

k-means with Imputation

`ClustImpute` package

PMS

18 May, 2023

Assumptions of the Algorithm

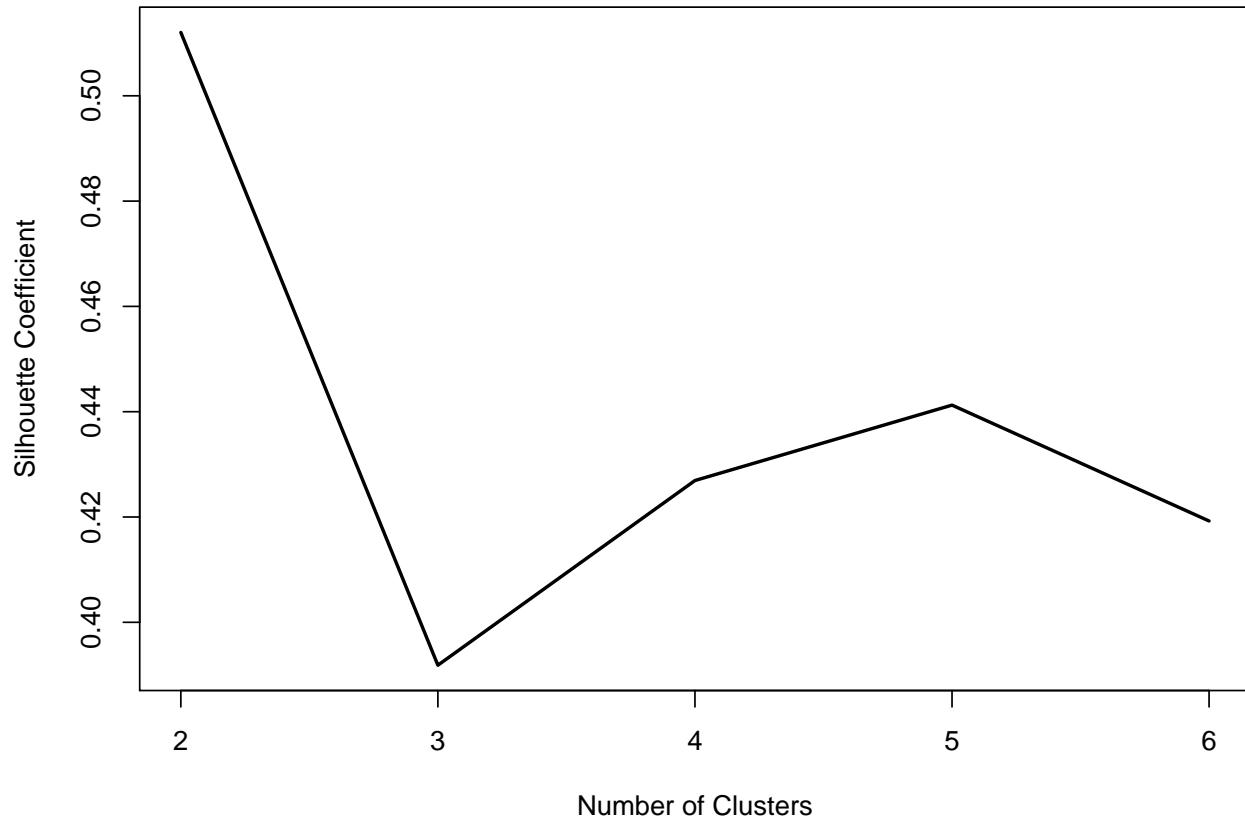
This algorithm “draws the missing values iteratively based on the current cluster assignment so that correlations are considered on this level”. Also, “penalizing weights are imposed on imputed values and successively decreased (to zero) as the missing data imputation gets better”. The idea is that the missing value is imputed by those other observations that are more similar to it (ie. in the same cluster).

Algorithm steps:

1. It replaces all NAs by random imputation, i.e., for each variable with missings, it draws from the marginal distribution of this variable not taking into account any correlations with other variables
 2. Weights < 1 are used to adjust the scale of an observation that was generated in step 1. The weights are calculated by a (linear) weight function that starts near zero and converges to 1 at n_end .
 3. A k-means clustering is performed with a number of c_steps steps starting with a random initialization.
 4. The values from step 2 are replaced by new draws conditionally on the assigned cluster from step 3.
 5. Steps 2-4 are repeated nr_iter times in total. The k-means clustering in step 3 uses the previous cluster centroids for initialization.
 6. After the last draws a final k-means clustering is performed.
-

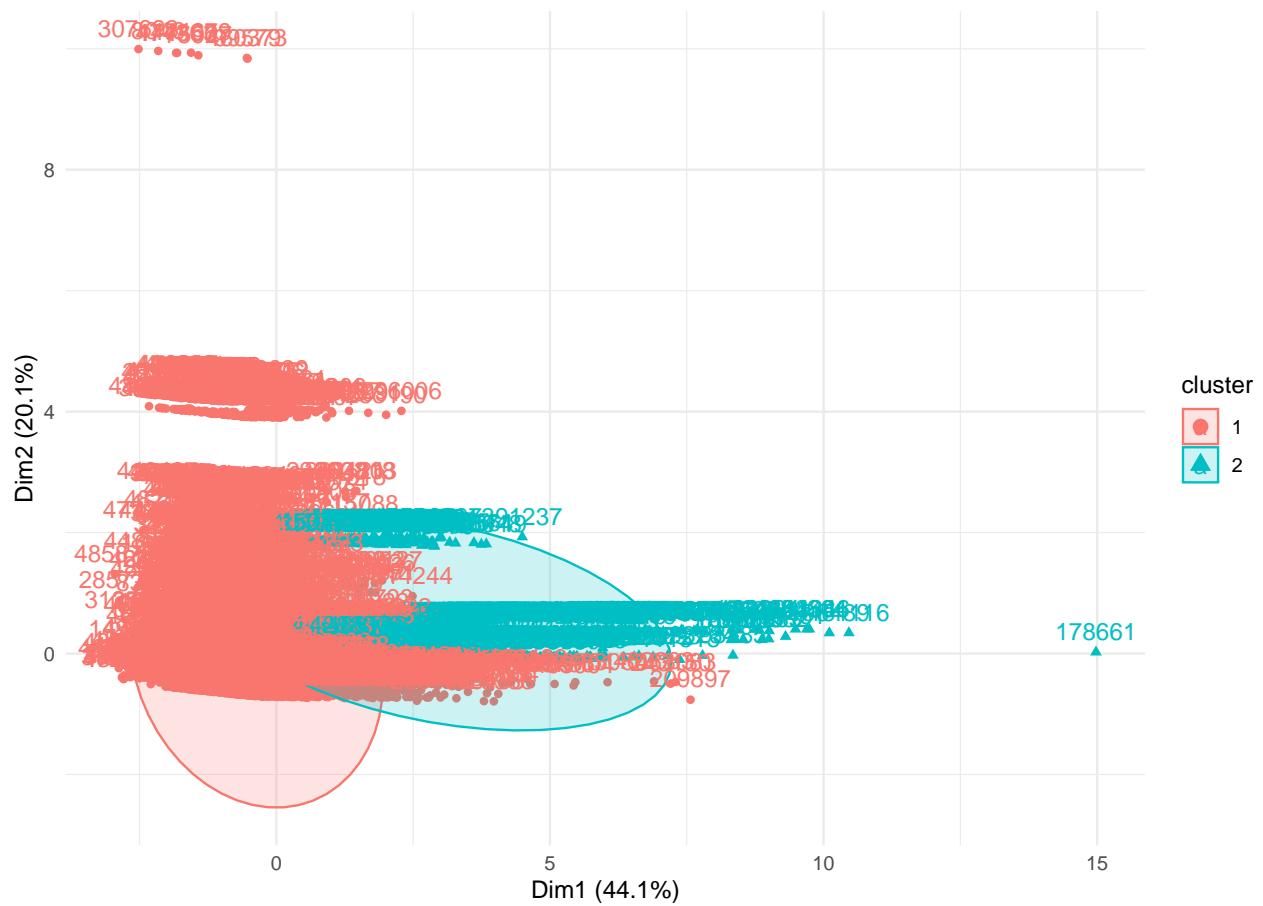
Amenities

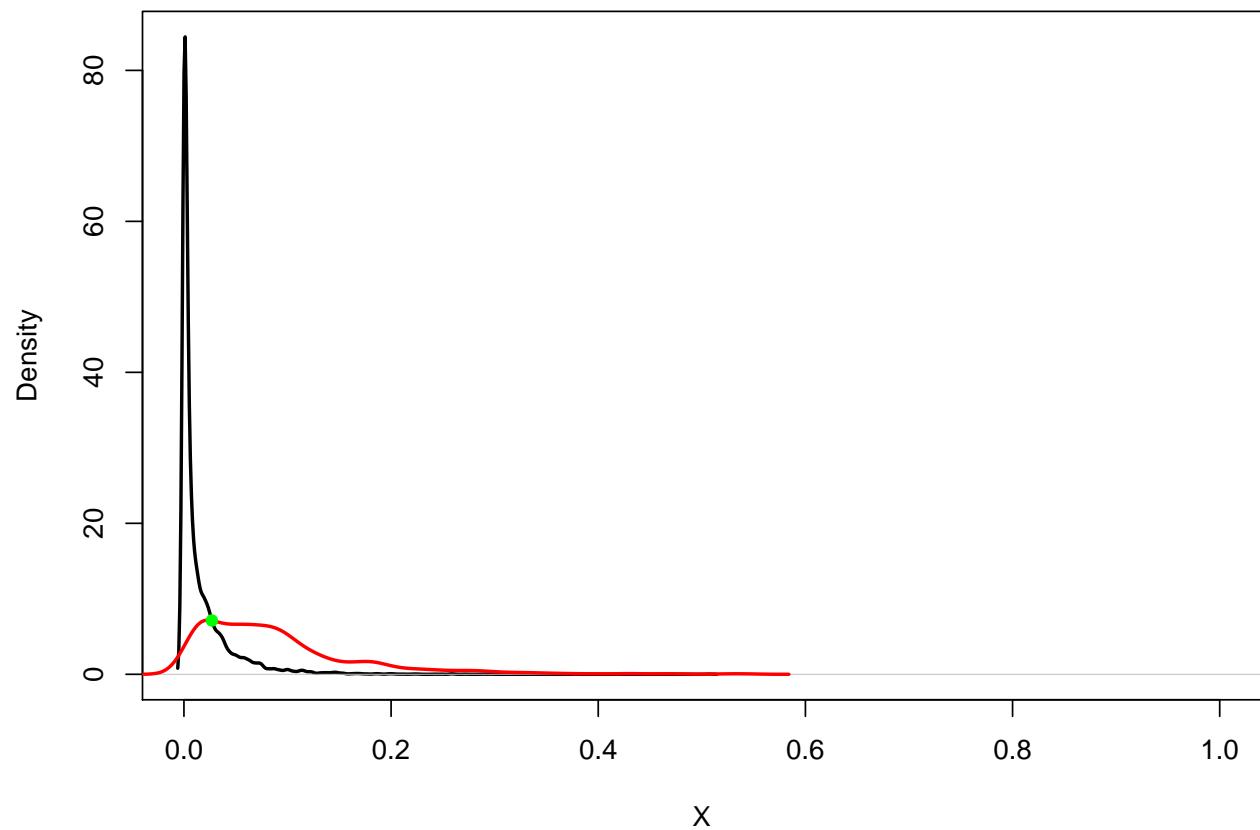
Employment



```
## [1] "Maximum silhouette coefficient: 0.512033342450295 For 2 clusters."
```

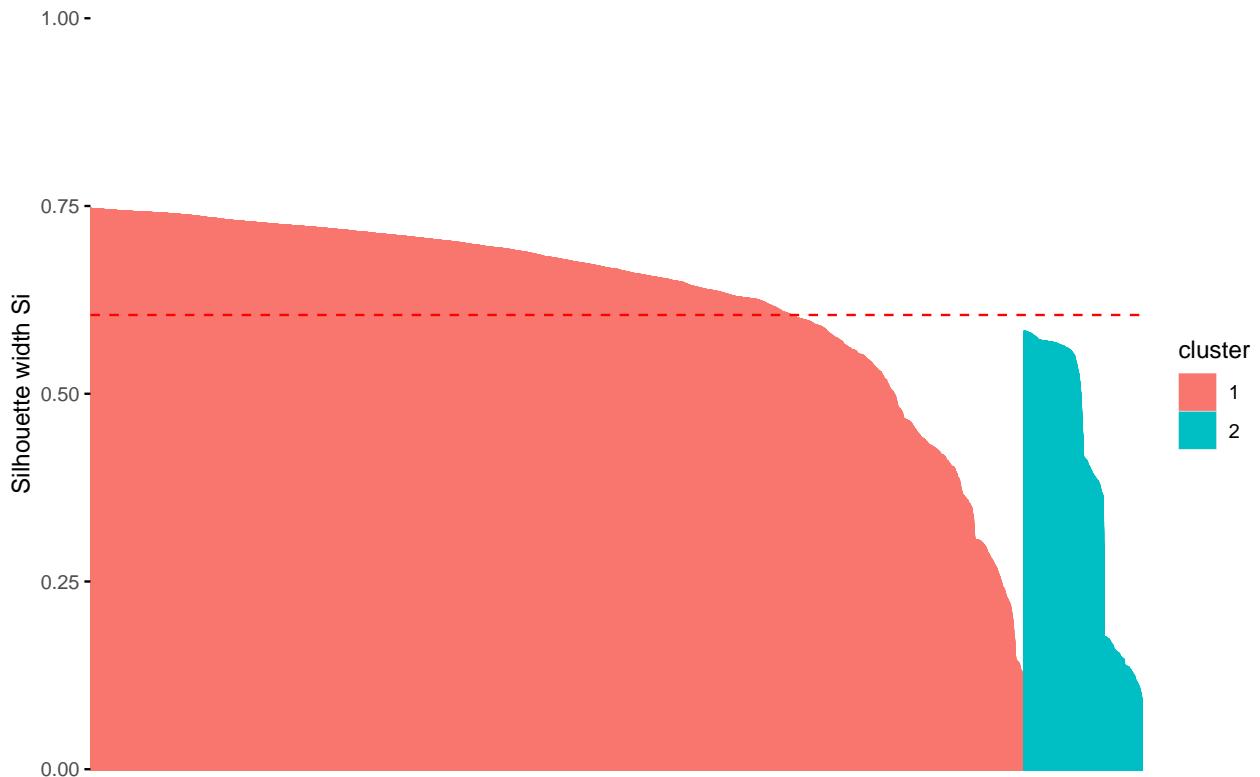
Cluster plot





```
## [1] "Segment cutoff values:"  
## [1] 0.02698673  
##   cluster  size ave.sil.width  
## 1        1 11239      0.63  
## 2        2 1414      0.39
```

Clusters silhouette plot
Average silhouette width: 0.6



```
## [1] "Cluster profiles:"  
## [1] "Num of DBs:"  
##   Cluster 1 Cluster 2  
##      13058     1632  
##  
##  
##  
##   DB Population:  
##   Cluster 1 Cluster 2  
##      72.6      72.1  
##  
##  
##  
##   CSD Population:  
##   Cluster 1 Cluster 2  
##      235127.6  227777.5  
##  
##  
##  
##   CMA Type:  
##   Cluster 1 Cluster 2  
##      5737      701  
##   B      5429      686  
##   D      1433      185  
##   K      459       60
```

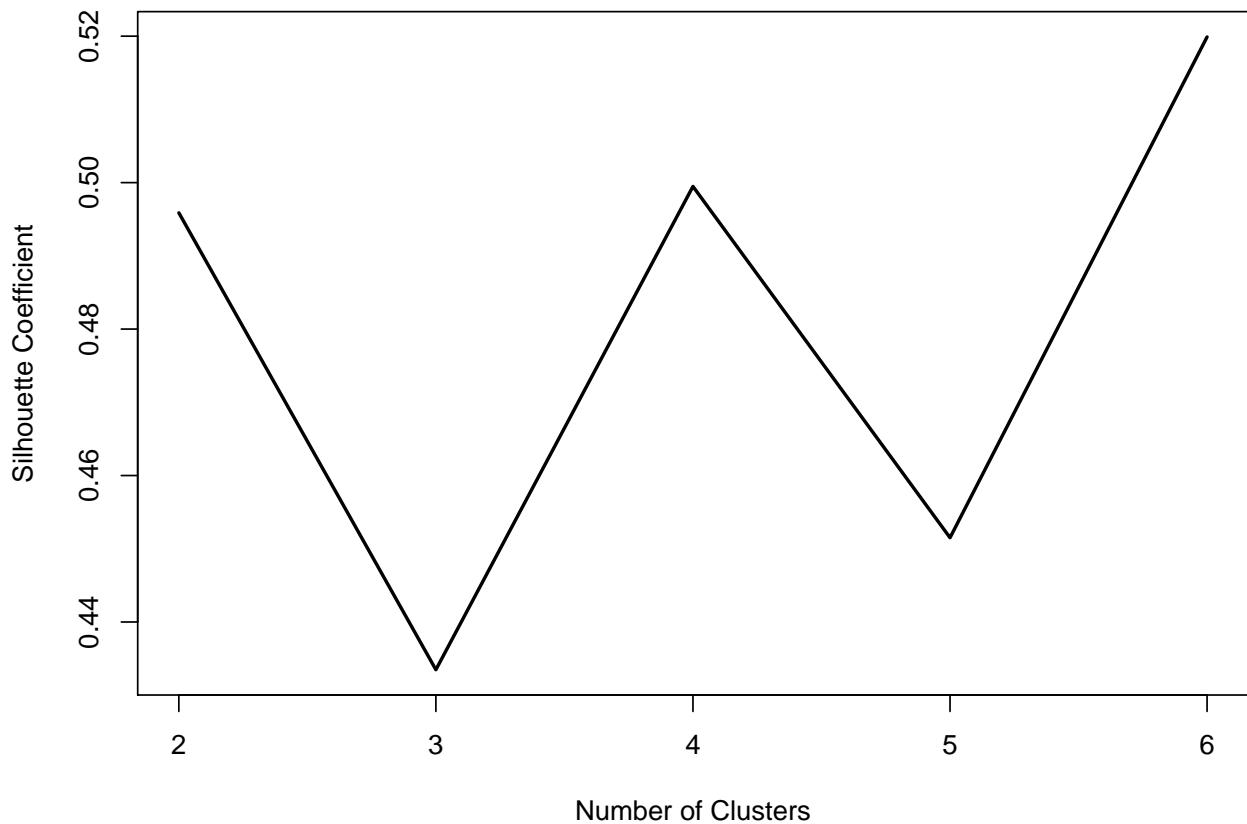
```

##
##
##
## Index of Remoteness:
## Cluster 1 Cluster 2
##      0.228      0.23
##
##
##
## Provinces:
##                  Cluster 1 Cluster 2
## Alberta            408      50
## BritishColumbia   652      71
## NewBrunswick       105      17
## NorthwestTerritories    7      0
## NovaScotia         402      48
## Ontario            1986     254
## Quebec             772      86
## Saskatchewan       67       4
## NA's               8659     1102
##
##
##
## Amenity dense:
## Cluster 1 Cluster 2
## 0      11813     1481
## 1      960       124
## 2      137       10
## F      148       17
##
##
##
## PMS_prox_idx_emp :
## Cluster 1 Cluster 2
##      0.0241    0.02317
##
##
##
## PMS_prox_idx_pharma :
## Cluster 1 Cluster 2
##      0.0429    0.03928
##
##
##
## PMS_prox_idx_childcare :
## Cluster 1 Cluster 2
##      0.0709    0.06878
##
##
##
## PMS_prox_idx_health :
## Cluster 1 Cluster 2
##      0.01332   0.01347
##

```

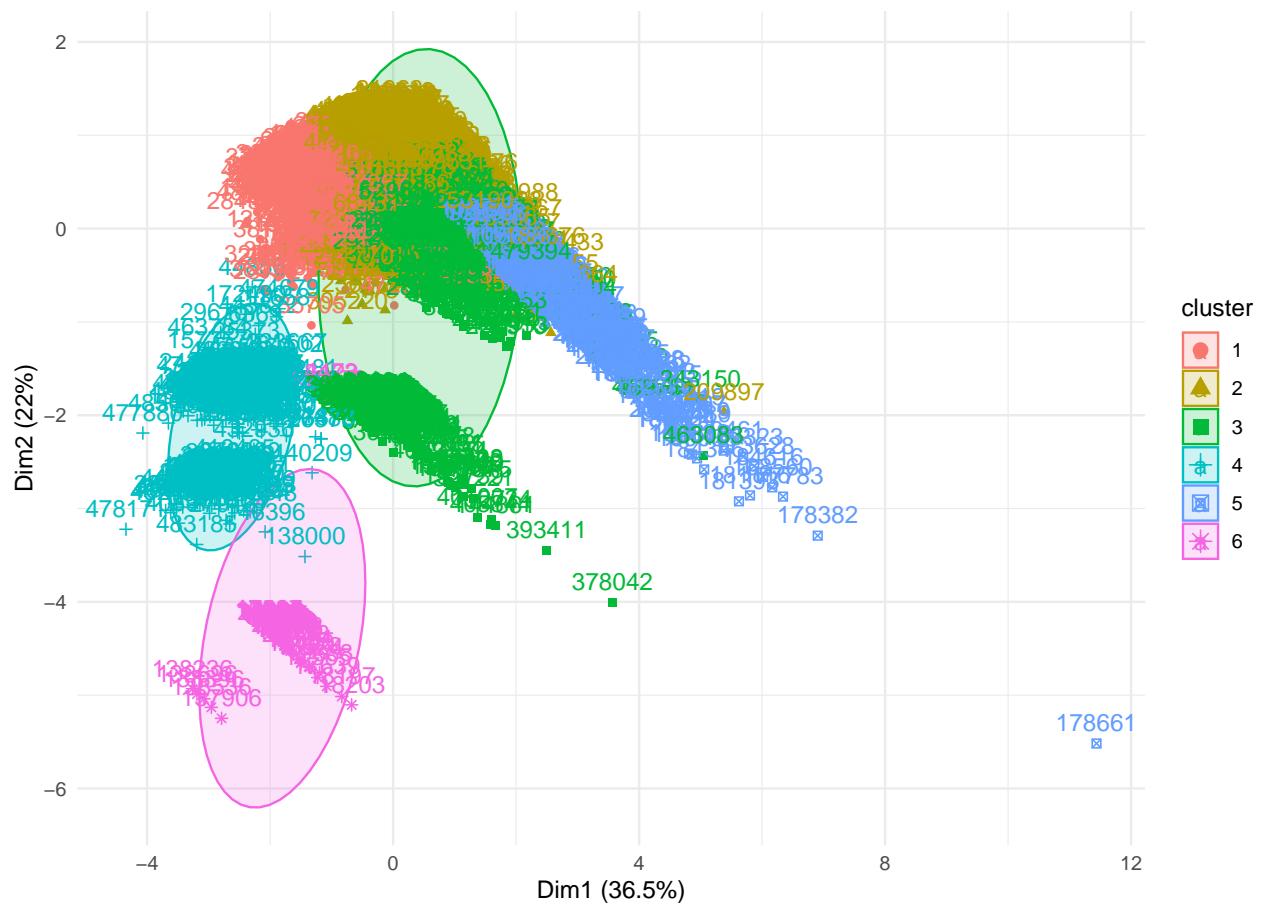
```
##  
##  
## PMS_prox_idx_grocery :  
## Cluster 1 Cluster 2  
## 0.06613 0.06478  
##  
##  
##  
## PMS_prox_idx_educpri :  
## Cluster 1 Cluster 2  
## 0.10733 0.10736  
##  
##  
##  
## PMS_prox_idx_educsec :  
## Cluster 1 Cluster 2  
## 0.09515 0.09893  
##  
##  
##  
## PMS_prox_idx_lib :  
## Cluster 1 Cluster 2  
## 0.10483 0.10152  
##  
##  
##  
## PMS_prox_idx_parks :  
## Cluster 1 Cluster 2  
## 0.06443 0.06435  
##  
##  
##  
## PMS_prox_idx_transit :  
## Cluster 1 Cluster 2  
## 0.01774 0.0158
```

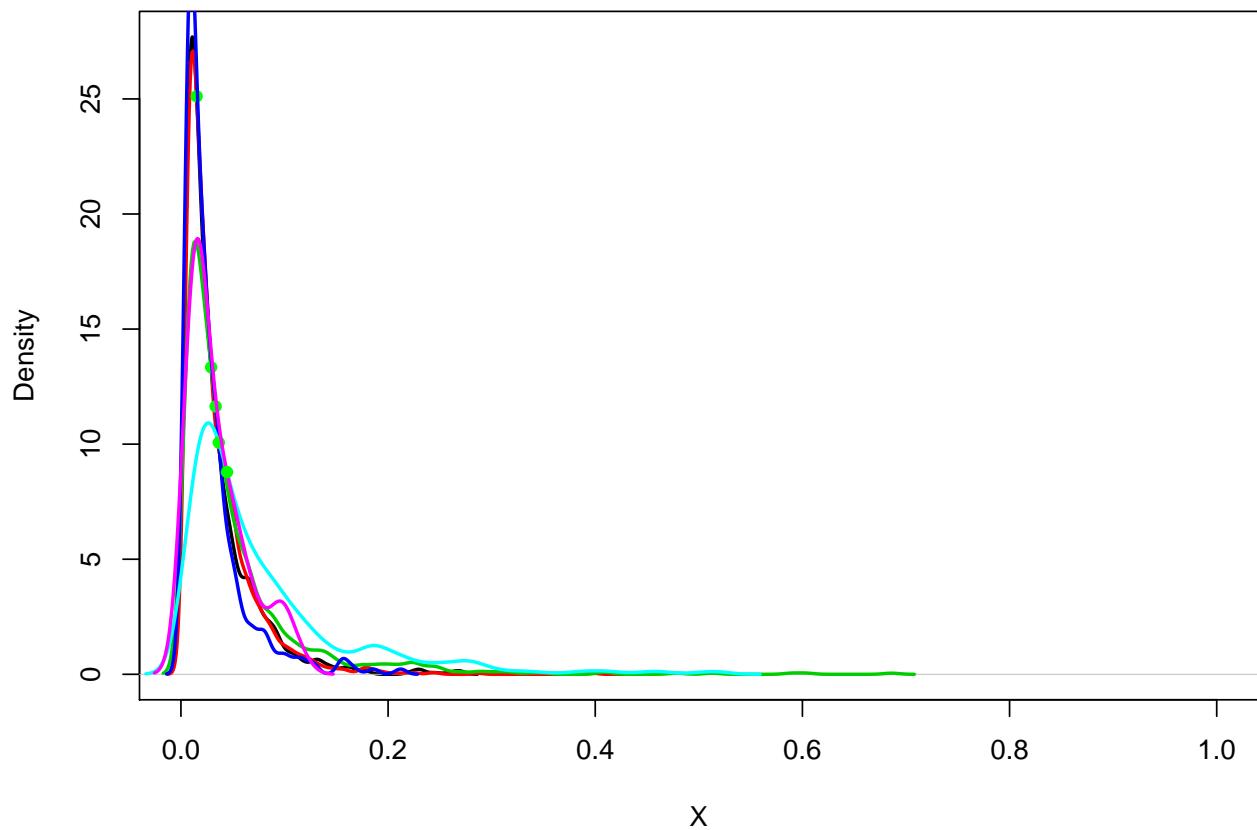
Pharmacy



```
## [1] "Maximum silhouette coefficient: 0.519893029124554 For 6 clusters."
```

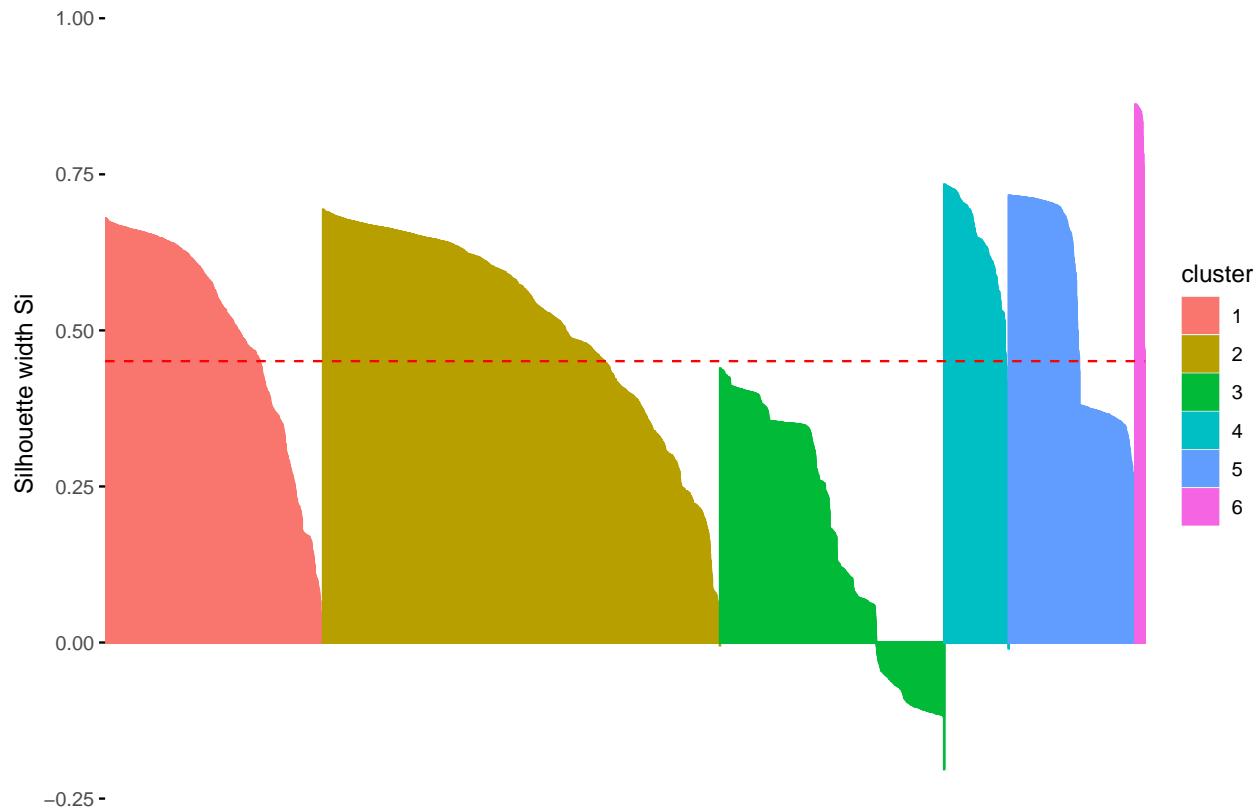
Cluster plot





```
## [1] "Segment cutoff values:"  
## [1] 0.0151599  
## [1] 0.02918385  
## [1] 0.03348747  
## [1] 0.03660353  
## [1] 0.04449562  
##   cluster size ave.sil.width  
## 1       1 1096      0.50  
## 2       2 1997      0.52  
## 3       3 1128      0.17  
## 4       4  325      0.64  
## 5       5  636      0.54  
## 6       6   49      0.76
```

Clusters silhouette plot
Average silhouette width: 0.45



```
## [1] "Cluster profiles:"
## [1] "Num of DBs:"
##   Cluster 1 Cluster 2 Cluster 3 Cluster 4 Cluster 5 Cluster 6
##      3074      5601      3155      920      1800      140
##
## 
## 
## 
##   DB Population:
##   Cluster 1 Cluster 2 Cluster 3 Cluster 4 Cluster 5 Cluster 6
##      70.2       74.3      74.8      68.5      66.4     105.6
##
## 
## 
## 
##   CSD Population:
##   Cluster 1 Cluster 2 Cluster 3 Cluster 4 Cluster 5 Cluster 6
##  235968.4  226833.1  239032.9  230063.7  244543.6  287058.1
##
## 
## 
## 
##   CMA Type:
##   Cluster 1 Cluster 2 Cluster 3 Cluster 4 Cluster 5 Cluster 6
##      1331      2462      1358      434      793       60
##   B      1282      2349      1289      367      768       60
##   D      336       593      391       94      189       15
##   K      125       197      117       25       50        5
```

```

##
##
##
## Index of Remoteness:
## Cluster 1 Cluster 2 Cluster 3 Cluster 4 Cluster 5 Cluster 6
##      0.226      0.23      0.229      0.231      0.226      0.227
##
##
##
## Provinces:
##          Cluster 1 Cluster 2 Cluster 3 Cluster 4 Cluster 5
## Alberta           104      156       96       33       67
## BritishColumbia   154      316      129       40       82
## NewBrunswick        28       39       31       8       16
## NorthwestTerritories   1       2       4       0       0
## NovaScotia         93      173      86      38      57
## Ontario            472      832      491     137     281
## Quebec             183      343      177      54      94
## Saskatchewan       17       30       14       2       7
## NA's              2022     3710     2127      608     1196
##          Cluster 6
## Alberta            2
## BritishColumbia    2
## NewBrunswick        0
## NorthwestTerritories   0
## NovaScotia          3
## Ontario             27
## Quebec              7
## Saskatchewan        1
## NA's                98
##
##
##
## Amenity dense:
##      Cluster 1 Cluster 2 Cluster 3 Cluster 4 Cluster 5 Cluster 6
##      0       2759      5063      2880      837      1625      130
##      1       247       414       220       63      134       6
##      2       33        53       29        7      23       2
##      F       35        71       26       13      18       2
##
##
##
## PMS_prox_idx_emp :
## Cluster 1 Cluster 2 Cluster 3 Cluster 4 Cluster 5 Cluster 6
##      0.0247    0.02396    0.0232    0.02314    0.02493    0.02098
##
##
##
## PMS_prox_idx_pharma :
## Cluster 1 Cluster 2 Cluster 3 Cluster 4 Cluster 5 Cluster 6
##      0.04302    0.04332    0.04056    0.03799    0.04491    0.03774
##
##
##

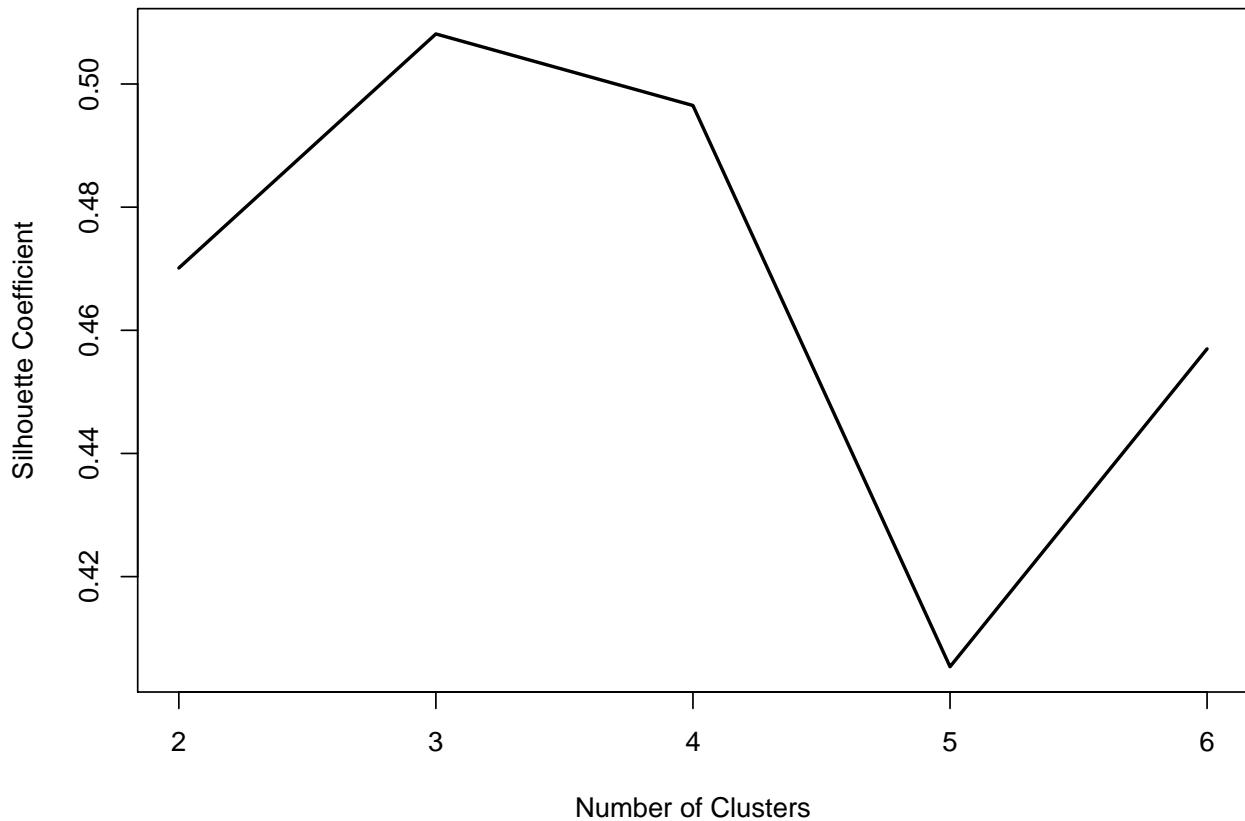
```

```

## PMS_prox_idx_childcare :
## Cluster 1 Cluster 2 Cluster 3 Cluster 4 Cluster 5 Cluster 6
##      0.07091    0.07119    0.0713    0.07179    0.06752    0.0643
##
## 
## 
## PMS_prox_idx_health :
## Cluster 1 Cluster 2 Cluster 3 Cluster 4 Cluster 5 Cluster 6
##      0.01365    0.01335    0.01308    0.01252    0.01369    0.01234
##
## 
## 
## PMS_prox_idx_grocery :
## Cluster 1 Cluster 2 Cluster 3 Cluster 4 Cluster 5 Cluster 6
##      0.0656    0.06644    0.06241    0.07176    0.06909    0.06403
##
## 
## 
## PMS_prox_idx_educpri :
## Cluster 1 Cluster 2 Cluster 3 Cluster 4 Cluster 5 Cluster 6
##      0.10801    0.10735    0.10575    0.10672    0.10812    0.12182
##
## 
## 
## PMS_prox_idx_educsec :
## Cluster 1 Cluster 2 Cluster 3 Cluster 4 Cluster 5 Cluster 6
##      0.09777    0.09508    0.09446    0.09634    0.09446    0.10011
##
## 
## 
## PMS_prox_idx_lib :
## Cluster 1 Cluster 2 Cluster 3 Cluster 4 Cluster 5 Cluster 6
##      0.1015    0.10419    0.10746    0.10711    0.10511    0.08854
##
## 
## 
## PMS_prox_idx_parks :
## Cluster 1 Cluster 2 Cluster 3 Cluster 4 Cluster 5 Cluster 6
##      0.06317    0.06535    0.0641    0.06353    0.06519    0.05909
##
## 
## 
## PMS_prox_idx_transit :
## Cluster 1 Cluster 2 Cluster 3 Cluster 4 Cluster 5 Cluster 6
##      0.01768    0.0175    0.01759    0.01691    0.01775    0.01488

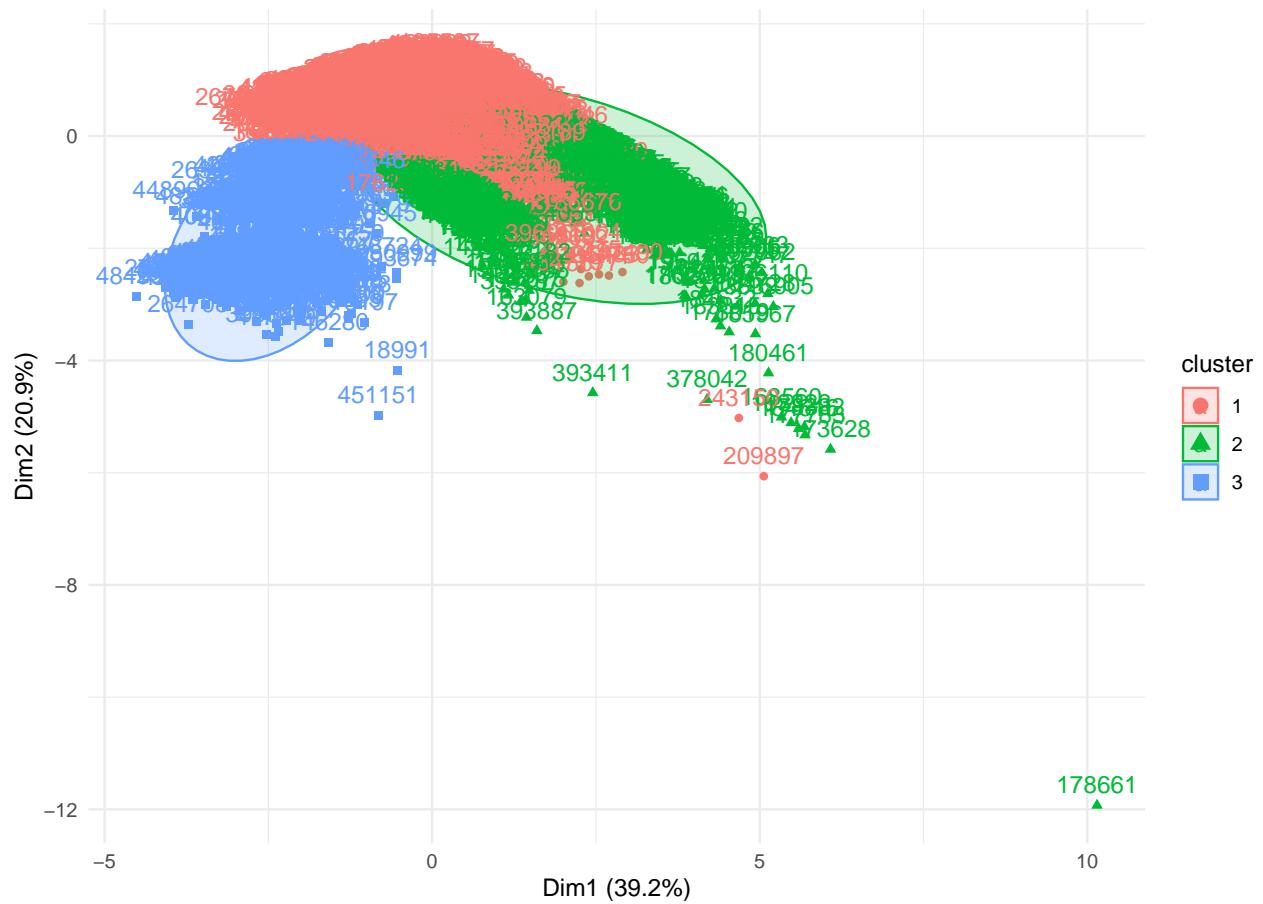
```

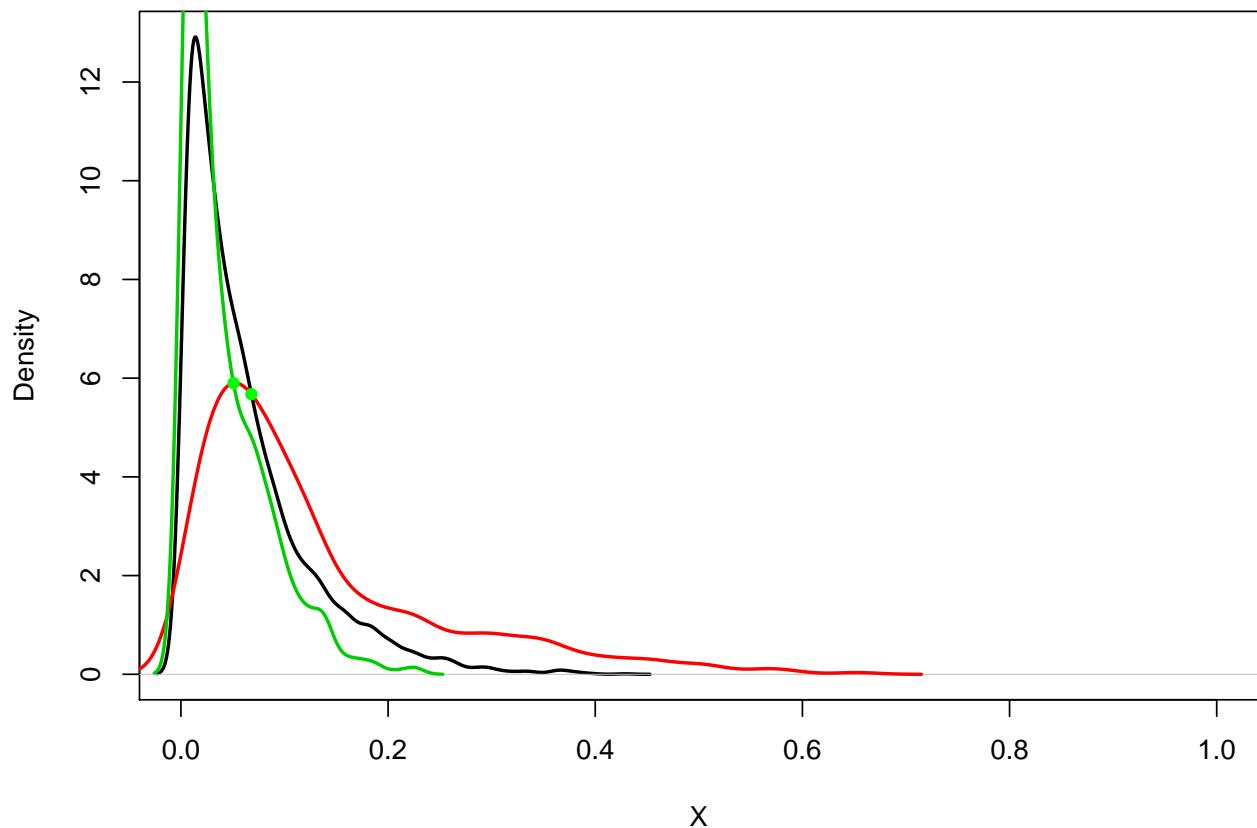
Childcare



```
## [1] "Maximum silhouette coefficient: 0.508128753084812 For 3 clusters."
```

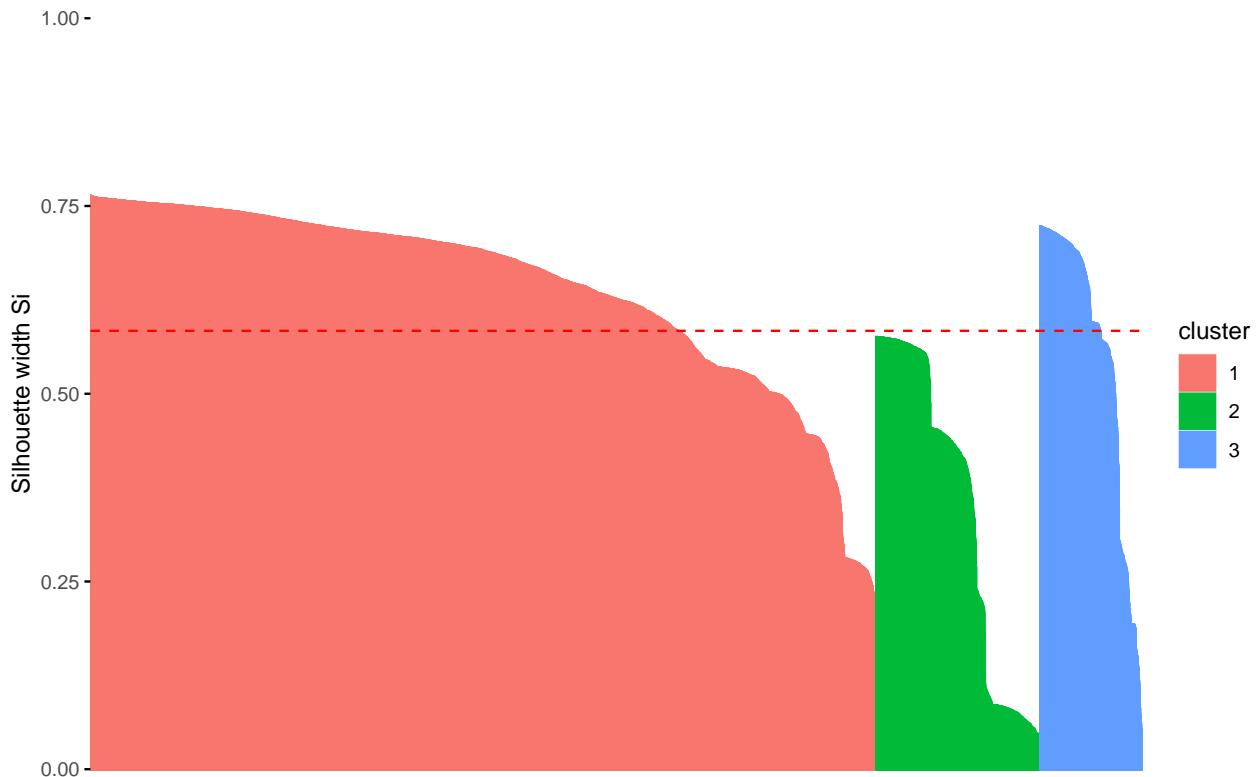
Cluster plot





```
## [1] "Segment cutoff values:"  
## [1] 0.06806655  
## [1] 0.05072628  
##   cluster size ave.sil.width  
## 1      1  5404      0.64  
## 2      2 1128      0.34  
## 3      3   699      0.54
```

Clusters silhouette plot
Average silhouette width: 0.58



```
## [1] "Cluster profiles:"  
## [1] "Num of DBs:"  
##   Cluster 1 Cluster 2 Cluster 3  
##      10979      2289      1422  
##  
##  
##  
##   DB Population:  
##   Cluster 1 Cluster 2 Cluster 3  
##      72.4      71.5      75.1  
##  
##  
##  
##   CSD Population:  
##   Cluster 1 Cluster 2 Cluster 3  
##      233442.7  237783.7  235422.8  
##  
##  
##  
##   CMA Type:  
##   Cluster 1 Cluster 2 Cluster 3  
##      4824      997      617  
##   B      4557      967      591  
##   D      1210      246      162  
##   K      388       79       52
```

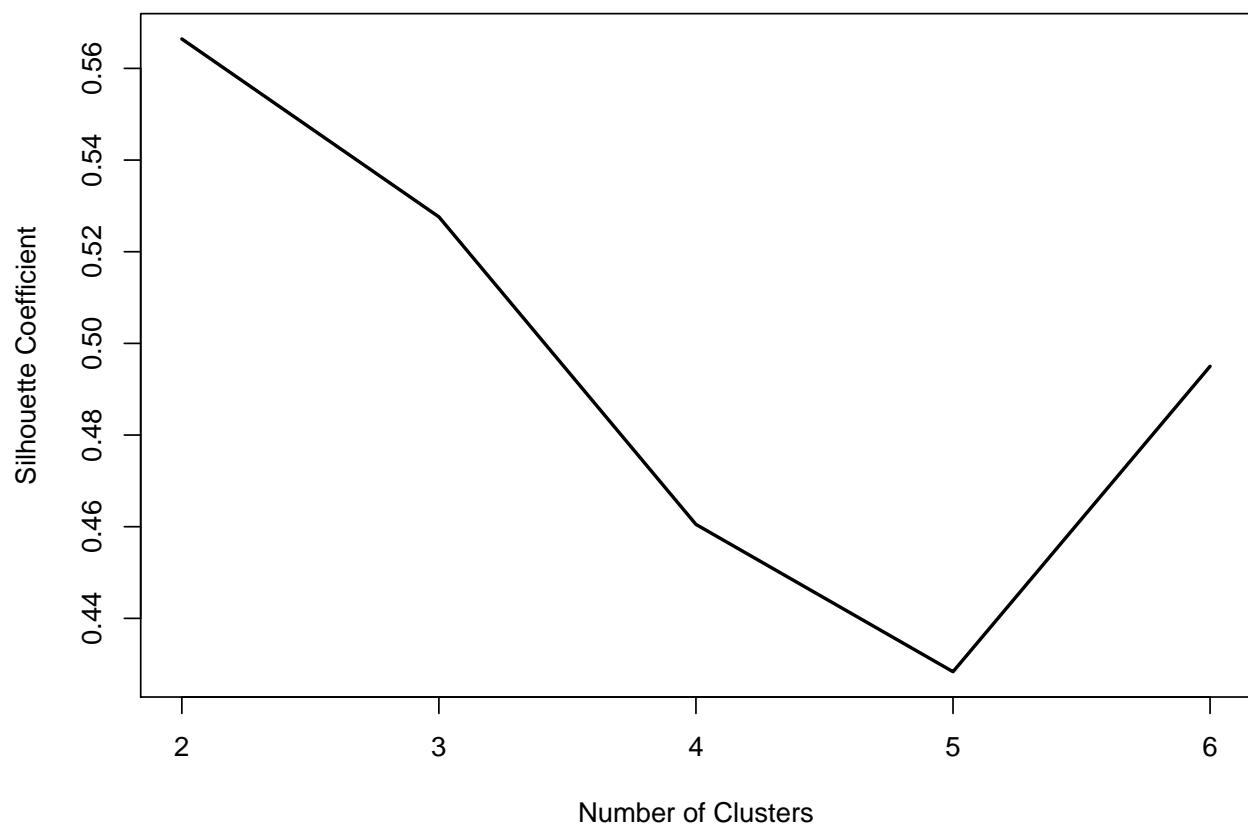
```

##
##
##
## Index of Remoteness:
## Cluster 1 Cluster 2 Cluster 3
##      0.228      0.232      0.226
##
##
##
## Provinces:
##                  Cluster 1 Cluster 2 Cluster 3
## Alberta            345       69       44
## BritishColumbia   550      100       73
## NewBrunswick       98        14       10
## NorthwestTerritories 5        0        2
## NovaScotia         338       64       48
## Ontario            1670      342      228
## Quebec             655      123       80
## Saskatchewan       53        11        7
## NA's               7265     1566      930
##
##
##
## Amenity dense:
## Cluster 1 Cluster 2 Cluster 3
## 0      9949      2053     1292
## 1      802       185       97
## 2      111       21        15
## F      117       30        18
##
##
##
## PMS_prox_idx_emp :
## Cluster 1 Cluster 2 Cluster 3
##      0.02398    0.0244    0.02345
##
##
##
## PMS_prox_idx_pharma :
## Cluster 1 Cluster 2 Cluster 3
##      0.04243    0.04261   0.04266
##
##
##
## PMS_prox_idx_childcare :
## Cluster 1 Cluster 2 Cluster 3
##      0.07056    0.06969   0.07292
##
##
##
## PMS_prox_idx_health :
## Cluster 1 Cluster 2 Cluster 3
##      0.01338    0.01346   0.01287
##

```

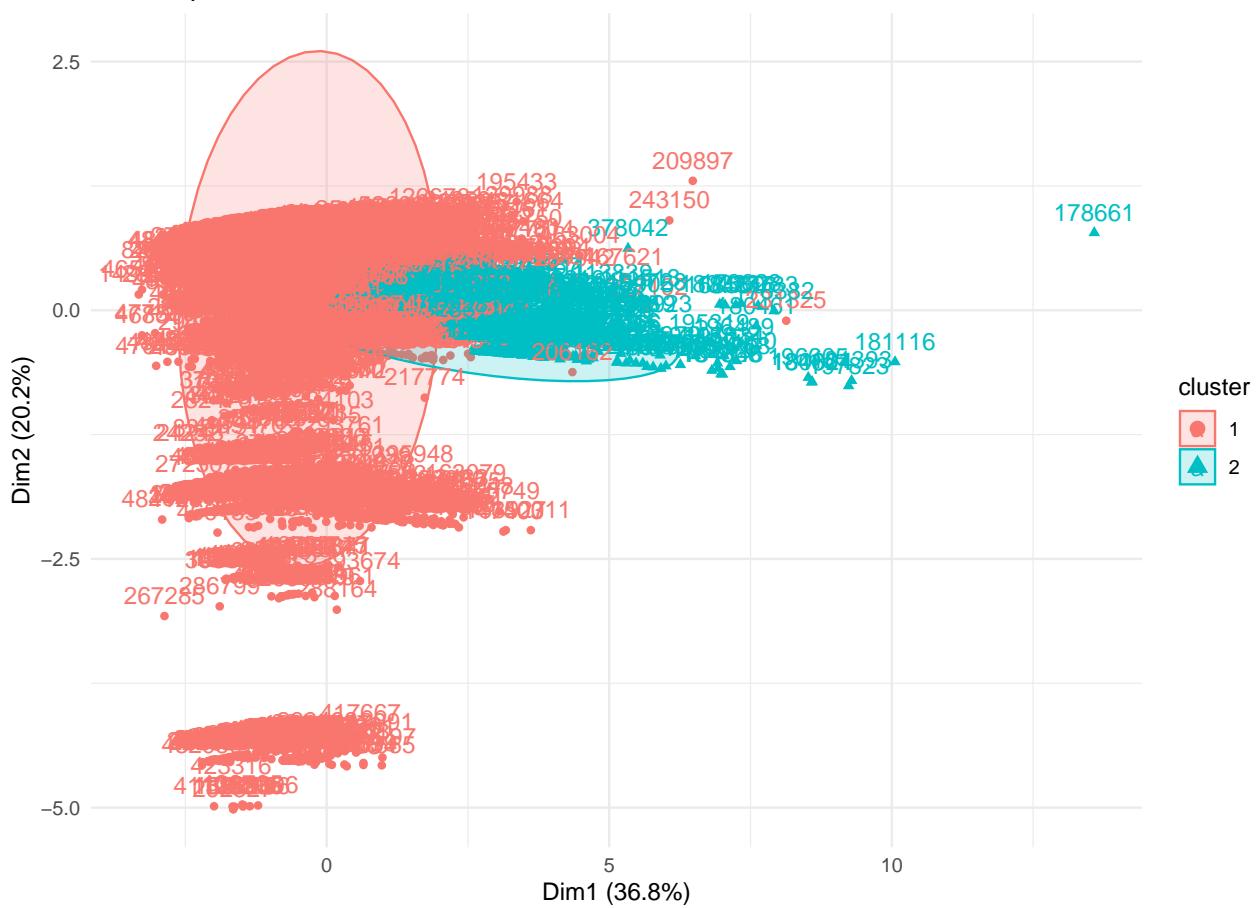
```
##  
##  
## PMS_prox_idx_grocery :  
## Cluster 1 Cluster 2 Cluster 3  
## 0.06569  0.06519  0.06975  
##  
##  
##  
## PMS_prox_idx_educpri :  
## Cluster 1 Cluster 2 Cluster 3  
## 0.10611  0.1101   0.11229  
##  
##  
##  
## PMS_prox_idx_educsec :  
## Cluster 1 Cluster 2 Cluster 3  
## 0.09516  0.09871  0.09375  
##  
##  
##  
## PMS_prox_idx_lib :  
## Cluster 1 Cluster 2 Cluster 3  
## 0.10431  0.10254  0.10876  
##  
##  
##  
## PMS_prox_idx_parks :  
## Cluster 1 Cluster 2 Cluster 3  
## 0.06441  0.06499  0.06354  
##  
##  
##  
## PMS_prox_idx_transit :  
## Cluster 1 Cluster 2 Cluster 3  
## 0.01745  0.01818  0.0171
```

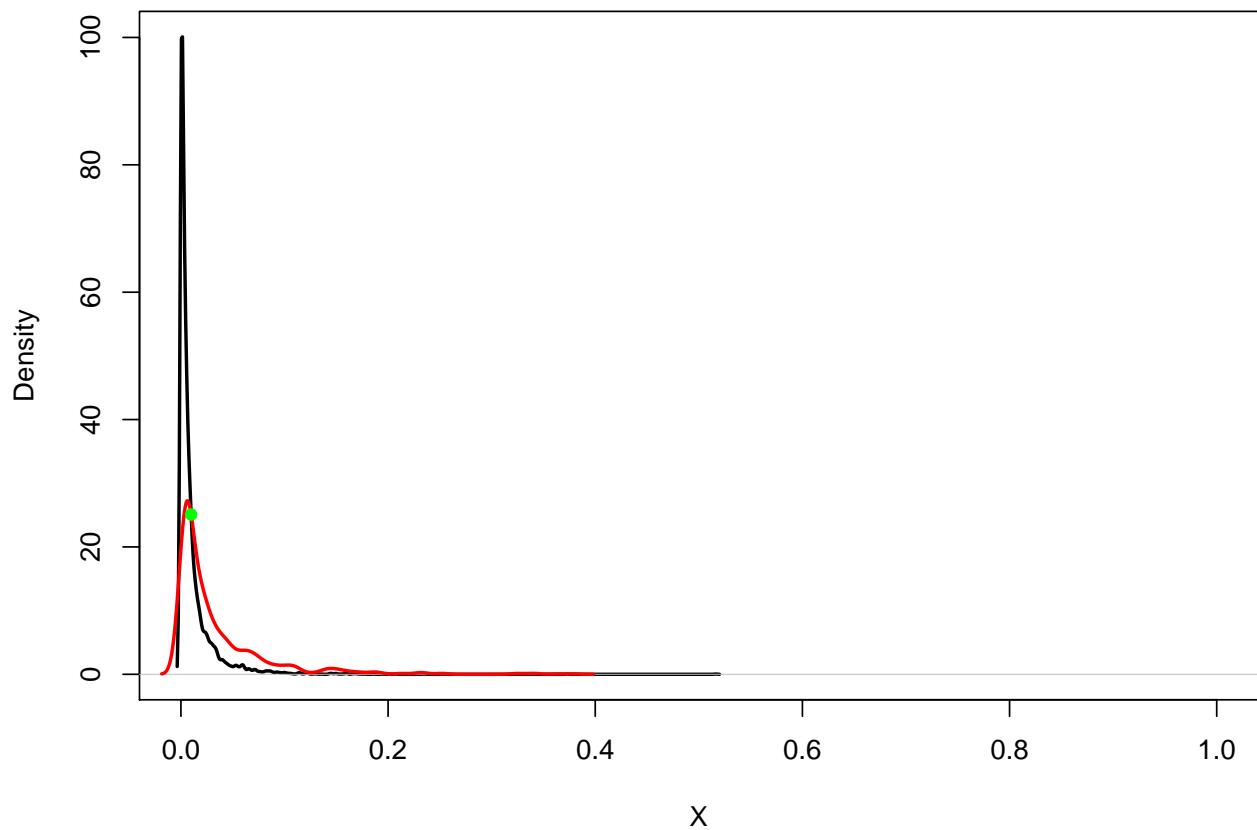
Health



```
## [1] "Maximum silhouette coefficient: 0.566427492840047 For 2 clusters."
```

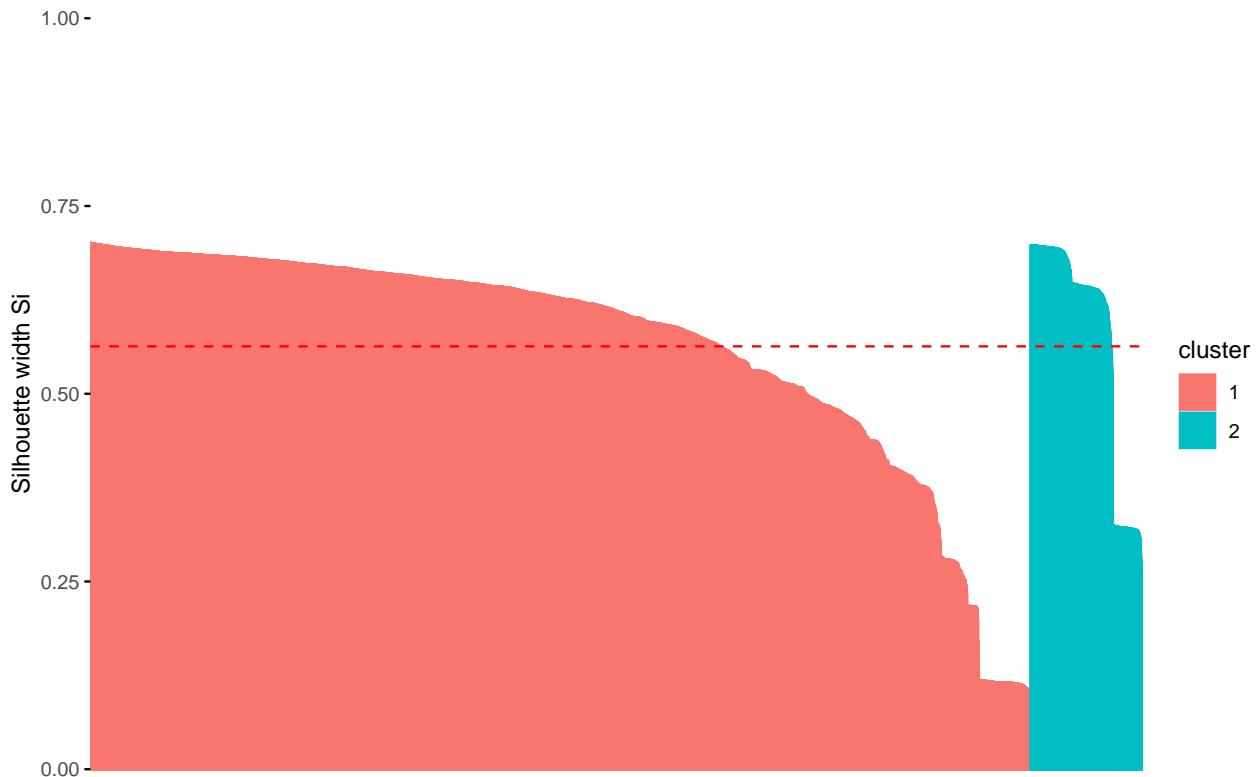
Cluster plot





```
## [1] "Segment cutoff values:"  
## [1] 0.009857409  
##   cluster size ave.sil.width  
## 1       1    7970      0.56  
## 2       2    943       0.57
```

Clusters silhouette plot
Average silhouette width: 0.56



```
## [1] "Cluster profiles:"  
## [1] "Num of DBs:"  
##   Cluster 1 Cluster 2  
##      13107      1583  
##  
##  
##  
##  
##   DB Population:  
##   Cluster 1 Cluster 2  
##      71.7       79  
##  
##  
##  
##  
##   CSD Population:  
##   Cluster 1 Cluster 2  
##      234812.3  230156.2  
##  
##  
##  
##  
##   CMA Type:  
##   Cluster 1 Cluster 2  
##      5718       720  
##   B      5474       641  
##   D      1452       166  
##   K      463        56
```

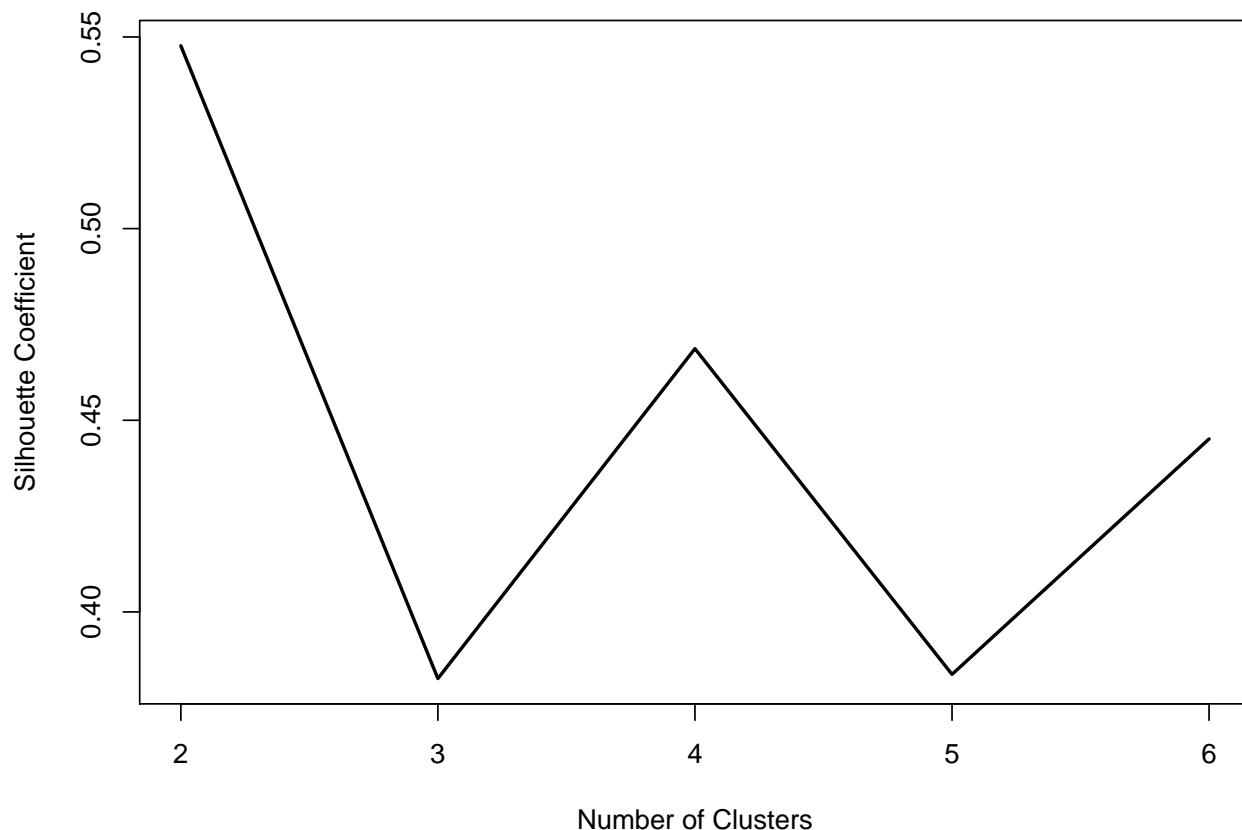
```

##
##
##
## Index of Remoteness:
## Cluster 1 Cluster 2
##      0.228      0.235
##
##
##
## Provinces:
##                  Cluster 1 Cluster 2
## Alberta            412      46
## BritishColumbia   648      75
## NewBrunswick       115       7
## NorthwestTerritories    7       0
## NovaScotia         403      47
## Ontario            2007     233
## Quebec             759      99
## Saskatchewan       58       13
## NA's               8698     1063
##
##
##
## Amenity dense:
## Cluster 1 Cluster 2
## 0      11877     1417
## 1      949       135
## 2      133       14
## F      148       17
##
##
##
## PMS_prox_idx_emp :
## Cluster 1 Cluster 2
##      0.02409    0.02316
##
##
##
## PMS_prox_idx_pharma :
## Cluster 1 Cluster 2
##      0.04252    0.04211
##
##
##
## PMS_prox_idx_childcare :
## Cluster 1 Cluster 2
##      0.07085    0.06907
##
##
##
## PMS_prox_idx_health :
## Cluster 1 Cluster 2
##      0.01322    0.01441
##

```

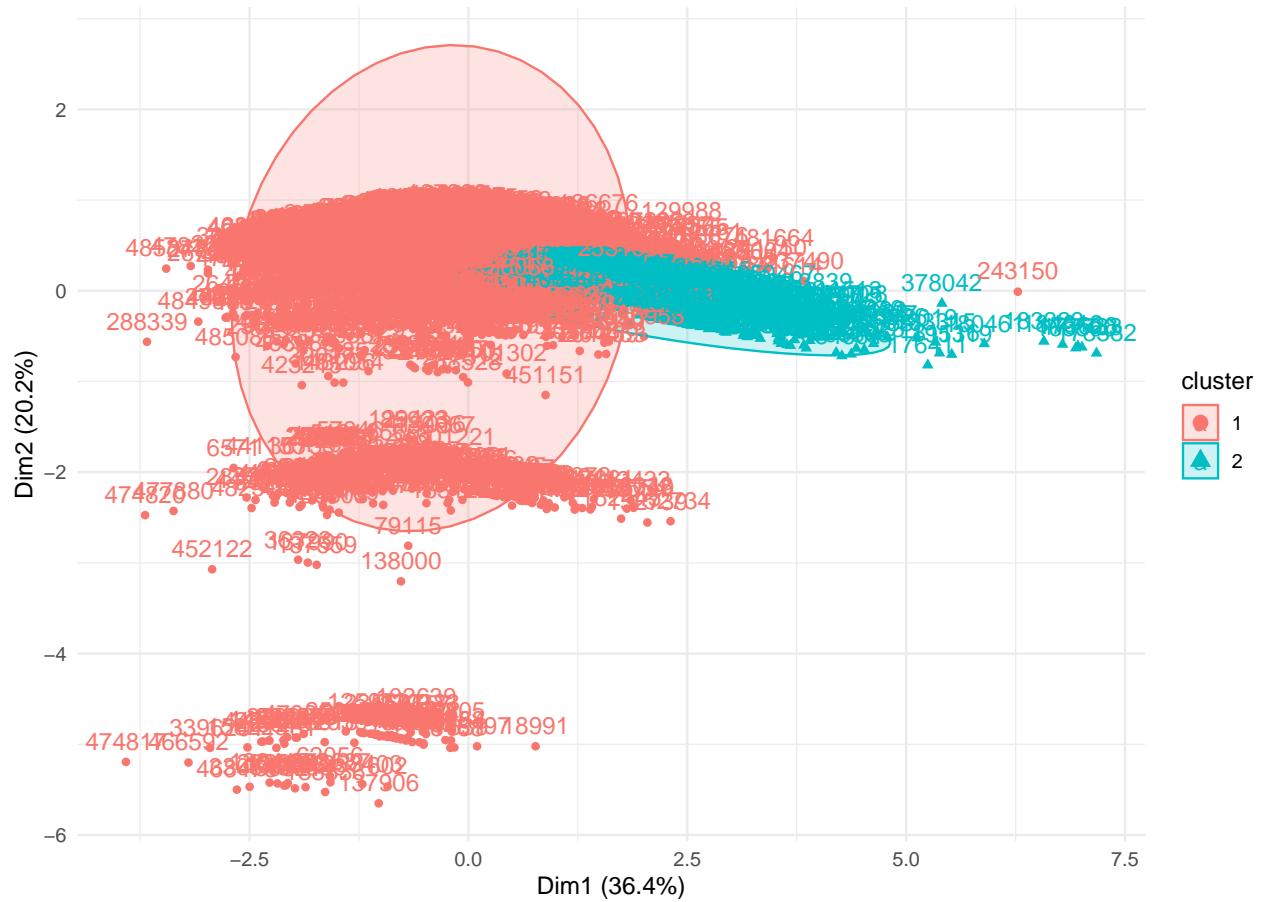
```
##  
##  
## PMS_prox_idx_grocery :  
## Cluster 1 Cluster 2  
## 0.06635 0.06293  
##  
##  
##  
## PMS_prox_idx_educpri :  
## Cluster 1 Cluster 2  
## 0.10733 0.10731  
##  
##  
##  
## PMS_prox_idx_educsec :  
## Cluster 1 Cluster 2  
## 0.09559 0.09526  
##  
##  
##  
## PMS_prox_idx_lib :  
## Cluster 1 Cluster 2  
## 0.1036 0.11152  
##  
##  
##  
## PMS_prox_idx_parks :  
## Cluster 1 Cluster 2  
## 0.06475 0.06163  
##  
##  
##  
## PMS_prox_idx_transit :  
## Cluster 1 Cluster 2  
## 0.01763 0.01665
```

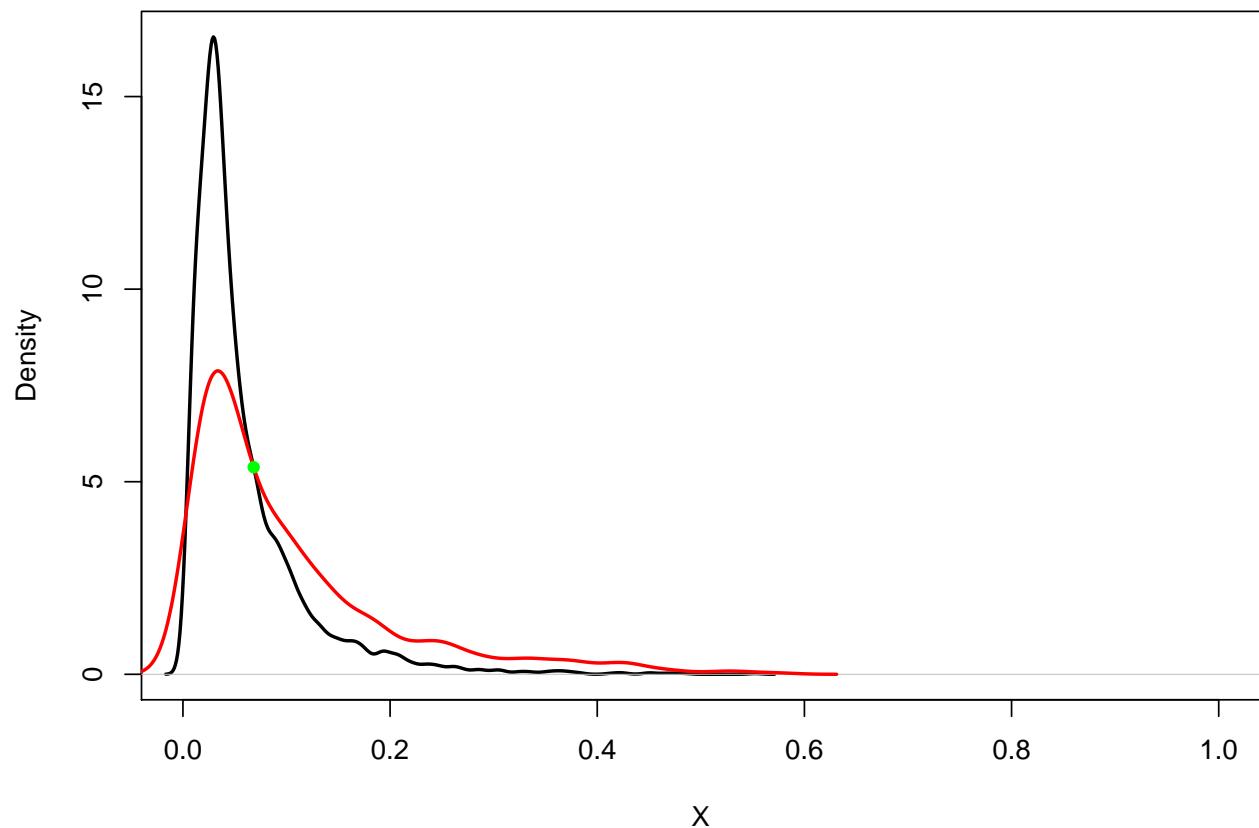
Grocery



```
## [1] "Maximum silhouete coefficient: 0.547696454609716 For 2 clusters."
```

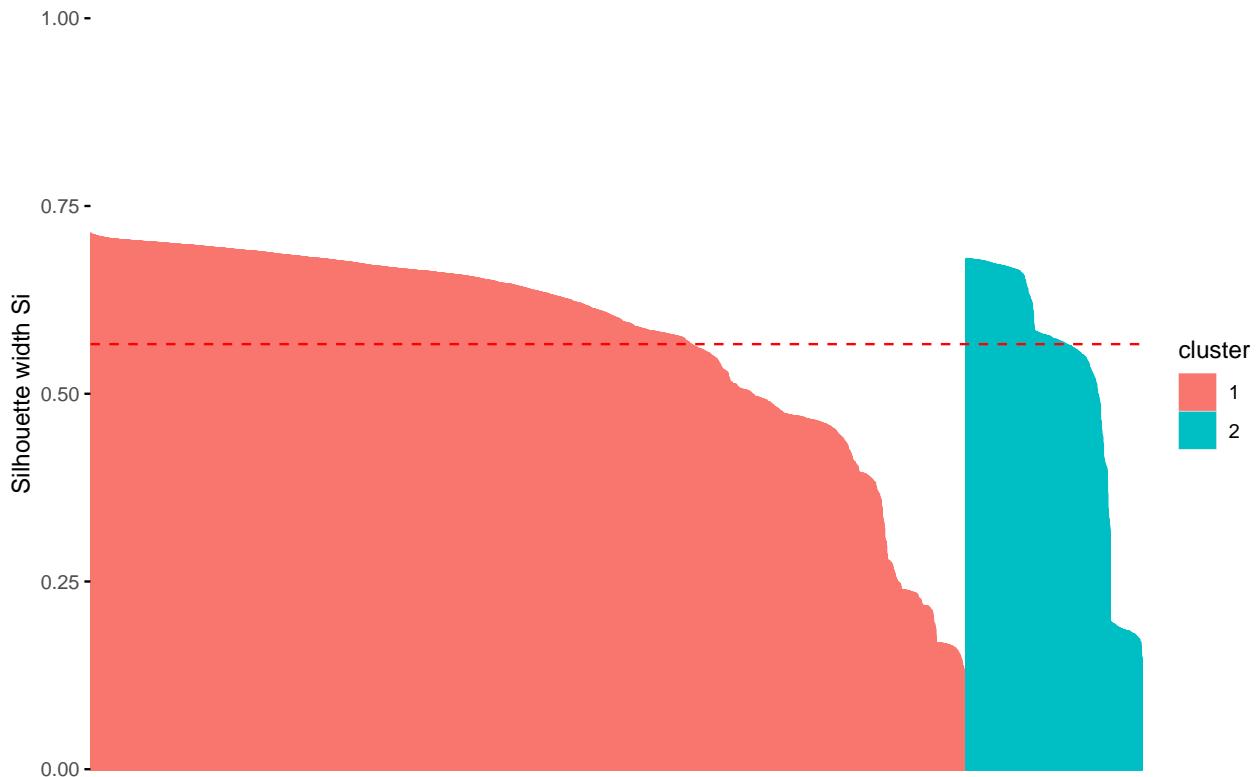
Cluster plot





```
## [1] "Segment cutoff values:"  
## [1] 0.06830663  
##   cluster size ave.sil.width  
## 1       1 3495      0.58  
## 2       2  700      0.52
```

Clusters silhouette plot
Average silhouette width: 0.57



```
## [1] "Cluster profiles:"  
## [1] "Num of DBs:"  
##   Cluster 1 Cluster 2  
##      12218     2472  
##  
##  
##  
##   DB Population:  
##   Cluster 1 Cluster 2  
##      72.5      72.6  
##  
##  
##  
##   CSD Population:  
##   Cluster 1 Cluster 2  
##      232517.5  243173.9  
##  
##  
##  
##   CMA Type:  
##   Cluster 1 Cluster 2  
##      5378      1060  
##   B       5062      1053  
##   D       1346       272  
##   K       432        87
```

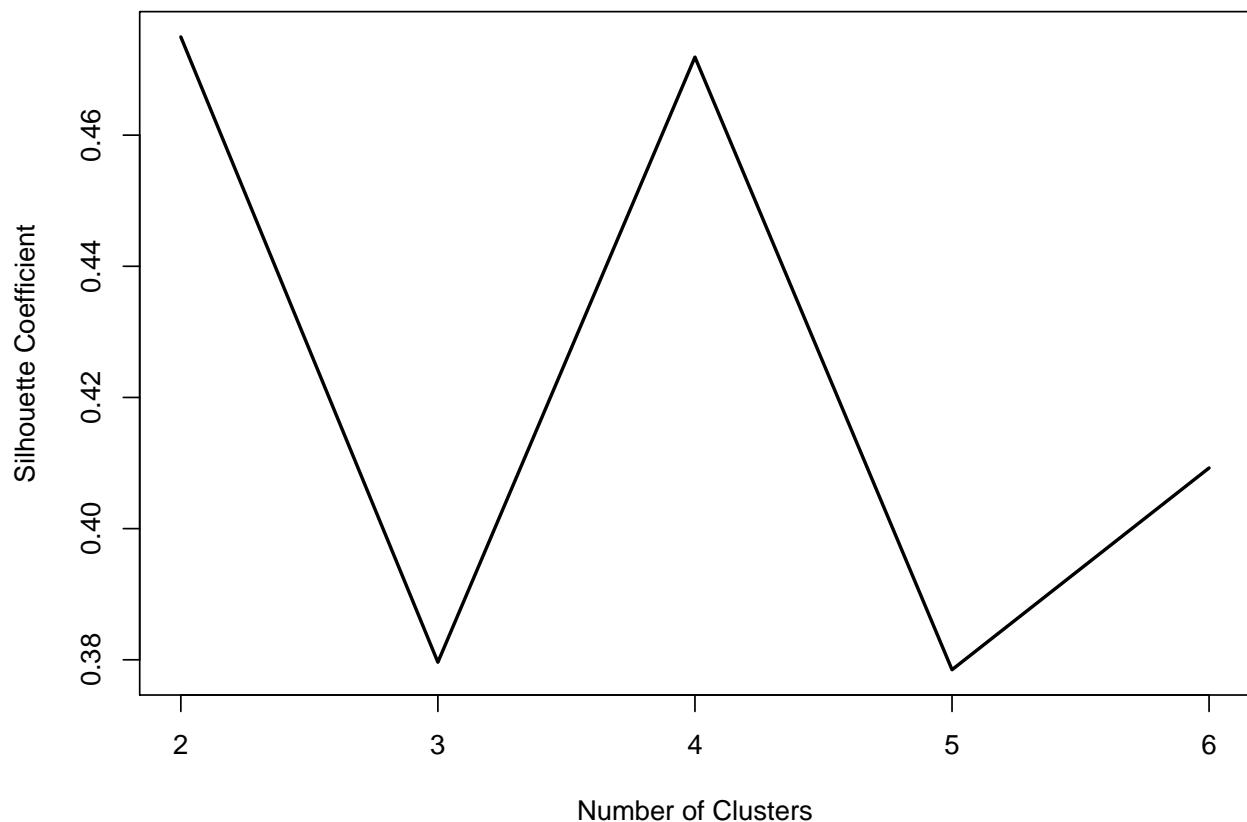
```

##
##
##
## Index of Remoteness:
## Cluster 1 Cluster 2
##      0.229      0.224
##
##
##
## Provinces:
##          Cluster 1 Cluster 2
## Alberta            377      81
## BritishColumbia    588     135
## NewBrunswick        102      20
## NorthwestTerritories   6       1
## NovaScotia         372      78
## Ontario            1871     369
## Quebec             706     152
## Saskatchewan       52       19
## NA's               8144    1617
##
##
##
## Amenity dense:
## Cluster 1 Cluster 2
## 0      11076     2218
## 1       889      195
## 2       118      29
## F       135      30
##
##
##
## PMS_prox_idx_emp :
## Cluster 1 Cluster 2
##      0.02384    0.02474
##
##
##
## PMS_prox_idx_pharma :
## Cluster 1 Cluster 2
##      0.0422     0.04386
##
##
##
## PMS_prox_idx_childcare :
## Cluster 1 Cluster 2
##      0.07023    0.07278
##
##
##
## PMS_prox_idx_health :
## Cluster 1 Cluster 2
##      0.01334    0.01333
##

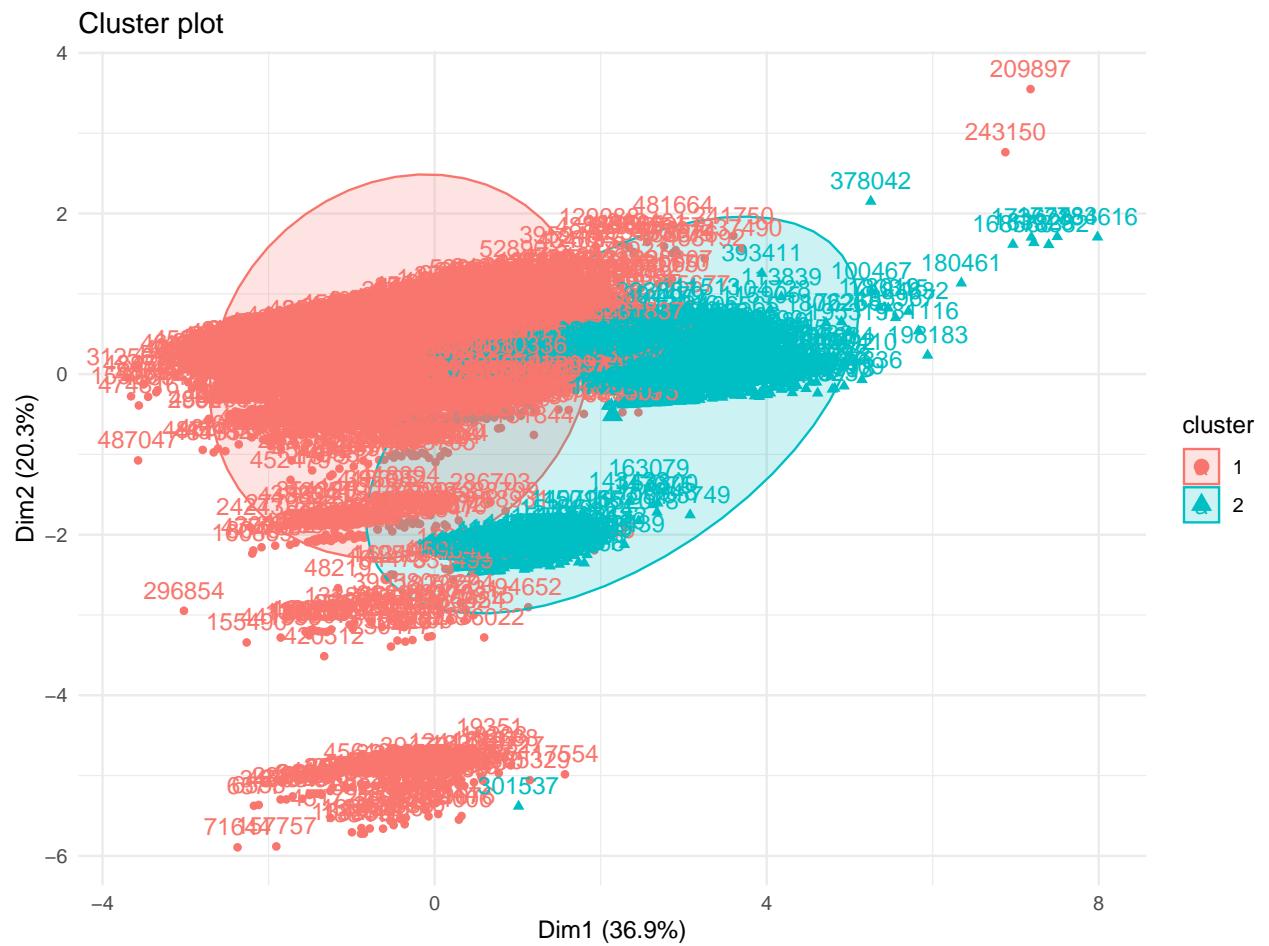
```

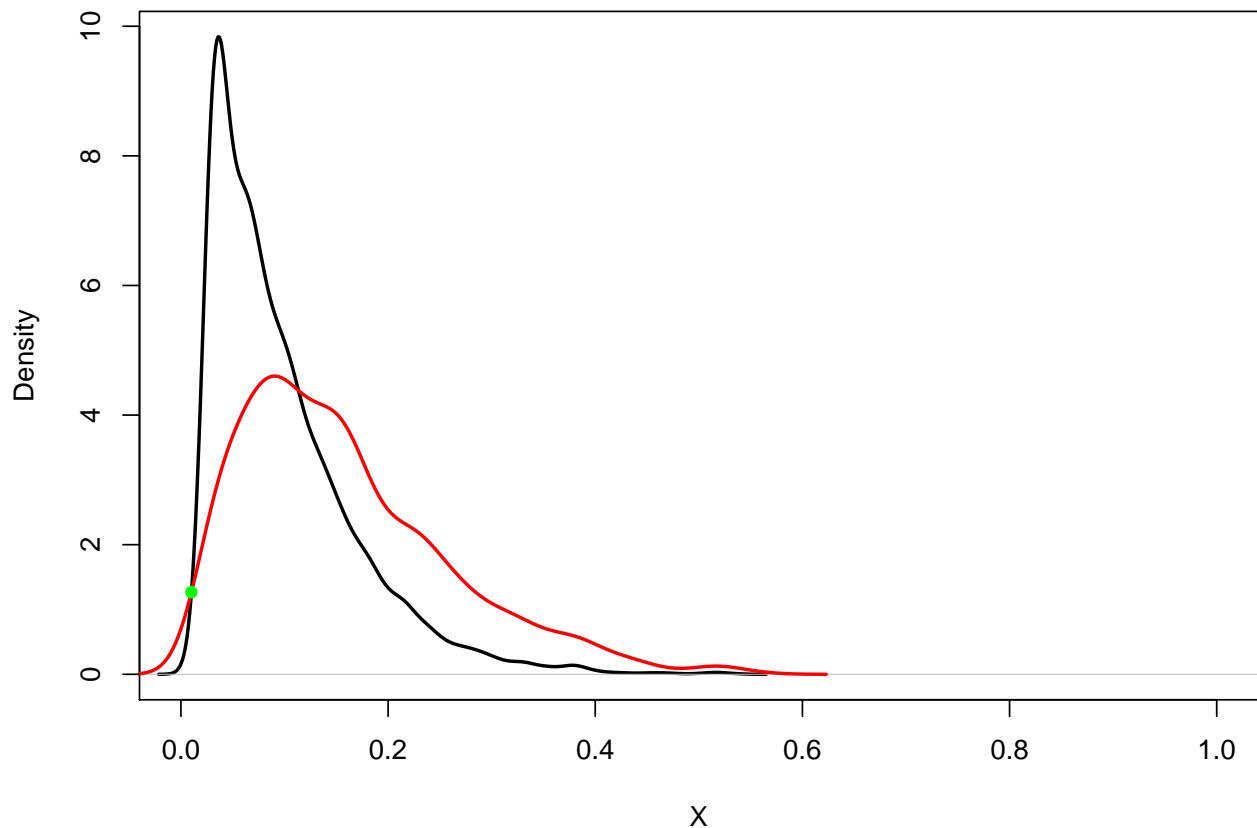
```
##  
##  
## PMS_prox_idx_grocery :  
## Cluster 1 Cluster 2  
## 0.06535 0.06885  
##  
##  
##  
## PMS_prox_idx_educpri :  
## Cluster 1 Cluster 2  
## 0.10686 0.10958  
##  
##  
##  
## PMS_prox_idx_educsec :  
## Cluster 1 Cluster 2  
## 0.09567 0.09496  
##  
##  
##  
## PMS_prox_idx_lib :  
## Cluster 1 Cluster 2  
## 0.10436 0.1049  
##  
##  
##  
## PMS_prox_idx_parks :  
## Cluster 1 Cluster 2  
## 0.06431 0.06495  
##  
##  
##  
## PMS_prox_idx_transit :  
## Cluster 1 Cluster 2  
## 0.01737 0.01828
```

Primary Education



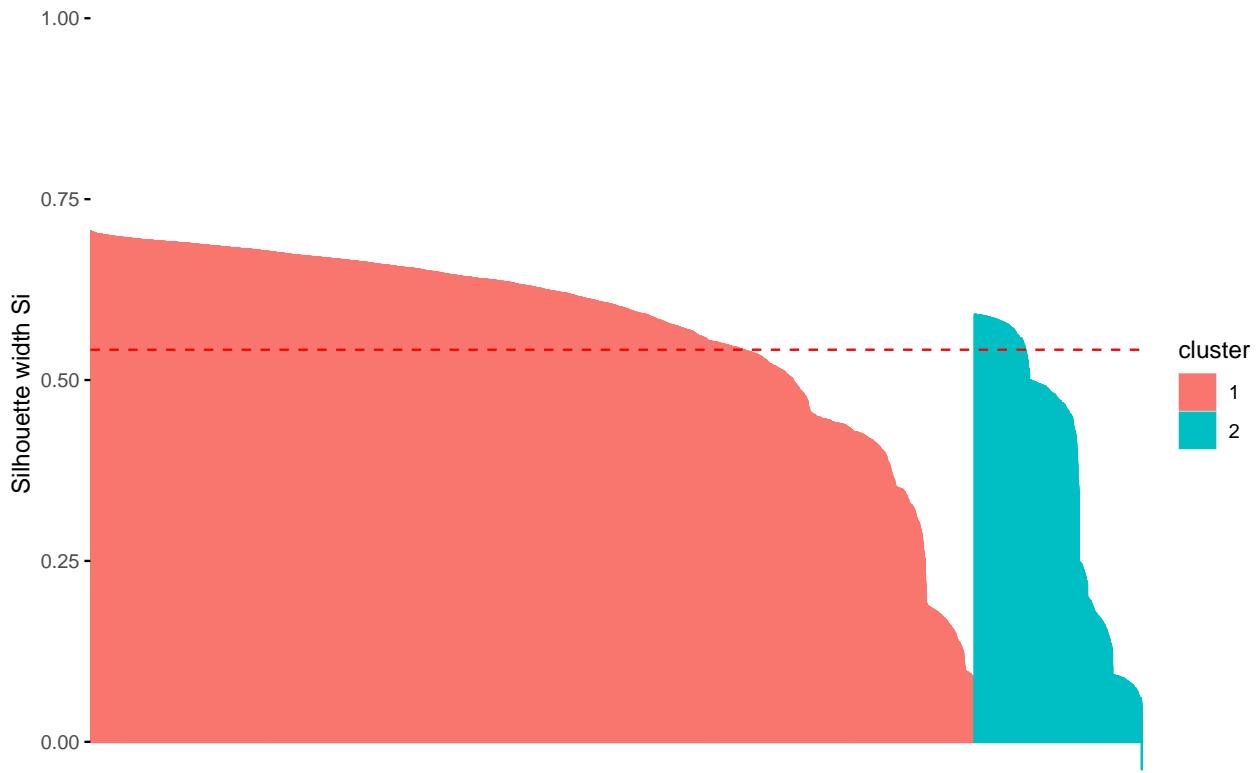
```
## [1] "Maximum silhouette coefficient: 0.474970752308207 For 2 clusters."
```





```
## [1] "Segment cutoff values:"  
## [1] 0.01012247  
##   cluster size ave.sil.width  
## 1      1 5627      0.57  
## 2      2 1064      0.38
```

Clusters silhouette plot
Average silhouette width: 0.54



```
## [1] "Cluster profiles:"  
## [1] "Num of DBs:"  
##   Cluster 1 Cluster 2  
##      12354      2336  
##  
##  
##  
##   DB Population:  
##   Cluster 1 Cluster 2  
##      73      69.8  
##  
##  
##  
##  
##   CSD Population:  
##   Cluster 1 Cluster 2  
##      237619.1  216822.7  
##  
##  
##  
##  
##   CMA Type:  
##   Cluster 1 Cluster 2  
##      5390      1048  
##   B      5169      946  
##   D      1346      272  
##   K      449       70
```

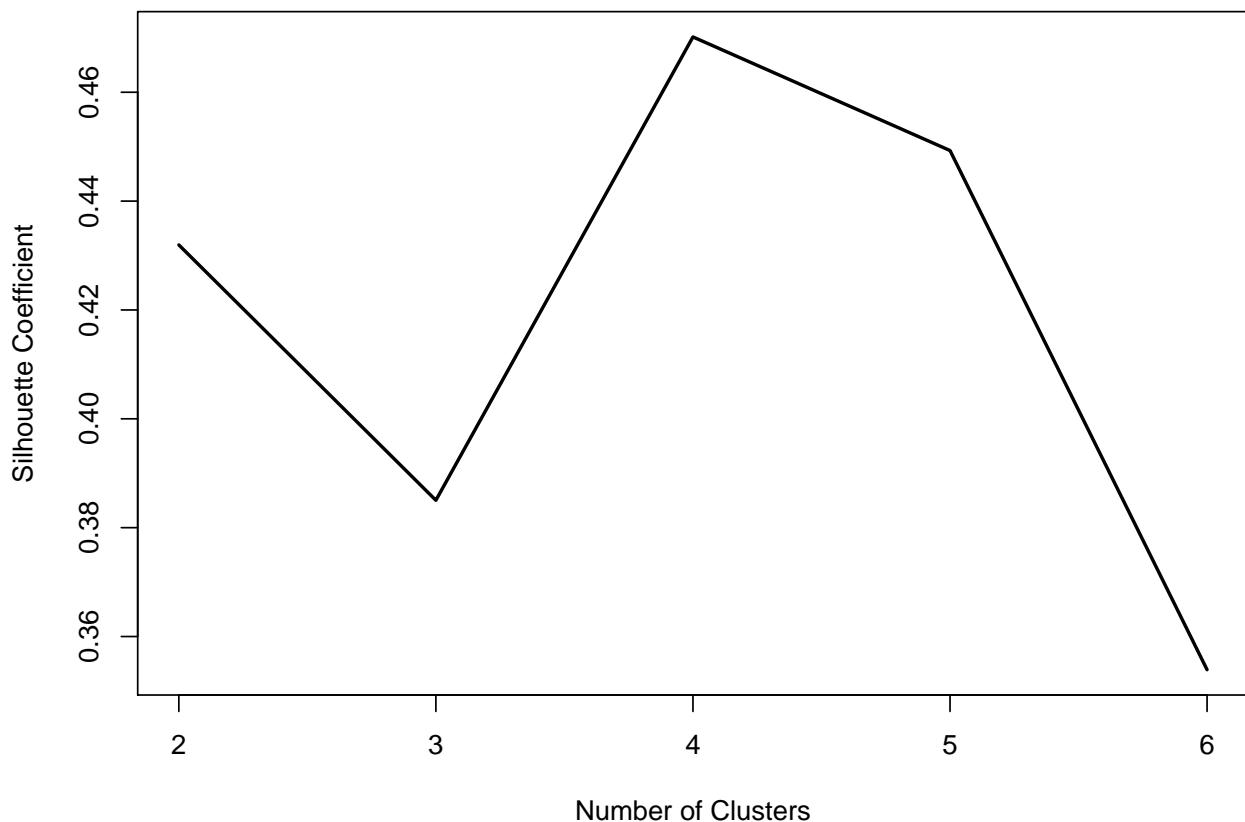
```

##
##
##
## Index of Remoteness:
## Cluster 1 Cluster 2
##      0.228      0.23
##
##
##
## Provinces:
##                  Cluster 1 Cluster 2
## Alberta            386      72
## BritishColumbia   595     128
## NewBrunswick       108      14
## NorthwestTerritories   6      1
## NovaScotia         386      64
## Ontario            1889     351
## Quebec             732     126
## Saskatchewan       61      10
## NA's               8191    1570
##
##
##
## Amenity dense:
## Cluster 1 Cluster 2
## 0      11191     2103
## 1       898      186
## 2       128      19
## F       137      28
##
##
##
## PMS_prox_idx_emp :
## Cluster 1 Cluster 2
##      0.02421    0.02287
##
##
##
## PMS_prox_idx_pharma :
## Cluster 1 Cluster 2
##      0.04232    0.04333
##
##
##
## PMS_prox_idx_childcare :
## Cluster 1 Cluster 2
##      0.07108    0.06846
##
##
##
## PMS_prox_idx_health :
## Cluster 1 Cluster 2
##      0.01348    0.01258
##

```

```
##  
##  
## PMS_prox_idx_grocery :  
## Cluster 1 Cluster 2  
## 0.06658 0.06275  
##  
##  
##  
## PMS_prox_idx_educpri :  
## Cluster 1 Cluster 2  
## 0.10791 0.10419  
##  
##  
##  
## PMS_prox_idx_educsec :  
## Cluster 1 Cluster 2  
## 0.09658 0.08995  
##  
##  
##  
## PMS_prox_idx_lib :  
## Cluster 1 Cluster 2  
## 0.10432 0.10515  
##  
##  
##  
## PMS_prox_idx_parks :  
## Cluster 1 Cluster 2  
## 0.06443 0.06439  
##  
##  
##  
## PMS_prox_idx_transit :  
## Cluster 1 Cluster 2  
## 0.01771 0.01655
```

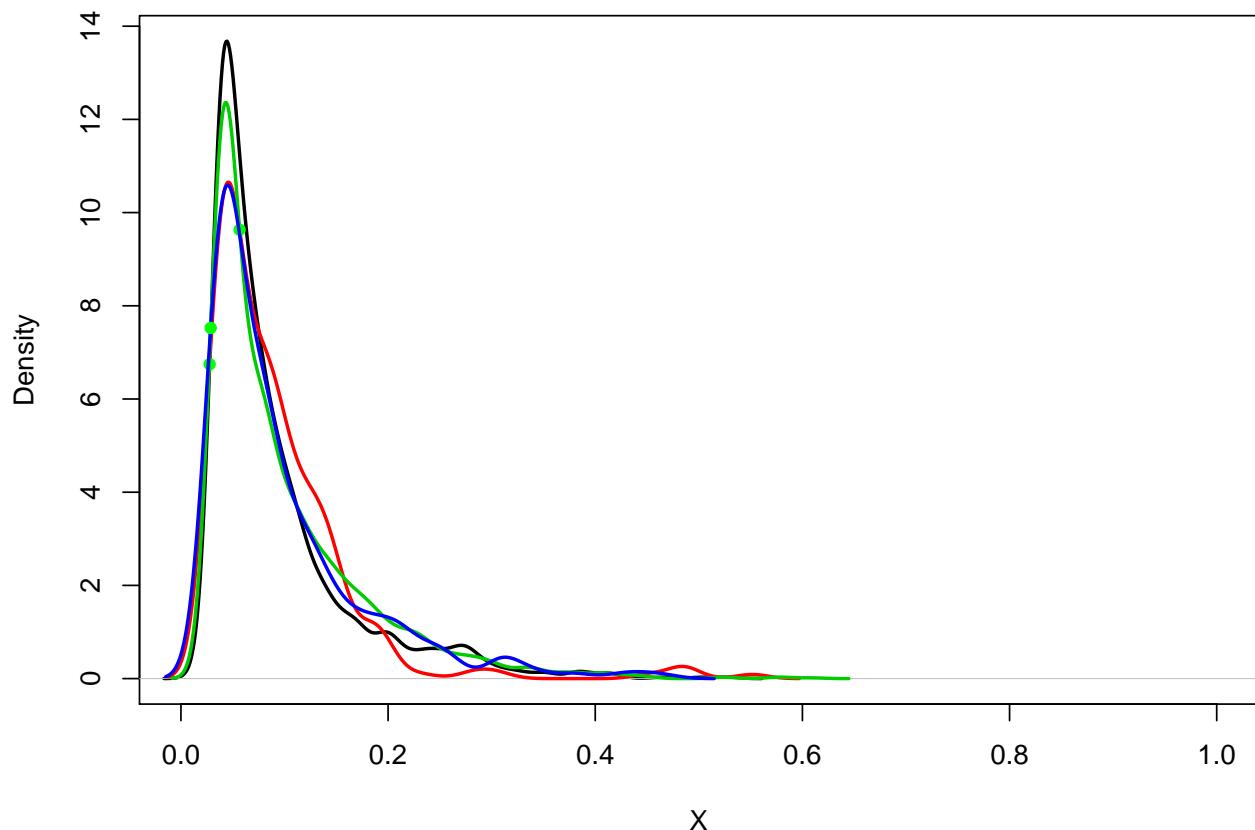
Secondary Education



```
## [1] "Maximum silhouette coefficient: 0.470158803103835 For 4 clusters."
```

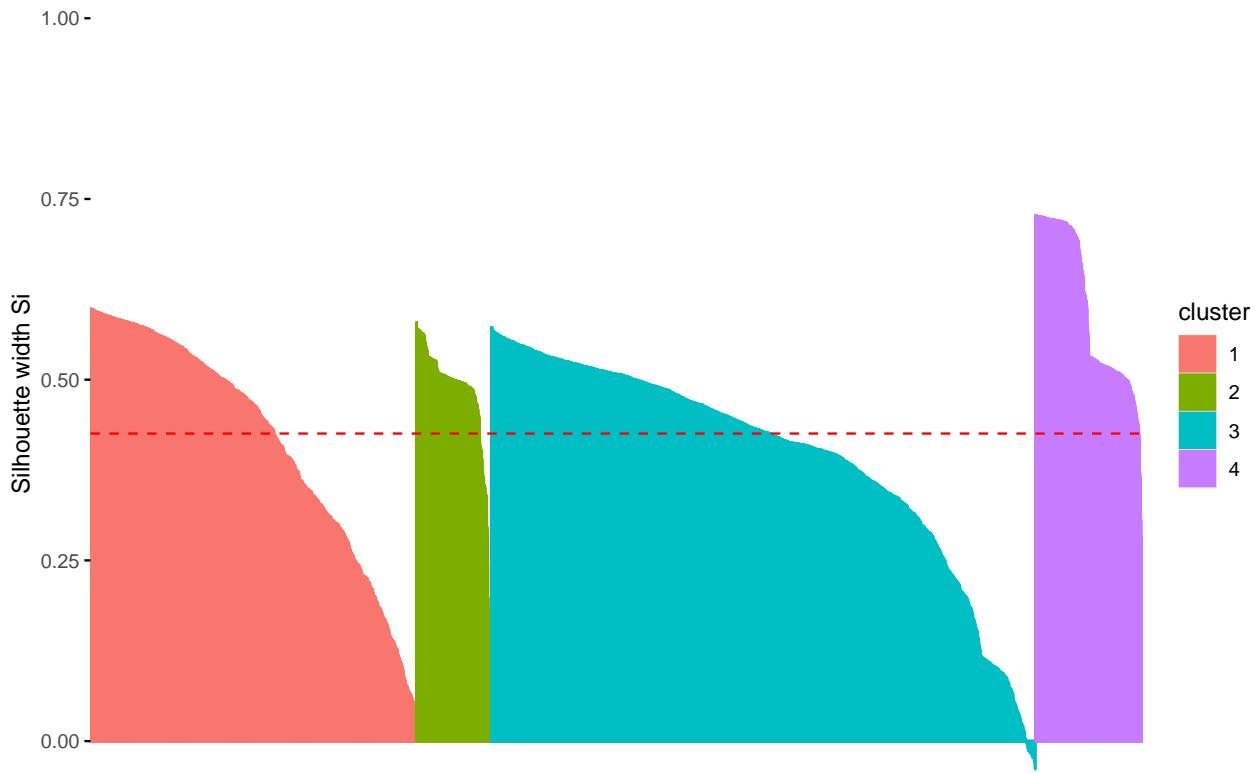
Cluster plot





```
## [1] "Segment cutoff values:"
## [1] 0.02768052
## [1] 0.05663609
## [1] 0.02871083
##   cluster size ave.sil.width
## 1       1 1299      0.41
## 2       2 298       0.48
## 3       3 2167      0.39
## 4       4 425       0.60
```

Clusters silhouette plot
Average silhouette width: 0.43



```
## [1] "Cluster profiles:"  
## [1] "Num of DBs:"  
##   Cluster 1 Cluster 2 Cluster 3 Cluster 4  
##      4531      1050     7602     1507  
##  
##  
##  
##   DB Population:  
##   Cluster 1 Cluster 2 Cluster 3 Cluster 4  
##      73.7       70      71.1      77.8  
##  
##  
##  
##   CSD Population:  
##   Cluster 1 Cluster 2 Cluster 3 Cluster 4  
##      229244.4   233837.4   239794.8   222207.6  
##  
##  
##  
##   CMA Type:  
##   Cluster 1 Cluster 2 Cluster 3 Cluster 4  
##      1981       462      3307      688  
##   B          1872       433      3201      609  
##   D          521        123      815      159  
##   K          157        32      279       51
```

```

##
##
##
## Index of Remoteness:
## Cluster 1 Cluster 2 Cluster 3 Cluster 4
##      0.227      0.23      0.228      0.233
##
##
##
## Provinces:
##          Cluster 1 Cluster 2 Cluster 3 Cluster 4
## Alberta            153       23     237      45
## BritishColumbia    227       48     369      79
## NewBrunswick        41        6      65      10
## NorthwestTerritories   4        0      3       0
## NovaScotia         127       28     260      35
## Ontario            662      186    1164     228
## Quebec             271       60     451      76
## Saskatchewan       16        5      44       6
## NA's              3030      694    5009    1028
##
##
##
## Amenity dense:
##          Cluster 1 Cluster 2 Cluster 3 Cluster 4
## 0      4092      944     6900    1358
## 1      335       76      561     112
## 2       49       13      67      18
## F       55       17      74      19
##
##
##
## PMS_prox_idx_emp :
##          Cluster 1 Cluster 2 Cluster 3 Cluster 4
##      0.02427    0.02445   0.02398    0.0229
##
##
##
## PMS_prox_idx_pharma :
##          Cluster 1 Cluster 2 Cluster 3 Cluster 4
##      0.04201    0.04462   0.04288    0.04034
##
##
##
## PMS_prox_idx_childcare :
##          Cluster 1 Cluster 2 Cluster 3 Cluster 4
##      0.07107    0.06759   0.07119    0.06872
##
##
##
## PMS_prox_idx_health :
##          Cluster 1 Cluster 2 Cluster 3 Cluster 4
##      0.01355    0.01377   0.0133     0.01258
##

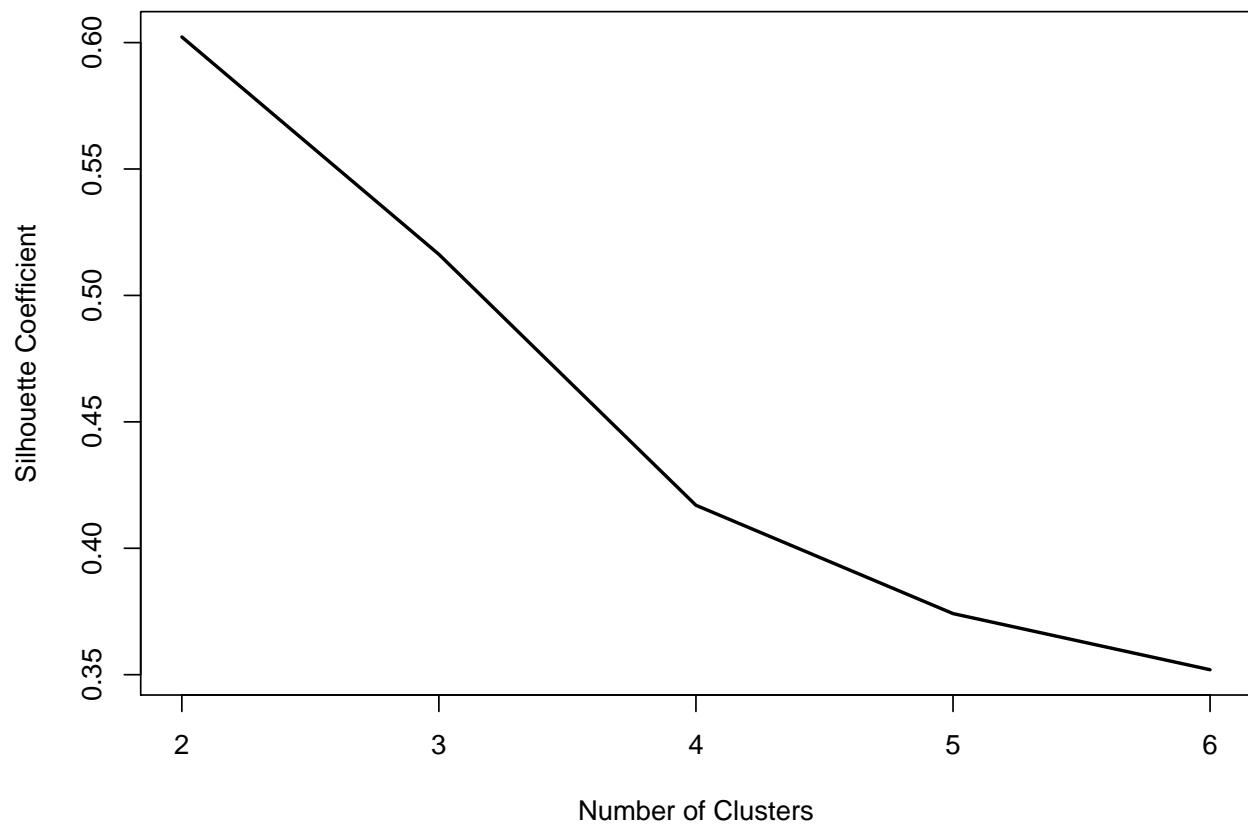
```

```

##
##
## PMS_prox_idx_grocery :
## Cluster 1 Cluster 2 Cluster 3 Cluster 4
##    0.06748    0.06592    0.06487    0.06748
##
##
## PMS_prox_idx_educpri :
## Cluster 1 Cluster 2 Cluster 3 Cluster 4
##    0.1072     0.10532    0.10777    0.10692
##
##
## PMS_prox_idx_educsec :
## Cluster 1 Cluster 2 Cluster 3 Cluster 4
##    0.09476    0.10143    0.09396    0.10249
##
##
## PMS_prox_idx_lib :
## Cluster 1 Cluster 2 Cluster 3 Cluster 4
##    0.10385    0.10988    0.10354    0.10699
##
##
## PMS_prox_idx_parks :
## Cluster 1 Cluster 2 Cluster 3 Cluster 4
##    0.06569    0.06005    0.06451    0.06318
##
##
## PMS_prox_idx_transit :
## Cluster 1 Cluster 2 Cluster 3 Cluster 4
##    0.018      0.0168     0.01748    0.01681

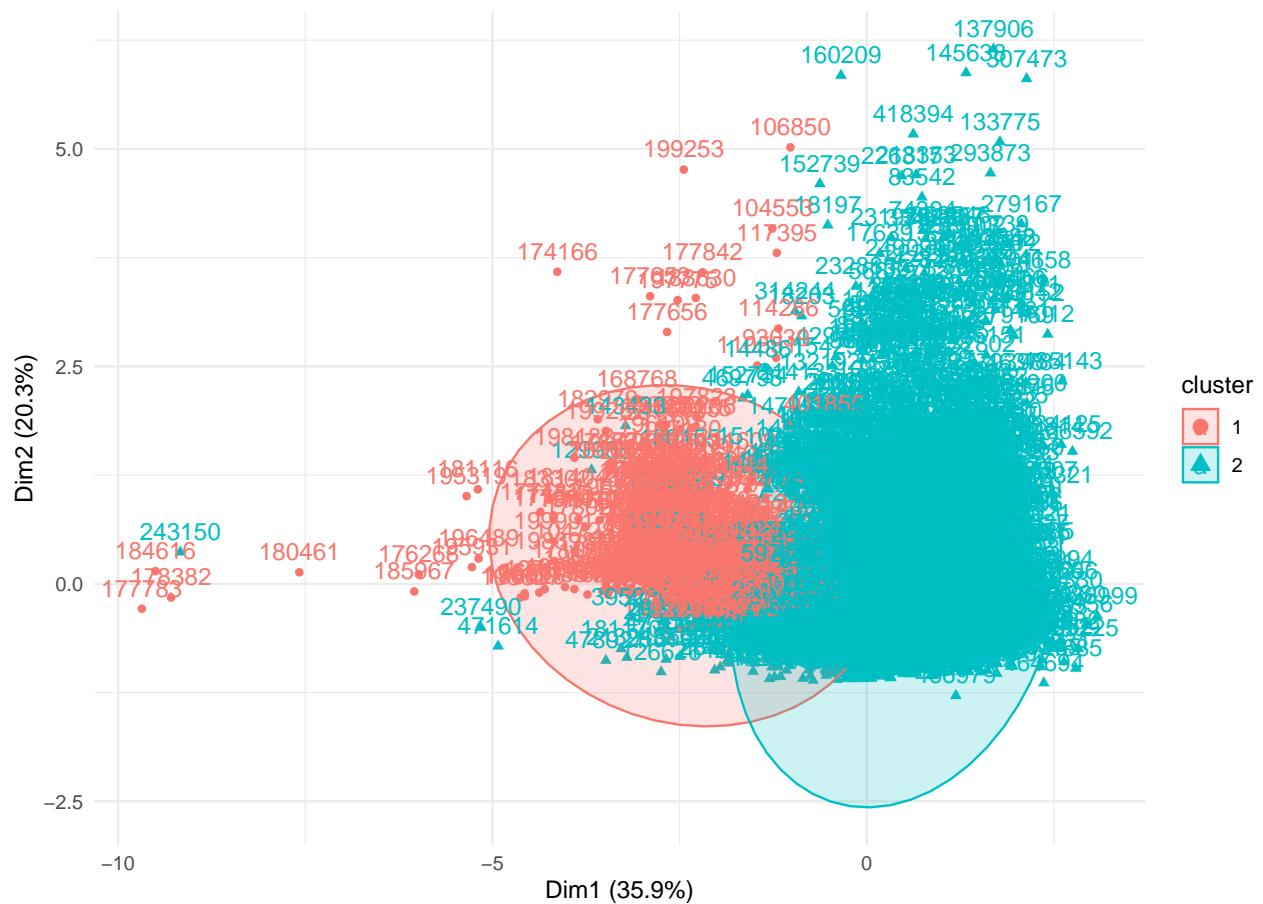
```

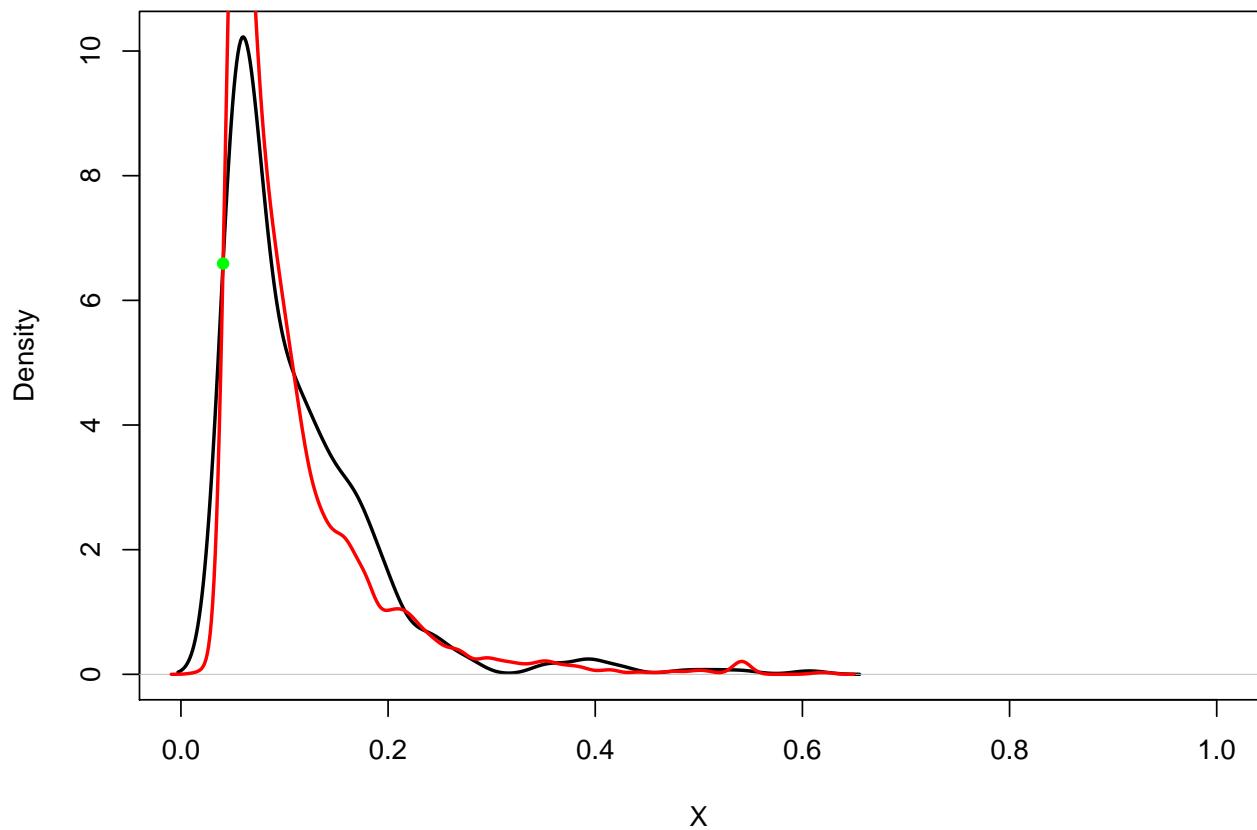
Libraries



```
## [1] "Maximum silhouette coefficient: 0.602230477127253 For 2 clusters."
```

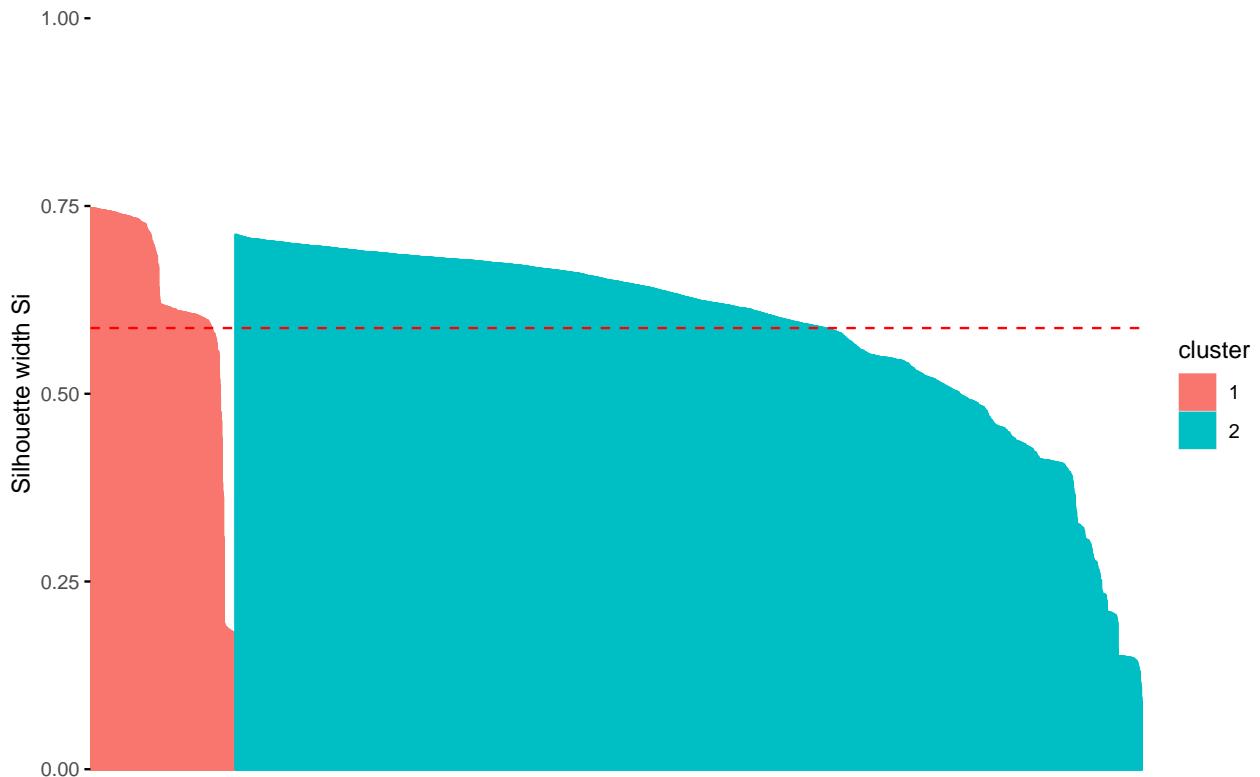
Cluster plot





```
## [1] "Segment cutoff values:"  
## [1] 0.04069306  
##   cluster size ave.sil.width  
## 1       1    454      0.62  
## 2       2   2836      0.58
```

Clusters silhouette plot
Average silhouette width: 0.59



```
## [1] "Cluster profiles:"  
## [1] "Num of DBs:"  
##   Cluster 1 Cluster 2  
##       2037      12653  
##  
##  
##  
##   DB Population:  
##   Cluster 1 Cluster 2  
##       71.2      72.7  
##  
##  
##  
##   CSD Population:  
##   Cluster 1 Cluster 2  
##       232758.6  234560.4  
##  
##  
##  
##   CMA Type:  
##   Cluster 1 Cluster 2  
##       903      5535  
##   B        830      5285  
##   D        229      1389  
##   K         75      444
```

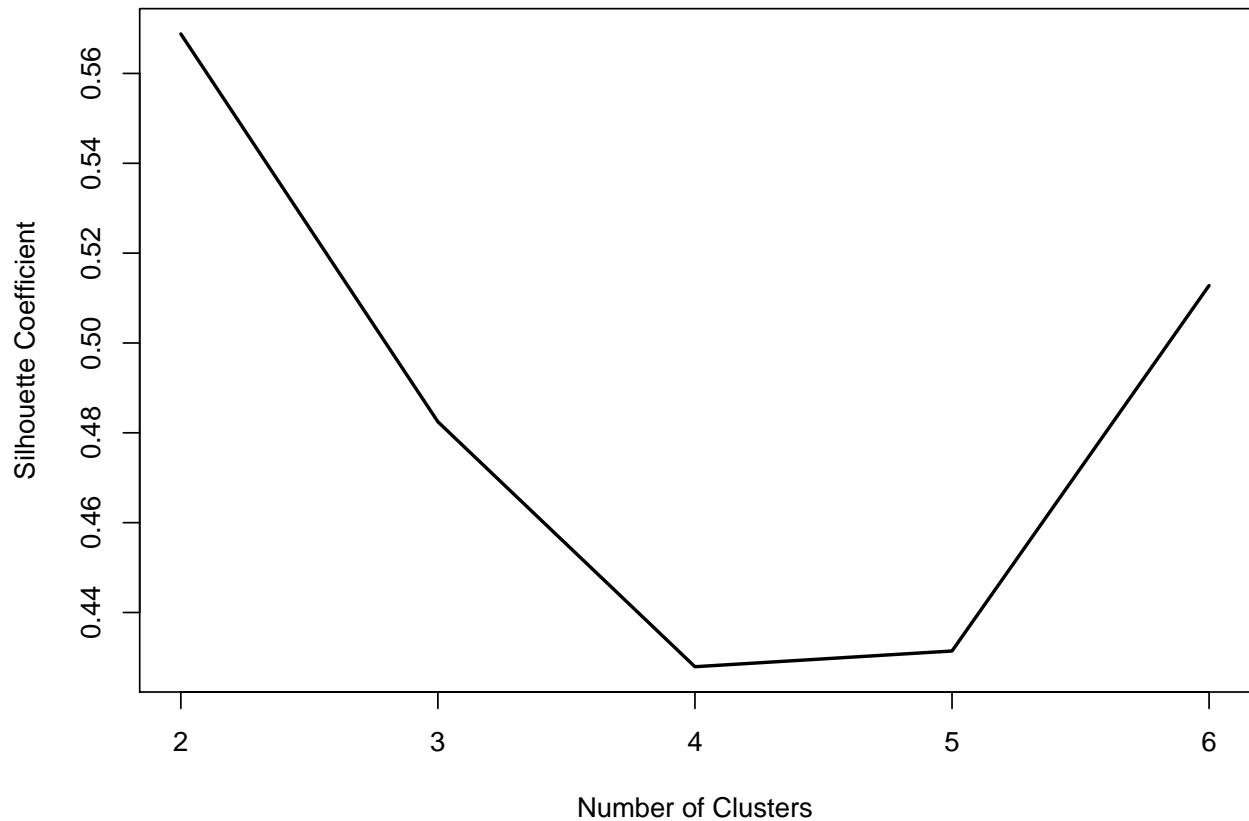
```

##
##
##
## Index of Remoteness:
## Cluster 1 Cluster 2
##      0.233      0.228
##
##
##
## Provinces:
##                  Cluster 1 Cluster 2
## Alberta            56      402
## BritishColumbia   96      627
## NewBrunswick       20      102
## NorthwestTerritories 1       6
## NovaScotia         54      396
## Ontario            297     1943
## Quebec             124     734
## Saskatchewan       11      60
## NA's                1378    8383
##
##
##
## Amenity dense:
## Cluster 1 Cluster 2
## 0      1840     11454
## 1      154      930
## 2      25       122
## F      18       147
##
##
##
## PMS_prox_idx_emp :
## Cluster 1 Cluster 2
##      0.02355    0.02406
##
##
##
## PMS_prox_idx_pharma :
## Cluster 1 Cluster 2
##      0.04227    0.04251
##
##
##
## PMS_prox_idx_childcare :
## Cluster 1 Cluster 2
##      0.07077    0.07064
##
##
##
## PMS_prox_idx_health :
## Cluster 1 Cluster 2
##      0.01276    0.01343
##

```

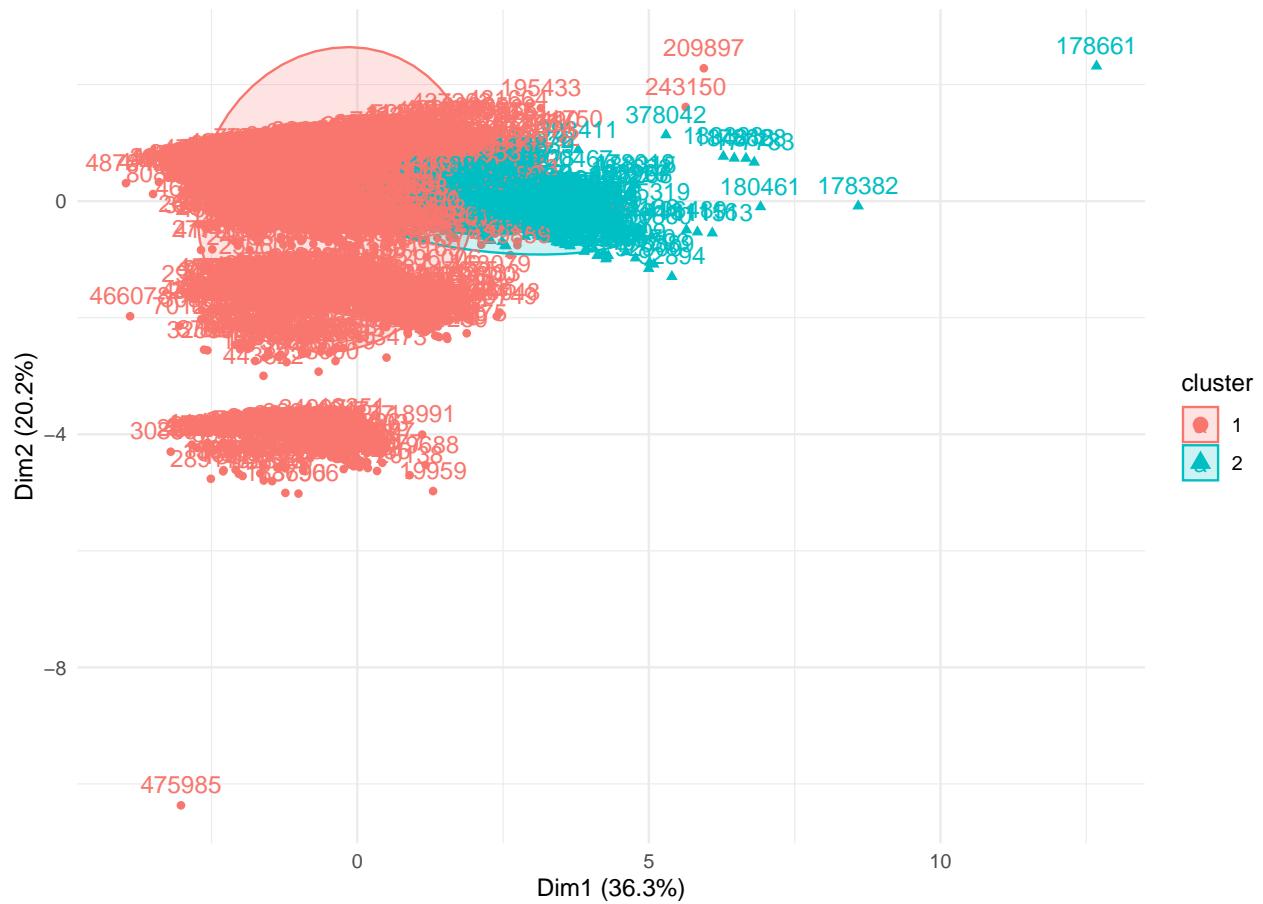
```
##  
##  
## PMS_prox_idx_grocery :  
## Cluster 1 Cluster 2  
## 0.06379  0.06633  
##  
##  
##  
## PMS_prox_idx_educpri :  
## Cluster 1 Cluster 2  
## 0.10663  0.10744  
##  
##  
##  
## PMS_prox_idx_educsec :  
## Cluster 1 Cluster 2  
## 0.09577  0.09552  
##  
##  
##  
## PMS_prox_idx_lib :  
## Cluster 1 Cluster 2  
## 0.10631  0.10414  
##  
##  
##  
## PMS_prox_idx_parks :  
## Cluster 1 Cluster 2  
## 0.06315  0.06463  
##  
##  
##  
## PMS_prox_idx_transit :  
## Cluster 1 Cluster 2  
## 0.01812  0.01744
```

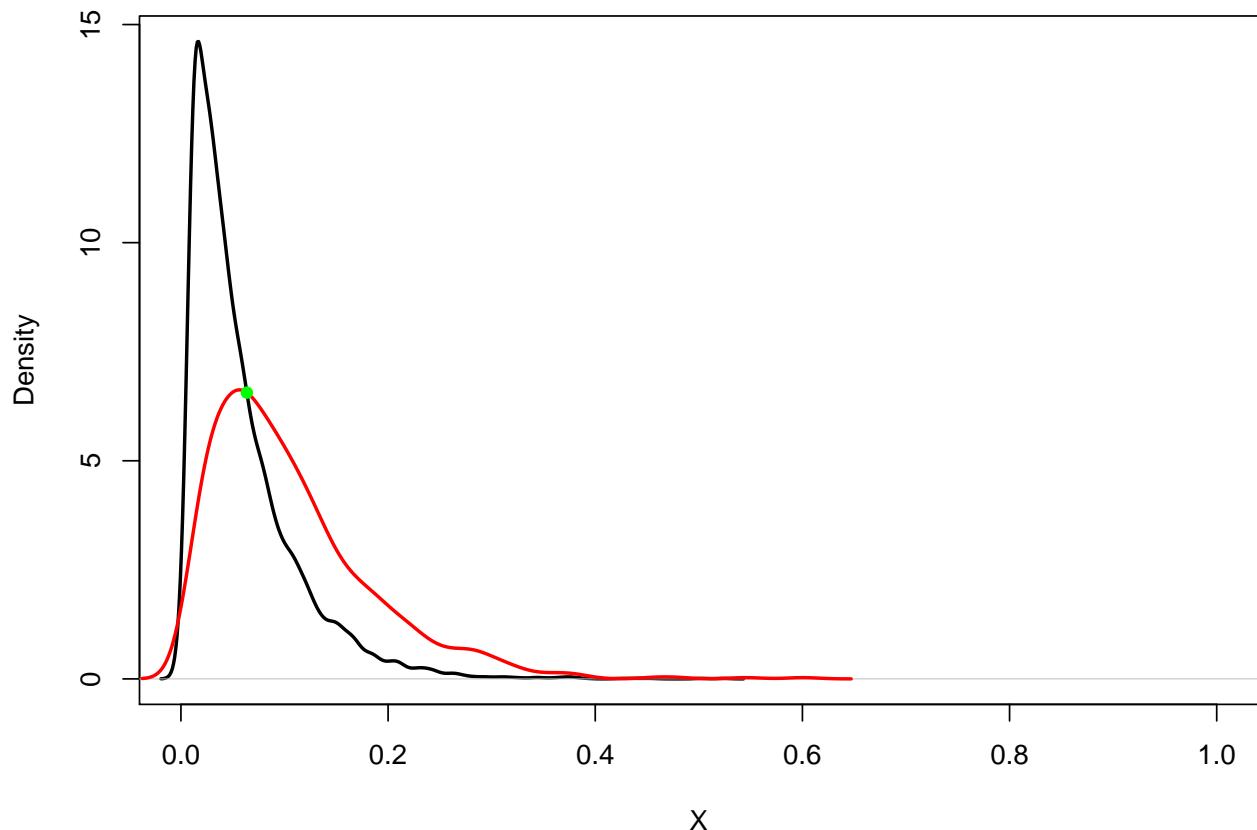
Parks



```
## [1] "Maximum silhouette coefficient: 0.568791600554314 For 2 clusters."
```

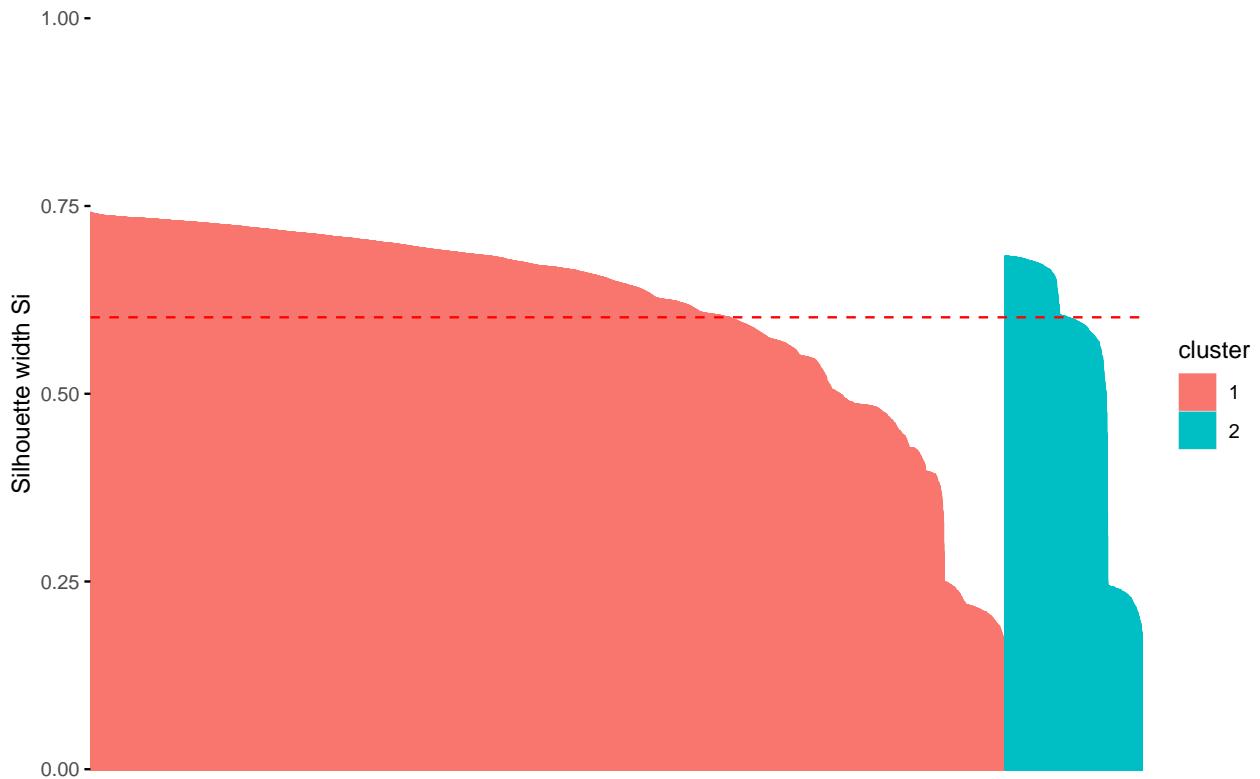
Cluster plot





```
## [1] "Segment cutoff values:"  
## [1] 0.06366117  
##   cluster size ave.sil.width  
## 1      1 6065      0.61  
## 2      2  904      0.52
```

Clusters silhouette plot
Average silhouette width: 0.6



```
## [1] "Cluster profiles:"  
## [1] "Num of DBs:"  
##   Cluster 1 Cluster 2  
##      12788     1902  
##  
##  
##  
##   DB Population:  
##   Cluster 1 Cluster 2  
##      73.2      68.1  
##  
##  
##  
##   CSD Population:  
##   Cluster 1 Cluster 2  
##      236951.3  216564.9  
##  
##  
##  
##   CMA Type:  
##   Cluster 1 Cluster 2  
##      5585      853  
##   B      5350      765  
##   D      1399      219  
##   K      454       65
```

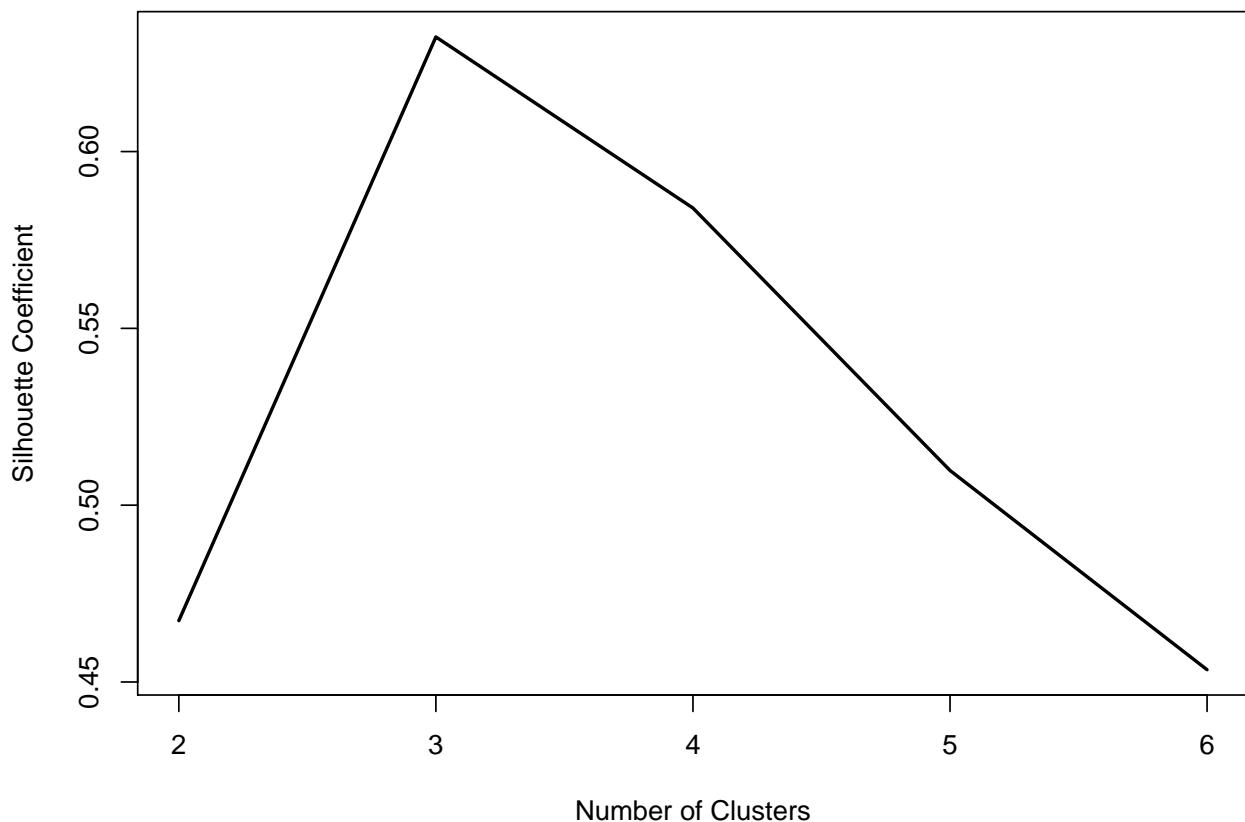
```

##
##
##
## Index of Remoteness:
## Cluster 1 Cluster 2
##      0.228      0.233
##
##
##
## Provinces:
##                  Cluster 1 Cluster 2
## Alberta            401      57
## BritishColumbia   628      95
## NewBrunswick       107      15
## NorthwestTerritories    7      0
## NovaScotia         385      65
## Ontario            1948     292
## Quebec             756      102
## Saskatchewan       62       9
## NA's               8494     1267
##
##
##
## Amenity dense:
## Cluster 1 Cluster 2
## 0      11566      1728
## 1      955       129
## 2      128       19
## F      139       26
##
##
##
## PMS_prox_idx_emp :
## Cluster 1 Cluster 2
##      0.02432     0.0218
##
##
##
## PMS_prox_idx_pharma :
## Cluster 1 Cluster 2
##      0.04291     0.03948
##
##
##
## PMS_prox_idx_childcare :
## Cluster 1 Cluster 2
##      0.07085     0.0693
##
##
##
## PMS_prox_idx_health :
## Cluster 1 Cluster 2
##      0.01345     0.01255
##

```

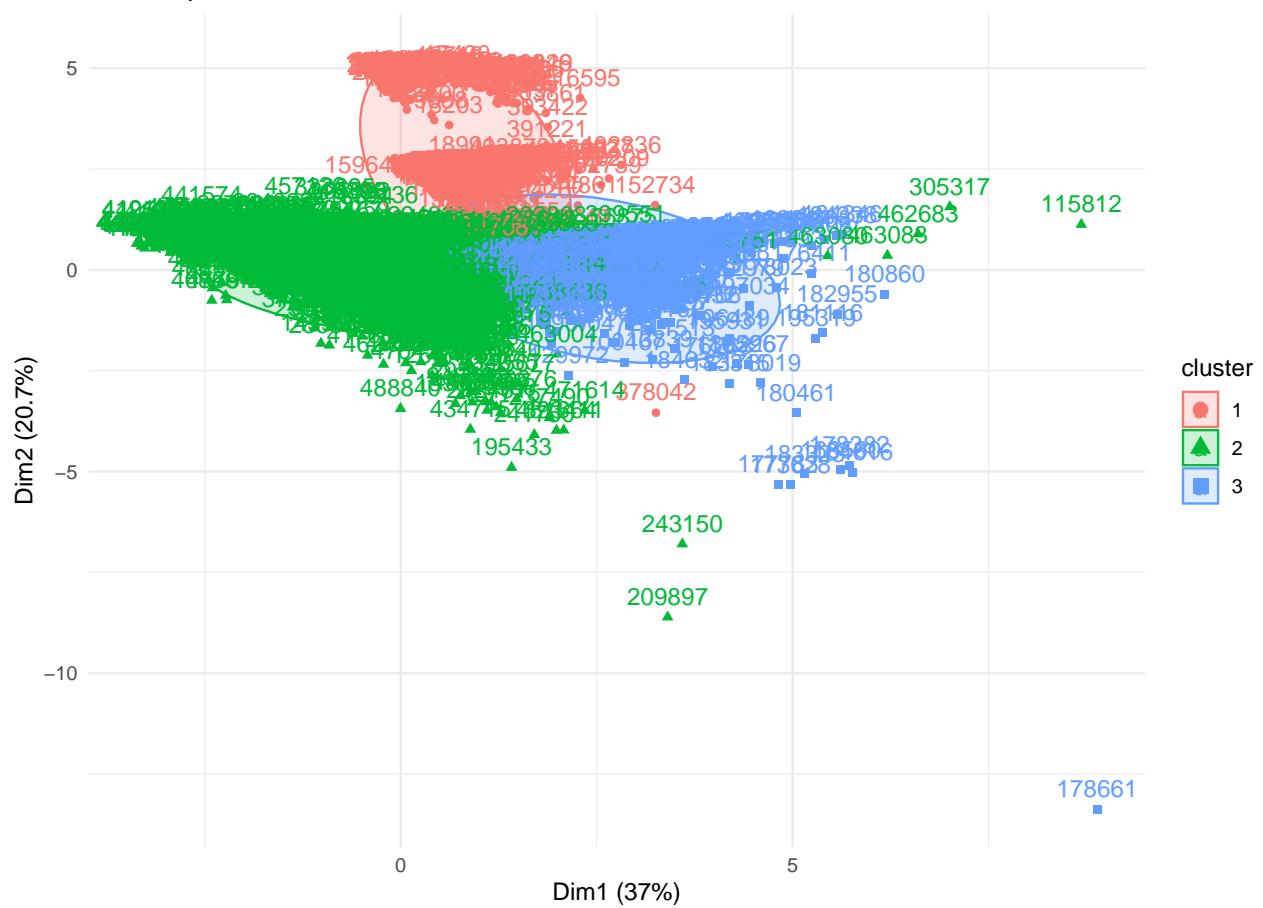
```
##  
##  
## PMS_prox_idx_grocery :  
## Cluster 1 Cluster 2  
## 0.06647 0.06237  
##  
##  
##  
## PMS_prox_idx_educpri :  
## Cluster 1 Cluster 2  
## 0.10775 0.10436  
##  
##  
##  
## PMS_prox_idx_educsec :  
## Cluster 1 Cluster 2  
## 0.09543 0.09649  
##  
##  
##  
## PMS_prox_idx_lib :  
## Cluster 1 Cluster 2  
## 0.1038 0.10917  
##  
##  
##  
## PMS_prox_idx_parks :  
## Cluster 1 Cluster 2  
## 0.06515 0.05937  
##  
##  
##  
## PMS_prox_idx_transit :  
## Cluster 1 Cluster 2  
## 0.01778 0.01578
```

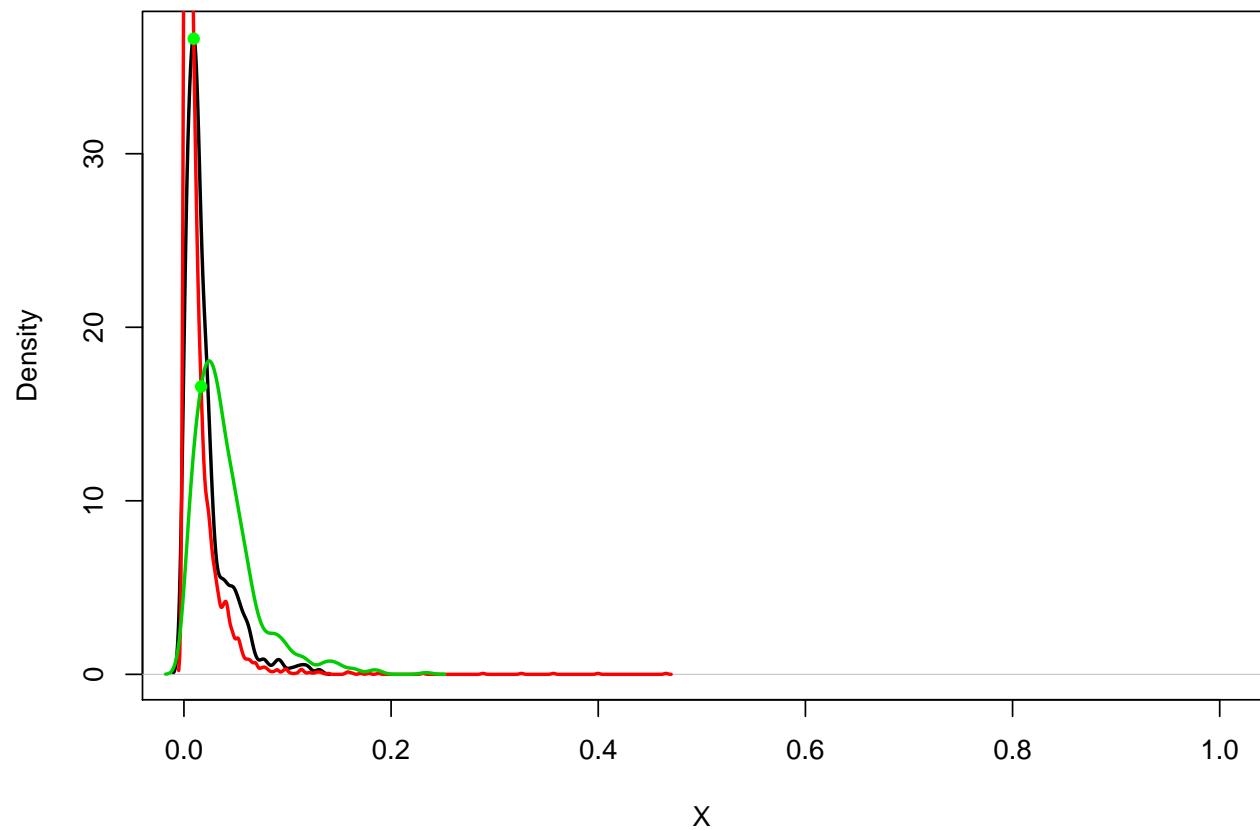
Transit



```
## [1] "Maximum silhouette coefficient: 0.632411685247099 For 3 clusters."
```

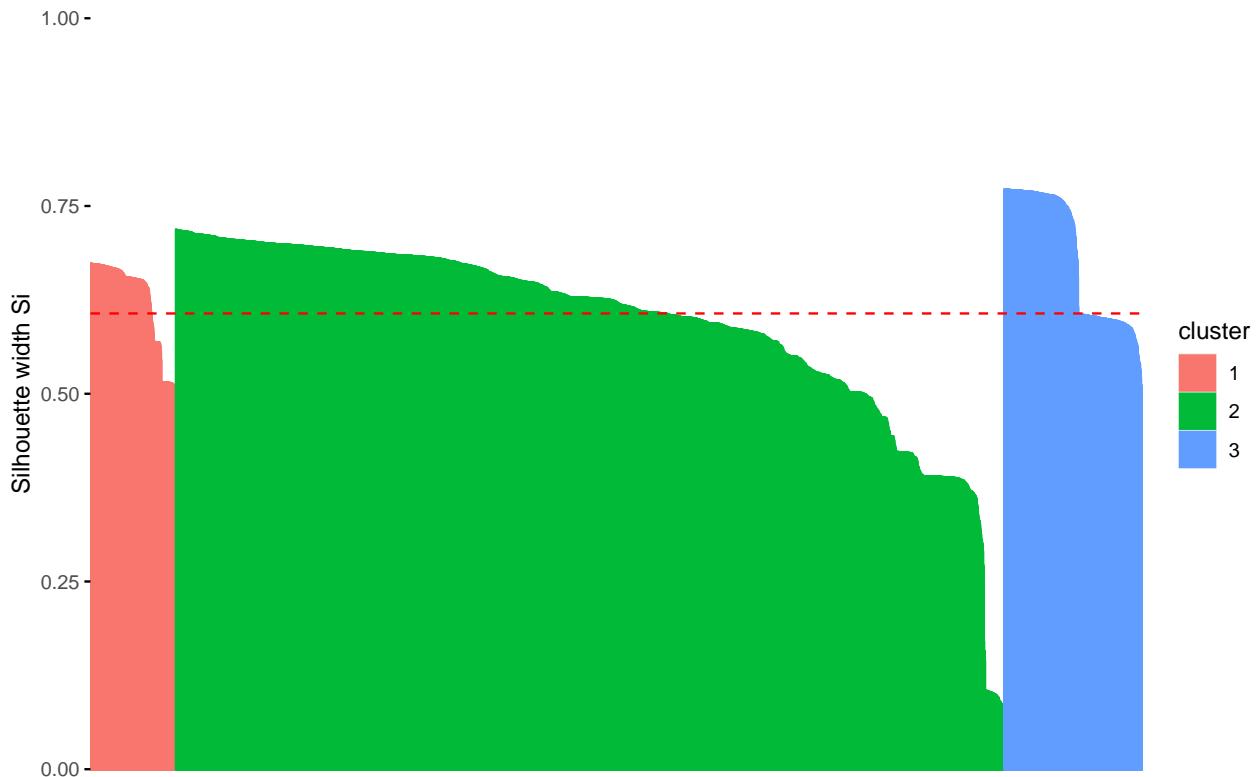
Cluster plot





```
## [1] "Segment cutoff values:"  
## [1] 0.009439102  
## [1] 0.01657504  
##   cluster size ave.sil.width  
## 1      1    435        0.62  
## 2      2   4217        0.59  
## 3      3    700        0.68
```

Clusters silhouette plot
Average silhouette width: 0.61



```
## [1] "Cluster profiles:"  
## [1] "Num of DBs:"  
##   Cluster 1 Cluster 2 Cluster 3  
##      1200     11559     1931  
##  
##  
##  
##   DB Population:  
##   Cluster 1 Cluster 2 Cluster 3  
##      75       72.7      69.8  
##  
##  
##  
##   CSD Population:  
##   Cluster 1 Cluster 2 Cluster 3  
##  242255.8  233104.2  236596.6  
##  
##  
##  
##   CMA Type:  
##   Cluster 1 Cluster 2 Cluster 3  
##      540      5038      860  
##   B        482      4820      813  
##   D        140      1273      205  
##   K         38       428       53
```

```

##
##
##
## Index of Remoteness:
## Cluster 1 Cluster 2 Cluster 3
##      0.23      0.228      0.229
##
##
##
## Provinces:
##          Cluster 1 Cluster 2 Cluster 3
## Alberta            34      372      52
## BritishColumbia    56      562     105
## NewBrunswick       10      97      15
## NorthwestTerritories 0       7       0
## NovaScotia         40      349      61
## Ontario            163     1771     306
## Quebec             81      671     106
## Saskatchewan       7       57       7
## NA's               809     7673    1279
##
##
##
## Amenity dense:
## Cluster 1 Cluster 2 Cluster 3
## 0      1094     10432     1768
## 1       77      880      127
## 2       16      115      16
## F       13      132      20
##
##
##
## PMS_prox_idx_emp :
## Cluster 1 Cluster 2 Cluster 3
##      0.02292    0.02431    0.02278
##
##
##
## PMS_prox_idx_pharma :
## Cluster 1 Cluster 2 Cluster 3
##      0.04579    0.04267    0.03938
##
##
##
## PMS_prox_idx_childcare :
## Cluster 1 Cluster 2 Cluster 3
##      0.07023    0.07112    0.06817
##
##
##
## PMS_prox_idx_health :
## Cluster 1 Cluster 2 Cluster 3
##      0.01307    0.01357    0.01209
##

```

```
##  
##  
## PMS_prox_idx_grocery :  
## Cluster 1 Cluster 2 Cluster 3  
## 0.06784 0.06627 0.063  
##  
##  
##  
## PMS_prox_idx_educpri :  
## Cluster 1 Cluster 2 Cluster 3  
## 0.10799 0.10712 0.1082  
##  
##  
##  
## PMS_prox_idx_educsec :  
## Cluster 1 Cluster 2 Cluster 3  
## 0.09821 0.09477 0.09864  
##  
##  
##  
## PMS_prox_idx_lib :  
## Cluster 1 Cluster 2 Cluster 3  
## 0.10693 0.10352 0.10891  
##  
##  
##  
## PMS_prox_idx_parks :  
## Cluster 1 Cluster 2 Cluster 3  
## 0.06262 0.06467 0.06404  
##  
##  
##  
## PMS_prox_idx_transit :  
## Cluster 1 Cluster 2 Cluster 3  
## 0.0169 0.01769 0.01693
```

Conclusion

text

