Amazon Fine Food Reviews Analysis

[1]. Reading Data

[1.1] Loading the data

```
%matplotlib inline
import warnings
warnings.filterwarnings("ignore")


import sqlite3
import pandas as pd
import numpy as np
import nltk
import string
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.feature_extraction.text import TfidfTransformer
from sklearn.feature_extraction.text import TfidfVectorizer

from sklearn.feature_extraction.text import CountVectorizer
from sklearn.metrics import confusion_matrix
from sklearn import metrics
from sklearn.metrics import roc_curve, auc
from nltk.stem.porter import PorterStemmer

import re
# Tutorial about Python regular expressions: https://pymotw.com/2/re/
import string
from nltk.corpus import stopwords
from nltk.stem import PorterStemmer
from nltk.stem.wordnet import WordNetLemmatizer

from gensim.models import Word2Vec
from gensim.models import KeyedVectors
import pickle

from tqdm import tqdm
import os


# using SQLite Table to read data.
con = sqlite3.connect('database.sqlite')


filtered_data = pd.read_sql_query(""" SELECT * FROM Reviews WHERE Score != 3 LIMIT 100000""", con)

# Give reviews with Score>3 a positive rating(1), and reviews with a score<3 a negative rating(0).
def partition(x):
    if x < 3:
        return 0
    return 1

#changing reviews with score less than 3 to be positive and vice-versa
actualScore = filtered_data['Score']
positiveNegative = actualScore.map(partition)
filtered_data['Score'] = positiveNegative
print("Number of data points in our data", filtered_data.shape)
```

```
filtered_data.head(3)
```

```
Number of data points in our data (100000, 10)
```

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	Helpfulne
0	1	B001E4KFG0	A3SGXH7AUHU8GW	delmartian	1	

```
display = pd.read_sql_query("""
SELECT UserId, ProductId, ProfileName, Time, Score, Text, COUNT(*)
FROM Reviews
GROUP BY UserId
HAVING COUNT(*)>1
""", con)
```

```
print(display.shape)
display.head()
```

```
(80668, 7)
```

	UserId	ProductId	ProfileName	Time	Score	
0	#oc-R115TNMSPFT9I7	B007Y59HVM	Breyton	1331510400	2	Overall
1	#oc-R11D9D7SHXIJB9	B005HG9ET0	Louis E. Emory "hoppy"	1342396800	5	My wife has
2	#oc-R11DNU2NBKQ23Z	B007Y59HVM	Kim Cieszykowski	1348531200	1	This c
3	#oc-R11O5J5ZVQE25C	B005HG9ET0	Penguin Chick	1346889600	5	This w
4	#oc-R12KPBODL2B5ZD	B007OSBE1U	Christopher P. Presta	1348617600	1	I d

```
display[display['UserId']=='AZY10LLTJ71NX']
```

	UserId	ProductId	ProfileName	Time	Score	
80638	AZY10LLTJ71NX	B006P7E5ZI	undertheshrine "undertheshrine"	1334707200	5	I was r

```
display['COUNT(*)'].sum()
```

```
393063
```

[2] Exploratory Data Analysis

[2.1] Data Cleaning: Deduplication

```
display= pd.read_sql_query("""
SELECT *
FROM Reviews
WHERE Score != 3 AND UserId="AR5J8UI46CURR"
ORDER BY ProductID
""", con)
display.head()
```

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	Helpfulness
0	78445	B000HDL1RQ	AR5J8UI46CURR	Geetha Krishnan	2	
1	138317	B000HDOPYC	AR5J8UI46CURR	Geetha Krishnan	2	
				Geetha		

```
#Sorting data according to ProductId in ascending order
sorted_data=filtered_data.sort_values('ProductId', axis=0, ascending=True, inplace=False, kind='quic
```

```
#Deduplication of entries
final=sorted_data.drop_duplicates(subset={"UserId","ProfileName","Time","Text"}, keep='first', inpla
final.shape
```

```
(87775, 10)
```

```
#Checking to see how much % of data still remains
(final['Id'].size*1.0)/(filtered_data['Id'].size*1.0)*100
```

```
87.775
```

```
display= pd.read_sql_query("""
SELECT *
FROM Reviews
WHERE Score != 3 AND Id=44737 OR Id=64422
ORDER BY ProductID
""", con)

display.head()
```

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	Helpfulness

```
final=final[final.HelpfulnessNumerator<=final.HelpfulnessDenominator]
```

```
0  64422  B000MIDROQ  A161DK06JJMCYF  Stephens  3
```

```
#Before starting the next phase of preprocessing lets see the number of entries left
print(final.shape)

#How many positive and negative reviews are present in our dataset?
final['Score'].value_counts()
```

```
(87773, 10)
1    73592
0    14181
Name: Score, dtype: int64
```

[3] Preprocessing

[3.1]. Preprocessing Review Tex

```
sent_0 = final['Text'].values[0]
print(sent_0)
print("="*50)

sent_1000 = final['Text'].values[1000]
print(sent_1000)
print("="*50)

sent_1500 = final['Text'].values[1500]
print(sent_1500)
print("="*50)

sent_4900 = final['Text'].values[4900]
print(sent_4900)
print("="*50)
```

```
My dogs loves this chicken but its a product from China, so we wont be buying it anymore
==================================================
The Candy Blocks were a nice visual for the Lego Birthday party but the candy has little
==================================================
was way to hot for my blood, took a bite and did a jig  lol
==================================================
My dog LOVES these treats. They tend to have a very strong fish oil smell. So if you are
==================================================
```

```
# remove urls from text python: https://stackoverflow.com/a/40823105/4084039
sent_0 = re.sub(r"http\S+", "", sent_0)
sent_1000 = re.sub(r"http\S+", "", sent_1000)
sent_150 = re.sub(r"http\S+", "", sent_1500)
sent_4900 = re.sub(r"http\S+", "", sent_4900)

print(sent_0)
```

```
My dogs loves this chicken but its a product from China, so we wont be buying it anymore
```

```
from bs4 import BeautifulSoup

soup = BeautifulSoup(sent_0, 'lxml')
text = soup.get_text()
print(text)
print("="*50)

soup = BeautifulSoup(sent_1000, 'lxml')
text = soup.get_text()
print(text)
print("="*50)

soup = BeautifulSoup(sent_1500, 'lxml')
text = soup.get_text()
print(text)
print("="*50)

soup = BeautifulSoup(sent_4900, 'lxml')
text = soup.get_text()
print(text)
```

```
My dogs loves this chicken but its a product from China, so we wont be buying it anymore
==================================================
The Candy Blocks were a nice visual for the Lego Birthday party but the candy has little
==================================================
was way to hot for my blood, took a bite and did a jig  lol
==================================================
My dog LOVES these treats. They tend to have a very strong fish oil smell. So if you are
```

```
import re

def decontracted(phrase):
    # specific
    phrase = re.sub(r"won't", "will not", phrase)
    phrase = re.sub(r"can\'t", "can not", phrase)

    # general
    phrase = re.sub(r"n\'t", " not", phrase)
    phrase = re.sub(r"\'re", " are", phrase)
    phrase = re.sub(r"\'s", " is", phrase)
    phrase = re.sub(r"\'d", " would", phrase)
    phrase = re.sub(r"\'ll", " will", phrase)
    phrase = re.sub(r"\'t", " not", phrase)
    phrase = re.sub(r"\'ve", " have", phrase)
    phrase = re.sub(r"\'m", " am", phrase)
    return phrase


sent_1500 = decontracted(sent_1500)
print(sent_1500)
print("="*50)
```

```
was way to hot for my blood, took a bite and did a jig  lol
==================================================
```

```
#remove words with numbers python: https://stackoverflow.com/a/18082370/4084039
sent_0 = re.sub("\S*\d\S*", "", sent_0).strip()
```

```
print(sent_0)
```

```
My dogs loves this chicken but its a product from China, so we wont be buying it anymore
```

```
#remove spacial character: https://stackoverflow.com/a/5843547/4084039
sent_1500 = re.sub('[^A-Za-z0-9]+', ' ', sent_1500)
print(sent_1500)
```

```
was way to hot for my blood took a bite and did a jig lol
```

```
stopwords= set(['br', 'the', 'i', 'me', 'my', 'myself', 'we', 'our', 'ours', 'ourselves', 'you', "yo
            "you'll", "you'd", 'your', 'yours', 'yourself', 'yourselves', 'he', 'him', 'his', 'himse
            'she', "she's", 'her', 'hers', 'herself', 'it', "it's", 'its', 'itself', 'they', 'them',
            'theirs', 'themselves', 'what', 'which', 'who', 'whom', 'this', 'that', "that'll", 'thes
            'am', 'is', 'are', 'was', 'were', 'be', 'been', 'being', 'have', 'has', 'had', 'having',
            'did', 'doing', 'a', 'an', 'the', 'and', 'but', 'if', 'or', 'because', 'as', 'until', 'w
            'at', 'by', 'for', 'with', 'about', 'against', 'between', 'into', 'through', 'during', '
            'above', 'below', 'to', 'from', 'up', 'down', 'in', 'out', 'on', 'off', 'over', 'under',
            'then', 'once', 'here', 'there', 'when', 'where', 'why', 'how', 'all', 'any', 'both', 'e
            'most', 'other', 'some', 'such', 'only', 'own', 'same', 'so', 'than', 'too', 'very', \
            's', 't', 'can', 'will', 'just', 'don', "don't", 'should', "should've", 'now', 'd', 'll'
            've', 'y', 'ain', 'aren', "aren't", 'couldn', "couldn't", 'didn', "didn't", 'doesn', "do
            "hadn't", 'hasn', "hasn't", 'haven', "haven't", 'isn', "isn't", 'ma', 'mightn', "mightn'
            "mustn't", 'needn', "needn't", 'shan', "shan't", 'shouldn', "shouldn't", 'wasn', "wasn't
            'won', "won't", 'wouldn', "wouldn't"])
```

```
# Combining all the above stundents
from tqdm import tqdm
preprocessed_reviews = []
# tqdm is for printing the status bar
for sentance in tqdm(final['Text'].values):
    sentance = re.sub(r"http\S+", "", sentance)
    sentance = BeautifulSoup(sentance, 'lxml').get_text()
    sentance = decontracted(sentance)
    sentance = re.sub("\S*\d\S*", "", sentance).strip()
    sentance = re.sub('[^A-Za-z]+', ' ', sentance)
    # https://gist.github.com/sebleier/554280
    sentance = ' '.join(e.lower() for e in sentance.split() if e.lower() not in stopwords)
    preprocessed_reviews.append(sentance.strip())
```

```
100%|██████████| 87773/8
```

[4] Featurization

[4.1] BAG OF WORDS

```
#BoW
count_vect = CountVectorizer() #in scikit-learn
count_vect.fit(preprocessed_reviews)
print("some feature names ", count_vect.get_feature_names()[:10])
print('='*50)

final_counts = count_vect.transform(preprocessed_reviews)
print("the type of count vectorizer ",type(final_counts))
print("the shape of out text BOW vectorizer ",final_counts.get_shape())
```

```
print("the number of unique words ", final_counts.get_shape()[1])
```

```
some feature names  ['aa', 'aaa', 'aaaa', 'aaaaa', 'aaaaaaaaaaa', 'aaaaaaaaaaaaaa', 'a
==================================================
the type of count vectorizer  <class 'scipy.sparse.csr.csr_matrix'>
the shape of out text BOW vectorizer  (87773, 54904)
the number of unique words  54904
```

[4.2] Bi-Grams and n-Grams

```
#bi-gram, tri-gram and n-gram

#removing stop words like "not" should be avoided before building n-grams
# count_vect = CountVectorizer(ngram_range=(1,2))
# please do read the CountVectorizer documentation http://scikit-learn.org/stable/modules/generated/

# you can choose these numebrs min_df=10, max_features=5000, of your choice
count_vect = CountVectorizer(ngram_range=(1,2), min_df=10, max_features=5000)
final_bigram_counts = count_vect.fit_transform(preprocessed_reviews)
print("the type of count vectorizer ",type(final_bigram_counts))
print("the shape of out text BOW vectorizer ",final_bigram_counts.get_shape())
print("the number of unique words including both unigrams and bigrams ", final_bigram_counts.get_sha
```

```
the type of count vectorizer  <class 'scipy.sparse.csr.csr_matrix'>
the shape of out text BOW vectorizer  (87773, 5000)
the number of unique words including both unigrams and bigrams  5000
```

[4.3] TF-IDF

```
tf_idf_vect = TfidfVectorizer(ngram_range=(1,2), min_df=10)
tf_idf_vect.fit(preprocessed_reviews)
print("some sample features(unique words in the corpus)",tf_idf_vect.get_feature_names()[0:10])
print('='*50)

final_tf_idf = tf_idf_vect.transform(preprocessed_reviews)
print("the type of count vectorizer ",type(final_tf_idf))
print("the shape of out text TFIDF vectorizer ",final_tf_idf.get_shape())
print("the number of unique words including both unigrams and bigrams ", final_tf_idf.get_shape()[1]
```

```
some sample features(unique words in the corpus) ['aa', 'aafco', 'aback', 'abandon', 'ab
==================================================
the type of count vectorizer  <class 'scipy.sparse.csr.csr_matrix'>
the shape of out text TFIDF vectorizer  (87773, 51709)
the number of unique words including both unigrams and bigrams  51709
```

[5] Truncated SVD

[5.1] Taking top features from TFIDF

```
# Standardization
from sklearn.preprocessing import StandardScaler
std = StandardScaler(with_mean = False)
```

```
std_data = std.fit_transform(final_tf_idf)
std_data
```

```
<87773x51709 sparse matrix of type '<class 'numpy.float64'>'
        with 4107655 stored elements in Compressed Sparse Row format>
```

```
# List of vocabulary
list(tf_idf_vect.vocabulary_.keys())[0:10]
```

```
['dogs',
 'loves',
 'chicken',
 'product',
 'china',
 'wont',
 'buying',
 'anymore',
 'hard',
 'find']
```

```
# List of vocabulary values
list(tf_idf_vect.vocabulary_.values())[0:10]
```

```
[12123, 26483, 7384, 35753, 7502, 50846, 6032, 1845, 20976, 15630]
```

```
# Get feature names from tfidf
features = tf_idf_vect.get_feature_names()
# feature weights based on idf score
coef = tf_idf_vect.idf_
# Store features with their idf score in a dataframe
coeff_df = pd.DataFrame({'Features' : features, 'Idf_score' : coef})
coeff_df = coeff_df.sort_values("Idf_score", ascending = True)[:2000]
print("shape of selected features :", coeff_df.shape)
print("Top 5 features :\n\n",coeff_df[0:10])
```

```
shape of selected features : (2000, 2)
Top 5 features :

       Features  Idf_score
30359      not   1.605378
24554     like   2.198111
19289     good   2.312714
20089    great   2.412216
31964      one   2.500359
44466    taste   2.516372
51056    would   2.591810
35753  product   2.653863
26110     love   2.681394
16145   flavor   2.697065
```

[5.2] Calulation of Co-occurrence matrix

```
# co-occurence matrix
co_occurence_matrix = np.zeros((len(coeff_df), len(coeff_df)))
print(co_occurence_matrix.shape)
```

```
df = pd.DataFrame(co_occurence_matrix, index = coeff_df["Features"], columns = coeff_df["Features"])
df.shape
```

```
(2000, 2000)
(2000, 2000)
```

```
# Calculate Co-Occurrence Matrix
# with windows size 4 in forward and backward pass
%time
window_size = 4
for sent in preprocessed_reviews:
    word = sent.split(" ")
    for i, d in enumerate(word):
        for j in range(max(i - window_size, 0), min(i + window_size, len(word))):
            if (word[i] != word[j]):
                    try:
                        df.loc[word[i], word[j]] += 1
                        df.loc[word[j], word[i]] += 1
                    except:
                        pass
```

```
Wall time: 0 ns
```

```
df.head()
```

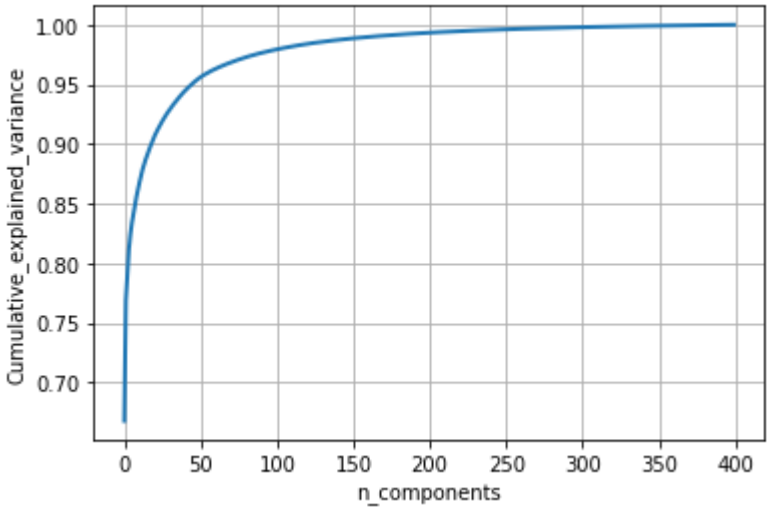
Features	not	like	good	great	one	taste	would	product	love	flav
Features										
not	0.0	22131.0	13164.0	6663.0	9091.0	15185.0	12803.0	8286.0	4599.0	984
like	22131.0	0.0	4346.0	2482.0	3596.0	9801.0	4900.0	2648.0	2019.0	438
good	13164.0	4346.0	0.0	2498.0	2701.0	6394.0	3038.0	3729.0	1660.0	408
great	6663.0	2482.0	2498.0	0.0	1668.0	5480.0	1935.0	5516.0	2293.0	393
one	9091.0	3596.0	2701.0	1668.0	0.0	1940.0	2569.0	1315.0	1503.0	182

5 rows × 2000 columns

[5.3] Finding optimal value for number of components (n) to be retained

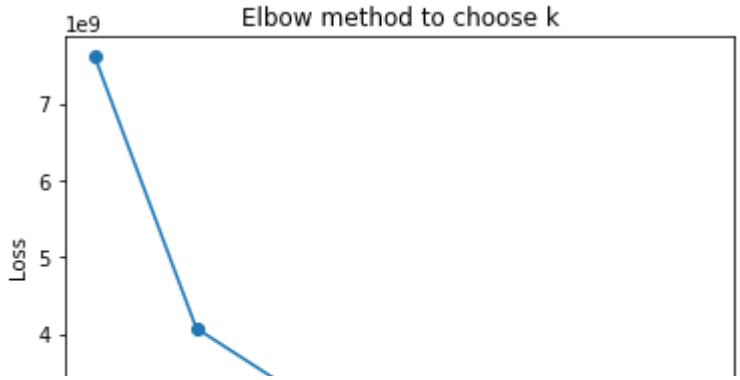
```
# TrucatedSVD
from sklearn.decomposition import TruncatedSVD
ts = TruncatedSVD(n_components = 400)
ts_data = ts.fit_transform(df)

percentage_var_explained = ts.explained_variance_ / np.sum(ts.explained_variance_)

cum_var_explained = np.cumsum(percentage_var_explained)

# Plot the PCA spectrum
plt.figure(1, figsize=(6, 4))

plt.clf()
```

```
plt.plot(cum_var_explained, linewidth = 2)
plt.axis('tight')
plt.grid()
plt.xlabel('n_components')
plt.ylabel('Cumulative_explained_variance')
plt.show()
```



[5.4] Applying k-means clustering

```
# Elbow method to find K
def find_optimal_k(data):
    loss = []
    k = list(range(2, 15, 2))
    for noc in k:
        model = KMeans(n_clusters = noc)
        model.fit(data)
        loss.append(model.inertia_)
    plt.plot(k, loss, "-o")
    plt.title("Elbow method to choose k")
    plt.xlabel("K")
    plt.ylabel("Loss")
    plt.show()


# Find best k using elbow method
find_optimal_k(ts_data)
```




```
# After applying truncated svd store data into dataframe
df = pd.DataFrame(ts_data)
```

2 4 6 8 10 12 14

```
# Data shape
df.shape
```

(2000, 400)

```
# K-means clustering
clf = KMeans(n_clusters = 10)
clf.fit(ts_data)
```

```
KMeans(algorithm='auto', copy_x=True, init='k-means++', max_iter=300,
    n_clusters=10, n_init=10, n_jobs=1, precompute_distances='auto',
    random_state=None, tol=0.0001, verbose=0)
```

```
# Assign each data-points with its correspondincg label
df["Cluster_labels"] = clf.labels_
df["Words"] = coeff_df["Features"].values
df.head()
```

	0	1	2	3	4	5	
0	47215.625631	28714.108289	-485.427388	816.159495	1631.876515	-988.146745	-217
1	27970.184723	-10604.126647	-3765.317659	8187.460166	2016.784608	-788.574999	-1755
2	20709.581567	-4005.340506	-1243.307962	4986.340604	-325.188110	-1363.594093	1972
3	15081.757186	-50.092773	120.002652	5135.196557	-2269.012568	-1196.628244	2377
4	15129.380055	-2327.386702	1428.802207	-650.210016	-316.670895	2599.730332	450

5 rows × 402 columns

```
reviews = preprocessed_reviews
# Getting all the reviews in different clusters
cluster1 = []
cluster2 = []
cluster3 = []
cluster4 = []
cluster5 = []
cluster6 = []
```

```
cluster7 = []
cluster8 = []
cluster9 = []

for i in range(kmeans.labels_.shape[0]):
    if kmeans.labels_[i] == 0:
        cluster1.append(reviews[i])
    elif kmeans.labels_[i] == 1:
        cluster2.append(reviews[i])
    elif kmeans.labels_[i] == 2:
        cluster3.append(reviews[i])
    elif kmeans.labels_[i] == 3:
        cluster4.append(reviews[i])
    elif kmeans.labels_[i] == 4:
        cluster5.append(reviews[i])
    elif kmeans.labels_[i] == 5:
        cluster6.append(reviews[i])
    elif kmeans.labels_[i] == 6:
        cluster7.append(reviews[i])
    elif kmeans.labels_[i] == 7:
        cluster8.append(reviews[i])
    else :
        cluster9.append(reviews[i])

# Number of reviews in different clusters
print("No. of reviews in Cluster-1 : ",len(cluster1))
print("\nNo. of reviews in Cluster-2 : ",len(cluster2))
print("\nNo. of reviews in Cluster-3 : ",len(cluster3))
print("\nNo. of reviews in Cluster-4 : ",len(cluster4))
print("\nNo. of reviews in Cluster-5 : ",len(cluster5))
print("\nNo. of reviews in Cluster-6 : ",len(cluster6))
print("\nNo. of reviews in Cluster-7 : ",len(cluster7))
print("\nNo. of reviews in Cluster-8 : ",len(cluster8))
print("\nNo. of reviews in Cluster-9 : ",len(cluster9))
```

```
No. of reviews in Cluster-1 :  1493

No. of reviews in Cluster-2 :  7

No. of reviews in Cluster-3 :  31

No. of reviews in Cluster-4 :  1

No. of reviews in Cluster-5 :  126

No. of reviews in Cluster-6 :  338

No. of reviews in Cluster-7 :  1

No. of reviews in Cluster-8 :  1

No. of reviews in Cluster-9 :  2
```

[5.5] Wordclouds of clusters obtained in the above section

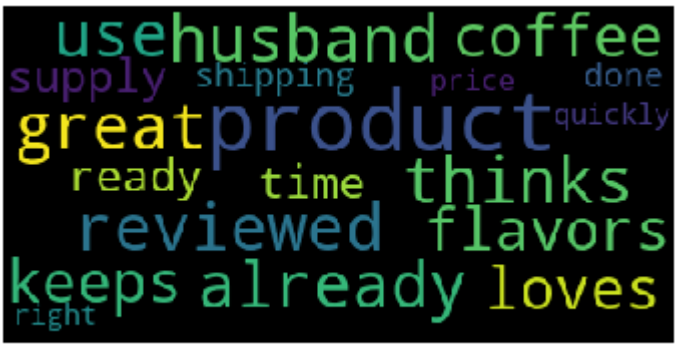
```
#Reading reviews manually
cluster1[0]
```

```
'disappointed regular nylabones pound dogs chewed sharp dangerous chunks within matter m
```

```
import nltk
nltk.download('punkt')
```

```
for val in cluster1:
    text = val.lower()
    tokens = nltk.word_tokenize(text)
    tokens = cluster1
    for words in tokens:
        cluster1_words = words + ' '

from wordcloud import WordCloud
plt.ion()
print ("cluster1 Word-Cloud")
wordcloud = WordCloud(max_font_size=50).generate(cluster1_words)
plt.figure()
plt.imshow(wordcloud)
plt.axis("off")
plt.show()
```

```
[nltk_data] Downloading package punkt to C:\Users\BALARAMI
[nltk_data]     REDDY\AppData\Roaming\nltk_data...
[nltk_data]   Package punkt is already up-to-date!
cluster1 Word-Cloud
```




```
cluster2[0]
```

```
'wish would read reviews making purchase basically cardsotck box sticky outside pink ish
```

```
for val in cluster2:
    text = val.lower()
    tokens = nltk.word_tokenize(text)
    tokens = cluster2
    for words in tokens:
        cluster2_words = words + ' '

from wordcloud import WordCloud
plt.ion()
print ("cluster2 Word-Cloud")
wordcloud = WordCloud(max_font_size=50).generate(cluster2_words)
plt.figure()
plt.imshow(wordcloud)
plt.axis("off")
plt.show()
```

cluster2 Word-Cloud


```
cluster3[0]
```

'placed around house several days setup fly attracting trap vicinity literally watched f

```
for val in cluster3:
    text = val.lower()
    tokens = nltk.word_tokenize(text)
    tokens = cluster3
    for words in tokens:
        cluster3_words = words + ' '

from wordcloud import WordCloud
plt.ion()
print ("cluster3 Word-Cloud")
wordcloud = WordCloud(max_font_size=50).generate(cluster3_words)
plt.figure()
plt.imshow(wordcloud)
plt.axis("off")
plt.show()
```

cluster3 Word-Cloud


```
cluster4[0]
```

'dogs loves chicken product china wont buying anymore hard find chicken products made us

```
for val in cluster4:
    text = val.lower()
    tokens = nltk.word_tokenize(text)
```

```
    tokens = cluster4
    for words in tokens:
        cluster4_words = words + ' '

from wordcloud import WordCloud
plt.ion()
print ("cluster4 Word-Cloud")
wordcloud = WordCloud(max_font_size=50).generate(cluster4_words)
plt.figure()
plt.imshow(wordcloud)
plt.axis("off")
plt.show()
```

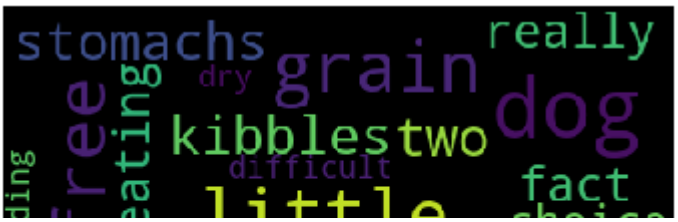
cluster4 Word-Cloud


```
cluster5[0]
```

'time spent waiting order fly traps arrive went bought regular fly ribbon bad fly proble

```
for val in cluster5:
    text = val.lower()
    tokens = nltk.word_tokenize(text)
    tokens = cluster5
    for words in tokens:
        cluster5_words = words + ' '

from wordcloud import WordCloud
plt.ion()
print ("cluster5 Word-Cloud")
wordcloud = WordCloud(max_font_size=50).generate(cluster5_words)
plt.figure()
plt.imshow(wordcloud)
plt.axis("off")
plt.show()
```

cluster5 Word-Cloud




```
cluster6[0]
```

'two terrier mixes lbs lbs love chew paws favorites past five years nylabone dental dino

```
for val in cluster6:
    text = val.lower()
    tokens = nltk.word_tokenize(text)
    tokens = cluster6
    for words in tokens:
        cluster6_words = words + ' '


from wordcloud import WordCloud
plt.ion()
print ("cluster6 Word-Cloud")
wordcloud = WordCloud(max_font_size=50).generate(cluster6_words)
plt.figure()
plt.imshow(wordcloud)
plt.axis("off")
plt.show()
```

cluster6 Word-Cloud

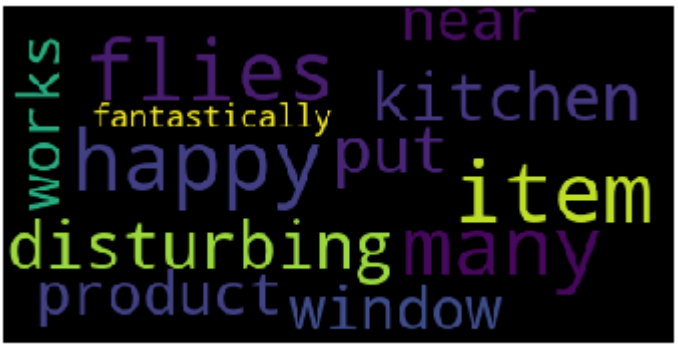

```
cluster7[0]
```

'happy item many flies disturbing kitchen put product near window works fantastically'

```
for val in cluster7:
    text = val.lower()
    tokens = nltk.word_tokenize(text)
    tokens = cluster7
    for words in tokens:
        cluster7_words = words + ' '


from wordcloud import WordCloud
```

```
plt.ion()
print ("cluster7 Word-Cloud")
wordcloud = WordCloud(max_font_size=50).generate(cluster7_words)
plt.figure()
plt.imshow(wordcloud)
plt.axis("off")
plt.show()
```

cluster7 Word-Cloud




```
cluster8[0]
```

'dogs love saw pet store tag attached regarding made china satisfied safe'

```
for val in cluster8:
    text = val.lower()
    tokens = nltk.word_tokenize(text)
    tokens = cluster8
    for words in tokens:
        cluster8_words = words + ' '
```

```
from wordcloud import WordCloud
plt.ion()
print ("cluster8 Word-Cloud")
wordcloud = WordCloud(max_font_size=50).generate(cluster8_words)
plt.figure()
plt.imshow(wordcloud)
plt.axis("off")
plt.show()
```

cluster8 Word-Cloud

```
cluster9[0]
```

'infestation fruitflies literally everywhere flying around kitchen bought product hoping

```
for val in cluster9:
    text = val.lower()
    tokens = nltk.word_tokenize(text)
    tokens = cluster9
    for words in tokens:
        cluster9_words = words + ' '


from wordcloud import WordCloud
plt.ion()
print ("cluster9 Word-Cloud")
wordcloud = WordCloud(max_font_size=50).generate(cluster9_words)
plt.figure()
plt.imshow(wordcloud)
plt.axis("off")
plt.show()
```

cluster9 Word-Cloud


```
# Calculate cosine similarity
from sklearn.metrics import pairwise_distances
def cosine_similarity(word_index, total_results):
    # calculate pairwise distances from given word
    # The smaller the distance, the more similar the word
    dist = pairwise_distances(ts_data, ts_data[word_index:word_index + 1,:])
    # Store index of the distances
    indices = np.argsort(dist.flatten())[0:total_results]
    # Sort distances
    pdist = np.sort(dist.flatten())[0:total_results]
    # put indices at particular index of dataframe
    df_indices = list(df.index[indices])
    print("Most_Similar Words \t Distances")
    # Loop through indices and find match
    for i in range(len(indices)):
```

```
            if indices[i] == df.index[indices[i]]:
                print(df.Words.loc[indices[i]], "\t\t\t", dist[indices[i]])
```

```
# given index of a word
# find how similar words are from this index word
cosine_similarity(119, 7)
```

```
Most_Similar Words       Distances
tasty                    [0.00010572]
kind                     [1444.80315447]
however                          [1497.55146585]
although                         [1499.9365148]
things                   [1507.055186]
may                      [1510.99135107]
probably                         [1519.11947247]
```

```
# given index of a word
# find how similar words are from this index word
cosine_similarity(56, 7)
```

```
Most_Similar Words       Distances
still                    [0.]
however                          [1686.2278009]
lot                      [1869.50328975]
say                      [1906.01828543]
stuff                    [1913.51065679]
way                      [1976.85773448]
actually                         [2009.43636588]
```