Part 2 - t-SNE on Amazon Fine Foods Review

By Aziz Presswala

In [1]:

```
#importing libraries
import sqlite3
import pandas as pd
import numpy as np
import seaborn as sn
import matplotlib.pyplot as plt

from sklearn.feature_extraction.text import CountVectorizer
from sklearn.feature_extraction.text import TfidfTransformer
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.manifold import TSNE

from gensim.models import Word2Vec
from gensim.models import KeyedVectors
from tqdm import tqdm
import os
```

```
C:\Users\Aziz\Anaconda3\lib\site-packages\gensim\utils.py:1209: UserWar
ning: detected Windows; aliasing chunkize to chunkize_serial
  warnings.warn("detected Windows; aliasing chunkize to chunkize_seria
l")
```

In [2]:

```
# Using the CleanedText column saved in final.sqlite db
con = sqlite3.connect('final.sqlite')
filtered_data = pd.read_sql_query("SELECT * FROM Reviews", con)
```

In [3]:

```
filtered_data.head(5)
```

Out[3]:

	index	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	Helpfulne
0	138706	150524	0006641040	ACITT7DI6IDDL	shari zychinski	0	
1	138688	150506	0006641040	A2IW4PEEKO2R0U	Tracy	1	
2	138689	150507	0006641040	A1S4A3IQ2MU7V4	sally sue "sally sue"	1	
3	138690	150508	0006641040	AZGXZ2UUK6X	Catherine Hallberg " (Kate)"	1	
4	138691	150509	0006641040	A3CMRKGE0P909G	Teresa	3	

Bag of Words (BoW)

In [4]:

```
count_vect = CountVectorizer() #in scikit-learn
final_counts = count_vect.fit_transform(filtered_data['CleanedText'].va
lues)
print("the shape of out text BOW vectorizer ",final_counts.get_shape())
```

```
the shape of out text BOW vectorizer  (364171, 71624)
```

In [5]:

```
#selecting the first 1k values
#tried for 10k values but not working (Memory Error)
final_values = final_counts[0:1000]
final_values.toarray()
label = filtered_data['Score'][0:1000]
```

In [6]:

```
#perplexity = 80
model = TSNE(n_components=2, random_state=0, perplexity=80, n_iter=5000
)
tsne_data = model.fit_transform(final_values.toarray())
```

In [7]:

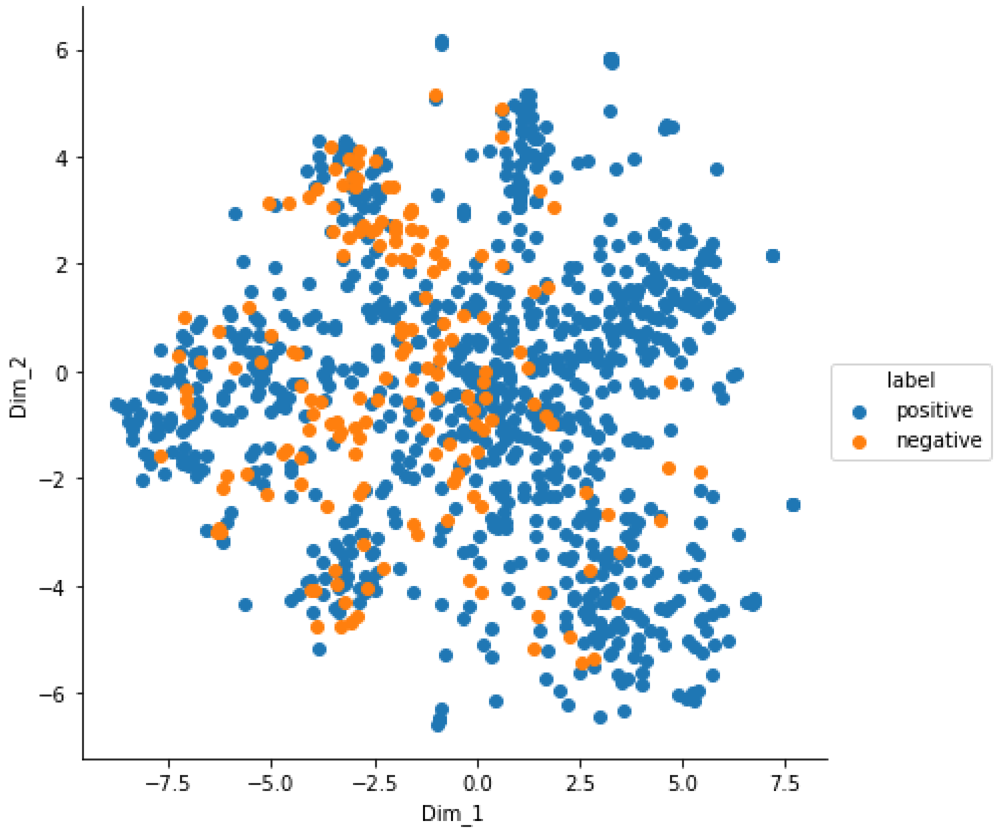
```
tsne_data = np.vstack((tsne_data.T, label)).T
tsne_data
```

Out[7]:

```
array([[1.135949969291687, -2.169593095779419, 'positive'],
       [2.943675994873047, -1.9148491621017456, 'positive'],
       [4.540219306945801, 4.536865711212158, 'positive'],
       ...,
       [-0.5467392802238464, -2.5423057079315186, 'positive'],
       [3.2111728191375732, -1.5342339277267456, 'positive'],
       [0.13811619579792023, -1.0979485511779785, 'negative']],
      dtype=object)
```

In [11]:

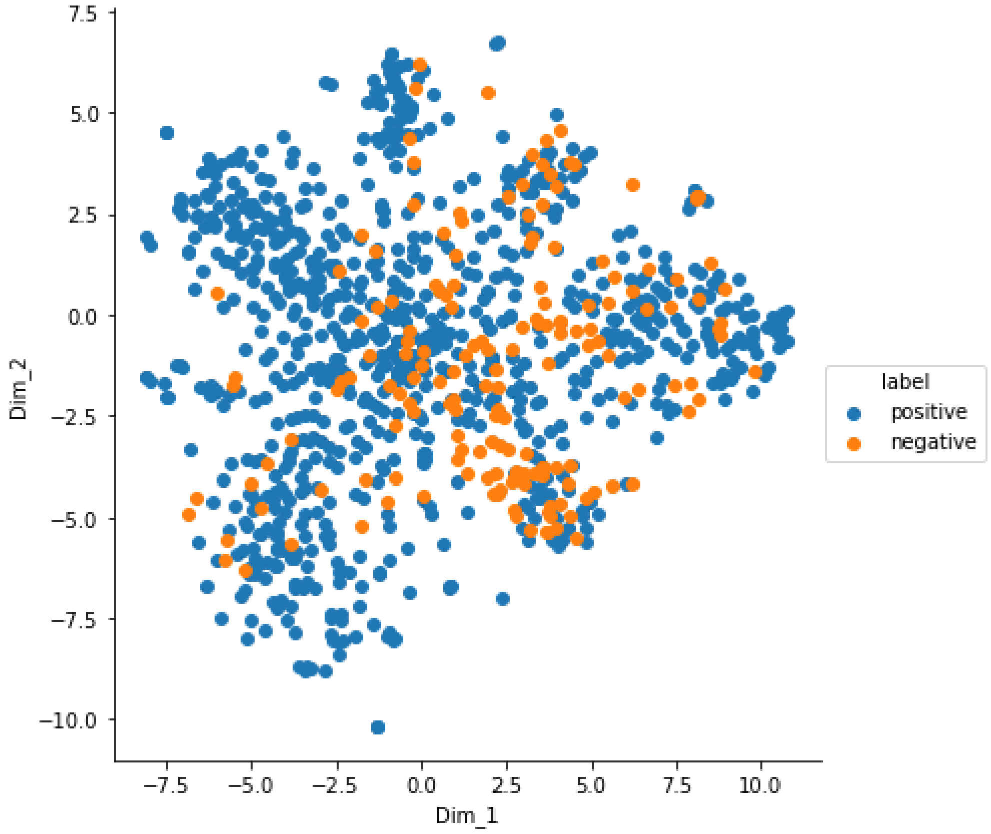
```
tsne_df = pd.DataFrame(data=tsne_data, columns=("Dim_1", "Dim_2", "labe
l"))
sn.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'Dim_1', 'D
im_2').add_legend()
plt.show()
```



```
In [12]: #perplexity = 60
         model = TSNE(n_components=2, random_state=0, perplexity=60, n_iter=5000
         )
         tsne_data = model.fit_transform(final_values.toarray())
         tsne_data = np.vstack((tsne_data.T, label)).T
         tsne_data
```

```
Out[12]: array([[-4.866368770599365, -2.1437766551971436, 'positive'],
                [-4.237192630767822, -2.696587562561035, 'positive'],
                [-8.084127426147461, -1.5494660139083862, 'positive'],
                ...,
                [-0.8321120142936707, 0.5222065448760986, 'positive'],
                [-3.476917266845703, -3.0578975677490234, 'positive'],
                [-0.6171197295188904, -1.9223294258117676, 'negative']],
               dtype=object)
```

In [13]:
```
tsne_df = pd.DataFrame(data=tsne_data, columns=("Dim_1", "Dim_2", "label"))
sn.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_legend()
plt.show()
```



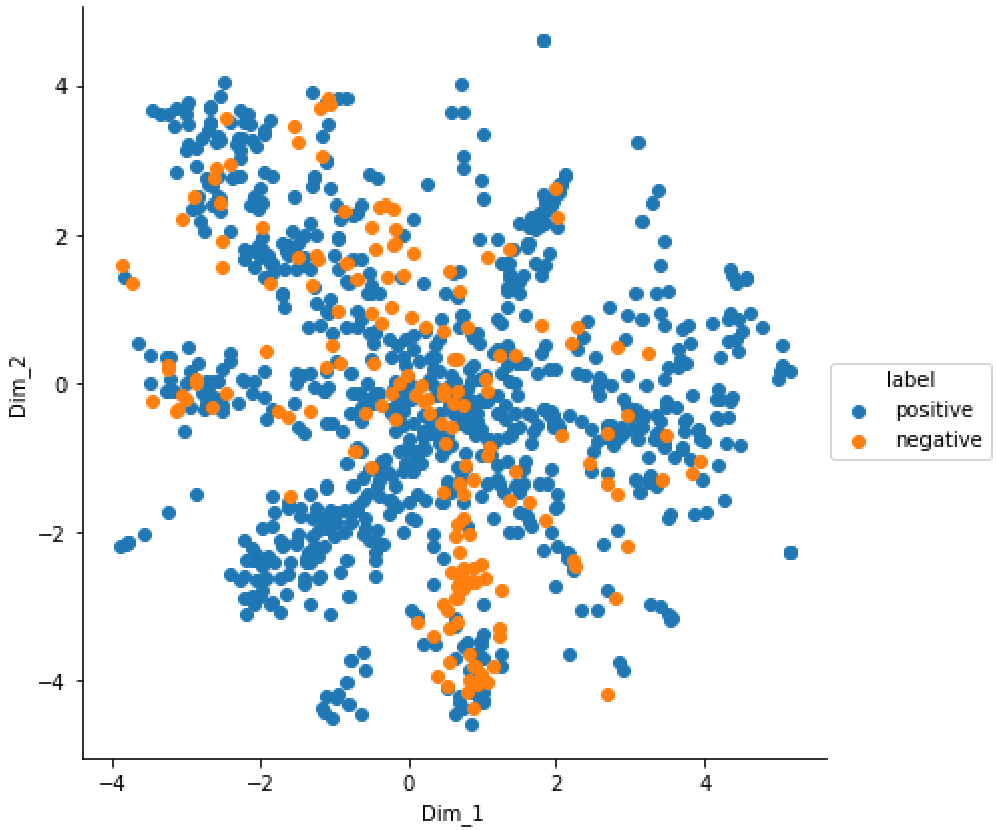
In [14]:
```
#perplexity = 150
model = TSNE(n_components=2, random_state=0, perplexity=150, n_iter=500
0)
tsne_data = model.fit_transform(final_values.toarray())
tsne_data = np.vstack((tsne_data.T, label)).T
tsne_data
```

Out[14]:

```
array([[1.5682780742645264, -1.051674723625183, 'positive'],
       [1.9349400997161865, -1.1618131399154663, 'positive'],
       [-1.0907014608383179, -4.203751087188721, 'positive'],
       ...,
       [0.7224600911140442, 0.9180004596710205, 'positive'],
       [1.8023749589920044, 0.4079337418079376, 'positive'],
       [0.6485686898231506, -0.1206492930650711, 'negative']],
      dtype=object)
```

In [15]:

```
tsne_df = pd.DataFrame(data=tsne_data, columns=("Dim_1", "Dim_2", "label"))
sn.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_legend()
plt.show()
```



Conclusion:- For the above plots using different perplexity values - (60,80,150), we clearly conclude that it is not possible to seperate the positive and negative review clusters from each other ie.there is a considerable overlap of the 2 clusters.

Word2Vec

In [16]:
```
i=0
list_of_sent=[]
```

```
for sent in filtered_data['CleanedText'].values:
    list_of_sent.append(sent.split())
```

In [17]:
```
w2v_model=Word2Vec(list_of_sent,min_count=5,size=50, workers=4)
```

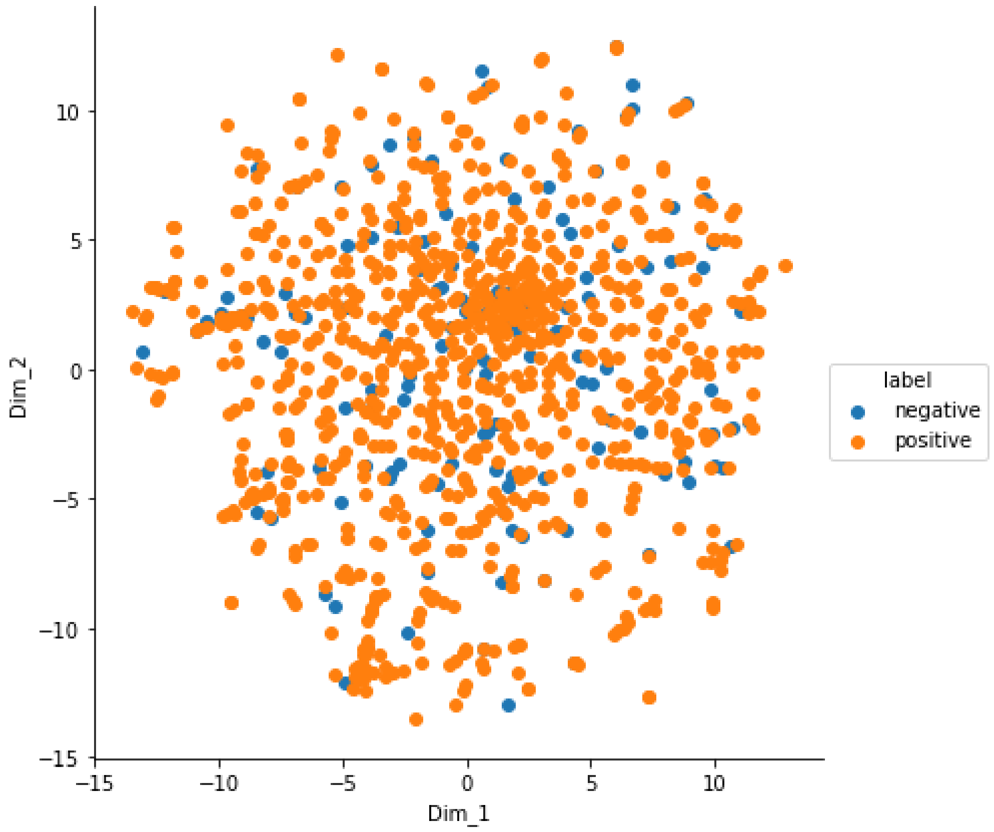
In [18]:
```
X = w2v_model[w2v_model.wv.vocab]
```

```
C:\Users\Aziz\Anaconda3\lib\site-packages\ipykernel_launcher.py:1: Depr
ecationWarning: Call to deprecated `__getitem__` (Method will be remove
d in 4.0.0, use self.wv.__getitem__() instead).
  """Entry point for launching an IPython kernel.
```

In [19]:
```
label = filtered_data['Score'][5000:6000]
final = X[5000:6000]
```

In [20]:
```
#perplexity = 80
model = TSNE(n_components=2, random_state=0, perplexity=80)
tsne_data = model.fit_transform(final)
tsne_data = np.vstack((tsne_data.T, label)).T
tsne_df = pd.DataFrame(data=tsne_data, columns=("Dim_1", "Dim_2", "labe
l"))
```

In [21]:
```
sn.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'Dim_1', 'D
im_2').add_legend()
plt.show()
```

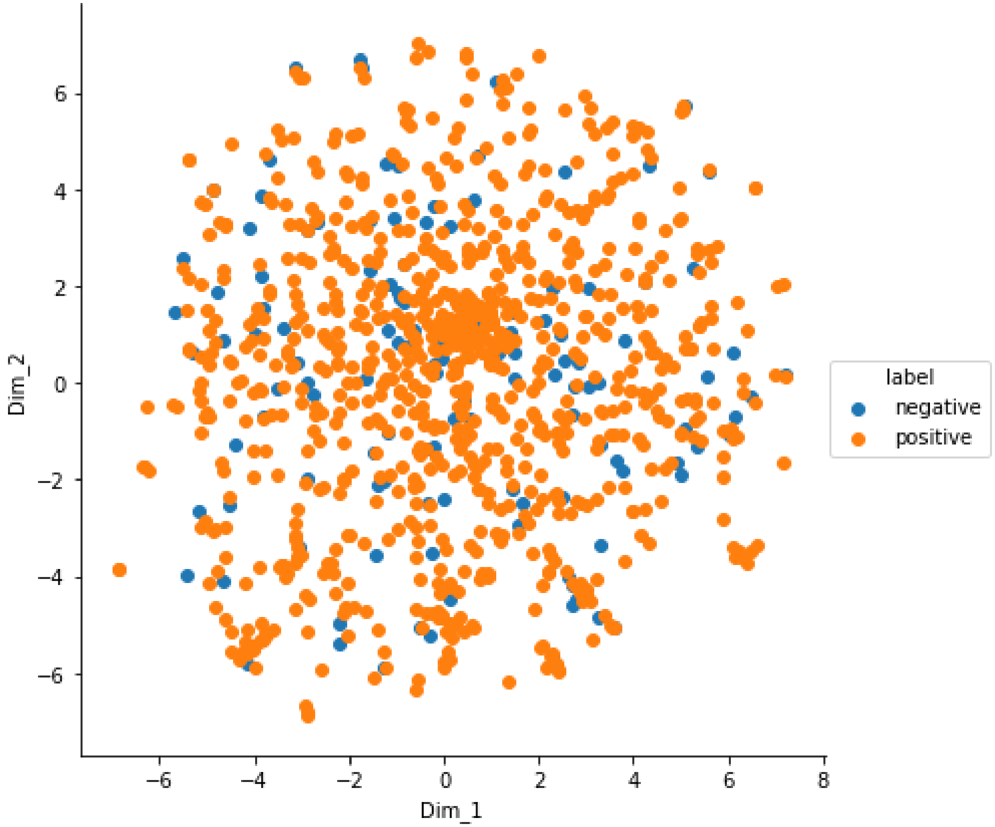


In [23]:

```
#perplexity = 150
model = TSNE(n_components=2, random_state=0, perplexity=150)
tsne_data = model.fit_transform(final)
tsne_data = np.vstack((tsne_data.T, label)).T
tsne_df = pd.DataFrame(data=tsne_data, columns=("Dim_1", "Dim_2", "labe
l"))
```

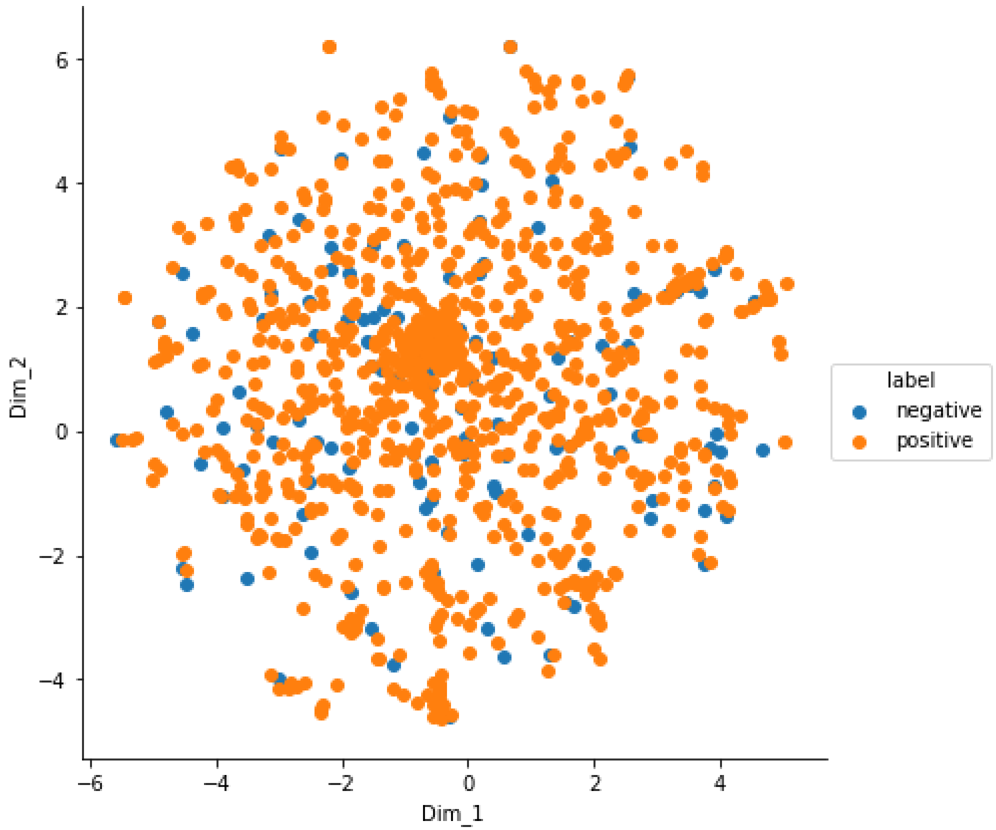
In [24]:

```
sn.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'Dim_1', 'D
im_2').add_legend()
plt.show()
```



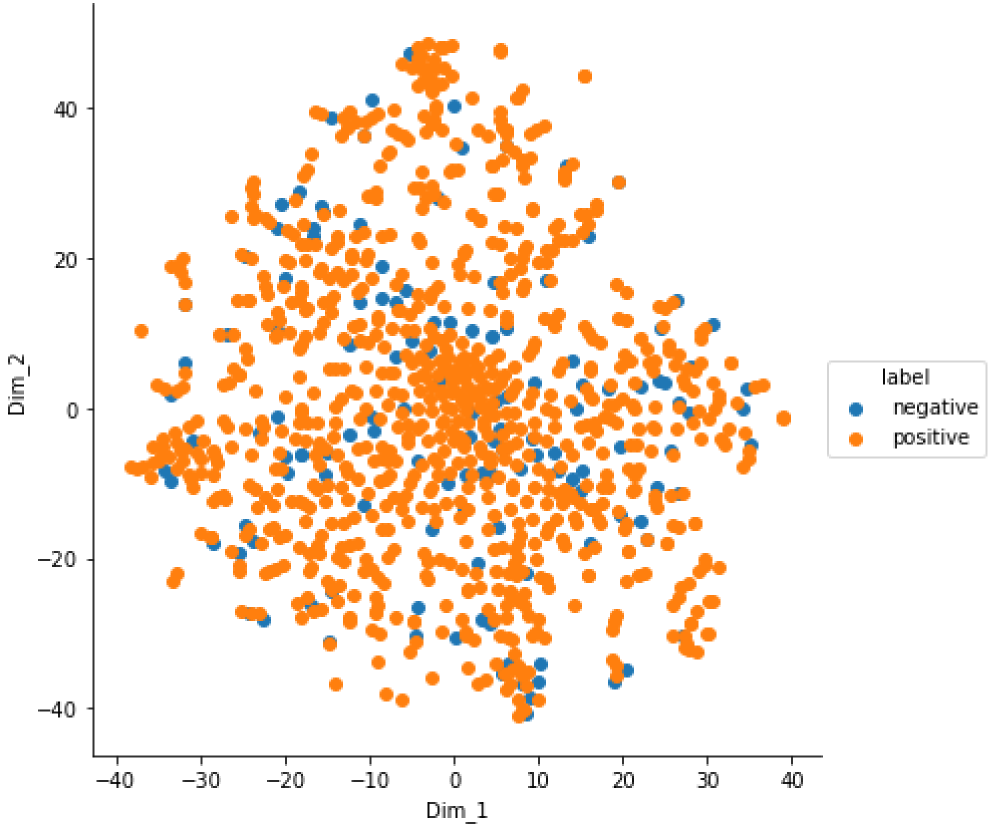
In [25]:
```
#perplexity = 200
model = TSNE(n_components=2, random_state=0, perplexity=200)
tsne_data = model.fit_transform(final)
tsne_data = np.vstack((tsne_data.T, label)).T
tsne_df = pd.DataFrame(data=tsne_data, columns=("Dim_1", "Dim_2", "labe
l"))
```

In [26]:
```
sn.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'Dim_1', 'D
im_2').add_legend()
plt.show()
```



```
In [29]: #perplexity = 20
         model = TSNE(n_components=2, random_state=0, perplexity=20)
         tsne_data = model.fit_transform(final)
         tsne_data = np.vstack((tsne_data.T, label)).T
         tsne_df = pd.DataFrame(data=tsne_data, columns=("Dim_1", "Dim_2", "labe
         l"))
```

```
In [30]: sn.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'Dim_1', 'D
         im_2').add_legend()
         plt.show()
```



Conclusion:- Applied t-SNE with different perplexity values - (80,150,200,20) for Word2Vec. From the plots, one can clearly observe that the 2 clusters are overlapping considerably, therefore it is difficult to visualize them seperately in a 2D Plane.

TF-IDF

In [31]:

```
tf_idf_vect = TfidfVectorizer()
final_tf_idf = tf_idf_vect.fit_transform(filtered_data['CleanedText'].v
alues)
```

```
print("the shape of out text TFIDF vectorizer ",final_tf_idf.get_shape
())
```

```
the shape of out text TFIDF vectorizer  (364171, 71624)
```

In [32]:

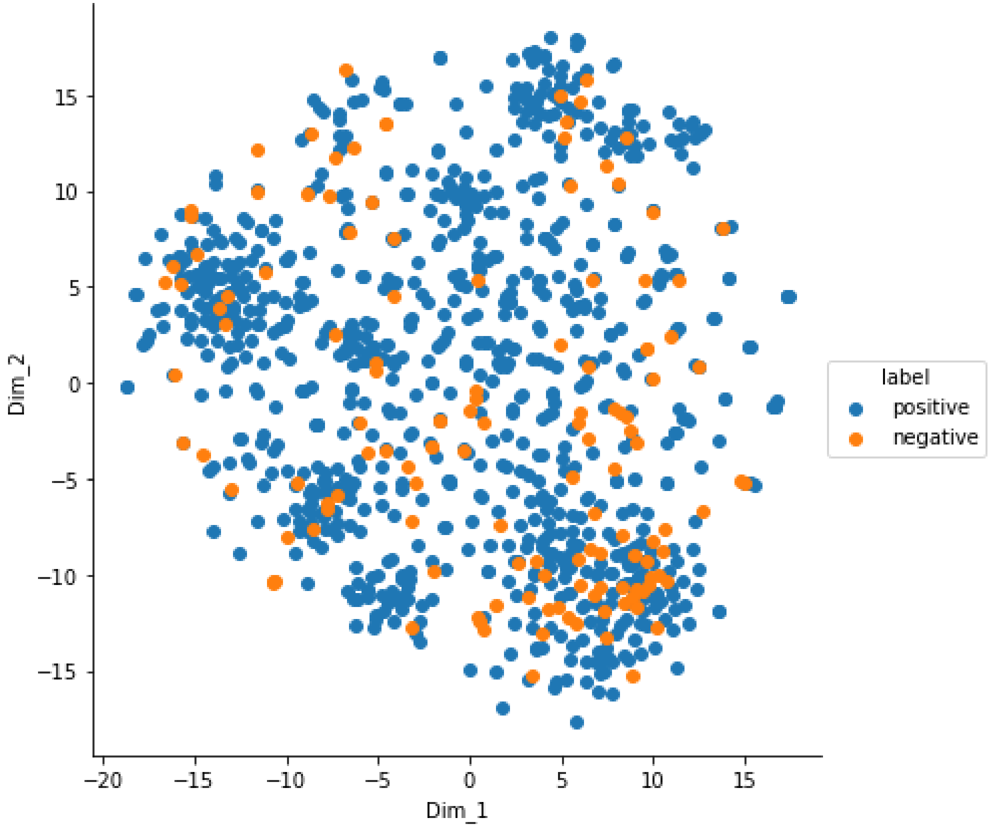
```
final_values = final_tf_idf[6000:7000]
label = filtered_data['Score'][6000:7000]
```

In [33]:

```
#perplexity = 100
model = TSNE(n_components=2, random_state=0, perplexity=100)
tsne_data = model.fit_transform(final_values.toarray())
tsne_data = np.vstack((tsne_data.T, label)).T
tsne_df = pd.DataFrame(data=tsne_data, columns=("Dim_1", "Dim_2", "labe
l"))
```

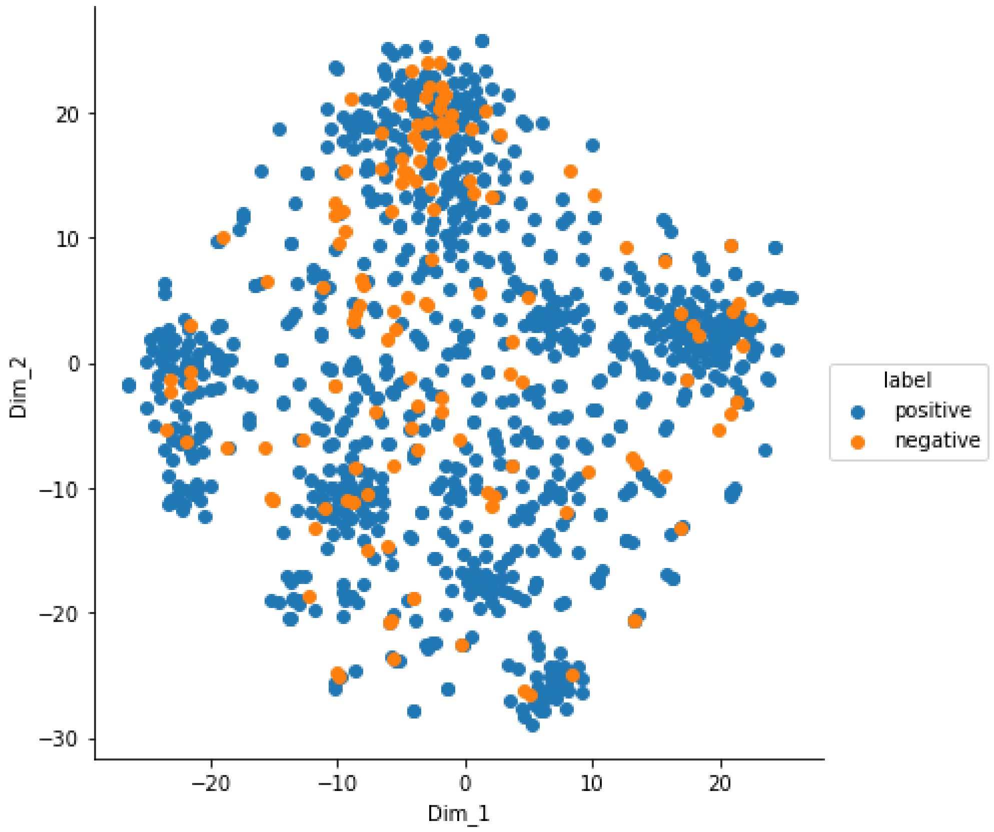
In [34]:

```
sn.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'Dim_1', 'D
im_2').add_legend()
plt.show()
```



```
In [35]: #perplexity = 60
         model = TSNE(n_components=2, random_state=0, perplexity=60)
         tsne_data = model.fit_transform(final_values.toarray())
         tsne_data = np.vstack((tsne_data.T, label)).T
         tsne_df = pd.DataFrame(data=tsne_data, columns=("Dim_1", "Dim_2", "labe
         l"))
```

```
In [36]: sn.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'Dim_1', 'D
         im_2').add_legend()
         plt.show()
```

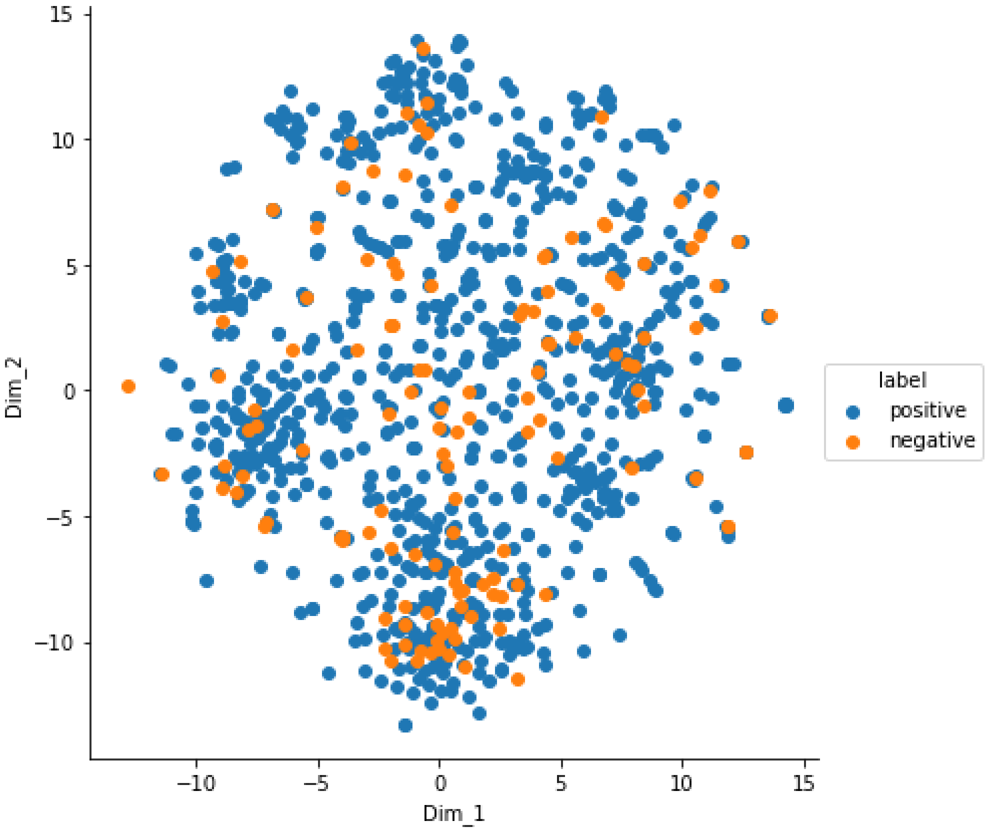


In [37]:

```
#perplexity = 150
model = TSNE(n_components=2, random_state=0, perplexity=150)
tsne_data = model.fit_transform(final_values.toarray())
tsne_data = np.vstack((tsne_data.T, label)).T
tsne_df = pd.DataFrame(data=tsne_data, columns=("Dim_1", "Dim_2", "labe
l"))
```

In [38]:

```
sn.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'Dim_1', 'D
im_2').add_legend()
plt.show()
```



Conclusion:- From the above plots, one can conclude that it is not possible to visualize the 2 clusters seperately in 2D plane without considerable overlap.

Average Word2Vec

In [39]:

```
w2v_words = list(w2v_model.wv.vocab)
sent_vectors = []; # the avg-w2v for each sentence/review is stored in
 this list
for sent in tqdm(list_of_sent): # for each review/sentence
    sent_vec = np.zeros(50) # as word vectors are of zero length
    cnt_words =0; # num of words with a valid vector in the sentence/review
    for word in sent: # for each word in a review/sentence
        if word in w2v_words:
            vec = w2v_model.wv[word]
            sent_vec += vec
            cnt_words += 1
    if cnt_words != 0:
        sent_vec /= cnt_words
    sent_vectors.append(sent_vec)
print(len(sent_vectors))
print(len(sent_vectors[0]))
```

```
100%|██████████████████████████████| 364171/364171 [50:48<00:00, 11
9.45it/s]
```

```
364171
50
```

In [41]:

```
vector = np.array(sent_vectors)
vector.shape
```

Out[41]:

```
(364171, 50)
```

In [42]:

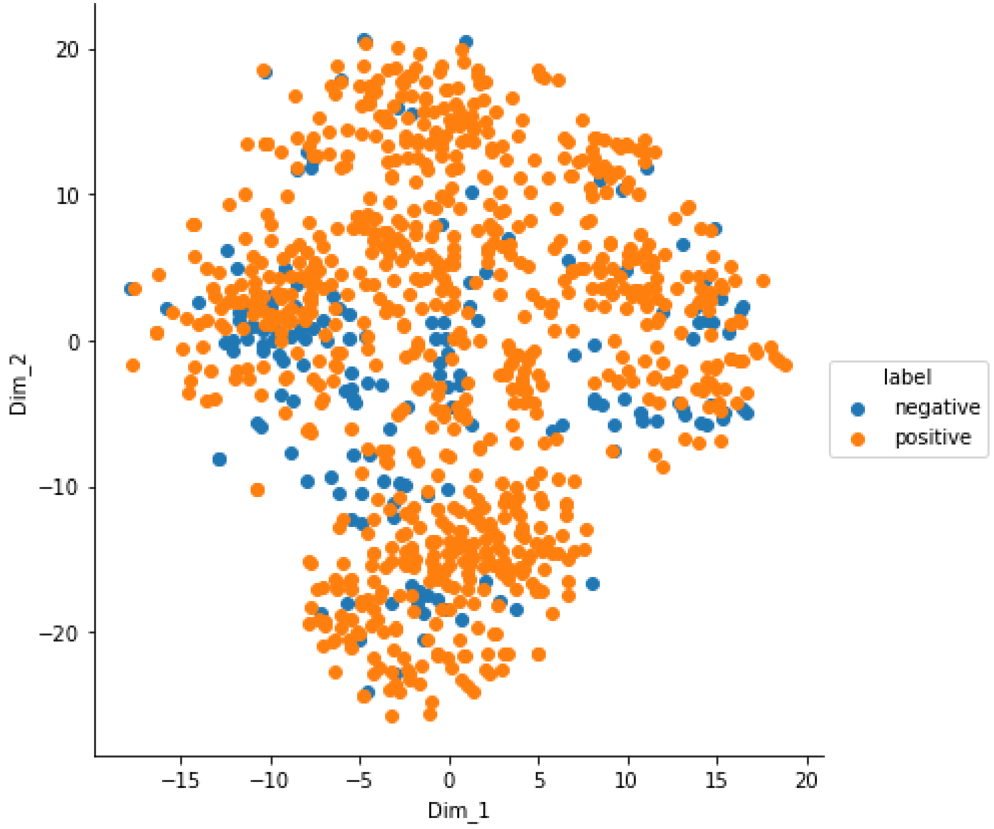
```
# randomly selecting 1k values
final = vector[7000:8000]
label = filtered_data['Score'][7000:8000]
```

In [43]:

```
# perplexity = 50
model = TSNE(n_components=2, random_state=0, perplexity=50)
tsne_data = model.fit_transform(final)
tsne_data = np.vstack((tsne_data.T, label)).T
tsne_df = pd.DataFrame(data=tsne_data, columns=("Dim_1", "Dim_2", "label"))
```

In [44]:

```
sn.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_legend()
plt.show()
```

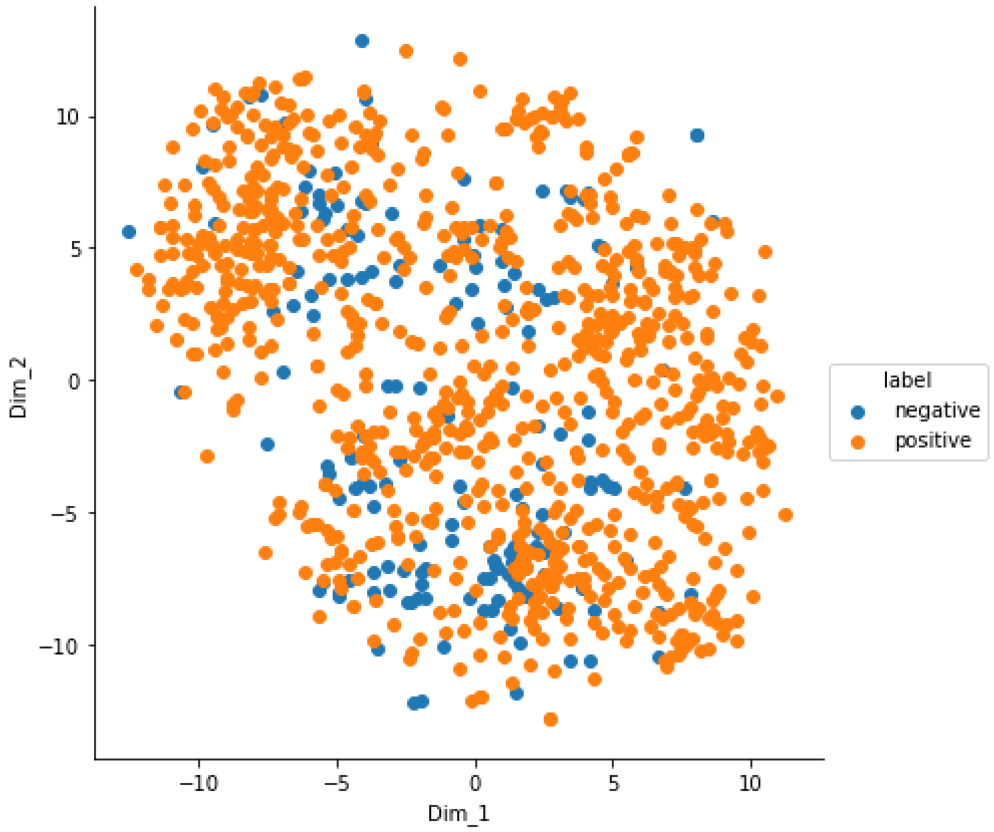


In [45]:

```
# perplexity = 80
model = TSNE(n_components=2, random_state=0, perplexity=80)
tsne_data = model.fit_transform(final)
tsne_data = np.vstack((tsne_data.T, label)).T
tsne_df = pd.DataFrame(data=tsne_data, columns=("Dim_1", "Dim_2", "label"))
```

In [46]:

```
sn.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_legend()
plt.show()
```

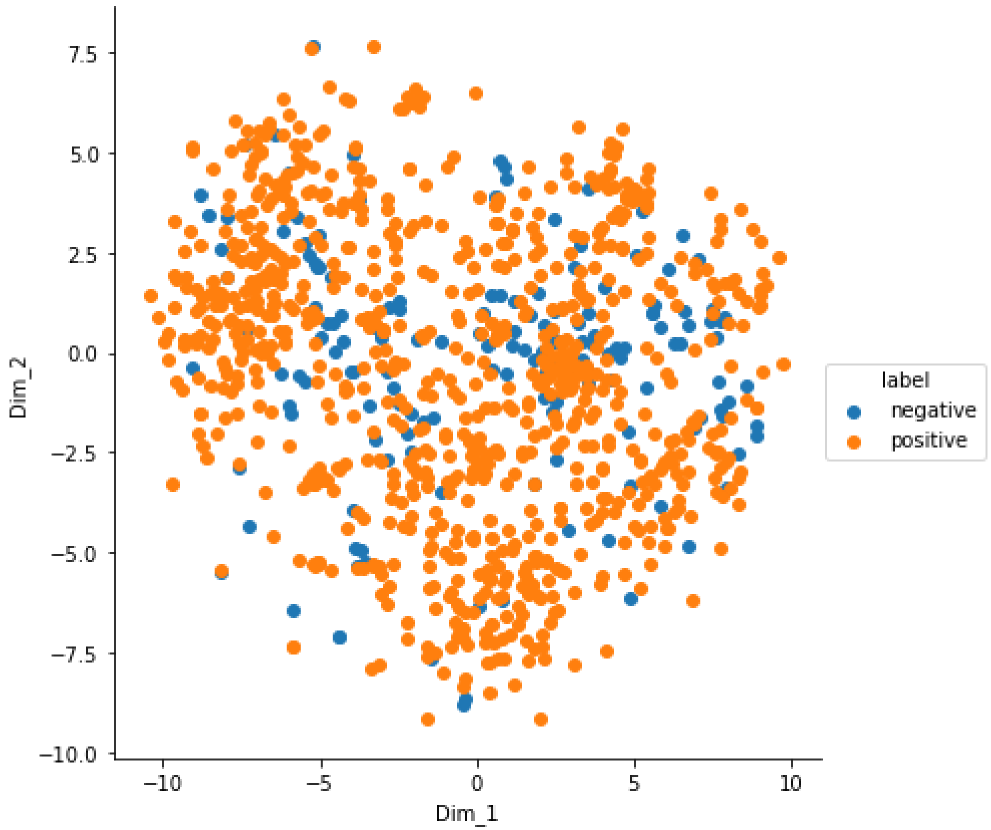


In [47]:

```
# perplexity = 120
model = TSNE(n_components=2, random_state=0, perplexity=120)
tsne_data = model.fit_transform(final)
tsne_data = np.vstack((tsne_data.T, label)).T
tsne_df = pd.DataFrame(data=tsne_data, columns=("Dim_1", "Dim_2", "label"))
```

In [48]:

```
sn.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_legend()
plt.show()
```



Conclusion:- From the above plots of different perplexity values - (50,80,120), one can clearly conclude that there is considerable overlap between the 2 clusters, therefore it is difficult to visualize them seperately in 2D plane.

Conclusion:-

Hence we have successfully implemented t-SNE using 4 different featurization methods - BoW, tfidf, Word2Vec, Avg. Word2Vec with different perplexity values for each method.