clickbait_analysis

April 15, 2018

1 Clickbait Analysis

In [170]:
```
# Import Packages

import math
import string
import numpy as np
import pandas as pd
import seaborn as sns

import matplotlib
%matplotlib inline
import matplotlib.pyplot as plt
plt.style.use('ggplot')

from nltk.corpus import stopwords
from nltk.stem import PorterStemmer
from sklearn.pipeline import Pipeline
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier
from sklearn.naive_bayes import MultinomialNB
from sklearn.cross_validation import train_test_split, cross_val_score
from sklearn.feature_extraction.text import CountVectorizer, TfidfTransformer

import warnings
warnings.simplefilter('ignore')
```

In [2]:
```
# Import datasets as Pandas DataFrames

clickbait_df = pd.read_excel('../data/clickbait_final.xlsx')
corpus_df = pd.read_excel('../data/corpus.xlsx')
```

In [3]:
```
clickbait_df.head()
```

Out[3]:

	title	clickbait	caps_ratio	exclamation	question
0	Please don't saved you a click us, you guys.	1	0.166667	0	0
1	IsConnor McGregor Hinting at a Possible Fight ...	1	1.285714	0	1
2	How Hillary Clinton Sill Can, And Should, Beco...	1	1.090909		
3	The internet has nominated the Twitter employe...	1	0.545455		
4	The Reason Cops Touch Your Car's Taillight Whe...	1	1.000000		

```
2            0         0
3            0         0
4            0         0
```

```
In [4]: corpus_df.head()
```

```
Out[4]:    clickbait  corpus
        0          1  please
        1          1   don't
        2          1   saved
        3          1   click
        4          1      us
```

```
In [5]: cb_caps = clickbait_df[clickbait_df['clickbait'] == 1]['caps_ratio']
        ncb_caps = clickbait_df[clickbait_df['clickbait'] == 0]['caps_ratio']
```

```
In [16]: ave_cb_caps = np.median(cb_caps)
         print('The average capitalization ratio for clickbait titles is: ' +
               str(round(ave_cb_caps, 2)))
```

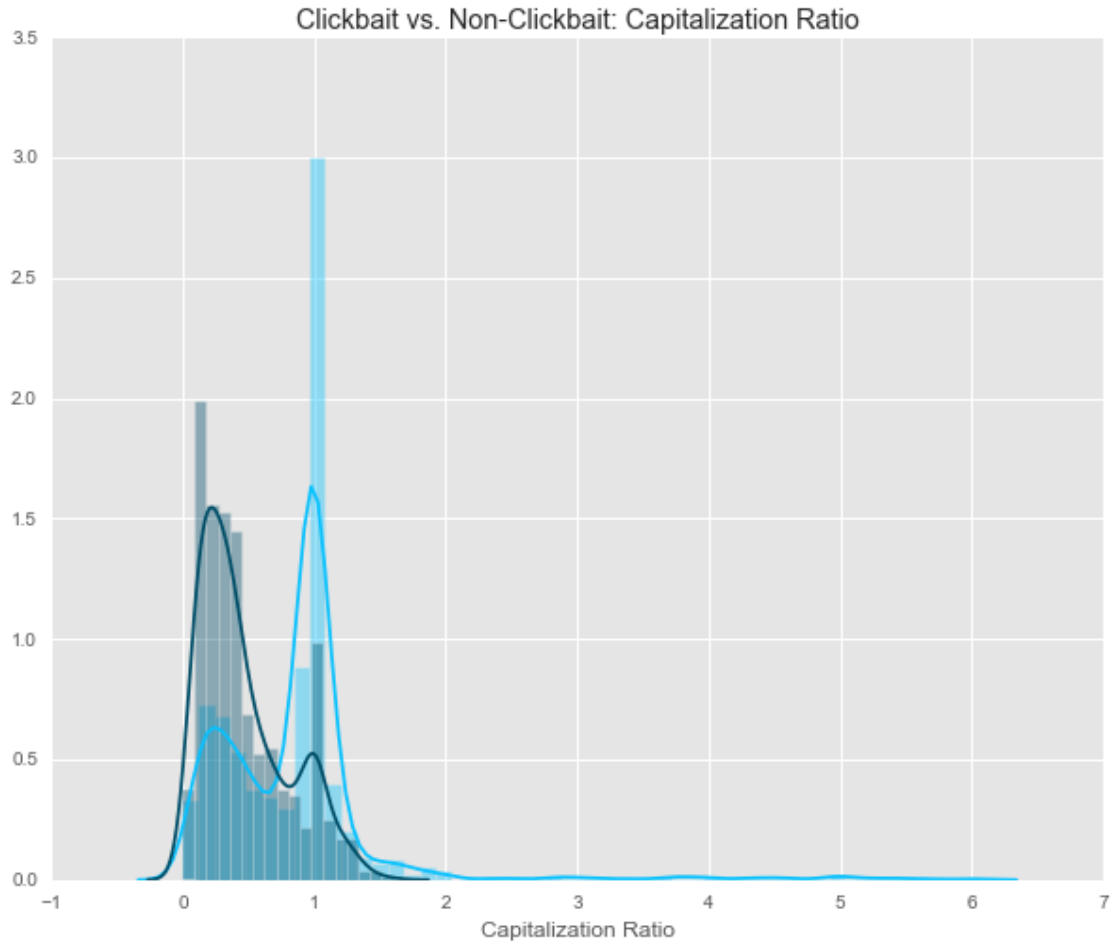
```
The average capitalization ratio for clickbait titles is: 1.0
```

```
In [17]: ave_ncb_caps = np.median(ncb_caps)
         print('The average capitalization ratio for non-clickbait titles is: ' +
               str(round(ave_ncb_caps, 2)))
```

```
The average capitalization ratio for non-clickbait titles is: 0.38
```

```
In [40]: plt.figure(figsize=(10, 8))
         plt.title('Clickbait vs. Non-Clickbait: Capitalization Ratio')
         sns.distplot(cb_caps, kde = True, color = '#09C2FF')
         sns.distplot(ncb_caps, kde = True, color = '#004E68')
         plt.xlabel('Capitalization Ratio')
```

```
Out[40]: <matplotlib.text.Text at 0x1160a52b0>
```




```
In [18]: cb_questions = clickbait_df[clickbait_df['clickbait'] == 1]['question']
         ncb_questions = clickbait_df[clickbait_df['clickbait'] == 0]['question']
```

```
In [28]: cb_question_percentage = sum(cb_questions)/len(cb_questions)
         print('The percentage of clickbait titles that are questions is: ' +
               str(round(cb_question_percentage * 100, 2)) + '%')
```

```
The percentage of clickbait titles that are questions is: 16.1%
```

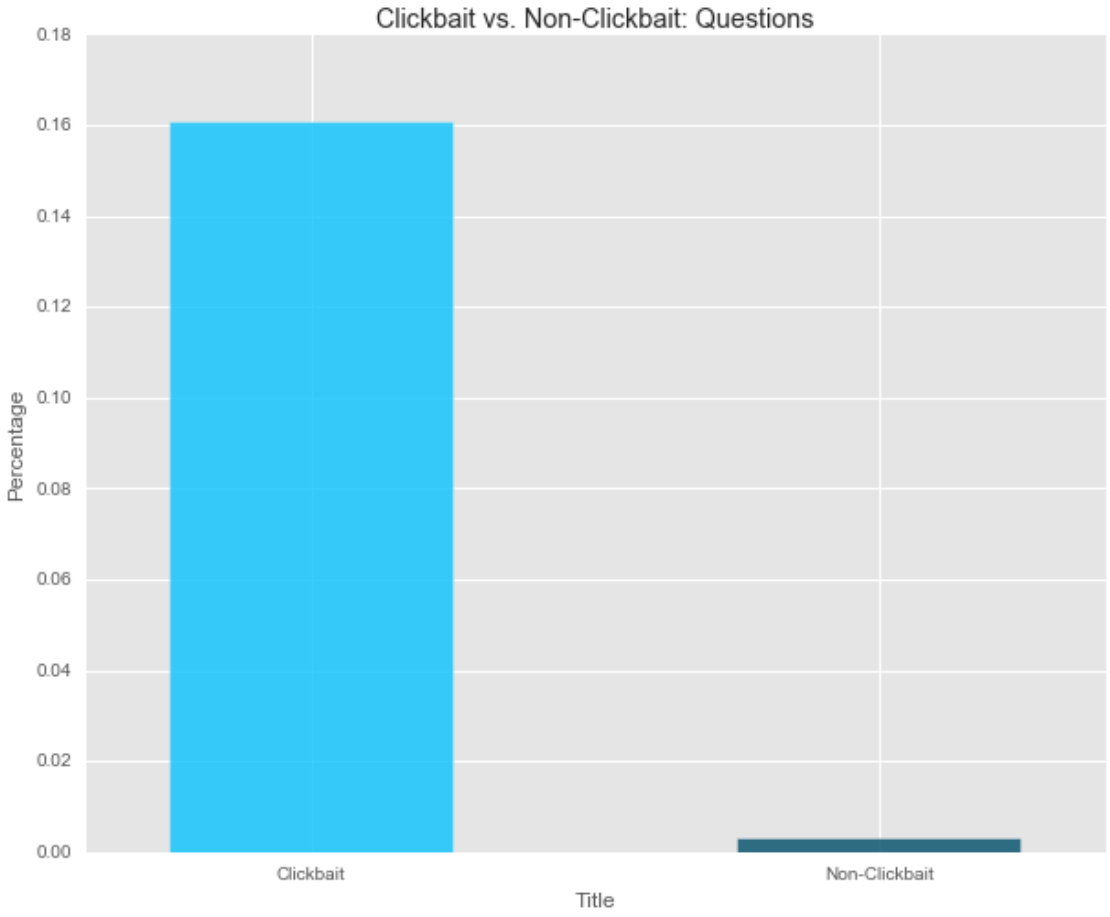
```
In [30]: ncb_question_percentage = sum(ncb_questions)/len(ncb_questions)
         print('The percentage of non-clickbait titles that are questions is: ' +
               str(round(ncb_question_percentage * 100, 3)) + '%')
```

```
The percentage of non-clickbait titles that are questions is: 0.302%
```

```
In [42]: plt.figure(figsize=(10, 8))
         plt.title('Clickbait vs. Non-Clickbait: Questions')
         plt.bar(
             np.arange(2),
             [cb_question_percentage, ncb_question_percentage],
             align = 'center',
             width = 0.5,
```

```
        alpha = 0.8,
        color = ['#09C2FF', '#004E68']
    )
    plt.xlabel('Title')
    plt.ylabel('Percentage')
    plt.xticks(np.arange(2), ['Clickbait', 'Non-Clickbait'])
```

```
Out[42]: ([<matplotlib.axis.XTick at 0x115d97128>,
           <matplotlib.axis.XTick at 0x116322630>],
          <a list of 2 Text xticklabel objects>)
```




```
In [19]: cb_exclamations = clickbait_df[clickbait_df['clickbait'] == 1]['exclamation']
         ncb_exclamations = clickbait_df[clickbait_df['clickbait'] == 0]['exclamation']
```

```
In [45]: cb_exclamations_percentage = sum(cb_exclamations)/len(cb_exclamations)
         print('The percentage of clickbait titles that are questions is: ' +
               str(round(cb_exclamations_percentage * 100, 2)) + '%')
```

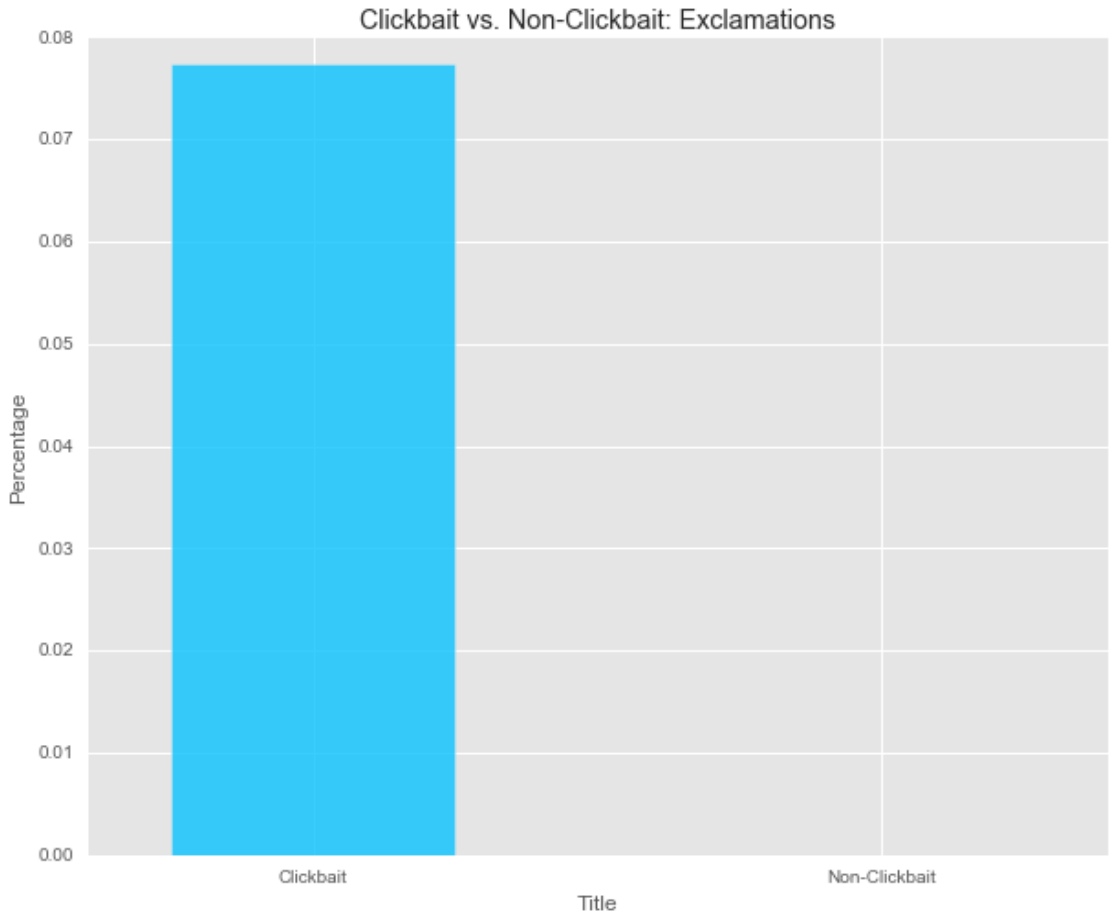
```
The percentage of clickbait titles that are questions is: 7.75%
```

```
In [46]: ncb_exclamations_percentage = sum(ncb_exclamations)/len(ncb_exclamations)
         print('The percentage of non-clickbait titles that are questions is: ' +
               str(round(ncb_exclamations_percentage * 100, 3)) + '%')
```

```
The percentage of non-clickbait titles that are questions is: 0.0%
```

```
In [47]: plt.figure(figsize=(10, 8))
         plt.title('Clickbait vs. Non-Clickbait: Exclamations')
         plt.bar(
             np.arange(2),
             [cb_exclamations_percentage, ncb_exclamations_percentage],
             align = 'center',
             width = 0.5,
             alpha = 0.8,
             color = ['#09C2FF', '#004E68']
         )
         plt.xlabel('Title')
         plt.ylabel('Percentage')
         plt.xticks(np.arange(2), ['Clickbait', 'Non-Clickbait'])
```

```
Out[47]: ([<matplotlib.axis.XTick at 0x11695fa58>,
           <matplotlib.axis.XTick at 0x1166b3f60>],
          <a list of 2 Text xticklabel objects>)
```




```
In [67]: def log_ratio(df, term_column = 'corpus', clickbait_indicator = 'clickbait'):
             """
```

```
    Find the frequency of words from clickbait tiles relative to non-clickbait titles
    """
    log_ratios = []
    cb_df = df[df[clickbait_indicator] == 1]
    ncb_df = df[df[clickbait_indicator] == 0]
    total_cb_corpus = len(cb_df) + 1
    total_ncb_corpus = len(ncb_df) + 1
    for term in df[term_column]:
        term_frequency_cb = (len(cb_df[cb_df[term_column] == term]) + 1)/total_cb_corpus
        term_frequency_ncb = (len(ncb_df[ncb_df[term_column] == term]) + 1)/total_ncb_corpus
        log_ratios += [math.log2(term_frequency_cb/term_frequency_ncb)]
    return log_ratios
```

In [69]:
```
log_ratios = log_ratio(corpus_df)
```

In [72]:
```
corpus_df['log_ratios'] = log_ratios
```

In [76]:
```
final_corpus_df=corpus_df.drop_duplicates().sort_values(by = ['log_ratios'], ascending = False
```

In [81]:
```
most_likely_cb = final_corpus_df[final_corpus_df['clickbait'] == 1].head(20)
most_likely_cb
```

Out[81]:

	clickbait	corpus	log_ratios
167	1	what	6.852069
115	1	here's	5.568276
340	1	why	5.470979
44	1	you	5.305242
13	1	how	4.998910
150	1	this	4.912611
168	1	happened	4.799602
528	1	did	4.799602
187	1	here's	4.688570
69	1	looks	4.629677
1026	1	they	4.629677
318	1	never	4.599303
141	1	most	4.366642
68	1	she	4.342395
36	1	reason	4.292642
283	1	happens	4.292642
166	1	guess	4.214639
842	1	actually	4.132177
645	1	do	4.044714
2405	1	really	4.044714

In [82]:
```
least_likely_cb = final_corpus_df[final_corpus_df['clickbait'] == 0].tail(20)
least_likely_cb
```

Out[82]:

	clickbait	corpus	log_ratios
10145	0	marijuana	-3.540248
10144	0	medical	-3.540248
10160	0	reports	-3.540248
10270	0	protest	-3.540248
9616	0	fired	-3.540248
9617	0	federal	-3.540248
9702	0	california	-3.655726
9805	0	russian	-3.655726

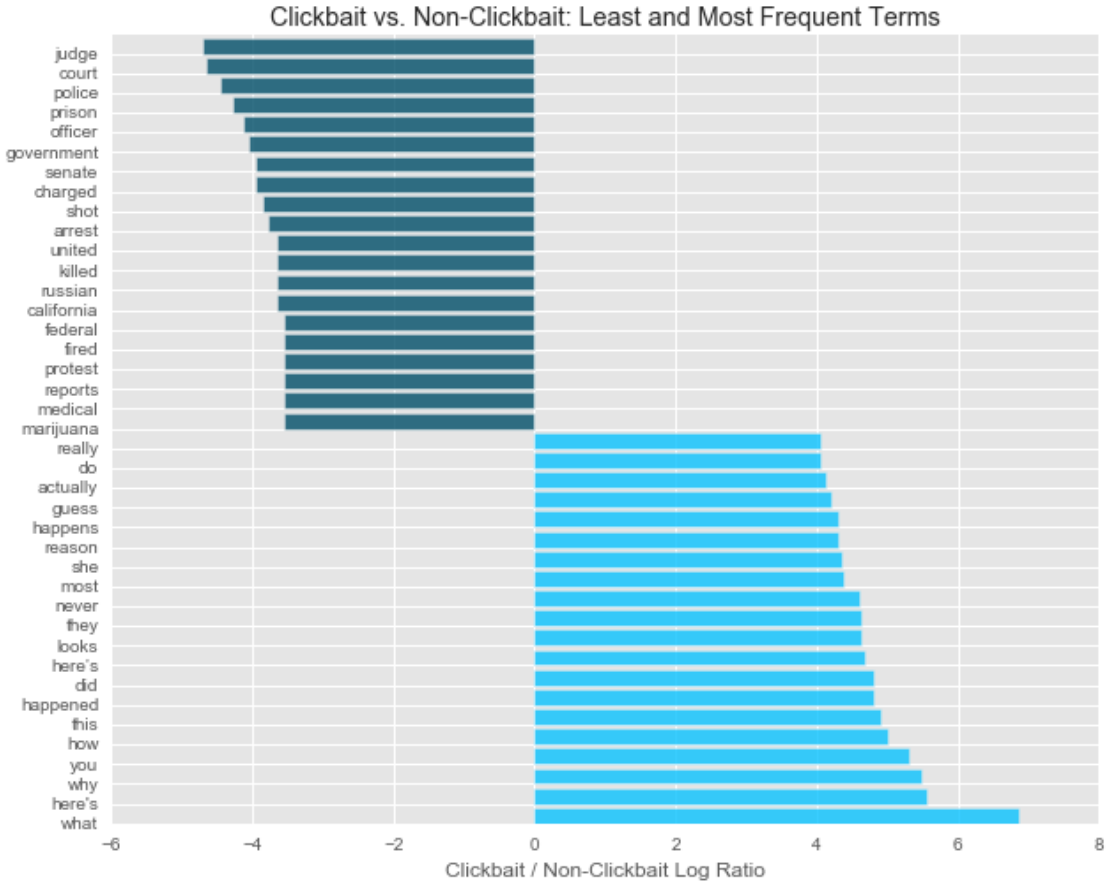
```
11494          0      killed   -3.655726
10240          0      united   -3.655726
10128          0      arrest   -3.762641
10846          0        shot   -3.862176
9785           0     charged   -3.955286
9703           0      senate   -3.955286
11669          0  government   -4.042749
10058          0     officer   -4.125211
9692           0      prison   -4.277214
9666           0      police   -4.457786
9694           0       court   -4.655726
9751           0       judge   -4.710173
```

In [101]:
```
concatenated_corpus_df = pd.concat([most_likely_cb, least_likely_cb])
```

In [105]:
```
plt.figure(figsize=(10, 8))
color_scheme = []
least_likely = ['#09C2FF'] * 20
most_likely = ['#004E68'] * 20
color_scheme += least_likely
color_scheme += most_likely
plt.title('Clickbait vs. Non-Clickbait: Least and Most Frequent Terms')
plt.barh(
    np.arange(len(most_likely_cb) + len(least_likely_cb)),
    most_likely_cb['log_ratios'].append(least_likely_cb['log_ratios']),
    alpha = 0.8,
    color = color_scheme
)
plt.xlabel('Clickbait / Non-Clickbait Log Ratio')
plt.yticks(np.arange(40), concatenated_corpus_df['corpus'])
```

Out[105]:
```
([<matplotlib.axis.YTick at 0x11977e9b0>,
  <matplotlib.axis.YTick at 0x11987f198>,
  <matplotlib.axis.YTick at 0x119aa3470>,
  <matplotlib.axis.YTick at 0x119ba7668>,
  <matplotlib.axis.YTick at 0x119bab198>,
  <matplotlib.axis.YTick at 0x119babc88>,
  <matplotlib.axis.YTick at 0x119bb07b8>,
  <matplotlib.axis.YTick at 0x119bb22e8>,
  <matplotlib.axis.YTick at 0x119bb2dd8>,
  <matplotlib.axis.YTick at 0x119bb7908>,
  <matplotlib.axis.YTick at 0x119bba438>,
  <matplotlib.axis.YTick at 0x119bbaf28>,
  <matplotlib.axis.YTick at 0x119bbfa58>,
  <matplotlib.axis.YTick at 0x119bc3588>,
  <matplotlib.axis.YTick at 0x119bc60b8>,
  <matplotlib.axis.YTick at 0x119bc6ba8>,
  <matplotlib.axis.YTick at 0x119bcb6d8>,
  <matplotlib.axis.YTick at 0x119bce208>,
  <matplotlib.axis.YTick at 0x119bcecf8>,
  <matplotlib.axis.YTick at 0x119bd3828>,
  <matplotlib.axis.YTick at 0x119bd7358>,
  <matplotlib.axis.YTick at 0x119bd7e48>,
  <matplotlib.axis.YTick at 0x119bda978>,
  <matplotlib.axis.YTick at 0x119bdf4a8>,
```

```
 <matplotlib.axis.YTick at 0x119bdff98>,
 <matplotlib.axis.YTick at 0x119be2ac8>,
 <matplotlib.axis.YTick at 0x119be75f8>,
 <matplotlib.axis.YTick at 0x119bec128>,
 <matplotlib.axis.YTick at 0x119becc18>,
 <matplotlib.axis.YTick at 0x119bf0748>,
 <matplotlib.axis.YTick at 0x119bf3278>,
 <matplotlib.axis.YTick at 0x119bf3d68>,
 <matplotlib.axis.YTick at 0x119bf8898>,
 <matplotlib.axis.YTick at 0x119bfb3c8>,
 <matplotlib.axis.YTick at 0x119bfbeb8>,
 <matplotlib.axis.YTick at 0x119bff9e8>,
 <matplotlib.axis.YTick at 0x119c05518>,
 <matplotlib.axis.YTick at 0x119c07048>,
 <matplotlib.axis.YTick at 0x119c07b38>,
 <matplotlib.axis.YTick at 0x119c0c668>],
<a list of 40 Text yticklabel objects>)
```



In [120]:
```
# Train-Test Split
X_train, X_test, y_train, y_test = train_test_split(
    clickbait_df[['caps_ratio', 'exclamation', 'question']],
    clickbait_df['clickbait'],
    random_state = 42,
```

```
    test_size = 0.2
)
```

In [156]:
```
# Logistic Regression Classification
logistic_regression = LogisticRegression()
logistic_regression = logistic_regression.fit(X_train, y_train)
logistic_regression.score(X_train, y_train)
```

Out[156]: 0.7383647798742138

In [158]:
```
# Logistic Regression Holdout Test
print('The Logistic Regression classifier performed with a '+
      str(sum(logistic_regression.predict(X_test) == np.array(y_test))/len(y_test) * 100) +
      '% accuracy on test data')
```

```
The Logistic Regression classifier performed with a 77.1356783919598% accuracy on test data
```

In [151]:
```
# Random Forest Classification
random_forest = RandomForestClassifier()
random_forest = random_forest.fit(X_train, y_train)
random_forest.score(X_train, y_train)
```

Out[151]: 0.7647798742138365

In [154]:
```
# Random Forest Holdout Test
print('The Random Forest classifier performed with a '+
      str(sum(random_forest.predict(X_test) == np.array(y_test))/len(y_test) * 100) +
      '% accuracy on test data')
```

```
The Random Forest classifier performed with a 77.63819095477386% accuracy on test data
```

In [159]:
```
# Preparing data for Naive Bayes Classification
stemmer = PorterStemmer()
processed_titles = []
for title in clickbait_df['title']:
    temp_np_title = title.strip(string.punctuation).split()
    np_title = [word.strip(string.punctuation) for word in temp_np_title]
    corpus = [word for word in np_title if word not in set(stopwords.words('english'))]
    lower_corpus = [word.lower() for word in corpus]
    final_corpus = [stemmer.stem(word) for word in lower_corpus]
    processed_titles += [' '.join(final_corpus)]
processed_titles = np.array(processed_titles)
```

In [163]:
```
X_train_nb, X_test_nb, y_train_nb, y_test_nb = train_test_split(
    processed_titles,
    clickbait_df['clickbait'],
    random_state = 42,
    test_size = 0.2
)
```

In [182]:
```
# Naive Bayes Classification
naive_bayes_pipeline = Pipeline([
    ('vect', CountVectorizer()),
    ('tfidf', TfidfTransformer()),
    ('multinomialnb', MultinomialNB())]
)
naive_bayes = naive_bayes_pipeline.fit(X_train_nb, y_train_nb)
naive_bayes.score(X_train_nb, y_train_nb)
```

```
Out[182]: 0.9861635220125786

In [185]: # Naive Bayes Holdout Test
          print('The Naive Bayes classifier performed with a '+
                str(sum(naive_bayes.predict(X_test_nb) == np.array(y_test_nb))/len(y_test_nb) * 100) +
                '% accuracy on test data')

The Naive Bayes classifier performed with a 89.9497487437186% accuracy on test data
```