REVENUE DEVELOPMENT IN RESTAURANT INDUSTRY

- Restaurant Industry is one of the biggest revenue generating industries of the world. Revenue from the restaurant industry was estimated at USD 799 Billions with 4.3% rise than the previous year which shows that restaurant trend has no near end. But, still we see that not all the restaurants shine in the market. There are a lot of restaurants which closes within an year of their opening.
- What do you think is the major reason behind the failure of any restaurant?
- Yes, it's the poor analytics !
- You can save your restaurant just by the good analysis which can help you in giving insights of the market competition and, analysis of your customers' reviews, which you can use to make development in your services and ultimately increase your restaurant's revenue.

In [1]:

```
from IPython.display import Image
Image("image.jpg")
```

Out[1]:

Dataset and it's features.

We have taken the dataset

- Restaurant Id: Unique id of every restaurant across various cities of the world
- Restaurant Name: Name of the restaurant
- Country Code: Country in which restaurant is located
- City: City in which restaurant is located
- Address: Address of the restaurant

- Locality: Location in the city
- Locality Verbose: Detailed description of the locality
- Longitude: Longitude coordinate of the restaurant's location
- Latitude: Latitude coordinate of the restaurant's location
- Cuisines: Cuisines offered by the restaurant
- Average Cost for two: Cost for two people in different currencies
- Currency: Currency of the country
- Has Table booking: yes/no
- Has Online delivery: yes/ no
- Is delivering: yes/ no
- Switch to order menu: yes/no
- Price range: range of price of food
- Aggregate Rating: Average rating out of 5
- Stars: Number of Stars out of 5
- Rating Date: The Date the rating was given
- Rating color: depending upon the average rating color
- Rating text: text on the basis of rating of rating Votes: Number of ratings casted by people

Importing the libraries

In [2]:

```
%matplotlib inline
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

Importing the dataset

In [3]:

```
df = pd.read_csv('/Users/saurabhkarambalkar/Desktop/Restaurant_Data/data.csv')
df.head()
```

Out[3]:

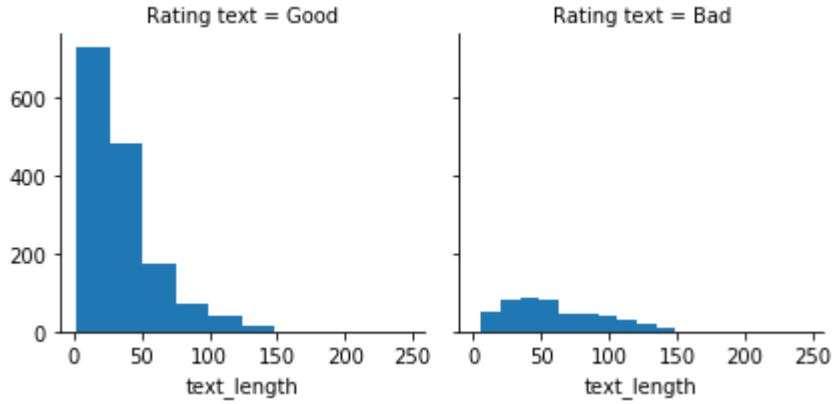
	Restaurant ID	Restaurant Name	Country Code	City	Address	Locality	Longitude	Latitude
0	6317637	Le Petit Souffle	162	Makati City	Third Floor, Century City Mall, Kalayaan Avenu...	Century City Mall, Poblacion, Makati City	121.027535	14.56544
1	6304287	Izakaya Kikufuji	162	Makati City	Little Tokyo, 2277 Chino Roces Avenue, Legaspi...	Little Tokyo, Legaspi Village, Makati City	121.014101	14.55370
2	6300002	Heat - Edsa Shangri-La	162	Mandaluyong City	Edsa Shangri-La, 1 Garden Way, Ortigas, Mandal...	Edsa Shangri-La, Ortigas, Mandaluyong City	121.056831	14.58140
3	6318506	Ooma	162	Mandaluyong City	Third Floor, Mega Fashion Hall, SM Megamall, O...	SM Megamall, Ortigas, Mandaluyong City	121.056475	14.58531
4	6314302	Sambo Kojin	162	Mandaluyong City	Third Floor, Mega Atrium, SM Megamall, Ortigas...	SM Megamall, Ortigas, Mandaluyong City	121.057508	14.58445

5 rows × 22 columns

Analysing the dataset

In [4]:

```
df['text_length'] = df.Review.apply(len)
g = sns.FacetGrid(df, col="Rating text")
g = g.map(plt.hist, "text_length")
```



We observe that the texts which are rated as 'good' are more in length than the ones which are rated as 'bad'.

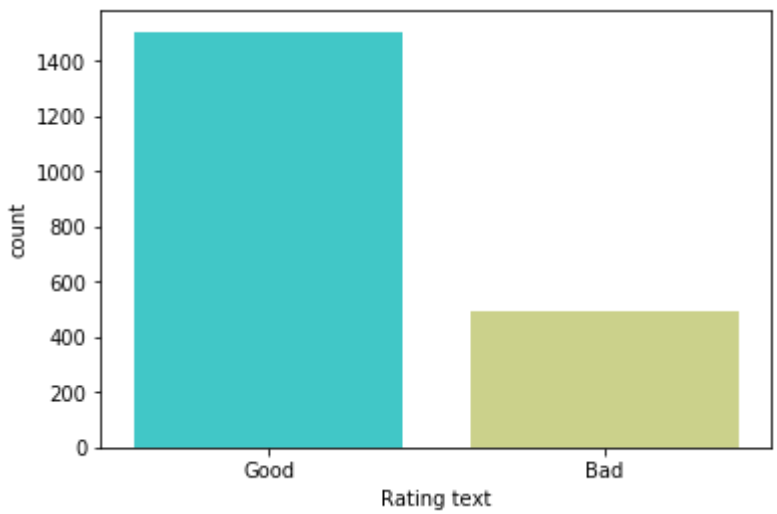
In [5]:

```
sns.countplot(x='Rating text',data=df,palette='rainbow')
```

```
/anaconda/lib/python3.6/site-packages/seaborn/categorical.py:1460: Fut
ureWarning: remove_na is deprecated and is a private function. Do not
use.
  stat_data = remove_na(group_data)
```

Out[5]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x11b4e56d8>
```



The number of 'good' rated texts are more than the 'bad' rated texts.

We import a new dataset which contains the details regarding the countries and their codes.

In [6]:

```
df_CC = pd.read_excel('Country-Code.xlsx')
df_CC.head()
```

Out[6]:

	Country Code	Country
0	1	India
1	14	Australia
2	30	Brazil
3	37	Canada
4	94	Indonesia

Grouping the data to take insights.

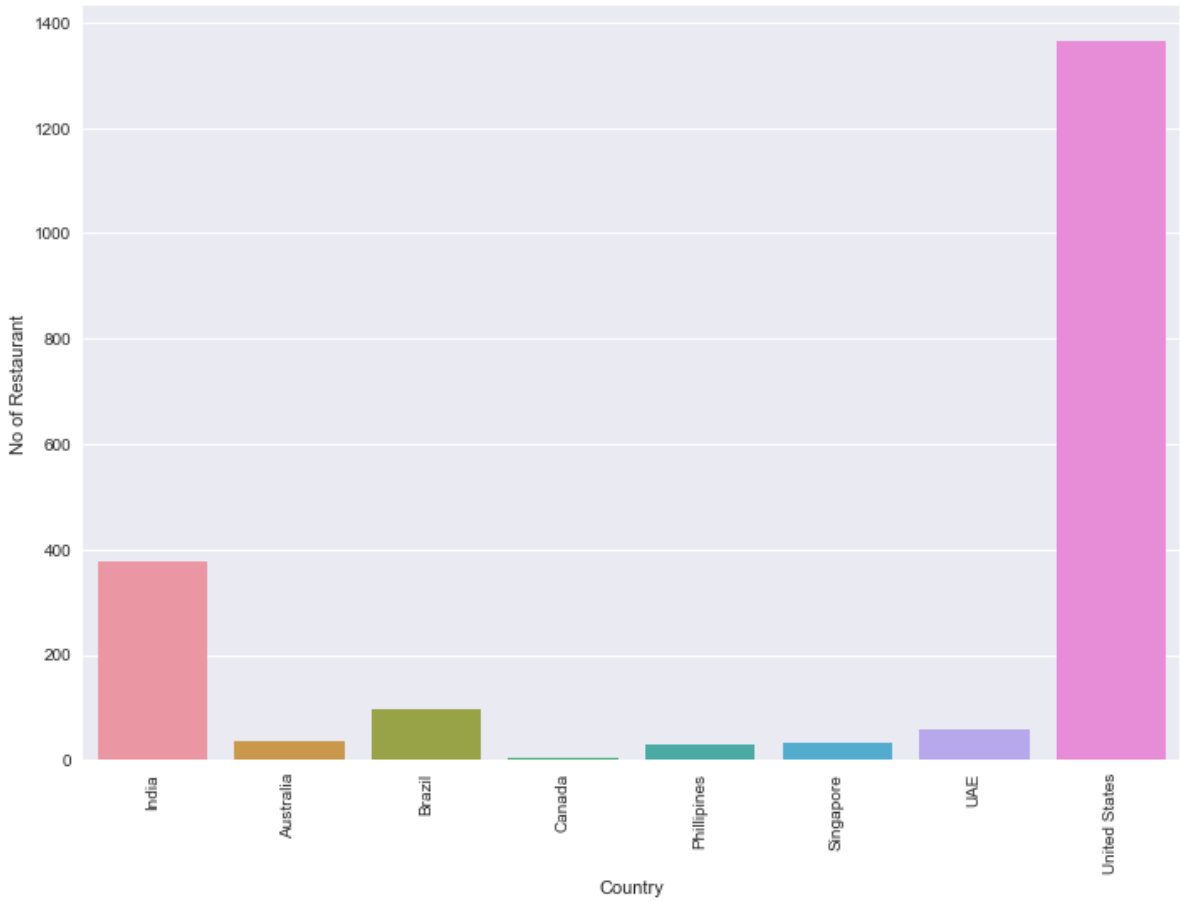
In [7]:

```
df_grp = df.groupby(['Country Code'], as_index=False).count()[['Country Code', 'Rest
df_grp.columns = ['Country Code', 'No of Restaurant']
res = df_grp.join(df_CC.set_index('Country Code'), on = 'Country Code')
```

In [8]:

```
sns.set(rc={'figure.figsize':(11.7,8.27)})
sns.barplot(res['Country'], res['No of Restaurant'])
plt.xticks(rotation = 90)
plt.show()
```

```
/anaconda/lib/python3.6/site-packages/seaborn/categorical.py:1460: Fut
ureWarning: remove_na is deprecated and is a private function. Do not
use.
  stat_data = remove_na(group_data)
```



The above graph on number of restaurants registered on the app based on countries shows that the United States tops the list, followed by India.

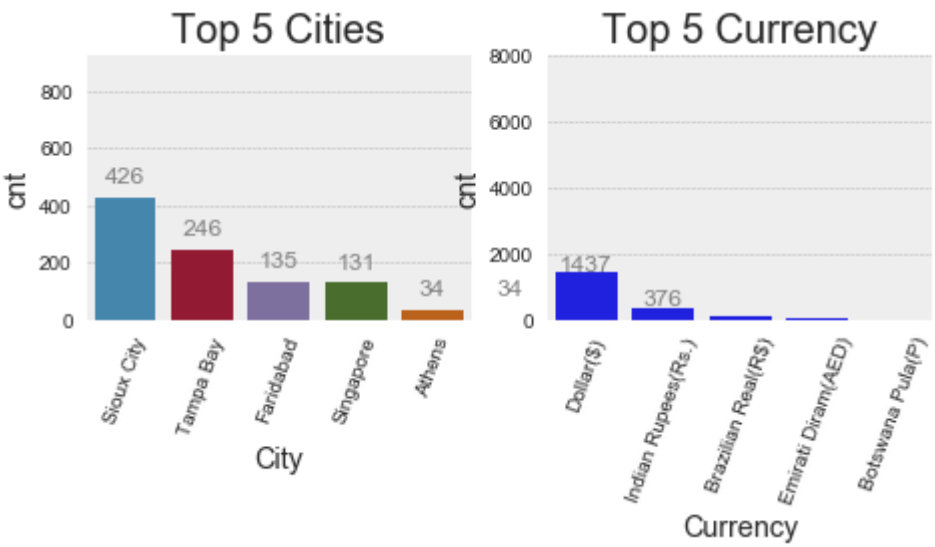
In [9]:

```
with plt.style.context('bmh'):

    cnt = df['Country Code'].value_counts().to_frame()
    ax = plt.subplot2grid((3,3),(2,0))
    cnt = df['City'].value_counts().reset_index()
    cnt.rename(columns = {'index':'City', 'City':'cnt'}, inplace = True)
    sns.barplot(x = 'City', y = 'cnt', data = cnt.head(5), ax = ax)
    ax.tick_params(axis='x', rotation=70)
    ax.set_title('Top 5 Cities', size = 20)
    ax.set_ylim([0, cnt['cnt'].head(1).values+500])
    for i, val in enumerate(cnt['cnt'].head(6)):
        ax.text(i, val+50, val, color = 'grey', ha = 'center')

    ax = plt.subplot2grid((3,3),(2,1))
    cnt = df['Currency'].value_counts().reset_index()
    cnt.rename(columns = {'index':'Currency', 'Currency':'cnt'}, inplace = True)
    sns.barplot(x = 'Currency', y = 'cnt', data =cnt.head(5), color = 'b', ax = ax)
    ax.set_title('Top 5 Currency', size = 20)
    ax.tick_params(axis='x', rotation=70)
    ax.set_ylim([0, 8000])
    for i, val in enumerate(cnt['cnt'].head(2)):
        ax.text(i, val+50, val, color = 'grey', ha = 'center')
    sns.despine(left=True, bottom=True)
    plt.show()
```

```
/anaconda/lib/python3.6/site-packages/seaborn/categorical.py:1460: Fut
ureWarning: remove_na is deprecated and is a private function. Do not
use.
  stat_data = remove_na(group_data)
```



The top 5 cities having maximum restaurants registered on the app is shown in the left graph. The top 5 currencies in which revenue is earned is shown in the right graph.

Data Pre-processing

In [10]:

```
cleanup_cols = {"Has Online delivery":{"No": 0, "Yes": 1},
                "Has Table booking":{"No": 0, "Yes": 1},
                "Is delivering now":{"No": 0, "Yes": 1},
                "Liked":{"No":0, "Yes":1},
                "Switch to order menu":{"No": 0, "Yes": 1}}


df.replace(cleanup_cols, inplace=True)
```

We will predict whether the customer likes the restaurants based on the reviews. It will give us an idea if the customer will return or not.

Natural Language Processing

In [11]:

```
# Cleaning the texts
import re
import nltk
nltk.download('stopwords')
from nltk.corpus import stopwords
from nltk.stem.porter import PorterStemmer
```

```
[nltk_data] Downloading package stopwords to
[nltk_data]     /Users/saurabhkarambalkar/nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
```

In [12]:

```
corpus = []
for i in range(0,2001):
    review = re.sub('[^a-zA-Z]', ' ', df['Review'][i])
    review = review.lower()
    review = review.split()
    ps = PorterStemmer()  # Taking roots of different versions of the same word;
                          # Not to have too many words in the end;
                          # To regroup same versions of the words;
    review = [ps.stem(word) for word in review if not word in set(stopwords.words('e
    review = ' '.join(review)
    corpus.append(review)
```

In [13]:

```
corpus
```

```
 place receiv star appet ',
 'cocktail handmad delici',
 'definit go back',
 'glad found place',
 'great food servic huge portion give militari discount',
 'alway great time do gringo',
 'updat went back second time still amaz',
 'got food appar never heard salt batter fish chewi',
 'great way finish great',
 'deal includ tast drink jeff went beyond expect',
 'good food',
 'servic meh',
 'took min get milkshak noth chocol milk',
 'guess known place would suck insid excalibur use common sens',
 'scallop dish quit appal valu well',
 'time bad custom servic',
 'sweet potato fri good season well',
 'today second time lunch buffet pretti good',
 'much good food vega feel cheat wast eat opportun go rice compani',
 'come like experienc underwhelm relationship parti wait person ask br
```

In [14]:

```
# Creating the Bag of Words model
from sklearn.feature_extraction.text import CountVectorizer
cv = CountVectorizer(max_features=1500)
X = cv.fit_transform(corpus).toarray()
y = df.iloc[:, 21].values
```

In [15]:

```
from sklearn.cross_validation import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X,y,test_size=0.2,random_state=0
```

```
/anaconda/lib/python3.6/site-packages/sklearn/cross_validation.py:41:
DeprecationWarning: This module was deprecated in version 0.18 in favo
r of the model_selection module into which all the refactored classes
and functions are moved. Also note that the interface of the new CV it
erators are different from that of this module. This module will be re
moved in 0.20.
  "This module will be removed in 0.20.", DeprecationWarning)
```

In [16]:

```
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)
```

```
/anaconda/lib/python3.6/site-packages/sklearn/utils/validation.py:475:
DataConversionWarning: Data with input dtype int64 was converted to fl
oat64 by StandardScaler.
  warnings.warn(msg, DataConversionWarning)
```

In [17]:

```
from sklearn.naive_bayes import GaussianNB
classifier = GaussianNB()
classifier.fit(X_train,y_train)
```

Out[17]:

```
GaussianNB(priors=None)
```

In [18]:

```
y_pred = classifier.predict(X_test)
```

In [19]:

```
from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, y_pred)
cm
```

Out[19]:

```
array([[ 84,  13],
       [112, 192]])
```

In [20]:

```
from sklearn.metrics import accuracy_score
accuracy_score(y_test,y_pred)
```

Out[20]:

```
0.6882793017456359
```

We get an accuracy of 77% which says if the customer will like the restaurant or not based on the reviews.

Now, we will see whether the customer likes the restaurant based on the price and the ratings.

In [21]:

```
X = df.iloc[:,[15,16]].values
y = df.iloc[:,21].values
```

In [22]:

```
from sklearn.utils import shuffle
shuffle(df)
from sklearn.cross_validation import train_test_split
X_train,X_test,y_train,y_test = train_test_split(X,y,test_size=0.2,random_state=1)
```

In [23]:

```
from sklearn.preprocessing import StandardScaler
sc_X = StandardScaler()
X_train = sc_X.fit_transform(X_train)
X_test = sc_X.transform(X_test)
```

```
/anaconda/lib/python3.6/site-packages/sklearn/utils/validation.py:475:
DataConversionWarning: Data with input dtype int64 was converted to fl
oat64 by StandardScaler.
  warnings.warn(msg, DataConversionWarning)
```

We will train our data on different classification models to check which model gives us the maximum accuracy

1. LDA
2. Gaussian NB
3. Logistic Regression
4. KNN
5. Random Forest

In [24]:

```
# Import necessary models from scikit_learn

from sklearn import model_selection
from sklearn.discriminant_analysis import LinearDiscriminantAnalysis
from sklearn.naive_bayes import GaussianNB
from sklearn.linear_model import LogisticRegression
from sklearn.neighbors import KNeighborsClassifier
from sklearn.ensemble import RandomForestClassifier
```

In [25]:

```
# Prepare configuration for cross validation test harness
seed = 123
```

In [26]:

```
# Prepare models

models = []
models.append(('LDA', LinearDiscriminantAnalysis()))
models.append(('NB', GaussianNB()))
models.append(('LOG',LogisticRegression()))
models.append(('KNN',KNeighborsClassifier()))
models.append(('RF',RandomForestClassifier()))
```

In [27]:

```
# Evaluate each model

results = []
names = []
scoring = 'accuracy'
for name, model in models:
    kfold = model_selection.KFold(n_splits=10, random_state=seed)
    cv_results = model_selection.cross_val_score(model, X, y, cv=kfold, scoring=scor
    results.append(cv_results)
    names.append(name)
    msg = "%s: %f (%f)" % (name, cv_results.mean(), cv_results.std())
    print(msg)
```

```
LDA: 0.725729 (0.237966)
NB: 0.731726 (0.260818)
LOG: 0.729729 (0.237499)
KNN: 0.584704 (0.149398)
RF: 0.733729 (0.261968)
```

We observe that Random Forest and Gaussian Naive Bayes model suits best for our data so we will try fitting them to our training set and check their accuracies.

Fitting Naive Bayes to the training set

In [28]:

```
from sklearn.naive_bayes import GaussianNB
classifier = GaussianNB()
classifier.fit(X_train, y_train)
```

Out[28]:

```
GaussianNB(priors=None)
```

In [29]:

```
# Predicting the Test set results
y_pred = classifier.predict(X_test)
```

In [30]:

```
# Making the Confusion Matrix
from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, y_pred)
cm
```

Out[30]:

```
array([[ 28,  83],
       [ 12, 278]])
```

In [31]:

```
from sklearn.metrics import accuracy_score
accuracy_score(y_test,y_pred)
```

Out[31]:

```
0.76309226932668328
```

Random Forest Classification to the training set

In [32]:

```
from sklearn.ensemble import RandomForestClassifier
classifier = RandomForestClassifier(n_estimators = 10, criterion = 'entropy', randor
classifier.fit(X_train, y_train)
```

Out[32]:

```
RandomForestClassifier(bootstrap=True, class_weight=None, criterion='e
ntropy',
            max_depth=None, max_features='auto', max_leaf_nodes=None,
            min_impurity_decrease=0.0, min_impurity_split=None,
            min_samples_leaf=1, min_samples_split=2,
            min_weight_fraction_leaf=0.0, n_estimators=10, n_jobs=1,
            oob_score=False, random_state=0, verbose=0, warm_start=Fal
se)
```

In [33]:

```
# Predicting the Test set results
y_pred = classifier.predict(X_test)
```

In [34]:

```
# Making the Confusion Matrix
from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, y_pred)
cm
```

Out[34]:

```
array([[ 24,  87],
       [ 10, 280]])
```

In [35]:

```
from sklearn.metrics import accuracy_score
accuracy_score(y_test,y_pred)
```

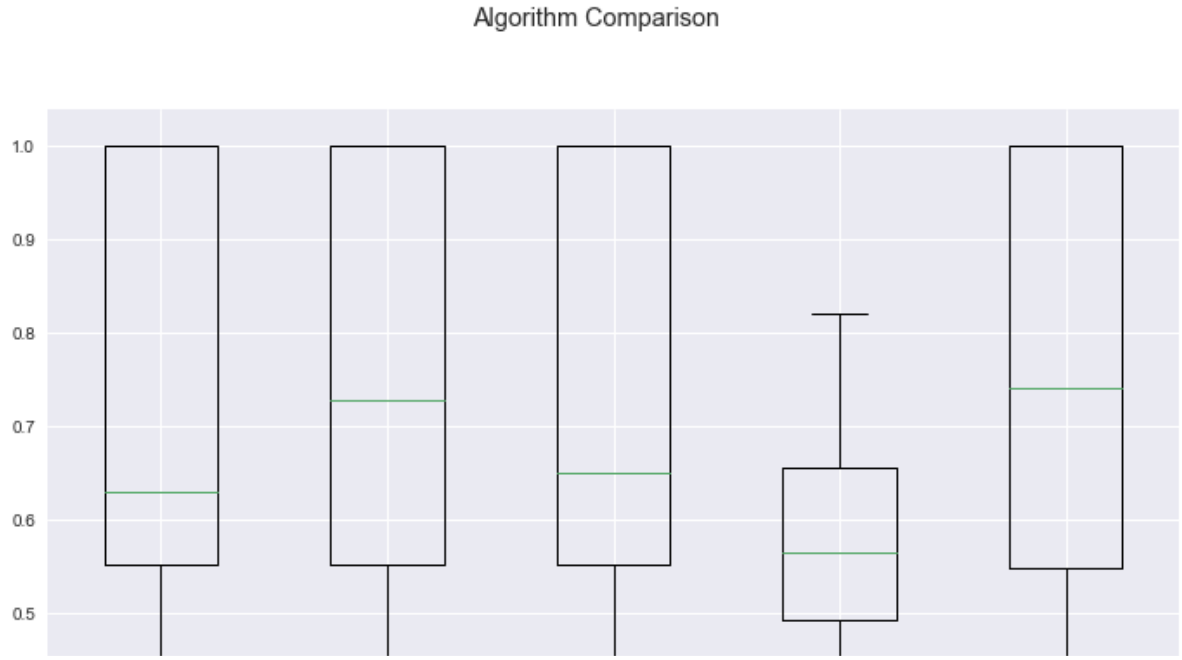
Out[35]:

```
0.75810473815461343
```

In [36]:

```
# Boxplot algorithm comparison

fig = plt.figure()
fig.suptitle('Algorithm Comparison')
ax = fig.add_subplot(111)
plt.boxplot(results)
ax.set_xticklabels(names)
plt.show()
```



We get the highest accuracy for the Gaussian Naive Bayes model with 76.30%

Further, we will move on to analysing the texts given in our Reviews column.

Sentiment Analysis

In [37]:

```
import json
from pandas.io.json import json_normalize
```

In [38]:

```
import textblob as tb
from textblob import TextBlob
```

In [39]:

```
!python -m textblob.download_corpora
```

```
/usr/local/opt/python@2/bin/python2.7: No module named textblob
```

In [40]:

```
reviews=df['Review']
```

In [41]:

```
# Cleaning the texts
import re
import nltk
nltk.download('stopwords')
from nltk.corpus import stopwords
from nltk.stem.porter import PorterStemmer
corpus = []
```

```
[nltk_data] Downloading package stopwords to
[nltk_data]     /Users/saurabhkarambalkar/nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
```

In [42]:

```
for i in range(0, 2000):
    review_clean = re.sub('[^a-zA-Z]', ' ', df['Review'][i])
    review_clean = review_clean.lower()
    review_clean = review_clean.split()
    ps = PorterStemmer()
    review_clean = [ps.stem(word) for word in review_clean if not word in set(stopwo
    review_clean = ' '.join(review_clean)
    corpus.append(review_clean)
```

In [43]:

```
#for fetching all reviews
#list=[]
#list= dataframe_final['Review']
wordstring = corpus[0]
```

In [44]:

```
n=1
while n < 2000:
    wordstring += corpus[n]
    n=n+1
```

In [45]:

```
wordstring #displays all reviews combined
```

Out[45]:

```
'wow love placecrust goodtasti textur nastistop late may bank holiday
rick steve recommend loveselect menu great priceget angri want damn ph
ohoneslti tast freshpotato like rubber could tell made ahead time kept
warmerfri greatgreat touchservic promptwould go backcashier care ever
say still end wayyy overprtri cape cod ravoli chicken cranberri mmmmdi
sgust pretti sure human hairshock sign indic cashhighli recommendwaitr
ess littl slow servicplace worth time let alon vegalikeburritto blahfo
od amazservic also cutecould care less interior beautiperformright red
velvet cake ohhh stuff goodlike final blowhole wall great mexican stre
et taco friendli stafftook hour get food tabl restaur food luke warm s
ever run around like total overwhelmworst salmon sashimialso combo lik
e burger fri beer decent deallike final blowfound place accid could ha
ppierseem like good quick place grab bite familiar pub food favor look
elsewheroveral like place lotredeem qualiti restaur inexpensampl porti
on good pricepoor servic waiter made feel like stupid everi time came
tablfirst visit hiro delightbest food evershrimp tender moistdeal good
enough would drag establishlunch time island visit famili friend serve
r wonder great memori seem sat ocean front patio enjoy view delici win
```

In [46]:

```
wordlist = wordstring.split()
wordlist
```

Out[46]:

```
['wow',
 'love',
 'placecrust',
 'goodtasti',
 'textur',
 'nastistop',
 'late',
 'may',
 'bank',
 'holiday',
 'rick',
 'steve',
 'recommend',
 'loveselect',
 'menu',
 'great',
 'priceget',
 'angri',
```

In [47]:

```
blob=TextBlob(wordstring)
```

In [48]:

```
Fos=blob.tags
```

In [49]:

```
labels=['Words','Figure of Speech']
df1= pd.DataFrame.from_records(Fos, columns=labels)
df1.head()
```

Out[49]:

	Words	Figure of Speech
0	wow	NN
1	love	VB
2	placecrust	NN
3	goodtasti	NN
4	textur	JJ

In [50]:

```
blob.sentences[0].words
```

Out[50]:

```
WordList(['wow', 'love', 'placecrust', 'goodtasti', 'textur', 'nastist
op', 'late', 'may', 'bank', 'holiday', 'rick', 'steve', 'recommend',
'loveselect', 'menu', 'great', 'priceget', 'angri', 'want', 'damn', 'p
hohoneslti', 'tast', 'freshpotato', 'like', 'rubber', 'could', 'tell',
'made', 'ahead', 'time', 'kept', 'warmerfri', 'greatgreat', 'touchserv
ic', 'promptwould', 'go', 'backcashier', 'care', 'ever', 'say', 'stil
l', 'end', 'wayyy', 'overprtri', 'cape', 'cod', 'ravoli', 'chicken',
'cranberri', 'mmmmdisgust', 'pretti', 'sure', 'human', 'hairshock', 's
ign', 'indic', 'cashhighli', 'recommendwaitress', 'littl', 'slow', 'se
rvicplace', 'worth', 'time', 'let', 'alon', 'vegalikeburritto', 'blahf
ood', 'amazservic', 'also', 'cutecould', 'care', 'less', 'interior',
'beautiperformright', 'red', 'velvet', 'cake', 'ohhh', 'stuff', 'goodl
ike', 'final', 'blowhole', 'wall', 'great', 'mexican', 'street', 'tac
o', 'friendli', 'stafftook', 'hour', 'get', 'food', 'tabl', 'restaur',
'food', 'luke', 'warm', 'sever', 'run', 'around', 'like', 'total', 'ov
erwhelmworst', 'salmon', 'sashimialso', 'combo', 'like', 'burger', 'fr
i', 'beer', 'decent', 'deallike', 'final', 'blowfound', 'place', 'acci
d', 'could', 'happierseem', 'like', 'good', 'quick', 'place', 'grab',
```

In [51]:

```
blob.noun_phrases
nouns=[]
```

In [52]:

```
for word,tag in blob.tags:
    if tag == 'NN':
        nouns.append(word)
```

In [53]:

```
counter = {}
for i in nouns:
    counter[i] = counter.get(i, 0) + 1
counter
POPULARwords= sorted([ (freq,word) for word, freq in counter.items() ], reverse=True
```

In [54]:

```
labels=['Count','Words']
popular_words= pd.DataFrame.from_records(POPULARwords, columns=labels)
popular_words.head()
```

Out[54]:

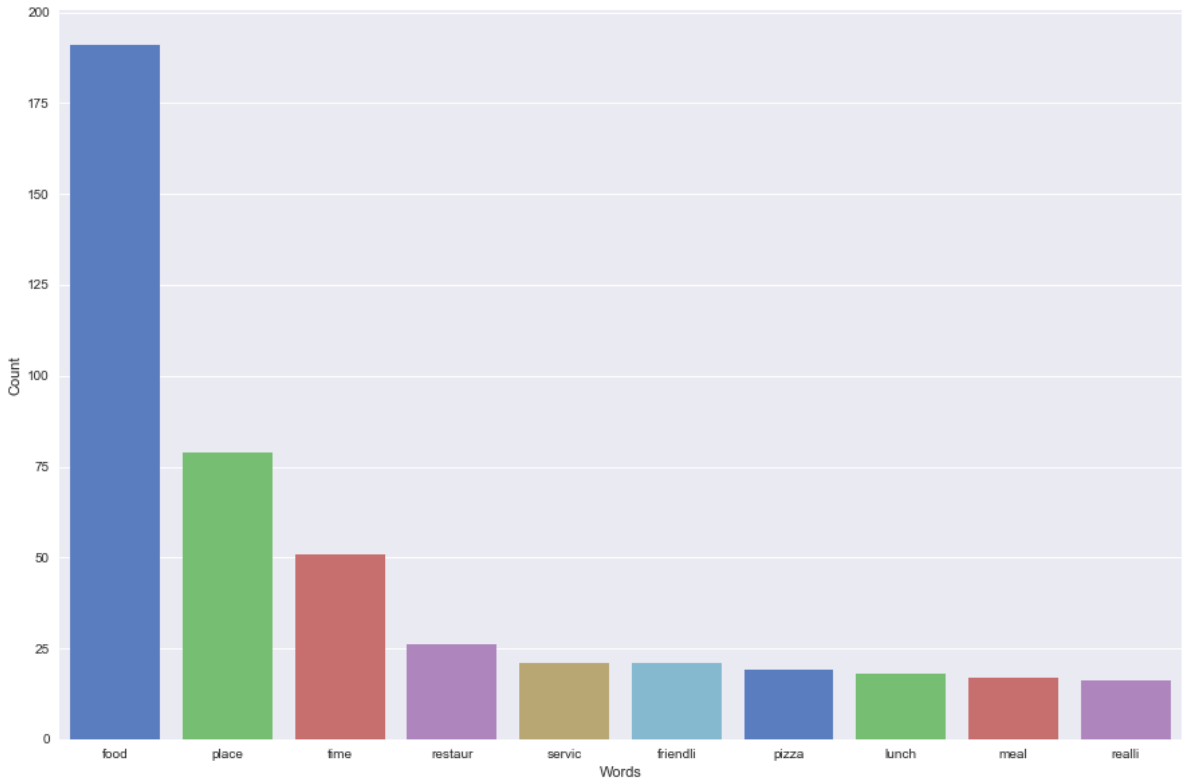
	Count	Words
0	191	food
1	79	place
2	51	time
3	26	restaur
4	21	servic

In [55]:

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

fig, ax = plt.subplots(figsize=(15, 10)) # defining the size of figure
sns.barplot(x='Words', y='Count', data=popular_words.head(10),palette='muted',
 ax=ax)
plt.show(fig)
```

```
/anaconda/lib/python3.6/site-packages/seaborn/categorical.py:1460: Fut
ureWarning: remove_na is deprecated and is a private function. Do not
use.
  stat_data = remove_na(group_data)
```



The above graph gives us an insight of most commonly used words in our reviews.

Verbs

In [56]:

```
verbs=[]
```

In [57]:

```
for word,tag in blob.tags:
    if tag == 'VB':
        verbs.append(word)
```

In [58]:

```
counter = {}
for i in verbs:
    counter[i] = counter.get(i, 0) + 1
counter

POPULARverbs= sorted([ (freq,word) for word, freq in counter.items() ], reverse=True
```

In [59]:

```
labels=['Count','Words']
popular_verbs= pd.DataFrame.from_records(POPULARverbs, columns=labels)
popular_verbs.head()
```

Out[59]:

	Count	Words
0	21	go
1	15	get
2	7	recommend
3	6	love
4	5	find

In [60]:

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

fig, ax = plt.subplots(figsize=(15, 10)) # defining the size of figure
sns.barplot(x='Words', y='Count', data=popular_verbs.head(10),palette='muted',
 ax=ax)
plt.show(fig)
```

```
ureWarning: remove_na is deprecated and is a private function. Do not
use.
  stat_data = remove_na(group_data)
```


The above graph gives us an idea of commonly used verbs.

In [61]:

```
blob.sentiment
```

Out[61]:

```
Sentiment(polarity=0.27729345535133143, subjectivity=0.523243206342848
8)
```

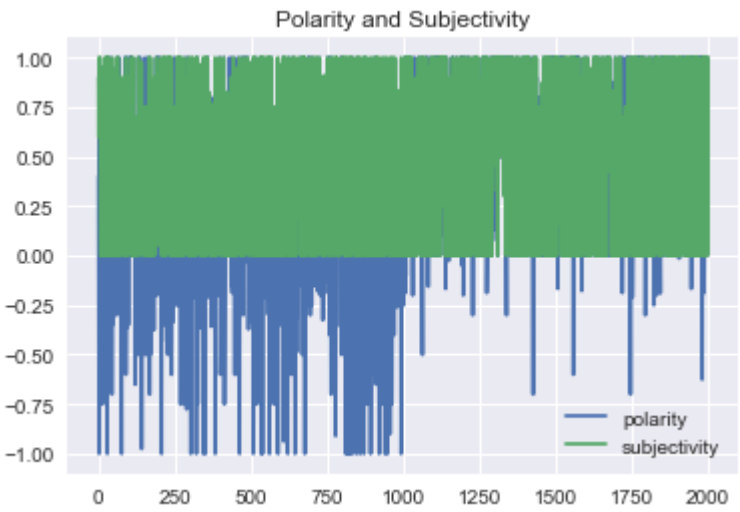
In [62]:

```
import matplotlib.pyplot as plot
%matplotlib inline
polarity=[]
subj=[]
for t in reviews:
    tx=TextBlob(t)
    polarity.append(tx.sentiment.polarity)
    subj.append(tx.sentiment.subjectivity)


poltweet= pd.DataFrame({'polarity':polarity,'subjectivity':subj})
poltweet.plot(title='Polarity and Subjectivity')
```

Out[62]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x129456b38>
```



At the end, we can conclude that analysis of the reviews gives us an idea about the likes and dislikes of the customers which when imporvised can lead to increase in the revenue of the restaurants.