In [1]:
```
import warnings
warnings.filterwarnings("ignore", category=DeprecationWarning)
warnings.filterwarnings("ignore", category=FutureWarning)
warnings.filterwarnings("ignore", category=UserWarning)
import numpy as np
import pandas as pd

#pd.set_option('display.max_colwidth', 200)

import matplotlib.pyplot as plt
import seaborn as sns

%matplotlib inline

import re
import string
```

In [2]:
```
test= pd.read_csv('Twitter Sentiment Test.csv')
train = pd.read_csv('Twitter Sentiment Train.csv')
```

In [3]:
```
print('Training dataset has {} rows and {} columns'.format(train.shape[0], train.shape[1]))
print('Testing dataset has {} rows and {} columns'.format(test.shape[0], test.shape[1]))
```

```
Training dataset has 31962 rows and 3 columns
Testing dataset has 17197 rows and 2 columns
```

In [4]:
```
train.head(10)
```

Out[4]:

	id	label	tweet
0	1	0	@user when a father is dysfunctional and is s...
1	2	0	@user @user thanks for #lyft credit i can't us...
2	3	0	bihday your majesty
3	4	0	#model i love u take with u all the time in ...
4	5	0	factsguide: society now #motivation
5	6	0	[2/2] huge fan fare and big talking before the...
6	7	0	@user camping tomorrow @user @user @user @use...
7	8	0	the next school year is the year for exams.ð ...
8	9	0	we won!!! love the land!!! #allin #cavs #champ...
9	10	0	@user @user welcome here ! i'm it's so #gr...

In [5]:
```
test.head(10)
```

Out[5]:

	id	tweet
0	31963	#studiolife #aislife #requires #passion #dedic...
1	31964	@user #white #supremacists want everyone to s...
2	31965	safe ways to heal your #acne!! #altwaystohe...
3	31966	is the hp and the cursed child book up for res...
4	31967	3rd #bihday to my amazing, hilarious #nephew...
5	31968	choose to be :) #momtips
6	31969	something inside me dies ð ¦ð ¿â ¨ eyes nes...
7	31970	#finished#tattoo#inked#ink#loveitâ ¤ï¸ #â ¤ï¸...
8	31971	@user @user @user i will never understand why...
9	31972	#delicious #food #lovelife #capetown mannaep...

In [6]:
```
train.label.unique()
```

Out[6]:
```
array([0, 1], dtype=int64)
```

In [7]:
```
train[train.label == 0].head(10)
```

Out[7]:

	id	label	tweet
0	1	0	@user when a father is dysfunctional and is s...
1	2	0	@user @user thanks for #lyft credit i can't us...
2	3	0	bihday your majesty
3	4	0	#model i love u take with u all the time in ...
4	5	0	factsguide: society now #motivation
5	6	0	[2/2] huge fan fare and big talking before the...
6	7	0	@user camping tomorrow @user @user @user @use...
7	8	0	the next school year is the year for exams.ð ...
8	9	0	we won!!! love the land!!! #allin #cavs #champ...
9	10	0	@user @user welcome here ! i'm it's so #gr...

In [8]:
```
train[train.label == 1].head(10)
```

Out[8]:

	id	label	tweet
13	14	1	@user #cnn calls #michigan middle school 'buil...
14	15	1	no comment! in #australia #opkillingbay #se...
17	18	1	retweet if you agree!
23	24	1	@user @user lumpy says i am a . prove it lumpy.
34	35	1	it's unbelievable that in the 21st century we'...
56	57	1	@user lets fight against #love #peace
68	69	1	ð ©the white establishment can't have blk fol...
77	78	1	@user hey, white people: you can call people '...
82	83	1	how the #altright uses &amp; insecurity to lu...
111	112	1	@user i'm not interested in a #linguistics tha...

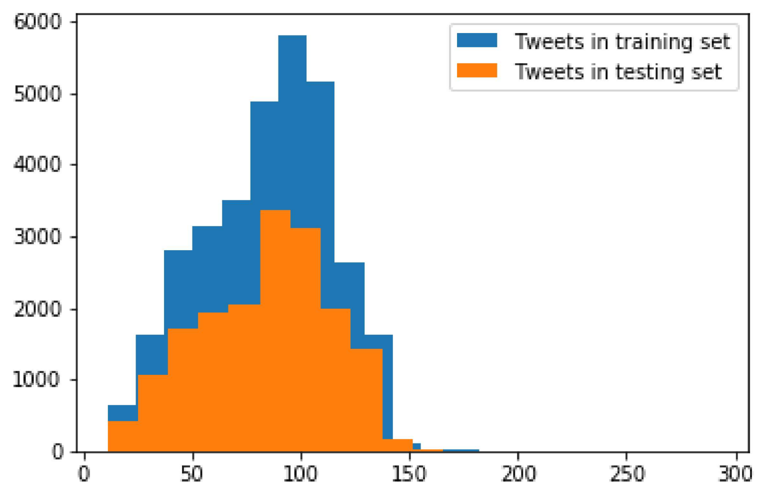
In [9]:
```
train.label.value_counts()
```

Out[9]:
```
0    29720
1     2242
Name: label, dtype: int64
```

In [10]:
```
train_length = train.tweet.str.len()
test_length = test.tweet.str.len()
print(train_length,test_length)
```

```
0        102
1        122
2         21
3         86
4         39
        ...
31957     68
31958    131
31959     63
31960     67
31961     32
Name: tweet, Length: 31962, dtype: int64 0         90
1        101
2         71
3        142
4         93
        ...
17192    108
17193     96
17194    145
17195    104
17196     64
Name: tweet, Length: 17197, dtype: int64
```

In [11]:
```
plt.hist(train_length, bins=20, label='Tweets in training set')
plt.hist(test_length, bins=20, label='Tweets in testing set')
plt.legend()
plt.show()
```



In [12]:
```
combined = train.append(test, ignore_index=True)
print('Combined data has {} rows and {} columns'.format(combined.shape[0], combined.shape[1]))
```

```
Combined data has 49159 rows and 3 columns
```

In [13]:
```
combined.head(10) #last values too
```

Out[13]:

	id	label	tweet
0	1	0.0	@user when a father is dysfunctional and is s...
1	2	0.0	@user @user thanks for #lyft credit i can't us...
2	3	0.0	bihday your majesty
3	4	0.0	#model i love u take with u all the time in ...
4	5	0.0	factsguide: society now #motivation
5	6	0.0	[2/2] huge fan fare and big talking before the...
6	7	0.0	@user camping tomorrow @user @user @user @use...
7	8	0.0	the next school year is the year for exams.ð ...
8	9	0.0	we won!!! love the land!!! #allin #cavs #champ...
9	10	0.0	@user @user welcome here ! i'm it's so #gr...

In [14]:
```
combined.tail(10)
```

Out[14]:

	id	label	tweet
49149	49150	NaN	loving lifeð ºð ¸â ï¸ ð #createyourfutu...
49150	49151	NaN	black professor demonizes, proposes nazi style...
49151	49152	NaN	learn how to think positive. #positive #ins...
49152	49153	NaN	we love the pretty, happy and fresh you! #teen...
49153	49154	NaN	2_damn_tuff-ruff_muff__techno_city-(ng005)-web...
49154	49155	NaN	thought factory: left-right polarisation! #tru...
49155	49156	NaN	feeling like a mermaid ð #hairflip #neverre...
49156	49157	NaN	#hillary #campaigned today in #ohio((omg)) &am...
49157	49158	NaN	happy, at work conference: right mindset leads...
49158	49159	NaN	my song "so glad" free download! #shoegaze ...

In [15]:
```
from nltk.stem.porter import PorterStemmer
stemmer = PorterStemmer()

def clean_tweet(tweet):

  '''This function takes raw tweet as input and
  returns cleaned tweet. It removes twitter handles, punctuation,
  short words and stopwords which does not contribute much to our
  analysis'''
  clean_handle = re.sub(r'@[\w]*', '', tweet)                          # Removes twitter handles from tweets
  clean_punc = re.sub(r'[^a-zA-Z#]', ' ', clean_handle)                 # Removes punctuation, special characte
  clean_short_tokenized = [word for word in clean_punc.split() if len(word) > 3] # Remove short words and tokenize
  clean_normalize = [stemmer.stem(word) for word in clean_short_tokenized]       # Stem tokenized words
  return ' '.join(clean_normalize)
```

In [16]:
```
clean_tweet(combined.tweet.iloc[3])
```

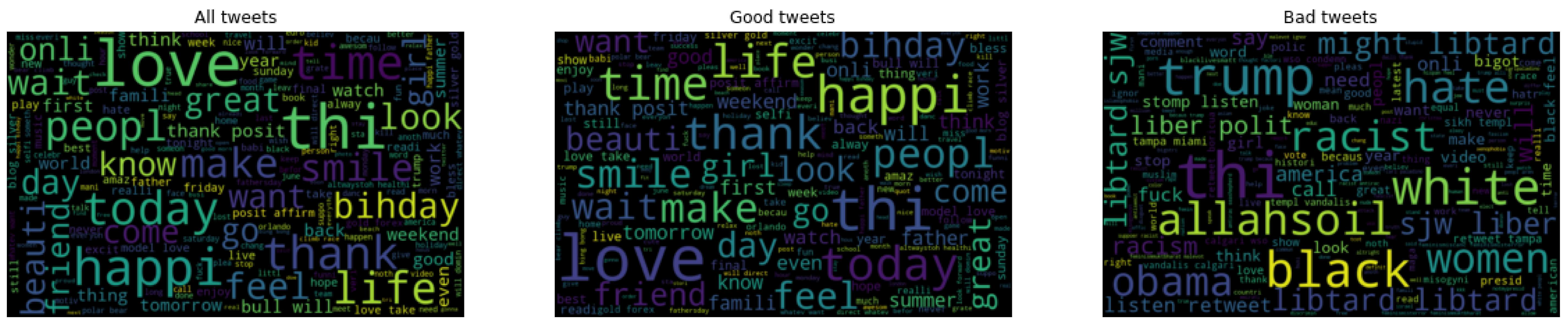
Out[16]:
```
'#model love take with time'
```

In [17]:
```
combined.tweet = combined.tweet.apply(lambda x : clean_tweet(x))
```

In [18]:
```
from wordcloud import WordCloud, STOPWORDS
wordcloud = WordCloud(width=800, height=500, random_state=42, max_font_size=110, stopwords=STOPWORDS)
```

In [19]:
```
all_tweets = ' '.join(combined.tweet)
good_tweets = ' '.join(combined[combined.label == 0].tweet)
bad_tweets = ' '.join(combined[combined.label == 1].tweet)
```

In [20]:
```
plt.figure(figsize=(20,12))
plt.subplot(1,3,1)
plt.imshow(wordcloud.generate(all_tweets), interpolation='bilinear')
plt.axis('off')
plt.title('All tweets')
plt.subplot(1,3,2)
plt.imshow(wordcloud.generate(good_tweets), interpolation='bilinear')
plt.axis('off')
plt.title('Good tweets')
plt.subplot(1,3,3)
plt.imshow(wordcloud.generate(bad_tweets), interpolation='bilinear')
plt.axis('off')
plt.title('Bad tweets')
plt.show()
```

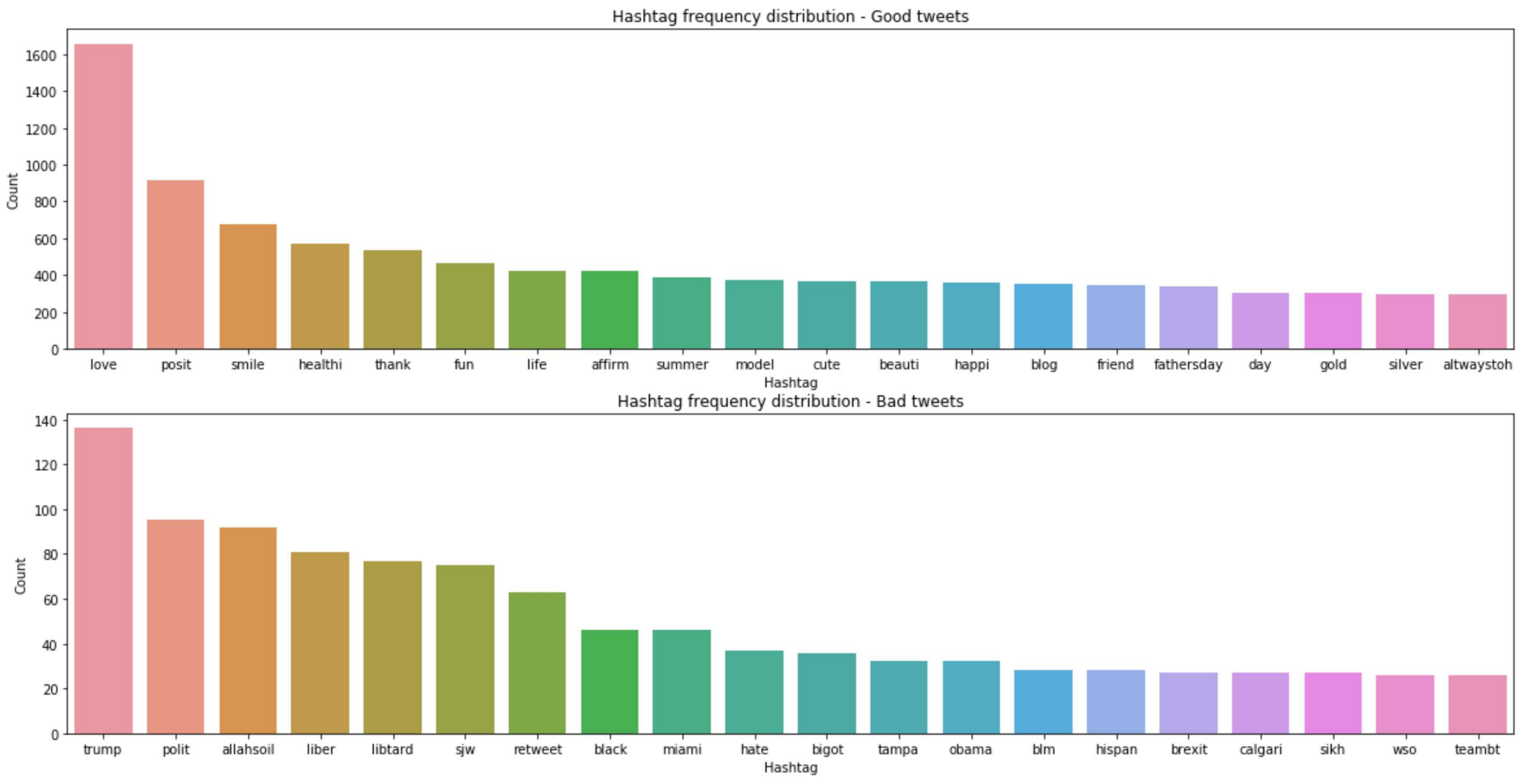


In [21]:
```
def extract_hashtags(tweet):
  hashtag = re.findall(r'#(\w+)', tweet)
  return hashtag
```

In [22]:
```
good_hashtags = extract_hashtags(good_tweets)
bad_hashtags = extract_hashtags(bad_tweets)
```

In [23]:
```
from nltk import FreqDist
good = FreqDist(good_hashtags)
bad = FreqDist(bad_hashtags)

good_ht = pd.DataFrame({'Hashtag' : list(good.keys()) , 'Count' : list(good.values())}).sort_values('Count', ascending=F
bad_ht = pd.DataFrame({'Hashtag' : list(bad.keys()) , 'Count' : list(bad.values())}).sort_values('Count', ascending=Fals
```

In [24]:
```
plt.figure(figsize=(20,10))
plt.subplot(2,1,1)
sns.barplot(data=good_ht.iloc[:20], x='Hashtag', y='Count')
plt.title('Hashtag frequency distribution - Good tweets')
plt.subplot(2,1,2)
sns.barplot(data=bad_ht.iloc[:20], x='Hashtag', y='Count')
plt.title('Hashtag frequency distribution - Bad tweets')
plt.show()
```



In [29]:
```
!pip install genism
```

```
Collecting genism

  ERROR: Could not find a version that satisfies the requirement genism (from versions: none)
ERROR: No matching distribution found for genism
```

In [30]:
```
from sklearn.feature_extraction.text import TfidfVectorizer, CountVectorizer
import gensim
```

```
---------------------------------------------------------------------------
ModuleNotFoundError                       Traceback (most recent call last)
<ipython-input-30-91226bfc434d> in <module>
      1 from sklearn.feature_extraction.text import TfidfVectorizer, CountVectorizer
----> 2 import gensim

ModuleNotFoundError: No module named 'gensim'
```

In [31]:
```
bow_vectorizer = CountVectorizer(max_df=0.90, min_df=2, max_features=1000, stop_words='english')
bow = bow_vectorizer.fit_transform(combined.tweet)
bow.shape
```

Out[31]:
```
(49159, 1000)
```

In [32]:
```
tfidf_vectorizer = TfidfVectorizer(max_df=0.90, min_df=2, max_features=1000, stop_words='english')
tfidf = tfidf_vectorizer.fit_transform(combined.tweet)
tfidf.shape
```

Out[32]:
```
(49159, 1000)
```

Logistic Regression

In [34]:
```
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import f1_score, confusion_matrix, accuracy_score, roc_curve, auc
train_bow = bow[:31962, :] # Training data had 31962 rows
test_bow_without_label = bow[31962:, :] # unlabbeled tweet data
x_bow_train, x_bow_test, y_bow_train, y_bow_test = train_test_split(train_bow, train.label, test_size=0.3, random_state=
```

In [35]:
```
model = LogisticRegression()
model.fit(x_bow_train, y_bow_train)
```

Out[35]:
```
LogisticRegression(C=1.0, class_weight=None, dual=False, fit_intercept=True,
                   intercept_scaling=1, l1_ratio=None, max_iter=100,
                   multi_class='warn', n_jobs=None, penalty='l2',
                   random_state=None, solver='warn', tol=0.0001, verbose=0,
                   warm_start=False)
```

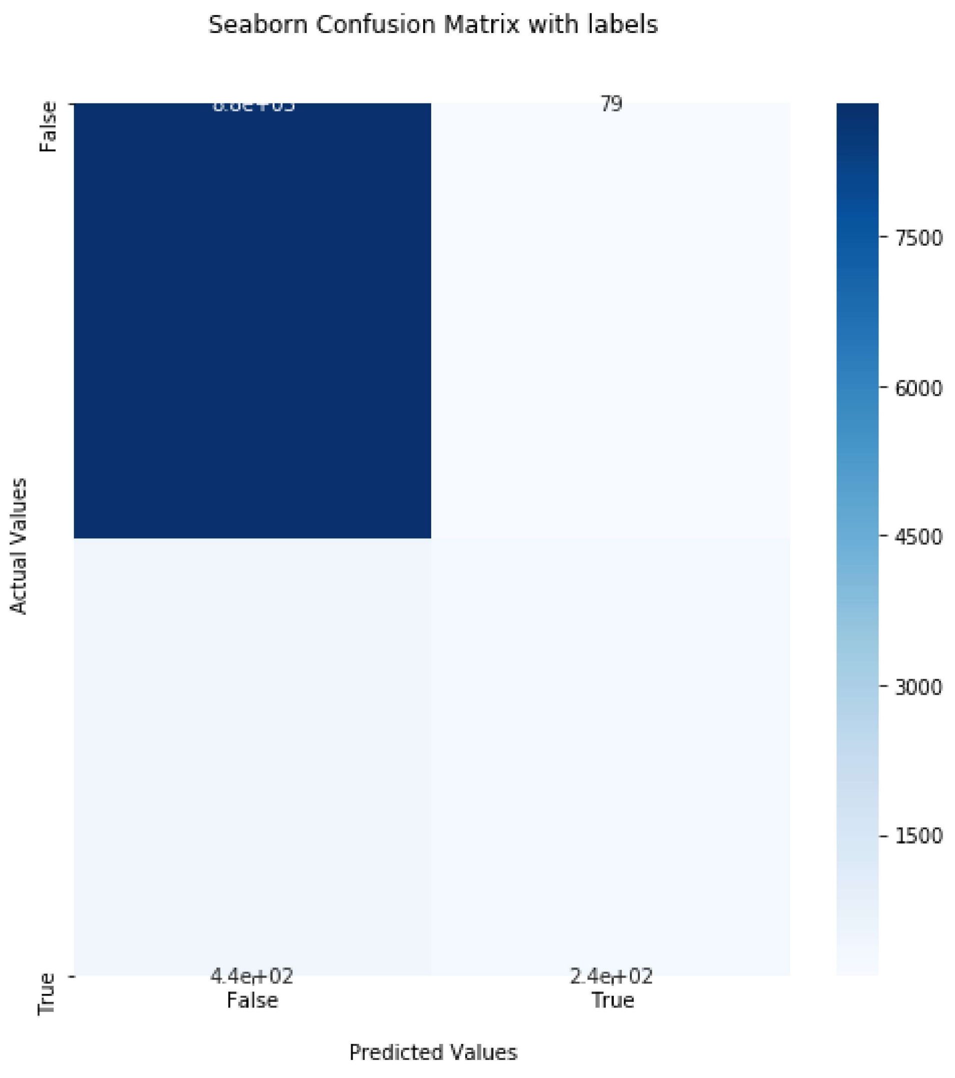
In [40]:
```
bow_pred = model.predict(x_bow_test)
print('Accuracy score : ',accuracy_score(y_bow_test, bow_pred))
print('F1 Score : ',f1_score(y_bow_test, bow_pred))
```

```
Accuracy score :  0.9458754823234957
F1 Score :  0.48460774577954313
```

In [48]:
```
from sklearn.metrics import confusion_matrix
import matplotlib.pyplot as plt
cf_matrix = confusion_matrix(y_bow_test,bow_pred)
cf_matrix
```

Out[48]:
```
array([[8826,   79],
       [ 440,  244]], dtype=int64)
```

In [85]:
```
import seaborn as sns

ax = sns.heatmap(cf_matrix, annot=True, cmap='Blues')

ax.set_title('Seaborn Confusion Matrix with labels\n\n');
ax.set_xlabel('\nPredicted Values')
ax.set_ylabel('Actual Values ');

## Ticket labels - List must be in alphabetical order
ax.xaxis.set_ticklabels(['False','True'])
ax.yaxis.set_ticklabels(['False','True'])
plt.rcParams['figure.figsize'] = [4,4]
## Display the visualization of the Confusion Matrix.
plt.show()
```



Support Vector Machines

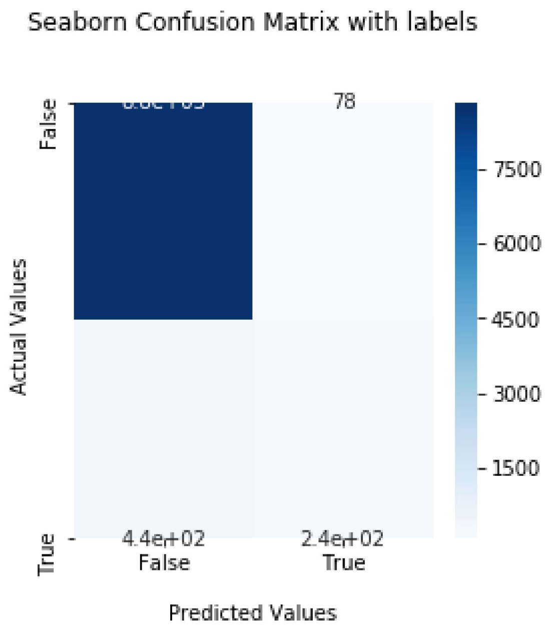
In [86]:
```
from sklearn.svm import SVC
model = SVC(kernel='linear', C=1, probability=True)
model.fit(x_bow_train, y_bow_train)
bow_pred = model.predict(x_bow_test)
print('Accuracy score : ',accuracy_score(y_bow_test, bow_pred))
print('F1 Score : ',f1_score(y_bow_test, bow_pred))
```

```
Accuracy score :  0.9456669100010429
F1 Score :  0.4805583250249251
```

In [87]:
```
from sklearn.metrics import confusion_matrix
import matplotlib.pyplot as plt
cf_matrix = confusion_matrix(y_bow_test,bow_pred)
cf_matrix
```

Out[87]:
```
array([[8827,   78],
       [ 443,  241]], dtype=int64)
```

In [88]:
```
import seaborn as sns

ax = sns.heatmap(cf_matrix, annot=True, cmap='Blues')

ax.set_title('Seaborn Confusion Matrix with labels\n\n');
ax.set_xlabel('\nPredicted Values')
ax.set_ylabel('Actual Values ');

## Ticket labels - List must be in alphabetical order
ax.xaxis.set_ticklabels(['False','True'])
ax.yaxis.set_ticklabels(['False','True'])
plt.rcParams['figure.figsize'] = [4,4]
## Display the visualization of the Confusion Matrix.
plt.show()
```



Random Forest

In [94]:
```
from sklearn.ensemble import RandomForestClassifier
rfc = RandomForestClassifier(n_estimators=400, random_state=11)
```

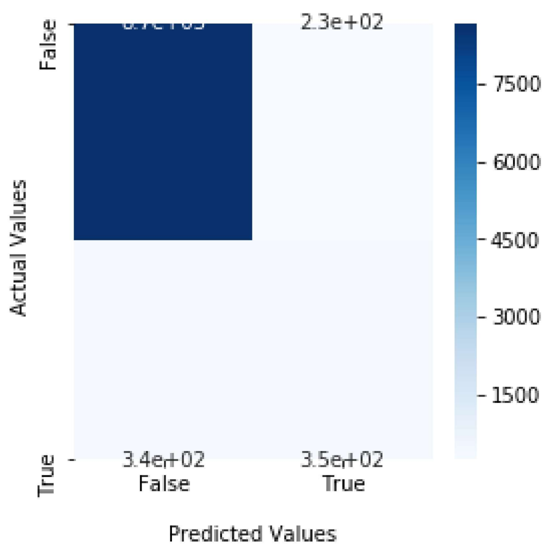
In [95]:
```
rfc.fit(x_bow_train, y_bow_train)
bow_pred = rfc.predict(x_bow_test)
print('Accuracy score : ',accuracy_score(y_bow_test, bow_pred))
print('F1 Score : ',f1_score(y_bow_test, bow_pred))
```

```
Accuracy score :  0.9406611742621754
F1 Score :  0.5494853523357086
```

In [97]:
```
from sklearn.metrics import confusion_matrix
import matplotlib.pyplot as plt
cf_matrix = confusion_matrix(y_bow_test,bow_pred)
print("Confusion_Matrix")
print(cf_matrix)
import seaborn as sns

ax = sns.heatmap(cf_matrix, annot=True, cmap='Blues')

ax.set_title('Seaborn Confusion Matrix with labels\n\n');
ax.set_xlabel('\nPredicted Values')
ax.set_ylabel('Actual Values ');

## Ticket labels - List must be in alphabetical order
ax.xaxis.set_ticklabels(['False','True'])
ax.yaxis.set_ticklabels(['False','True'])
plt.rcParams['figure.figsize'] = [4,4]
## Display the visualization of the Confusion Matrix.
plt.show()
```

```
Confusion_Matrix
[[8673  232]
 [ 337  347]]
```

Seaborn Confusion Matrix with labels



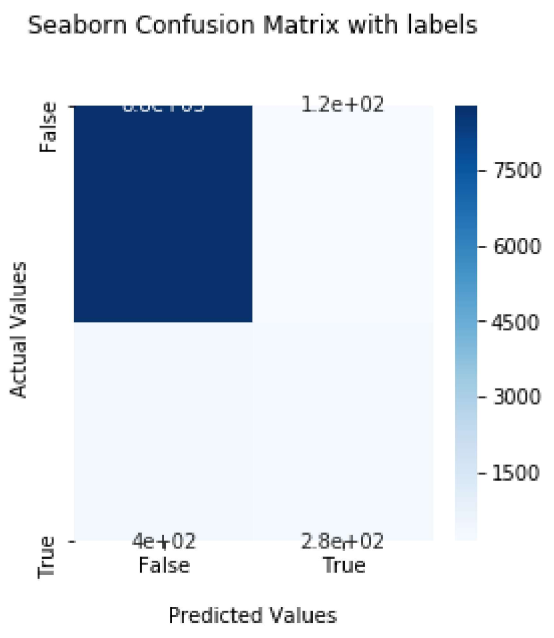
XGBoost

In [99]:
```
from xgboost import XGBClassifier
xgb = XGBClassifier(max_depth=6, n_estimators=1000)
xgb.fit(x_bow_train, y_bow_train)
bow_pred = xgb.predict(x_bow_test)
print('Accuracy score : ',accuracy_score(y_bow_test, bow_pred))
print('F1 Score : ',f1_score(y_bow_test, bow_pred))
```

```
Accuracy score :  0.9461883408071748
F1 Score :  0.5248618784530387
```

In [100]:
```
from sklearn.metrics import confusion_matrix
import matplotlib.pyplot as plt
cf_matrix = confusion_matrix(y_bow_test,bow_pred)
print("Confusion_Matrix")
print(cf_matrix)
import seaborn as sns

ax = sns.heatmap(cf_matrix, annot=True, cmap='Blues')

ax.set_title('Seaborn Confusion Matrix with labels\n\n');
ax.set_xlabel('\nPredicted Values')
ax.set_ylabel('Actual Values ');

## Ticket labels - List must be in alphabetical order
ax.xaxis.set_ticklabels(['False','True'])
ax.yaxis.set_ticklabels(['False','True'])
plt.rcParams['figure.figsize'] = [4,4]
## Display the visualization of the Confusion Matrix.
plt.show()
```

```
Confusion_Matrix
[[8788  117]
 [ 399  285]]
```



In [ ]:
```
```