High value customers identification for an E-Commerce company.

Q1) Use the clustering methodology to segment customers into groups:
Use the following clustering algorithms:

K means

Hierarchical

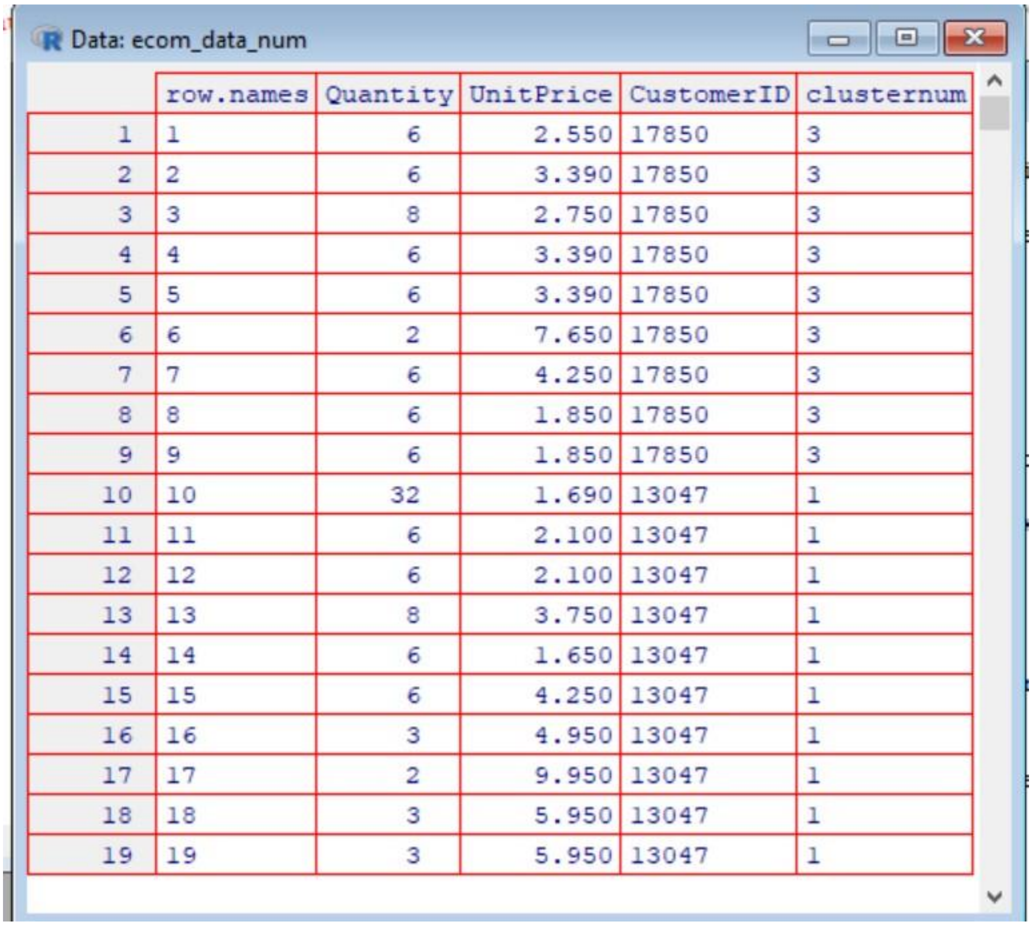
Ans) The below mention is the code in R which gives an overview of the K-Means

```
print("High Value Customer Identification")


ecom_data<-read.csv("C:/Users/shiva/Desktop/Shivani/SimpliLearn/Data Science with R/Data Science with R Projects/Ecommerce.csv")

print(ecom_data)

str(ecom_data)

print("K-Means Algorithm")

set.seed(110)

# Data Cleaning


del_vars<-names(ecom_data)%in%c("InvoiceNo","StockCode","Description","InvoiceDate","Country")


cluster_up<-kmeans(ecom_data,3,iter.max=10)

ecom_data_num<-ecom_data[!del_vars]

ecom_data_num<-na.omit(ecom_data_num)

View(ecom_data_num)


cluster_up<-kmeans(ecom_data_num,3,iter.max=10)

str(cluster_up)


ecom_data_num<-cbind(ecom_data_num,clusternum=cluster_up$cluster)

View(ecom_data_num)
```

The output of the K-Means is mention below:

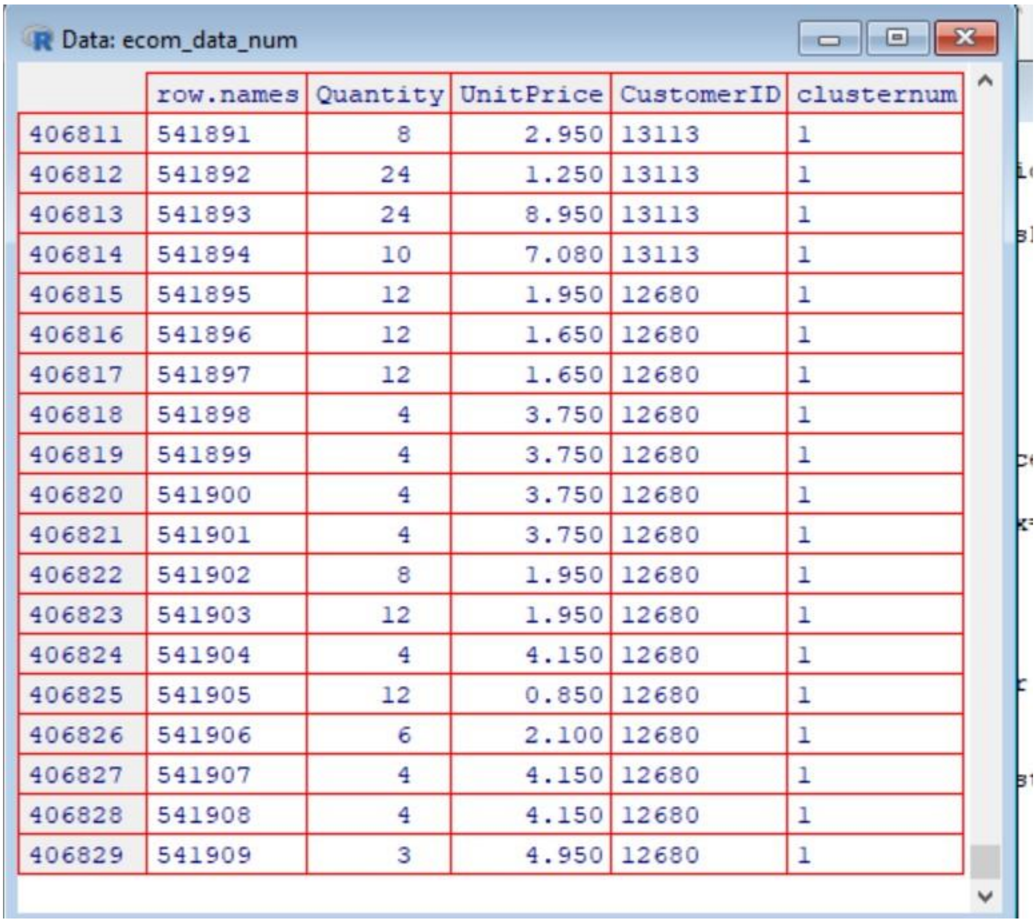
```
str(ecom_data)
'data.frame':   541909 obs. of  8 variables:
 $ InvoiceNo  : chr  "536365" "536365" "536365" "536365" ...
 $ StockCode  : chr  "85123A" "71053" "84406B" "84029G" ...
 $ Description: chr  "WHITE HANGING HEART T-LIGHT HOLDER" "WHITE METAL LANTERN" "CREAM CUPID HEARTS COAT HANGER" "KNITTED UNION FLAG HOT WATER BOTTLE" ...
 $ Quantity   : int  6 6 8 6 6 2 6 6 6 32 ...
 $ InvoiceDate: chr  "29-Nov-16" "29-Nov-16" "29-Nov-16" "29-Nov-16" ...
 $ UnitPrice  : num  2.55 3.39 2.75 3.39 3.39 7.65 4.25 1.85 1.85 1.69 ...
 $ CustomerID : int  17850 17850 17850 17850 17850 17850 17850 17850 17850 13047 ...
 $ Country    : chr  "United Kingdom" "United Kingdom" "United Kingdom" "United Kingdom" ...
>
```

The above mention output represent the structure of the ecommerce data where the datatypes of various columns are listed accordingly.

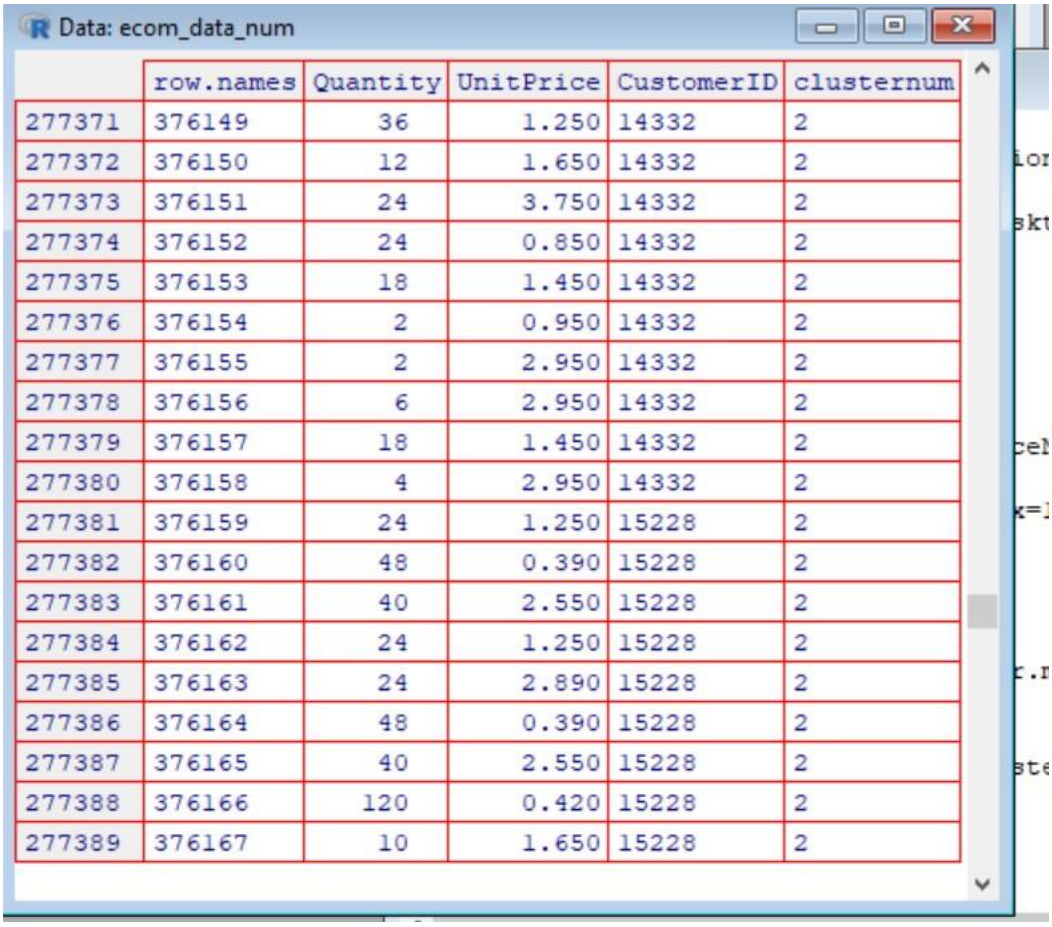


Data: ecom_data_num

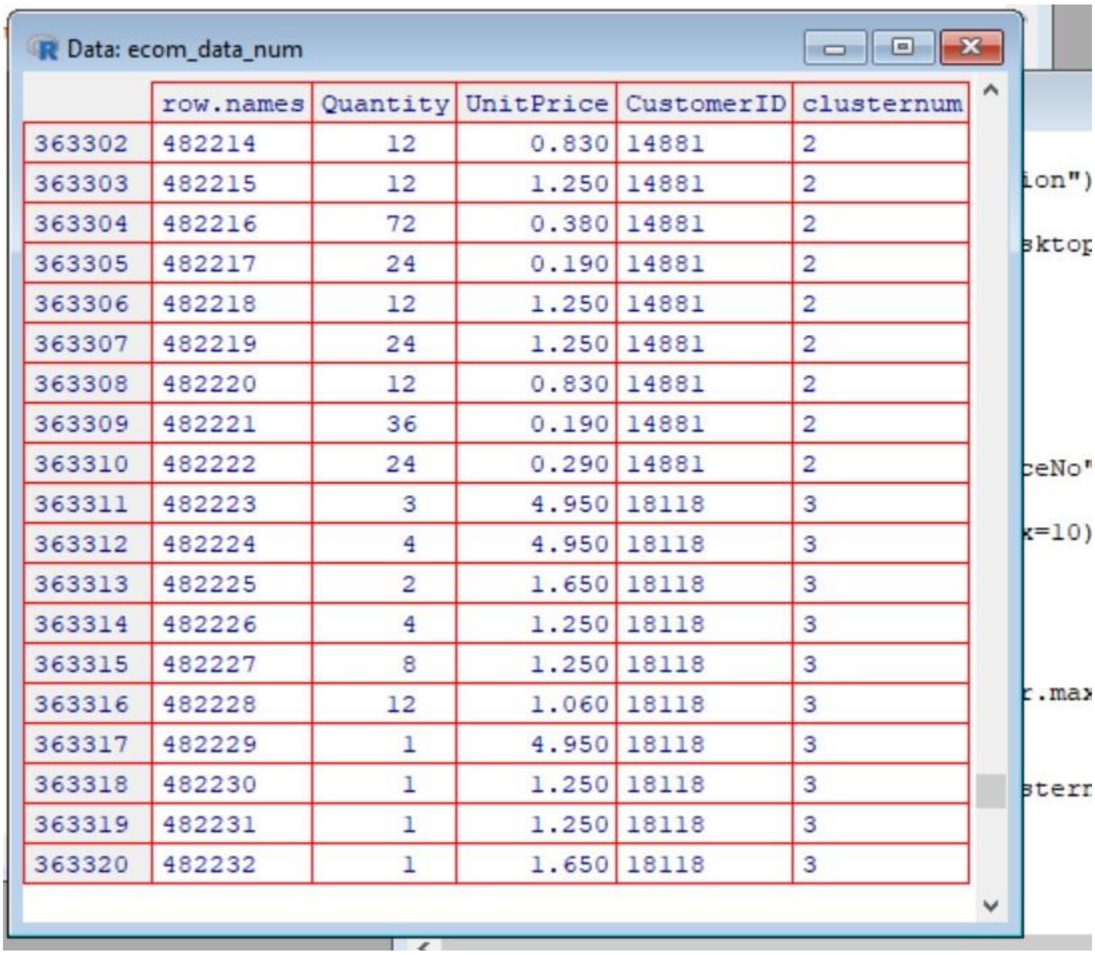
	row.names	Quantity	UnitPrice	CustomerID	clusternum
1	1	6	2.550	17850	3
2	2	6	3.390	17850	3
3	3	8	2.750	17850	3
4	4	6	3.390	17850	3
5	5	6	3.390	17850	3
6	6	2	7.650	17850	3
7	7	6	4.250	17850	3
8	8	6	1.850	17850	3
9	9	6	1.850	17850	3
10	10	32	1.690	13047	1
11	11	6	2.100	13047	1
12	12	6	2.100	13047	1
13	13	8	3.750	13047	1
14	14	6	1.650	13047	1
15	15	6	4.250	13047	1
16	16	3	4.950	13047	1
17	17	2	9.950	13047	1
18	18	3	5.950	13047	1
19	19	3	5.950	13047	1



	row.names	Quantity	UnitPrice	CustomerID	clusternum
406811	541891	8	2.950	13113	1
406812	541892	24	1.250	13113	1
406813	541893	24	8.950	13113	1
406814	541894	10	7.080	13113	1
406815	541895	12	1.950	12680	1
406816	541896	12	1.650	12680	1
406817	541897	12	1.650	12680	1
406818	541898	4	3.750	12680	1
406819	541899	4	3.750	12680	1
406820	541900	4	3.750	12680	1
406821	541901	4	3.750	12680	1
406822	541902	8	1.950	12680	1
406823	541903	12	1.950	12680	1
406824	541904	4	4.150	12680	1
406825	541905	12	0.850	12680	1
406826	541906	6	2.100	12680	1
406827	541907	4	4.150	12680	1
406828	541908	4	4.150	12680	1
406829	541909	3	4.950	12680	1



	row.names	Quantity	UnitPrice	CustomerID	clusternum
277371	376149	36	1.250	14332	2
277372	376150	12	1.650	14332	2
277373	376151	24	3.750	14332	2
277374	376152	24	0.850	14332	2
277375	376153	18	1.450	14332	2
277376	376154	2	0.950	14332	2
277377	376155	2	2.950	14332	2
277378	376156	6	2.950	14332	2
277379	376157	18	1.450	14332	2
277380	376158	4	2.950	14332	2
277381	376159	24	1.250	15228	2
277382	376160	48	0.390	15228	2
277383	376161	40	2.550	15228	2
277384	376162	24	1.250	15228	2
277385	376163	24	2.890	15228	2
277386	376164	48	0.390	15228	2
277387	376165	40	2.550	15228	2
277388	376166	120	0.420	15228	2
277389	376167	10	1.650	15228	2



	row.names	Quantity	UnitPrice	CustomerID	clusternum
363302	482214	12	0.830	14881	2
363303	482215	12	1.250	14881	2
363304	482216	72	0.380	14881	2
363305	482217	24	0.190	14881	2
363306	482218	12	1.250	14881	2
363307	482219	24	1.250	14881	2
363308	482220	12	0.830	14881	2
363309	482221	36	0.190	14881	2
363310	482222	24	0.290	14881	2
363311	482223	3	4.950	18118	3
363312	482224	4	4.950	18118	3
363313	482225	2	1.650	18118	3
363314	482226	4	1.250	18118	3
363315	482227	8	1.250	18118	3
363316	482228	12	1.060	18118	3
363317	482229	1	4.950	18118	3
363318	482230	1	1.250	18118	3
363319	482231	1	1.250	18118	3
363320	482232	1	1.650	18118	3

The above mention screenshots represents the data of the ecommerce company where the data is segregated via K-Means Algorithm into three different clusters. Here, the data is divided into 3 clusters and maximum number of iterations is upto 10

The below mention is the code in R which gives an overview of the Hierarchical Algorithm

```
print("High Value Customer Identification")


ecom_data<-read.csv("C:/Users/shiva/Desktop/Shivani/SimpliLearn/Data Science with R/Data Science with R Projects/Ecommerce.csv")

print(ecom_data)

ecom_data<-na.omit(ecom_data)

head(ecom_data)


ecom_data<-ecom_data[,-1]
```

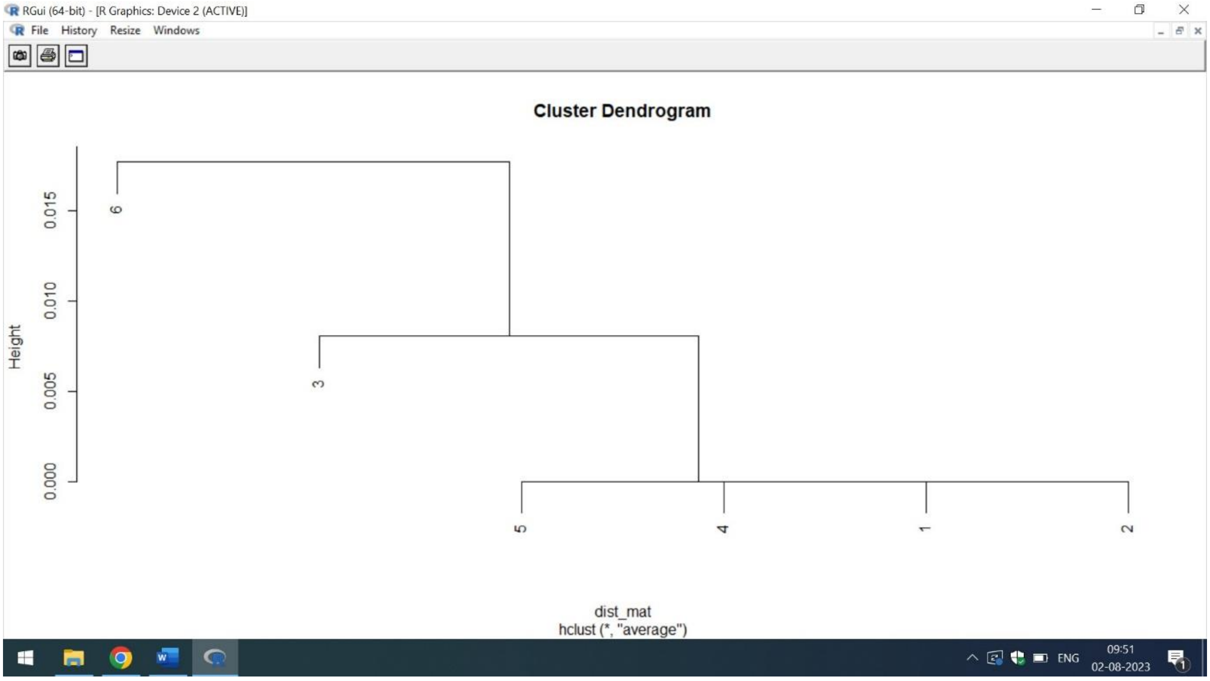
```
ecom_data<-ecom_data[,-2]
ecom_data<-ecom_data[,-3]
ecom_data<-ecom_data[,-5]
ecom_data<-ecom_data[,-8]

str(ecom_data)
ecom_data<- as.data.frame(scale(ecom_data))

print(ecom_data)
ecom_data<-head(ecom_data)
summary(ecom_data)
hclust_avg <- hclust(dist_mat, method = 'average')
plot(hclust_avg)
```

The below mention are the output of the Hierarchical Algorithm

```
ecom_data<-na.omit(ecom_data)
> head(ecom_data)
  InvoiceNo StockCode                        Description Quantity InvoiceDate
1    536365    85123A  WHITE HANGING HEART T-LIGHT HOLDER        6   29-Nov-16
2    536365     71053                 WHITE METAL LANTERN        6   29-Nov-16
3    536365    84406B      CREAM CUPID HEARTS COAT HANGER        8   29-Nov-16
4    536365    84029G KNITTED UNION FLAG HOT WATER BOTTLE        6   29-Nov-16
5    536365    84029E      RED WOOLLY HOTTIE WHITE HEART.        6   29-Nov-16
6    536365     22752        SET 7 BABUSHKA NESTING BOXES        2   29-Nov-16
  UnitPrice CustomerID        Country
1      2.55      17850 United Kingdom
2      3.39      17850 United Kingdom
3      2.75      17850 United Kingdom
4      3.39      17850 United Kingdom
```

```
5     3.39     17850 United Kingdom
6     7.65     17850 United Kingdom
>
```

The above mention screenshot represents the top 6 rows of ecommerce data



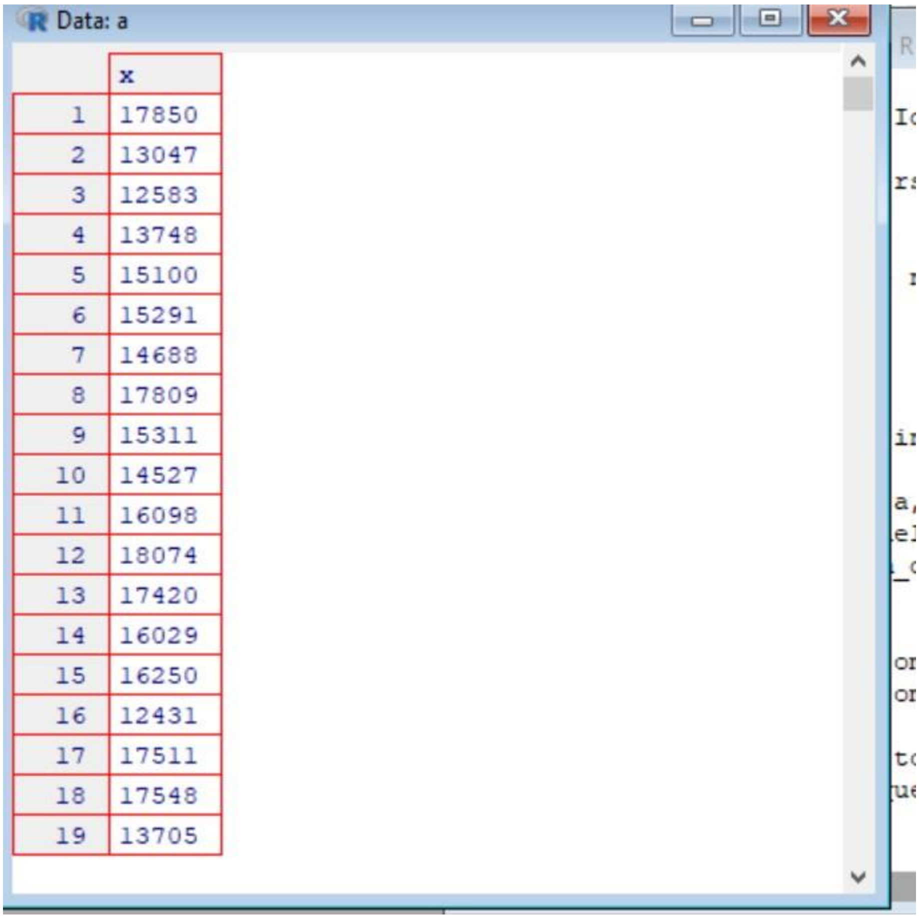
From the above mention cluster Dendogram,it is clear that highest value of quantities of each product per transaction is 6. It simply means that Customers of various countries have purchased maximum of 6 products

Q2) Identify the right number of customer segments.

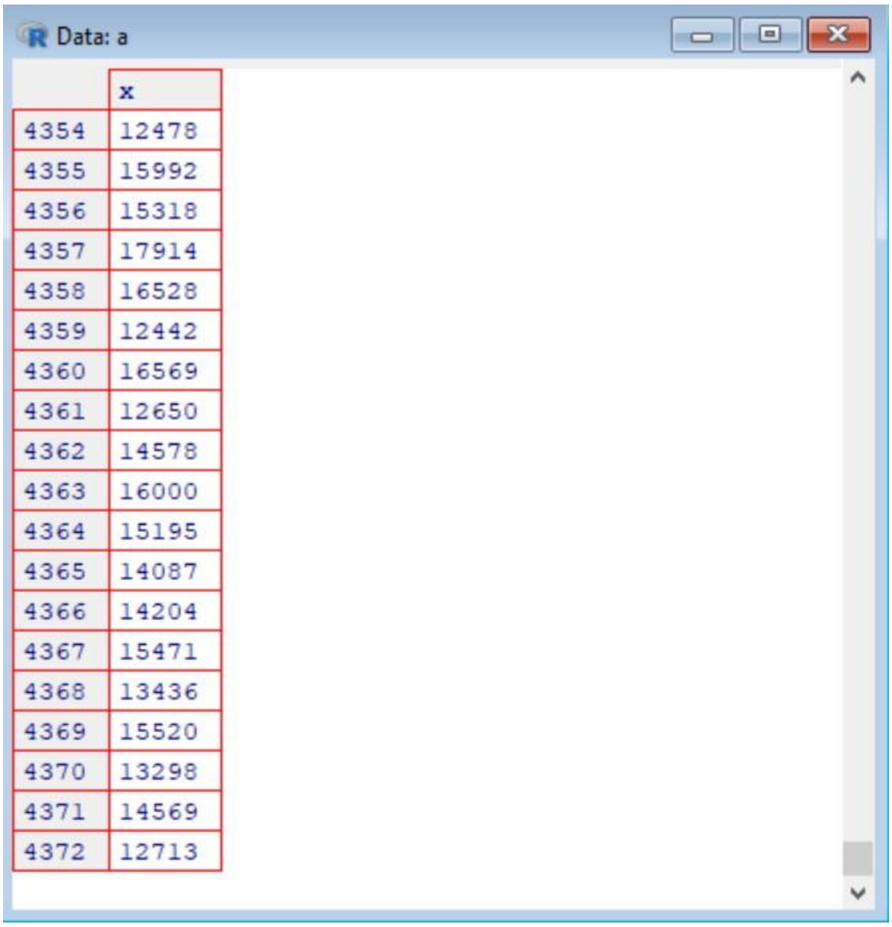
Ans) The right number of customer segments can be identified by K-Means Clustering Method.Below mentioned is the code in R which gives the list of customerids identified by K-Means

```
print("High Value Customer Identification")


ecom_data<-read.csv("C:/Users/shiva/Desktop/Shivani/SimpliLearn/Data Science with R/Data Science with R Projects/Ecommerce.csv")

print(ecom_data)

str(ecom_data)

# From K-Means identify the number of valued customers
```

```
print("K-Means Algorithm")
set.seed(110)
# Data Cleaning


del_vars<-
names(ecom_data)%in%c("InvoiceNo","StockCode","Description","InvoiceDate","Country"
)


cluster_up<-kmeans(ecom_data,3,iter.max=10)
ecom_data_num<-ecom_data[!del_vars]
ecom_data_num<-na.omit(ecom_data_num)
View(ecom_data_num)


a<-print(ecom_data_num$CustomerID)
View(a)  # List of the CustomerID's with duplicate values


a<-unique(ecom_data_num$CustomerID)
View(a)  # List of the unique CustomerID's
```



	x
1	17850
2	13047
3	12583
4	13748
5	15100
6	15291
7	14688
8	17809
9	15311
10	14527
11	16098
12	18074
13	17420
14	16029
15	16250
16	12431
17	17511
18	17548
19	13705



	x
4354	12478
4355	15992
4356	15318
4357	17914
4358	16528
4359	12442
4360	16569
4361	12650
4362	14578
4363	16000
4364	15195
4365	14087
4366	14204
4367	15471
4368	13436
4369	15520
4370	13298
4371	14569
4372	12713

The above mention screenshot represent the list of some of the customerID's which are identified via K-Means Algorithm

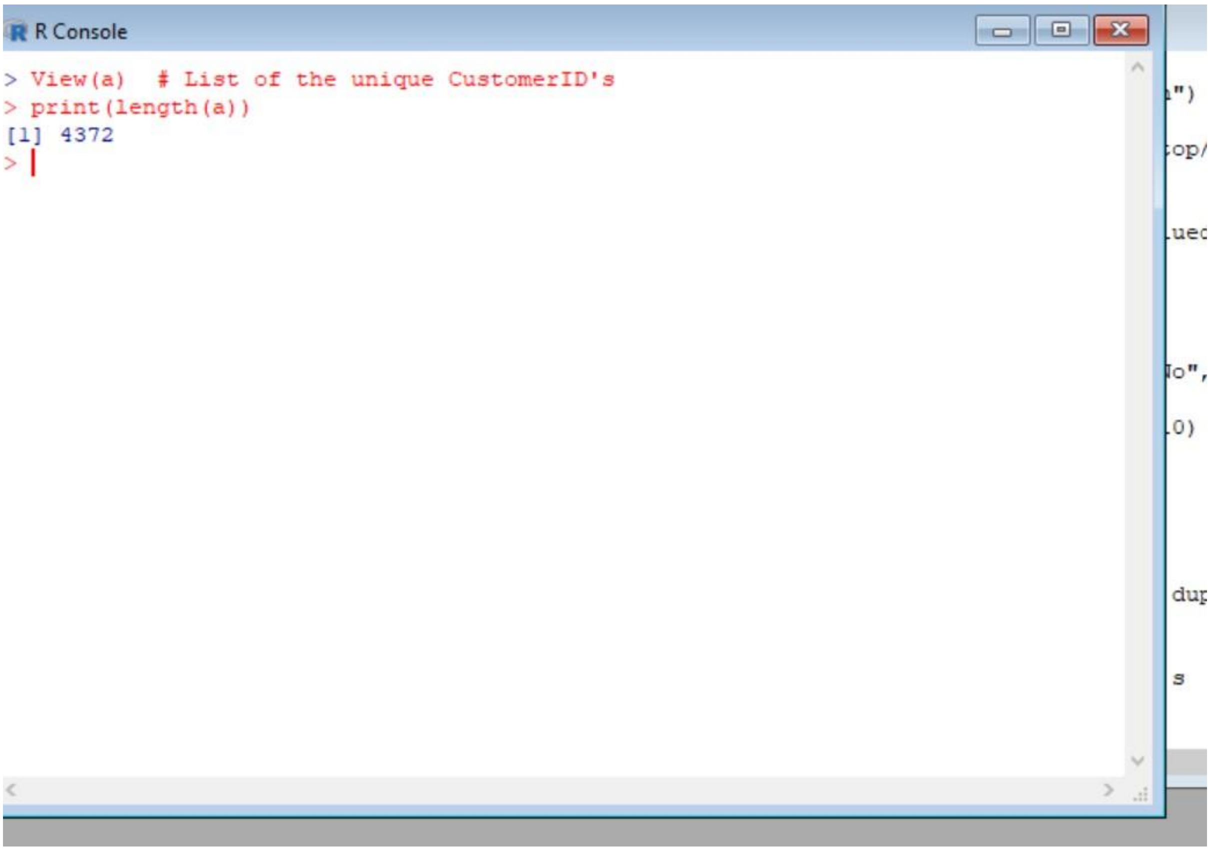
Q3) Provide the number of customers who are highly valued.

Ans) By using K-Means Algorithm the number of highly valued customers can be identified.

The below mention is the code in R

```
print("High Value Customer Identification")


ecom_data<-read.csv("C:/Users/shiva/Desktop/Shivani/SimpliLearn/Data Science with R/Data Science with R Projects/Ecommerce.csv")

print(ecom_data)

str(ecom_data)

# From K-Means identify the number of valued customers

print("K-Means Algorithm")

set.seed(110)
```

```
# Data Cleaning

del_vars<-names(ecom_data)%in%c("InvoiceNo","StockCode","Description","InvoiceDate","Country")

cluster_up<-kmeans(ecom_data,3,iter.max=10)
ecom_data_num<-ecom_data[!del_vars]
ecom_data_num<-na.omit(ecom_data_num)
View(ecom_data_num)

a<-print(ecom_data_num$CustomerID)
View(a)  # List of the CustomerID's with duplicate values

a<-unique(ecom_data_num$CustomerID)
View(a)  # List of the unique CustomerID's
print(length(a))
```



```
> View(a)   # List of the unique CustomerID's
> print(length(a))
[1] 4372
> 
```

The above mention screenshot highlights that the total count of customers who are highly valued are 4372. Hence, the total count is 4372. This count is identified via K-Means

Q5) Identify the clustering algorithm that gives maximum accuracy and explains robust clusters.

Ans) Naïve Bayes is one of the clustering Algorithm which gives the maximum accuracy.

Below attached is the code in R. The analysis is done on the columns of **InvoiceNo,Quantity,UnitPrice and CustomerID of UK customers only.**

print("High Value Customers")

ecom_data<-read.csv("https://raw.githubusercontent.com/shivanipriya89/Ecommerce/main/MyEcommerce.csv")

print(ecom_data)

View(ecom_data)

ecom_data<-na.omit(ecom_data)

any(is.na(ecom_data))

```
# Convert admit to factor

ecom_data$CustomerID<-sapply(ecom_data$CustomerID,factor)


# Build the model


tree_model<-naiveBayes(CustomerID~.,data=ecom_data)

print(tree_model)

summary(tree_model)
```

The below mention is the output of NaiveBayes

```
print(tree_model)

Naive Bayes Classifier for Discrete Predictors

Call:
naiveBayes.default(x = X, y = Y, laplace = laplace)

A-priori probabilities:
Y
       17850        13047        13748        15100        15291
8.621690e-04 5.416190e-04 7.737414e-05 1.658017e-05 3.012065e-04
       14688        17809        15311        14527        16098
9.920470e-04 1.768552e-04 6.883535e-03 2.793759e-03 1.851453e-04
       18074        17420        16029        16250        17511
3.592371e-05 8.290087e-05 7.571613e-04 6.632069e-05 2.973378e-03
       17548        13705        13747        13408        13767
4.697716e-05 7.737414e-05 2.763362e-06 1.384444e-03 1.102582e-03
       17924        13448        15862        15513        16218
1.050078e-04 5.499091e-04 4.062142e-04 8.676957e-04 2.487026e-04
       14045        14307        17908        17920        12838
1.658017e-05 4.974052e-04 1.602750e-04 1.923300e-03 3.398936e-04
       13255        16583        18085        13758        13694
3.868707e-05 3.868707e-05 8.013750e-05 3.233134e-04 1.616567e-03
       15983        14849        17968        16210        17897
3.122599e-04 1.083238e-03 2.348858e-04 3.398936e-04 3.177867e-04
       17377        16552        17181        17951        14729
1.157849e-03 4.697716e-05 6.355733e-05 5.803061e-05 1.961987e-04
       12748        15012        12868        17572        14078
1.282753e-02 3.537104e-04 2.956798e-04 3.316035e-05 1.796185e-04
       14001        15525        14237        17905        15485
1.105345e-04 4.974052e-04 2.487026e-05 9.395432e-05 2.376492e-04
       16955        15350        15605        18144        15922
7.184742e-05 1.381681e-05 1.851453e-04 1.188246e-04 3.316035e-05
       14594        15165        16456        17841        17346
1.464582e-04 7.461078e-05 3.067332e-04 2.205992e-02 1.389971e-03
       17643        17873        13093        12921        13468
2.210690e-05 1.271147e-04 4.697716e-04 2.047651e-03 8.455888e-04
       17760        16928        16048        16274        14496
```

```
6.908406e-05 5.885962e-04 2.487026e-05 1.851453e-04 5.250388e-05 
       14696        16539        17025        13777        17690 
3.675272e-04 1.243513e-04 2.487026e-05 6.051763e-04 7.129475e-04 
       12947        17460        18229        14142        17069 
2.846263e-04 1.022444e-04 4.531914e-04 6.079397e-05 4.255578e-04 
       13065        14606        16835        15235        13576 
3.868707e-05 7.687674e-03 2.763362e-05 3.951608e-04 3.592371e-04 
       18011        13090        15694        14741        13715 
7.737414e-05 4.449013e-04 2.183056e-04 1.630384e-04 2.984431e-04 
       14092        17732        12855        15752        17855 
5.996496e-04 4.974052e-05 8.290087e-06 1.138505e-03 4.697716e-05 
       14047        17925        13941        17017        14135 
9.395432e-05 2.763362e-06 1.298780e-04 7.405811e-04 3.702905e-04 
       13108        15601        13418        14766        15658 
2.763362e-05 1.144032e-03 8.676957e-04 3.785806e-04 1.547483e-04 
       14388        14901        18041        15955        15070 
5.278022e-04 2.708095e-04 1.309834e-03 5.112220e-04 2.763362e-06 
       16244        15111        14390        16546        15260 
2.514660e-04 2.321224e-04 8.041384e-04 8.566423e-05 2.155423e-04 
       13305        14491        14060        15923        16752 
2.238323e-04 4.697716e-05 5.609625e-04 5.803061e-05 2.487026e-05 
       17287        15363        12915        15544        15738 
3.426569e-04 4.697716e-05 6.079397e-05 7.212375e-04 4.863518e-04 
       16042        17381        15827        14180        13117 
2.072522e-04 3.039698e-04 3.702905e-04 6.853138e-04 2.100155e-04 
       16916        17964        14466        17235        16510 
3.951608e-04 2.873897e-04 1.989621e-04 8.013750e-05 3.592371e-05 
       17802        15107        17976        14449        15838 
4.062142e-04 5.526724e-05 1.796185e-04 7.129475e-04 4.670082e-04 
       16781        17547        13491        16186        17685 
5.250388e-05 5.526724e-06 2.376492e-04 6.051763e-04 3.592371e-04 
       17581        15732        13138        15823        17567 
1.249040e-03 3.868707e-05 1.740918e-04 4.697716e-05 4.891151e-04 
       15061        16203        15640        15574        16770 
1.132979e-03 9.948104e-05 1.367864e-03 4.642449e-04 4.034509e-04 
       17838        17228        14829        17412        14031 
3.785806e-04 5.747793e-04 1.243513e-04 1.823819e-04 7.129475e-04 
       14775        12971        15834        17659        15299 
1.658017e-04 8.511156e-04 7.626880e-04 4.449013e-04 3.316035e-05 
       15646        13958        14443        16995        13402 
9.948104e-05 1.381681e-05 2.708095e-04 2.763362e-06 1.077711e-04 
       18168        17757        14625        13011        13798 
3.868707e-04 2.050415e-03 1.575116e-04 8.290087e-06 1.213116e-03 
       15384        14264        13295        16754        16634 
1.188246e-04 5.250388e-05 3.039698e-05 5.526724e-06 2.487026e-05 
       18239        14576        13145        14395        14865 
2.431759e-04 2.763362e-06 1.934354e-05 9.754669e-04 1.105345e-05 
       15093        16150        17552        14236        17961 
3.094966e-04 3.758173e-04 1.409315e-04 4.145043e-05 6.880772e-04 
       14573        17135        17396        14213        12967 
6.659703e-04 1.436948e-04 7.461078e-05 1.381681e-05 9.119095e-05 
       14679        15240        18225        13370        16883 
2.763362e-06 2.293591e-04 7.903216e-04 1.215879e-04 1.050078e-04 
       12841        16905        17967        16891        14589 
1.213116e-03 5.775427e-04 1.326414e-04 5.609625e-04 8.290087e-06 
       14680        17884        14083        13013        14210 
```

```
8.842759e-04 3.233134e-04 5.001686e-04 6.134664e-04 2.846263e-04
       16477        16013        17949        16926        17787
4.034509e-04 4.172677e-04 2.183056e-04 3.868707e-05 3.702905e-04
       14723        17954        17819        15373        16140
7.682147e-04 1.351284e-03 1.354047e-04 3.785806e-04 1.022444e-04
       17198        17238        15769        14396        14898
2.652828e-04 1.564063e-03 4.062142e-04 2.017254e-04 3.288401e-04
       16725        16455        13081        15545        17243
4.200311e-04 2.735729e-04 2.931927e-03 2.238323e-04 1.124688e-03
       15465        15708        13089        16033        13838
2.873897e-04 8.207186e-04 5.131564e-03 3.183393e-03 4.808250e-04
       15351        18055        15038        18109        13069
6.438634e-04 1.003100e-03 3.675272e-04 1.254566e-03 1.298780e-03
       16241        14800        16839        16168        16931
1.829346e-03 1.083238e-03 8.234819e-04 2.735729e-04 2.481499e-03
       16814        13269        14813        17062        14810
8.980927e-04 8.842759e-04 8.290087e-05 1.961987e-04 7.046574e-04
       16353        18118        13831        13506        17796
2.597561e-04 3.548157e-03 2.044888e-04 8.013750e-05 2.265957e-04
       15716        18156        15221        16983        17059
3.260767e-04 3.868707e-04 3.039698e-05 4.117410e-04 1.425895e-03
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       15281        13473        14320        17742        16351
4.145043e-04 6.079397e-05 1.160612e-04 4.145043e-05 2.210690e-05
       13144        15346        15370        14295        16034
8.290087e-06 4.697716e-05 2.625194e-04 1.934354e-05 6.079397e-05
       17365        15189        14669        18095        15518
1.293254e-03 6.411000e-04 4.697716e-04 5.803061e-05 6.079397e-04
       15749        14209        15569        17569        13784
4.145043e-05 2.431759e-04 8.566423e-05 8.013750e-05 8.566423e-05
       13862        16791        16235        14270        16655
3.923974e-04 8.898026e-04 1.326414e-04 8.013750e-05 7.212375e-04
       16359        16554        15939        14587        14715
1.934354e-04 2.044888e-04 2.127789e-04 1.061131e-03 1.961987e-04
       14185        14040        14514        15171        14167
8.290087e-06 6.659703e-04 2.017254e-04 1.934354e-05 1.436948e-04
 [ reached getOption("max.print") -- omitted 2950 entries ]

Conditional probabilities:
```
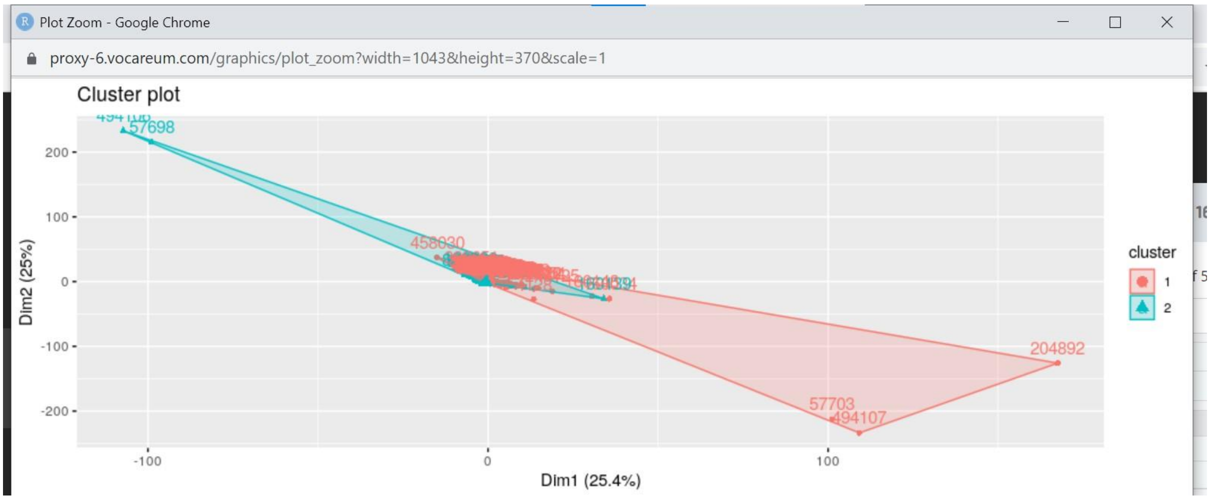

If,I look at the above mentione output,the Apriori Probabilites of different customer IDs are listed accordingly

Q5) If the number of observations is loaded in one of the clusters, break down that cluster further using the clustering algorithm. [hint: Here loaded means if any cluster has more number of data points as compared to other clusters then split that clusters by increasing the number of clusters and observe, compare the results with previous results.]

Ans) The below mention is the clustering Algorithm which gives an overview of various Clusters. The code below is mentioned in R and the analysis is done on on the columns of **InvoiceNo,Quantity,UnitPrice and CustomerID of UK customers only.**

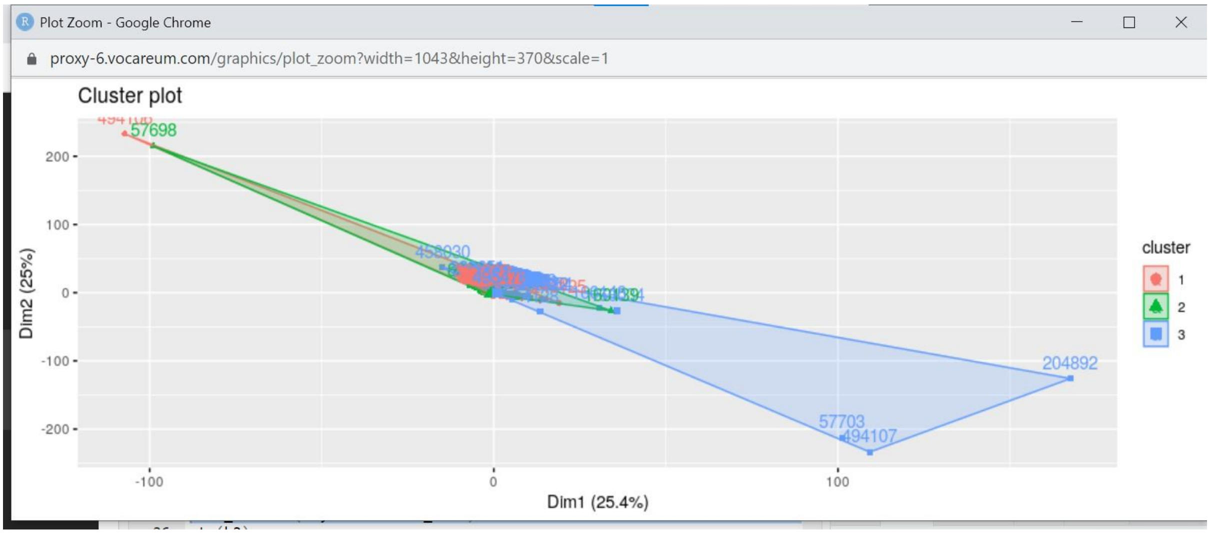
```
ecom_data<-read.csv("https://raw.githubusercontent.com/shivanipriya89/Ecommerce/main/MyEcommerce.csv")
print(ecom_data)
View(ecom_data)
str(ecom_data)
ecom_data$InvoiceNo<-as.integer(ecom_data$InvoiceNo)
ecom_data<-na.omit(ecom_data)
str(ecom_data)
ecom_data<- scale(ecom_data)

k2<-kmeans(ecom_data, centers = 2, nstart = 25)
str(k2)

fviz_cluster(k2, data =ecom_data)



k3<-kmeans(ecom_data, centers = 3, nstart = 25)
fviz_cluster(k3, data =ecom_data)
str(k3)

k4<-kmeans(ecom_data, centers = 4, nstart = 25)
fviz_cluster(k4, data =ecom_data)
str(k4)
```

Below attached are the screenshots of various clusters



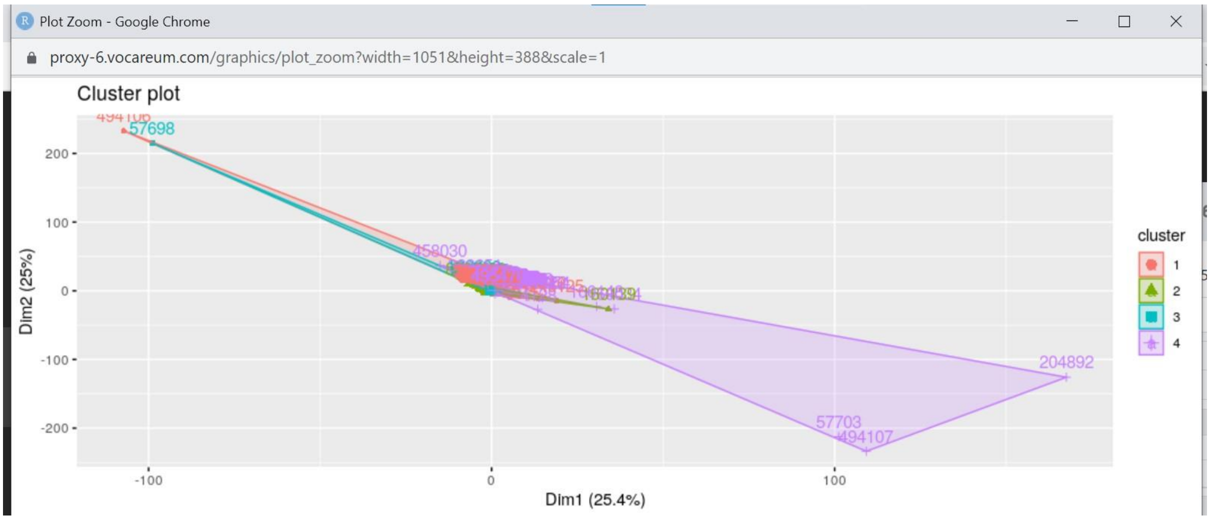
Plot Zoom - Google Chrome

proxy-6.vocareum.com/graphics/plot_zoom?width=1043&height=370&scale=1



Plot Zoom - Google Chrome

proxy-6.vocareum.com/graphics/plot_zoom?width=1043&height=370&scale=1



The above mention screenshot represents the datapoints of various Clusters