Oops... Nothing Here.. So, you are on your own this time.

Data

```
# !pip install wget
# import wget


# wget.download("https://github.com/MIE451-1513-2019/course-datasets/raw/master/reviews.zip")
# !unzip reviews.zip


# def submission():
#     """remove this function before submission
#     """
#     assert False, "I didn't submit assignment on time!"


# submission()


import sys
print(sys.version)
```

```
3.6.8 (default, Oct  7 2019, 12:59:55)
[GCC 8.3.0]
```

```
!pip install twython
```

```
Requirement already satisfied: twython in /usr/local/lib/python3.6/dist-packages (3.7.0)
Requirement already satisfied: requests>=2.1.0 in /usr/local/lib/python3.6/dist-packages
Requirement already satisfied: requests-oauthlib>=0.4.0 in /usr/local/lib/python3.6/dist
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.6/dist-packa
Requirement already satisfied: urllib3<1.25,>=1.21.1 in /usr/local/lib/python3.6/dist-pa
Requirement already satisfied: chardet<3.1.0,>=3.0.2 in /usr/local/lib/python3.6/dist-pa
Requirement already satisfied: idna<2.9,>=2.5 in /usr/local/lib/python3.6/dist-packages
Requirement already satisfied: oauthlib>=3.0.0 in /usr/local/lib/python3.6/dist-packages
```

```
#Plot
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline

#Data Packages
import math
import pandas as pd
import numpy as np
```

```
#Progress bar
from tqdm import tqdm

#Counter
from collections import Counter

#Operation
import operator

#Natural Language Processing Packages
import re
import nltk

## Download Resources
nltk.download("vader_lexicon")
nltk.download("stopwords")
nltk.download("averaged_perceptron_tagger")
nltk.download("wordnet")

from nltk.sentiment import SentimentAnalyzer
from nltk.sentiment.vader import SentimentIntensityAnalyzer
from nltk.sentiment.util import *
from nltk import tokenize
from nltk.corpus import stopwords
from nltk.tag import PerceptronTagger
from nltk.data import find

## Machine Learning
import sklearn
import sklearn.metrics as metrics
```

```
[nltk_data] Downloading package vader_lexicon to /root/nltk_data...
[nltk_data]   Package vader_lexicon is already up-to-date!
[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
[nltk_data] Downloading package averaged_perceptron_tagger to
[nltk_data]     /root/nltk_data...
[nltk_data]   Package averaged_perceptron_tagger is already up-to-
[nltk_data]       date!
[nltk_data] Downloading package wordnet to /root/nltk_data...
[nltk_data]   Package wordnet is already up-to-date!
```

```
hotelDfRaw = pd.read_csv('reviews.csv', header = None)
hotelDfRaw.columns=['filePath','hotelName','reviewColumn','ratingScore','groundTruth']
```

```
hotelDfRaw
```

	filePath	hotelName	
0	data/ca/3956429/3949020/185992828.html	Woodland Gardens Bed and Breakfast	"Such a treat

1	data/ca/3956429/3949020/168112894.html	Woodland Gardens Bed and Breakfast	"The firs
2	data/ca/3956429/3949020/609506248.html	Woodland Gardens Bed and Breakfast	"My friend
3	data/ca/3956429/3949020/609296519.html	Woodland Gardens Bed and Breakfast	"What a su
4	data/ca/3956429/3949020/352236414.html	Woodland Gardens Bed and Breakfast	"A group of
...	...	...	
2014	data/ca/796987/6210656/659526184.html	Road 121 Motel	"I read the rev
2015	data/ca/796987/6210656/515696104.html	Road 121 Motel	"Room was
2016	data/ca/796987/6210656/681638034.html	Road 121 Motel	"ROOM #5\n\
2017	data/ca/796987/6210656/288535737.html	Road 121 Motel	"I would no
2018	data/ca/796987/6210656/385900635.html	Road 121 Motel	"Just a pla

2019 rows × 5 columns

```
grouped = hotelDfRaw.groupby(['hotelName']).filter(lambda x: len(x) > 30)#.filter(lambda x: l
hotelDf = grouped.loc[grouped.groupby(['hotelName']).ratingScore.filter(lambda x: x.mean() <
hotelDf.loc[hotelDf.groundTruth == 'positive', 'groundTruth'] = 1
hotelDf.loc[hotelDf.groundTruth == 'negative', 'groundTruth'] = 0

hotelDf = hotelDf.reset_index(drop=True)

hotelDf.hotelName.value_counts()
```

```
Peterborough Inn &amp;amp; Suites Hotel                    100
Days Inn and Suites by Wyndham Lindsay                  100
Stillwater on the Lake                                  100
Quality Inn Peterborough                                100
Holiday Inn Peterborough                                100
Best Western Plus Otonabee Inn                          100
```

```
Comfort Inn &amp;amp; Suites                                  100
Howard Johnson by Wyndham Lindsay                          100
Elmhirst&#39;s Resort                                      100
Super 8 by Wyndham Peterborough                            100
Westwind Inn                                               100
Best Western Plus Cobourg Inn &amp;amp; Convention Centre  100
Comfort Inn Port Hope                                       90
Kent Inn                                                    85
Motel 6 Peterborough                                        70
Comfort Inn Cobourg                                         64
Village Inn of Lakefield                                    59
Pine Vista Resort                                           49
Admiral Inn &amp;amp; Conference Centre                     48
Knights Inn Lindsay                                         35
Name: hotelName, dtype: int64
```

```
#check empty reviews
hotelDf[hotelDf['reviewColumn'] == ''].index
```

```
Int64Index([], dtype='int64')
```

```
hotelDf[hotelDf['reviewColumn'].isna()]
```

	filePath	hotelName	reviewColumn	ratingScore	groundTruth

```
# Use vader to evaluated sentiment of reviews
def evalSentences(sentences, to_df=False, columns=[]):
    #Instantiate an instance to access SentimentIntensityAnalyzer class
    sid = SentimentIntensityAnalyzer()
    pdlist = []
    if to_df:
        for sentence in tqdm(sentences):
            ss = sid.polarity_scores(sentence)
            pdlist.append([sentence]+[ss['compound']])
        reviewDf = pd.DataFrame(pdlist)
        reviewDf.columns = columns
        return reviewDf

    else:
        for sentence in tqdm(sentences):
            print(sentence)
            ss = sid.polarity_scores(sentence)
            for k in sorted(ss):
                print('{0}: {1}, '.format(k, ss[k]), end='')
            print()
```

```
reviews = hotelDf['reviewColumn'].values
reviewDF = evalSentences(reviews, to_df=True, columns=['reviewCol','vader'])
```

```
100%|██████████| 1700/1700 [00:02<00:00, 818.63it/s]
```

Q1. Sentiment Analysis and Aggregation

(a)

```
hotelDf['vader'] = reviewDF['vader']
hotelMeanScore = hotelDf.groupby(['hotelName']).mean()
hotelMeanScore.reset_index(inplace=True)
```

(b)

```
hotelMeanScore.sort_values(by='vader', ascending=False).head(5)
```

	hotelName	ratingScore	groundTruth	vader
16	Stillwater on the Lake	4.970000	0.990000	0.940308
14	Pine Vista Resort	4.693878	0.959184	0.920153
19	Westwind Inn	4.250000	0.800000	0.892692
18	Village Inn of Lakefield	4.389831	0.898305	0.882390
2	Best Western Plus Otonabee Inn	4.350000	0.880000	0.839094

```
hotelMeanScore.sort_values(by='groundTruth', ascending=False).head(5)
```

	hotelName	ratingScore	groundTruth	vader
16	Stillwater on the Lake	4.970000	0.990000	0.940308
14	Pine Vista Resort	4.693878	0.959184	0.920153
6	Days Inn and Suites by Wyndham Lindsay	4.670000	0.950000	0.838556
18	Village Inn of Lakefield	4.389831	0.898305	0.882390
2	Best Western Plus Otonabee Inn	4.350000	0.880000	0.839094

```
hotelMeanScore.sort_values(by='vader', ascending=True).head(5)
```

	hotelName	ratingScore	groundTruth	vader
0	Admiral Inn & Conference Centre	2.645833	0.375000	0.090758
9	Howard Johnson by Wyndham Lindsay	3.050000	0.420000	0.294749

4	Comfort Inn Cobourg	3.203125	0.437500	0.493953
12	Motel 6 Peterborough	3.471429	0.571429	0.535274
15	Quality Inn Peterborough	3.410000	0.550000	0.599163

```
hotelMeanScore.sort_values(by='groundTruth', ascending=True).head(5)
```

	hotelName	ratingScore	groundTruth	vader
0	Admiral Inn & Conference Centre	2.645833	0.375000	0.090758
9	Howard Johnson by Wyndham Lindsay	3.050000	0.420000	0.294749
11	Knights Inn Lindsay	3.171429	0.428571	0.604649
4	Comfort Inn Cobourg	3.203125	0.437500	0.493953
5	Comfort Inn Port Hope	3.255556	0.444444	0.608629

they mostly agree with each other, especially the top and bottom 2.

Q2. Frequency Analysis

(a)

```
# Note: You may want to use an NLTK tokenizer instead of a regular expression in the followin
def dataFrameTransformation(hotelDf, k=500):
    reviews = hotelDf['reviewColumn'].values

    stop = set(stopwords.words('english'))
    #Add possible Stop Words for Hotel Reviews
    stop.add('hotel')
    stop.add('room')
    stop.add('rooms')
    stop.add('stay')
    stop.add('staff')

    # Top-k frequent terms
    counter = Counter()
    for review in reviews:
            counter.update([word.lower()
                            for word
                            in re.findall(r'\w+', review)
                            if word.lower() not in stop and len(word) > 2])
    topk = counter.most_common(k)

    #Find out if a particular review has the word from topk list
```

```
    freqReview = []
    for i in range(len(reviews)):
        tempCounter = Counter([word.lower() for word in re.findall(r'\w+',reviews[i])])
        topkinReview = [1 if tempCounter[word] > 0 else 0 for (word,wordCount) in topk]
        freqReview.append(topkinReview)


    #Prepare freqReviewDf
    freqReviewDf = pd.DataFrame(freqReview)
    dfName = []
    for c in topk:
        dfName.append(c[0])
    freqReviewDf.columns = dfName
    finaldf = hotelDf[['hotelName','ratingScore','groundTruth','reviewColumn','vader']].join(
    return topk, finaldf


topk, finaldf = dataFrameTransformation(hotelDf, k=10000)



def getTopK(df, k, label_value, label_column='groundTruth', operation=operator.eq, value_colu
    stop = set(stopwords.words('english'))
    #Add possible Stop Words for Hotel Reviews
    stop.add('hotel')
    stop.add('room')
    stop.add('rooms')
    stop.add('stay')
    stop.add('staff')
    counter = Counter()
    for review in df.loc[operation(df[label_column],label_value)][value_column]:
            counter.update([word.lower()
                            for word
                            in re.findall(r'\w+', review)
                            if word.lower() not in stop and len(word) > 2])
    topk = counter.most_common(k)
    return topk


topkGroundPos = getTopK(df=finaldf, k=50, label_value=1)
topkGroundNeg = getTopK(df=finaldf, k=50, label_value=0)
topkVaderPos = getTopK(df=finaldf,
                       k=50,
                       label_value=0,
                       label_column='vader',
                       operation=operator.gt)
topkVaderNeg = getTopK(df=finaldf,
                       k=50,
                       label_value=0,
                       label_column='vader',
                       operation=operator.lt)
```

(i)

```
```

```
topkGroundPos
```



```
[('clean', 688),
 ('breakfast', 626),
 ('great', 624),
 ('good', 483),
 ('friendly', 446),
 ('would', 442),
```

```
('nice', 402),
('stayed', 379),
('comfortable', 365),
('well', 340),
('place', 327),
('time', 325),
('inn', 298),
('night', 293),
('one', 283),
('lake', 278),
('area', 268),
('pool', 253),
('helpful', 241),
('nthe', 237),
('family', 219),
('back', 217),
('food', 213),
('like', 206),
('recommend', 205),
('peterborough', 201),
('beautiful', 201),
('bed', 199),
('hot', 193),
('service', 191),
('could', 188),
('front', 187),
('two', 185),
('beds', 184),
('location', 182),
('really', 180),
('also', 174),
('enjoyed', 170),
('desk', 167),
('excellent', 166),
('little', 165),
('everything', 165),
('small', 164),
('definitely', 163),
('always', 163),
('next', 162),
('best', 157),
('free', 156),
('weekend', 149),
('day', 149)]
```

(ii)

```
topkGroundNeg
```

```
 [('would', 296),
```

The top positive words have 'lake' and 'peterborough' in the list as the place Peterborough has a lot of have many reviews contains 'lake'.

```
 ('good', 190),
```

(b)

```
tagger = PerceptronTagger()
pos_tag = tagger.tag
grammar = r"""
    NBAR:
        {<NN.*|JJ>*<NN.*>}  # Nouns and Adjectives, terminated with Nouns

    NP:
        {<NBAR>}
        {<NBAR><IN><NBAR>}  # Above, connected with in/of/etc...
"""
# Create phrase tree
chunker = nltk.RegexpParser(grammar)
#tree= chunker.parse(taggedToks)
# Noun Phrase Extraction Support Functions
from nltk.corpus import stopwords
stop = stopwords.words('english')
lemmatizer = nltk.WordNetLemmatizer()
stemmer = nltk.stem.porter.PorterStemmer()

# generator, generate leaves one by one
def leaves(tree):
    """Finds NP (nounphrase) leaf nodes of a chunk tree."""
    for subtree in tree.subtrees(filter = lambda t: t.label()=='NP' or t.label()=='JJ' or t.l
        yield subtree.leaves()

# stemming, lematizing, lower case...
def normalise(word):
    """Normalises words to lowercase and stems and lemmatizes it."""
    word = word.lower()
    word = stemmer.stem(word)
    word = lemmatizer.lemmatize(word)
    return word

# stop-words and length control
def acceptable_word(word):
    """Checks conditions for acceptable word: length, stopword."""
    accepted = bool(2 <= len(word) <= 40
        and word.lower() not in stop)
    return accepted

# generator, create item once a time
def get_terms(tree):
    for leaf in leaves(tree):
        term = [normalise(w) for w,t in leaf if acceptable_word(w) ]
        # Phrase only
        if len(term)>1:
            yield term
# Flatten phrase lists to get tokens for analysis
```

```
    def flatten(npTokenList):
        finalList =[]
        for phrase in npTokenList:
            token = ''
            for word in phrase:
                token += word + ' '
            finalList.append(token.rstrip())
        return finalList

    # Revise the previous dataframe transform function...
    def newDataFrameTransformation(hotelDf, k=500):
        reviews = hotelDf['reviewColumn'].values
        review_pos = hotelDf[hotelDf['groundTruth']==1]['reviewColumn'].values
        review_neg = hotelDf[hotelDf['groundTruth']==0]['reviewColumn'].values

        # Top-k frequent terms
        counter = Counter()
        c_pos = Counter()
        c_neg = Counter()

        for review in reviews:
                counter.update(flatten([word
                                for word
                                in get_terms(chunker.parse(pos_tag(re.findall(r'\w+', review))))
                                ]))
        topk = counter.most_common(k)

        for review in review_pos:
                c_pos.update(flatten([word
                                for word
                                in get_terms(chunker.parse(pos_tag(re.findall(r'\w+', review))))
                                ]))
        topkPos = c_pos.most_common(k)

        for review in review_neg:
                c_neg.update(flatten([word
                                for word
                                in get_terms(chunker.parse(pos_tag(re.findall(r'\w+', review))))
                                ]))
        topkNeg = c_neg.most_common(k)

        #Find out if a particular review has the word from topk list
        freqReview = []
        for i in range(len(reviews)):
            tempCounter = Counter(flatten([word
                                           for word
                                           in get_terms(chunker.parse(pos_tag(re.findall(r'\w+',r
            topkinReview = [1 if tempCounter[word] > 0 else 0 for (word,wordCount) in topk]
            freqReview.append(topkinReview)


        #Prepare freqReviewDf
```

```
    freqReviewDf = pd.DataFrame(freqReview)
    dfName = []
    for c in topk:
        dfName.append(c[0])
    freqReviewDf.columns = dfName
    finaldf = hotelDf[['hotelName','ratingScore','groundTruth','reviewColumn']].join(freqRevi
    return topk, topkPos, topkNeg, finaldf

topk_phrase, topk_phrase_pos, topk_phrase_neg, finaldf_phrase = newDataFrameTransformation(ho
```

(i)

```
topk_phrase_pos[:50]
```

```
[('front desk', 62),
 ('hot tub', 53),
 ('great place', 30),
 ('friendli staff', 29),
 ('continent breakfast', 28),
 ('westwind inn', 25),
```

```
('comfort inn', 24),
('kent inn', 24),
('pine vista', 21),
('next time', 19),
('clean staff', 19),
('front desk staff', 19),
('villag inn', 19),
('nthe room', 18),
('coffe maker', 18),
('next year', 18),
('indoor pool', 18),
('rice lake', 18),
('next day', 17),
('first time', 17),
('minut drive', 16),
('good valu', 15),
('queen bed', 15),
('night stay', 15),
('great stay', 14),
('mini fridg', 14),
('hotel staff', 14),
('beauti view', 14),
('great time', 14),
('outdoor pool', 14),
('great hotel', 13),
('main street', 13),
('ground floor', 13),
('comfort bed', 13),
('breakfast room', 13),
('pine vista resort', 13),
('dine room', 13),
('qualiti inn', 12),
('free breakfast', 12),
('saturday night', 12),
('nthe staff', 12),
('complimentari breakfast', 11),
('great experi', 11),
('hot breakfast', 11),
('breakfast area', 11),
('downtown area', 11),
('nthe hotel', 11),
('park lot', 11),
('great locat', 11),
('nice place', 11)]
```

(ii)

```
topk_phrase_neg[:50]
```

```
[('front desk', 78),
```

Front desk and hot tub plays major role in both positive and negative reviews, which means they play hotels. Front desk is very common among hotel reviews as they are one of the few first hotel staff to r hand, I could not immagine myself to put it this high in my judgement of hotels. This could be a very l

```
('hockey tournament', 13),
```

Q3. Mutual Information

```
('hot water', 11),
```

(a)

```
('doubt bed', 10),
```

```
# get Top K mutual information terms from the dataframe
def getMI(topk, df, label_column='groundTruth'):
    miScore = []
    for word in topk:
        miScore.append([word[0]]+[metrics.mutual_info_score(df[label_column], df[word[0]])])
    miScoredf = pd.DataFrame(miScore).sort_values(1,ascending=0)
    miScoredf.columns = ['Word','MI Score']
    return miScoredf
```

```
('first floor', 8)
```

```
miScoredf = getMI(topk, finaldf)
```

```
('custom service', 8),
```

```
miScoredf.head(10)
```

	Word	MI Score
285	dirty	0.026500
3	great	0.022638
296	carpet	0.021738
8	friendly	0.018487
166	told	0.018377
120	peter	0.017827
103	sunny	0.017400
244	smell	0.017306
94	wonderful	0.016480
89	old	0.015829

Dirty, great and friendly are words with sentiment implied while the word carpet also make sence as d
something people really care about. The word told could be because the interaction wth staff in the h

(b)

```
miScoredf_phrase = getMI(topk_phrase, finaldf_phrase, label_column='groundTruth')
```

```
miScoredf_phrase.head(10)
```

	Word	MI Score
0	front desk	0.007124
166	cigarett smoke	0.004392
62	air condition	0.004214
87	smoke room	0.004214
76	first room	0.003927
237	hard time	0.003657
220	non smoke room	0.003657
4	park lot	0.003642
37	next year	0.003641
32	villag inn	0.003234

As discussed before, front desk plays major role in defining good or bad hotel, while the smoking, fror playing an even higher weight if combined. This is very understandable as no matter how great a fron cigarett smell will not be pleasant.

Q4. Pointwise Mutual Information

(a)

```
# Simple example of getting pairwise mutual information of a term
def pmiCal(df, x):
    pmilist=[]
    for i in [1,0]:
        for j in [0,1]:
            px = sum(df['groundTruth']==i)/len(df)
            py = sum(df[x]==j)/len(df)
            pxy = len(df[(df['groundTruth']==i) & (df[x]==j)])/len(df)
            if pxy==0:#Log 0 cannot happen
                pmi = math.log((pxy+0.0001)/(px*py))
            else:
                pmi = math.log(pxy/(px*py))
            pmilist.append([i]+[j]+[px]+[py]+[pxy]+[pmi])
    pmidf = pd.DataFrame(pmilist)
    pmidf.columns = ['x','y','px','py','pxy','pmi']
    return pmidf
```

```
def pmiIndivCal(df,x,gt, label_column='groundTruth'):
    px = sum(df[label_column]==gt)/len(df)
    py = sum(df[x]==1)/len(df)
    pxy = len(df[(df[label_column]==gt) & (df[x]==1)])/len(df)
    if pxy==0:#Log 0 cannot happen
        pmi = math.log((pxy+0.0001)/(px*py))
    else:
        pmi = math.log(pxy/(px*py))
    return pmi


# Compute PMI for all terms and all possible labels
def pmiForAllCal(df, label_column='groundTruth', topk=topk):
    #Try calculate all the pmi for top k and store them into one pmidf dataframe
    pmilist = []
    pmiposlist = []
    pmineglist = []
    for word in tqdm(topk):
        pmilist.append([word[0]]+[pmiCal(df,word[0])])
        pmiposlist.append([word[0]]+[pmiIndivCal(df,word[0],1,label_column)])
        pmineglist.append([word[0]]+[pmiIndivCal(df,word[0],0,label_column)])
    pmidf = pd.DataFrame(pmilist)
    pmiposlist = pd.DataFrame(pmiposlist)
    pmineglist = pd.DataFrame(pmineglist)
    pmiposlist.columns = ['word','pmi']
    pmineglist.columns = ['word','pmi']
    pmidf.columns = ['word','pmi']
    return pmiposlist, pmineglist, pmidf


pmiposlist, pmineglist, pmidf = pmiForAllCal(finaldf, topk=topk)
```

```
100%|██████████| 8646/8646 [10:23<00:00, 12.78it/s]
```

```
finaldf[(finaldf['groundTruth']==1) & (finaldf['oasis']==1)]['reviewColumn']
```

```
384    "Sunny and Peter Montgomery run an amazingly t...
388    "Truly an experience not to be missed if you'r...
427    "Sunny and Peter truly have a passion and love...
443    "Sunny and Peter were the perfect hosts. Our r...
444    "After needing to change business travel plans...
462    "Ontario has many wonderful Spas, B & B's, and...
523    "This staff makes it easy to check in and out ...
Name: reviewColumn, dtype: object
```

```
#Sorted top pmi words for positive reviews
pmiposlist.sort_values('pmi',ascending=0).head(5)
```

	word	pmi
1771	unique	0.341662

1684	winery	0.341662
1810	smoothies	0.341662
1809	oasis	0.341662
1699	favorite	0.341662

```
#Sorted top pmi words for negative reviews
pmineglist.sort_values('pmi',ascending=0).head(5)
```

	word	pmi
1784	stain	1.239905
1609	brown	1.239905
1614	curtain	1.239905
1461	hairs	1.239905
1714	clock	1.239905

In the positive reviews winery and oasis are very locale-specic. The Peterborough area has a lot of wir Garden Centres, which features 'hot tubs'! So hot tub in Q3 make sense now.

(b)

```
pmiposlist_phrase, pmineglist_phrase, pmidf_phrase = pmiForAllCal(finaldf_phrase, topk=topk_p
```

```
100%|██████████| 500/500 [00:09<00:00, 50.32it/s]
```

```
#Sorted top pmi non phrase for positive reviews
pmiposlist_phrase.sort_values('pmi',ascending=0).head(10)
```

	word	pmi
58	outdoor pool	0.341662
136	excel valu	0.341662

147	short walk	0.341662
151	help staff	0.341662
162	bedroom cottag	0.341662
249	third year	0.341662
265	lake ontario	0.341662
263	kid klub	0.341662
262	confer room	0.341662
251	march break	0.341662

```
#Sorted top pmi non phrase for negative reviews
pmineglist_phrase.sort_values('pmi',ascending=0).head(10)
```

	word	pmi
277	bathroom floor	1.239905
374	non smoke	1.239905
325	bad experi	1.239905
460	hot spot	1.239905
468	hour notic	1.239905
352	major renov	1.239905
457	bed bug	1.239905
412	room number	1.239905
237	hard time	1.239905
411	toilet tank	1.239905

The top negative phrse has a very alarming phrase, bed bug! I heard it is a very big problem in the area

(c)

```
hotelDfTop = hotelDf[hotelDf['hotelName']=='Stillwater on the Lake'].reset_index(drop=True)
hotelDfBot = hotelDf[hotelDf['hotelName']=='Admiral Inn &amp;amp; Conference Centre'].reset_index
```

```
topk_top, topHoteldf_word = dataFrameTransformation(hotelDfTop, k=10000)
topk_phrase_top, topk_phrase_pos_top, topk_phrase_neg_top, topHoteldf_phrase = newDataFrameTr
```

```
topk_bot, botHoteldf_word = dataFrameTransformation(hotelDfBot, k=10000)
topk_phrase_bot, topk_phrase_pos_bot, topk_phrase_neg_bot, botHoteldf_phrase = newDataFrameTr
```

```
pmiposlistTop, pmineglistTop, pmidfTop = pmiForAllCal(topHoteldf_word, topk=topk_top)
pmiposlist_phraseTop, pmineglist_phraseTop, pmidf_phraseTop = pmiForAllCal(topHoteldf_phrase,
```

```
100%|██████████| 1977/1977 [00:29<00:00, 66.94it/s]
100%|██████████| 500/500 [00:06<00:00, 73.40it/s]
```

```
pmiposlistBot, pmineglistBot, pmidfBot = pmiForAllCal(botHoteldf_word, topk=topk_bot)
pmiposlist_phraseBot, pmineglist_phraseBot, pmidf_phraseBot = pmiForAllCal(botHoteldf_phrase,
```

```
100%|██████████| 1111/1111 [00:14<00:00, 76.16it/s]
100%|██████████| 338/338 [00:04<00:00, 81.97it/s]
```

```
pmiposlist_phraseTop.sort_values('pmi',ascending=0).head(20)
```

	word	pmi
0	hot tub	0.01005
16	next time	0.01005

1	beauti place	0.01005
29	peterborough area	0.01005
28	next stay	0.01005
27	egg benedict	0.01005
25	star rate	0.01005
24	picnic basket	0.01005
23	graciou host	0.01005
22	hot chocol	0.01005
21	first time	0.01005
20	welcom host	0.01005
19	top notch	0.01005
18	deck side suit	0.01005
17	wonder host	0.01005
26	fantast breakfast	0.01005
15	mini fridg	0.01005
4	decksid suit	0.01005
13	littl piec	0.01005
14	star hotel	0.01005

```
pmineglist_phraseBot.sort_values('pmi',ascending=0).head(20)
```

	word	pmi
169	non function wi fi	0.470004
193	noisi window	0.470004

176	bathroom sink	0.470004
177	broken hanger	0.470004
178	good element	0.470004
179	mini fridg	0.470004
180	top nthey	0.470004
184	first room	0.470004
185	faulti fridg	0.470004
186	fruit basket	0.470004
187	second morn	0.470004
188	new flat screen hitachi tv	0.470004
189	analog cabl	0.470004
190	honeymoon suit	0.470004
191	honeymoon vibe	0.470004
192	replac heat	0.470004
194	bedroom side leather furnitur	0.470004
174	dirti feel	0.470004
195	live room area	0.470004
196	noth fanci everi inch	0.470004

The top hotel Stillwater on the Lake has hot tub, delicious food (egg benedict, picnic basket, hot choc want to come back next time or for next stay.

The bottom hotel Admiral Inn & Conference Centre has not function wifi, noisy window and broken ha a good hotel.

Q5. General Plots

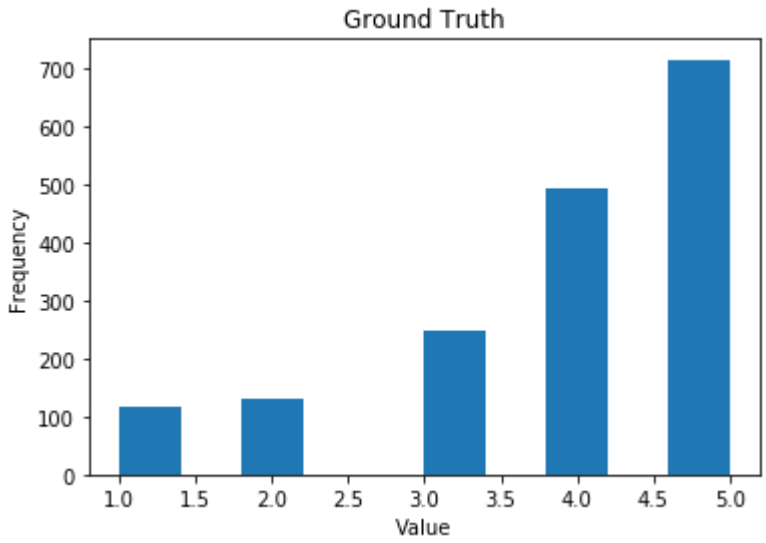
(a)Histogram

(a)

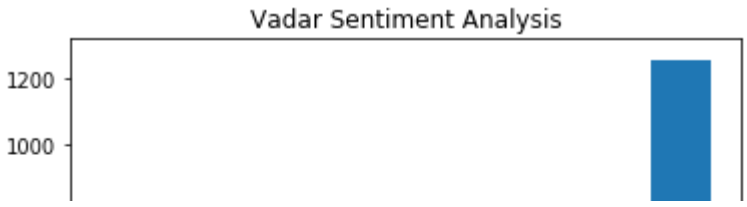
```
def getHistogram(measure, title):
    if measure=='both':
        x = [finaldf['ratingScore'].values/5]
        y = [finaldf['vader'].values]
```

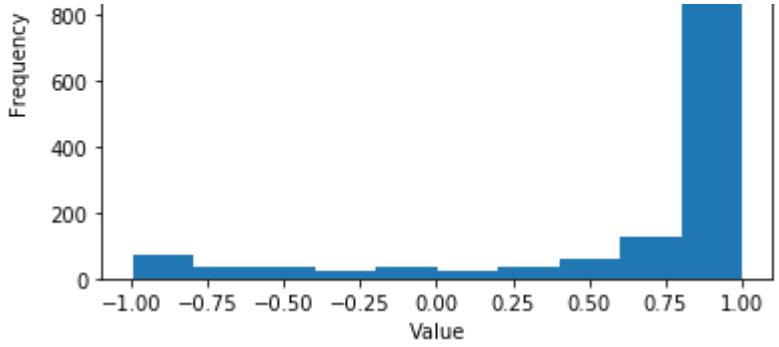
```
        bins = np.linspace(-1, 1, 100)
        plt.title(title)
        plt.hist(x, bins, label='x')
        plt.hist(y, bins, label='y')
        plt.legend(loc='upper right')
        plt.show()

    else:
        plt.hist(finaldf[measure].values)
        plt.title(title)
        plt.xlabel("Value")
        plt.ylabel("Frequency")
        fig = plt.gcf()
```

```
getHistogram('ratingScore', 'Ground Truth')
```

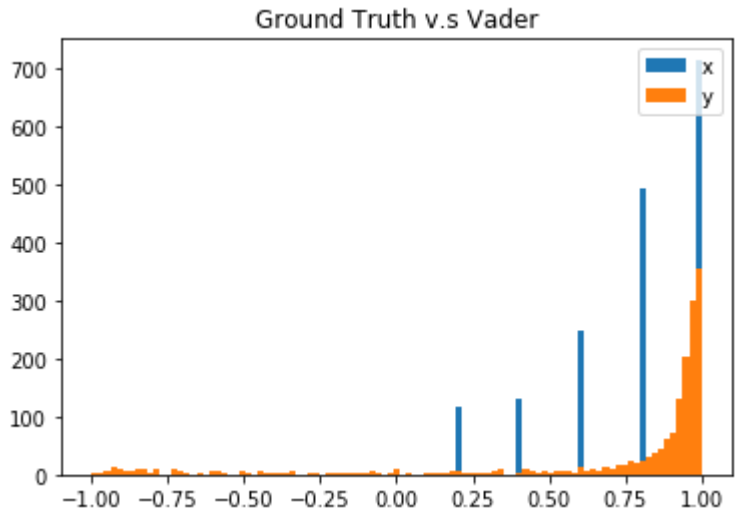



```
getHistogram('vader', 'Vadar Sentiment Analysis')
```





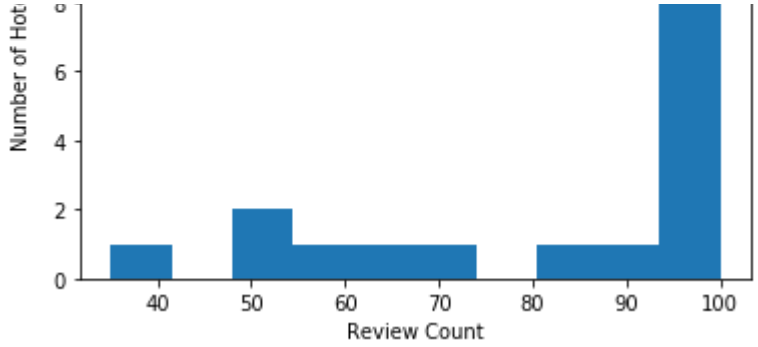

```
getHistogram('both', 'Ground Truth v.s Vader')
```



Most reviews are good as all the plots skewed to the right. A good experience tend to have people lea

(b)

```
plt.hist(hotelDf.hotelName.value_counts())
plt.title('Hotel Review Counts')
plt.xlabel("Review Count")
plt.ylabel("Number of Hotels")
fig = plt.gcf()
```

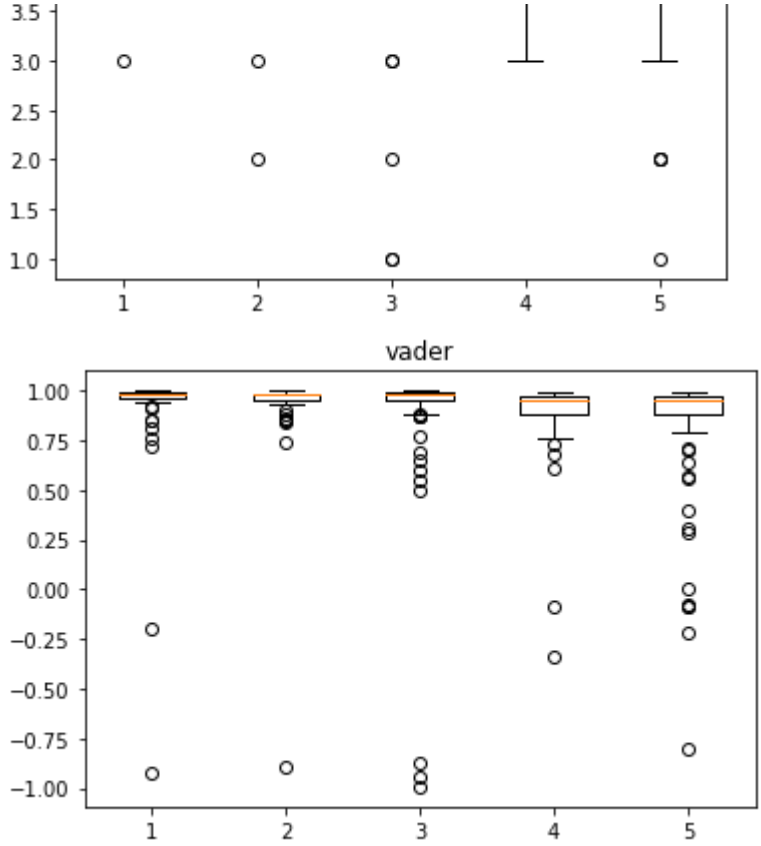


Hotel with good rating tend to get more reviews. As stated before, the more the reviews a hotel has, th resulted from people attracked by good reviews.

(b)Boxplots

(a)

```
#Plot top 5 side-by-side boxplot for top 5 ground truth rated hotel
i=1
for conf in ['ratingScore', 'vader']:
  tp5gthotel = hotelMeanScore.sort_values(by=conf, ascending=False).head(5)

  top1 = hotelDf.loc[hotelDf['hotelName'] == tp5gthotel['hotelName'].values[0]][conf]
  top2 = hotelDf.loc[hotelDf['hotelName'] == tp5gthotel['hotelName'].values[1]][conf]
  top3 = hotelDf.loc[hotelDf['hotelName'] == tp5gthotel['hotelName'].values[2]][conf]
  top4 = hotelDf.loc[hotelDf['hotelName'] == tp5gthotel['hotelName'].values[3]][conf]
  top5 = hotelDf.loc[hotelDf['hotelName'] == tp5gthotel['hotelName'].values[4]][conf]

  data = [top1, top2, top3, top4, top5]
  # multiple box plots on one figure
  x = plt.figure(i)
  plt.boxplot(data)
  plt.title(conf)
  x.show()
  i+=1
```



(b)

```
top5star = hotelMeanScore.sort_values(by='ratingScore', ascending=False).head(5)
hotelDf[hotelDf['hotelName'].isin(top5star['hotelName'].values)].describe().loc[['mean','std'
```

	ratingScore	groundTruth	vader	reviewLength
mean	4.627451	0.936275	0.879765	100.514706
std	0.696380	0.244563	0.274353	99.888782

(c)

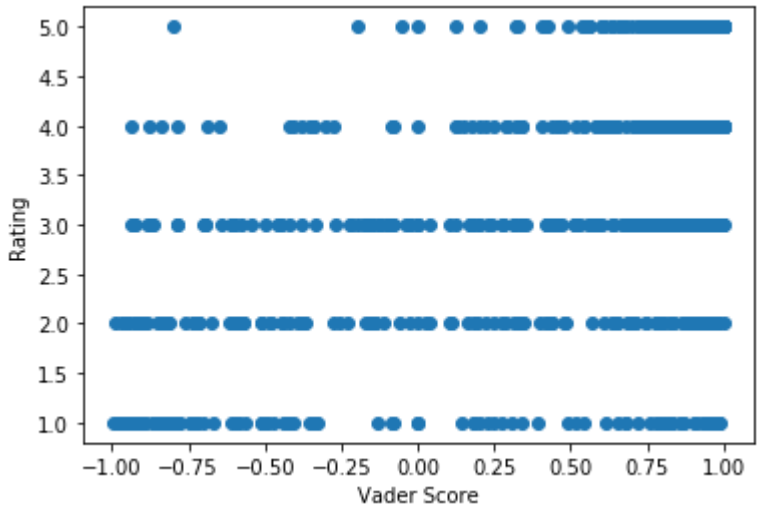
The boxplot is much more informative as it not only reports the mean and variance, but also the maxi and also the overall distribution of the data points.

(c)Scatterplots and heatmaps

(a)

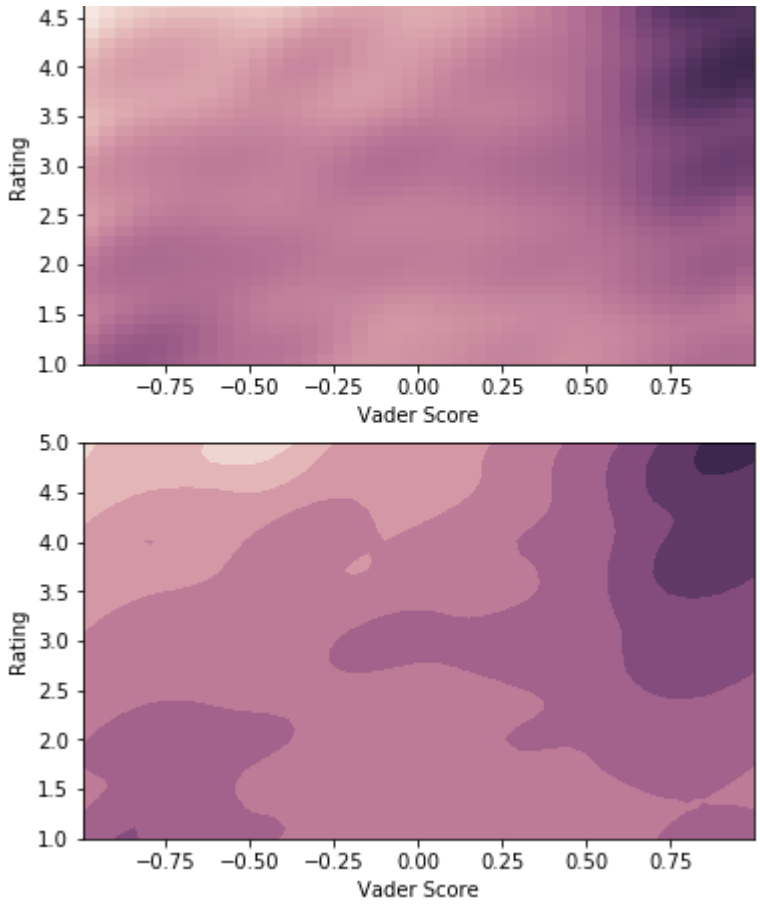
```
y = hotelDf['ratingScore'].values
x = hotelDf['vader'].values
plt.plot(x, y,"o")
plt.ylabel('Rating')
plt.xlabel('Vader Score')
```

```
Text(0.5, 0, 'Vader Score')
```




```
from scipy.stats.kde import gaussian_kde

k = gaussian_kde(np.vstack([x, y]))
xi, yi = np.mgrid[x.min():x.max():x.size**0.5*1j,y.min():y.max():y.size**0.5*1j]
zi = k(np.vstack([xi.flatten(), yi.flatten()]))


cmap = sns.cubehelix_palette(light=1, as_cmap=True)
fig = plt.figure(figsize=(6,8))
ax1 = fig.add_subplot(211)
ax2 = fig.add_subplot(212)

ax1.pcolormesh(xi, yi, np.log10(zi.reshape(xi.shape)), cmap=cmap)
ax2.contourf(xi, yi, np.log10(zi.reshape(xi.shape)), cmap=cmap)

ax1.set_xlim(x.min(), x.max())
ax1.set_ylim(y.min(), y.max())
ax2.set_xlim(x.min(), x.max())
ax2.set_ylim(y.min(), y.max())

ax1.set_xlabel('Vader Score')
ax1.set_ylabel('Rating')

ax2.set_xlabel('Vader Score')
ax2.set_ylabel('Rating')
```

```
Text(0, 0.5, 'Rating')
```

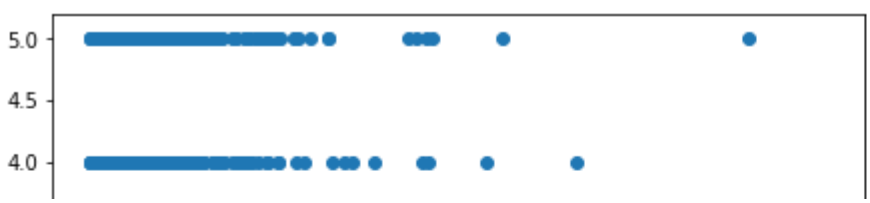


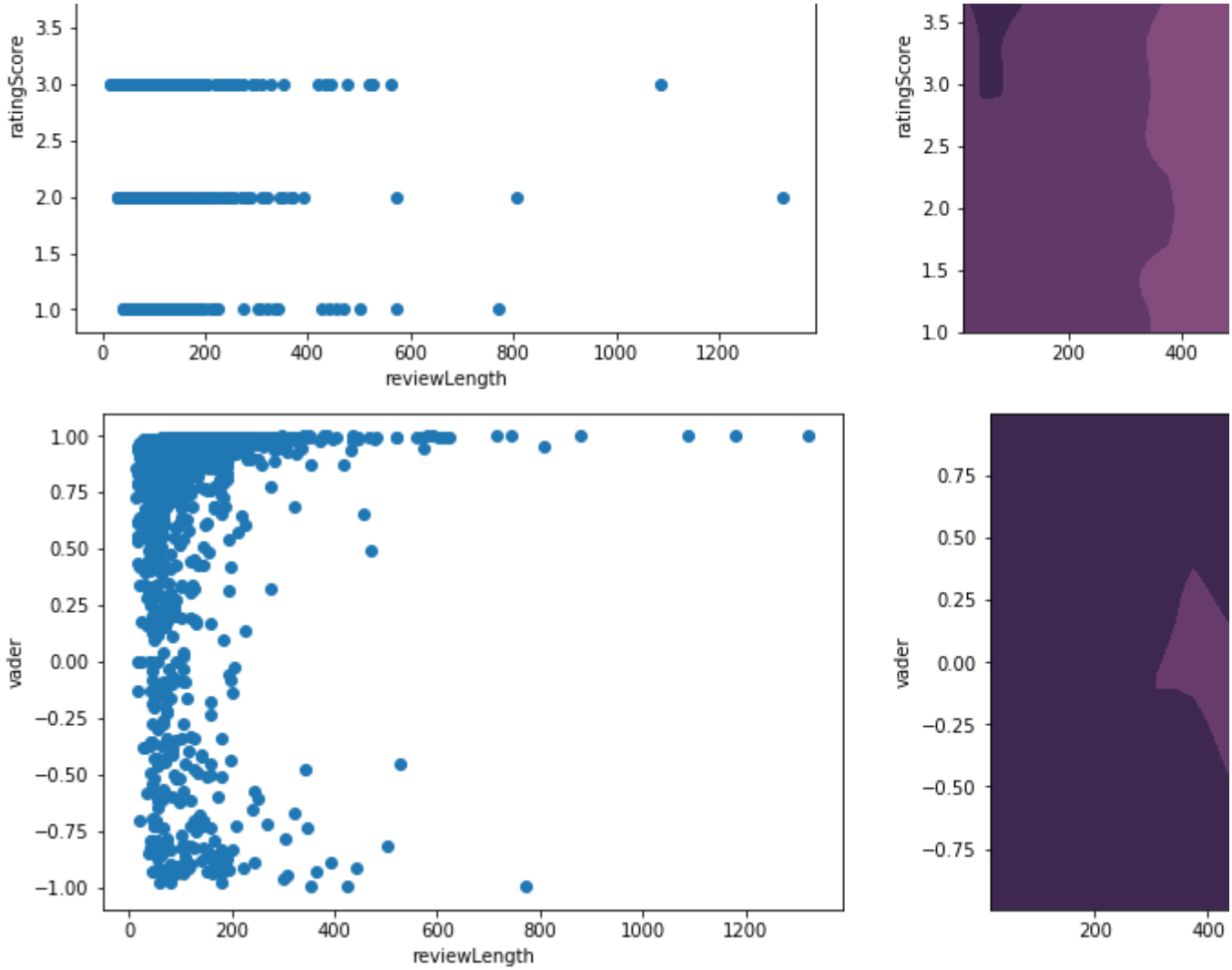
The scatter plot shows that the vader score is closer to the actual rating in higher ratings, like 4 or 5 s
though vader score thinks some rating has really high positive emotion, the actual rating is lower than
tend to has higher than expected vader scores. Positives are much higher correlated than negatives.

(b)

```
hotelDf['reviewLength'] = hotelDf['reviewColumn'].str.split().str.len()


i=1
for rate in ['ratingScore', 'vader']:
  y = hotelDf[rate].values
  x = hotelDf['reviewLength'].values
  fig = plt.figure(i,figsize=(16,5))
  ax1 = fig.add_subplot(121)
  ax2 = fig.add_subplot(122)

  ax1.plot(x, y,"o")
  ax1.set_ylabel(rate)
  ax1.set_xlabel('reviewLength')

  k = gaussian_kde(np.vstack([x, y]))
  xi, yi = np.mgrid[x.min():x.max():x.size**0.5*1j,y.min():y.max():y.size**0.5*1j]
  zi = k(np.vstack([xi.flatten(), yi.flatten()]))
```

```
    cmap = sns.cubehelix_palette(light=1, as_cmap=True)

    ax2.contourf(xi, yi, np.log10(zi.reshape(xi.shape)), cmap=cmap)

    ax2.set_xlim(x.min(), x.max())
    ax2.set_ylim(y.min(), y.max())


    ax2.set_xlabel('reviewLength')
    ax2.set_ylabel(rate)

    i+=1
```



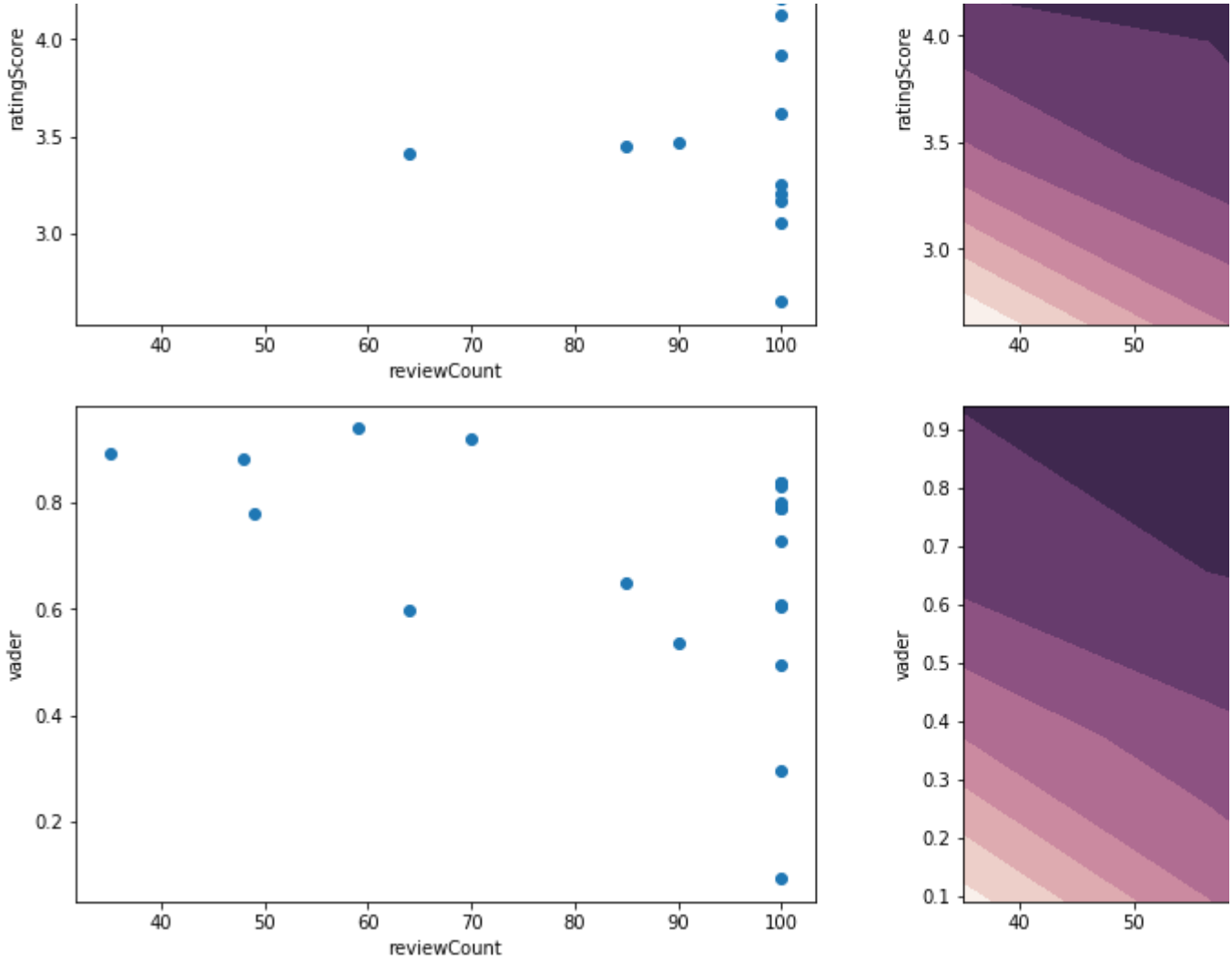


It can be seen that the longer a review is , the more likely it has a good vader score, while in the groun
word. This could be because a very long review could have many words that get the vader score highe

(c)

```
hotelMeanScore['reviewCount'] = hotelDf.hotelName.value_counts().values


i=1
for rate in ['ratingScore', 'vader']:
  y = hotelMeanScore[rate].values
  x = hotelMeanScore['reviewCount'].values
  fig = plt.figure(i,figsize=(16,5))
  ax1 = fig.add_subplot(121)
  ax2 = fig.add_subplot(122)

  ax1.plot(x, y,"o")
  ax1.set_ylabel(rate)
  ax1.set_xlabel('reviewCount')
```

```
k = gaussian_kde(np.vstack([x, y]))
xi, yi = np.mgrid[x.min():x.max():x.size**0.5*1j,y.min():y.max():y.size**0.5*1j]
zi = k(np.vstack([xi.flatten(), yi.flatten()]))
cmap = sns.cubehelix_palette(light=1, as_cmap=True)

ax2.contourf(xi, yi, np.log10(zi.reshape(xi.shape)), cmap=cmap)

ax2.set_xlim(x.min(), x.max())
ax2.set_ylim(y.min(), y.max())


ax2.set_xlabel('reviewCount')
ax2.set_ylabel(rate)

i+=1
```



High review count could result in a wide range of rating and vader scores, but low review count has ve vader scores. Given the hotels with avgerage of 5 stars have been filtered out during data preprocessi big hotels provide very good service with personal touch.