objective :

Applying knn to classify the amazon food reviews.

In [152]:

```
import sqlite3 as s
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np
from sklearn.neighbors import KNeighborsClassifier
from sklearn.cross_validation import train_test_split
from sklearn.cross_validation import cross_val_score
from sklearn.metrics import accuracy_score
```

In [153]:

```
con=s.connect("database.sqlite")
con
```

Out[153]:

```
<sqlite3.Connection at 0x12855a4d490>
```

In [154]:

```
data=pd.read_sql_query("SELECT * FROM Reviews WHERE Score!=3",con)
data.head(5)
```

Out[154]:

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenominat
0	1	B001E4KFG0	A3SGXH7AUHU8GW	delmartian	1	
1	2	B00813GRG4	A1D87F6ZCVE5NK	dll pa	0	
2	3	B000LQOCH0	ABXLMWJIXXAIN	Natalia Corres "Natalia Corres"	1	
3	4	B000UA0QIQ	A395BORC6FGVXV	Karl	3	
4	5	B006K2ZZ7K	A1UQRSCLF8GW1T	Michael D. Bigham "M. Wassir"	0	

In [155]:

```
#function to change the score to positive/negative
def change(x):
    if x<3:
        return 'negative'
    else:
        return 'positive'
```

In [156]:

```
a_s=data.Score
a_s=a_s.map(change)
data.Score=a_s
data.Score.head(5)
```

Out[156]:

```
0    positive
1    negative
2    positive
3    negative
4    positive
Name: Score, dtype: object
```

Data cleaning

The data needs to get clean as it may have some unwanted things such as duplicates.

In [157]:

```
#sorting the values by product ids
data=data.sort_values("ProductId")
```

In [158]:

```
#removing the duplicates from the data
final_data=data.drop_duplicates(subset={"UserId","Text","ProfileName","Time"},kee
```

In [159]:

```
print(final_data.shape)
print(final_data.Score.value_counts())
```

```
(364173, 10)
positive    307063
negative     57110
Name: Score, dtype: int64
```

In [160]:

```
p_data=final_data[final_data.Score=="positive"]
n_data=final_data[final_data.Score=="negative"]
```

In [161]:

```
#randomly selecting points
p_data=p_data.sample(17000)
n_data=n_data.sample(3000)
```

In [162]:

```
print(p_data.shape,n_data.shape)
```

```
(17000, 10) (3000, 10)
```

In [163]:

```
d=pd.concat((p_data,n_data))
```

In [165]:

```
d.shape
```

Out[165]:

```
(20000, 10)
```

In [305]:

```
#sorting according to time stamp
d=d.sort_values('Time')
```

In [306]:

```
d.Score.value_counts()
```

Out[306]:

```
positive    17000
negative     3000
Name: Score, dtype: int64
```

Data preprocessing

The data should be preprocessed after cleaning it

In [167]:

```
import string
from nltk.corpus import stopwords
from nltk.stem import SnowballStemmer
import re
```

In [168]:

```
#stopwords
stop_words=set(stopwords.words("english"))
#initializing snowball stemmer
sno=SnowballStemmer("english")
```

In [169]:

```
#function to remove html tags
def cleanhtml(s):
    cleanr=re.compile("<.*?>")
    cleant=re.sub(cleanr," ",s)
    return cleant
```

In [170]:

```
#funtion to remove punctuation and special character
def cleanpunc(s):
    cleaned = re.sub(r'[?|!|\'|"|#]',r'',s)
    cleaned = re.sub(r'[.|,|)|(|\|/]',r' ',cleaned)
    return  cleaned
```

In [171]:
```
i=0
final=[]

for s in d.Text.values:
    f=[]
    c=cleanhtml(s)
    for w in cleanpunc(c).split():
        if w.isalpha() and len(w)>2:
            if w not in stop_words:
                sne=(sno.stem(w.lower())).encode('utf-8')
                f.append(sne)

            else:
                continue
        else:
            continue
    te=b" ".join(f)
    final.append(te)
    i+=1
```

In [172]:
```
#adding the preprocessed data into another column
d["cleaned"]=final
```

In [173]:
```
#checking if new column is added
d.columns
```

Out[173]:
```
Index(['Id', 'ProductId', 'UserId', 'ProfileName', 'HelpfulnessNumerator',
       'HelpfulnessDenominator', 'Score', 'Time', 'Summary', 'Text',
       'cleaned'],
      dtype='object')
```

In [174]:
```
import sqlite3
conn=sqlite3.connect("future.sqlite")
c=conn.cursor()
conn.text_factory=str
d.to_sql('Reviews',conn,if_exists='replace',index=True)
```

Bag of words

In [259]:
```
from sklearn.feature_extraction.text import CountVectorizer
```

In [260]:
```
#bigrams
count_vect=CountVectorizer(ngram_range=(1,2))
```

In [261]:
```
bdata=count_vect.fit_transform(d.cleaned.values)
```

In [262]:
```
x=bdata
y=d.Score
```

In [263]:
```
x_1, x_test, y_1, y_test = train_test_split(x, y, test_size=0.3, random_state=0)

x_tr, x_cv, y_tr, y_cv = train_test_split(x_1, y_1, test_size=0.3)
```

In [264]:
```
x_cv.shape
```

Out[264]:
```
(4200, 408862)
```

In [266]:
```
#list of different k
neighbors=list(range(1,50,2))
```

I have used two ways to find k

1. cross_val_score
2. gridsearchcv

In [267]:
```
#cross_val_score
cv_scores=[]
for k in neighbors:
    knn=KNeighborsClassifier(n_neighbors=k,algorithm='brute')
    scores=cross_val_score(knn,x_1,y_1,cv=10,scoring="accuracy")
    cv_scores.append(scores.mean())
print(cv_scores)
```

```
[0.8366443031712917, 0.8476446627560232, 0.8515000206632758, 0.851928847303347
7, 0.8525001231414622, 0.852571500728898, 0.8525001741254533, 0.85228583728140
38, 0.8523573169097098, 0.8523572658528323, 0.8523572658528323, 0.8522857862245
263, 0.8523572658528323, 0.8522857862245263, 0.8522857862245263, 0.852285786224
5263, 0.8522857862245263, 0.8522857862245263, 0.8522857862245263, 0.85228578622
45263, 0.8522857862245263, 0.8522857862245263, 0.8522857862245263, 0.8522857862
245263, 0.8522857862245263]
```

we have calculated the accuracy score for different k values,now we find error i.e is nothing but 1-accuracy

In [268]:
```
#calculating error
error=[1-x for x in cv_scores]
print(error)
```

```
[0.16335569682870832, 0.15235533724397676, 0.1484999793367242, 0.14807115269665
228, 0.14749987685853783, 0.14742849927110024, 0.1474998258745467, 0.1477141627
1859616, 0.14764268309029016, 0.14764273414716766, 0.14764273414716766, 0.14771
421377547367, 0.14764273414716766, 0.14771421377547367, 0.14771421377547367, 0.
14771421377547367, 0.14771421377547367, 0.14771421377547367, 0.1477142137754736
7, 0.14771421377547367, 0.14771421377547367, 0.14771421377547367, 0.14771421377
547367, 0.14771421377547367, 0.14771421377547367]
```

In [269]:

```
#finding the k with least error
optimal_k=neighbors[error.index(min(error))]
print(optimal_k)
```

```
11
```

performance can be measured in different methods ,i am using accuracy and confusion matrix

In [271]:

```
#accuracy
knn=KNeighborsClassifier(n_neighbors=optimal_k)
knn.fit(x_1,y_1)
pred=knn.predict(x_test)
acc = accuracy_score(y_test, pred) * 100
print('\nThe accuracy of the knn classifier for k = %d is %f%%' % (optimal_k, acc
```

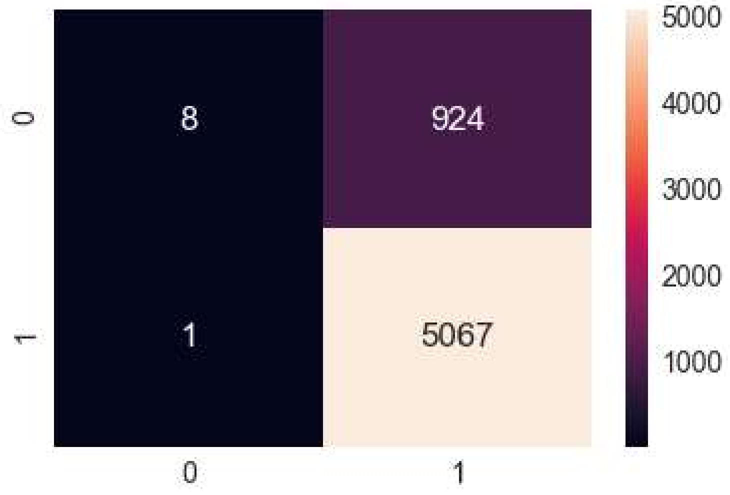
```
The accuracy of the knn classifier for k = 11 is 84.583333%
```

In [272]:

```
#confusion matrix
from sklearn.metrics import confusion_matrix
df_cm=pd.DataFrame(confusion_matrix(y_test, pred))
sns.set(font_scale=1.4)#for label size
sns.heatmap(df_cm,annot=True,fmt='d')
```

Out[272]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x12814621358>
```



The accuracy seems to be good and even the TP value is high,so the model is good.

In [274]:

```
#gridsearchcv
from sklearn.model_selection import GridSearchCV
from sklearn.model_selection import TimeSeriesSplit
#params we need to try on classifier
knn = KNeighborsClassifier(algorithm='brute')
param_grid = {'n_neighbors':np.arange(1,40,2)}
#For time based splitting
t = TimeSeriesSplit(n_splits=10)

gsv = GridSearchCV(knn,param_grid,cv=t)
gsv.fit(x_1,y_1)
print("Best HyperParameter: ",gsv.best_params_)
print("Best Accuracy: %.2f%%"%(gsv.best_score_*100))
```

```
Best HyperParameter:  {'n_neighbors': 13}
Best Accuracy: 85.19%
```

In [275]:

```
#accuracy
knn=KNeighborsClassifier(n_neighbors=13)
knn.fit(x_1,y_1)
pred=knn.predict(x_test)
acc = accuracy_score(y_test, pred) * 100
print('\nThe accuracy of the knn classifier is %f%%' % ( acc))
```

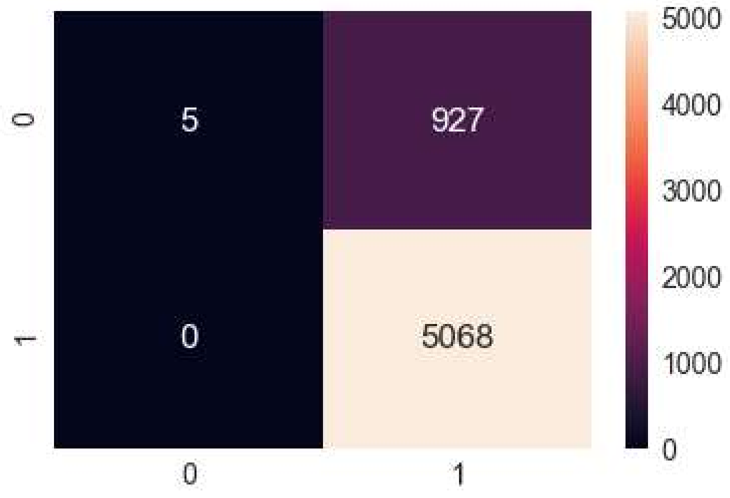
```

The accuracy of the knn classifier is 84.550000%
```

In [276]:

```
#confusion matrix
from sklearn.metrics import confusion_matrix
df_cm=pd.DataFrame(confusion_matrix(y_test, pred))
sns.set(font_scale=1.4)#for label size
sns.heatmap(df_cm,annot=True,fmt='d')
```

Out[276]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x128584c6f98>
```



The TP and accuracy is good so the model is good with k=13

Tfidf

In [277]:
```
from sklearn.feature_extraction.text import TfidfVectorizer
```

In [278]:
```
#bigrams
tfidf=TfidfVectorizer(ngram_range=(1,2))
tdata=tfidf.fit_transform(d.cleaned.values)
```

In [279]:
```
x=tdata
y=d.Score
```

In [280]:
```
x_1, x_test, y_1, y_test = train_test_split(x, y, test_size=0.3, random_state=0)

x_tr, x_cv, y_tr, y_cv = train_test_split(x_1, y_1, test_size=0.3)
```

using cross_val_score

In [281]:
```
cv_scores=[]
for k in neighbors:
    knn=KNeighborsClassifier(n_neighbors=k,algorithm="brute")
    scores=cross_val_score(knn,x_1,y_1,cv=10,scoring="accuracy")
    cv_scores.append(scores.mean())
print(cv_scores)
```

```
[0.8144278191687124, 0.84871303090315, 0.8592849716468514, 0.8624992577984552,
0.8611416553565296, 0.8612134924558635, 0.8602136449705187, 0.8595708897227572,
0.8597855836734029, 0.8594280324341274, 0.859356450764953, 0.858642215961772,
0.8584280831994594, 0.8584279812314772, 0.8580708893583255, 0.8576423688408588,
0.8576423688408588, 0.857285276967707, 0.8573568586368813, 0.8568567565231267,
0.8568567055391355, 0.8569280319968093, 0.8565710420916396, 0.856071144132508,
0.8558567563044676]
```

we have got the accuracy scores for different k values,now lets calculate the error i.e 1-accuracy

In [283]:
```
#calculating error
error=[1-x for x in cv_scores]
print(error)
```

```
[0.18557218083128757, 0.15128696909685002, 0.14071502835314864, 0.1375007422015
4485, 0.13885834464347035, 0.13878650754413646, 0.13978635502948134, 0.14042911
02772428, 0.14021441632659715, 0.14057196756587265, 0.14064354923504696, 0.1413
5778403822796, 0.1415719168005406, 0.14157201876852277, 0.14192911064167446, 0.
14235763115914124, 0.14235763115914124, 0.14271472303229304, 0.1426431413631187
3, 0.14314324347687335, 0.1431432944608645, 0.14307196800319066, 0.143428957908
3604, 0.14392885586749204, 0.14414324369553244]
```

In [284]:
```
#finding k with least error
optimal_k=neighbors[error.index(min(error))]
print(optimal_k)
```

```
7
```

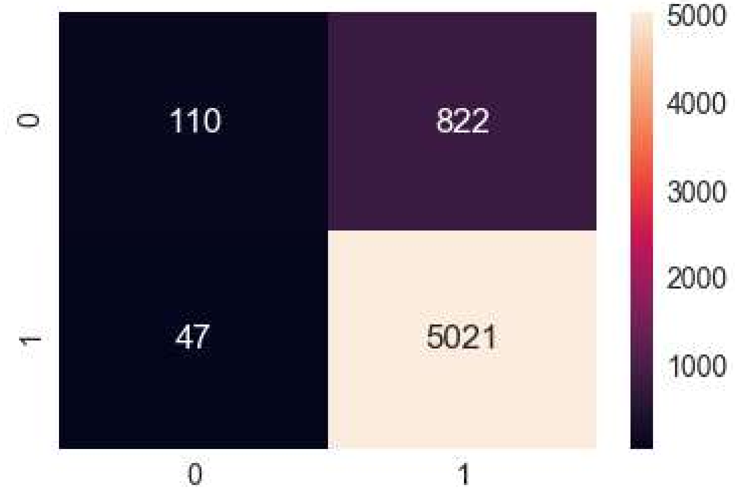
performance can be measured using different methods i have used 1. accuracy_score 2. confusion matrix

In [285]:
```
#accuracy
knn=KNeighborsClassifier(n_neighbors=optimal_k)
knn.fit(x_1,y_1)
pred=knn.predict(x_test)
acc = accuracy_score(y_test, pred) * 100
print('\nThe accuracy of the knn classifier for k = %d is %f%%' % (optimal_k, acc
```

```

The accuracy of the knn classifier for k = 7 is 85.516667%
```

In [286]:
```
#confusion_matrix
from sklearn.metrics import confusion_matrix
df_cm=pd.DataFrame(confusion_matrix(y_test, pred))
sns.set(font_scale=1.4)#for label size
sns.heatmap(df_cm,annot=True,fmt='d')
```

Out[286]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1282a79d518>
```



the accuracy and TP are good ,so the model is good.

In [287]:

```
#gridsearch cv
from sklearn.model_selection import GridSearchCV as g
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import TimeSeriesSplit

knn = KNeighborsClassifier(algorithm='brute')
#params we need to try on classifier
param_grid = {'n_neighbors':np.arange(1,40,2)}
#For time based splitting
t = TimeSeriesSplit(n_splits=10)

gsv = g(knn,param_grid,cv=t)
gsv.fit(x_1,y_1)
print("Best HyperParameter: ",gsv.best_params_)
print("Best Accuracy: %.2f%%"%(gsv.best_score_*100))
```

```
Best HyperParameter:  {'n_neighbors': 13}
Best Accuracy: 85.90%
```

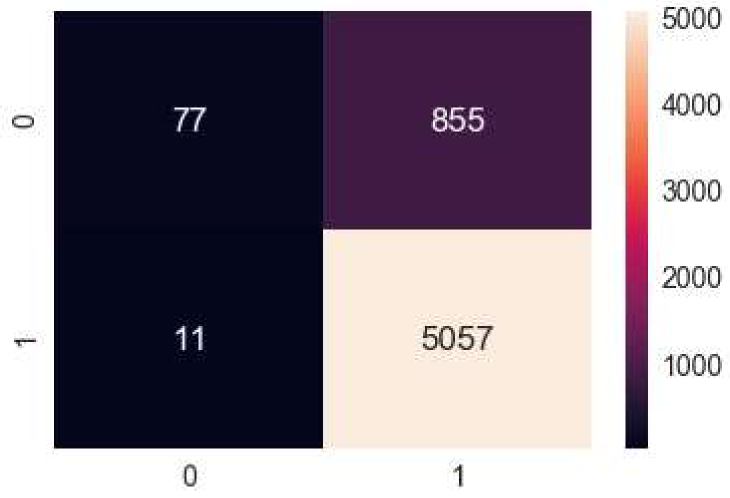
In [288]:

```
from sklearn.metrics import confusion_matrix
knn=KNeighborsClassifier(n_neighbors=13)
knn.fit(x_1,y_1)
pred=knn.predict(x_test)
acc = accuracy_score(y_test, pred) * 100
print('\nThe accuracy of the knn classifier is %f%%' % ( acc))
df_cm=pd.DataFrame(confusion_matrix(y_test, pred))
sns.set(font_scale=1.4)#for label size
sns.heatmap(df_cm,annot=True,fmt='d')
```

```

The accuracy of the knn classifier is 85.566667%
```

Out[288]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x128263d8828>
```



The TP and accuracy are good,so,the model is good.

Word2Vec

In [224]:

```
from gensim.models import Word2Vec
#making list of sentences
import string
i=0
list_s=[]
for s in d.Text.values:
    filtered=[]
    s=cleanhtml(s)
    for w in s.split():
        for c_w in cleanpunc(w).split():
            if c_w.isalpha():
                filtered.append(c_w.lower())
            else:
                continue
    list_s.append(filtered)
#training our own model
w2v_model=Word2Vec(list_s,min_count=5,size=50,workers=4)
```

Average word2vec

In [290]:

```
#creating avg word2vec
sv=[]
for s in list_s:
    sum=np.zeros(50)
    i=0
    for w in s:
        try:

            x=w2v_model.wv[w]
            sum+=x
            i+=1
        except:
            pass
    sum/=i
    sv.append(sum)

#cheking the dimension
print(len(sv))
print(len(sv[0]))
```

```
20000
50
```

In [291]:

```
x=np.asarray(sv)
y=d.Score
```

In [292]:

```
x_1, x_test, y_1, y_test = train_test_split(x, y, test_size=0.3, random_state=0)

x_tr, x_cv, y_tr, y_cv = train_test_split(x_1, y_1, test_size=0.3)
```

I have used two ways to find k

1. cross_val_score

2. gridsearchcv

```
In [293]: #cross_val_score
cv_scores=[]
for k in neighbors:
    knn=KNeighborsClassifier(n_neighbors=k,algorithm='brute')
    scores=cross_val_score(knn,x_1,y_1,cv=10,scoring="accuracy")
    cv_scores.append(scores.mean())
print(cv_scores)
```

```
[0.8007867973037597, 0.8420018051029619, 0.8487147146868079, 0.855642266945763
1, 0.857714308053947l, 0.859143033382014, 0.8613578294464144, 0.861429206960965
7, 0.8597866043007455, 0.8606435943516881, 0.8600010432585498, 0.86035787999308
74, 0.8587865022598772, 0.8592864512029997, 0.8582859917639901, 0.8592150227044
577, 0.8599291552481112, 0.8597149206635892, 0.8593576246358143, 0.859143338921
5286, 0.8585716550657132, 0.858000124161871, 0.8578573180030048, 0.858214409949
043, 0.8574999709183526]
```

we got accuracy score for different k values , so the lets calculate error i.e. 1-accuracy

```
In [295]: #cal error
error=[1-x for x in cv_scores]
print(error)
```

```
[0.19921320269624032, 0.15799819489703815, 0.15128528531319207, 0.1443577330542
3694, 0.1422856919460529, 0.14085696661798597, 0.13864217055358563, 0.138570793
0390343, 0.1402133956992545, 0.13935640564831187, 0.13999895674145024, 0.139642
12000691256, 0.14121349774012282, 0.14071354879700027, 0.14171400823600988, 0.1
407849772955423, 0.1400708447518888, 0.14028507933641077, 0.14064237536418567,
0.1408566610784714, 0.1414283449342868, 0.141999875838129, 0.1421426819969952,
0.14178559005095703, 0.14250002908164738]
```

```
In [296]: #finding the k value with least error
optimal_k=neighbors[error.index(min(error))]
print(optimal_k)
```

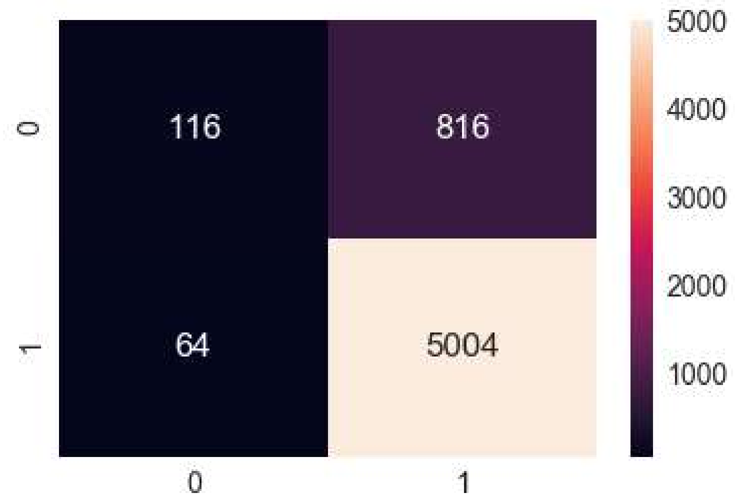
```
15
```

performance measured with accuracy score and confusion matirx

In [297]:
```
from sklearn.metrics import confusion_matrix
knn=KNeighborsClassifier(n_neighbors=optimal_k)
knn.fit(x_1,y_1)
pred=knn.predict(x_test)
acc = accuracy_score(y_test, pred) * 100
print('\nThe accuracy of the knn classifier for k = %d is %f%%' % (optimal_k, acc
df_cm=pd.DataFrame(confusion_matrix(y_test, pred))
sns.set(font_scale=1.4)#for label size
sns.heatmap(df_cm,annot=True,fmt='d')
```

```
The accuracy of the knn classifier for k = 15 is 85.333333%
```

Out[297]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x12862d2e8d0>
```



The TP and accuracy score are quiet good ,so the model seems to be good

In [300]:
```
#gridsearchcv
from sklearn.model_selection import GridSearchCV as g
from sklearn.model_selection import TimeSeriesSplit
knn = KNeighborsClassifier(algorithm='brute')
#params we need to try on classifier
param_grid = {'n_neighbors':np.arange(1,40,2)}
#For time based splitting
t = TimeSeriesSplit(n_splits=10)

gsv = g(knn,param_grid,cv=t)
gsv.fit(x_1,y_1)
print("Best HyperParameter: ",gsv.best_params_)
print("Best Accuracy: %.2f%%"%(gsv.best_score_*100))
```

```
Best HyperParameter:  {'n_neighbors': 31}
Best Accuracy: 85.59%
```

Performance :

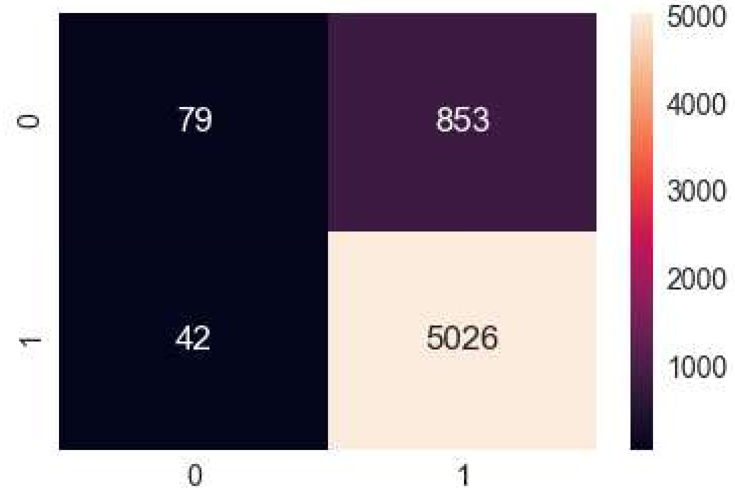
In [301]:

```
from sklearn.metrics import confusion_matrix
knn=KNeighborsClassifier(n_neighbors=31)
knn.fit(x_1,y_1)
pred=knn.predict(x_test)
acc = accuracy_score(y_test, pred) * 100
print('\nThe accuracy of the knn classifier is %f%%' % ( acc))
df_cm=pd.DataFrame(confusion_matrix(y_test, pred))
sns.set(font_scale=1.4)#for label size
sns.heatmap(df_cm,annot=True,fmt='d')
```

```
The accuracy of the knn classifier is 85.083333%
```

Out[301]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x128583f0860>
```



The TP and the accuracy are good .so the model is good

Tfidf word2vec

In [225]:

```
tfidf_feat = tfidf.get_feature_names()
tf=tfidf.fit_transform(d.Text.values)
tfidfsv = []
row=0;
for s in list_s:
    sum = np.zeros(50)
    i=0;
    for word in s:
        try:
            vec = w2v_model.wv[word]
            tf_idf = tf[row, tfidf_feat.index(word)]
            sum += (vec * tf_idf)
            i += tf_idf
        except:
            pass
    sum /= i
    tfidfsv.append(sum)
    row += 1
```

In [226]:
```
x=np.asarray(tfidfsv)
y=d.Score
x
```

Out[226]:
```
array([[nan, nan, nan, ..., nan, nan, nan],
       [nan, nan, nan, ..., nan, nan, nan],
       [nan, nan, nan, ..., nan, nan, nan],
       ...,
       [nan, nan, nan, ..., nan, nan, nan],
       [nan, nan, nan, ..., nan, nan, nan],
       [nan, nan, nan, ..., nan, nan, nan]])
```

In [245]:
```
#splitting of the data
x_1, x_test, y_1, y_test = train_test_split(x, y, test_size=0.3)

x_tr, x_cv, y_tr, y_cv = train_test_split(x_1, y_1, test_size=0.3)
```

The 'x' array has 'NaN' values we have to change them .

In [246]:
```
# changing 'NaN' to numeric value
x_1=np.isnan(x_1)
np.where(np.isnan(x_1))
np.nan_to_num(x_1)

x_test=np.isnan(x_test)
np.where(np.isnan(x_test))
np.nan_to_num(x_test)
```

Out[246]:
```
array([[ True,  True,  True, ...,  True,  True,  True],
       [ True,  True,  True, ...,  True,  True,  True],
       [ True,  True,  True, ...,  True,  True,  True],
       ...,
       [ True,  True,  True, ...,  True,  True,  True],
       [ True,  True,  True, ...,  True,  True,  True],
       [ True,  True,  True, ...,  True,  True,  True]])
```

I have used two ways to identify hyperparameter(k) value :

1. using the cross validation score.
2. using gridsearchcv

lets see both of them

In [249]:

```
#neighors=(1,50,2)
cv_scores=[]
for k in neighbors:
    knn=KNeighborsClassifier(n_neighbors=k)
    scores=cross_val_score(knn,x_1,y_1,cv=10,scoring="accuracy")
    cv_scores.append(scores.mean())
print(cv_scores)
```

```
[0.6411209697045763, 0.710835255418862, 0.7801428928207178, 0.7105714642492893,
0.8499286071064323, 0.8499286071064323, 0.8499286071064323, 0.8499286071064323,
0.8499286071064323, 0.8499286071064323, 0.8499286071064323, 0.8499286071064323,
0.8499286071064323, 0.8499286071064323, 0.8499286071064323, 0.8499286071064323,
0.8499286071064323, 0.8499286071064323, 0.8499286071064323, 0.8499286071064323,
0.8499286071064323, 0.8499286071064323, 0.8499286071064323, 0.8499286071064323,
0.8499286071064323]
```

We have got cv_scores it basically has the accuracy score repective to k neighbor,now lets see what is the error i.e. nothing but 1-accuracy.

In [250]:

```
#calculation of error
error=[1-x for x in cv_scores]
print(error)
```

```
[0.3588790302954237, 0.28916474458113794, 0.2198571071792822, 0.289428535750710
7, 0.15007139289356775, 0.15007139289356775, 0.15007139289356775, 0.15007139289
356775, 0.15007139289356775, 0.15007139289356775, 0.15007139289356775, 0.150071
39289356775, 0.15007139289356775, 0.15007139289356775, 0.15007139289356775, 0.1
5007139289356775, 0.15007139289356775, 0.15007139289356775, 0.1500713928935677
5, 0.15007139289356775, 0.15007139289356775, 0.15007139289356775, 0.15007139289
356775, 0.15007139289356775, 0.15007139289356775]
```

In [251]:

```
#finding k with least error
optimal_k=neighbors[error.index(min(error))]
print(optimal_k)
```

```
9
```

We can measure the accuracy by accuracy but it is not the only method .confusion matrix is also one the method.

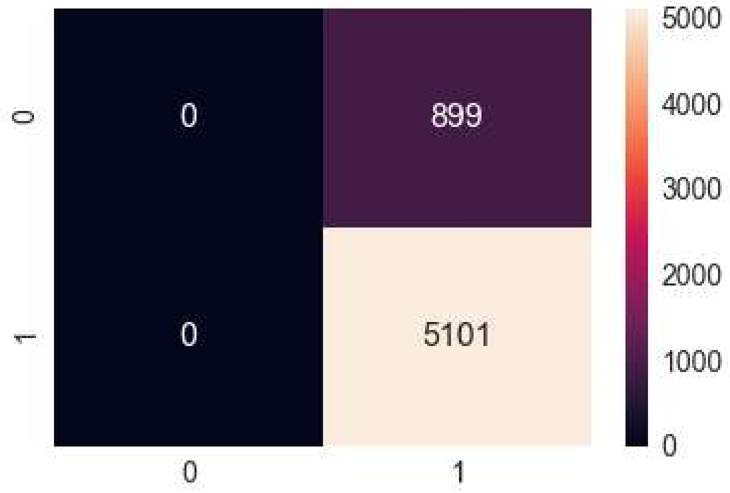
In [257]:

```
#measuring with accuracy
knn=KNeighborsClassifier(n_neighbors=optimal_k)
knn.fit(x_1,y_1)
pred=knn.predict(x_test)
acc = accuracy_score(y_test, pred) * 100
print('\nThe accuracy of the knn classifier for k = %d is %f%%' % (optimal_k, acc
```

```

The accuracy of the knn classifier for k = 9 is 85.016667%
```

```
In [258]: #confusion matirx
          from sklearn.metrics import confusion_matrix
          df_cm = pd.DataFrame(confusion_matrix(y_test, pred), range(2),range(2))
          sns.set(font_scale=1.4)#for label size
          sns.heatmap(df_cm, annot=True,annot_kws={"size": 16}, fmt='g')
```

```
Out[258]: <matplotlib.axes._subplots.AxesSubplot at 0x12852a4a390>
```



the accuracy is high and even TP in confusion is high.so we can say model is good.

```
In [254]: #gridsearch_cv
          from sklearn.model_selection import GridSearchCV as g
          from sklearn.model_selection import TimeSeriesSplit
          knn = KNeighborsClassifier(algorithm='brute')
          #parameter to implement on classifier
          param_grid = {'n_neighbors':np.arange(1,40,2)}
          #time based splitting
          t = TimeSeriesSplit(n_splits=10)

          gsv = g(knn,param_grid,cv=t)
          gsv.fit(x_1,y_1)
          print("Best HyperParameter: ",gsv.best_params_)
          print("Best Accuracy: %.2f%%"%(gsv.best_score_*100))
```

```
Best HyperParameter:  {'n_neighbors': 1}
Best Accuracy: 85.06%
```

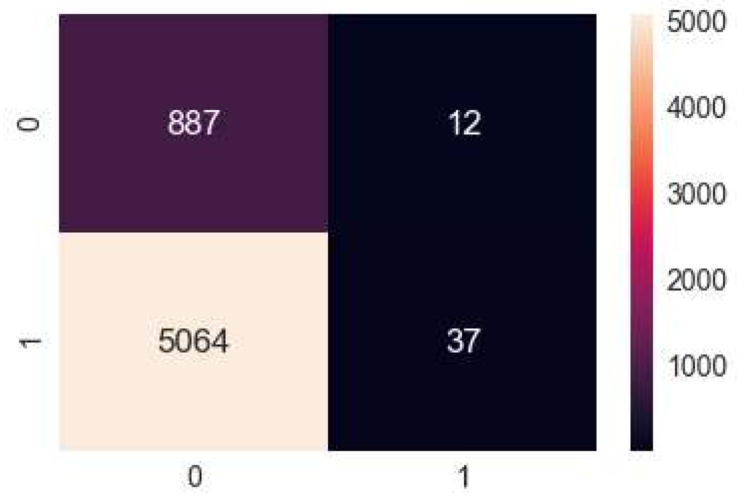
In [256]:

```
from sklearn.metrics import confusion_matrix
knn=KNeighborsClassifier(n_neighbors=1)
knn.fit(x_1,y_1)
pred=knn.predict(x_test)
acc = accuracy_score(y_test, pred) * 100
print('\nThe accuracy of the knn classifier is %f%%' % (acc))

df_cm = pd.DataFrame(confusion_matrix(y_test, pred))
#size of the label
sns.set(font_scale=1.4)
sns.heatmap(df_cm, annot=True, fmt='g')
```

```
The accuracy of the knn classifier is 15.400000%
```

Out[256]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1285f473a90>
```



the accuracy is very less for the test data and we saw that we had high accuracy in train data, k is small so, the model seems to overfitting

Conclusion :

1.The more the data ,more will be the accuracy.
2.if the test and train data have different distribution,the model does not work properly ,as we can see in tfidf word2vec i.e above cell our train accuracy is good but the test accuracy is vey low .
3.you cannot pass sparse matrix to the kdtree.
4.doing cross validation can increase your train data which increases your accuracy as we know more the data more is the accuracy.

In [ ]: