American International University - Bangladesh (AIUB)

INTRODUCTION TO DATA SCIENCE [E]

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Final Term Project (Applying K-means)

Introduction: The straightforward and widely used unsupervised machine learning approach K-means clustering. Unsupervised algorithms often draw conclusions from datasets using just the input vectors and no knowledge of the known, or labeled, results. Household Living Cost dataset collected from https://www.stats.govt.nz/large-datasets/csv-files-for-download/ this site.

1) Observing the Dataset

mydata <- read.csv("D:/Shanto IDS Project/Household-living - costs.csv",header=TRUE,sep=",")

mydata

```
> mydata <- read.csv("D:/Shanto IDS Project/Household-living-costs.csv",header=TRUE,sep='
> mydata
   year tot_hhs     own own_wm own_prop own_wm_prop prop_hhs  age size income expenditure
1  2008 1560859 1087580 574406     69.7        36.8    100.0 35.9  2.7  46704        4239
2  2008  185965   71256  39405     38.3        21.2     11.9 29.9  2.6  23404        2527
3  2008  312376  191470  48424     61.3        15.5     20.0 40.0  2.3  16747        2114
4  2008  312333  196203  84171     62.8        26.9     20.0 34.7  2.8  31308        2985
5  2008  312240  217657 141318     69.7        45.3     20.0 31.5  3.0  49106        4656
6  2008  312336  229014 147658     73.3        47.3     20.0 35.3  2.6  61674        5277
7  2008  311574  253235 152835     81.3        49.1     20.0 39.3  2.5  96861        7282
8  2008  312761  194358  49448     62.1        15.8     20.0 38.7  2.5  23680        1641
9  2008  311973  206342  86390     66.1        27.7     20.0 36.1  2.7  34155        2908
10 2008  311840  194361 108065     62.3        34.7     20.0 33.0  2.8  49771        4266
11 2008  312257  231612 149007     74.2        47.7     20.0 35.1  2.7  60863        5901
12 2008  312028  260907 181496     83.6        58.2     20.0 36.7  2.5  77434        8905
13 2008  253018  119963  77076     47.4        30.5     16.2 28.9  3.2  42885        3531
14 2008  300243  263054  15406     87.6         5.1     19.2 70.3  1.6  22367        2153
15 2011 1607228 1048164 523698     65.2        32.6    100.0 36.3  2.6  53103        4609
16 2011  197237   56665  27129     28.7        13.8     12.3 28.0  2.7  25902        2760
17 2011  321848  166355  49952     51.7        15.5     20.0 36.3  2.4  19787        2422
18 2011  321751  187275  77561     58.2        24.1     20.0 35.0  2.9  37370        3420
19 2011  321372  204957 119746     63.8        37.3     20.0 33.4  2.9  54894        4943
```

2) Standarized the Data

mydata1 <- scale (mydata[,2:5])

head(mydata1)

set.seed(1)

```
> mydata1 <- scale (mydata[,2:5])
> head(mydata1)
        tot_hhs        own      own_wm
[1,]  3.2889138  3.4319910  3.45779744  0.
[2,] -0.6488650 -0.8289141 -0.70151966 -1.
[3,] -0.2868163 -0.3249208 -0.63140226 -0.
[4,] -0.2869395 -0.3050779 -0.35349043 -0.
```

3) Clustering Result

kR<- pam(mydata1,k=4)

summary(kR)

```
> kR<- pam(mydata1,k=4)
```

```
> summary(kR)
Medoids:
     ID    tot_hhs         own      own_wm   own_prop
[1,] 29  3.5138743  3.44494990  3.28811317  0.1977045
[2,] 31 -0.2410687 -0.41014949 -0.59822885 -0.7530882
[3,] 33 -0.2433113 -0.20652974 -0.08486124  0.2373209
[4,] 35 -0.2423547  0.01023339  0.16808696  1.2739491
Clustering vector:
 [1] 1 2 2 3 3 3 4 3 3 3 3 4 2 4 1 2 2 2 3 3 4 2 2 3 3 4 2 4 1 2 2 2 3 3 4 2 2 3 3 4 2 4 1 2 2 2 3 3 4 2
[64] 2 2 3 3 4 2 4
Objective function:
    build      swap
0.4596551 0.4545288

Numerical information per cluster:
     size  max_diss   av_diss  diameter separation
[1,]    5 0.4362275 0.2620728 0.6989996 5.58139556
[2,]   27 2.1207135 0.6080233 2.6938439 0.05478447
[3,]   23 0.6419911 0.3199364 1.1508055 0.05478447
```

```
Average silhouette width per cluster:
[1] 0.9281013 0.2982502 0.5544197 0.4651107
Average silhouette width of total data set:
[1] 0.4631654

2415 dissimilarities, summarized :
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
0.03288 0.68462 1.34750 2.02860 2.31620 8.29160
Metric :  euclidean
Number of objects : 70
```

4) Cluster Structure

mydata2 <-data.frame(mydata,kR$clustering)

head(mydata2)

set.seed(1)

kR2 <- kmeans(mydata1,4)

kR2$cluster

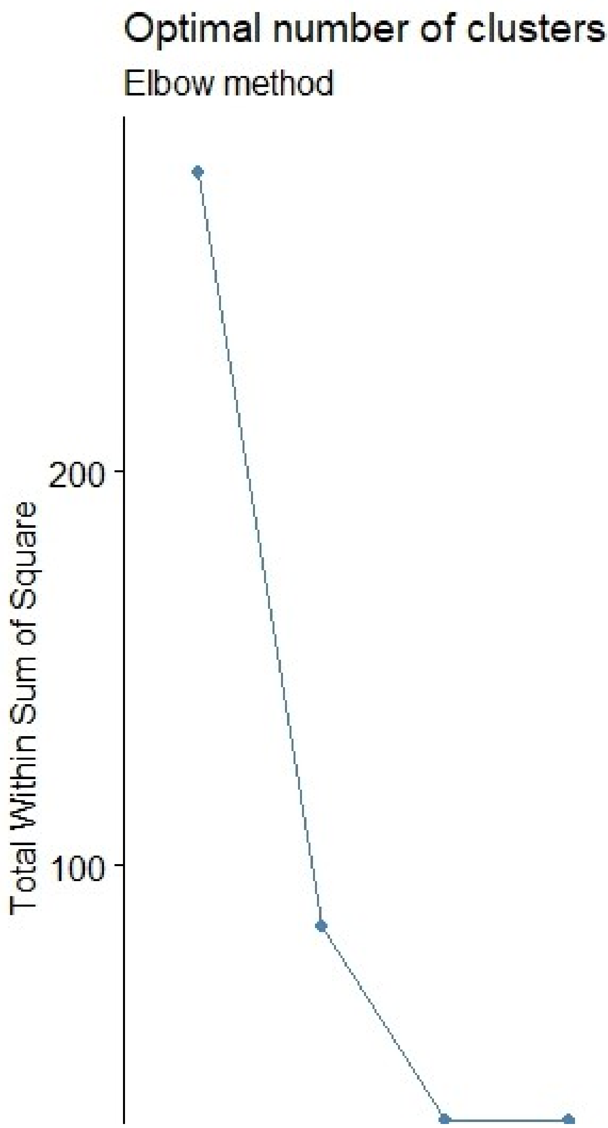
kR2$centers

```
> mydata2 <-data.frame(mydata,kR$clustering)
> head(mydata2)
  year tot_hhs     own own_wm own_prop own_wm_prop prop_hhs  age size income expenditure eqv_income eqv_
1 2008 1560859 1087580 574406     69.7        36.8    100.0 35.9  2.7  46704       42394      26869   25
2 2008  185965   71256  39405     38.3        21.2     11.9 29.9  2.6  23404       25270      14258   15
3 2008  312376  191470  48424     61.3        15.5     20.0 40.0  2.3  16747       21145      13402   14
4 2008  312333  196203  84171     62.8        26.9     20.0 34.7  2.8  31308       29855      18917   18
5 2008  312240  217657 141318     69.7        45.3     20.0 31.5  3.0  49106       46561      26870   24
6 2008  312336  229014 147658     73.3        47.3     20.0 35.3  2.6  61674       52776      36691   31
> set.seed(1)
> kR2 <- kmeans(mydata1,4)
> kR2$cluster
 [1] 3 2 4 4 1 1 1 4 4 4 1 1 4 1 3 2 4 4 4 1 1 4 4 4 1 1 2 1 3 2 4 4 4 1 1 4 4 4 1 1 4 1 3 2 4 4 4 1 1 4
[64] 4 4 4 4 1 4 1
> kR2$centers
    tot_hhs         own       own_wm   own_prop
1 -0.2306044 -0.02606027  0.0002860428  1.0257966
2 -0.6133278 -0.86571416 -0.7304611993 -2.1869805
```

Elbow Method:

fviz_nbclust(mydata1, kmeans, method = "wss", diss=NULL) +

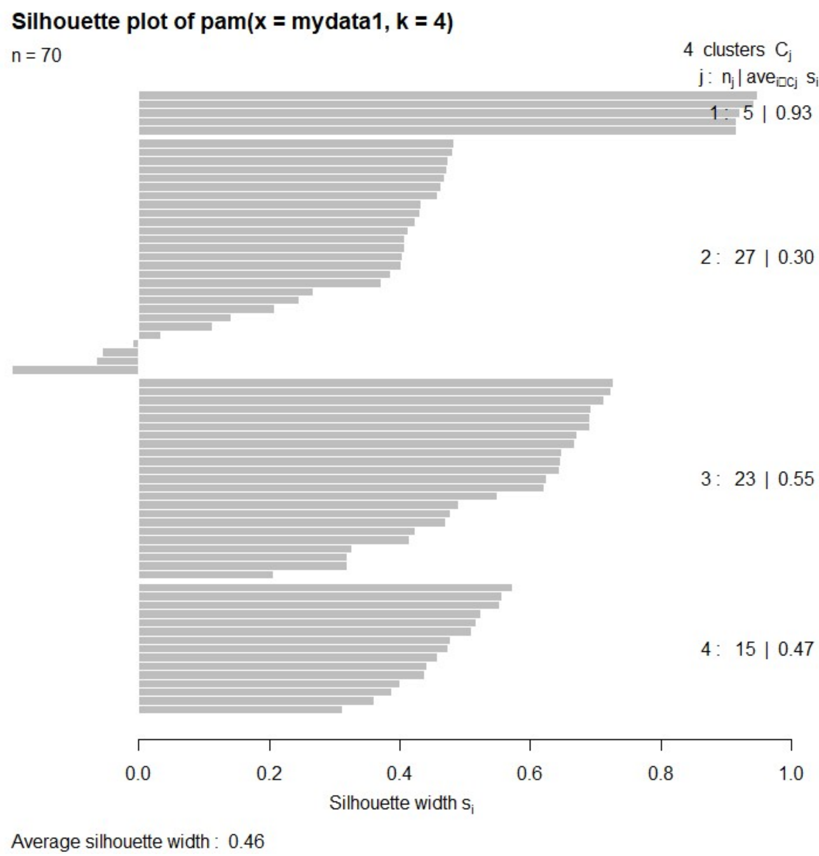
labs(subtitle = "Elbow method")



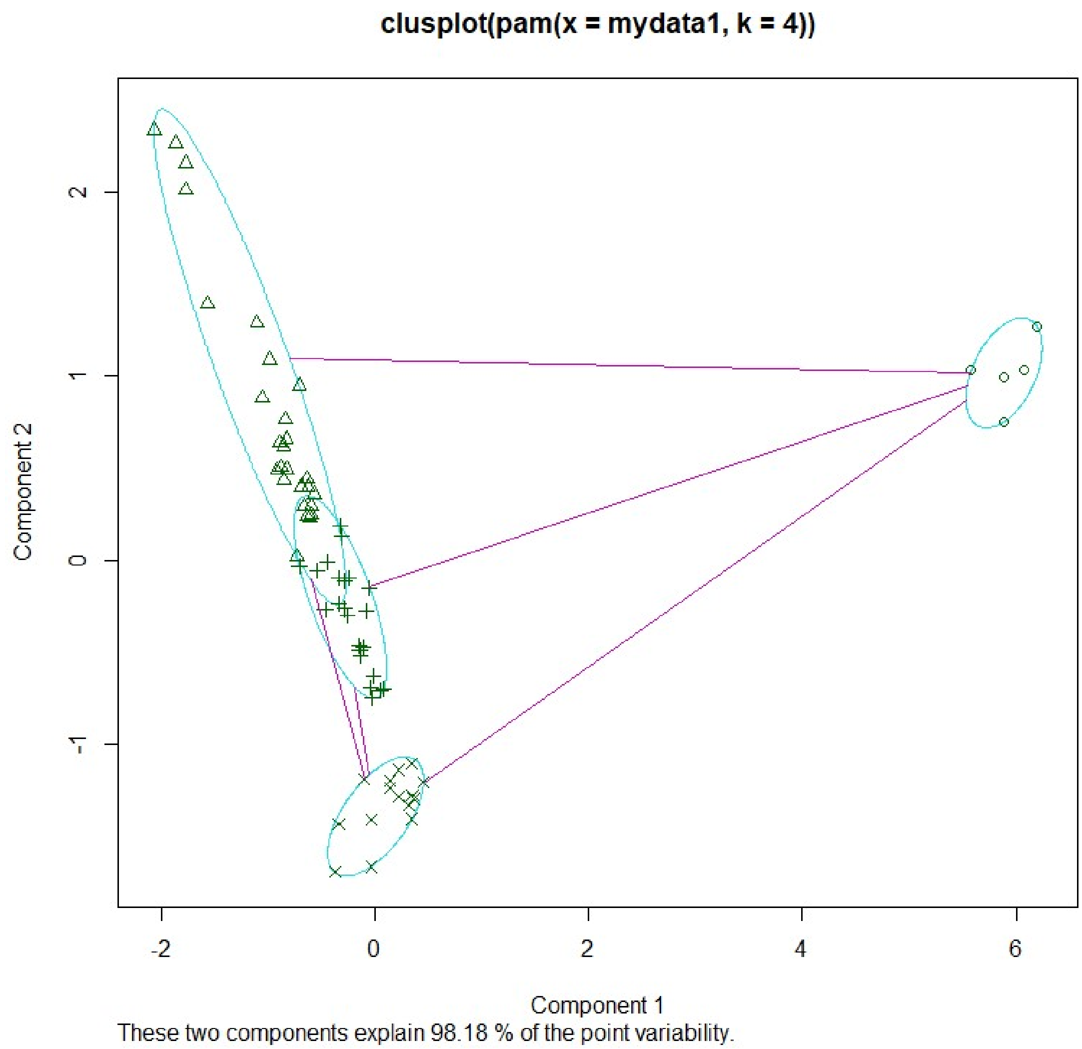
5) **Cluster and Silhouette Plot**

plot(kR)

Silhouette Plot:



Cluster Plot:



Conclusion: K-means clustering is an unsupervised machine learning method that is a component of a vast array of data approaches and operations in the field of data science. Data points are categorized using kmeans into unique, non-overlapping groupings. It is very easy to put into practice. Cluster generalization for various sizes and forms.

References:

[1] https://www.stats.govt.nz/large-datasets/csv-files-for-download/
[2] https://www.analyticsvidhya.com/blog/2019/08/comprehensive-guide-k-means-clustering/
[3] https://towardsdatascience.com/understanding-k-means-clustering-in-machine-learning-6a6e67336aa1
[4] https://www.geeksforgeeks.org/k-means-clustering-introduction/
[5] https://www.javatpoint.com/k-means-clustering-algorithm-in-machine-learning
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