CSE 4062 – Introduction to Data Science and Analytics Spring 2021

Delivery #5 - Descriptive Analytics

Project Report - Group #8

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Project Title: Fraud Detection on Financial Data

Lecturer: Assoc. Prof. Murat Can Ganiz

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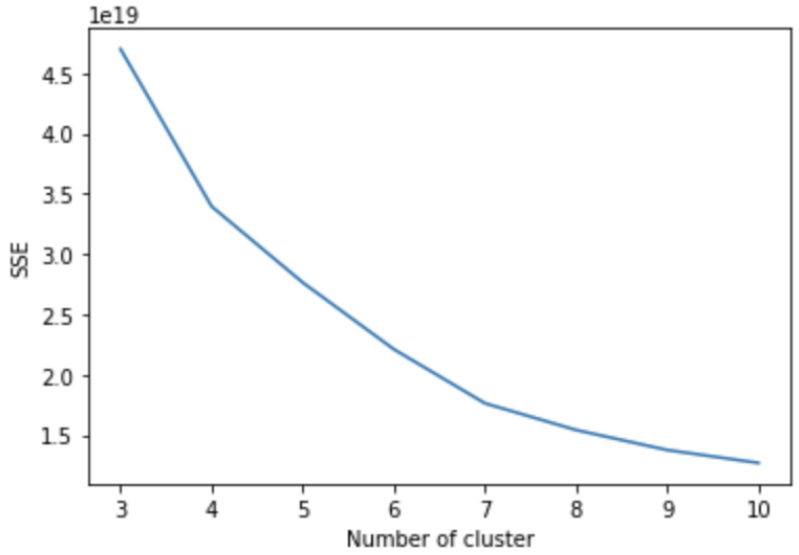


Figure 1: The Elbow Plot Showing the Optimal k=4

Max silhouette coeficient for df is 0.7021559575716491 for 3 cluster

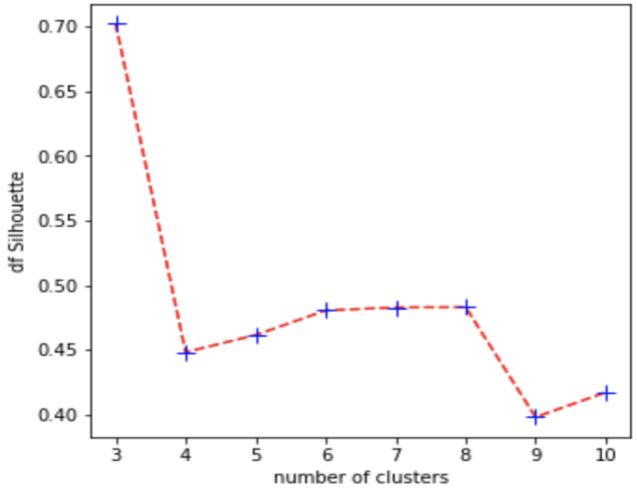


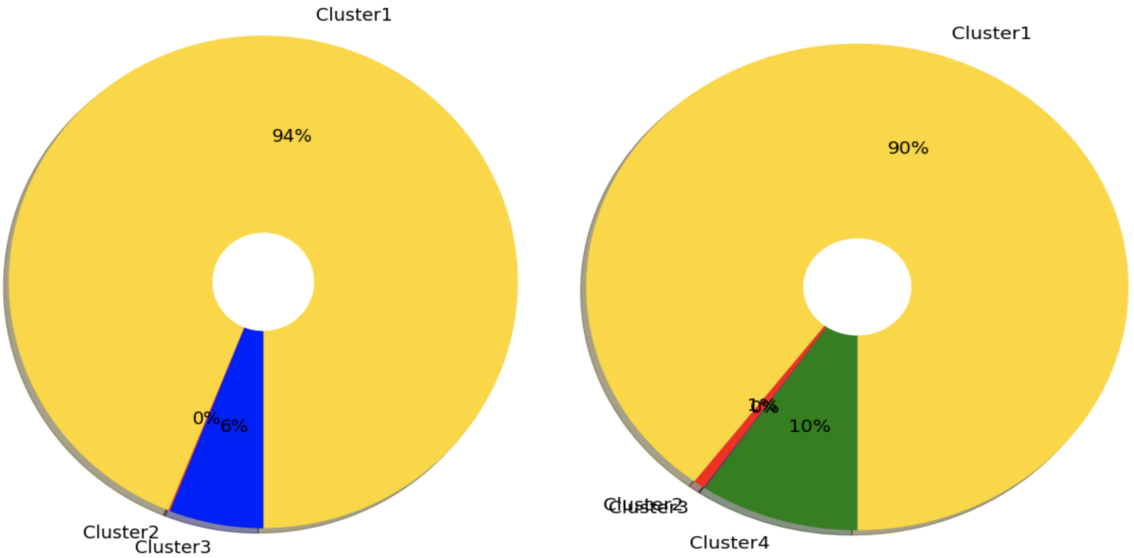
Figure 2: Silhouette coefficient calculation with different cluster numbers

1- Table listing features and their values

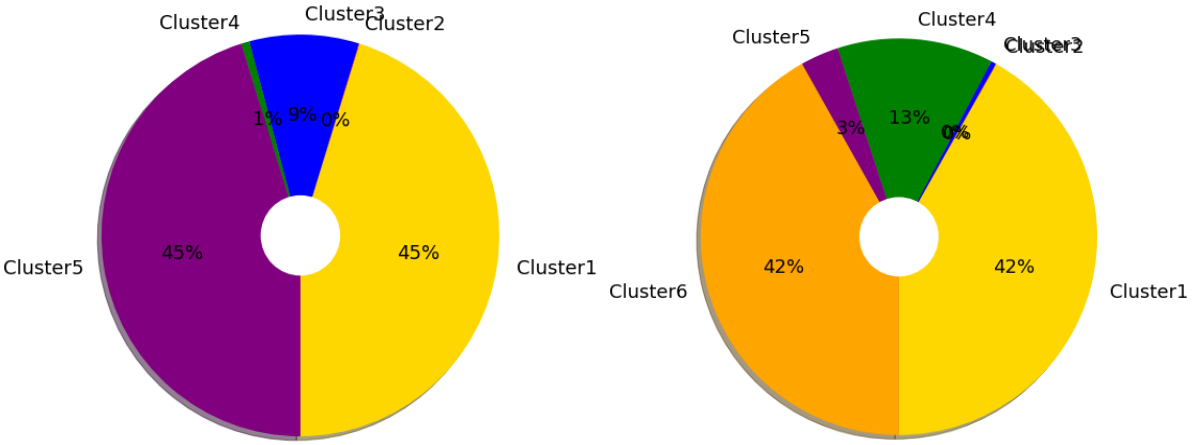
At the below table, features and their clusters by k-means algorithm (k=4) are listed.

#	*feature name*	*description*	*type*	*overall avg./ mode*	*cluster 1*	*cluster 2*	*cluster 3*	*cluster 4*
	step	maps a unit of time in the real world	numeric	*243.397*	*1117466*	*463432*	*10474462*	*142065*
	amount	*amount of the transaction in local currency*	*numeric*	*179861.9*	*2648758*	*9141*	*111705*	*805*
	nameOrig	*customer who started the transaction*	*nominal*	*C1999539787*	*692293*	*690546*	*699864*	*687706*
	oldbalanceOrg	*initial balance before the transaction*	*numeric*	*833883.1*	*2657750*	*985*	*69*	*111605*
	newbalanceOrig	*new balance after the transaction*	*numeric*	*855113.6*	*2707346*	*842*	*59*	*62162*
	nameDest	*customer who is the recipient of the transaction*	*nominal*	*C1286084959*	*689529*	*690622*	*697683*	*692575*
	oldbalanceDest	*initial balance recipient before the transaction*	*numeric*	*1100701.66*	*2488963*	*19153*	*1099*	*261194*
	newbalanceDest	*new balance recipient after the transaction*	*numeric*	*1224996.39*	*2481277*	*19568*	*1350*	*268214*

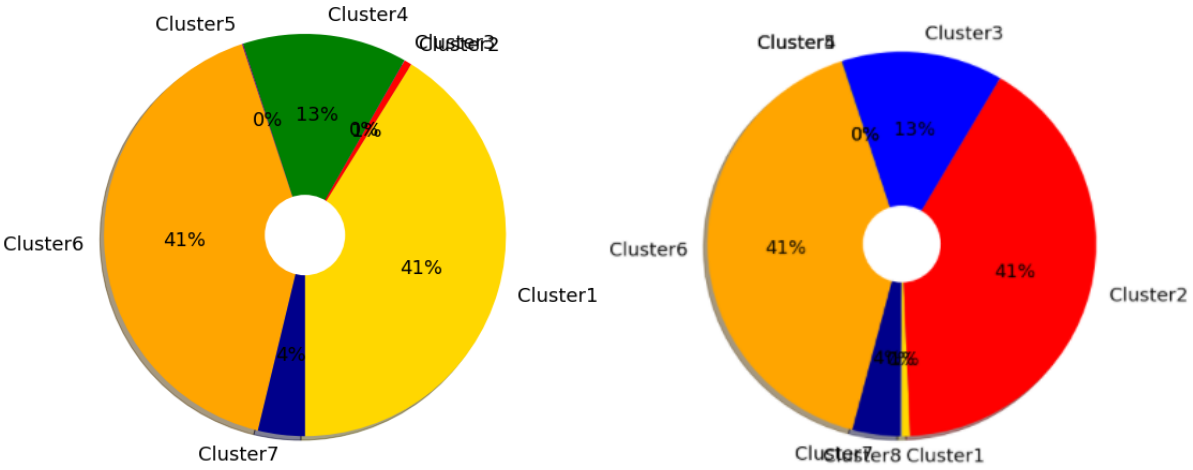
2- Pie charts showing the instance distributions of each cluster as percentages



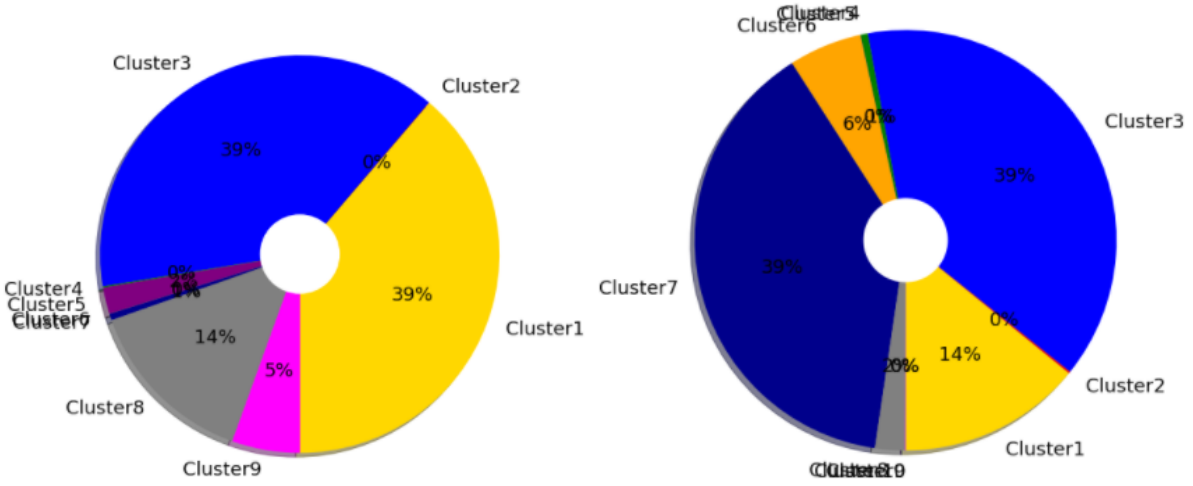
Graph 1 and 2: Pie chart of instance distribution when k=3 and k=4



Graph 3 and 4: Pie chart of instance distribution when k=5 and k=6



Graph 5 and 6: Pie chart of instance distribution when k=7 and k=8



Graph 7 and 8: Pie chart of instance distribution when k=9 and k=10

3- Table for evaluation of clustering experiments

At the below table, instances and their clusters by k-means algorithm with different k values are listed.

Experiment	*# of clusters*	*avg. number of instances in clusters*	*std.dev.*	*SSE*	*NMI*	*Silhouette Value*	*RI*
1	*k=3*	*0:2602389 1:2863 2:165157*	*0.47*	*4.7*	*0.00035*	*0.70*	*-0.0032*
2	*k=4*	*0: 2486468 1: 19187 2: 1182 3: 263572*	*0.88*	*3.39*	*0.000177*	*0.44*	*-0.00209*
3	*k=5*	*0: 1252392 1: 1180 2: 246299 3: 18738 4: 1251800*	*1.90*	*2.76*	*6.61e-05*	*0.46*	*-0.000292*
4	*k=6*	*0: 1158884 1: 1039 2: 11616 3: 352473 4: 86594 5: 1159803*	*2.30*	*2.21*	*0.00011*	*0.48*	*-0.000414*
5	*k=7*	*0: 1139539 1: 16878 2: 506 3: 366760 4: 2439 5: 1139916 6: 104371*	*2.36*	*1.76*	*0.000127*	*0.48*	*-0.000440*
6	*k=8*	*0: 18931 1: 1132563 2: 371895 3: 920 4: 216 5: 1132195 6: 110247 7: 3442*	*1.54*	*1.96*	*0.000131*	*0.48*	*-0.000447*

7	k=9	0: 1074103 1: 885 2: 1074747 3: 3010 4: 59599 5: 210 6: 14768 7: 390814 8: 152273	2.66	1.37	0.000153	0.39	-0.000486
8	k=10	0: 390756 1: 3783 2: 1070432 3: 15489 4: 498 5: 155246 6: 1069712 7: 63065 8: 1329 9: 99	2.33	1.26	0.0001615	0.41	-0.000493

4. Our Inferences and Results

In this section, we analyzed our dataset with K-Means clustering. We are testing the clustering algorithm with different k(3,10) values then we draw a plot for k(3,10) values to SSE values. While using the k-means clustering algorithm, we used the Elbow method to select an optimum k number. Elbow the method is very simple and common; experiments with different values of k and takes the sum of squared errors. The plot has an elbow-like shape. where the break is the shape of an elbow, this place indicates the optimum k to be selected. The higher the value of k, the closer the cluster centers are to each other. After a point, the development of the model will decrease and will be the most optimum value for the elbow point and the k value. According to the plot, the optimum k value is 4 according to the k-means clustering model. We obtained 8 experiments by changing the number of clusters between 3 and 10. We saw that each time we increased the number of clusters, the number of standard deviations increased, but the SSE value decreased. We see that the NMI value varies between 0.00015-0.00030 for all data according to the changing k values. In a sense, NMI tells us how much the uncertainty about class labels decreases when we know the cluster labels. So, we can say that the correlation between the values is low. Rand index values are quite low. This shows that the success of the model

is not high. The silhouette score ranges from -1 to 1. If the score is 1, the cluster is dense and well separated from the other clusters. A value close to 0 represents clusters that overlap with samples very close to the decision boundary of neighboring clusters. In our trials, we obtained the highest silhouette score (0.70) at k=3. In other words, the experiment in which the data is most consistently distributed to the clusters is the experiment where the k value is 3. The lowest score is the experiment with 0.39 and k=9.