Kaggle ML Project using Yelp Dataset

Rohit Gupta

July 26, 2021

```
In [1]: import os
        import pandas as pd
        import numpy as np
        import seaborn as sns
        import matplotlib.pyplot as plt

In [2]: #os.getcwd()
        os.chdir("C:\\Users\\Mommy\\Desktop\\Self_Learning\\yelp")

In [3]: yelp_data = pd.read_csv("yelp.csv")

In [4]: #yelp_data.head(10)
        yelp_data.shape

Out[4]: (10000, 10)

In [5]: yelp_data.columns

Out[5]: Index([u'business_id', u'date', u'review_id', u'stars', u'text', u'type',
               u'user_id', u'cool', u'useful', u'funny'],
              dtype='object')

In [6]: #yelp_data.head(10)

In [7]: yelp_data.stars.shape

Out[7]: (10000L,)

In [8]: # Filter data frame to have rows with stars being 5 and 1 only. These are the two classe
        yelp_data1 = yelp_data[yelp_data['stars']==1]

In [9]: yelp_data2 = yelp_data[yelp_data['stars']==5]

In [10]: yelp_data1.shape

Out[10]: (749, 10)

In [11]: yelp_data2.shape

Out[11]: (3337, 10)
```

```
In [12]: yelp_final = pd.merge(yelp_data1, yelp_data2, on='stars')

In [13]: 3337+749

Out[13]: 4086

In [14]: yelp_final = yelp_data.apply(lambda row: row[yelp_data['stars'].isin([5,1])])

In [15]: # Further you can have yelp_final to have only two columns - the review text and the st
         # yelp_final.head(10)

In [16]: yelp_final2 = yelp_final[['stars','text']]

In [17]: # Split into training and testing datasets :
         # initialize X and Y as series :

         X = yelp_final.text
         Y = yelp_final.stars

         from sklearn.cross_validation import train_test_split

         X_train,X_test,Y_train,Y_test = train_test_split(X,Y,random_state=1)

C:\ProgramData\Anaconda2\lib\site-packages\sklearn\cross_validation.py:41: DeprecationWarning: T
  "This module will be removed in 0.20.", DeprecationWarning)


In [18]: # check sizes of the train and test datasets
         X_train.shape

Out[18]: (3064L,)

In [19]: Y_train.shape

Out[19]: (3064L,)

In [20]: X_test.shape

Out[20]: (1022L,)

In [21]: Y_test.shape

Out[21]: (1022L,)

In [22]: # check if X is series
         type(X_train)

Out[22]: pandas.core.series.Series

In [23]: type(X_test)
```

```
Out[23]: pandas.core.series.Series
```

```
In [24]: # import countVectorizer module from sklearn
         from sklearn.feature_extraction.text import CountVectorizer

         # instantiate the model
         count_vec = CountVectorizer()
```

```
In [25]: # now we need the coun vectorizer model to learn the vocabulary :
         # we need to first learn the vocabulary of the reviews
         # and then create a document term amtrix -
         # with that we will have the mapping of the occurence of each vocab with its occurence
         # go through the row - you build the review/the statement.

         count_vec.fit(X_train)
```

```
Out[25]: CountVectorizer(analyzer=u'word', binary=False, decode_error=u'strict',
                 dtype=<type 'numpy.int64'>, encoding=u'utf-8', input=u'content',
                 lowercase=True, max_df=1.0, max_features=None, min_df=1,
                 ngram_range=(1, 1), preprocessor=None, stop_words=None,
                 strip_accents=None, token_pattern=u'(?u)\\b\\w\\w+\\b',
                 tokenizer=None, vocabulary=None)
```

```
In [26]: # get feature names or the trained vocab of the review section :
         # count_vec.get_feature_names()
```

```
In [27]: # How to build the doucment term matrix ?
         # use the transform function using . operator on the model you trained.

         yelp_dtm_train =  count_vec.transform(X_train)
         yelp_dtm_test = count_vec.transform(X_test)
         #help(count_vec.transform)
```

```
In [28]: import pandas as pd
         yelp_vect_df_train =  pd.DataFrame(yelp_dtm_train.toarray(),columns=count_vec.get_featu
         yelp_vect_df_train.head(3)
```

```
Out[28]:    00  000  00a  00am  00pm  01  02  03  03342  04 ...  zucchini  zuchinni  \
         0   0    0    0     0     0   0   0   0      0   0 ...         0         0
         1   0    0    0     0     0   0   0   0      0   0 ...         0         0
         2   0    0    0     0     0   0   0   0      0   0 ...         0         0

            zumba  zupa  zuzu  zwiebel  zzed  éclairs  école  ém
         0      0     0     0        0     0        0      0   0
         1      0     0     0        0     0        0      0   0
         2      0     0     0        0     0        0      0   0

         [3 rows x 16825 columns]
```

```
In [29]: # create the document term matrix for the
         yelp_dtm_test = count_vec.transform(X_test)

         # create dataframe having column names as trained vocab and rows representing the state
         yelp_vect_df_test = pd.DataFrame(yelp_dtm_test.toarray(), columns = count_vec.get_featu

         # get shape
         yelp_vect_df_test.shape

Out[29]: (1022, 16825)
```

```
In [30]: # Now ML begins !!!
```

```
In [31]: # now I have the document term matrix - so now using it what to do ?
         # well using the document term matrix, we have integer feature representation, so we wi
         # along with the star rating.

         from sklearn.naive_bayes import MultinomialNB

         # instantiate model
         mult_nb = MultinomialNB()

         # train the data :
         mult_nb.fit(yelp_vect_df_train,Y_train)

Out[31]: MultinomialNB(alpha=1.0, class_prior=None, fit_prior=True)
```

```
In [32]: # testing the data :
         Y_pred_mult_nb = mult_nb.predict(yelp_vect_df_test)
```

```
In [33]: print(Y_pred_mult_nb)

[5 5 5 ... 5 1 5]
```

```
In [34]: #now we check the accuracy of our model
         from sklearn import metrics

         metrics.accuracy_score(Y_test,Y_pred_mult_nb)

         #0.9187866927592955

Out[34]: 0.9187866927592955
```

```
In [35]: # get roc_auc score and get the confusion matrix as well
         # Let us print the confusion matrix first :

         metrics.confusion_matrix(Y_test,Y_pred_mult_nb)

Out[35]: array([[126,  58],
                [ 25, 813]], dtype=int64)
```

```
In [36]: #help(metrics.classification_report)
         #metrics.classification_report(Y_test,Y_pred_mult_nb)
```

```
In [37]: # get the roc_auc score :
         # to get the roc_auc score i need to get the probabilities of the pred class :

         #Y_pred_mult_nb_prob = mult_nb.predict_proba(Y_pred_mult_nb)
```

```
In [38]: # Let us use logistic regression
         from sklearn.linear_model import LogisticRegression

         # instantiate the model
         logreg = LogisticRegression()

         # Train the model using the document term matrices
         %time logreg.fit(yelp_vect_df_train,Y_train)

Wall time: 3.71 s


Out[38]: LogisticRegression(C=1.0, class_weight=None, dual=False, fit_intercept=True,
                   intercept_scaling=1, max_iter=100, multi_class='ovr', n_jobs=1,
                   penalty='l2', random_state=None, solver='liblinear', tol=0.0001,
                   verbose=0, warm_start=False)
```

```
In [39]: # test the model :
         Y_pred_logreg = logreg.predict(yelp_vect_df_test)
```

```
In [40]: metrics.accuracy_score(Y_test,Y_pred_logreg)

         #0.9256360078277887

Out[40]: 0.9256360078277887
```

```
In [41]: # print the confusion matrix, from the accuracy score - logistic regression performs be
         metrics.confusion_matrix(Y_test,Y_pred_logreg)

Out[41]: array([[140,  44],
                [ 32, 806]], dtype=int64)
```

```
In [42]: from sklearn import metrics
         metrics.confusion_matrix(Y_test,Y_pred_logreg)

Out[42]: array([[140,  44],
                [ 32, 806]], dtype=int64)
```

```
In [43]: #Calculate which 10 tokens are the most predictive of 5-star reviews,
         #and which 10 tokens are the most predictive of 1-star reviews.

         #create a dataframe with token - and the corresponding rating - 5 star or 1 - star.
         #columns : label,tokens ,label_num

         # tokens are the feature names
         # now for prediction whether the rating is 5 star or 1 star - certain key words will re
         # and based on those key words - we get rating. So we can determine occurence of each t
         # the 5 star and 1 star rating.

         one_star_count = mult_nb.feature_count_[0,:]
         five_star_count = mult_nb.feature_count_[1,:]
```

```
In [44]: tokens_df2 = pd.DataFrame({'text_review_tokens':yelp_vect_df_train.columns ,'one_star':
```

```
In [45]: tokens_df2['one_star'] = tokens_df2.one_star + 1
         tokens_df2['five_star'] = tokens_df2.five_star + 1
```

```
In [46]: #tokens_df2.head(3)
         #five_star_ratio = five_star_count/five_star_class_count [observation/total frequency]
         tokens_df2['one_star'] = tokens_df2.one_star/mult_nb.class_count_[0]
         tokens_df2['five_star'] = tokens_df2.five_star/mult_nb.class_count_[1]
         #tokens_df.sort_values('five_star_ratio',ascending=False).head(3)



         # five star to one star ratio :
         tokens_df2['five_one_ratio'] = tokens_df2.five_star/tokens_df2.one_star
```

```
In [47]: # top ten key words that predict whether the review will be a five star rating.
         tokens_df2.sort_values('five_one_ratio',ascending=False).head(3)
```

```
Out[47]:        five_star  one_star text_review_tokens  five_one_ratio
         5596    0.077231   0.00354          fantastic       21.817727
         10949   0.098039   0.00531            perfect       18.464052
         16751   0.024810   0.00177                yum       14.017607
```

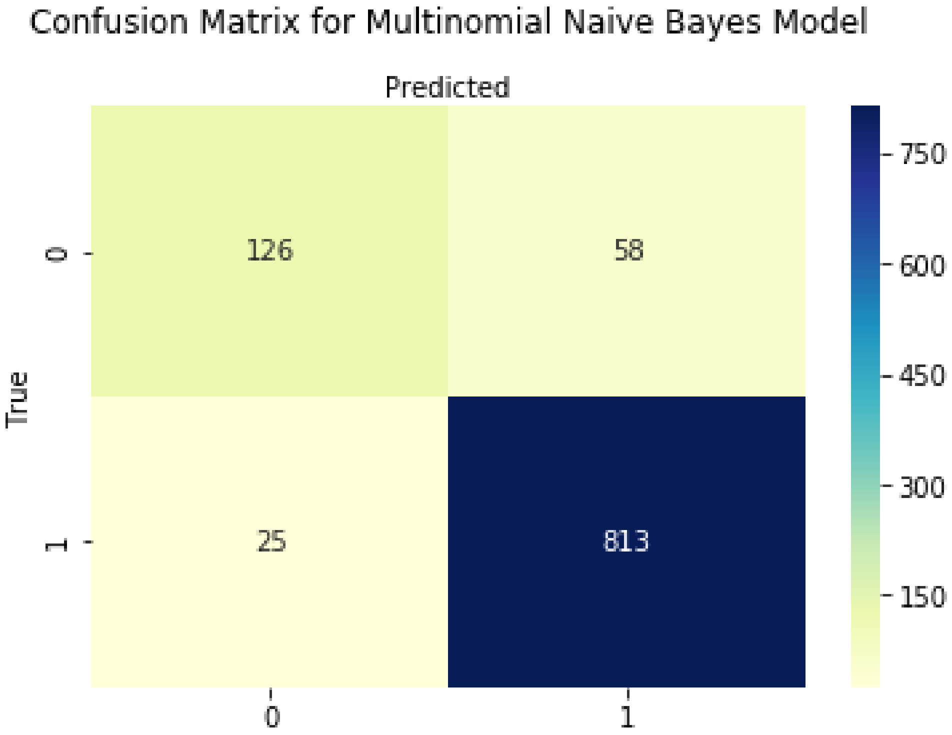
```
In [48]: # top ten key words that predict whether the review will be a one star rating.
         tokens_df2.sort_values('five_one_ratio',ascending=False).tail(3)
```

```
Out[48]:        five_star  one_star text_review_tokens  five_one_ratio
         4538      0.0008  0.042478         disgusting        0.018841
         12172     0.0004  0.024779            refused        0.016149
         14110     0.0004  0.030088        staffperson        0.013299
```

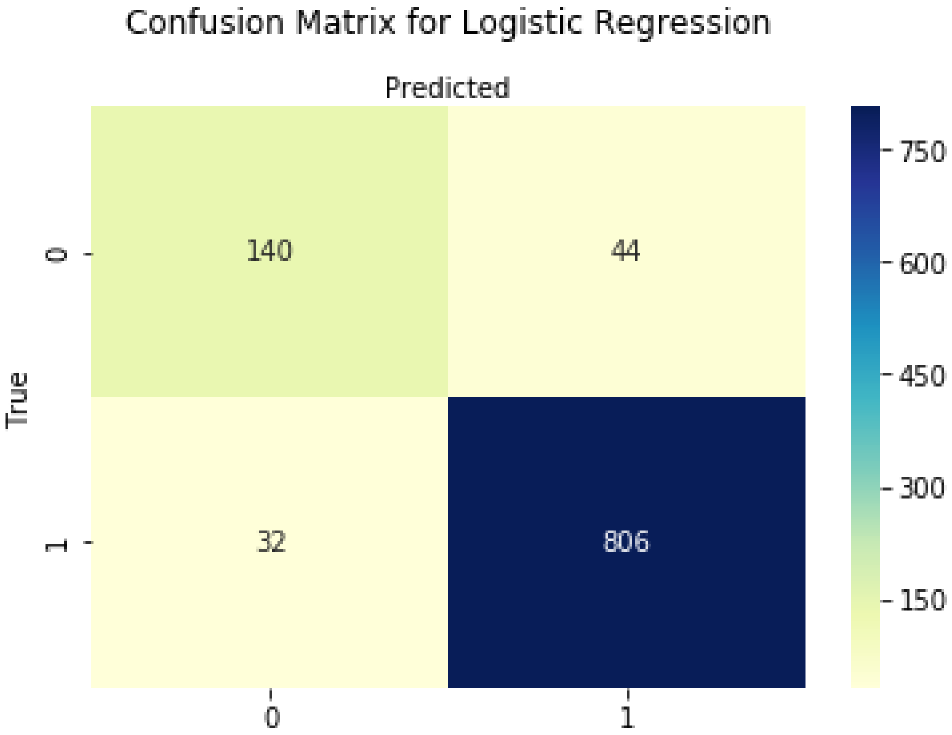
```
In [49]: # Visualizations :
         # Confusion matrix plot for the multnb model :
         conf_matrix_multnb_model = metrics.confusion_matrix(Y_test, Y_pred_mult_nb)

         labels = [0, 1]
         fig, ax = plt.subplots()
         tick_marks = np.arange(len(labels))
```

```
        plt.xticks(tick_marks, labels)
        plt.yticks(tick_marks, labels)

        # create heatmap
        sns.heatmap(pd.DataFrame(conf_matrix_multnb_model), annot=True, cmap="YlGnBu", fmt='g')
        ax.xaxis.set_label_position("top")
        plt.title('Confusion Matrix for Multinomial Naive Bayes Model', y=1.1)
        plt.ylabel('True')
        plt.xlabel('Predicted')
```

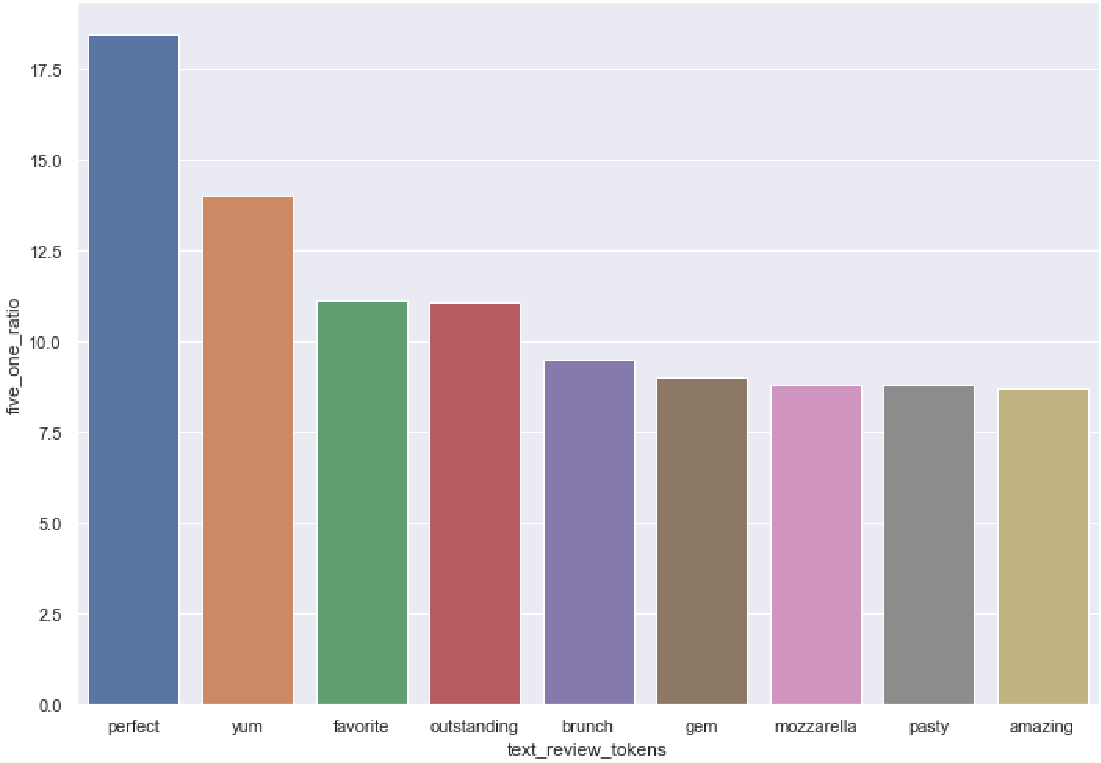
```
Out[49]: Text(0.5,15,'Predicted')
```



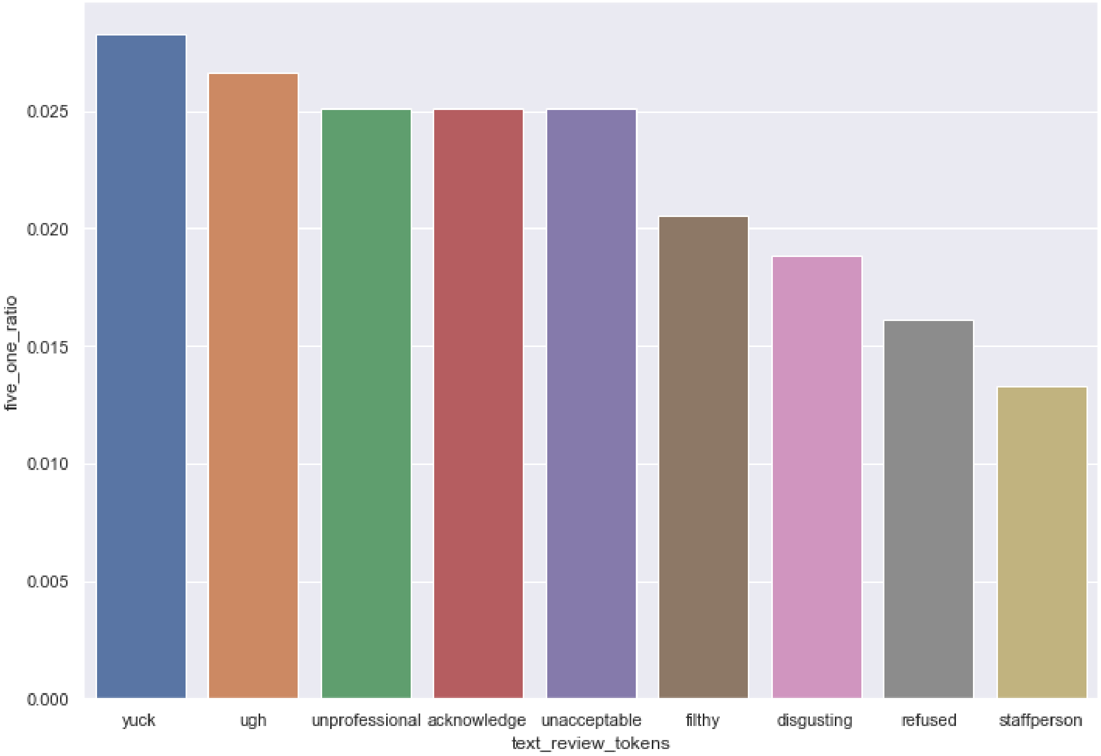
```
In [50]: # Confusion matrix plot for the logistic regression model :

         conf_matrix_logreg_model = metrics.confusion_matrix(Y_test, Y_pred_logreg)

         labels = [0, 1]
         fig, ax = plt.subplots()
         tick_marks = np.arange(len(labels))
         plt.xticks(tick_marks, labels)
         plt.yticks(tick_marks, labels)

         # create heatmap
         sns.heatmap(pd.DataFrame(conf_matrix_logreg_model), annot=True, cmap="YlGnBu", fmt='g')
         ax.xaxis.set_label_position("top")
         plt.title('Confusion Matrix for Logistic Regression', y=1.1)
         plt.ylabel('True')
         plt.xlabel('Predicted')

Out[50]: Text(0.5,15,'Predicted')
```



```
In [51]: import matplotlib.pyplot as plt
         import matplotlib.pyplot as hist
         import seaborn as sns

         top_ten_fivestar_predictors = tokens_df2.sort_values('five_one_ratio',ascending=False).
         top_ten_onestar_predictors = tokens_df2.sort_values('five_one_ratio',ascending=False).t


         #plt.plot(top_ten_fivestar_predictors.text_review_tokens[1:10],top_ten_fivestar_predict

         sns.set(rc={'figure.figsize':(11.7,8.27)})
         sns.barplot(x=top_ten_fivestar_predictors.text_review_tokens[1:10], y=top_ten_fivestar_

Out[51]: <matplotlib.axes._subplots.AxesSubplot at 0x18d24ba8>
```



```
In [52]: # Top ten token reviews that predict one star rating :

         sns.set(rc={'figure.figsize':(11.7,8.27)})
         sns.barplot(x=top_ten_onestar_predictors.text_review_tokens[1:10], y=top_ten_onestar_pr

Out[52]: <matplotlib.axes._subplots.AxesSubplot at 0x1904cda0>
```



```
In [53]: #tokens_df2.text_review_tokens[1:10]
```

```
In [54]: # generate wordcloud for the top ten tokens predicting the 5 stars rating :
```

```
In [55]: # Confusion matrix plot for the logistic regression model :
```

```
In [56]: #5-class classification problem

         #Define X and y using the original DataFrame. (y should contain 5 different classes.)
         #Split X and y into training and testing sets.
         #Create document-term matrices using CountVectorizer.
         #Calculate the testing accuracy of a Multinomial Naive Bayes model.
         #Compare the testing accuracy with the null accuracy, and comment on the results.
         #Print the confusion matrix, and comment on the results. (This Stack Overflow answer ex
         #Print the classification report, and comment on the results.
         #If you are unfamiliar with the terminology it uses, research the terms, and then try t
         #calculate these metrics manually from the confusion matrix!

         # encountering a problem : my computer cant handle this apparently.
```

```
In [57]: #yelp_final.columns
```

```
In [58]: # initialize the data :
         #X = yelp_data.text
         #Y = yelp_data.stars
```

```
In [59]: # initialize training and testing datasets :
         #X_train,X_test,Y_train,Y_test = train_test_split(X,Y,random_state=1)

In [60]: # initialize a new countvectorizer
         #from sklearn.feature_extraction.text import CountVectorizer

         # instantiate new countvec
         #countvec_new = CountVectorizer()

         # train the data
         #countvec_new.fit(X_train)

In [61]: # get the feature names
         #countvec_new.get_feature_names()

         # memory taken alot so the code and output commented.

In [62]: # now convert to get document term matrix for training and testing datasets
         #X_train_dtm_2 = countvec_new.transform(X_train)

In [63]: # look at the array
         #X_train_dtm_2.toarray(5)

In [64]: # get the pandas dataframe having column names as learnt vocab and rows representing th

         #X_train_dtm_df_2 = pd.DataFrame(X_train_dtm_2.toarray(), columns=countvec_new.get_feat
         #

In [65]: #X_train_dtm_df_2.shape

In [66]: # get dtm for test data
         #X_test_dtm_2=countvec_new.transform(X_test)

         # create pandas df :
         #X_test_dtm_df_2 = pd.DataFrame(X_test_dtm_2.toarray(), columns = countvec_new.get_feat

         #X_test_dtm_df_2.head(5)

In [67]: # create the ML model
         #from sklearn.naive_bayes import MultinomialNB

         #mult_nb_2 = MultinomialNB()

         #%time mult_nb_2.fit(X_train_dtm_df_2, Y_train)
         # cannot run 5 class prediction problem - the computer hangs - too resource intensive.

In [68]: #Y_pred_mult_nb_multiclass = mult_nb_2.predict(X_test_dtm_df_2)
```