'][['Text', 'Source']]
#ALGORITMS

# Preparing the data
X = data['Text']
y = data['Sentiment']

# Splitting the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Feature extraction using TF-IDF vectorizer
tfidf_vectorizer = TfidfVectorizer(max_features=5000)
X_train_tfidf = tfidf_vectorizer.fit_transform(X_train)
X_test_tfidf = tfidf_vectorizer.transform(X_test)

# Support Vector Machine (SVM)
svm_classifier = SVC(kernel='linear', C=1)
svm_classifier.fit(X_train_tfidf, y_train)

# Predictions
svm_predictions = svm_classifier.predict(X_test_tfidf)

# Evaluating SVM
svm_accuracy = accuracy_score(y_test, svm_predictions)
```

```
print("SVM Accuracy:", svm_accuracy)
print("\nClassification Report for SVM:\n", classification_report(y_test, svm_predictions))
print("Confusion Matrix for SVM:\n", confusion_matrix(y_test, svm_predictions))

# Random Forest
rf_classifier = RandomForestClassifier(n_estimators=100, random_state=42)
rf_classifier.fit(X_train_tfidf, y_train)

# Predictions
rf_predictions = rf_classifier.predict(X_test_tfidf)

# Evaluating Random Forest
rf_accuracy = accuracy_score(y_test, rf_predictions)
print("\nRandom Forest Accuracy:", rf_accuracy)
print("\nClassification Report for Random Forest:\n", classification_report(y_test, rf_predictions))
print("Confusion Matrix for Random Forest:\n", confusion_matrix(y_test, rf_predictions))

#_____plots_____

# Function to plot confusion matrix
def plot_confusion_matrix(y_true, y_pred, title, labels):
    cm = confusion_matrix(y_true, y_pred)
    plt.figure(figsize=(6, 4))
    sns.heatmap(cm, annot=True, fmt='d', cmap='pink', xticklabels=labels, yticklabels=labels)
    plt.title(title)
    plt.xlabel('Predicted')
    plt.ylabel('True')
    plt.show()

# Plotting Confusion Matrix for SVM
plot_confusion_matrix(y_test, svm_predictions, 'SVM Confusion Matrix', ['negative', 'positive'])

# Plotting Confusion Matrix for Random Forest
```

```
plot_confusion_matrix(y_test, rf_predictions, 'Random Forest Confusion Matrix', ['negative', 'positive'])



# Plotting Accuracy Comparison
models = ['SVM', 'Random Forest']
accuracies = [svm_accuracy, rf_accuracy]

plt.figure(figsize=(8, 5))
plt.bar(models, accuracies, color=['brown', 'lightblue'])
plt.ylabel('Accuracy')
plt.title('Accuracy Comparison - SVM vs Random Forest')
plt.ylim(0, 1)
plt.show()
# Function to plot confusion matrix
def plot_confusion_matrix(y_true, y_pred, title, labels):
    cm = confusion_matrix(y_true, y_pred)
    plt.figure(figsize=(6, 4))
    sns.heatmap(cm, annot=True, fmt='d', cmap='tab20', xticklabels=labels, yticklabels=labels)
    plt.title(title)
    plt.xlabel('Predicted')
    plt.ylabel('True')
    plt.show()

# Plotting Confusion Matrix for SVM (Test Set)
plot_confusion_matrix(y_test, svm_predictions, 'SVM Test Set Confusion Matrix', ['negative', 'positive'])

# Plotting Confusion Matrix for Random Forest (Test Set)
plot_confusion_matrix(y_test, rf_predictions, 'Random Forest Test Set Confusion Matrix', ['negative', 'positive'])

# Plotting Confusion Matrix for SVM (Training Set)
svm_train_predictions = svm_classifier.predict(X_train_tfidf)
plot_confusion_matrix(y_train, svm_train_predictions, 'SVM Training Set Confusion Matrix', ['negative',
'positive'])
```

```
# Plotting Confusion Matrix for Random Forest (Training Set)
rf_train_predictions = rf_classifier.predict(X_train_tfidf)
plot_confusion_matrix(y_train, rf_train_predictions, 'Random Forest Training Set Confusion Matrix',
['negative', 'positive'])

# Plotting Accuracy Comparison
models = ['SVM Test Set', 'Random Forest Test Set', 'SVM Training Set', 'Random Forest Training Set']
accuracies = [accuracy_score(y_test, svm_predictions), accuracy_score(y_test, rf_predictions),
        accuracy_score(y_train, svm_train_predictions), accuracy_score(y_train, rf_train_predictions)]
plt.figure(figsize=(12, 8))
plt.bar(models, accuracies, color=['lightgreen', 'lightblue', 'pink', 'red'])
plt.ylabel('Accuracy')
plt.title('Accuracy Comparison - SVM vs Random Forest (Training and Test Sets)')
plt.ylim(0, 1)
plt.show()

#Data Distribution
sns.countplot(x='Sentiment', data=data, palette= ['lightgreen', 'red'])
plt.xlabel('Sentiment')
plt.ylabel('Count')
plt.title('Count of Positive and Negative Reviews')
plt.show()
data['Sentiment'] = data['Sentiment'].str.strip()
data['Sentiment'] = data['Sentiment'].str.lower()
data['DayOfWeek'] = data['Date'].dt.day_name()
custom_order = ['Monday', 'Tuesday', 'Wednesday', 'Thursday', 'Friday', 'Saturday', 'Sunday']
data['DayOfWeek'] = pd.Categorical(data['DayOfWeek'], categories=custom_order, ordered=True)

sns.countplot(x='DayOfWeek', hue='Sentiment', data=data, palette= ['lightgreen', 'red'])

plt.xlabel('Day of the Week')
plt.ylabel('Count')
plt.title('Sentiment Distribution by Weekday')
plt.legend(title='Sentiment', labels=['Positive', 'Negative'], bbox_to_anchor=(1.02, 1), loc='upper left')
plt.xticks(rotation=45)
```

```
plt.show()
sns.countplot(y='Source', hue='Sentiment', data=data, palette=['lightgreen', 'red'])
plt.xlabel('Count')
plt.ylabel('Source')
plt.title('Positive and Negative Reviews by Source')
plt.legend(title='Sentiment', loc='center left', bbox_to_anchor=(1, 0.5), labels=['Positive', 'Negative'])
plt.show()

sns.countplot(y='Location', hue='Sentiment', data=data, palette=['lightgreen', 'red'])
plt.xlabel('Count')
plt.ylabel('Source')
plt.title('Positive and Negative Reviews by Location')
plt.legend(title='Sentiment', loc='center left', bbox_to_anchor=(1, 0.5), labels=['Positive', 'Negative'])
plt.show()
```