GREAT LEARNING

PROJECT ON UNSUPERVISED LEARNING -2

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Session: 2024-25

From the business perspective we have to find the driving factors and to identify the different segments in the customer, based on their spending patterns and their past interaction with the bank, to provide the recommendations to the bank.

PROBLEM STATEMENT

AllLife Bank wants to focus on its credit card customer base in the next financial year. They have been advised by their marketing research team, that the penetration in the market can be improved. Based on this input, the Marketing team proposes to run personalized campaigns to target new customers as well as upsell to existing customers. Another insight from the market research was that the customers perceive the support services of the back poorly. Based on this, the Operations team wants to upgrade the service delivery model, to ensure that customer queries are resolved faster. The Head of Marketing and Head of Delivery both decide to reach out to the Data Science team for help

OBJECTIVE

To identify different segments in the existing customers, based on their spending patterns as well as past interaction with the bank, using clustering algorithms, and provide recommendations to the bank on how to better market to and service these customers.

DATA DESCRIPTION

SI.NO	Column Name	Description
1	Sl_No	Primary key of the records
2	Customer Key	Customer identification number
3	Average Credit Limit	Average credit limit of each customer for all credit cards
4	Total credit cards	Total number of credit cards possessed by the customer
5	Total visits bank	Total number of visits that the customer made (yearly) personally to the bank

6	Total visits online	Total number of visits or online logins made by the customer (yearly)
7	Total calls made	Total number of calls made by the customer to the bank or its customer service department (yearly)

List of Image

	Sl_No	Customer Key	Avg_Credit_Limit	Total_Credit_Cards	Total_visits_bank	Total_visits_online	Total_calls_made
0	1	87073	100000	2	1	1	0
1	2	38414	50000	3	0	10	9
2	3	17341	50000	7	1	3	4
3	4	40496	30000	5	1	1	4
4	5	47437	100000	6	0	12	3
5	6	58634	20000	3	0	1	8
6	7	48370	100000	5	0	11	2
7	8	37376	15000	3	0	1	1
8	9	82490	5000	2	0	2	2
9	10	44770	3000	4	0	1	7

Image 1

Above Image shows top 10 rows of the data set.

	Sl_No	Customer Key	Avg_Credit_Limit	Total_Credit_Cards	Total_visits_bank	Total_visits_online	Total_calls_made
650	651	78996	195000	10	1	12	2
651	652	78404	132000	9	1	12	2
652	653	28525	156000	8	1	8	0
653	654	51826	95000	10	0	15	1
654	655	65750	172000	10	1	9	1
655	656	51108	99000	10	1	10	0
656	657	60732	84000	10	1	13	2
657	658	53834	145000	8	1	9	1
658	659	80655	172000	10	1	15	0
659	660	80150	167000	9	0	12	2

Image 2

Above image shows bottom 10 rows of the data set.

```
RangeIndex: 660 entries, 0 to 659
Data columns (total 7 columns):
 #   Column               Non-Null Count  Dtype
---  ------               --------------  -----
 0   Sl_No                660 non-null    int64
 1   Customer Key         660 non-null    int64
 2   Avg_Credit_Limit     660 non-null    int64
 3   Total_Credit_Cards   660 non-null    int64
 4   Total_visits_bank    660 non-null    int64
 5   Total_visits_online  660 non-null    int64
 6   Total_calls_made     660 non-null    int64
(660, 7)
```

Image 3

Above image shows that we have total 7 columns and 660 rows.

Above image also shows that we have no missing values available in our data set.

We have total 7 columns with Integer data type as the project is for the Unsupervised Learning so we don't have any target Variable.

We don't have any duplicate values in our data set.

```
Sl_No                  0
Customer Key           0
Avg_Credit_Limit       0
Total_Credit_Cards     0
Total_visits_bank      0
Total_visits_online    0
Total_calls_made       0
```

Image 4

We don't have any missing value in our data set.

	count	mean	std	min	25%	50%	75%	max
Sl_No	660.0	330.500000	190.669872	1.0	165.75	330.5	495.25	660.0
Customer Key	660.0	55141.443939	25627.772200	11265.0	33825.25	53874.5	77202.50	99843.0
Avg_Credit_Limit	660.0	34574.242424	37625.487804	3000.0	10000.00	18000.0	48000.00	200000.0
Total_Credit_Cards	660.0	4.706061	2.167835	1.0	3.00	5.0	6.00	10.0
Total_visits_bank	660.0	2.403030	1.631813	0.0	1.00	2.0	4.00	5.0
Total_visits_online	660.0	2.606061	2.935724	0.0	1.00	2.0	4.00	15.0
Total_calls_made	660.0	3.583333	2.865317	0.0	1.00	3.0	5.00	10.0

Image 5

Above image shows the statistical summary of the data set.

Above image shows average customers have 5 Credit Cards.

Average credit limit is around 34573 rupees, but about 50% of the persons credit limit is about 18000.

Average around 3 times customer contact the Credit company in a year by call, and they visit twice in a year physically.

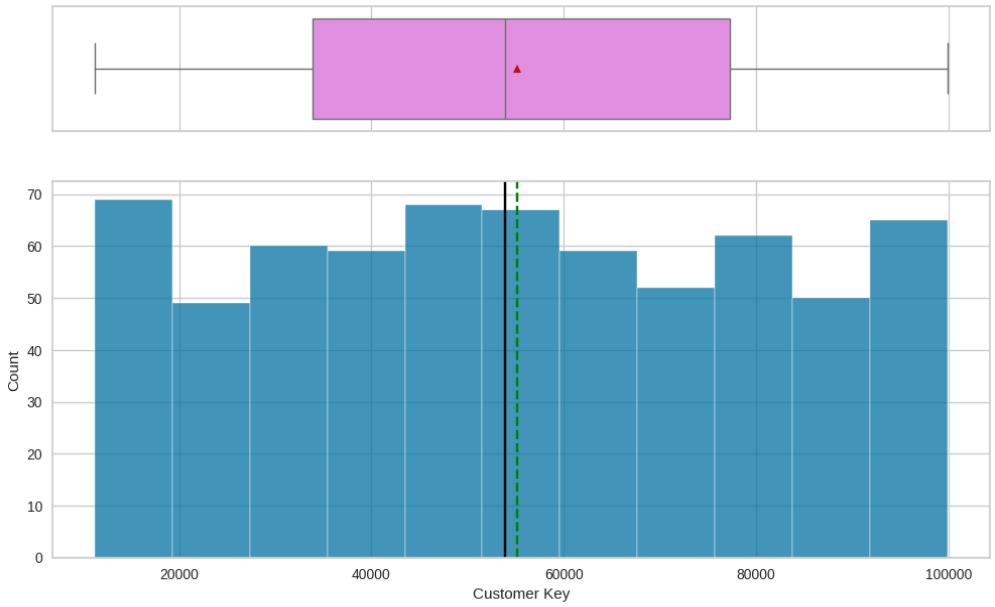


Image 6

Above image shows the average value of Customer key.

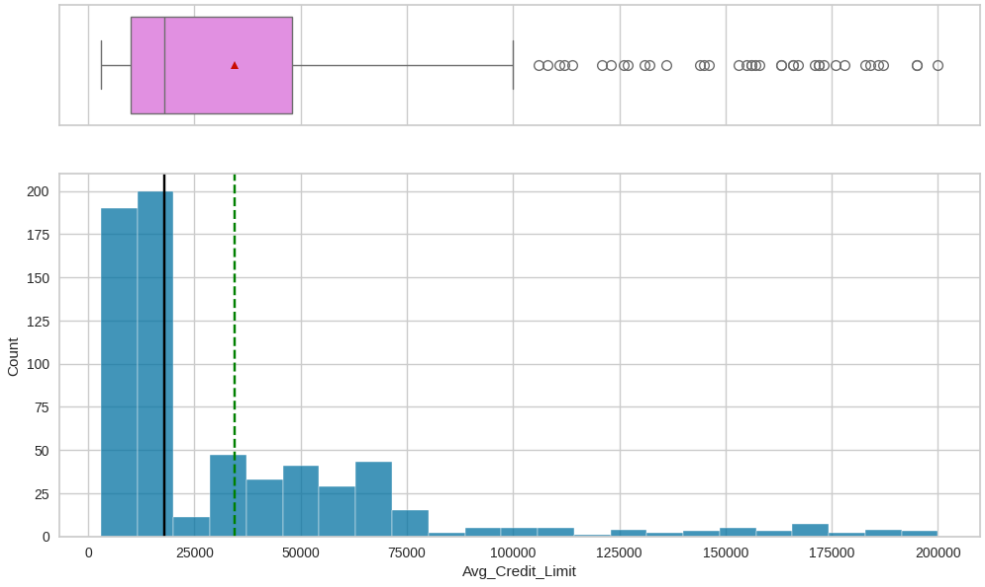


Image 7

Above image shows our data is right skewed, some outliers in right side shows many customers have the Credit limit of 2 lakhs.

As average credit limit is Mean is around: 34574, Median is: 18000.00.

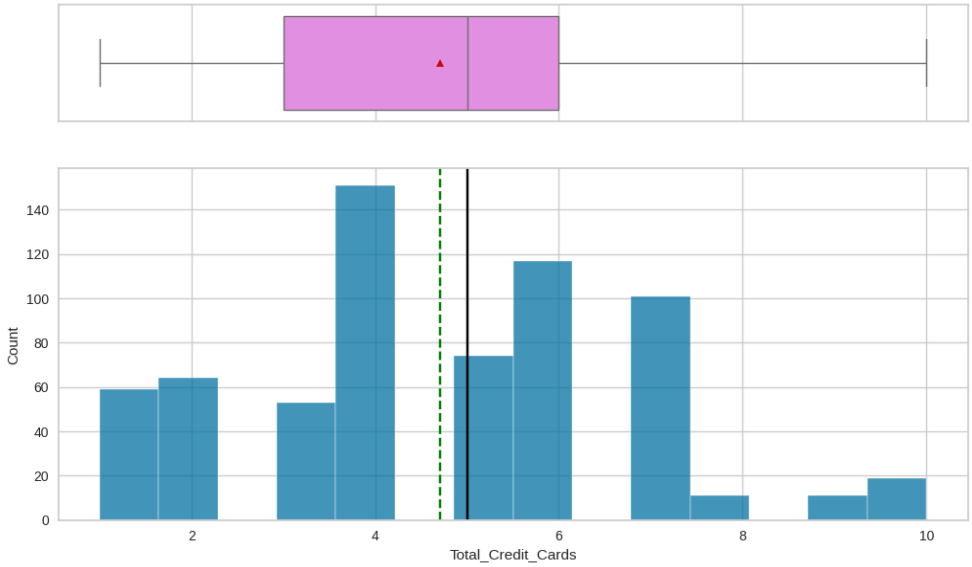


Image 8

Above image shows average customers have 5 Credit cards.

Our data set for the Average Credit cards is left skewed.

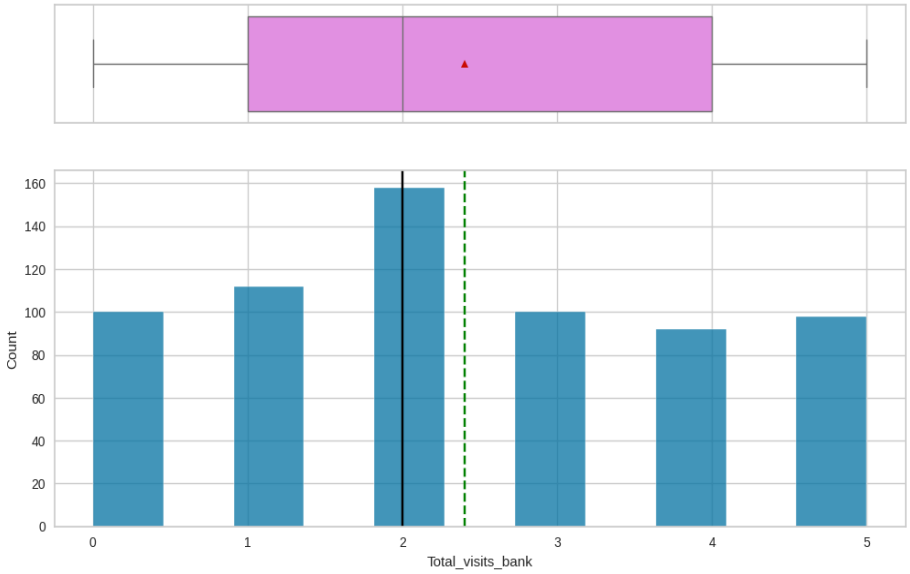


Image 9

Above image shows our data set for the visit bank is right skewed.

Average a customer visit 2 times to bank.

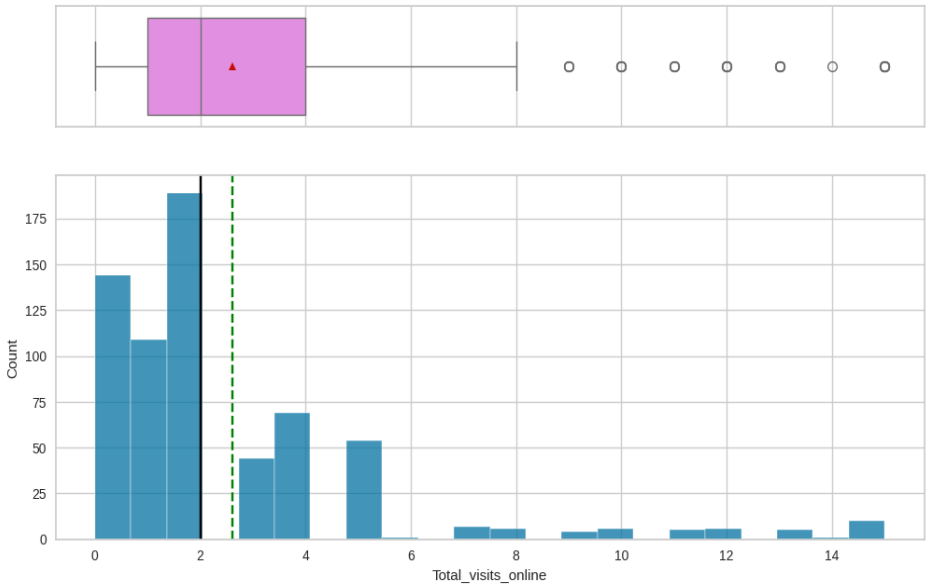


Image 10

Above image shows our data set for the total visits online is right skewed.

Average 3 times a person login online made by the customers.

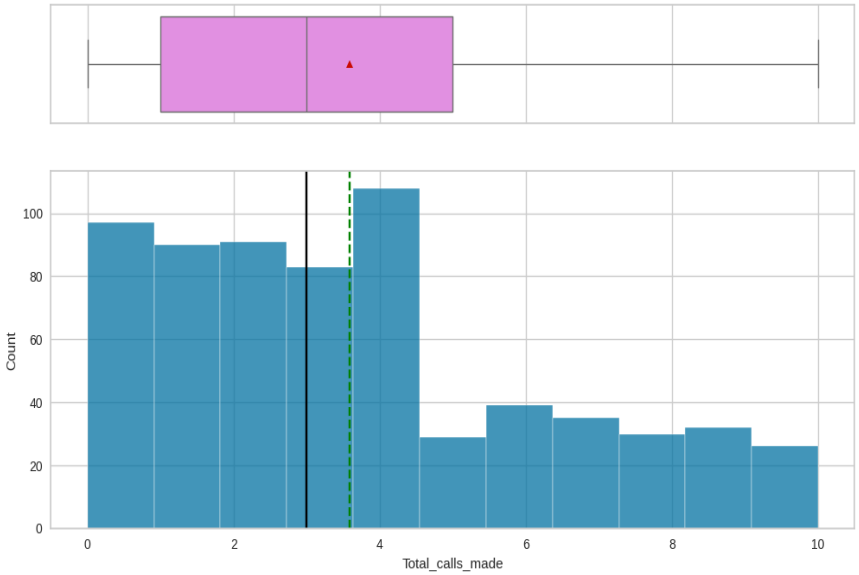


Image 11

Average 3 times calls are made by the customers to the bank or the customer service department yearly.

Our data is right skewed for the numbers of calls made.

Image 12

Our heat map shows there is positive relationship b\w the Average Credit limit and total Credit Cards.

Also heat map shows there is positive relationship b\w the Average Credit limit and total calls made.

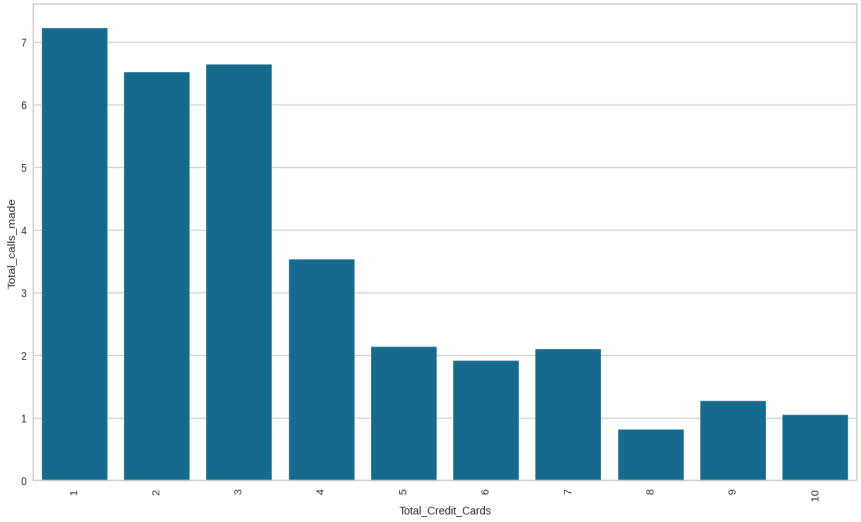


Image 13

Above image shows the relation ship b\w the customer having the total credit cards they have and they make the calls to the customer care or to the bank in a year.

We found as the persons have many cards they stop calling the banks in regular manner.

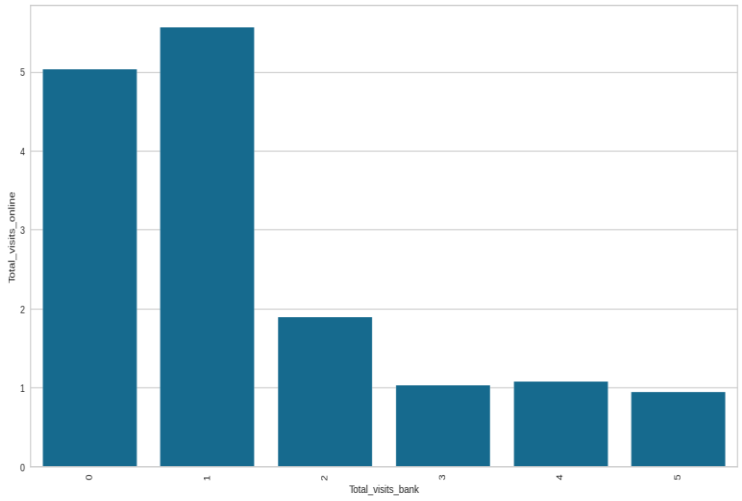


Image 14

Above image shows the relationship b\w the total number of visits in bank and total visit online.

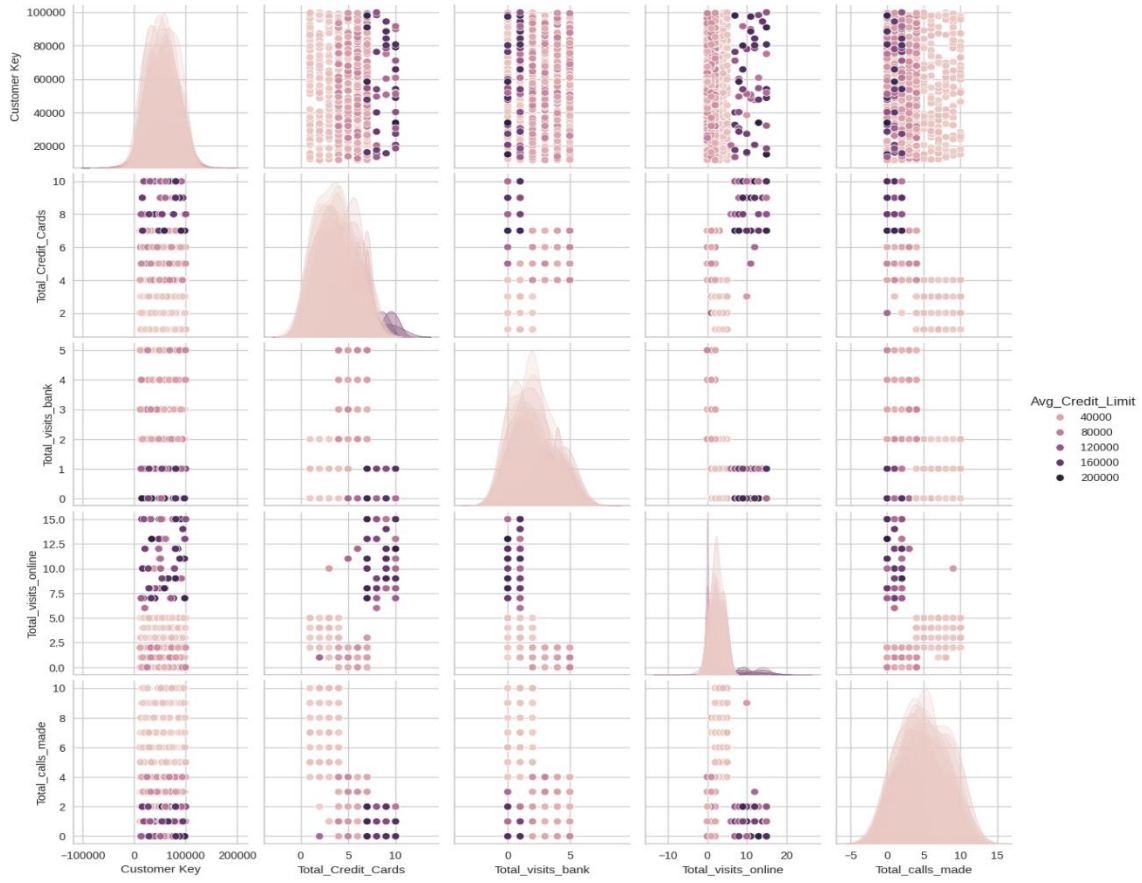


Image 15

Above image show the pair plots b\w the different vaiables

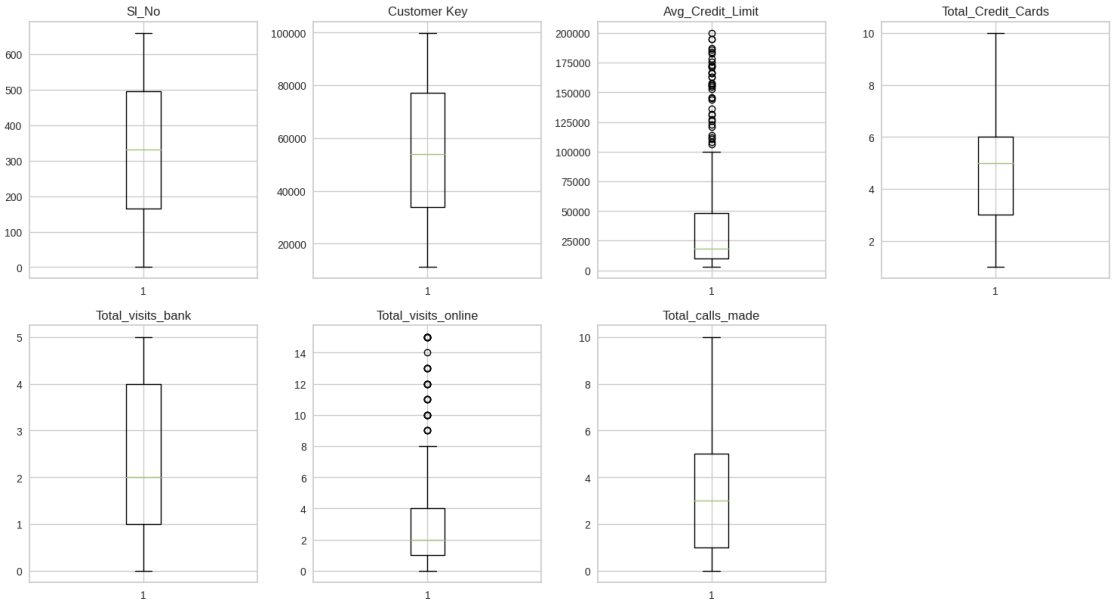


Image 16

Above image shows the total outliers in our different variables.

```
Number of Clusters: 1   Average Distortion: 2.006922226250361
Number of Clusters: 2   Average Distortion: 1.7178787250175898
Number of Clusters: 3   Average Distortion: 1.1466276549150365
Number of Clusters: 4   Average Distortion: 1.0902973540817666
Number of Clusters: 5   Average Distortion: 0.9906853650098948
Number of Clusters: 6   Average Distortion: 0.9515009282361341
Number of Clusters: 7   Average Distortion: 0.9094119827472316
Number of Clusters: 8   Average Distortion: 0.9191292344244387
Number of Clusters: 9   Average Distortion: 0.8990131857179275
Number of Clusters: 10  Average Distortion: 0.8723089051392604
Number of Clusters: 11  Average Distortion: 0.8353621156593081
Number of Clusters: 12  Average Distortion: 0.80956116944126
Number of Clusters: 13  Average Distortion: 0.7950761910849837
Number of Clusters: 14  Average Distortion: 0.7740825528304727
```

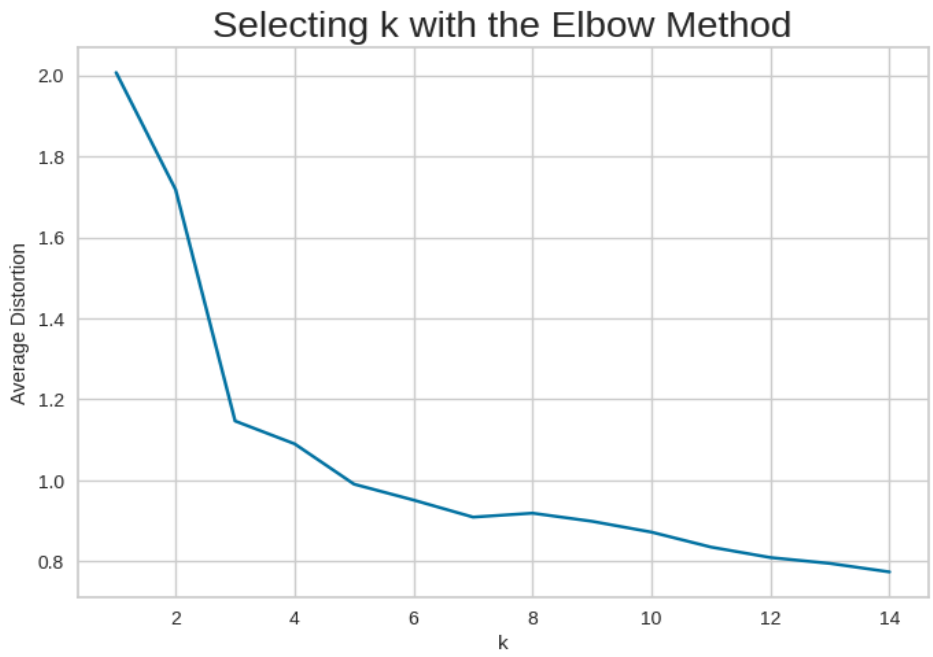


Image 17

The appropriate value of k from the elbow curve seems to be 3.

```
For n_clusters = 2, the silhouette score is 0.5703183487340514)
For n_clusters = 3, the silhouette score is 0.5157182558881063)
For n_clusters = 4, the silhouette score is 0.3744071798973986)
For n_clusters = 5, the silhouette score is 0.27167502160723267)
For n_clusters = 6, the silhouette score is 0.24804756291576194)
For n_clusters = 7, the silhouette score is 0.24791254258020035)
For n_clusters = 8, the silhouette score is 0.22570382558070443)
For n_clusters = 9, the silhouette score is 0.19931783829027247)
For n_clusters = 10, the silhouette score is 0.20939001908412339)
For n_clusters = 11, the silhouette score is 0.21874494421167007)
For n_clusters = 12, the silhouette score is 0.21076471529358776)
For n_clusters = 13, the silhouette score is 0.2110262471212854)
For n_clusters = 14, the silhouette score is 0.21513441980318038)
```

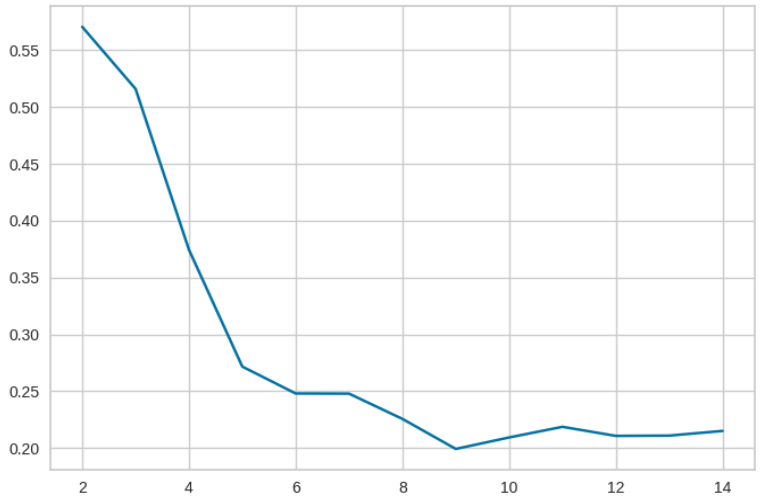


Image 18

Silhouette score for 2 is the highest.

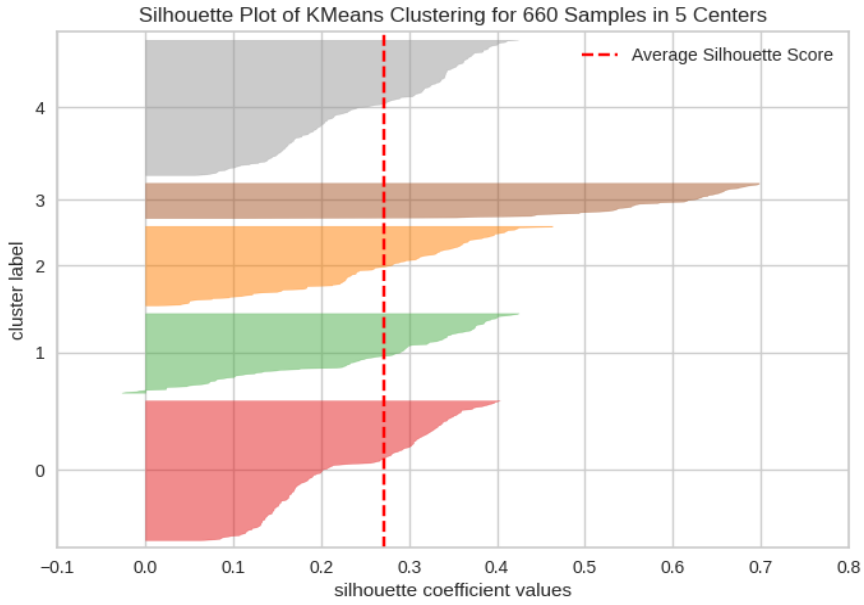


Image 19

Cluster 3 seems to be too thin in comparison to the others.

Cluster 0 seems to be too large in comparison to the others.

Creating Final Model

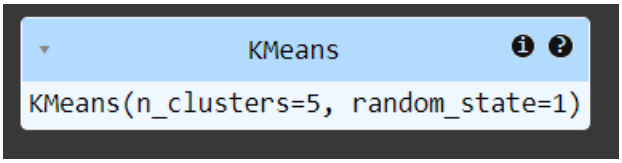


Image 20

Cluster Profiling

KM_segments	Sl_No	Customer Key	Avg_Credit_Limit	Total_Credit_Cards	Total_visits_bank	Total_visits_online	Total_calls_made	count_in_each_segment
0	419.627551	54073.484694	36260.204082	5.551020	2.494898	0.954082	2.061224	196
1	122.955357	56043.991071	12401.785714	2.214286	0.910714	3.669643	8.535714	112
2	112.758929	54435.669643	11946.428571	2.607143	0.955357	3.437500	5.205357	112
3	611.280000	56708.760000	141040.000000	8.740000	0.600000	10.900000	1.080000	50
4	415.363158	55714.684211	31226.315789	5.478947	4.515789	1.010526	1.936842	190

```
In cluster 0, the following companies are present:
[87073 17341 40496 54838 35254 97825 35483 45909 14263 46813 35549 39122
 81531 18595 40898 27101 45088 23302 65372 56843 20072 47496 53936 66504
 51319 21233 74544 52025 45652 77026 49331 54906 94666 11698 34677 57565
 31384 16374 91987 51552 24998 45673 81863 23881 44645 17933 47437 85614
 96548 19137 69028 70779 67046 64897 36628 17565 11799 81940 66706 87838
 47866 61996 15318 89635 71862 88807 82376 80347 17649 44579 61994 24702
 27824 45878 72431 19215 85122 55060 31113 68439 88207 96929 78618 31551
 29864 45440 97954 90189 55090 33991 88884 45808 53932 65908 25321 48602
 48657 49913 53002 82807 93496 37252 41287 52460 58019 87219 36839 48667
 42887 14439 81166 14816 11265 84351 89446 64774 53166 36504 15798 84360
 46776 67258 44804 29919 74446 36632 76024 75065 51682 56367 95147 23102
 20043 44144 53552 62530 41741 61216 83192 82023 64550 17382 27117 21717
 81910 76492 43000 48692 43034 13140 91242 63710 90860 58708 57451 69868
 43679 30256 26334 47848 17377 51771 68040 34775 85645 44157 75398 33295
 80942 97850 35268 88411 58116 75366 14377 96534 31870 24748 68920 67637
 59170 47703 76398 93310 36836 94700 67860 93381 72339 44403 58276 85234
 31948 90191 11562 16253]

In cluster 1, the following companies are present:
[38414 58634 92503 55196 39137 14309 87241 24001 68067 65034 14854 82164
 28254 46388 52142 37659 83132 20119 99026 37252 51182 96386 43886 78503
 17937 71632 81566 36929 61355 66524 69214 21976 33187 59656 12026 99589
 38165 49198 59619 91099 25742 88338 96213 26599 73007 97935 26089 41634
 83244 87291 15310 98499 93997 25440 63663 69811 39454 70199 14248 52750
 95507 23743 53410 53898 58389 59151 60475 77758 23768 87471 97011 18564
 61009 24054 52758 59783 64241 32374 36978 54281 98602 97687 38410 25330
 41787 95495 41946 86410 38205 63405 18145 98288 69704 29058 15546 16715
 87350 13215 20593 56624 40486 90958 61776 55275 28208 68003 79632 72892
 51773 96163 55849 56156]

In cluster 3, the following companies are present:
[47437 48370 94391 50598 40019 77910 89832 98216 54495 47650 32107 84192
```

```
 53916 32584 97285 20337 15585 20620 75009 76203 33837 14916 97935 16180
 49493 70974 40217 88442 17538 90839 99843 27212 91575 60190 18519 48762
 58392 79953 13315 30570 78996 78404 28525 51826 65750 51108 60732 53834
 80655 80150]

In cluster 2, the following companies are present:
[37376 82490 44770 52741 52326 25084 68517 62617 96463 29794 30507 61061
 81130 29112 13999 32550 61517 30888 74126 52363 50769 68502 83326 62040
 74625 60301 68419 32828 29759 70248 91673 60403 85868 76205 35149 27120
 18821 93482 90168 71881 38970 57990 39447 79694 79403 47296 37559 18007
 37016 74704 11937 52736 18916 92501 14946 74795 73435 84069 18086 33369
 35256 89007 16577 81116 36111 11602 49697 28701 61627 34103 31256 45583
 66200 61347 37802 95489 85707 97951 54785 35103 63751 78473 80457 97536
 33110 28842 38261 20524 37671 11412 55892 76718 98969 77143 53851 52783
 48510 97463 14398 33317 99596 72430 16676 67212 44226 94251 18609 54477
 12122 73811 61234 72156]

In cluster 4, the following companies are present:
[46635 83125 15129 83290 56486 31903 81878 85799 69965 44398 32352 33457
 27408 21531 17165 89328 71402 24808 17036 67193 34423 97109 55382 51811
 53207 18514 36340 36934 95925 49771 22919 73952 49418 75775 95610 41380
 38033 85337 38994 67911 92956 77641 53814 30712 19785 50878 78002 83459
 11596 87485 28414 33240 11466 49844 92782 22824 26767 26678 50412 34495
 22610 41159 64672 62483 38244 46223 77381 94437 33790 44402 29886 66804
 71681 96186 22348 36243 98126 62807 92522 57459 45476 11398 23409 16418
 55478 65574 96929 78912 62864 31515 77954 75792 17703 50706 92140 88123
 87456 97530 76209 61122 64519 31950 23110 96297 28408 26604 12663 60851
 41266 37438 65747 20570 24980 37934 70707 17325 45341 94595 55170 92489
 92933 40508 70101 77613 48402 65781 12456 62649 18397 29102 44379 76957
 42921 61324 49690 22842 65825 77826 73000 90131 94529 27476 15086 99131
 99437 39285 35585 39644 29176 55706 83585 51867 75417 83545 38125 90999
 70376 26493 43841 79885 59316 83466 81510 11734 96269 87683 26063 42479
 67282 84888 59074 60839 90586 56270 87670 35421 58511 46373 99473 68862
 46548 74083 48660 13720 99284 47198 67415 49341 80623]


KM_segments  Avg_Credit_Limit
0            5000                4
             6000                9
             7000                4
             8000                8
             9000                1
                                 ..
4            71000               3
             72000               2
             73000               1
             74000               4
             75000               1
```

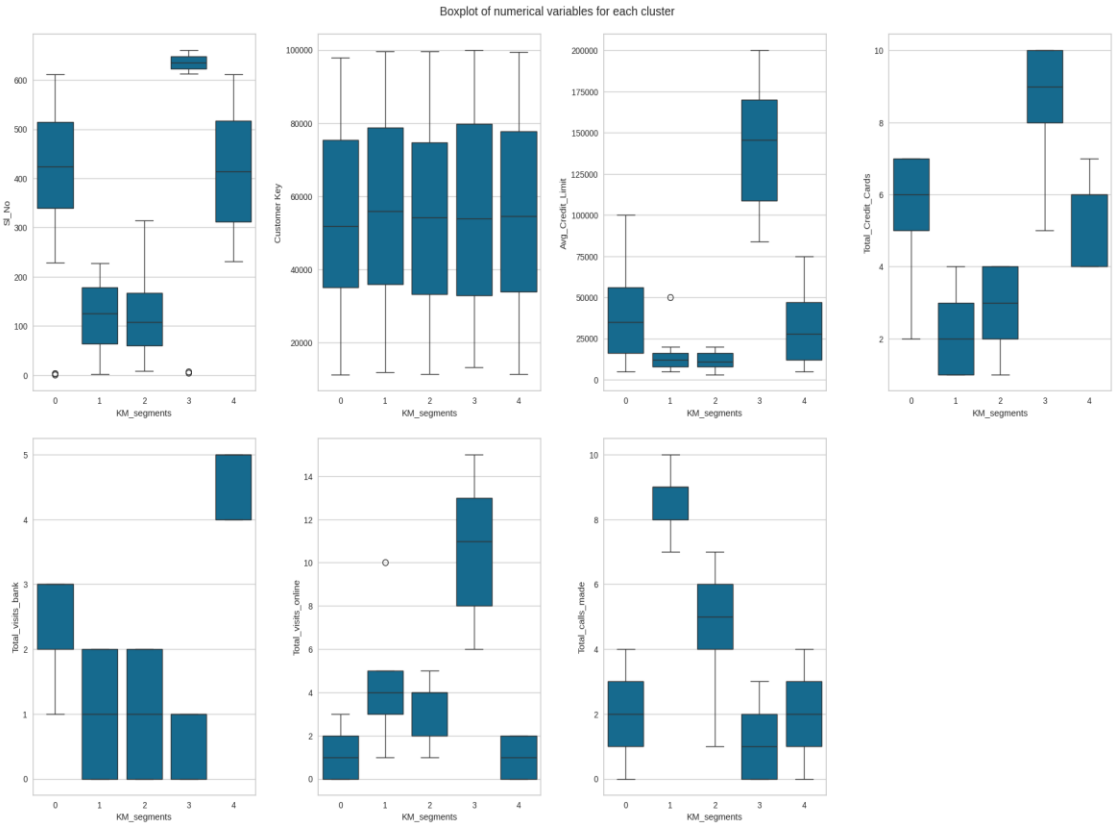


Image 21

Hierarchical Clustering

Computing Cophenetic Correlation

```
Cophenetic correlation for Euclidean distance and single linkage is
0.7391220243806552.
Cophenetic correlation for Euclidean distance and complete linkage is
0.8599730607972423.
Cophenetic correlation for Euclidean distance and average linkage is
0.8977080867389372.
Cophenetic correlation for Euclidean distance and weighted linkage is
0.8861746814895477.
Cophenetic correlation for Chebyshev distance and single linkage is
0.7382354769296767.
Cophenetic correlation for Chebyshev distance and complete linkage is
0.8533474836336782.
Cophenetic correlation for Chebyshev distance and average linkage is
0.8974159511838106.
Cophenetic correlation for Chebyshev distance and weighted linkage is
```

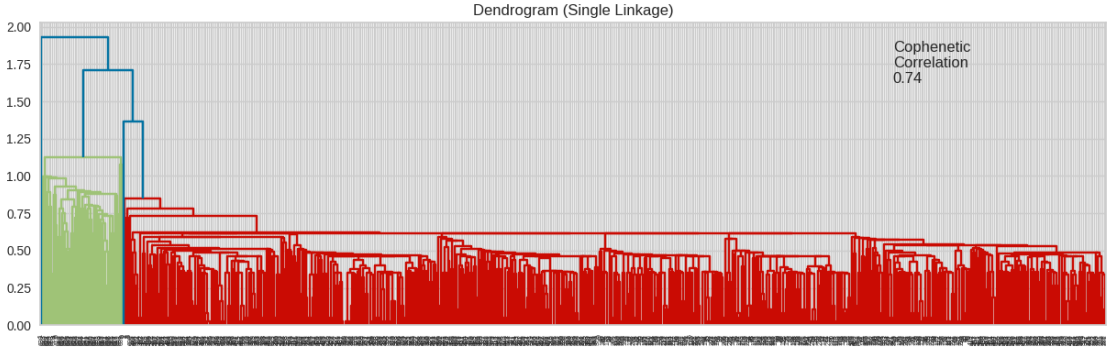
```
0.8913624010768603.
Cophenetic correlation for Mahalanobis distance and single linkage is
0.7058064784553605.
Cophenetic correlation for Mahalanobis distance and complete linkage is
0.6663534463875359.
Cophenetic correlation for Mahalanobis distance and average linkage is
0.8326994115042136.
Cophenetic correlation for Mahalanobis distance and weighted linkage is
0.7805990615142518.
Cophenetic correlation for Cityblock distance and single linkage is
0.7252379350252723.
Cophenetic correlation for Cityblock distance and complete linkage is
0.8731477899179829.
Cophenetic correlation for Cityblock distance and average linkage is
0.896329431104133.
Cophenetic correlation for Cityblock distance and weighted linkage is
0.8825520731498188.
**********************************************************************
**********
Highest cophenetic correlation is 0.8977080867389372, which is obtained with
Euclidean distance and average linkage.
```

Let's explore different linkage methods with Euclidean distance only.

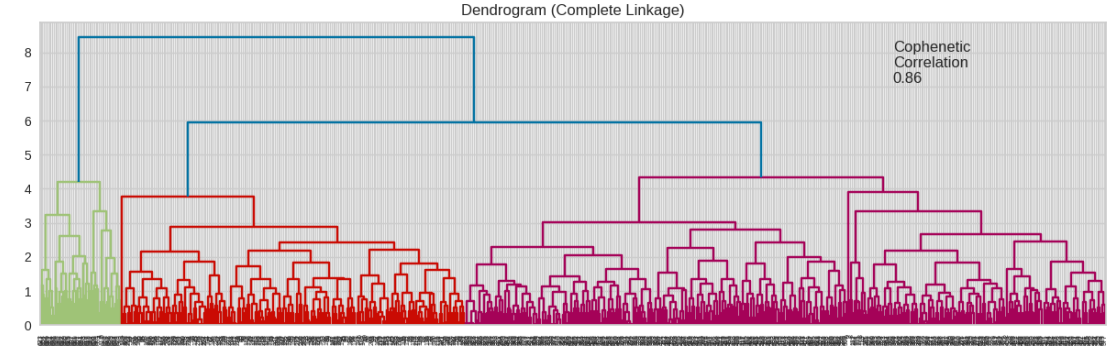
```
Cophenetic correlation for single linkage is 0.7391220243806552.
Cophenetic correlation for complete linkage is 0.8599730607972423.
Cophenetic correlation for average linkage is 0.8977080867389372.
Cophenetic correlation for centroid linkage is 0.8939385846326323.
Cophenetic correlation for ward linkage is 0.7415156284827493.
Cophenetic correlation for weighted linkage is 0.8861746814895477.
**********************************************************************
**********
Highest cophenetic correlation is 0.8977080867389372, which is obtained with
average linkage.
```

Checking Dendrograms

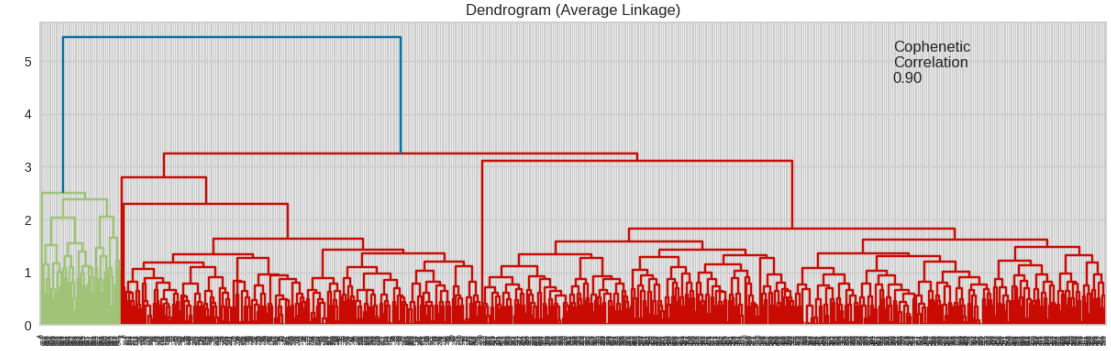
Dendrogram (Single Linkage)



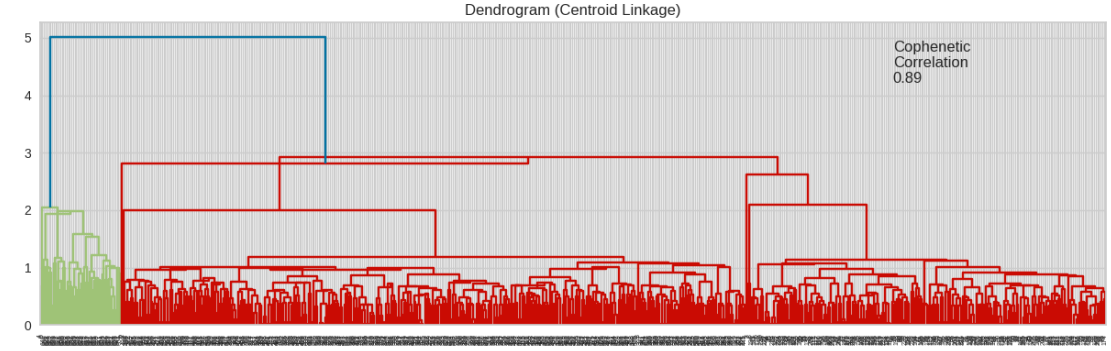
Dendrogram (Complete Linkage)



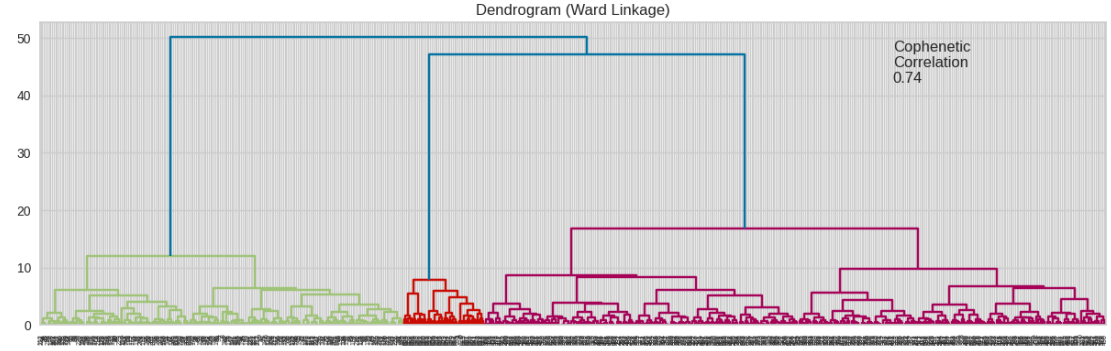
Dendrogram (Average Linkage)



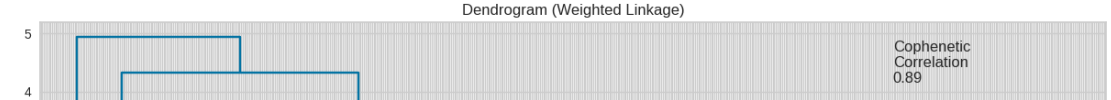
Dendrogram (Centroid Linkage)



Dendrogram (Ward Linkage)



Dendrogram (Weighted Linkage)



	Linkage	Cophenetic Coefficient
0	single	0.739122
4	ward	0.741516
1	complete	0.859973
5	weighted	0.886175
3	centroid	0.893939
2	average	0.897708

Image 22

We have best performance with Average Linkage with cluster 3 with sklearn model

Creating model using sklearn

```
AgglomerativeClustering
AgglomerativeClustering(linkage='average', n_clusters=3)
```

Image 23

Final model with sklearn for Agglomerative Clustering

Cluster Profiling

HC_segments	Sl_No	Customer Key	Avg_Credit_Limit	Total_Credit_Cards	Total_visits_bank	Total_visits_online	Total_calls_made	count_in_each_segment
0	417.260982	54925.966408	33713.178295	5.511628	3.485788	0.984496	2.005168	387
1	611.280000	56708.760000	141040.000000	8.740000	0.600000	10.900000	1.080000	50
2	116.977578	55163.973094	12197.309417	2.403587	0.928251	3.560538	6.883408	223

```
In cluster 0, the following companies are present:
[87073 17341 40496 54838 35254 46635 97825 83125 35483 15129 83290 56486
 31903 45909 14263 46813 81878 35549 85799 39122 81531 69965 18595 44398
 32352 40898 27101 33457 45088 23302 27408 65372 21531 56843 17165 89328
 20072 71402 47496 24808 17036 67193 34423 97109 55382 51811 53936 66504
 53207 18514 51319 36340 36934 95925 49771 22919 21233 74544 52025 45652
 73952 49418 77026 49331 75775 54906 94666 11698 34677 95610 41380 38033
 85337 38994 67911 92956 77641 57565 53814 30712 19785 31384 16374 50878
 78002 83459 91987 51552 72156 24998 45673 11596 87485 28414 81863 33240
 11466 23881 44645 49844 92782 22824 26767 26678 50412 17933 34495 47437
 22610 41159 64672 62483 85614 96548 19137 69028 70779 38244 67046 64897
 46223 36628 17565 77381 11799 81940 66706 87838 94437 33790 44402 29886
 66804 47866 61996 15318 89635 71681 71862 96186 22348 36243 88807 82376
 98126 80347 17649 62807 92522 57459 44579 45476 61994 11398 24702 27824
 45878 72431 19215 23409 16418 85122 55060 55478 65574 31113 96929 78912
```

```
 68439 62864 31515 77954 88207 78618 31551 75792 29864 45440 97954 90189
 55090 17703 33991 88884 45808 50706 92140 88123 53932 65908 25321 87456
 48602 97530 48657 76209 49913 53002 61122 82807 93496 64519 31950 23110
 96297 28408 37252 41287 52460 26604 58019 87219 36839 12663 48667 42887
 14439 60851 41266 37438 65747 81166 20570 14816 11265 24980 37934 70707
 84351 89446 17325 64774 53166 45341 94595 55170 92489 92933 36504 40508
 15798 70101 77613 84360 48402 46776 67258 44804 29919 65781 12456 62649
 74446 36632 76024 75065 51682 18397 29102 56367 95147 44379 76957 42921
 23102 61324 49690 20043 44144 53552 62530 41741 22842 65825 77826 61216
 83192 82023 73000 64550 90131 17382 27117 94529 21717 81910 76492 43000
 48692 27476 15086 43034 99131 13140 99437 91242 39285 63710 90860 35585
 58708 57451 69868 43679 30256 26334 47848 17377 39644 29176 55706 51771
 83585 51867 68040 75417 34775 85645 83545 44157 38125 75398 90999 70376
 33295 80942 26493 97850 43841 79885 59316 83466 81510 35268 11734 88411
 96269 87683 26063 42479 58116 67282 84888 75366 14377 59074 96534 31870
 24748 68920 67637 60839 59170 90586 56270 87670 47703 35421 58511 76398
 93310 36836 46373 94700 67860 99473 68862 93381 46548 74083 48660 13720
 72339 99284 47198 67415 44403 58276 85234 31948 90191 49341 11562 16253
 80623]

In cluster 2, the following companies are present:
[38414 58634 37376 82490 44770 52741 52326 92503 25084 68517 55196 62617
 96463 39137 14309 29794 87241 30507 61061 24001 68067 65034 14854 81130
 29112 13999 32550 82164 61517 28254 30888 46388 74126 52142 37659 83132
 20119 52363 50769 68502 99026 83326 62040 37252 74625 51182 60301 96386
 43886 78503 68419 32828 17937 71632 81566 29759 36929 70248 91673 61355
 60403 85868 76205 66524 69214 21976 35149 27120 18821 33187 93482 90168
 71881 59656 12026 99589 38970 57990 39447 79694 79403 47296 37559 38165
 49198 18007 59619 37016 91099 74704 25742 11937 52736 88338 18916 92501
 96213 26599 73007 97935 26089 14946 74795 73435 41634 84069 83244 87291
 18086 33369 15310 98499 35256 89007 93997 16577 25440 81116 63663 69811
 36111 39454 70199 11602 49697 28701 61627 34103 14248 31256 45583 52750
 95507 23743 53410 53898 66200 58389 61347 59151 37802 60475 95489 77758
 23768 87471 85707 97951 54785 97011 35103 18564 61009 24054 63751 52758
 78473 80457 59783 64241 32374 97536 33110 36978 54281 98602 97687 28842
 38410 38261 20524 37671 25330 41787 11412 55892 95495 41946 86410 76718
 98969 77143 38205 53851 52783 63405 48510 97463 18145 14398 98288 69704
 29058 15546 16715 87350 13215 20593 56624 33317 99596 72430 16676 40486
 90958 67212 44226 94251 61776 55275 18609 54477 12122 28208 68003 79632
 73811 72892 51773 96163 61234 55849 56156]

In cluster 1, the following companies are present:
[47437 48370 94391 50598 40019 77910 89832 98216 54495 47650 32107 84192
 53916 32584 97285 20337 15585 20620 75009 76203 33837 14916 97935 16180
 49493 70974 40217 88442 17538 90839 99843 27212 91575 60190 18519 48762
 58392 79953 13315 30570 78996 78404 28525 51826 65750 51108 60732 53834
 80655 80150]
```

HC_segments	Avg_Credit_Limit	
0	5000	8
	6000	14
	7000	12
	8000	15
	9000	10
	10000	12
	11000	9
	12000	10
	13000	10
	14000	9
	15000	6
	16000	9
	17000	10
	18000	14
	19000	13
	20000	7
	25000	1
	26000	5
	27000	2
	28000	3
	29000	5
	30000	6
	31000	5
	32000	2
	33000	4
	34000	6
	35000	2
	36000	11
	37000	6
	38000	8
	39000	7
	40000	3
	41000	6
	42000	2
	43000	1
	44000	3
	45000	3
	46000	3
	47000	6
	48000	6
	49000	4
	50000	7
	51000	4
	52000	6
	54000	4
	55000	1
	56000	7
	57000	3
	58000	3

	59000	4
	60000	5
	61000	3
	62000	3
	63000	2
	64000	4
	65000	5
	66000	4
	67000	3
	68000	7
	69000	4
	70000	10
	71000	4
	72000	3
	73000	4
	74000	6
	75000	2
	100000	1
1	84000	2
	91000	1
	94000	1
	95000	1
	96000	1
	97000	1
	98000	1
	99000	1
	100000	2
	106000	1
	108000	1
	111000	1
	112000	1
	114000	1
	121000	1
	123000	1
	126000	1
	127000	1
	131000	1
	132000	1
	136000	1
	144000	1
	145000	1
	146000	1
	153000	1
	155000	1
	156000	2
	157000	1
	158000	1
	163000	2
	166000	2
	167000	1

	171000	1
	172000	2
	173000	1
	176000	1
	178000	1
	183000	1
	184000	1
	186000	1
	187000	1
	195000	2
	200000	1
2	3000	1
	5000	13
	6000	17
	7000	12
	8000	20
	9000	18
	10000	14
	11000	15
	12000	8
	13000	18
	14000	14
	15000	11
	16000	13
	17000	13
	18000	9
	19000	13
	20000	13
	50000	1

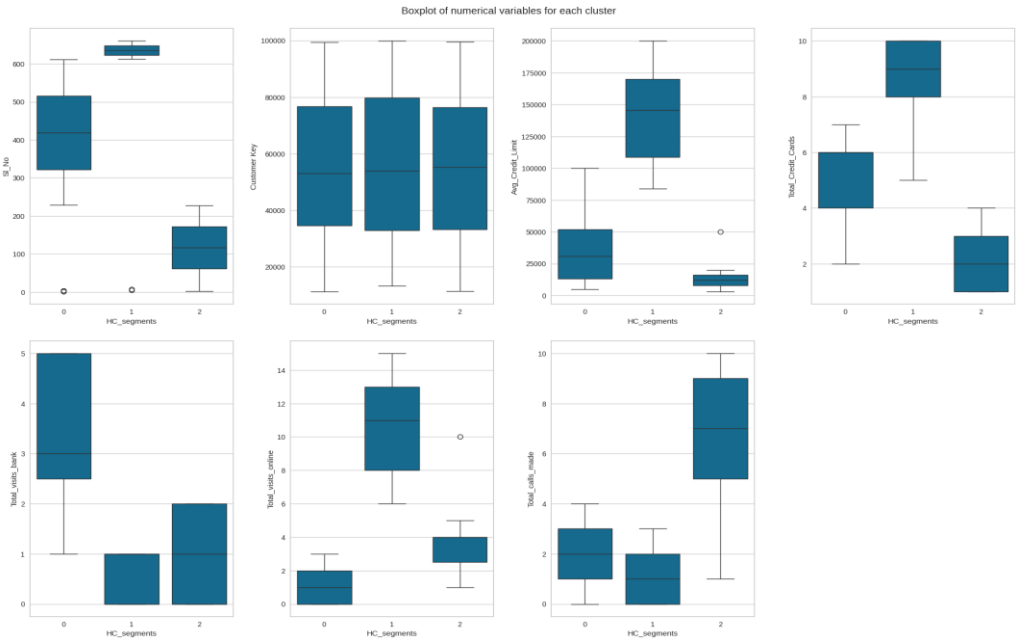


Image 24

Image showing Boxplot of numerical variables for each cluster

Actionable Insights and Recommendations

Observations (Mean):

- Avg_Credit_Limit: 34574.24
- Total_Credit_Cards:4.70
- Total_visits_bank:2.40
- Total_visits_online:2.60
- Total_calls_made:3.58

Univariate Analysis (continuous numerical)

- Feature: Avg_Credit_Limit, Mean: 34574.25, Median: 18000.0, Mode: 100000

Univariate analysis (discrete numerical)

- Feature: Total_Credit_Cards, Mean: 4.7, Median: 5.0, Mode: 2
- Feature: Total_visits_bank, Mean: 2.4, Median: 2.0, Mode: 1
- Feature: Total_visits_online, Mean: 2.6, Median: 2.0, Mode: 1
- Feature: Total calls made, Mean: 3.5, Median: 3.0, Mode: 0

Insights

Cluster 0

The highest Average Credit Limit with higher variance

The second highest number of credit cards with the little variance

Total number of bank visit highest with greater variance

Total visits made online is the lowest with little variance

Total calls made is second highest with little variance

Cluster 1

The second highest Average Credit Limit with higher variance

The highest number of credit cards with the higher variance

Total number of bank visit is second highest with little variance

Total visit made online is the highest with the highest variance

Total calls made is lowest with lowest variance

Cluster 2

The lowest Average Credit Limit with less variance

The lowest number of Credit Cards with little variance

Total number of visits is the lowest with the little variance

Total visit made online is second highest with little variance

Total calls made is highest with greater variance.

Business Recommendations

Cluster 0

The person having **Highest Average Credit Limit** likes to visit the bank in person. It is important to identify the visiting pattern to improve the experience. With this we can use it to show them our new products and services

Cluster 1

The person having **Average Credit Limit** likes to login online. It is important to find the identify the visiting pattern of them so we can improve their experience by tracking their internet flow so we can show new our new products and services

Cluster 2

The person having the **Lowest Average Credit Limit** likes to call the bank. It is important to find if they are the type of customer who wants to invest in the bank. Because to set up the better call center experience can be expensive as customer in this cluster enjoys phone call experience