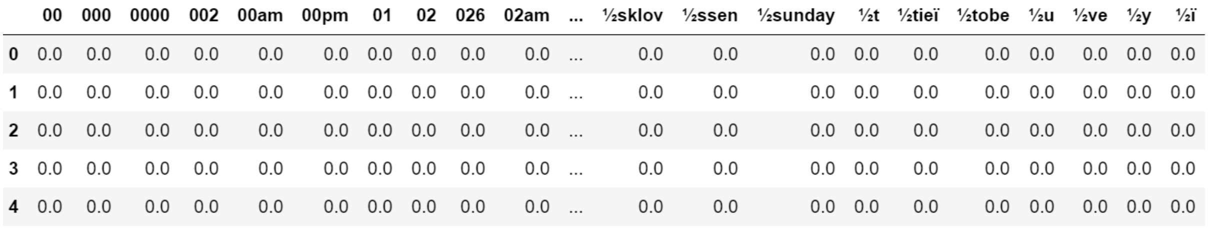
INTRODUCTION TO DATA SCIENCE AND ANALYTICS

Project Delivery #5:
Descriptive Analysis

Project Title:
Social Media Sentiment Analysis

Features

We use Term Frequency-Inverse Document Frequency (TF-IDF) to transform the text data. You can obtain the tf-idf array from Figure 1.



	00	000	0000	002	00am	00pm	01	02	026	02am	...	½sklov	½ssen	½sunday	½t	½tieï	½tobe	½u	½ve	½y	½ï
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	...	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure 1. tf-idf array.

We used the Elbow method to make sure we choose the optimal number of clusters. We decided to make experiments 2 and 3 number of clusters.

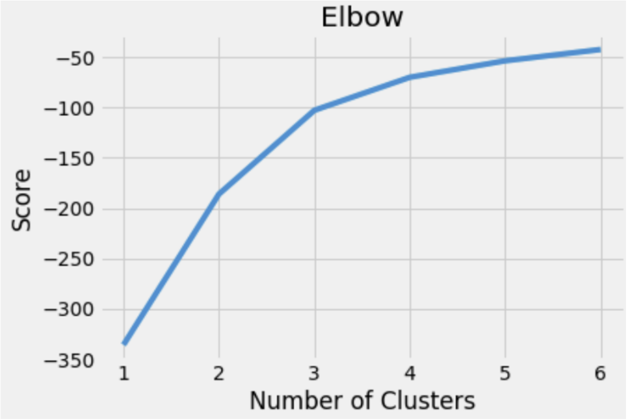
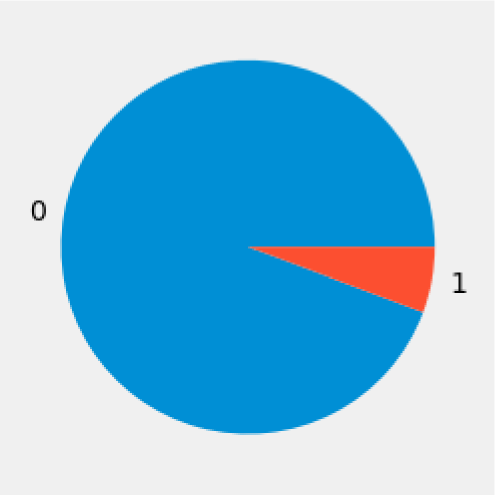


Figure 2. Elbow method to get optimal number of clusters.

Instance Distributions Pie Chart



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28300 1700
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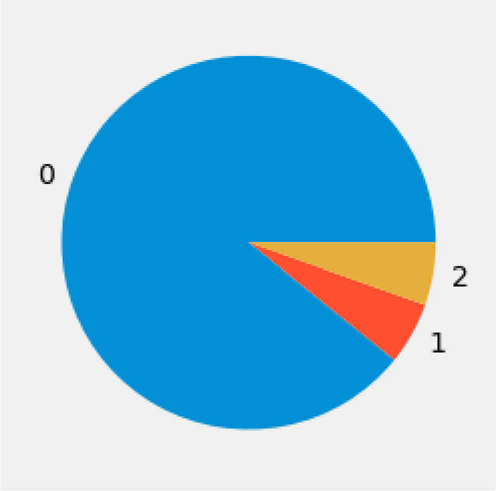
Cluster 0 Percentage = 94.3%
Cluster 1 Percentage = 5.7%
Figure 3. A pie chart showing the instance distributions for 2 clusters.



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26584 1609 1609
```

Cluster 0 Percentage = 88.6%
Cluster 1 Percentage = 5.7%
Cluster 2 Percentage = 5.7%
Figure 4. A pie chart showing the instance distributions for 3 clusters.

Evaluation of Clustering Experiments

- **Experiment 1 - Number of clusters = 2**

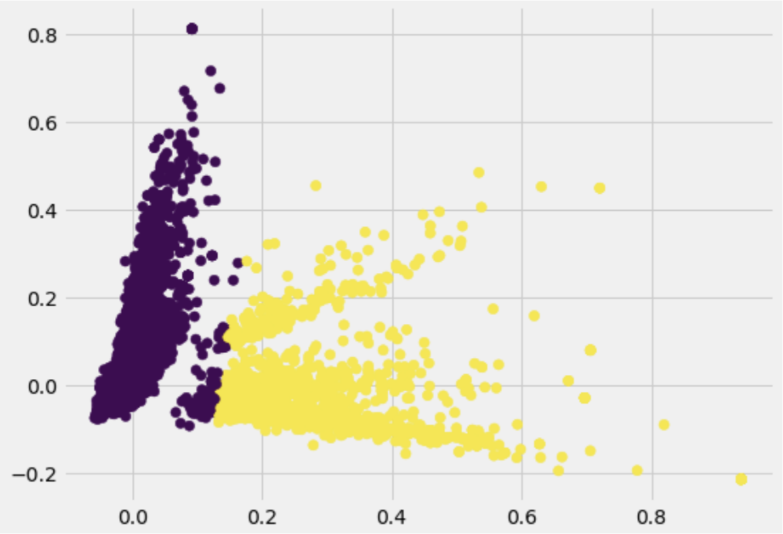
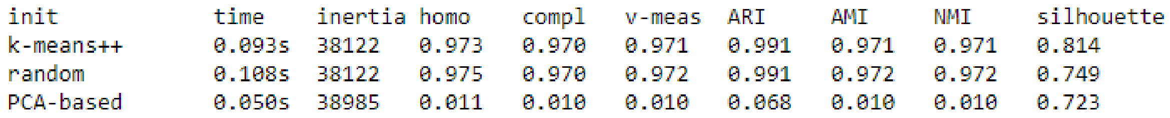


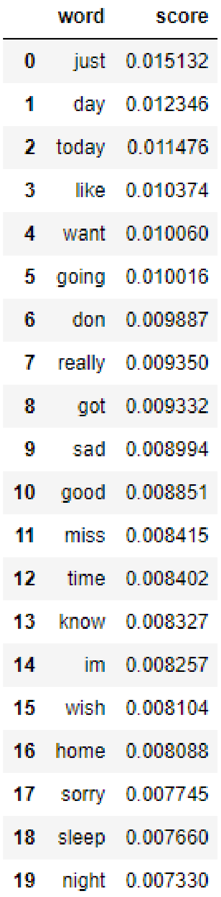
Figure 5. 2 Clusters



```
init            time    inertia homo    compl   v-meas  ARI     AMI     NMI     silhouette
k-means++       0.093s  38122   0.973   0.970   0.971   0.991   0.971   0.971   0.814
random          0.108s  38122   0.975   0.970   0.972   0.991   0.972   0.972   0.749
PCA-based       0.050s  38985   0.011   0.010   0.010   0.068   0.010   0.010   0.723
```

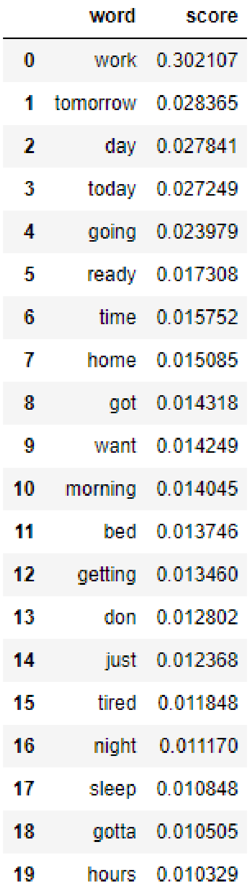
Figure 6. Evaluation metrics for 2 clusters.

Most important words in Cluster 0:



	word	score
0	just	0.015132
1	day	0.012346
2	today	0.011476
3	like	0.010374
4	want	0.010060
5	going	0.010016
6	don	0.009887
7	really	0.009350
8	got	0.009332
9	sad	0.008994
10	good	0.008851
11	miss	0.008415
12	time	0.008402
13	know	0.008327
14	im	0.008257
15	wish	0.008104
16	home	0.008088
17	sorry	0.007745
18	sleep	0.007660
19	night	0.007330

Most important words in Cluster 1:



	word	score
0	work	0.302107
1	tomorrow	0.028365
2	day	0.027841
3	today	0.027249
4	going	0.023979
5	ready	0.017308
6	time	0.015752
7	home	0.015085
8	got	0.014318
9	want	0.014249
10	morning	0.014045
11	bed	0.013746
12	getting	0.013460
13	don	0.012802
14	just	0.012368
15	tired	0.011848
16	night	0.011170
17	sleep	0.010848
18	gotta	0.010505
19	hours	0.010329

- **Experiment 2 - Number of clusters = 3**

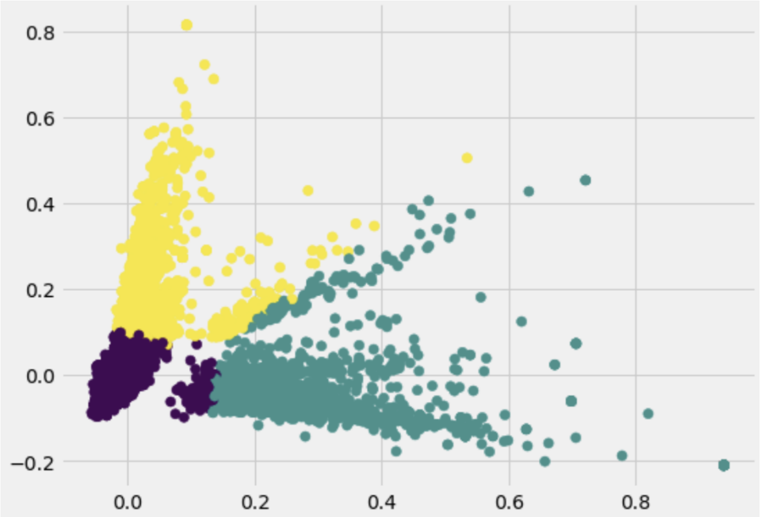
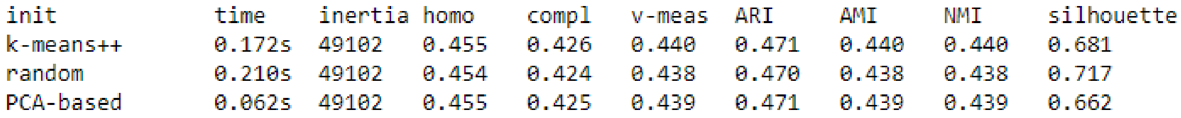


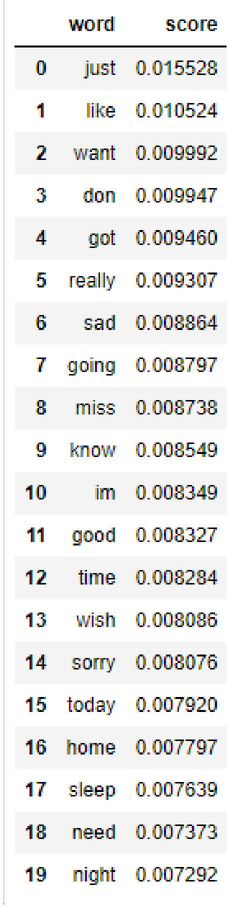
Figure 7. 3 Clusters



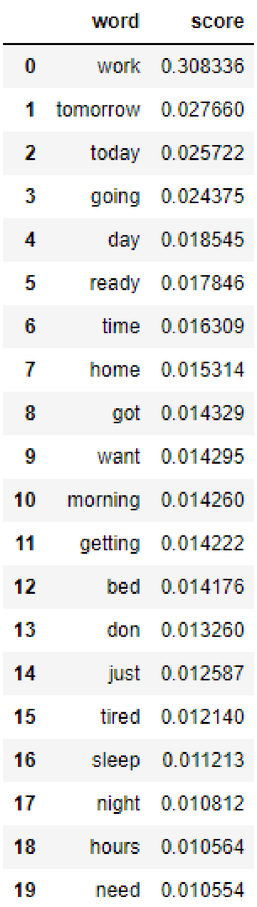
```
init            time    inertia homo    compl   v-meas  ARI     AMI     NMI     silhouette
k-means++       0.172s  49102   0.455   0.426   0.440   0.471   0.440   0.440   0.681
random          0.210s  49102   0.454   0.424   0.438   0.470   0.438   0.438   0.717
PCA-based       0.062s  49102   0.455   0.425   0.439   0.471   0.439   0.439   0.662
```

Figure 8. Evaluation metrics for 2 clusters.

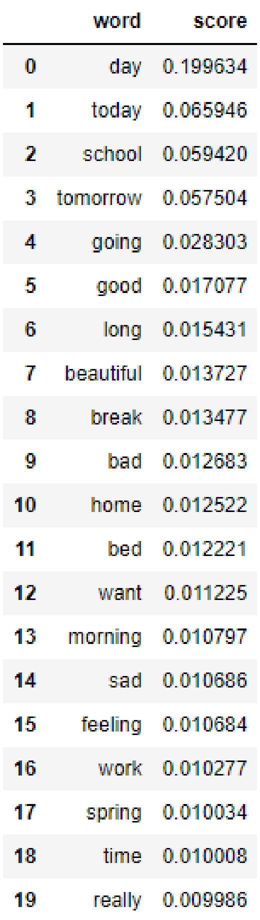
Most important words in Cluster 0:   Most important words in Cluster 1:   Most important words in Cluster 2:



	word	score
0	just	0.015528
1	like	0.010524
2	want	0.009992
3	don	0.009947
4	got	0.009460
5	really	0.009307
6	sad	0.008864
7	going	0.008797
8	miss	0.008738
9	know	0.008549
10	im	0.008349
11	good	0.008327
12	time	0.008284
13	wish	0.008086
14	sorry	0.008076
15	today	0.007920
16	home	0.007797
17	sleep	0.007639
18	need	0.007373
19	night	0.007292



	word	score
0	work	0.308336
1	tomorrow	0.027660
2	today	0.025722
3	going	0.024375
4	day	0.018545
5	ready	0.017846
6	time	0.016309
7	home	0.015314
8	got	0.014329
9	want	0.014295
10	morning	0.014260
11	getting	0.014222
12	bed	0.014176
13	don	0.013260
14	just	0.012587
15	tired	0.012140
16	sleep	0.011213
17	night	0.010812
18	hours	0.010564
19	need	0.010554



	word	score
0	day	0.199634
1	today	0.065946
2	school	0.059420
3	tomorrow	0.057504
4	going	0.028303
5	good	0.017077
6	long	0.015431
7	beautiful	0.013727
8	break	0.013477
9	bad	0.012683
10	home	0.012522
11	bed	0.012221
12	want	0.011225
13	morning	0.010797
14	sad	0.010686
15	feeling	0.010684
16	work	0.010277
17	spring	0.010034
18	time	0.010008
19	really	0.009986

Result

K-means is a very simple and powerful algorithm to cluster a dataset. However, one of the problems is that clusters are spherical. Therefore, it can not be reliable for all situations.

We are using text data for our project. So, we need to represent the data as the model understands. For this reason, firstly, we vectorize our data with tf-idf vectorizer. Then, we use the elbow method to make sure we choose the optimal number of clusters. We decided to make experiments with 2 and 3 numbers of clusters.

Therefore, we have two different experiments with 2 and 3 clusters, we have 2 different instance distributions pie charts. For two clusters, we can see that Cluster-0 has a really huge ratio, with 94.3%, in 30,000 instances. When we applied the experiment with 3 clusters, we can see that Cluster-1 did not lose any instances, but Cluster-0 is split into two. Cluster-2 has an equal ratio with Cluster-1.

We compare three approaches kmeans++, random initialization and initialization based on PCA projection for 2 and 3 numbers of clusters. Evaluation metrics for each 2 experiments as shown in Figure 6 and Figure 8.

We score the words in each cluster in order of importance. In Experiment 1 (number of cluster is 2), we obtain most important words of Cluster-0 are like, good, wish, sorry. They can be said mostly positive words. On the other hand, Cluster-1's most important words are not distinguishable.

In Experiment 2 (number of cluster is 3), Cluster-0 has mostly positive words such as good, like, miss, sorry, wish. Cluster-1 seems like neutral and Cluster-2 has some negative words such as bad and sad.

The K-means is clustering words according to some semblance of meaning in our experiments, but experiments can be developed with even more accurate parameters.