KevinSmithMidterm506

November 8, 2023

0.1 Kevin Smith CS506 Midterm Project

[29]:
```
import pandas as pd
trainingSet = pd.read_csv("./data/train.csv")
```

0.2 Exploration

[49]:
```
import matplotlib.pyplot as plt
import math

print("Each review has the following attributes:")
print(trainingSet.dtypes)
print()
print(trainingSet.head())
print()

#COUNT OF EACH SCORE
trainingSet['Score'].value_counts().plot(kind='bar', legend=True, alpha=.5)
plt.title("Count of Scores")
plt.show()

#MEAN HELPFULNESS NUMERATOR PER SCORE
trainingSet[['Score', 'HelpfulnessNumerator']].groupby('Score').mean().
 ↪plot(kind='bar', legend=True, alpha=.5)
plt.title("Mean Helpfulness Numerator per Score")
plt.show()

#MEAN HELPFULNESS DENOMINATOR PER SCORE
trainingSet[['Score', 'HelpfulnessDenominator']].groupby('Score').mean().
 ↪plot(kind='bar', legend=True, alpha=.5)
plt.title("Mean Helpfulness Denominator per Score")
plt.show()

#MEAN HELPFULNESS PER SCORE
trainingSet['Helpfulness'] = trainingSet['HelpfulnessNumerator'] /␣
 ↪trainingSet['HelpfulnessDenominator']
trainingSet['Helpfulness'] = trainingSet['Helpfulness'].fillna(0)
```

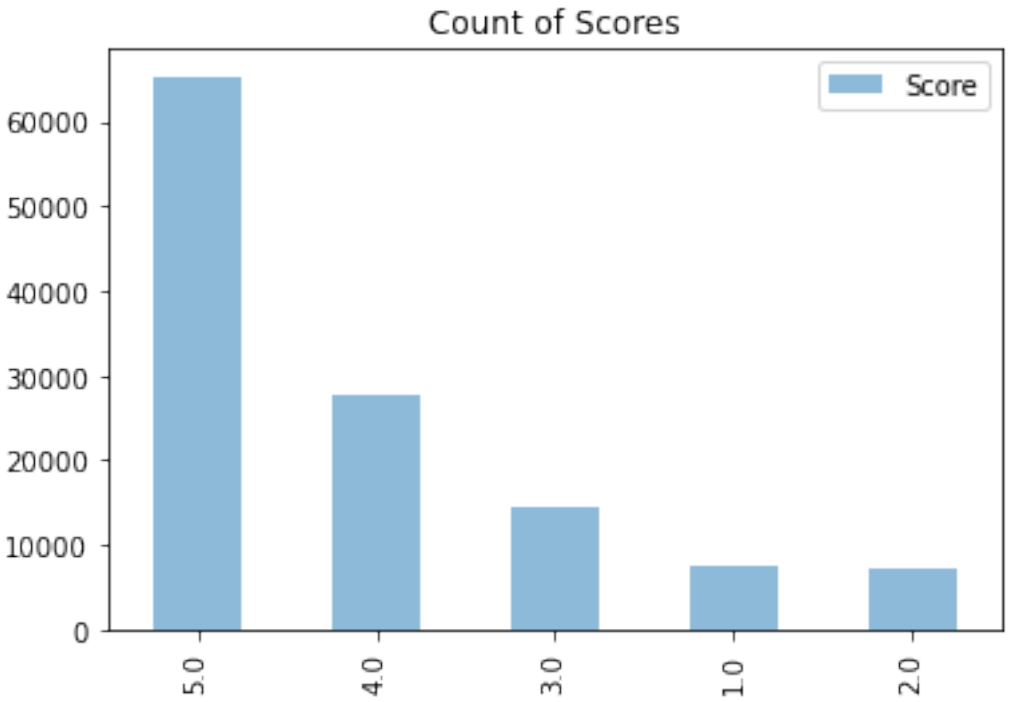
```
trainingSet[['Score', 'Helpfulness']].groupby('Score').mean().plot(kind='bar',␣
 ↪legend=True, alpha=.5)
plt.title("Mean Helpfulness per Score")
plt.show()

def getHour(time):
    return math.floor(time/(1000*3600))%24

#TIME DISTRIBUTION OF 1-STAR REVIEWS
one_star_reviews = trainingSet[trainingSet['Score'] == 1]
one_star_reviews.loc[:, 'Hour'] = one_star_reviews['Time'].apply(getHour)
hourly_counts = one_star_reviews['Hour'].value_counts().sort_index()
hourly_index = range(24)
hourly_counts = hourly_counts.reindex(hourly_index, fill_value=0)
plt.figure(figsize=(10, 6))
plt.bar(hourly_counts.index, hourly_counts.values, tick_label=hourly_counts.
 ↪index)
plt.xlabel('Hour of the Day')
plt.ylabel('Number of 1-Star Reviews')
plt.title('Time Distribution of 1-Star Reviews')
plt.xticks(hourly_counts.index)
plt.grid(axis='y', linestyle='--', alpha=0.5)
plt.show()

#TIME DISTRIBUTION OF 2-STAR REVIEWS
two_star_reviews = trainingSet[trainingSet['Score'] == 2]
two_star_reviews.loc[:, 'Hour'] = two_star_reviews['Time'].apply(getHour)
hourly_counts = two_star_reviews['Hour'].value_counts().sort_index()
hourly_index = range(24)
hourly_counts = hourly_counts.reindex(hourly_index, fill_value=0)
plt.figure(figsize=(10, 6))
plt.bar(hourly_counts.index, hourly_counts.values, tick_label=hourly_counts.
 ↪index)
plt.xlabel('Hour of the Day')
plt.ylabel('Number of 1-Star Reviews')
plt.title('Time Distribution of 1-Star Reviews')
plt.xticks(hourly_counts.index)
plt.grid(axis='y', linestyle='--', alpha=0.5)
plt.show()

#TIME DISTRIBUTION OF 3-STAR REVIEWS
three_star_reviews = trainingSet[trainingSet['Score'] == 3]
three_star_reviews.loc[:, 'Hour'] = three_star_reviews['Time'].apply(getHour)
hourly_counts = three_star_reviews['Hour'].value_counts().sort_index()
hourly_index = range(24)
hourly_counts = hourly_counts.reindex(hourly_index, fill_value=0)
plt.figure(figsize=(10, 6))
```

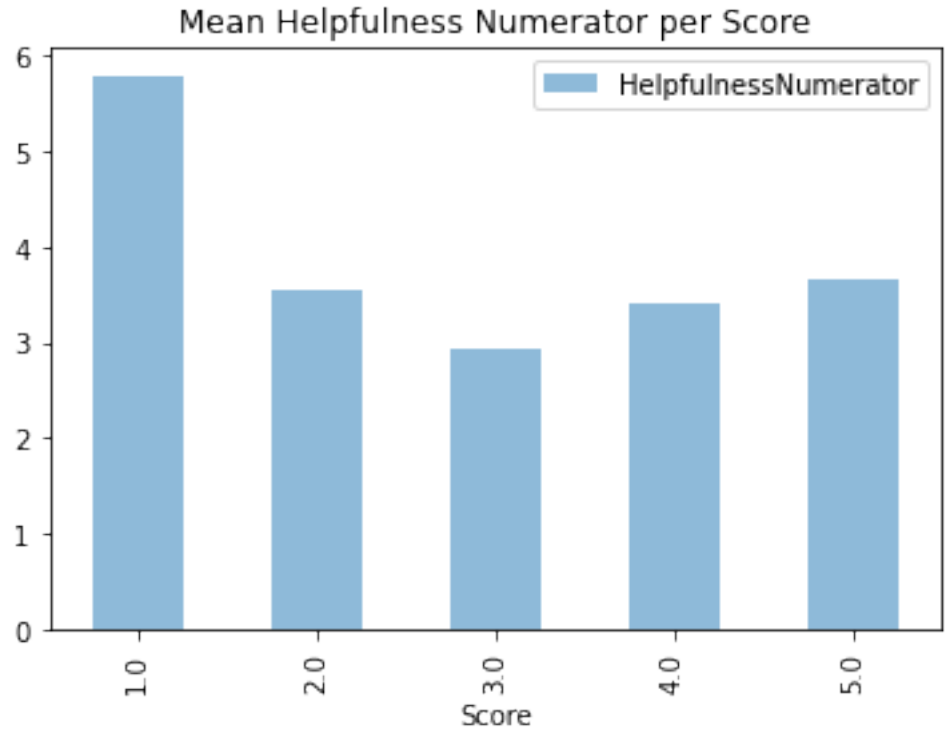
```
plt.bar(hourly_counts.index, hourly_counts.values, tick_label=hourly_counts.
 ↪index)
plt.xlabel('Hour of the Day')
plt.ylabel('Number of 1-Star Reviews')
plt.title('Time Distribution of 1-Star Reviews')
plt.xticks(hourly_counts.index)
plt.grid(axis='y', linestyle='--', alpha=0.5)
plt.show()

#TIME DISTRIBUTION OF 4-STAR REVIEWS
four_star_reviews = trainingSet[trainingSet['Score'] == 4]
four_star_reviews.loc[:, 'Hour'] = four_star_reviews['Time'].apply(getHour)
hourly_counts = four_star_reviews['Hour'].value_counts().sort_index()
hourly_index = range(24)
hourly_counts = hourly_counts.reindex(hourly_index, fill_value=0)
plt.figure(figsize=(10, 6))
plt.bar(hourly_counts.index, hourly_counts.values, tick_label=hourly_counts.
 ↪index)
plt.xlabel('Hour of the Day')
plt.ylabel('Number of 1-Star Reviews')
plt.title('Time Distribution of 1-Star Reviews')
plt.xticks(hourly_counts.index)
plt.grid(axis='y', linestyle='--', alpha=0.5)
plt.show()

#TIME DISTRIBUTION OF 5-STAR REVIEWS
five_star_reviews = trainingSet[trainingSet['Score'] == 5]
five_star_reviews.loc[:, 'Hour'] = five_star_reviews['Time'].apply(getHour)
hourly_counts = five_star_reviews['Hour'].value_counts().sort_index()
hourly_index = range(24)
hourly_counts = hourly_counts.reindex(hourly_index, fill_value=0)
plt.figure(figsize=(10, 6))
plt.bar(hourly_counts.index, hourly_counts.values, tick_label=hourly_counts.
 ↪index)
plt.xlabel('Hour of the Day')
plt.ylabel('Number of 1-Star Reviews')
plt.title('Time Distribution of 1-Star Reviews')
plt.xticks(hourly_counts.index)
plt.grid(axis='y', linestyle='--', alpha=0.5)
plt.show()

#MEAN REVIEW LENGTH PER SCORE
trainingSet['ReviewLength'] = trainingSet.apply(lambda row : len(row['Text'].
 ↪split()) if type(row['Text']) == str else 0, axis = 1)
trainingSet[['Score', 'ReviewLength']].groupby('Score').mean().plot(kind='bar',␣
 ↪legend=True, alpha=.5)
plt.title("Mean Review Length per Score")
```

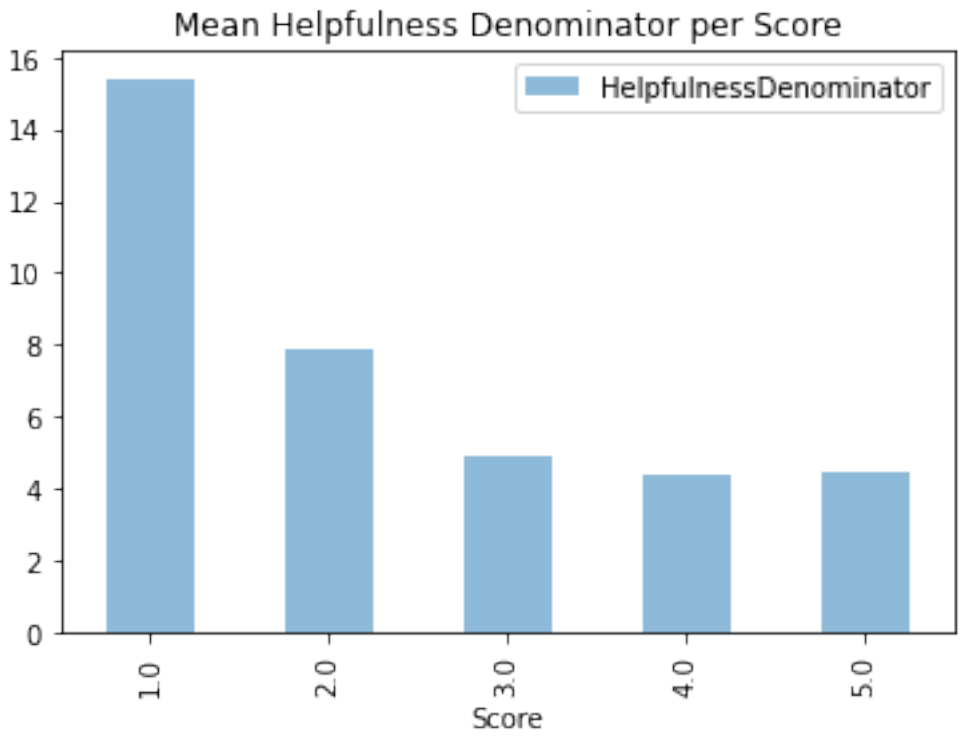
```
plt.show()
```

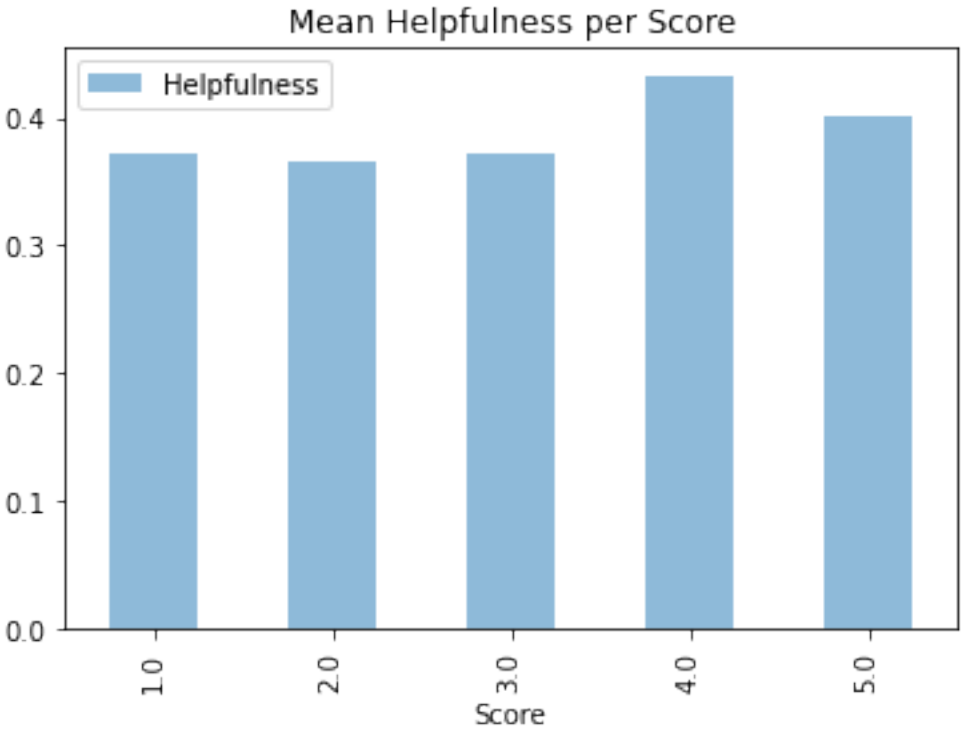
```
Each review has the following attributes:
Id                          int64
ProductId                  object
UserId                     object
HelpfulnessNumerator        int64
HelpfulnessDenominator      int64
Time                        int64
Summary                    object
Text                       object
Score                     float64
Helpfulness               float64
dtype: object
```

	Id	ProductId	UserId	HelpfulnessNumerator	HelpfulnessDenominator	Time	Summary	Text	Score	Helpfulness
0	195370	1890228583	A3VLX5Z090RQ0V	1	2	1030838400	An Unexplained Anime Review	I was very anxious to see the Uncut version of…	2.0	0.500000
1	1632470	B00BEIYSL4	AUDXDMFM49NGY	0	1	1405036800	not great.	Movie was okay…not great.	3.0	0.000000
2	9771	0767809335	A3LFIA97BUU5IE	3	36	983750400	Technical problem with this DVD	Like the Dinosaur Collector's Edition DVD, thi…	1.0	0.083333
3	218855	6300215792	A1QZM75342ZQVQ	1	1	1394841600	Heeeeyyyyy LAAAAADEEE!!!!	Come on, now… this has to be, by far, the…	5.0	1.000000
4	936225	B000B5XOZW	ANM2SCEUL3WL1	1	1	1163721600	Herzog the Great Traveler of both natural and …	I've always been a great admirer of Herzog's o…	4.0	1.000000

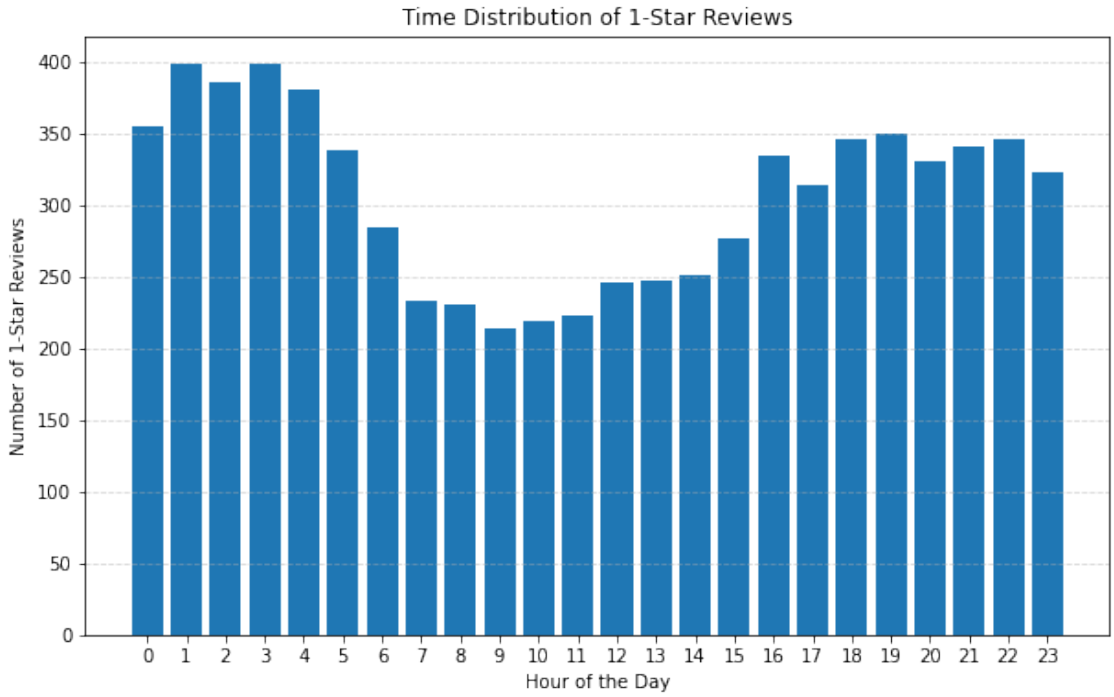

Count of Scores
Score
60000
50000
40000
30000
20000
10000
0
5.0
4.0
3.0
1.0
2.0


Mean Helpfulness Numerator per Score
HelpfulnessNumerator
6
5
4
3
2
1
0
1.0
2.0
3.0
4.0
5.0
Score

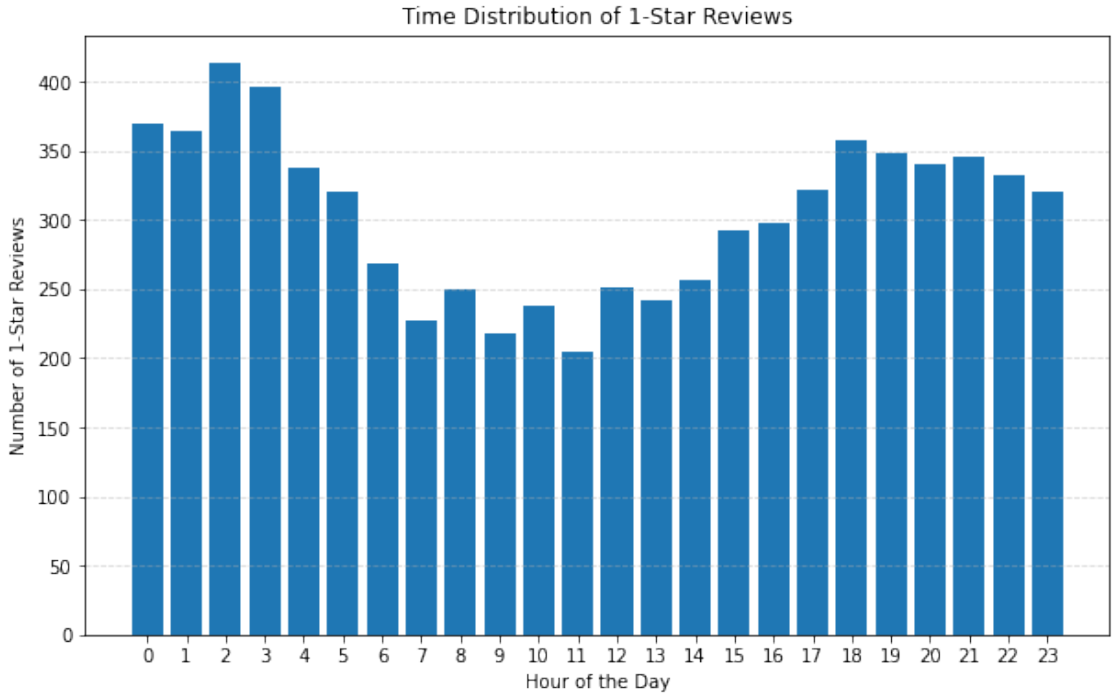

Mean Helpfulness Denominator per Score
HelpfulnessDenominator
16
14
12
10
8
6
4
2
0
1.0
2.0
3.0
4.0
5.0
Score


Mean Helpfulness per Score
Helpfulness
0.4
0.3
0.2
0.1
0.0
1.0
2.0
3.0
4.0
5.0
Score

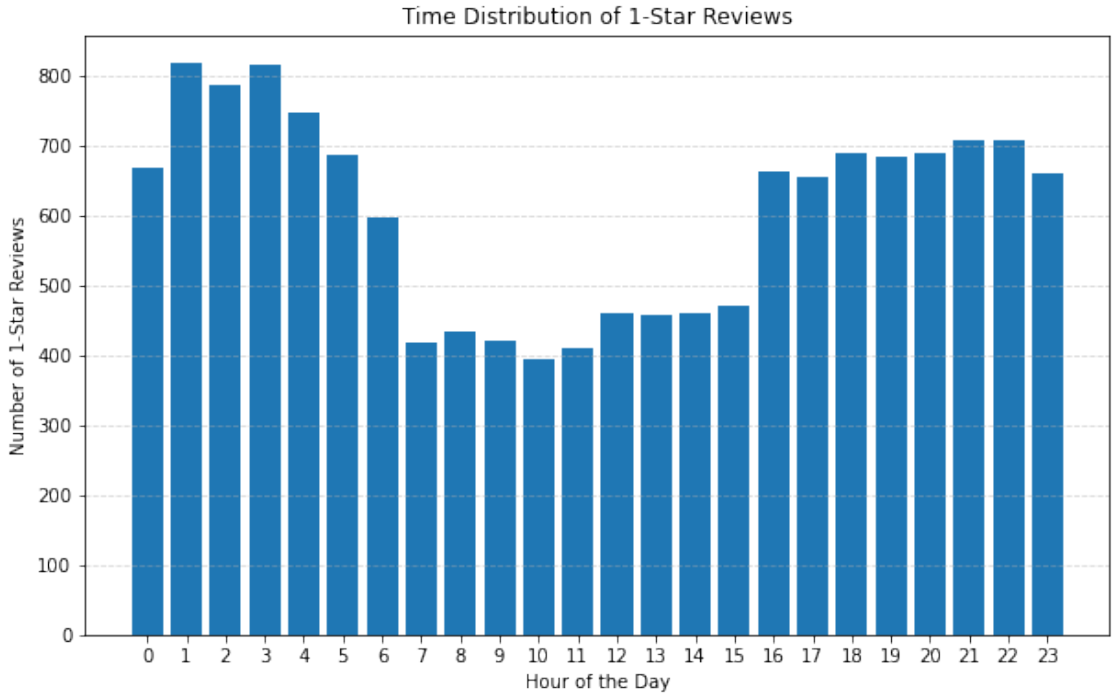
```
/var/folders/n1/mp2n6fsd09963xzzjvzq12g80000gn/T/ipykernel_73938/3394742300.py:3
7: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  one_star_reviews.loc[:, 'Hour'] = one_star_reviews['Time'].apply(getHour)
```



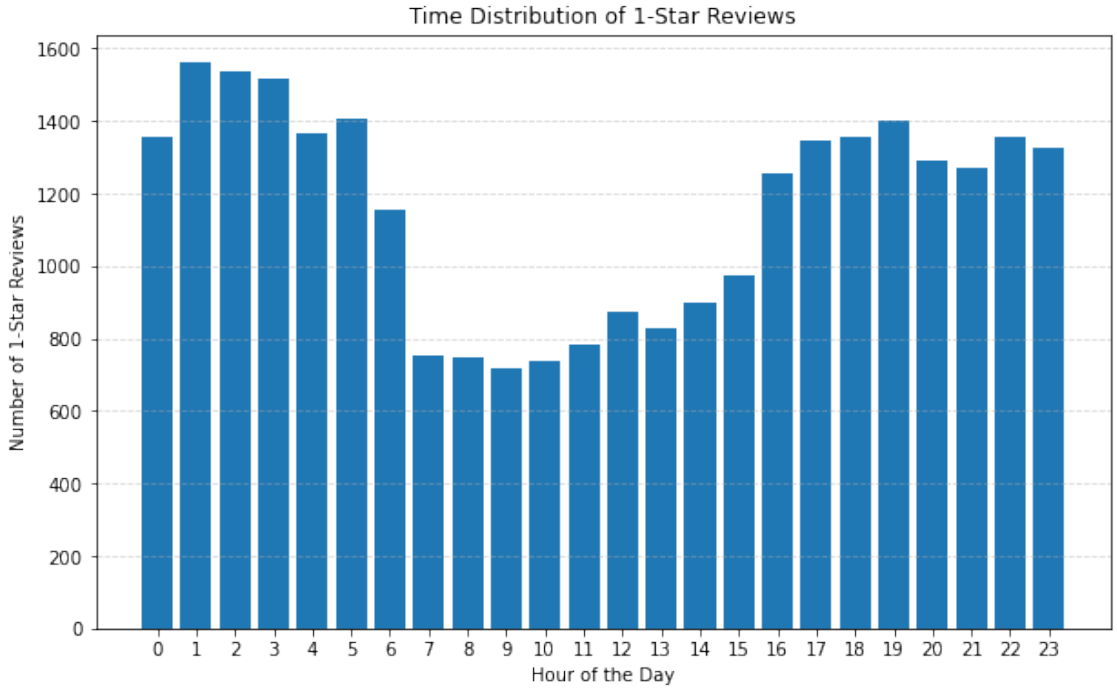

```
/var/folders/n1/mp2n6fsd09963xzzjvzq12g80000gn/T/ipykernel_73938/3394742300.py:5
2: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  two_star_reviews.loc[:, 'Hour'] = two_star_reviews['Time'].apply(getHour)
```



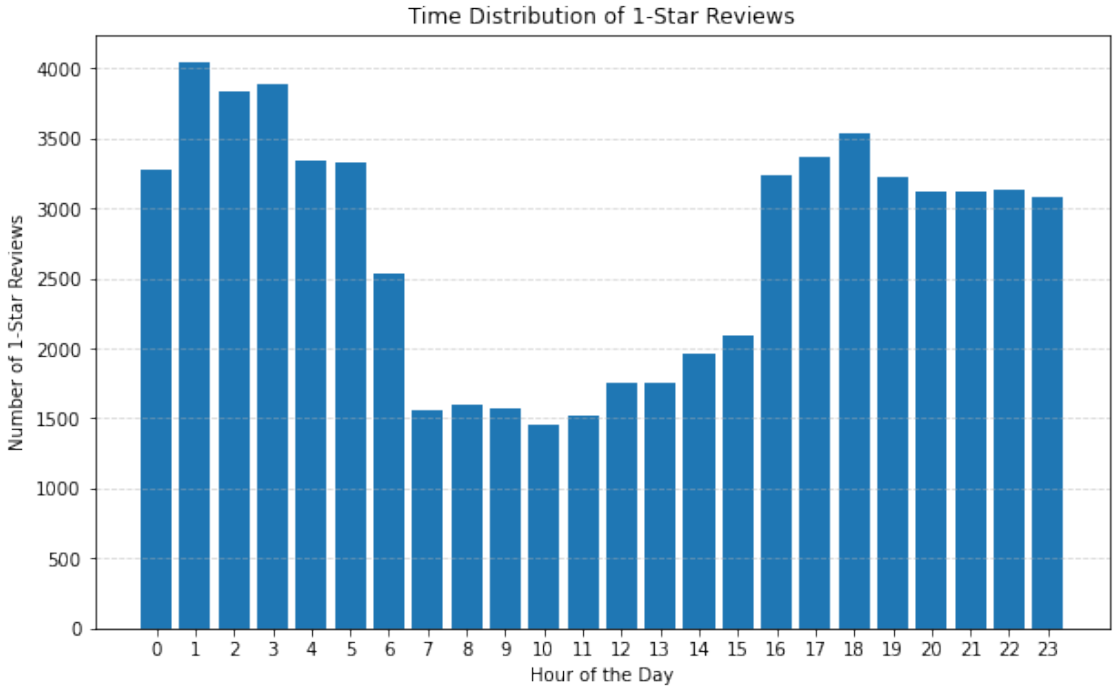

```
/var/folders/n1/mp2n6fsd09963xzzjvzq12g80000gn/T/ipykernel_73938/3394742300.py:6
7: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  three_star_reviews.loc[:, 'Hour'] = three_star_reviews['Time'].apply(getHour)
```

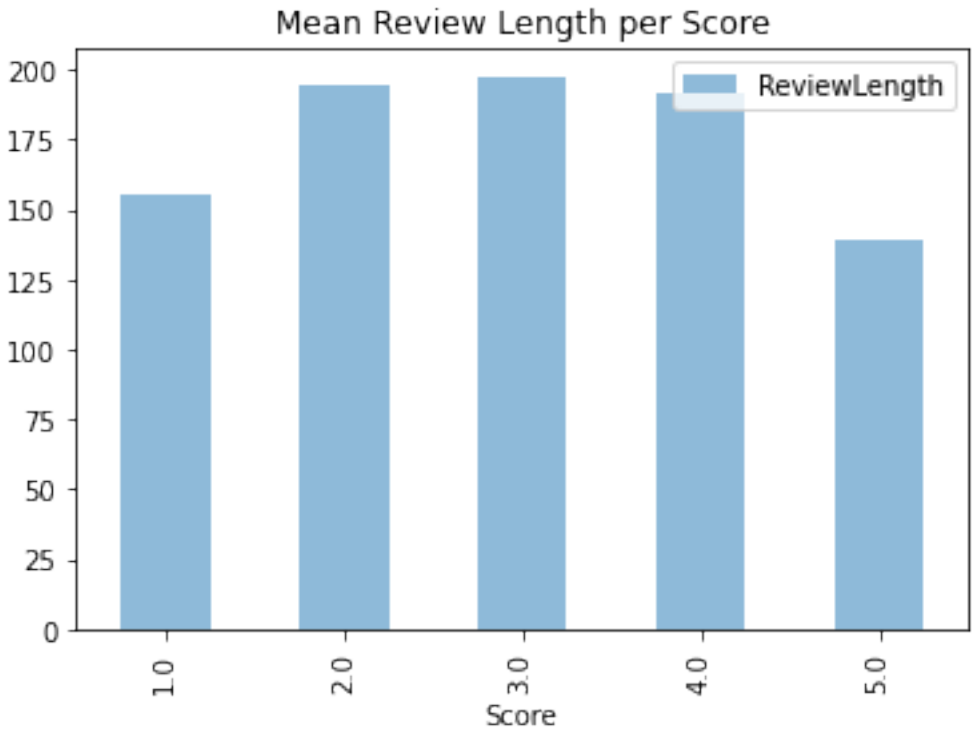



```
/var/folders/n1/mp2n6fsd09963xzzjvzq12g80000gn/T/ipykernel_73938/3394742300.py:8
2: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  four_star_reviews.loc[:, 'Hour'] = four_star_reviews['Time'].apply(getHour)
```




```
/var/folders/n1/mp2n6fsd09963xzzjvzq12g80000gn/T/ipykernel_73938/3394742300.py:9
7: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  five_star_reviews.loc[:, 'Hour'] = five_star_reviews['Time'].apply(getHour)
```


Time Distribution of 1-Star Reviews
Number of 1-Star Reviews
Hour of the Day
0
500
1000
1500
2000
2500
3000
3500
4000
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23


Mean Review Length per Score
ReviewLength
0
25
50
75
100
125
150
175
200
1.0
2.0
3.0
4.0
5.0
Score

0.3 Feature Extraction

[71]:
```
import pandas as pd
import numpy as np
from sklearn.preprocessing import LabelEncoder, MinMaxScaler
from vaderSentiment.vaderSentiment import SentimentIntensityAnalyzer

#NEW FEATURES ARE EXTRACTED HERE
def process(df):

    ## SIMPLE EDITS ##

    df = df.rename(columns={'ProductId': 'MovieID'})
    df = df.rename(columns={'UserId': 'UserID'})

    df['Summary'] = df['Summary'].fillna('neutral')
    df['Text'] = df['Text'].fillna('neutral')
    df['Summary'] = df['Summary'].apply(lambda x : x.lower())
    df['Text'] = df['Text'].apply(lambda x : x.lower())

    ## SENTIMENT ANALYSIS ##

    analyzer = SentimentIntensityAnalyzer()

    def get_positivity_score(text):
        sentiment = analyzer.polarity_scores(text)
        return sentiment['compound']

    textPS = df['Text'].apply(get_positivity_score)
    summaryPS = df['Summary'].apply(get_positivity_score)

    df['PositivityScore'] = textPS

    print(df.head())

    return df

# Load the dataset
trainingSet = pd.read_csv("./data/train.csv")
testingSet = pd.read_csv("./data/test.csv")

# Process the DataFrames
train_processed = process(trainingSet)

# Load test set
submissionSet = pd.read_csv("./data/test.csv")

# Merge on Id so that the test set can have feature columns as well
```

```
testX= pd.merge(train_processed, submissionSet, left_on='Id', right_on='Id')
testX = testX.drop(columns=['Score_x'])
testX = testX.rename(columns={'Score_y': 'Score'})

# The training set is where the score is not null
trainX =  train_processed[train_processed['Score'].notnull()]

# Save the datasets with the new features for easy access later
testX.to_csv("./data/X_test.csv", index=False)
trainX.to_csv("./data/X_train.csv", index=False)
```

```
       Id     MovieID          UserID  HelpfulnessNumerator  \
0   195370  1890228583  A3VLX5Z090RQ0V                     1
1  1632470  B00BEIYSL4   AUDXDMFM49NGY                     0
2     9771  0767809335  A3LFIA97BUU5IE                     3
3   218855  6300215792  A1QZM75342ZQVQ                     1
4   936225  B000B5XOZW   ANM2SCEUL3WL1                     1

   HelpfulnessDenominator        Time  \
0                       2  1030838400
1                       1  1405036800
2                      36   983750400
3                       1  1394841600
4                       1  1163721600

                                       Summary  \
0                       an unexplained anime review
1                                    not great.
2                   technical problem with this dvd
3                         heeeeyyyyy laaaaadeee!!!!
4  herzog the great traveler of both natural and …

                                                Text  Score  PositivityScore
0  i was very anxious to see the uncut version of…    2.0          -0.8824
1                      movie was okay…not great.     3.0           0.6249
2  like the dinosaur collector's edition dvd, thi…    1.0          -0.0351
3  come on, now…  this has to be, by far, the…    5.0           0.9770
4  i've always been a great admirer of herzog's o…    4.0           0.9823
```

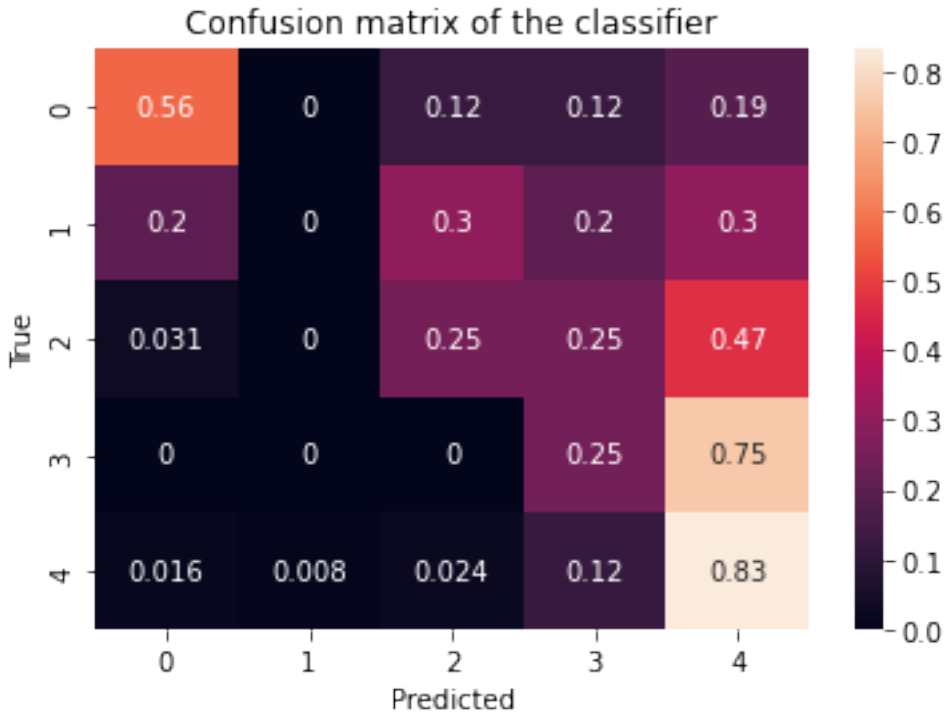
0.4 Creating your model

[111]:
```
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import train_test_split
```

```
from sklearn.metrics import accuracy_score, confusion_matrix,␣
 ↪mean_squared_error, classification_report
from sklearn.feature_extraction.text import TfidfVectorizer
from scipy.sparse import hstack
from sklearn.ensemble import AdaBoostClassifier

# Load training set with new features into DataFrame
trainingSet = pd.read_csv("./data/X_train.csv").sample(1000)

# SPLIT DATA INTO TRAINING & TESTING SETS
X_text = trainingSet['Text']
X_other = trainingSet[['HelpfulnessNumerator',␣
 ↪'HelpfulnessDenominator','PositivityScore']]  # Include other relevant␣
 ↪columns
Y = trainingSet['Score']

X_text_train, X_text_test, X_other_train, X_other_test, Y_train, Y_test =␣
 ↪train_test_split(
    X_text, X_other, Y, test_size=0.25, random_state=33)

# APPLY TF-IDF VECTORIZATION TO THE 'Text' COLUMN
tfidf_vectorizer = TfidfVectorizer()
X_text_train_tfidf = tfidf_vectorizer.fit_transform(X_text_train)
X_text_test_tfidf = tfidf_vectorizer.transform(X_text_test)

# COMBINE TF-IDF VECTORIZED 'Text' COLUMN WITH OTHER COLUMNS
X_train = hstack((X_text_train_tfidf, X_other_train))
X_test = hstack((X_text_test_tfidf, X_other_test))

# TRAIN KNN CLASSIFIER
model = KNeighborsClassifier(n_neighbors=10)
model.fit(X_train, Y_train)

# Evaluate your model on the testing set
Y_test_predictions = model.predict(X_test)
print("Accuracy on testing set = ", accuracy_score(Y_test, Y_test_predictions))
print("RMSE on testing set 10= ", mean_squared_error(Y_test,␣
 ↪Y_test_predictions)**(1/2))
print("Classification Report:\n", classification_report(Y_test,␣
 ↪Y_test_predictions))


# Plot a confusion matrix
cm = confusion_matrix(Y_test, Y_test_predictions, normalize='true')
sns.heatmap(cm, annot=True)
plt.title('Confusion matrix of the classifier')
plt.xlabel('Predicted')
```

```
plt.ylabel('True')
plt.show()
```

```
Accuracy on testing set =  0.54
RMSE on testing set 10=  1.1610340218959994
Classification Report:
              precision    recall  f1-score   support

         1.0       0.56      0.56      0.56        16
         2.0       0.00      0.00      0.00        20
         3.0       0.42      0.25      0.31        32
         4.0       0.33      0.25      0.28        57
         5.0       0.61      0.83      0.70       125

    accuracy                           0.54       250
   macro avg       0.38      0.38      0.37       250
weighted avg       0.47      0.54      0.49       250
```



0.5 Create the Kaggle submission

[113]:
```
X_submission = pd.read_csv("./data/X_test.csv")

X_submission_tfidf = tfidf_vectorizer.transform(X_submission['Text'])
X_submission_other = X_submission[['HelpfulnessNumerator',␣
 ↪'HelpfulnessDenominator', 'PositivityScore']]
X_submission_combined = hstack((X_submission_tfidf, X_submission_other))

submission_predictions = model.predict(X_submission_combined)
submission = pd.DataFrame({'Id': X_submission['Id'], 'Score':␣
 ↪submission_predictions})

submission.to_csv("./data/submission.csv", index=False)
print("Submission saved to submission.csv.")
```

```
Submission saved to submission.csv.
```

Now you can upload the `submission.csv` to kaggle