USED CAR PRICES CASE STUDY
Deliverable 2: PCA, CA and Clustering

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Contents

1   R libraries imports, useful functions and data loading

In this first section we will load all required packages and libraries, declare additional functions, and load our data.

1.1   Load Required Packages

```
# Load Required Packages: to be increased over the course
options(contrasts=c("contr.treatment","contr.treatment"))

requiredPackages <- c("effects","FactoMineR","car","missMDA","mvoutlier","chemometrics", "factoextra","P

#use this function to check if each package is on the local machine
#if a package is installed, it will be loaded
#if any are not, the missing package(s) will be installed and loaded
package.check <- lapply(requiredPackages, FUN = function(x) {
  if (!require(x, character.only = TRUE)) {
    install.packages(x, dependencies = TRUE)
    library(x, character.only = TRUE)
  }
})
#verify they are loaded
search()
```

1.2 Sample load

```
# Clear plots
if(!is.null(dev.list())) dev.off()

# Clean workspace
rm(list=ls())

# Users file path
miquel_fp <- "C:/Users/Miquel/Documents/GitHub/ADEI/"
xavi_fp <- "~/Documents/FIB/ADEI/ADEI/"
filepath <- xavi_fp

# Set working directory
setwd(filepath)

# Load data from file
load(paste0(filepath,"MyOldCars-5000Clean.RData"))

# Index reset
row.names(df) <- NULL
```

2 PCA

We have done PCA in order to combine related variables, and focus on uncorrelated or independent ones, especially those along which the observations have high variance. Also, to obtain a smaller set of variables that explain most of the variance in the original data, in more compact and insightful form.

```
names(df)
```

```
##  [1] "model"          "year"           "price"          "transmission"
##  [5] "mileage"        "fuelType"       "tax"            "mpg"
##  [9] "engineSize"     "manufacturer"   "years_sell"     "totalMOE"
## [13] "aux_price"      "aux_mileage"    "aux_tax"        "aux_mpg"
## [17] "aux_years_sell" "Audi"           "mout"
```

```
vars_con<-names(df)[c(5,7,8,11)]
vars_res<-names(df)[c(3,18)]
vars_dis<-names(df)[c(1,2,4,6,9,10,13,14,15,16,17)]

# Multivariant outliers should be included as supplementary observations
ll <- which( df$mout == "YesMOut")
res.pca<-PCA(df[,c(vars_res, vars_dis, vars_con)],quali.sup=c(2:13),quanti.sup=c(1),ind.sup=ll)
```

PCA graph of individuals

PCA graph of variables

As we can see in the first two plots tax and years_sell/mileage have almost an angle of 90 degrees, meaning that probably these variable are not that much related. Instead, years_sell and mileage are positively related. Price although it doesn't completely go in the opposite direction we can see that is inversely related to years_sell and mileage.
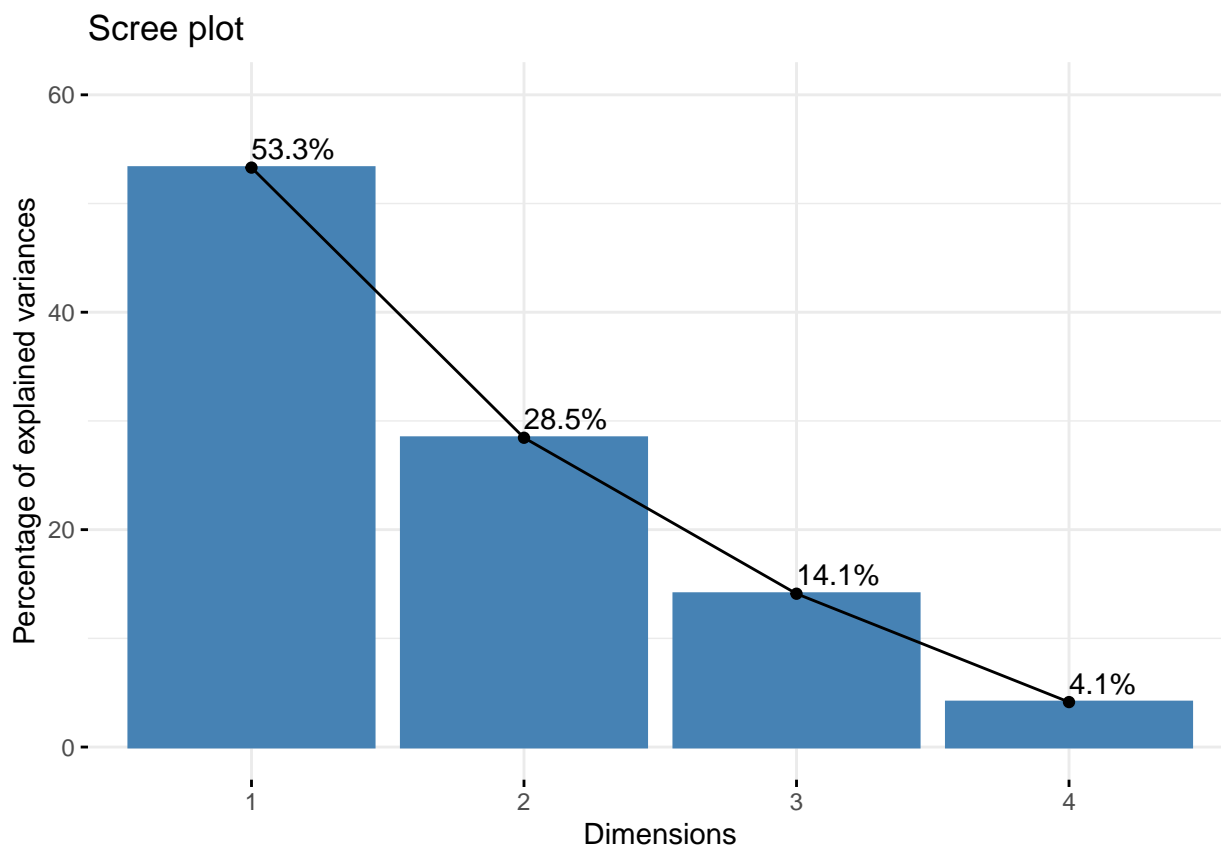
2.1 Eigenvalues and dominant axes analysis

```
res.pca$eig[,1:3]
```

```
##        eigenvalue percentage of variance cumulative percentage of variance
## comp 1  2.1320997              53.302492                         53.30249
## comp 2  1.1381377              28.453443                         81.75594
## comp 3  0.5642237              14.105591                         95.86153
## comp 4  0.1655389               4.138473                        100.00000
```

```
fviz_eig(res.pca, addlabels = TRUE, ylim = c(0, 60))
```


The eigenvalue of the first component is larger than the other ones. Starting from the second component with an eigenvalue of 1.138. . . the consequent eigenvalues get smaller.

According to the kaiser criteria we will use the first 2 dimensions (the ones with an eigenvalue > 1).

And according to Elbow's rule (based on selecting dimensions until the difference in variance of that of the next factorial plane is almost the same as that of the current plane) we can also use the first two dimensions (Dim.1 and Dim.2). The difference between the dimensions 2 and 3 is significantly less that the one we can see between dimensions 1 and 2.

With the two dimensions we capture/retain an 81.76% of the total variance.

2.2 Individuals point of view (contribution)

```
fviz_contrib(res.pca, choice = "ind", axes = 1:2, top = 20)
```

Contribution of individuals to Dim−1−2
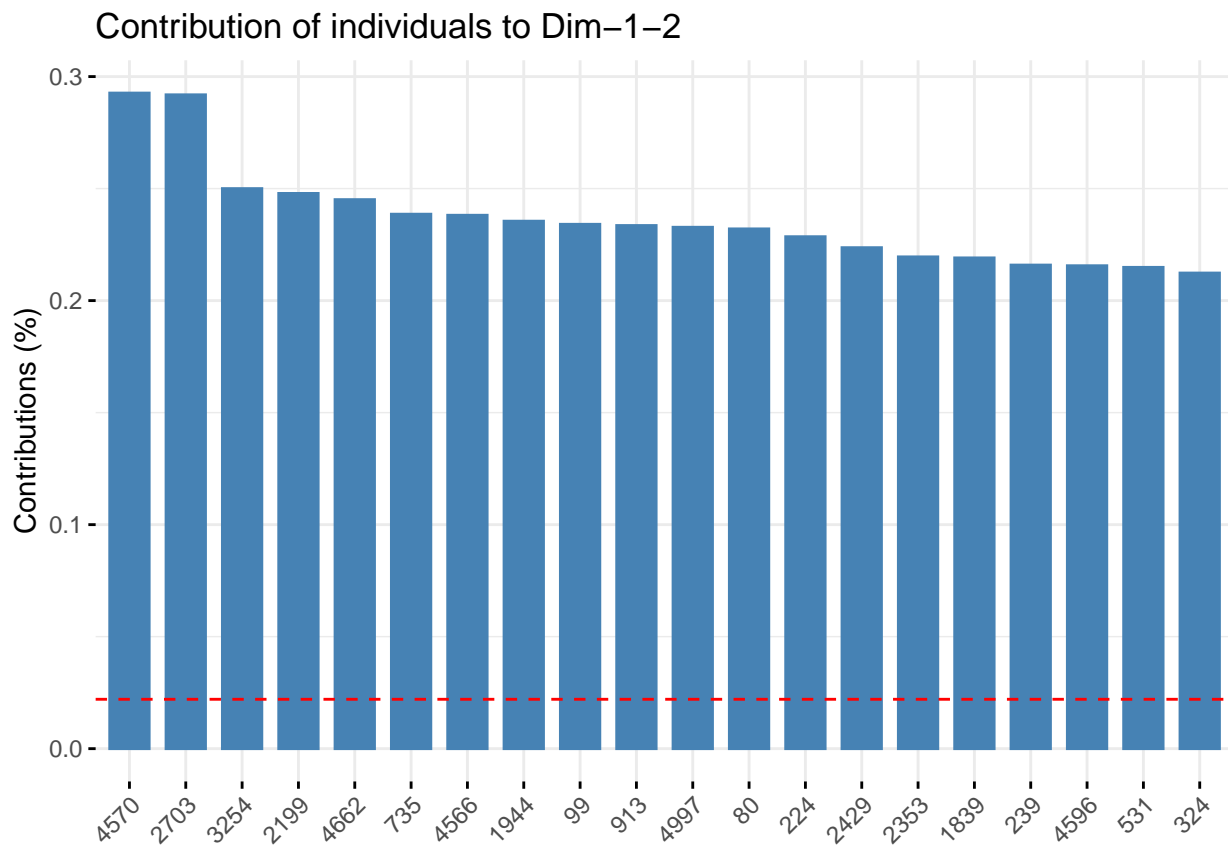
As we can see from the Contribution of individuals to Dim-1-2 plot, the 20 most contributive individuals in descending order are 4570, 2703, 3254, 2199, 4662, 735, 4566, 1944, 99, 913, 4997, 80, 224, 2429, 2353, 1839, 239, 4596, 531 and 324.

2.3 Interpreting the axes

2.3.1 Dimension 1

```
fviz_contrib(res.pca, choice = "var", axes = 1)
```

Contribution of variables to Dim−1


```
fviz_cos2(res.pca, choice = "var", axes = 1)
```
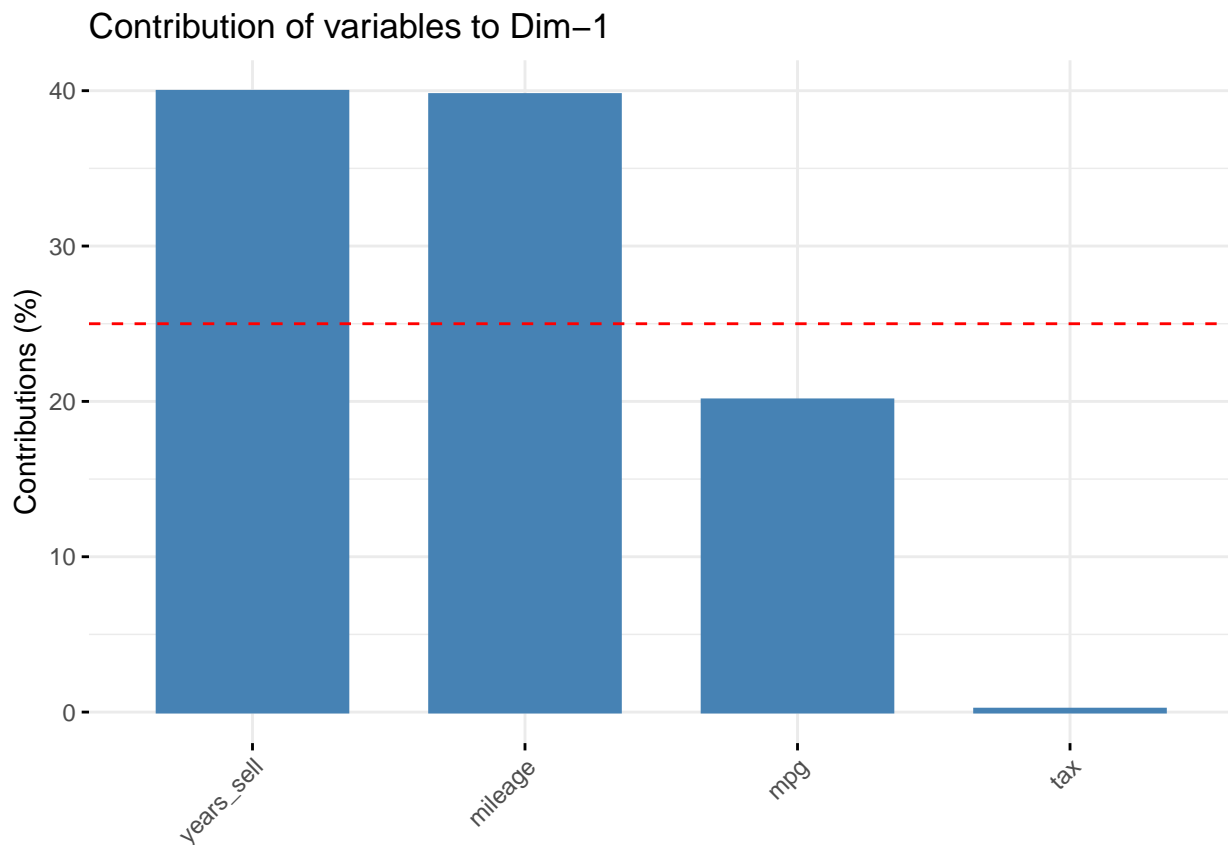
Cos2 of variables to Dim−1
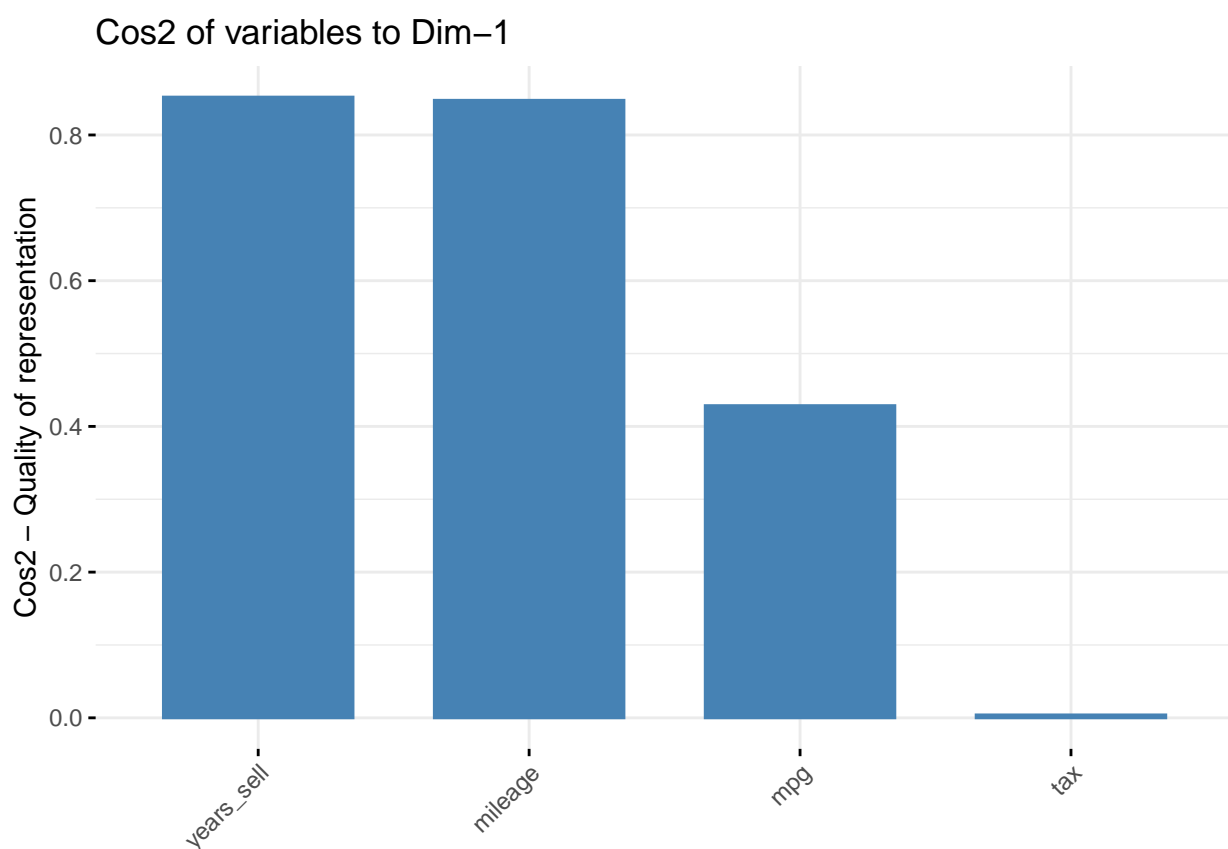
The years_sell, mileage, mpg and tax variables have a positive first dimension. Dimension 1 shows a positive correlation to years_sell and mileage. Price target variable (supplementary) is negatively associated to the first factorial axis. As we can see with cos2 years_sell and mileage are the best represented in the first dimension.

2.3.2 Dimension 2

```
fviz_contrib(res.pca, choice = "var", axes = 2)
```

Contribution of variables to Dim−2


```
fviz_cos2(res.pca, choice = "var", axes = 2)
```
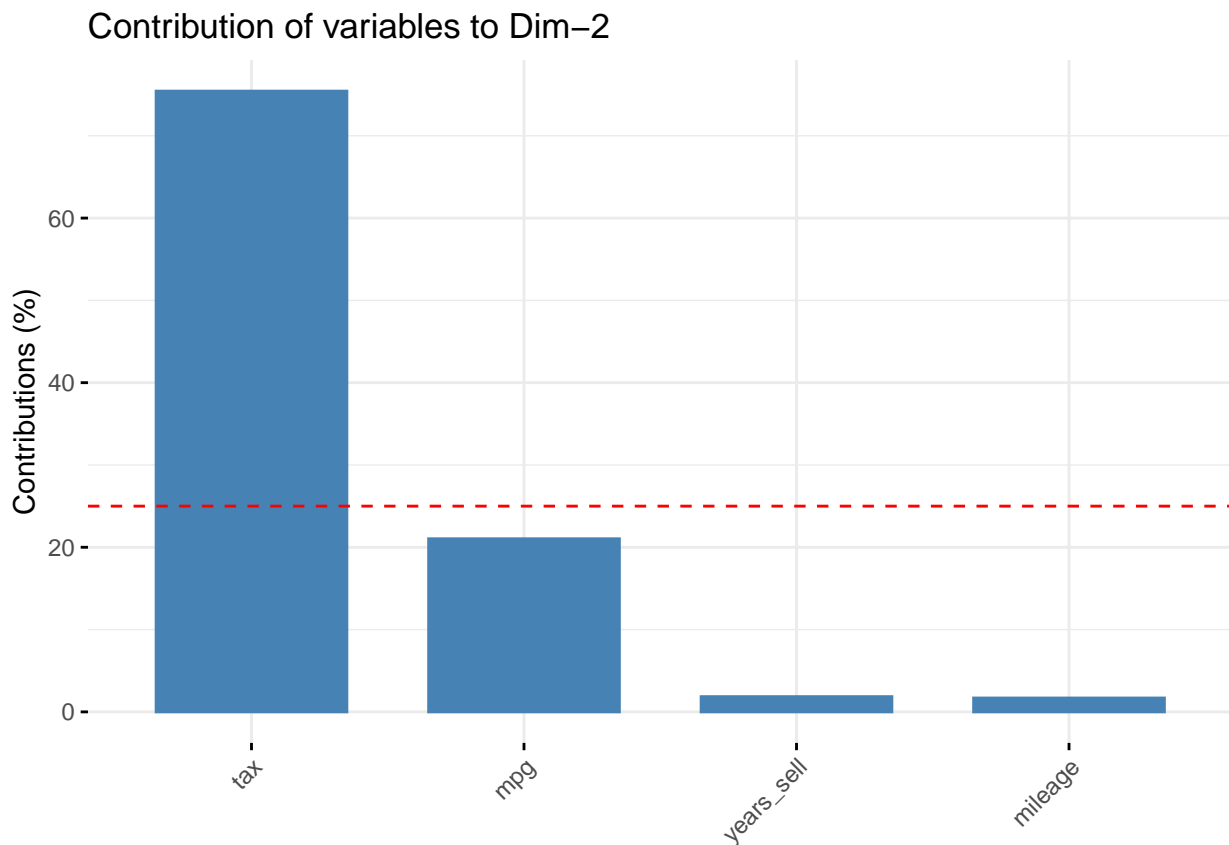
Cos2 of variables to Dim−2
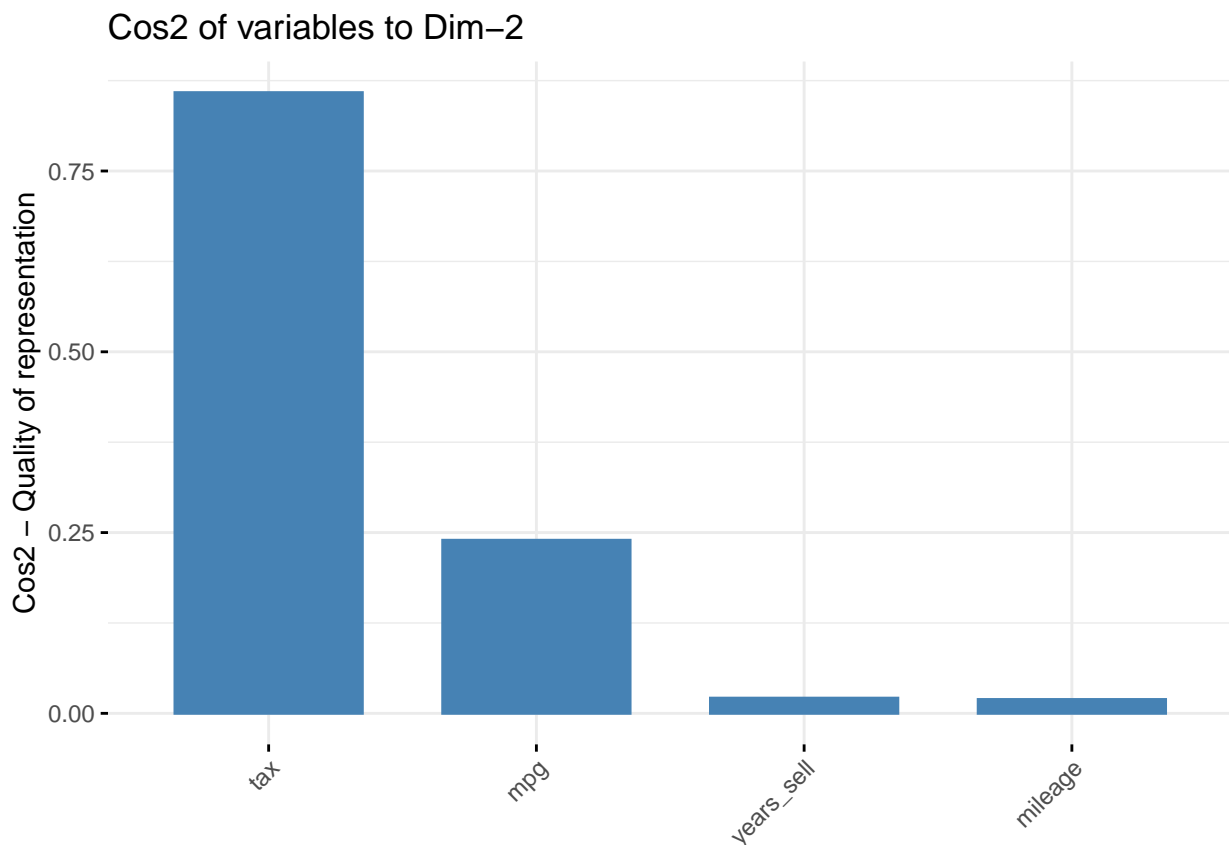
The
tax, years_sell and mileage variables have a positive second dimension and the mpg variable has a negative second

dimension. Dimension 2 shows the greatest positive correlation to tax and the lowest negative correlation to mpg. As we can see with cos2 tax is the best represented in the second dimension.

3 Hierarchical Clustering

As we have seen previously in this report we should pick 2 clusters. But we will pick 7 because it distributes the data more proportionately among the clusters. But you also can see in the table below that the number of individuals for each cluster is still quite unbalanced.

```
res.pca<-PCA(df[,c(vars_res, vars_dis, vars_con)],quali.sup=c(2:13),quanti.sup= c(1), ind.sup = ll )
```


PCA graph of individuals

PCA graph of variables
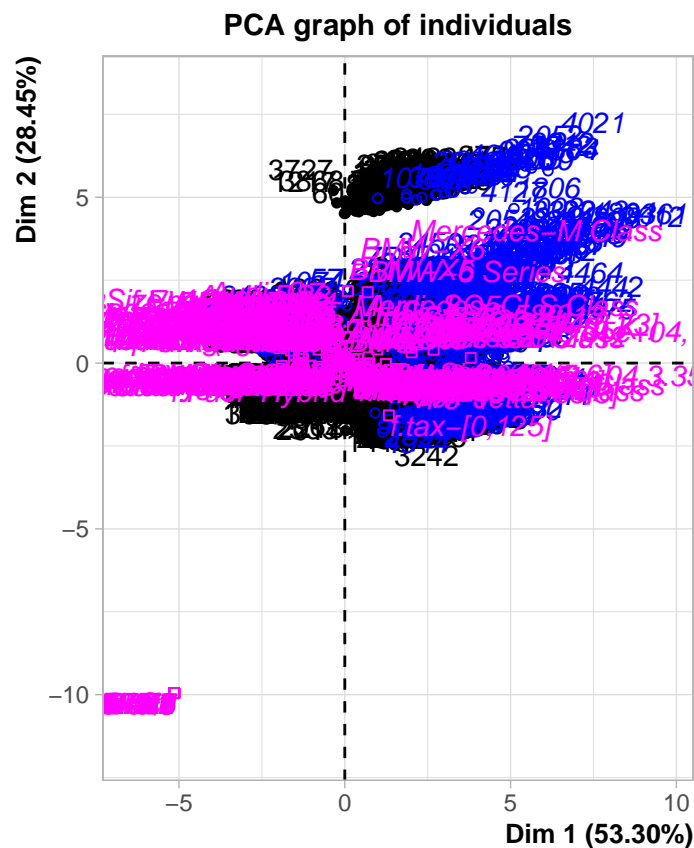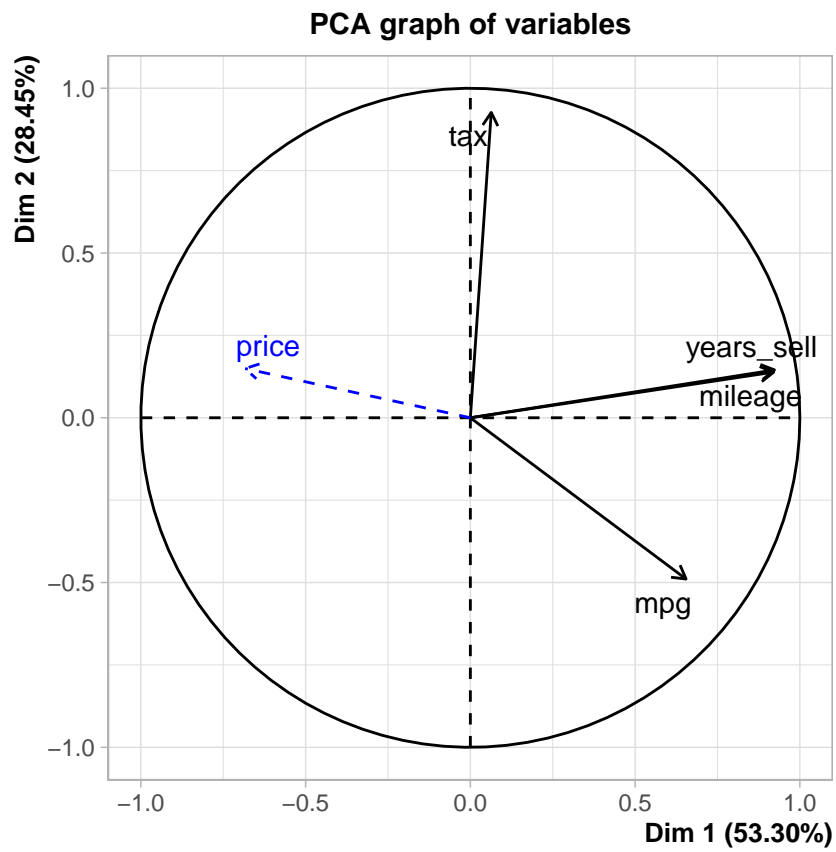

```
res.hcpc<-HCPC(res.pca,nb.clust=7,graph=T)
```

Hierarchical Clustering

Hierarchical Classification

inertia gain
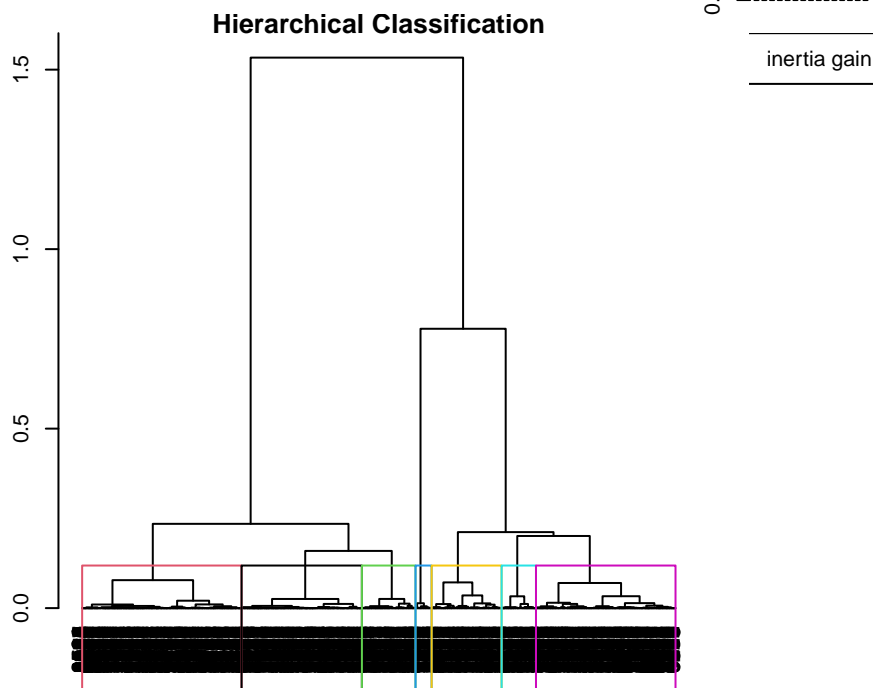
Hierarchical clustering on the factor map
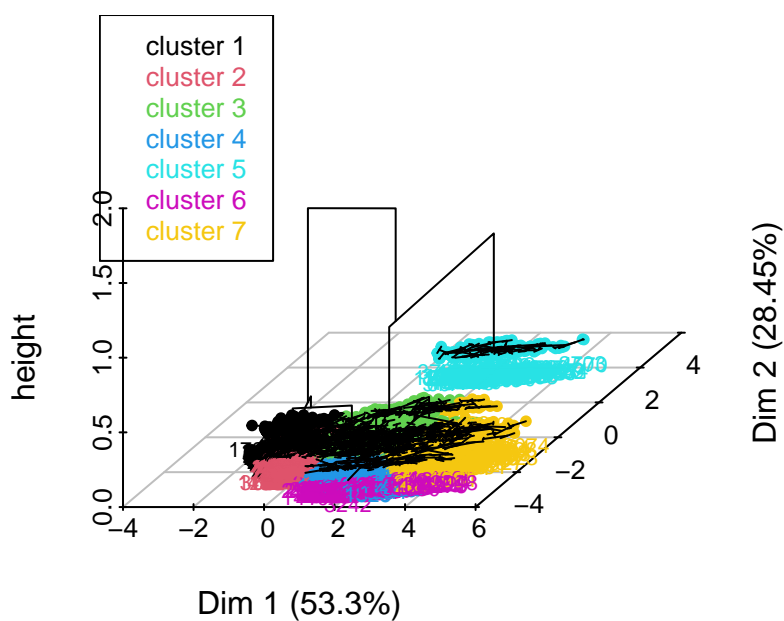
Factor map
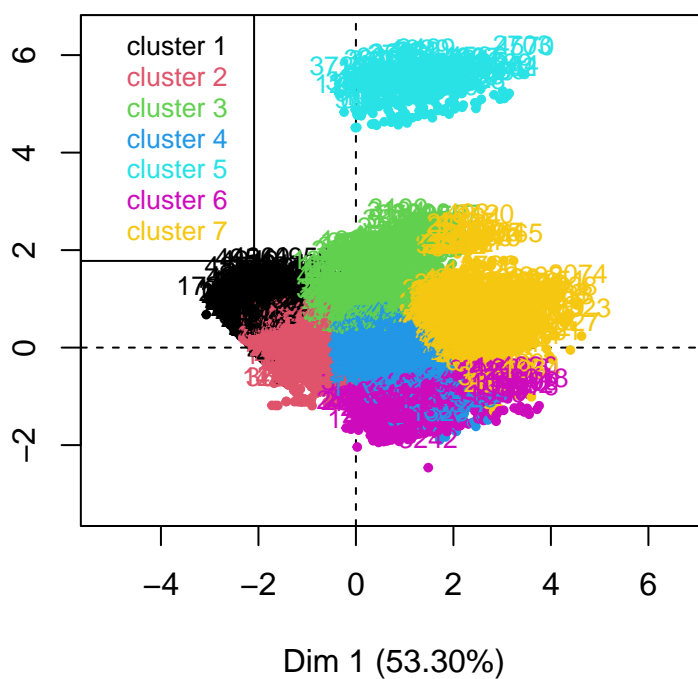

```
table(res.hcpc$data.clust$clust)
```

```
##
##    1    2    3    4    5    6    7
## 1115 1085  572  950  123  263  429
```

```
res.hcpc$desc.var$test.chi2
```

```
##                     p.value  df
## year           0.000000e+00  48
## engineSize     0.000000e+00  96
## aux_price      0.000000e+00  18
## aux_mileage    0.000000e+00  18
## aux_tax        0.000000e+00  12
## aux_mpg        0.000000e+00  18
## aux_years_sell 0.000000e+00  18
## model          1.400798e-299 462
## fuelType       4.027676e-107  18
## transmission   1.786437e-77   12
## manufacturer   1.922873e-34   18
## Audi           2.820428e-17    6
```

```
res.hcpc$desc.var$category
```

```
## $'1'
##                                         Cla/Mod    Mod/Cla     Global
## aux_years_sell=f.years_sell-[2,3]     54.4671690 90.7623318 40.9521710
## aux_mpg=f.mpg-[8.8,44.8]              78.3303730 79.1031390 24.8181618
## year=f.Year-2019                      52.7296082 73.6322870 34.3178312
## aux_price=f.price-(26,110]            58.4562012 60.4484305 25.4132687
## aux_mileage=f.mileage-[4,6e+03]       55.6203164 59.9103139 26.4712365
## fuelType=f.Fuel-Petrol                38.7080366 68.2511211 43.3325986
## aux_tax=f.tax-(125,145]               32.4631861 86.9955157 65.8584968
## year=f.Year-2020                      63.4551495 17.1300448  6.6343399
## engineSize=f.EngSize-1.5             47.4766355 22.7802691 11.7919330
## transmission=f.Trans-SemiAuto         32.2816901 51.3901345 39.1227683
## aux_mileage=f.mileage-(6e+03,1.65e+04] 34.6787479 37.7578475 26.7577695
## engineSize=f.EngSize-3               39.8706897 16.5919283 10.2270223
## model=VW-Sharan                       90.0000000  1.6143498  0.4408199
## engineSize=f.EngSize-1.3             56.5789474  3.8565022  1.6751157
## model=Audi-Q5                         55.0000000  3.9461883  1.7632797
## manufacturer=Audi                     31.6666667 27.2645740 21.1593564
## Audi=Audi Yes                         31.6666667 27.2645740 21.1593564
## transmission=f.Trans-Automatic        30.2573203 30.5829596 24.8402028
## model=VW-Tiguan Allspace              85.7142857  1.0762332  0.3085739
## model=Audi-Q2                         48.1012658  3.4080717  1.7412387
## model=Mercedes-X-CLASS                90.9090909  0.8968610  0.2424510
## model=VW-T-Roc                        50.7936508  2.8699552  1.3885828
## model=Mercedes-GLC Class              42.7272727  4.2152466  2.4245096
## engineSize=f.EngSize-2.3             90.0000000  0.8071749  0.2204100
## model=VW-Amarok                       78.5714286  0.9865471  0.3085739
## model=VW-Touareg                      58.0645161  1.6143498  0.6832709
## model=BMW-M4                          88.8888889  0.7174888  0.1983690
## model=Audi-Q7                         66.6666667  1.0762332  0.3967379
## model=VW-Caravelle                   100.0000000  0.5381166  0.1322460
## model=BMW-Z4                          75.0000000  0.8071749  0.2644920
## model=Mercedes-GLE Class              46.9387755  2.0627803  1.0800088
## aux_price=f.price-(19.5,26]           28.1840592 30.7623318 26.8238924
## model=BMW-M2                         100.0000000  0.4484305  0.1102050
## model=Audi-Q3                         36.4285714  4.5739910  3.0857395
## model=VW-Tiguan                       33.7579618  4.7533632  3.4604364
## model=VW-Golf SV                      47.8260870  0.9865471  0.5069429
## model=Mercedes-SL CLASS               44.8275862  1.1659193  0.6391889
## model=Audi-TT                         44.4444444  1.0762332  0.5951069
## engineSize=f.EngSize-2               26.2526096 45.1121076 42.2305488
## engineSize=f.EngSize-2.9             53.8461538  0.6278027  0.2865330
## model=BMW-X4                          50.0000000  0.7174888  0.3526559
## model=Mercedes-GLS Class              54.5454545  0.5381166  0.2424510
```

```
## engineSize=f.EngSize-2.5                       66.6666667  0.3587444  0.1322460
## model=Mercedes-S Class                          0.0000000  0.0000000  0.2644920
## model=Mercedes-GL Class                         0.0000000  0.0000000  0.2644920
## model=Mercedes-GLA Class                        14.8148148  1.0762332  1.7853207
## model=VW-Scirocco                                4.7619048  0.0896861  0.4628609
## model=Mercedes-E Class                          17.1597633  2.6008969  3.7249284
## fuelType=f.Fuel-Hybrid                           9.5238095  0.3587444  0.9257218
## year=f.Year-2018                                20.1257862  8.6098655 10.5135552
## model=Audi-A6                                   10.7142857  0.5381166  1.2342958
## engineSize=f.EngSize-1.8                         0.0000000  0.0000000  0.3967379
## model=BMW-4 Series                              12.2222222  0.9865471  1.9836897
## model=BMW-1 Series                              13.8888889  2.2421525  3.9673793
## model=BMW-5 Series                               5.6338028  0.3587444  1.5649107
## engineSize=f.EngSize-1                           15.7107232  5.6502242  8.8384395
## model=BMW-3 Series                              10.9523810  2.0627803  4.6286092
## manufacturer=BMW                                18.0921053 14.7982063 20.1013886
## Audi=Audi No                                    22.6726307 72.7354260 78.8406436
## model=Mercedes-A Class                           9.9206349  2.2421525  5.5543311
## model=VW-Up                                      0.0000000  0.0000000  1.8734847
## year=f.Year-2013                                 0.0000000  0.0000000  1.8955257
## aux_mpg=f.mpg-(44.8,53.3]                       17.7591463 20.8968610 28.9177871
## model=VW-Polo                                    8.5798817  2.6008969  7.4498567
## engineSize=f.EngSize-1.2                         0.0000000  0.0000000  2.6669605
## engineSize=f.EngSize-1.6                         5.2287582  1.4349776  6.7445449
## year=f.Year-2014                                 0.0000000  0.0000000  3.5706414
## engineSize=f.EngSize-1.4                         2.9411765  0.7174888  5.9951510
## engineSize=f.EngSize-2.1                         2.7472527  0.8968610  8.0229226
## aux_tax=f.tax-[0,125]                            0.0000000  0.0000000  5.7747410
## aux_tax=f.tax-(145,580]                         11.2665113 13.0044843 28.3667622
## year=f.Year-2015                                 0.0000000  0.0000000  7.7363897
## transmission=f.Trans-Manual                     12.2935780 18.0269058 36.0370289
## aux_price=f.price-(14,19.5]                       8.3050847  8.7892377 26.0083756
## aux_years_sell=f.years_sell-(3,5]                7.8866769  9.2376682 28.7855411
## fuelType=f.Fuel-Diesel                          13.7753077 31.1210762 55.5212696
## aux_years_sell=f.years_sell-(6,23]               0.0000000  0.0000000 13.3568437
## year=f.Year-2017                                 0.8443908  0.6278027 18.2719859
## aux_years_sell=f.years_sell-(5,6]                0.0000000  0.0000000 16.9054441
## year=f.Year-2016                                 0.0000000  0.0000000 16.9054441
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]        0.0000000  0.0000000 19.9030196
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]        2.1328958  2.3318386 26.8679744
## aux_mpg=f.mpg-(61.4,88.3]                         0.0000000  0.0000000 21.7544633
## aux_price=f.price-[0.65,14]                       0.0000000  0.0000000 21.7544633
## aux_mpg=f.mpg-(53.3,61.4]                         0.0000000  0.0000000 24.5095878
##                                                    p.value     v.test
## aux_years_sell=f.years_sell-[2,3]                0.000000e+00       Inf
## aux_mpg=f.mpg-[8.8,44.8]                         0.000000e+00       Inf
## year=f.Year-2019                                3.070798e-216  31.386725
## aux_price=f.price-(26,110]                       3.426577e-192  29.571981
## aux_mileage=f.mileage-[4,6e+03]                  6.734426e-172  27.949238
## fuelType=f.Fuel-Petrol                           1.961580e-83  19.351980
## aux_tax=f.tax-(125,145]                          1.168407e-73  18.155182
## year=f.Year-2020                                 7.800606e-50  14.842324
## engineSize=f.EngSize-1.5                         7.124526e-35  12.319374
## transmission=f.Trans-SemiAuto                    9.589759e-22   9.581228
## aux_mileage=f.mileage-(6e+03,1.65e+04]           1.019223e-20   9.334028
## engineSize=f.EngSize-3                           1.358027e-14   7.700248
## model=VW-Sharan                                  1.121696e-09   6.091054
## engineSize=f.EngSize-1.3                         2.304898e-09   5.974717
## model=Audi-Q5                                    5.055685e-09   5.845329
## manufacturer=Audi                                1.798473e-08   5.630347
## Audi=Audi Yes                                    1.798473e-08   5.630347
## transmission=f.Trans-Automatic                   4.847435e-07   5.032255
## model=VW-Tiguan Allspace                         2.660194e-06   4.695451
## model=Audi-Q2                                    5.445340e-06   4.546855
```

```
## model=Mercedes-X-CLASS                         6.861728e-06   4.497933
## model=VW-T-Roc                                  7.186481e-06   4.488089
## model=Mercedes-GLC Class                        2.544234e-05   4.210840
## engineSize=f.EngSize-2.3                        2.567567e-05   4.208777
## model=VW-Amarok                                 3.500141e-05   4.138218
## model=VW-Touareg                                8.202679e-05   3.938400
## model=BMW-M4                                    9.516327e-05   3.902604
## model=Audi-Q7                                   2.149759e-04   3.700735
## model=VW-Caravelle                              2.180825e-04   3.697093
## model=BMW-Z4                                    3.652986e-04   3.563962
## model=Mercedes-GLE Class                        6.895772e-04   3.393690
## aux_price=f.price-(19.5,26]                     7.097020e-04   3.385803
## model=BMW-M2                                    8.904053e-04   3.323045
## model=Audi-Q3                                   1.519800e-03   3.170876
## model=VW-Tiguan                                 8.520028e-03   2.630736
## model=VW-Golf SV                                1.674905e-02   2.392171
## model=Mercedes-SL CLASS                         1.806534e-02   2.364276
## model=Audi-TT                                   2.516003e-02   2.238937
## engineSize=f.EngSize-2                          2.519116e-02   2.238459
## engineSize=f.EngSize-2.9                        2.697003e-02   2.211951
## model=BMW-X4                                    3.087581e-02   2.158670
## model=Mercedes-GLS Class                        3.827764e-02   2.071869
## engineSize=f.EngSize-2.5                        3.955736e-02   2.058342
## model=Mercedes-S Class                          3.373433e-02  -2.123233
## model=Mercedes-GL Class                         3.373433e-02  -2.123233
## model=Mercedes-GLA Class                        3.348628e-02  -2.126204
## model=VW-Scirocco                               2.342657e-02  -2.266405
## model=Mercedes-E Class                          1.910976e-02  -2.343383
## fuelType=f.Fuel-Hybrid                          1.584254e-02  -2.412523
## year=f.Year-2018                                1.545434e-02  -2.421553
## model=Audi-A6                                   1.029583e-02  -2.565732
## engineSize=f.EngSize-1.8                        6.171855e-03  -2.738509
## model=BMW-4 Series                              3.691949e-03  -2.903349
## model=BMW-1 Series                              3.548332e-04  -3.571581
## model=BMW-5 Series                              2.786018e-05  -4.190287
## engineSize=f.EngSize-1                          6.959690e-06  -4.494918
## model=BMW-3 Series                              4.345937e-07  -5.053145
## manufacturer=BMW                                1.880334e-07  -5.210795
## Audi=Audi No                                    1.798473e-08  -5.630347
## model=Mercedes-A Class                          1.540776e-09  -6.040038
## model=VW-Up                                     2.988633e-11  -6.647130
## year=f.Year-2013                                2.240132e-11  -6.689448
## aux_mpg=f.mpg-(44.8,53.3]                       3.708387e-12  -6.947871
## model=VW-Polo                                   5.875836e-15  -7.806585
## engineSize=f.EngSize-1.2                        8.864362e-16  -8.041641
## engineSize=f.EngSize-1.6                        1.542555e-20  -9.290023
## year=f.Year-2014                                5.476292e-21  -9.399615
## engineSize=f.EngSize-1.4                        5.662246e-24 -10.097580
## engineSize=f.EngSize-2.1                        7.469337e-33 -11.938346
## aux_tax=f.tax-[0,125]                           6.184918e-34 -12.143846
## aux_tax=f.tax-(145,580]                         1.781394e-43 -13.825793
## year=f.Year-2015                                9.278471e-46 -14.199109
## transmission=f.Trans-Manual                     8.518581e-51 -14.990130
## aux_price=f.price-(14,19.5]                      9.039267e-60 -16.305368
## aux_years_sell=f.years_sell-(3,5]               8.266194e-72 -17.919775
## fuelType=f.Fuel-Diesel                          5.628185e-80 -18.937229
## aux_years_sell=f.years_sell-(6,23]              2.417339e-81 -19.102272
## year=f.Year-2017                                1.252978e-100 -21.295376
## aux_years_sell=f.years_sell-(5,6]               2.997051e-105 -21.788279
## year=f.Year-2016                                2.997051e-105 -21.788279
## aux_mileage=f.mileage-(3.35e+04,1.16e+05] 2.039927e-126 -23.916968
## aux_mileage=f.mileage-(1.65e+04,3.35e+04] 7.040396e-134 -24.623712
## aux_mpg=f.mpg-(61.4,88.3]                       5.656096e-140 -25.186326
## aux_price=f.price-[0.65,14]                      5.656096e-140 -25.186326
```

```
## aux_mpg=f.mpg-(53.3,61.4]                    6.907205e-161 -27.028119
##
## $`2`
##                                         Cla/Mod    Mod/Cla     Global
## aux_years_sell=f.years_sell-[2,3]      45.209903 77.4193548 40.9521710
## year=f.Year-2019                       46.885035 67.2811060 34.3178312
## aux_mpg=f.mpg-(44.8,53.3]              43.597561 52.7188940 28.9177871
## aux_tax=f.tax-(125,145]                32.061580 88.2949309 65.8584968
## aux_mileage=f.mileage-[4,6e+03]        44.046628 48.7557604 26.4712365
## aux_mileage=f.mileage-(6e+03,1.65e+04] 42.998353 48.1105991 26.7577695
## year=f.Year-2018                       44.863732 19.7235023 10.5135552
## aux_price=f.price-(19.5,26]            35.168447 39.4470046 26.8238924
## engineSize=f.EngSize-1                 41.645885 15.3917051  8.8384395
## fuelType=f.Fuel-Diesel                 28.384279 65.8986175 55.5212696
## Audi=Audi No                           26.251048 86.5437788 78.8406436
## model=BMW-2 Series                     51.538462  6.1751152  2.8653295
## aux_mpg=f.mpg-(53.3,61.4]              31.205036 31.9815668 24.5095878
## aux_price=f.price-(26,110]             30.182134 32.0737327 25.4132687
## model=VW-T-Cross                       76.000000  1.7511521  0.5510249
## manufacturer=BMW                       30.482456 25.6221198 20.1013886
## year=f.Year-2020                       36.544850 10.1382488  6.6343399
## model=Mercedes-A Class                 36.111111  8.3870968  5.5543311
## engineSize=f.EngSize-1.6               34.313725  9.6774194  6.7445449
## model=BMW-5 Series                     45.070423  2.9493088  1.5649107
## model=VW-Arteon                        59.259259  1.4746544  0.5951069
## engineSize=f.EngSize-1.3               43.421053  3.0414747  1.6751157
## engineSize=f.EngSize-2                 26.670146 47.0967742 42.2305488
## model=BMW-X2                           59.090909  1.1981567  0.4849019
## model=BMW-4 Series                     40.000000  3.3179724  1.9836897
## model=VW-T-Roc                         42.857143  2.4884793  1.3885828
## model=VW-Up                            38.823529  3.0414747  1.8734847
## engineSize=f.EngSize-2.2               70.000000  0.6451613  0.2204100
## model=Mercedes-B Class                 41.379310  2.2119816  1.2783778
## manufacturer=Mercedes                  26.672039 30.5069124 27.3528764
## transmission=f.Trans-SemiAuto          25.971831 42.4884793 39.1227683
## model=Mercedes-C Class                 29.673591  9.2165899  7.4278157
## model=Mercedes-S Class                 58.333333  0.6451613  0.2644920
## model=BMW-X3                           42.105263  1.4746544  0.8375579
## model=Audi-A8                          53.333333  0.7373272  0.3306149
## model=BMW-3 Series                     30.952381  5.9907834  4.6286092
## model=Mercedes-E Class                 30.769231  4.7926267  3.7249284
## model=Audi-Q2                          34.177215  2.4884793  1.7412387
## model=Mercedes-X-CLASS                  0.000000  0.0000000  0.2424510
## model=Mercedes-GLS Class                0.000000  0.0000000  0.2424510
## model=BMW-7 Series                      0.000000  0.0000000  0.2424510
## model=Mercedes-GL Class                 0.000000  0.0000000  0.2644920
## model=BMW-Z4                            0.000000  0.0000000  0.2644920
## transmission=f.Trans-Manual            22.079511 33.2718894 36.0370289
## engineSize=f.EngSize-0                  0.000000  0.0000000  0.2865330
## model=Audi-A3                          17.032967  2.8571429  4.0114613
## model=VW-Tiguan Allspace                0.000000  0.0000000  0.3085739
## model=VW-Amarok                         0.000000  0.0000000  0.3085739
## model=BMW-X4                            0.000000  0.0000000  0.3526559
## model=Mercedes-V Class                  0.000000  0.0000000  0.3967379
## model=Audi-Q7                           0.000000  0.0000000  0.3967379
## model=VW-Sharan                         0.000000  0.0000000  0.4408199
## model=Mercedes-SL CLASS                 3.448276  0.0921659  0.6391889
## model=VW-Scirocco                       0.000000  0.0000000  0.4628609
## model=BMW-X5                            0.000000  0.0000000  0.5289839
## model=Audi-TT                           0.000000  0.0000000  0.5951069
## model=VW-Touareg                        0.000000  0.0000000  0.6832709
## model=Audi-A1                          10.000000  1.1981567  2.8653295
## model=VW-Tiguan                         9.554140  1.3824885  3.4604364
## model=Mercedes-GLE Class                0.000000  0.0000000  1.0800088
```

```
## model=Audi-Q5                                3.750000  0.2764977  1.7632797
## aux_years_sell=f.years_sell-(3,5]           18.759571 22.5806452 28.7855411
## engineSize=f.EngSize-1.4                      9.926471  2.4884793  5.9951510
## aux_mpg=f.mpg-(61.4,88.3]                    16.818642 15.2995392 21.7544633
## engineSize=f.EngSize-2.1                     11.538462  3.8709677  8.0229226
## aux_price=f.price-(14,19.5]                  17.288136 18.8018433 26.0083756
## model=Audi-Q3                                 4.285714  0.5529954  3.0857395
## year=f.Year-2013                              0.000000  0.0000000  1.8955257
## engineSize=f.EngSize-1.2                      1.652893  0.1843318  2.6669605
## manufacturer=Audi                            15.208333 13.4562212 21.1593564
## Audi=Audi Yes                                15.208333 13.4562212 21.1593564
## engineSize=f.EngSize-3                       10.560345  4.5161290 10.2270223
## fuelType=f.Fuel-Petrol                       17.955239 32.5345622 43.3325986
## year=f.Year-2014                              0.000000  0.0000000  3.5706414
## aux_price=f.price-[0.65,14]                  10.638298  9.6774194 21.7544633
## aux_tax=f.tax-[0,125]                         0.000000  0.0000000  5.7747410
## year=f.Year-2015                              0.000000  0.0000000  7.7363897
## aux_tax=f.tax-(145,580]                       9.867910 11.7050691 28.3667622
## year=f.Year-2017                              3.739445  2.8571429 18.2719859
## aux_years_sell=f.years_sell-(6,23]            0.000000  0.0000000 13.3568437
## aux_years_sell=f.years_sell-(5,6]             0.000000  0.0000000 16.9054441
## year=f.Year-2016                              0.000000  0.0000000 16.9054441
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]     2.789171  3.1336406 26.8679744
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]     0.000000  0.0000000 19.9030196
## aux_mpg=f.mpg-[8.8,44.8]                      0.000000  0.0000000 24.8181618
##                                                 p.value     v.test
## aux_years_sell=f.years_sell-[2,3]          1.802046e-174 28.160111
## year=f.Year-2019                           5.785152e-146 25.727312
## aux_mpg=f.mpg-(44.8,53.3]                   5.114833e-82 19.183186
## aux_tax=f.tax-(125,145]                     5.517244e-81 19.059142
## aux_mileage=f.mileage-[4,6e+03]             2.653358e-75 18.361865
## aux_mileage=f.mileage-(6e+03,1.65e+04]      4.931594e-69 17.560640
## year=f.Year-2018                            1.619144e-26 10.656894
## aux_price=f.price-(19.5,26]                 1.053248e-25 10.481266
## engineSize=f.EngSize-1                      1.769201e-16  8.236771
## fuelType=f.Fuel-Diesel                      1.917669e-15  7.946557
## Audi=Audi No                                1.538197e-13  7.383813
## model=BMW-2 Series                          5.604083e-12  6.889368
## aux_mpg=f.mpg-(53.3,61.4]                   1.283188e-10  6.429151
## aux_price=f.price-(26,110]                  1.358003e-08  5.678602
## model=VW-T-Cross                            5.858820e-08  5.423057
## manufacturer=BMW                            3.459745e-07  5.096509
## year=f.Year-2020                            3.737191e-07  5.081879
## model=Mercedes-A Class                      7.910134e-06  4.467602
## engineSize=f.EngSize-1.6                    2.131118e-05  4.250691
## model=BMW-5 Series                          9.003901e-05  3.915977
## model=VW-Arteon                             1.041471e-04  3.880721
## engineSize=f.EngSize-1.3                    1.738740e-04  3.754232
## engineSize=f.EngSize-2                      2.086889e-04  3.708259
## model=BMW-X2                                5.088414e-04  3.476058
## model=BMW-4 Series                          6.544851e-04  3.407968
## model=VW-T-Roc                              9.088825e-04  3.317311
## model=VW-Up                                 2.079432e-03  3.078647
## engineSize=f.EngSize-2.2                    2.927648e-03  2.975234
## model=Mercedes-B Class                      3.234960e-03  2.944482
## manufacturer=Mercedes                       7.990628e-03  2.652466
## transmission=f.Trans-SemiAuto               9.439525e-03  2.595712
## model=Mercedes-C Class                      1.166698e-02  2.522060
## model=Mercedes-S Class                      1.300157e-02  2.483726
## model=BMW-X3                                1.359369e-02  2.467825
## model=Audi-A8                               1.603097e-02  2.408210
## model=BMW-3 Series                          1.708746e-02  2.384820
## model=Mercedes-E Class                      3.786949e-02  2.076265
## model=Audi-Q2                               3.790334e-02  2.075899
```

```
## model=Mercedes-X-CLASS                        4.927928e-02  -1.966167
## model=Mercedes-GLS Class                       4.927928e-02  -1.966167
## model=BMW-7 Series                             4.927928e-02  -1.966167
## model=Mercedes-GL Class                        3.746575e-02  -2.080652
## model=BMW-Z4                                   3.746575e-02  -2.080652
## transmission=f.Trans-Manual                    2.921754e-02  -2.180539
## engineSize=f.EngSize-0                         2.848225e-02  -2.190579
## model=Audi-A3                                  2.274406e-02  -2.277707
## model=VW-Tiguan Allspace                       2.165130e-02  -2.296430
## model=VW-Amarok                                2.165130e-02  -2.296430
## model=BMW-X4                                   1.250870e-02  -2.497459
## model=Mercedes-V Class                         7.224689e-03  -2.686306
## model=Audi-Q7                                  7.224689e-03  -2.686306
## model=VW-Sharan                                4.171619e-03  -2.864884
## model=Mercedes-SL CLASS                        3.929126e-03  -2.883797
## model=VW-Scirocco                              3.169581e-03  -2.950794
## model=BMW-X5                                   1.389668e-03  -3.196789
## model=Audi-TT                                  6.089000e-04  -3.427619
## model=VW-Touareg                               2.024412e-04  -3.715950
## model=Audi-A1                                  4.621518e-05  -4.073986
## model=VW-Tiguan                                3.130672e-06  -4.662055
## model=Mercedes-GLE Class                       1.406442e-06  -4.824090
## model=Audi-Q5                                  8.774816e-07  -4.917295
## aux_years_sell=f.years_sell-(3,5]              1.467824e-07  -5.256551
## engineSize=f.EngSize-1.4                       1.444467e-09  -6.050445
## aux_mpg=f.mpg-(61.4,88.3]                      1.261615e-09  -6.072210
## engineSize=f.EngSize-2.1                       6.619362e-10  -6.174928
## aux_price=f.price-(14,19.5]                    2.177960e-10  -6.348237
## model=Audi-Q3                                  1.795469e-10  -6.377888
## year=f.Year-2013                               4.790495e-11  -6.577306
## engineSize=f.EngSize-1.2                       2.206914e-12  -7.020743
## manufacturer=Audi                              1.538197e-13  -7.383813
## Audi=Audi Yes                                  1.538197e-13  -7.383813
## engineSize=f.EngSize-3                         1.747156e-14  -7.667988
## fuelType=f.Fuel-Petrol                         9.832501e-17  -8.306791
## year=f.Year-2014                               2.330472e-20  -9.246002
## aux_price=f.price-[0.65,14]                    4.688957e-32  -11.784554
## aux_tax=f.tax-[0,125]                          6.672042e-33  -11.947733
## year=f.Year-2015                               2.348438e-44  -13.970839
## aux_tax=f.tax-(145,580]                        7.624179e-50  -14.843858
## year=f.Year-2017                               6.061011e-67  -17.285390
## aux_years_sell=f.years_sell-(6,23]             8.130952e-79  -18.796079
## aux_years_sell=f.years_sell-(5,6]              5.837475e-102 -21.438574
## year=f.Year-2016                               5.837475e-102 -21.438574
## aux_mileage=f.mileage-(1.65e+04,3.35e+04] 1.558050e-118 -23.147012
## aux_mileage=f.mileage-(3.35e+04,1.16e+05] 1.906170e-122 -23.532289
## aux_mpg=f.mpg-[8.8,44.8]                       4.069569e-158 -26.791403
##
## $'3'
##                                               Cla/Mod    Mod/Cla     Global
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]  30.1886792 64.3356643 26.86797443
## aux_tax=f.tax-(145,580]                    25.8741259 58.2167832 28.36676218
## year=f.Year-2017                           29.1917973 42.3076923 18.27198589
## aux_mpg=f.mpg-(44.8,53.3]                  23.6280488 54.1958042 28.91778708
## aux_years_sell=f.years_sell-(3,5]          23.6600306 54.0209790 28.78554111
## engineSize=f.EngSize-3                     33.6206897 27.2727273 10.22702226
## engineSize=f.EngSize-1.4                   41.9117647 19.9300699  5.99515098
## aux_years_sell=f.years_sell-(5,6]          22.2946545 29.8951049 16.90544413
## year=f.Year-2016                           22.2946545 29.8951049 16.90544413
## fuelType=f.Fuel-Petrol                     16.6327569 57.1678322 43.33259863
## model=VW-Tiguan                            33.7579618  9.2657343  3.46043641
## aux_price=f.price-(14,19.5]                18.1355932 37.4125874 26.00837558
## model=Mercedes-GLE Class                   44.8979592  3.8461538  1.08000882
## model=Audi-Q3                              30.0000000  7.3426573  3.08573948
```

```
## engineSize=f.EngSize-1.8                        61.1111111  1.9230769  0.39673793
## year=f.Year-2015                                21.0826211 12.9370629  7.73638968
## model=VW-Scirocco                               52.3809524  1.9230769  0.46286092
## model=Mercedes-V Class                          55.5555556  1.7482517  0.39673793
## model=VW-Touareg                                41.9354839  2.2727273  0.68327088
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]       16.1683278 25.5244755 19.90301962
## model=BMW-M3                                    80.0000000  0.6993007  0.11020498
## manufacturer=Audi                               15.6250000 26.2237762 21.15935640
## Audi=Audi Yes                                   15.6250000 26.2237762 21.15935640
## model=BMW-X3                                    31.5789474  2.0979021  0.83755786
## aux_mpg=f.mpg-[8.8,44.8]                        15.2753108 30.0699301 24.81816178
## model=Audi-Q5                                   25.0000000  3.4965035  1.76327970
## engineSize=f.EngSize-4.2 or more               57.1428571  0.6993007  0.15428697
## model=Mercedes-GLS Class                        45.4545455  0.8741259  0.24245096
## model=Audi-SQ5                                 100.0000000  0.3496503  0.04408199
## model=VW-Shuttle                                44.4444444  0.6993007  0.19836897
## model=Mercedes-CLS Class                        33.3333333  1.0489510  0.39673793
## aux_price=f.price-(19.5,26]                     14.4617913 30.7692308 26.82389244
## model=BMW-3 Series                              17.6190476  6.4685315  4.62860921
## aux_years_sell=f.years_sell-(6,23]              15.1815182 16.0839161 13.35684373
## model=BMW-7 Series                              36.3636364  0.6993007  0.24245096
## model=Mercedes-E Class                           7.6923077  2.2727273  3.72492837
## model=VW-T-Cross                                 0.0000000  0.0000000  0.55102491
## model=Mercedes-A Class                           8.3333333  3.6713287  5.55433106
## model=BMW-5 Series                               4.2253521  0.5244755  1.56491073
## model=VW-T-Roc                                   3.1746032  0.3496503  1.38858276
## model=Mercedes-GLA Class                         3.7037037  0.5244755  1.78532070
## model=Mercedes-GLC Class                         4.5454545  0.8741259  2.42450959
## model=Audi-A3                                    6.0439560  1.9230769  4.01146132
## model=VW-Passat                                  2.5641026  0.3496503  1.71919771
## Audi=Audi No                                    11.7975958 73.7762238 78.84064360
## manufacturer=Mercedes                            9.8307816 21.3286713 27.35287635
## model=Mercedes-B Class                           0.0000000  0.0000000  1.27837778
## engineSize=f.EngSize-1.6                         6.2091503  3.3216783  6.74454485
## model=VW-Up                                      1.1764706  0.1748252  1.87348468
## year=f.Year-2013                                 1.1627907  0.1748252  1.89552568
## engineSize=f.EngSize-1.2                         2.4793388  0.5244755  2.66696055
## aux_price=f.price-[0.65,14]                      8.9159068 15.3846154 21.75446330
## engineSize=f.EngSize-1.3                         0.0000000  0.0000000  1.67511572
## model=Mercedes-C Class                           5.6379822  3.3216783  7.42781574
## engineSize=f.EngSize-2.1                         4.6703297  2.9720280  8.02292264
## aux_mpg=f.mpg-(53.3,61.4]                        8.0935252 15.7342657 24.50958783
## aux_price=f.price-(26,110]                       8.1526453 16.4335664 25.41326868
## fuelType=f.Fuel-Diesel                           9.4481937 41.6083916 55.52126956
## model=VW-Polo                                    2.0710059  1.2237762  7.44985673
## aux_tax=f.tax-[0,125]                            0.0000000  0.0000000  5.77474102
## engineSize=f.EngSize-1.5                         2.6168224  2.4475524 11.79193300
## year=f.Year-2020                                 0.0000000  0.0000000  6.63433987
## engineSize=f.EngSize-1                           0.4987531  0.3496503  8.83843950
## aux_mileage=f.mileage-(6e+03,1.65e+04]           4.7775947 10.1398601 26.75776945
## aux_tax=f.tax-(125,145]                          7.9986613 41.7832168 65.85849680
## aux_mpg=f.mpg-(61.4,88.3]                        0.0000000  0.0000000 21.75446330
## aux_mileage=f.mileage-[4,6e+03]                  0.0000000  0.0000000 26.47123650
## year=f.Year-2019                                 0.0000000  0.0000000 34.31783117
## aux_years_sell=f.years_sell-[2,3]                0.0000000  0.0000000 40.95217104
##                                                      p.value     v.test
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]       2.435623e-91  20.268584
## aux_tax=f.tax-(145,580]                         4.327399e-58  16.067268
## year=f.Year-2017                                1.456410e-47  14.487356
## aux_mpg=f.mpg-(44.8,53.3]                       3.473193e-42  13.610404
## aux_years_sell=f.years_sell-(3,5]               4.006287e-42  13.599964
## engineSize=f.EngSize-3                          2.048401e-36  12.602391
## engineSize=f.EngSize-1.4                        2.290340e-36  12.593584
## aux_years_sell=f.years_sell-(5,6]               1.091130e-16   8.294424
```

```
## year=f.Year-2016                            1.091130e-16    8.294424
## fuelType=f.Fuel-Petrol                      1.237524e-12    7.101117
## model=VW-Tiguan                             2.594591e-12    6.998099
## aux_price=f.price-(14,19.5]                  1.244481e-10    6.433805
## model=Mercedes-GLE Class                     2.335002e-08    5.585149
## model=Audi-Q3                                3.311930e-08    5.524093
## engineSize=f.EngSize-1.8                     1.741718e-06    4.781292
## year=f.Year-2015                             3.428847e-06    4.643302
## model=VW-Scirocco                            1.390402e-05    4.345371
## model=Mercedes-V Class                       1.755580e-05    4.293905
## model=VW-Touareg                             4.933271e-05    4.058766
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]    4.496551e-04    3.509083
## model=BMW-M3                                 1.157564e-03    3.249135
## manufacturer=Audi                            1.905398e-03    3.104595
## Audi=Audi Yes                                1.905398e-03    3.104595
## model=BMW-X3                                 2.206044e-03    3.060993
## aux_mpg=f.mpg-[8.8,44.8]                      2.240698e-03    3.056323
## model=Audi-Q5                                2.342203e-03    3.043015
## engineSize=f.EngSize-4.2 or more             6.920410e-03    2.700650
## model=Mercedes-GLS Class                     8.560110e-03    2.629140
## model=Audi-SQ5                               1.587049e-02    2.411880
## model=VW-Shuttle                             2.124516e-02    2.303599
## model=Mercedes-CLS Class                     2.352383e-02    2.264818
## aux_price=f.price-(19.5,26]                  2.425359e-02    2.253088
## model=BMW-3 Series                           3.163045e-02    2.149050
## aux_years_sell=f.years_sell-(6,23]           4.421418e-02    2.012055
## model=BMW-7 Series                           4.739645e-02    1.982740
## model=Mercedes-E Class                       4.117496e-02   -2.041764
## model=VW-T-Cross                             3.409585e-02   -2.118936
## model=Mercedes-A Class                       2.921485e-02   -2.180575
## model=BMW-5 Series                           1.999853e-02   -2.326375
## model=VW-T-Roc                               1.203195e-02   -2.511206
## model=Mercedes-GLA Class                     7.150056e-03   -2.689773
## model=Mercedes-GLC Class                     4.760492e-03   -2.822809
## model=Audi-A3                                3.461902e-03   -2.923437
## model=VW-Passat                              2.220153e-03   -3.059083
## Audi=Audi No                                 1.905398e-03   -3.104595
## manufacturer=Mercedes                        4.253072e-04   -3.523861
## model=Mercedes-B Class                       3.823670e-04   -3.551964
## engineSize=f.EngSize-1.6                     1.707725e-04   -3.758738
## model=VW-Up                                  1.372640e-04   -3.813047
## year=f.Year-2013                             1.208687e-04   -3.844358
## engineSize=f.EngSize-1.2                     8.521546e-05   -3.929238
## aux_price=f.price-[0.65,14]                  4.600481e-05   -4.075048
## engineSize=f.EngSize-1.3                     3.252555e-05   -4.155023
## model=Mercedes-C Class                       1.305403e-05   -4.359197
## engineSize=f.EngSize-2.1                     1.327104e-07   -5.275063
## aux_mpg=f.mpg-(53.3,61.4]                    5.743292e-08   -5.426615
## aux_price=f.price-(26,110]                   4.280801e-08   -5.478858
## fuelType=f.Fuel-Diesel                       9.775118e-13   -7.133637
## model=VW-Polo                                6.941994e-13   -7.180573
## aux_tax=f.tax-[0,125]                        1.491918e-16   -8.257150
## engineSize=f.EngSize-1.5                     7.653835e-18   -8.604667
## year=f.Year-2020                             5.359536e-19   -8.904566
## engineSize=f.EngSize-1                       4.888317e-22   -9.650570
## aux_mileage=f.mileage-(6e+03,1.65e+04]       2.080141e-25  -10.416715
## aux_tax=f.tax-(125,145]                      1.599169e-36  -12.621899
## aux_mpg=f.mpg-(61.4,88.3]                    1.762414e-66  -17.223734
## aux_mileage=f.mileage-[4,6e+03]              2.274157e-83  -19.344359
## year=f.Year-2019                             2.672856e-114 -22.722697
## aux_years_sell=f.years_sell-[2,3]            7.497481e-144 -25.537823
##
## $`4`
##                                              Cla/Mod    Mod/Cla     Global
```

```
## aux_mpg=f.mpg-(61.4,88.3]                     58.4599797 60.7368421 21.75446330
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]     49.7949139 63.8947368 26.86797443
## year=f.Year-2017                              56.0916767 48.9473684 18.27198589
## aux_years_sell=f.years_sell-(3,5]             43.2618683 59.4736842 28.78554111
## aux_price=f.price-[0.65,14]                   41.6413374 43.2631579 21.75446330
## model=VW-Polo                                 52.6627219 18.7368421  7.44985673
## engineSize=f.EngSize-1.2                      76.0330579  9.6842105  2.66696055
## aux_years_sell=f.years_sell-(5,6]             39.3741851 31.7894737 16.90544413
## year=f.Year-2016                              39.3741851 31.7894737 16.90544413
## transmission=f.Trans-Manual                   31.3149847 53.8947368 36.03702887
## aux_mpg=f.mpg-(53.3,61.4]                     33.5431655 39.2631579 24.50958783
## aux_price=f.price-(14,19.5]                   30.9322034 38.4210526 26.00837558
## engineSize=f.EngSize-2.1                      39.8351648 15.2631579  8.02292264
## engineSize=f.EngSize-1                        37.6558603 15.8947368  8.83843950
## fuelType=f.Fuel-Diesel                        25.1290195 66.6315789 55.52126956
## aux_tax=f.tax-(125,145]                       24.0963855 75.7894737 65.85849680
## manufacturer=VW                               26.0533708 39.0526316 31.38637866
## model=VW-Up                                   45.8823529  4.1052632  1.87348468
## model=Audi-A1                                 36.9230769  5.0526316  2.86532951
## engineSize=f.EngSize-1.6                      28.4313725  9.1578947  6.74454485
## model=Audi-A3                                 30.7692308  5.8947368  4.01146132
## model=Mercedes-A Class                        28.5714286  7.5789474  5.55433106
## model=BMW-1 Series                            29.4444444  5.5789474  3.96737933
## model=Mercedes-E Class                        29.5857988  5.2631579  3.72492837
## Audi=Audi No                                  21.6102880 81.3684211 78.84064360
## model=BMW-i3                                  75.0000000  0.3157895  0.08816399
## engineSize=f.EngSize-2.9                       0.0000000  0.0000000  0.28653295
## model=VW-Tiguan Allspace                       0.0000000  0.0000000  0.30857395
## model=VW-Amarok                                0.0000000  0.0000000  0.30857395
## manufacturer=Audi                             18.4375000 18.6315789 21.15935640
## Audi=Audi Yes                                 18.4375000 18.6315789 21.15935640
## model=Audi-A8                                  0.0000000  0.0000000  0.33061494
## model=BMW-X4                                   0.0000000  0.0000000  0.35265594
## model=VW-Arteon                                3.7037037  0.1052632  0.59510690
## model=BMW-4 Series                            11.1111111  1.0526316  1.98368966
## engineSize=f.EngSize-1.8                       0.0000000  0.0000000  0.39673793
## model=Mercedes-V Class                         0.0000000  0.0000000  0.39673793
## model=Mercedes-CLS Class                       0.0000000  0.0000000  0.39673793
## model=Audi-Q7                                  0.0000000  0.0000000  0.39673793
## model=VW-Sharan                                0.0000000  0.0000000  0.44081993
## model=Mercedes-GLC Class                      10.9090909  1.2631579  2.42450959
## model=BMW-X2                                   0.0000000  0.0000000  0.48490192
## model=BMW-X5                                   0.0000000  0.0000000  0.52898391
## model=VW-T-Cross                               0.0000000  0.0000000  0.55102491
## aux_tax=f.tax-(145,580]                       17.8710179 24.2105263 28.36676218
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]     17.0542636 16.2105263 19.90301962
## model=VW-Touareg                               0.0000000  0.0000000  0.68327088
## model=BMW-X3                                   0.0000000  0.0000000  0.83755786
## model=VW-T-Roc                                 3.1746032  0.2105263  1.38858276
## model=BMW-2 Series                             7.6923077  1.0526316  2.86532951
## model=Audi-Q2                                  3.7974684  0.3157895  1.74123870
## model=Mercedes-GLE Class                       0.0000000  0.0000000  1.08000882
## model=Audi-Q3                                  7.1428571  1.0526316  3.08573948
## manufacturer=BMW                              15.3508772 14.7368421 20.10138858
## transmission=f.Trans-Automatic                15.4392192 18.3157895 24.84020278
## aux_years_sell=f.years_sell-(6,23]            12.7062706  8.1052632 13.35684373
## engineSize=f.EngSize-1.3                       0.0000000  0.0000000  1.67511572
## model=Audi-Q5                                  0.0000000  0.0000000  1.76327970
## aux_mileage=f.mileage-(6e+03,1.65e+04]        15.2388797 19.4736842 26.75776945
## model=VW-Tiguan                                4.4585987  0.7368421  3.46043641
## year=f.Year-2013                               0.0000000  0.0000000  1.89552568
## engineSize=f.EngSize-2                        16.2317328 32.7368421 42.23054882
## year=f.Year-2014                               2.4691358  0.4210526  3.57064139
## fuelType=f.Fuel-Petrol                        15.4628688 32.0000000 43.33259863
```

```
## aux_price=f.price-(19.5,26]              13.1470830 16.8421053 26.82389244
## transmission=f.Trans-SemiAuto            14.8732394 27.7894737 39.12276835
## aux_tax=f.tax-[0,125]                      0.0000000  0.0000000  5.77474102
## year=f.Year-2020                           0.0000000  0.0000000  6.63433987
## engineSize=f.EngSize-3                      0.8620690  0.4210526 10.22702226
## aux_price=f.price-(26,110]                  1.2142238  1.4736842 25.41326868
## aux_mpg=f.mpg-[8.8,44.8]                    0.0000000  0.0000000 24.81816178
## aux_mileage=f.mileage-[4,6e+03]            0.3330558  0.4210526 26.47123650
## aux_mpg=f.mpg-(44.8,53.3]                   0.0000000  0.0000000 28.91778708
## year=f.Year-2019                           0.3853565  0.6315789 34.31783117
## aux_years_sell=f.years_sell-[2,3]          0.3229279  0.6315789 40.95217104
##                                               p.value      v.test
## aux_mpg=f.mpg-(61.4,88.3]                   4.614655e-204   30.481278
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]  3.483871e-167   27.558670
## year=f.Year-2017                           1.288506e-141   25.335803
## aux_years_sell=f.years_sell-(3,5]          1.165581e-112   22.556265
## aux_price=f.price-[0.65,14]                2.108484e-65    17.079519
## model=VW-Polo                              3.088334e-41    13.449770
## engineSize=f.EngSize-1.2                   1.494476e-39    13.159817
## aux_years_sell=f.years_sell-(5,6]          2.108409e-38    12.958310
## year=f.Year-2016                           2.108409e-38    12.958310
## transmission=f.Trans-Manual                7.814524e-37    12.678160
## aux_mpg=f.mpg-(53.3,61.4]                  2.205144e-30    11.455567
## aux_price=f.price-(14,19.5]                1.717482e-21     9.520862
## engineSize=f.EngSize-2.1                   8.819806e-18     8.588388
## engineSize=f.EngSize-1                     7.196956e-16     8.067131
## fuelType=f.Fuel-Diesel                     5.299809e-15     7.819584
## aux_tax=f.tax-(125,145]                    1.261159e-13     7.410193
## manufacturer=VW                            1.635732e-08     5.646683
## model=VW-Up                                2.277319e-07     5.175147
## model=Audi-A1                              2.233091e-05     4.240212
## engineSize=f.EngSize-1.6                   1.265265e-03     3.223744
## model=Audi-A3                              1.470743e-03     3.180395
## model=Mercedes-A Class                     3.086880e-03     2.958951
## model=BMW-1 Series                         5.915979e-03     2.752402
## model=Mercedes-E Class                     6.806730e-03     2.706155
## Audi=Audi No                               3.058544e-02     2.162425
## model=BMW-i3                               3.280477e-02     2.134465
## engineSize=f.EngSize-2.9                   4.693882e-02    -1.986852
## model=VW-Tiguan Allspace                   3.708209e-02    -2.084859
## model=VW-Amarok                            3.708209e-02    -2.084859
## manufacturer=Audi                          3.058544e-02    -2.162425
## Audi=Audi Yes                              3.058544e-02    -2.162425
## model=Audi-A8                              2.929345e-02    -2.179515
## model=BMW-X4                               2.313937e-02    -2.271126
## model=VW-Arteon                            1.584832e-02    -2.412390
## model=BMW-4 Series                         1.511297e-02    -2.429661
## engineSize=f.EngSize-1.8                   1.443566e-02    -2.446236
## model=Mercedes-V Class                     1.443566e-02    -2.446236
## model=Mercedes-CLS Class                   1.443566e-02    -2.446236
## model=Audi-Q7                              1.443566e-02    -2.446236
## model=VW-Sharan                            9.003667e-03    -2.611915
## model=Mercedes-GLC Class                   5.716365e-03    -2.763622
## model=BMW-X2                               5.614355e-03    -2.769493
## model=BMW-X5                               3.500078e-03    -2.920021
## model=VW-T-Cross                           2.763301e-03    -2.992911
## aux_tax=f.tax-(145,580]                    1.247111e-03    -3.227880
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]  1.124804e-03    -3.257293
## model=VW-Touareg                           6.683313e-04    -3.402251
## model=BMW-X3                               1.272461e-04    -3.831729
## model=VW-T-Roc                             5.903356e-05    -4.016641
## model=BMW-2 Series                         3.690155e-05    -4.126070
## model=Audi-Q2                              1.491090e-05    -4.330001
## model=Mercedes-GLE Class                   9.334924e-06    -4.432032
```

```
## model=Audi-Q3                             6.862020e-06  -4.497924
## manufacturer=BMW                          1.919396e-06  -4.761731
## transmission=f.Trans-Automatic            8.433764e-08  -5.357594
## aux_years_sell=f.years_sell-(6,23]        2.059508e-08  -5.606927
## engineSize=f.EngSize-1.3                  1.485881e-08  -5.663186
## model=Audi-Q5                             5.699286e-09  -5.825351
## aux_mileage=f.mileage-(6e+03,1.65e+04]    5.265164e-09  -5.838567
## model=VW-Tiguan                           3.154182e-09  -5.923366
## year=f.Year-2013                          1.351397e-09  -6.061164
## engineSize=f.EngSize-2                    1.753241e-11  -6.725223
## year=f.Year-2014                          2.614903e-12  -6.997006
## fuelType=f.Fuel-Petrol                    1.125090e-15  -8.012381
## aux_price=f.price-(19.5,26]               6.033134e-16  -8.088647
## transmission=f.Trans-SemiAuto             2.775839e-16  -8.182687
## aux_tax=f.tax-[0,125]                     2.289411e-28 -11.046102
## year=f.Year-2020                          1.206237e-32 -11.898410
## engineSize=f.EngSize-3                    8.602897e-44 -13.878070
## aux_price=f.price-(26,110]               3.219729e-113 -22.613118
## aux_mpg=f.mpg-[8.8,44.8]                 1.641438e-135 -24.775639
## aux_mileage=f.mileage-[4,6e+03]          6.059006e-137 -24.908232
## aux_mpg=f.mpg-(44.8,53.3]                9.160220e-163 -27.187372
## year=f.Year-2019                         2.242778e-187 -29.195025
## aux_years_sell=f.years_sell-[2,3]        4.818828e-240 -33.085408
##
## $`5`
##                                            Cla/Mod     Mod/Cla      Global
## aux_tax=f.tax-(145,580]                   9.5571096 100.0000000 28.36676218
## aux_years_sell=f.years_sell-(6,23]        9.4059406  46.3414634 13.35684373
## aux_mileage=f.mileage-(3.35e+04,1.16e+05] 7.0874862  52.0325203 19.90301962
## engineSize=f.EngSize-3                    9.4827586  35.7723577 10.22702226
## aux_mpg=f.mpg-[8.8,44.8]                  5.6838366  52.0325203 24.81816178
## year=f.Year-2015                          9.1168091  26.0162602  7.73638968
## aux_years_sell=f.years_sell-(5,6]         6.2581486  39.0243902 16.90544413
## year=f.Year-2016                          6.2581486  39.0243902 16.90544413
## model=BMW-X5                             37.5000000   7.3170732  0.52898391
## aux_price=f.price-(19.5,26]               4.6836483  46.3414634 26.82389244
## aux_mpg=f.mpg-(44.8,53.3]                 4.4969512  47.9674797 28.91778708
## model=Audi-Q5                            13.7500000   8.9430894  1.76327970
## year=f.Year-2014                          9.2592593  12.1951220  3.57064139
## year=f.Year-2013                         11.6279070   8.1300813  1.89552568
## aux_mileage=f.mileage-(1.65e+04,3.35e+04] 4.1017227  40.6504065 26.86797443
## engineSize=f.EngSize-2                    3.6534447  56.9105691 42.23054882
## model=BMW-6 Series                       30.0000000   2.4390244  0.22040996
## model=Mercedes-M Class                   50.0000000   1.6260163  0.08816399
## model=BMW-X6                             50.0000000   1.6260163  0.08816399
## manufacturer=Audi                         4.0625000  31.7073171 21.15935640
## Audi=Audi Yes                             4.0625000  31.7073171 21.15935640
## model=Audi-Q3                             7.1428571   8.1300813  3.08573948
## transmission=f.Trans-Automatic            3.9041704  35.7723577 24.84020278
## model=Audi-A8                            20.0000000   2.4390244  0.33061494
## model=BMW-X4                             18.7500000   2.4390244  0.35265594
## model=Mercedes-CLS Class                 16.6666667   2.4390244  0.39673793
## model=Audi-Q7                            16.6666667   2.4390244  0.39673793
## model=Mercedes-S Class                   16.6666667   1.6260163  0.26449196
## model=BMW-Z4                             16.6666667   1.6260163  0.26449196
## model=Mercedes-GLC Class                  0.0000000   0.0000000  2.42450959
## model=Audi-A4                             0.0000000   0.0000000  2.53471457
## engineSize=f.EngSize-1.2                  0.0000000   0.0000000  2.66696055
## model=Audi-A1                             0.0000000   0.0000000  2.86532951
## engineSize=f.EngSize-1.4                  0.7352941   1.6260163  5.99515098
## manufacturer=Mercedes                     1.7727639  17.8861789 27.35287635
## model=Mercedes-E Class                    0.0000000   0.0000000  3.72492837
## aux_price=f.price-[0.65,14]               1.5197568  12.1951220 21.75446330
## Audi=Audi No                              2.3483366  68.2926829 78.84064360
```

```
## aux_price=f.price-(26,110]                     1.5611448  14.6341463 25.41326868
## model=Mercedes-C Class                         0.2967359   0.8130081  7.42781574
## aux_tax=f.tax-[0,125]                           0.0000000   0.0000000  5.77474102
## aux_years_sell=f.years_sell-(3,5]               1.3782542  14.6341463 28.78554111
## year=f.Year-2020                                0.0000000   0.0000000  6.63433987
## engineSize=f.EngSize-1.6                        0.0000000   0.0000000  6.74454485
## model=VW-Polo                                   0.0000000   0.0000000  7.44985673
## engineSize=f.EngSize-1                          0.0000000   0.0000000  8.83843950
## transmission=f.Trans-Manual                     1.2844037  17.0731707 36.03702887
## year=f.Year-2018                                0.0000000   0.0000000 10.51355521
## engineSize=f.EngSize-1.5                        0.0000000   0.0000000 11.79193300
## aux_mileage=f.mileage-(6e+03,1.65e+04]          0.7413509   7.3170732 26.75776945
## aux_mpg=f.mpg-(61.4,88.3]                       0.0000000   0.0000000 21.75446330
## aux_mpg=f.mpg-(53.3,61.4]                       0.0000000   0.0000000 24.50958783
## aux_mileage=f.mileage-[4,6e+03]                 0.0000000   0.0000000 26.47123650
## year=f.Year-2019                                0.0000000   0.0000000 34.31783117
## aux_years_sell=f.years_sell-[2,3]               0.0000000   0.0000000 40.95217104
## aux_tax=f.tax-(125,145]                         0.0000000   0.0000000 65.85849680
##                                                      p.value     v.test
## aux_tax=f.tax-(145,580]                         6.369576e-70  17.676438
## aux_years_sell=f.years_sell-(6,23]              1.747650e-19   9.028046
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]       9.893635e-16   8.028171
## engineSize=f.EngSize-3                          1.191617e-14   7.716934
## aux_mpg=f.mpg-[8.8,44.8]                        5.773887e-11   6.549477
## year=f.Year-2015                                4.319601e-10   6.242018
## aux_years_sell=f.years_sell-(5,6]               3.330832e-09   5.914402
## year=f.Year-2016                                3.330832e-09   5.914402
## model=BMW-X5                                    5.690657e-09   5.825604
## aux_price=f.price-(19.5,26]                     2.778016e-06   4.686585
## aux_mpg=f.mpg-(44.8,53.3]                       6.590133e-06   4.506514
## model=Audi-Q5                                   9.140160e-06   4.436575
## year=f.Year-2014                                3.083755e-05   4.167191
## year=f.Year-2013                                1.083519e-04   3.871085
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]       8.036222e-04   3.351544
## engineSize=f.EngSize-2                          9.523471e-04   3.304239
## model=BMW-6 Series                              2.125145e-03   3.072162
## model=Mercedes-M Class                          4.297143e-03   2.855483
## model=BMW-X6                                    4.297143e-03   2.855483
## manufacturer=Audi                               5.625656e-03   2.768838
## Audi=Audi Yes                                   5.625656e-03   2.768838
## model=Audi-Q3                                   5.644753e-03   2.767734
## transmission=f.Trans-Automatic                  6.215898e-03   2.736170
## model=Audi-A8                                   7.527234e-03   2.672571
## model=BMW-X4                                    9.138136e-03   2.606843
## model=Mercedes-CLS Class                        1.295435e-02   2.485022
## model=Audi-Q7                                   1.295435e-02   2.485022
## model=Mercedes-S Class                          4.386434e-02   2.015385
## model=BMW-Z4                                     4.386434e-02   2.015385
## model=Mercedes-GLC Class                        4.685259e-02  -1.987630
## model=Audi-A4                                    4.069296e-02  -2.046645
## engineSize=f.EngSize-1.2                        3.435337e-02  -2.115899
## model=Audi-A1                                    2.663509e-02  -2.216824
## engineSize=f.EngSize-1.4                        2.253878e-02  -2.281163
## manufacturer=Mercedes                           1.392839e-02  -2.459105
## model=Mercedes-E Class                          8.788103e-03  -2.620189
## aux_price=f.price-[0.65,14]                     6.270384e-03  -2.733297
## Audi=Audi No                                    5.625656e-03  -2.768838
## aux_price=f.price-(26,110]                      3.637814e-03  -2.907972
## model=Mercedes-C Class                          8.006980e-04  -3.352553
## aux_tax=f.tax-[0,125]                           5.994214e-04  -3.431876
## aux_years_sell=f.years_sell-(3,5]               2.108001e-04  -3.705709
## year=f.Year-2020                                1.909925e-04  -3.730642
## engineSize=f.EngSize-1.6                        1.648160e-04  -3.767613
## model=VW-Polo                                   6.389464e-05  -3.997946
```

```
## engineSize=f.EngSize-1                          9.679875e-06  -4.424203
## transmission=f.Trans-Manual                     3.084650e-06  -4.665101
## year=f.Year-2018                                9.552526e-07  -4.900639
## engineSize=f.EngSize-1.5                         1.583524e-07  -5.242573
## aux_mileage=f.mileage-(6e+03,1.65e+04]           3.867777e-08  -5.496785
## aux_mpg=f.mpg-(61.4,88.3]                        4.916478e-14  -7.534118
## aux_mpg=f.mpg-(53.3,61.4]                        5.527285e-16  -8.099308
## aux_mileage=f.mileage-[4,6e+03]                  2.041982e-17  -8.491380
## year=f.Year-2019                                 1.452254e-23 -10.004772
## aux_years_sell=f.years_sell-[2,3]                2.226146e-29 -11.253487
## aux_tax=f.tax-(125,145]                          1.435974e-59 -16.277063
##
## $`6`
##                                            Cla/Mod     Mod/Cla     Global
## aux_tax=f.tax-[0,125]                   100.00000000 99.6197719   5.7747410
## aux_mpg=f.mpg-(53.3,61.4]                16.54676259 69.9619772  24.5095878
## aux_years_sell=f.years_sell-(5,6]        16.81877445 49.0494297  16.9054441
## year=f.Year-2016                         16.81877445 49.0494297  16.9054441
## engineSize=f.EngSize-2.1                 21.70329670 30.0380228   8.0229226
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]  14.17497231 48.6692015  19.9030196
## aux_price=f.price-(14,19.5]              11.69491525 52.4714829  26.0083756
## aux_years_sell=f.years_sell-(6,23]       13.20132013 30.4182510  13.3568437
## model=Mercedes-GLC Class                 24.54545455 10.2661597   2.4245096
## model=Mercedes-GLA Class                 27.16049383  8.3650190   1.7853207
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]   9.51599672 44.1064639  26.8679744
## model=BMW-X1                             28.57142857  7.6045627   1.5428697
## manufacturer=Mercedes                     8.78323932 41.4448669  27.3528764
## fuelType=f.Fuel-Diesel                    7.26478761 69.5817490  55.5212696
## year=f.Year-2015                         11.96581197 15.9695817   7.7363897
## year=f.Year-2013                         18.60465116  6.0836502   1.8955257
## model=Mercedes-GL Class                  41.66666667  1.9011407   0.2644920
## year=f.Year-2014                         12.96296296  7.9847909   3.5706414
## manufacturer=BMW                          7.78508772 26.9961977  20.1013886
## model=VW-Touran                          17.64705882  2.2813688   0.7493939
## aux_price=f.price-[0.65,14]               7.39614995 27.7566540  21.7544633
## Audi=Audi No                             6.17836176 84.0304183  78.8406436
## manufacturer=Audi                         4.37500000 15.9695817  21.1593564
## Audi=Audi Yes                             4.37500000 15.9695817  21.1593564
## model=VW-T-Roc                            0.00000000  0.0000000   1.3885828
## engineSize=f.EngSize-1.3                  0.00000000  0.0000000   1.6751157
## model=Audi-Q5                             0.00000000  0.0000000   1.7632797
## model=VW-Up                               0.00000000  0.0000000   1.8734847
## aux_years_sell=f.years_sell-(3,5]         4.13476263 20.5323194  28.7855411
## engineSize=f.EngSize-1.5                  2.99065421  6.0836502  11.7919330
## model=VW-Polo                             2.07100592  2.6615970   7.4498567
## aux_price=f.price-(19.5,26]               3.86195563 17.8707224  26.8238924
## fuelType=f.Fuel-Petrol                    4.01831129 30.0380228  43.3325986
## model=VW-Golf                             1.53508772  2.6615970  10.0506943
## engineSize=f.EngSize-3                    1.29310345  2.2813688  10.2270223
## year=f.Year-2020                          0.00000000  0.0000000   6.6343399
## manufacturer=VW                           2.87921348 15.5893536  31.3863787
## engineSize=f.EngSize-1                    0.00000000  0.0000000   8.8384395
## year=f.Year-2018                          0.00000000  0.0000000  10.5135552
## aux_mileage=f.mileage-(6e+03,1.65e+04]    1.56507414  7.2243346  26.7577695
## aux_price=f.price-(26,110]                0.43365134  1.9011407  25.4132687
## aux_mpg=f.mpg-(61.4,88.3]                 0.00000000  0.0000000  21.7544633
## aux_mpg=f.mpg-[8.8,44.8]                  0.08880995  0.3802281  24.8181618
## aux_mileage=f.mileage-[4,6e+03]           0.00000000  0.0000000  26.4712365
## aux_tax=f.tax-(145,580]                   0.00000000  0.0000000  28.3667622
## year=f.Year-2019                          0.00000000  0.0000000  34.3178312
## aux_years_sell=f.years_sell-[2,3]         0.00000000  0.0000000  40.9521710
## aux_tax=f.tax-(125,145]                   0.03346720  0.3802281  65.8584968
##                                             p.value     v.test
## aux_tax=f.tax-[0,125]                    0.000000e+00       Inf
```

```
## aux_mpg=f.mpg-(53.3,61.4]                    4.289299e-58  16.067817
## aux_years_sell=f.years_sell-(5,6]            1.006143e-35  12.476250
## year=f.Year-2016                             1.006143e-35  12.476250
## engineSize=f.EngSize-2.1                     1.130251e-27  10.901779
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]    2.738265e-27  10.820982
## aux_price=f.price-(14,19.5]                  4.361829e-21   9.423527
## aux_years_sell=f.years_sell-(6,23]           9.291914e-14   7.450597
## model=Mercedes-GLC Class                     6.260056e-11   6.537393
## model=Mercedes-GLA Class                     5.039742e-10   6.217862
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]    5.874826e-10   6.193753
## model=BMW-X1                                 1.202966e-09   6.079848
## manufacturer=Mercedes                        3.857900e-07   5.075839
## fuelType=f.Fuel-Diesel                       1.633256e-06   4.794200
## year=f.Year-2015                             4.209724e-06   4.600750
## year=f.Year-2013                             3.116050e-05   4.164815
## model=Mercedes-GL Class                      3.809536e-04   3.552938
## year=f.Year-2014                             4.991480e-04   3.481213
## manufacturer=BMW                             5.426874e-03   2.780539
## model=VW-Touran                              1.502677e-02   2.431733
## aux_price=f.price-[0.65,14]                  1.780602e-02   2.369627
## Audi=Audi No                                 3.006261e-02   2.169264
## manufacturer=Audi                            3.006261e-02  -2.169264
## Audi=Audi Yes                                3.006261e-02  -2.169264
## model=VW-T-Roc                               2.262183e-02  -2.279762
## engineSize=f.EngSize-1.3                     1.028050e-02  -2.566249
## model=Audi-Q5                                8.061550e-03  -2.649481
## model=VW-Up                                  5.946842e-03  -2.750698
## aux_years_sell=f.years_sell-(3,5]            1.779870e-03  -3.124699
## engineSize=f.EngSize-1.5                     1.562562e-03  -3.162807
## model=VW-Polo                                7.284769e-04  -3.378631
## aux_price=f.price-(19.5,26]                  4.797187e-04  -3.491833
## fuelType=f.Fuel-Petrol                       5.383407e-06  -4.549263
## model=VW-Golf                                2.706381e-06  -4.691931
## engineSize=f.EngSize-3                       3.833616e-07  -5.077039
## year=f.Year-2020                             8.223950e-09  -5.763803
## manufacturer=VW                              1.832350e-09  -6.012012
## engineSize=f.EngSize-1                       1.250816e-11  -6.774217
## year=f.Year-2018                             8.092862e-14  -7.468801
## aux_mileage=f.mileage-(6e+03,1.65e+04]       1.700696e-16  -8.241497
## aux_price=f.price-(26,110]                   1.636107e-27 -10.868078
## aux_mpg=f.mpg-(61.4,88.3]                    1.048457e-29 -11.319687
## aux_mpg=f.mpg-[8.8,44.8]                     1.819404e-32 -11.864057
## aux_mileage=f.mileage-[4,6e+03]              4.304970e-37 -12.724814
## aux_tax=f.tax-(145,580]                      3.353107e-40 -13.272261
## year=f.Year-2019                             1.502424e-50 -14.952397
## aux_years_sell=f.years_sell-[2,3]            2.588001e-63 -16.796517
## aux_tax=f.tax-(125,145]                      1.403298e-127 -24.028430
##
## $`7`
##                                                 Cla/Mod    Mod/Cla     Global
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]    45.5149502 95.8041958 19.90301962
## aux_years_sell=f.years_sell-(6,23]           49.5049505 69.9300699 13.35684373
## aux_price=f.price-[0.65,14]                  29.8885512 68.7645688 21.75446330
## aux_tax=f.tax-(145,580]                      25.5633256 76.6899767 28.36676218
## year=f.Year-2014                             64.8148148 24.4755245  3.57064139
## aux_mpg=f.mpg-(61.4,88.3]                    24.7213779 56.8764569 21.75446330
## year=f.Year-2015                             37.0370370 30.3030303  7.73638968
## year=f.Year-2013                             68.6046512 13.7529138  1.89552568
## fuelType=f.Fuel-Diesel                       13.4974196 79.2540793 55.52126956
## transmission=f.Trans-Manual                  14.6177370 55.7109557 36.03702887
## aux_years_sell=f.years_sell-(5,6]            15.2542373 27.2727273 16.90544413
## year=f.Year-2016                             15.2542373 27.2727273 16.90544413
## engineSize=f.EngSize-1.6                     18.9542484 13.5198135  6.74454485
## engineSize=f.EngSize-2.1                     17.8571429 15.1515152  8.02292264
```

```
## year=f.Year-2012                              85.7142857  1.3986014  0.15428697
## model=VW-Passat                               25.6410256  4.6620047  1.71919771
## model=Audi-A3                                 17.5824176  7.4592075  4.01146132
## model=Mercedes-SLK                           100.0000000  0.6993007  0.06612299
## model=BMW-3 Series                            15.7142857  7.6923077  4.62860921
## engineSize=f.EngSize-1.4                      14.3382353  9.0909091  5.99515098
## model=BMW-1 Series                            15.0000000  6.2937063  3.96737933
## model=VW-Touareg                               0.0000000  0.0000000  0.68327088
## model=BMW-2 Series                             4.6153846  1.3986014  2.86532951
## manufacturer=Mercedes                          7.8968574 22.8438228 27.35287635
## model=Audi-Q5                                  2.5000000  0.4662005  1.76327970
## model=Mercedes-GLE Class                       0.0000000  0.0000000  1.08000882
## model=Audi-Q2                                  1.2658228  0.2331002  1.74123870
## model=VW-T-Roc                                 0.0000000  0.0000000  1.38858276
## engineSize=f.EngSize-1.3                       0.0000000  0.0000000  1.67511572
## engineSize=f.EngSize-1                         4.4887781  4.1958042  8.83843950
## model=Mercedes-GLC Class                       0.0000000  0.0000000  2.42450959
## engineSize=f.EngSize-3                         4.3103448  4.6620047 10.22702226
## engineSize=f.EngSize-1.5                       3.7383178  4.6620047 11.79193300
## aux_tax=f.tax-[0,125]                          0.0000000  0.0000000  5.77474102
## year=f.Year-2020                               0.0000000  0.0000000  6.63433987
## aux_mpg=f.mpg-(44.8,53.3]                      4.5731707 13.9860140 28.91778708
## transmission=f.Trans-SemiAuto                  5.4084507 22.3776224 39.12276835
## year=f.Year-2018                               0.0000000  0.0000000 10.51355521
## year=f.Year-2017                               1.4475271  2.7972028 18.27198589
## fuelType=f.Fuel-Petrol                         4.1709054 19.1142191 43.33259863
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]      1.4766202  4.1958042 26.86797443
## aux_mpg=f.mpg-[8.8,44.8]                       0.6216696  1.6317016 24.81816178
## aux_years_sell=f.years_sell-(3,5]              0.9188361  2.7972028 28.78554111
## aux_price=f.price-(19.5,26]                    0.4930156  1.3986014 26.82389244
## aux_price=f.price-(26,110]                     0.0000000  0.0000000 25.41326868
## aux_mileage=f.mileage-[4,6e+03]                0.0000000  0.0000000 26.47123650
## aux_mileage=f.mileage-(6e+03,1.65e+04]         0.0000000  0.0000000 26.75776945
## aux_tax=f.tax-(125,145]                        3.3467202 23.3100233 65.85849680
## year=f.Year-2019                               0.0000000  0.0000000 34.31783117
## aux_years_sell=f.years_sell-[2,3]              0.0000000  0.0000000 40.95217104
##                                                    p.value      v.test
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]     9.891670e-299  36.941721
## aux_years_sell=f.years_sell-(6,23]            1.190092e-189  29.373713
## aux_price=f.price-[0.65,14]                   2.196663e-109  22.220082
## aux_tax=f.tax-(145,580]                       6.461240e-107  21.963313
## year=f.Year-2014                               3.367288e-71  17.841469
## aux_mpg=f.mpg-(61.4,88.3]                      2.802331e-63  16.791796
## year=f.Year-2015                               2.895136e-50  14.908658
## year=f.Year-2013                               1.379575e-41  13.509230
## fuelType=f.Fuel-Diesel                         4.718653e-27  10.770997
## transmission=f.Trans-Manual                    2.843931e-18   8.717507
## aux_years_sell=f.years_sell-(5,6]              1.360434e-08   5.678296
## year=f.Year-2016                               1.360434e-08   5.678296
## engineSize=f.EngSize-1.6                       1.152278e-07   5.300909
## engineSize=f.EngSize-2.1                       1.910522e-07   5.207839
## year=f.Year-2012                               4.523182e-06   4.585769
## model=VW-Passat                                2.947729e-05   4.177467
## model=Audi-A3                                  4.960550e-04   3.482878
## model=Mercedes-SLK                             8.400591e-04   3.339247
## model=BMW-3 Series                             3.183018e-03   2.949487
## engineSize=f.EngSize-1.4                       7.344760e-03   2.680795
## model=BMW-1 Series                             1.501424e-02   2.432036
## model=VW-Touareg                               4.550310e-02  -1.999974
## model=BMW-2 Series                             4.308395e-02  -2.022895
## manufacturer=Mercedes                          2.589983e-02  -2.227710
## model=Audi-Q5                                  1.800941e-02  -2.365425
## model=Mercedes-GLE Class                       7.488184e-03  -2.674316
## model=Audi-Q2                                  3.787305e-03  -2.895355
```

```
## model=VW-T-Roc                                  1.830504e-03  -3.116438
## engineSize=f.EngSize-1.3                         4.927869e-04  -3.484647
## engineSize=f.EngSize-1                           1.171853e-04  -3.851941
## model=Mercedes-GLC Class                         1.562498e-05  -4.319688
## engineSize=f.EngSize-3                           1.391587e-05  -4.345184
## engineSize=f.EngSize-1.5                         1.132372e-07  -5.304089
## aux_tax=f.tax-[0,125]                            2.195269e-12  -7.021482
## year=f.Year-2020                                 3.482496e-14  -7.578992
## aux_mpg=f.mpg-(44.8,53.3]                        2.626474e-14  -7.615512
## transmission=f.Trans-SemiAuto                    1.180600e-14  -7.718118
## year=f.Year-2018                                 1.573773e-22  -9.766111
## year=f.Year-2017                                 1.054585e-24 -10.261136
## fuelType=f.Fuel-Petrol                           1.457598e-28 -11.086577
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]        7.890038e-38 -12.856673
## aux_mpg=f.mpg-[8.8,44.8]                         3.074791e-45 -14.114894
## aux_years_sell=f.years_sell-(3,5]               6.145270e-49 -14.703235
## aux_price=f.price-(19.5,26]                      1.044903e-51 -15.128860
## aux_price=f.price-(26,110]                       1.369910e-58 -16.138426
## aux_mileage=f.mileage-[4,6e+03]                  1.947890e-61 -16.538190
## aux_mileage=f.mileage-(6e+03,1.65e+04]           3.242714e-62 -16.645860
## aux_tax=f.tax-(125,145]                          1.866950e-80 -18.995250
## year=f.Year-2019                                 4.922035e-84 -19.423107
## aux_years_sell=f.years_sell-[2,3]               1.508111e-105 -21.819710
```

We start with the description of the categorical variables that characterize the clusters:

Cluster 1: Cluster one has cars with few years_sell, low mpg, medium taxes, low mileage and high price. Also, cars with semiAuto transmission and cars with petrol as fuel predominate. We can say this because these categories are overrepresented in the cluster.

Cluster 2: Cluster two has cars with few years_sell, low mpg and medium taxes and high price. Also, cars with diesel as fuel and non-Audi cars predominate.

Cluster 3: Cluster three has cars with high taxes, few years_sell, low mpg and high mileage and medium price. Also, cars with petrol as fuel predominate.

Cluster 4: Cluster four has cars with high mpg, high mileage, few years_sell, low price and medium taxes. Also, cars with manual transmission and cars with diesel as fuel predominate.

Cluster 5: Cluster five has cars high taxes, high years_sell, high mileage, low mpg and medium-high price.

Cluster 6: Cluster six has cars with low taxes, high mpg, high years_sell, high mileage and low price. Also, non-Audi cars predominate.

Cluster 7: Cluster seven has cars with high mileage, high years_sell, low price, high taxes and high mpg. Also, cars with diesel as fuel and cars with manual transmission predominate.

Cluster 8: Cluster of multivariant outliers.

```
res.hcpc$desc.var$quanti.var
```

```
##                 Eta2 P-value
## price      0.4588663       0
## mileage    0.7666377       0
## tax        0.9299117       0
## mpg        0.7156411       0
## years_sell 0.7859983       0
```

```
res.hcpc$desc.var$quanti
```

```
## $'1'
##             v.test Mean in category Overall mean sd in category    Overall sd
## price     36.976855     30102.827803 21432.746088     9015.830564   9014.199606
## tax       -2.662444       145.628274   146.384170        1.792052     10.914805
## mileage  -32.039923      5812.507623 19240.275517     4656.415718  16111.883519
## years_sell -35.496314        2.927354     4.523914        0.526530      1.729163
```

```
## mpg          -45.379436     39.915067   52.881019      5.380837   10.984473
##                        p.value
## price      2.697200e-299
## tax          7.757544e-03
## mileage    3.033028e-225
## years_sell 5.603063e-276
## mpg          0.000000e+00
##
## $`2`
##               v.test Mean in category Overall mean sd in category   Overall sd
## price        8.589204     23483.266359 21432.746088   6917.8501498 9014.199606
## mpg          7.462959        55.052091    52.881019      6.0517425   10.984473
## tax         -3.231640       145.450007   146.384170      1.9954547   10.914805
## mileage    -29.232483      6766.554839 19240.275517   5011.2700906 16111.883519
## years_sell -29.935866         3.152995     4.523914      0.6240959    1.729163
##                        p.value
## price        8.757425e-18
## mpg          8.460078e-14
## tax          1.230818e-03
## mileage      7.498773e-188
## years_sell   6.721228e-197
##
## $`3`
##               v.test Mean in category Overall mean sd in category   Overall sd
## years_sell  14.983046         5.536713     4.523914      0.9700308    1.729163
## mileage     12.801364     27303.145105 19240.275517   9058.2672706 16111.883519
## tax          7.126435       149.424883   146.384170      5.3695727   10.914805
## price       -3.052076     20357.248252 21432.746088   6431.1260475 9014.199606
## mpg        -12.187832        47.647512    52.881019      6.2757653   10.984473
##                        p.value
## years_sell 9.477153e-51
## mileage    1.610955e-37
## tax        1.030021e-12
## price      2.272647e-03
## mpg        3.608931e-34
##
## $`4`
##               v.test Mean in category Overall mean sd in category   Overall sd
## mpg         37.392552        64.731383    52.881019      5.7548139   10.984473
## years_sell  16.885568         5.366316     4.523914      0.8120942    1.729163
## mileage     11.635725     24649.152848 19240.275517   8540.2117516 16111.883519
## tax         -5.614238       144.616203   146.384170      2.6134466   10.914805
## price      -24.094376     15166.460000 21432.746088   4574.8333275 9014.199606
##                        p.value
## mpg        5.163404e-306
## years_sell 5.746074e-64
## mileage    2.712746e-31
## tax        1.974307e-08
## price      2.863163e-128
##
## $`5`
##               v.test Mean in category Overall mean sd in category   Overall sd
## tax         56.608581       201.341463   146.384170       2.215354   10.914805
## years_sell  13.508968         6.601626     4.523914       1.124305    1.729163
## mileage     11.129509     35189.861789 19240.275517   12894.252868 16111.883519
## mpg         -8.894295        44.191057    52.881019       3.462083   10.984473
##                        p.value
## tax        0.000000e+00
## years_sell 1.384490e-41
## mileage    9.013013e-29
## mpg        5.879132e-19
##
## $`6`
##               v.test Mean in category Overall mean sd in category   Overall sd
```

```
## years_sell  17.274191           6.311787     4.523914  1.093419e+00     1.729163
## mileage     16.556216        35206.794677 19240.275517  1.360068e+04 16111.883519
## mpg          5.038208           56.193536    52.881019  3.281298e+00    10.984473
## price        -9.151840        16494.889734 21432.746088  4.336134e+03  9014.199606
## tax         -32.732077          125.000000   146.384170  8.720414e-01    10.914805
##                   p.value
## years_sell  7.359876e-67
## mileage     1.443955e-61
## mpg         4.699110e-07
## price       5.597194e-20
## tax         5.462959e-235
##
## $'7'
##              v.test Mean in category Overall mean sd in category   Overall sd
## mileage     39.657865      48598.22335 19240.275517    9424.304078 16111.883519
## years_sell  34.099871          7.23310     4.523914       1.118493     1.729163
## mpg         18.635327         62.28618    52.881019       7.687089    10.984473
## tax          3.072233        147.92488   146.384170       3.800915    10.914805
## price      -22.229546      12225.96503 21432.746088    3378.880783  9014.199606
##                  p.value
## mileage     0.000000e+00
## years_sell  7.408703e-255
## mpg         1.661350e-77
## tax         2.124637e-03
## price       1.779241e-109
```

Regarding quantitative variables:

Cluster 1: As we can see price mean is greater in cluster 1 than in the overall mean. Also, we can see that tax, mileage, years_sell and mpg means are lower in cluster 1 than in the overall means. So we can say that cluster 1 is a cluster of expensive cars with low tax, low mileage, few years_sell and low mpg.

Cluster 2: As we can see price and mpg means are greater in cluster 2 than in the overall means. Also, we can see that tax, mileage and years_sell means are lower in cluster 2 than in the overall means. So we can say that cluster 2 is a cluster of expensive cars with high mpg, low tax, low mileage and few years_sell.

Cluster 3: As we can see years_sell, mileage and tax means are greater in cluster 3 than in the overall means. Also, we can see that price and mpg means are lower in cluster 3 than in the overall means. So we can say that cluster 3 is a cluster of cheap cars with high years_sell, high mileage, high tax and low mpg.

Cluster 4: As we can see mpg, years_sell and mileage means are greater in cluster 4 than in the overall means. Also, we can see that tax and price means are lower in cluster 4 than in the overall means. So we can say that cluster 4 is a cluster of cheap cars with high mpg, many years_sell, high mileage and low tax.

Cluster 5: As we can see tax, years_sell and mileage means are greater in cluster 5 than in the overall means. Also, we can see that mpg mean is lower in cluster 5 than in the overall mean. So we can say that cluster 5 is a cluster of cars with high tax, many years_sell, high mileage and low mpg.

Cluster 6: As we can see years_sell, mileage and mpg means are greater in cluster 6 than in the overall means. Also, we can see that price and tax means are lower in cluster 6 than in the overall means. So we can say that cluster 6 is a cluster of cheap cars with many years_sell, high mileage, high mpg and low tax.

Cluster 7: As we can see mileage, years_sell, mpg and tax means are greater in cluster 7 than in the overall means. Also, we can see that price mean is lower in cluster 7 than in the overall mean. So we can say that cluster 7 is a cluster of cheap cars with high mileage, many years_sell, high mpg and high tax.

Cluster 8: Cluster of multivariant outliers.

We have created a new variable indicating the cluster to which the individual belongs after the Hierarchical clustering.

```
df$claHC<-8
df[ row.names(res.hcpc$data.clust), "claHC" ]<-res.hcpc$data.clust$clust
df$claHC<-factor(df$claHC)
levels( df$claHC ) <- paste0("claHCPC-",levels( df$claHC ) )
```

4 K-Means Classification

```
res.pca<-PCA(df[,c(vars_res, vars_dis, vars_con)],quali.sup=c(2:13),quanti.sup= c(1), ind.sup = ll,ncp =
```

PCA graph of individuals

PCA graph of variables
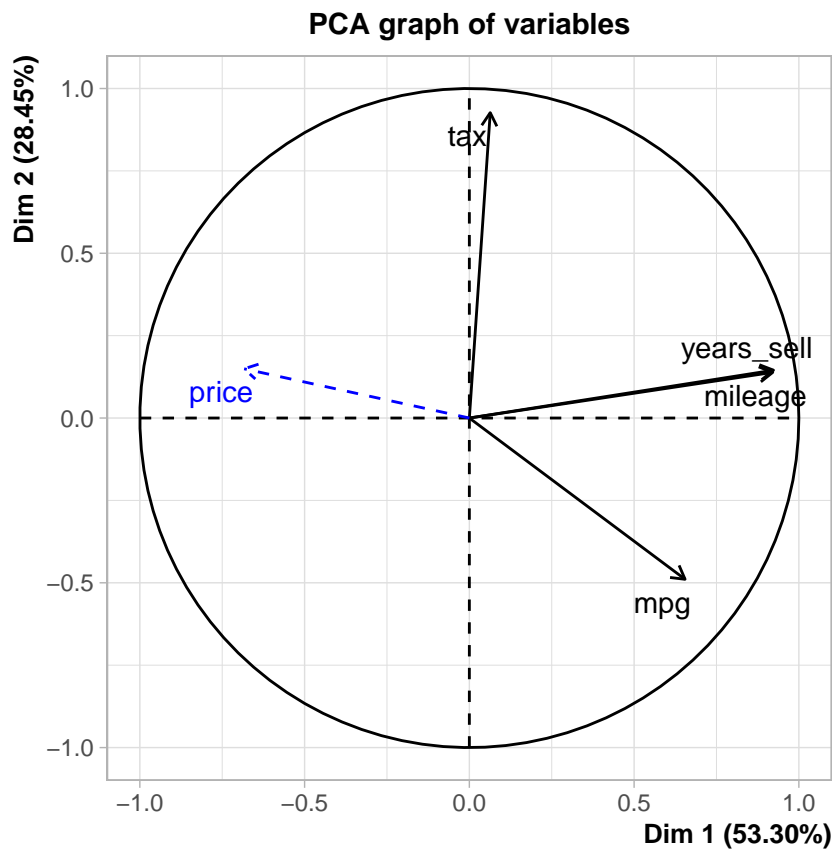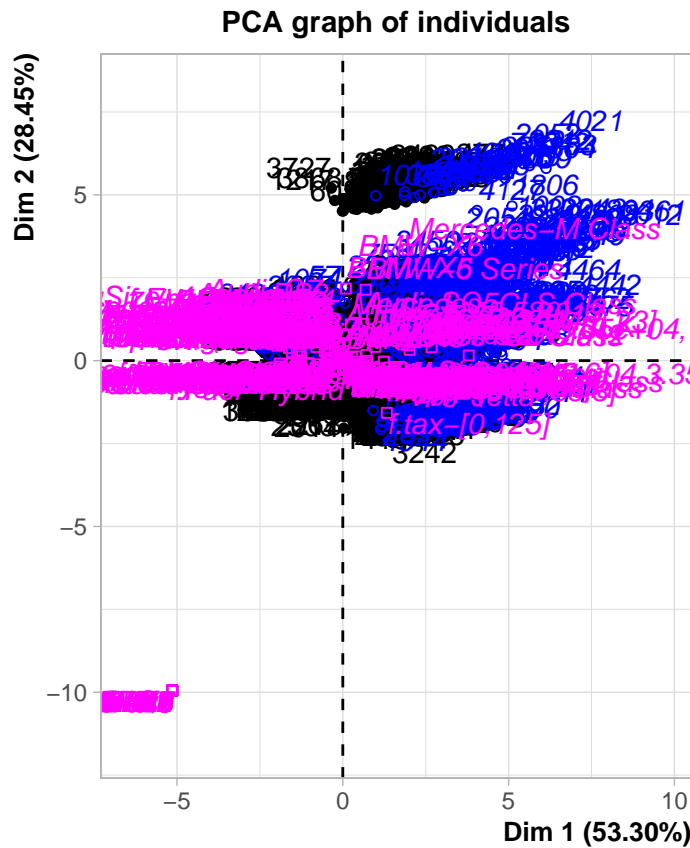

```
ppcc<-res.pca$ind$coord[,1:2]
dim(ppcc)
```

```
## [1] 4537    2
```

```
dist<-dist(ppcc)
kc<-kmeans(dist,7, iter.max = 30, trace=T)
```

```
## KMNS(*, k=7): iter=  1, indx=9
##   QTRAN(): istep=4537, icoun=6
##   QTRAN(): istep=9074, icoun=4
##   QTRAN(): istep=13611, icoun=2
##   QTRAN(): istep=18148, icoun=3
##   QTRAN(): istep=22685, icoun=109
##   QTRAN(): istep=27222, icoun=54
##   QTRAN(): istep=31759, icoun=13
##   QTRAN(): istep=36296, icoun=803
##   QTRAN(): istep=40833, icoun=1233
##   QTRAN(): istep=45370, icoun=120
##   QTRAN(): istep=49907, icoun=527
##   QTRAN(): istep=54444, icoun=1439
##   QTRAN(): istep=58981, icoun=3998
## KMNS(*, k=7): iter=  2, indx=17
##   QTRAN(): istep=4537, icoun=12
##   QTRAN(): istep=9074, icoun=11
##   QTRAN(): istep=13611, icoun=25
##   QTRAN(): istep=18148, icoun=16
##   QTRAN(): istep=22685, icoun=14
##   QTRAN(): istep=27222, icoun=4
##   QTRAN(): istep=31759, icoun=0
##   QTRAN(): istep=36296, icoun=63
##   QTRAN(): istep=40833, icoun=68
##   QTRAN(): istep=45370, icoun=181
##   QTRAN(): istep=49907, icoun=653
##   QTRAN(): istep=54444, icoun=1220
## KMNS(*, k=7): iter=  3, indx=98
##   QTRAN(): istep=4537, icoun=27
##   QTRAN(): istep=9074, icoun=103
##   QTRAN(): istep=13611, icoun=9
##   QTRAN(): istep=18148, icoun=190
##   QTRAN(): istep=22685, icoun=83
##   QTRAN(): istep=27222, icoun=34
##   QTRAN(): istep=31759, icoun=30
##   QTRAN(): istep=36296, icoun=149
##   QTRAN(): istep=40833, icoun=184
##   QTRAN(): istep=45370, icoun=54
##   QTRAN(): istep=49907, icoun=66
##   QTRAN(): istep=54444, icoun=238
##   QTRAN(): istep=58981, icoun=5
##   QTRAN(): istep=63518, icoun=210
##   QTRAN(): istep=68055, icoun=709
##   QTRAN(): istep=72592, icoun=812
##   QTRAN(): istep=77129, icoun=557
##   QTRAN(): istep=81666, icoun=2318
## KMNS(*, k=7): iter=  4, indx=4537
```

We have created a new variable indicating the cluster to which the individual belongs after the K-Means classification.

```
df$claKM<-8
df[ -ll, "claKM" ]<-kc$cluster
df$claKM<-factor(df$claKM)
# levels( df$claKM ) <- paste0("claKMPC-",levels( df$claKM ) )

kc$betweenss/kc$totss
```

```
## [1] 0.9047152
```

```
names(df)
```

```
##  [1] "model"          "year"          "price"         "transmission"
##  [5] "mileage"        "fuelType"      "tax"           "mpg"
##  [9] "engineSize"     "manufacturer"  "years_sell"    "totalMOE"
## [13] "aux_price"      "aux_mileage"   "aux_tax"       "aux_mpg"
## [17] "aux_years_sell" "Audi"          "mout"          "claHC"
## [21] "claKM"
```

```
catdes(df,21)
```

```
##
## Link between the cluster variable and the categorical variables (chi-square test)
## ===============================================================================
##                    p.value  df
## year          0.000000e+00   77
## aux_price     0.000000e+00   21
## aux_mileage   0.000000e+00   21
## aux_tax       0.000000e+00   14
## aux_mpg       0.000000e+00   21
## aux_years_sell 0.000000e+00  21
## mout          0.000000e+00    7
## claHC         0.000000e+00   49
## engineSize    9.551679e-310 147
## model         2.963732e-227 609
## fuelType      7.385921e-93   21
## transmission  2.143109e-70   14
## manufacturer  5.299796e-34   21
## Audi          3.870162e-14    7
##
## Description of each cluster by the categories
## =============================================
## $'1'
##                                          Cla/Mod     Mod/Cla Global
## claHC=claHCPC-5                        100.00000000 99.1935484   2.46
## aux_tax=f.tax-(145,580]                  7.73067332 100.0000000  32.08
## aux_years_sell=f.years_sell-(6,23]       6.90476190 46.7741935  16.80
## engineSize=f.EngSize-3                   7.82918149 35.4838710  11.24
## aux_mileage=f.mileage-(3.35e+04,1.16e+05] 5.20000000 52.4193548  25.00
## aux_mpg=f.mpg-[8.8,44.8]                 4.92307692 51.6129032  26.00
## year=f.Year-2015                         7.63723150 25.8064516   8.38
## aux_years_sell=f.years_sell-(5,6]        5.56844548 38.7096774  17.24
## year=f.Year-2016                         5.56844548 38.7096774  17.24
## model=BMW-X5                            27.27272727  7.2580645   0.66
## aux_price=f.price-(19.5,26]              4.57831325 45.9677419  24.90
## aux_mpg=f.mpg-(44.8,53.3]                4.28156749 47.5806452  27.56
## mout=NoMOut                              2.73308354 100.0000000  90.74
## model=Audi-Q5                           11.82795699  8.8709677   1.86
## year=f.Year-2014                         7.61421320 12.0967742   3.94
## aux_mileage=f.mileage-(1.65e+04,3.35e+04] 4.00000000 40.3225806  25.00
## engineSize=f.EngSize-2                   3.41510342 57.2580645  41.58
## year=f.Year-2013                         8.26446281  8.0645161   2.42
## model=BMW-6 Series                      30.00000000  2.4193548   0.20
## model=Audi-Q3                            7.04225352  8.0645161   2.84
## model=Audi-A8                           18.75000000  2.4193548   0.32
## model=Mercedes-CLS Class                16.66666667  2.4193548   0.36
## model=BMW-X4                            16.66666667  2.4193548   0.36
## Audi=Audi Yes                            3.59447005 31.4516129  21.70
## manufacturer=Audi                        3.59447005 31.4516129  21.70
## model=BMW-X6                            28.57142857  1.6129032   0.14
```

```
## transmission=f.Trans-Automatic              3.42726580  36.2903226  26.26
## model=Mercedes-M Class                     25.00000000   1.6129032   0.16
## transmission=f.Trans-SemiAuto               3.06553911  46.7741935  37.84
## model=VW-Golf                               3.89344262  15.3225806   9.76
## model=Mercedes-GLC Class                    0.00000000   0.0000000   2.38
## engineSize=f.EngSize-1.2                    0.00000000   0.0000000   2.50
## model=Audi-A4                               0.00000000   0.0000000   2.72
## model=Audi-A1                               0.00000000   0.0000000   2.74
## engineSize=f.EngSize-1.4                    0.69204152   1.6129032   5.78
## manufacturer=Mercedes                       1.62842339  17.7419355  27.02
## Audi=Audi No                                2.17113665  68.5483871  78.30
## model=Mercedes-E Class                      0.00000000   0.0000000   3.60
## aux_price=f.price-(26,110]                  1.44000000  14.5161290  25.00
## claHC=claHCPC-6                             0.00000000   0.0000000   5.26
## model=Mercedes-C Class                      0.27247956   0.8064516   7.34
## aux_price=f.price-[0.65,14]                 1.27084988  12.9032258  25.18
## aux_years_sell=f.years_sell-(3,5]           1.30434783  14.5161290  27.60
## aux_tax=f.tax-[0,125]                       0.00000000   0.0000000   5.94
## year=f.Year-2020                            0.00000000   0.0000000   6.42
## claHC=claHCPC-7                             0.23310023   0.8064516   8.58
## model=VW-Polo                               0.00000000   0.0000000   6.96
## engineSize=f.EngSize-1.6                    0.00000000   0.0000000   7.06
## engineSize=f.EngSize-1                      0.00000000   0.0000000   8.14
## claHC=claHCPC-8                             0.00000000   0.0000000   9.26
## mout=YesMOut                                0.00000000   0.0000000   9.26
## transmission=f.Trans-Manual                 1.16991643  16.9354839  35.90
## year=f.Year-2018                            0.00000000   0.0000000   9.86
## engineSize=f.EngSize-1.5                    0.00000000   0.0000000  11.06
## aux_mileage=f.mileage-(6e+03,1.65e+04]      0.72115385   7.2580645  24.96
## claHC=claHCPC-3                             0.00000000   0.0000000  11.44
## claHC=claHCPC-4                             0.00000000   0.0000000  19.00
## aux_mpg=f.mpg-(61.4,88.3]                   0.08818342   0.8064516  22.68
## claHC=claHCPC-2                             0.00000000   0.0000000  21.70
## claHC=claHCPC-1                             0.00000000   0.0000000  22.30
## aux_mpg=f.mpg-(53.3,61.4]                   0.00000000   0.0000000  23.76
## aux_mileage=f.mileage-[4,6e+03]             0.00000000   0.0000000  25.04
## year=f.Year-2019                            0.00000000   0.0000000  31.94
## aux_years_sell=f.years_sell-[2,3]           0.00000000   0.0000000  38.36
## aux_tax=f.tax-(125,145]                     0.00000000   0.0000000  61.98
##                                               p.value      v.test
## claHC=claHCPC-5                           7.271869e-248  33.624846
## aux_tax=f.tax-(145,580]                    2.094315e-63  16.809070
## aux_years_sell=f.years_sell-(6,23]         4.184290e-15   7.849281
## engineSize=f.EngSize-3                     6.029798e-13   7.199807
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]  3.985859e-11   6.604602
## aux_mpg=f.mpg-[8.8,44.8]                   8.282529e-10   6.139416
## year=f.Year-2015                           4.579058e-09   5.861789
## aux_years_sell=f.years_sell-(5,6]          9.535900e-09   5.738784
## year=f.Year-2016                           9.535900e-09   5.738784
## model=BMW-X5                               6.544170e-08   5.403257
## aux_price=f.price-(19.5,26]                2.737784e-07   5.140658
## aux_mpg=f.mpg-(44.8,53.3]                  1.682204e-06   4.788276
## mout=NoMOut                                4.991816e-06   4.565131
## model=Audi-Q5                              1.763827e-05   4.292865
## year=f.Year-2014                           1.134463e-04   3.859872
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]  1.518566e-04   3.788014
## engineSize=f.EngSize-2                     3.972387e-04   3.541912
## year=f.Year-2013                           9.325408e-04   3.310126
## model=BMW-6 Series                         1.640267e-03   3.148650
## model=Audi-Q3                              3.269376e-03   2.941205
## model=Audi-A8                              7.103710e-03   2.691943
## model=Mercedes-CLS Class                   1.009465e-02   2.572570
## model=BMW-X4                               1.009465e-02   2.572570
## Audi=Audi Yes                              1.057283e-02   2.556509
```

```
## manufacturer=Audi                               1.057283e-02    2.556509
## model=BMW-X6                                     1.229328e-02    2.503612
## transmission=f.Trans-Automatic                   1.286622e-02    2.487451
## model=Mercedes-M Class                           1.625249e-02    2.403196
## transmission=f.Trans-SemiAuto                    4.038975e-02    2.049741
## model=VW-Golf                                    4.667769e-02    1.989213
## model=Mercedes-GLC Class                         4.857224e-02   -1.972327
## engineSize=f.EngSize-1.2                         4.161974e-02   -2.037302
## model=Audi-A4                                    3.133905e-02   -2.152741
## model=Audi-A1                                    3.054011e-02   -2.163014
## engineSize=f.EngSize-1.4                         2.701161e-02   -2.211350
## manufacturer=Mercedes                            1.526728e-02   -2.425976
## Audi=Audi No                                     1.057283e-02   -2.556509
## model=Mercedes-E Class                           1.000905e-02   -2.575516
## aux_price=f.price-(26,110]                       4.362603e-03   -2.850679
## claHC=claHCPC-6                                  1.129091e-03   -3.256213
## model=Mercedes-C Class                           8.388829e-04   -3.339636
## aux_price=f.price-[0.65,14]                      7.452915e-04   -3.372352
## aux_years_sell=f.years_sell-(3,5]                5.128147e-04   -3.473972
## aux_tax=f.tax-[0,125]                            4.567325e-04   -3.504927
## year=f.Year-2020                                 2.401405e-04   -3.672552
## claHC=claHCPC-7                                  1.781239e-04   -3.748178
## model=VW-Polo                                    1.160457e-04   -3.854333
## engineSize=f.EngSize-1.6                         1.013765e-04   -3.887274
## engineSize=f.EngSize-1                           2.333207e-05   -4.230357
## claHC=claHCPC-8                                  4.991816e-06   -4.565131
## mout=YesMOut                                     4.991816e-06   -4.565131
## transmission=f.Trans-Manual                      2.785021e-06   -4.686069
## year=f.Year-2018                                 2.167893e-06   -4.737108
## engineSize=f.EngSize-1.5                         4.019794e-07   -5.068018
## aux_mileage=f.mileage-(6e+03,1.65e+04]           2.944867e-07   -5.126942
## claHC=claHCPC-3                                  2.346213e-07   -5.169579
## claHC=claHCPC-4                                  3.117802e-12   -6.972309
## aux_mpg=f.mpg-(61.4,88.3]                        3.527652e-13   -7.272550
## claHC=claHCPC-2                                  4.358821e-14   -7.549813
## claHC=claHCPC-1                                  1.653648e-14   -7.675042
## aux_mpg=f.mpg-(53.3,61.4]                        1.514369e-15   -7.975767
## aux_mileage=f.mileage-[4,6e+03]                  1.791654e-16   -8.235262
## year=f.Year-2019                                 9.147008e-22   -9.586108
## aux_years_sell=f.years_sell-[2,3]                3.323699e-27  -10.803212
## aux_tax=f.tax-(125,145]                          6.429876e-54  -15.460300
##
## $'2'
##                                                 Cla/Mod    Mod/Cla Global
## aux_years_sell=f.years_sell-(3,5]               38.4782609 72.8395062  27.60
## year=f.Year-2018                                59.0263692 39.9176955   9.86
## claHC=claHCPC-2                                 34.7465438 51.7146776  21.70
## aux_mileage=f.mileage-(6e+03,1.65e+04]          32.1314103 55.0068587  24.96
## claHC=claHCPC-3                                 43.8811189 34.4307270  11.44
## mout=NoMOut                                     16.0678863 100.0000000  90.74
## year=f.Year-2017                                27.0574972 32.9218107  17.74
## aux_price=f.price-(19.5,26]                     23.6144578 40.3292181  24.90
## aux_tax=f.tax-(125,145]                         17.7153921 75.3086420  61.98
## manufacturer=Mercedes                           20.3552924 37.7229081  27.02
## aux_mileage=f.mileage-(1.65e+04,3.35e+04] 20.4000000 34.9794239  25.00
## engineSize=f.EngSize-1.4                        28.0276817 11.1111111   5.78
## aux_mpg=f.mpg-(53.3,61.4]                       19.2760943 31.4128944  23.76
## model=Mercedes-A Class                          23.3333333  8.6419753   5.40
## model=Mercedes-E Class                          25.5555556  6.3100137   3.60
## model=Mercedes-V Class                          50.0000000  1.2345679   0.36
## model=Mercedes-C Class                          20.9809264 10.5624143   7.34
## transmission=f.Trans-SemiAuto                   16.7547569 43.4842250  37.84
## fuelType=f.Fuel-Petrol                          16.4514586 47.1879287  41.82
## aux_mpg=f.mpg-(44.8,53.3]                       16.9811321 32.0987654  27.56
```

```
## Audi=Audi No                                15.3256705 82.3045267 78.30
## model=Mercedes-GLA Class                    26.1904762  3.0178326  1.68
## model=VW-Shuttle                            55.5555556  0.6858711  0.18
## model=VW-Tiguan                             21.3414634  4.8010974  3.28
## model=VW-Scirocco                           33.3333333  1.0973937  0.48
## model=Audi-Q2                               23.7500000  2.6063100  1.60
## aux_price=f.price-(14,19.5]                 16.3723917 27.9835391 24.92
## model=BMW-M3                                50.0000000  0.4115226  0.12
## year=f.Year-2012                             0.0000000  0.0000000  0.38
## model=BMW-3 Series                          10.2880658  3.4293553  4.86
## year=f.Year-2011                             0.0000000  0.0000000  0.42
## year=f.Year-2010                             0.0000000  0.0000000  0.42
## manufacturer=VW                             13.0033003 27.0233196 30.30
## model=VW-Sharan                              0.0000000  0.0000000  0.44
## engineSize=f.EngSize-1.6                    10.7648725  5.2126200  7.06
## engineSize=f.EngSize-1.2                     8.0000000  1.3717421  2.50
## model=Audi-A6                                5.6338028  0.5486968  1.42
## model=VW-T-Cross                             0.0000000  0.0000000  0.50
## model=BMW-X1                                 5.4054054  0.5486968  1.48
## manufacturer=BMW                            12.2020972 17.5582990 20.98
## model=Audi-A3                                8.5427136  2.3319616  3.98
## transmission=f.Trans-Automatic             12.4143184 22.3593964 26.26
## fuelType=f.Fuel-Diesel                      13.4060521 52.2633745 56.84
## model=Audi-Q7                                0.0000000  0.0000000  0.64
## Audi=Audi Yes                               11.8894009 17.6954733 21.70
## manufacturer=Audi                           11.8894009 17.6954733 21.70
## year=f.Year-2009 or before                   0.0000000  0.0000000  0.84
## aux_price=f.price-(26,110]                  11.8400000 20.3017833 25.00
## model=VW-Golf                                9.6311475  6.4471879  9.76
## model=VW-Passat                              3.1914894  0.4115226  1.88
## aux_tax=f.tax-(145,580]                     10.9725686 24.1426612 32.08
## claHC=claHCPC-4                              9.4736842 12.3456790 19.00
## year=f.Year-2019                            10.5197245 23.0452675 31.94
## year=f.Year-2013                             0.0000000  0.0000000  2.42
## claHC=claHCPC-5                              0.0000000  0.0000000  2.46
## claHC=claHCPC-6                              1.5209125  0.5486968  5.26
## year=f.Year-2014                             0.0000000  0.0000000  3.94
## aux_tax=f.tax-[0,125]                        1.3468013  0.5486968  5.94
## aux_mpg=f.mpg-[8.8,44.8]                     7.3076923 13.0315501 26.00
## aux_years_sell=f.years_sell-[2,3]            8.7591241 23.0452675 38.36
## aux_price=f.price-[0.65,14]                  6.5925338 11.3854595 25.18
## year=f.Year-2015                             1.1933174  0.6858711  8.38
## year=f.Year-2020                             0.0000000  0.0000000  6.42
## claHC=claHCPC-7                              0.0000000  0.0000000  8.58
## aux_mileage=f.mileage-[4,6e+03]              5.1916933  8.9163237 25.04
## claHC=claHCPC-8                              0.0000000  0.0000000  9.26
## mout=YesMOut                                 0.0000000  0.0000000  9.26
## aux_years_sell=f.years_sell-(5,6]            2.9002320  3.4293553 17.24
## year=f.Year-2016                             2.9002320  3.4293553 17.24
## aux_years_sell=f.years_sell-(6,23]           0.5952381  0.6858711 16.80
## claHC=claHCPC-1                              0.6278027  0.9602195 22.30
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]  0.6400000  1.0973937 25.00
##                                                 p.value      v.test
## aux_years_sell=f.years_sell-(3,5]           3.977432e-171  27.885703
## year=f.Year-2018                            6.248516e-135  24.721713
## claHC=claHCPC-2                             1.449215e-85   19.603297
## aux_mileage=f.mileage-(6e+03,1.65e+04]      1.868663e-80   18.995202
## claHC=claHCPC-3                             1.659328e-75   18.387337
## mout=NoMOut                                 4.088824e-34   12.177652
## year=f.Year-2017                            2.110418e-27   10.844824
## aux_price=f.price-(19.5,26]                 1.861992e-23    9.980143
## aux_tax=f.tax-(125,145]                     1.994858e-16    8.222391
## manufacturer=Mercedes                       7.722385e-12    6.843607
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]   6.597773e-11    6.529527
```

```
## engineSize=f.EngSize-1.4                      1.057836e-09   6.100430
## aux_mpg=f.mpg-(53.3,61.4]                     3.118794e-07   5.116123
## model=Mercedes-A Class                        8.333631e-05   3.934597
## model=Mercedes-E Class                        8.451487e-05   3.931223
## model=Mercedes-V Class                        4.587596e-04   3.503748
## model=Mercedes-C Class                        5.683101e-04   3.446304
## transmission=f.Trans-SemiAuto                 7.368660e-04   3.375482
## fuelType=f.Fuel-Petrol                        1.551472e-03   3.164879
## aux_mpg=f.mpg-(44.8,53.3]                     3.378022e-03   2.931065
## Audi=Audi No                                  3.909686e-03   2.885358
## model=Mercedes-GLA Class                      5.100159e-03   2.800639
## model=VW-Shuttle                              5.451577e-03   2.779064
## model=VW-Tiguan                               1.748518e-02   2.376343
## model=VW-Scirocco                             2.141479e-02   2.300591
## model=Audi-Q2                                 2.813057e-02   2.195461
## aux_price=f.price-(14,19.5]                   4.034704e-02   2.050178
## model=BMW-M3                                  4.908940e-02   1.967814
## year=f.Year-2012                              4.978400e-02  -1.961815
## model=BMW-3 Series                            4.561916e-02  -1.998900
## year=f.Year-2011                              3.627674e-02  -2.093812
## year=f.Year-2010                              3.627674e-02  -2.093812
## manufacturer=VW                               3.612588e-02  -2.095508
## model=VW-Sharan                               3.096528e-02  -2.157519
## engineSize=f.EngSize-1.6                      3.058465e-02  -2.162435
## engineSize=f.EngSize-1.2                      2.657973e-02  -2.217635
## model=Audi-A6                                 2.085284e-02  -2.310638
## model=VW-T-Cross                              1.925421e-02  -2.340572
## model=BMW-X1                                  1.493493e-02  -2.433953
## manufacturer=BMW                              1.280927e-02  -2.489029
## model=Audi-A3                                 9.641776e-03  -2.588418
## transmission=f.Trans-Automatic               8.829569e-03  -2.618583
## fuelType=f.Fuel-Diesel                        7.135344e-03  -2.690461
## model=Audi-Q7                                 6.346276e-03  -2.729332
## Audi=Audi Yes                                 3.909686e-03  -2.885358
## manufacturer=Audi                             3.909686e-03  -2.885358
## year=f.Year-2009 or before                    1.296164e-03  -3.216828
## aux_price=f.price-(26,110]                    1.275954e-03  -3.221334
## model=VW-Golf                                 6.727895e-04  -3.400434
## model=VW-Passat                               3.197919e-04  -3.598716
## aux_tax=f.tax-(145,580]                       4.070939e-07  -5.065610
## claHC=claHCPC-4                               2.435536e-07  -5.162592
## year=f.Year-2019                              1.180380e-08  -5.702536
## year=f.Year-2013                              4.065923e-09  -5.881489
## claHC=claHCPC-5                               2.941563e-09  -5.934827
## claHC=claHCPC-6                               7.339303e-14  -7.481654
## year=f.Year-2014                              1.669562e-14  -7.673814
## aux_tax=f.tax-[0,125]                         4.046311e-16  -8.137168
## aux_mpg=f.mpg-[8.8,44.8]                      5.306232e-20  -9.157604
## aux_years_sell=f.years_sell-[2,3]             2.662304e-21  -9.475208
## aux_price=f.price-[0.65,14]                   2.841766e-23  -9.938107
## year=f.Year-2015                              2.481838e-23  -9.951591
## year=f.Year-2020                              1.705714e-23  -9.988837
## claHC=claHCPC-7                               1.538855e-31 -11.683997
## aux_mileage=f.mileage-[4,6e+03]               1.856427e-32 -11.862371
## claHC=claHCPC-8                               4.088824e-34 -12.177652
## mout=YesMOut                                  4.088824e-34 -12.177652
## aux_years_sell=f.years_sell-(5,6]             8.022523e-35 -12.309796
## year=f.Year-2016                              8.022523e-35 -12.309796
## aux_years_sell=f.years_sell-(6,23]            5.487200e-55 -15.618034
## claHC=claHCPC-1                               6.813668e-75 -18.310583
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]     2.874112e-85 -19.568428
##
## $‘3‘
##                                               Cla/Mod    Mod/Cla Global
```

```
## claHC=claHCPC-7                              64.56876457  74.2627346   8.58
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]    28.48000000  95.4423592  25.00
## aux_years_sell=f.years_sell-(6,23]           35.95238095  80.9651475  16.80
## aux_price=f.price-[0.65,14]                  21.12787927  71.3136729  25.18
## year=f.Year-2014                             56.34517766  29.7587131   3.94
## aux_tax=f.tax-(145,580]                      16.20947631  69.7050938  32.08
## year=f.Year-2013                             60.33057851  19.5710456   2.42
## year=f.Year-2015                             26.73031026  30.0268097   8.38
## aux_mpg=f.mpg-(61.4,88.3]                    16.84303351  51.2064343  22.68
## fuelType=f.Fuel-Diesel                       10.59113300  80.6970509  56.84
## mout=NoMOut                                   8.22129160 100.0000000  90.74
## transmission=f.Trans-Manual                  11.58774373  55.7640751  35.90
## engineSize=f.EngSize-1.6                     16.14730878  15.2815013   7.06
## claHC=claHCPC-6                              17.11026616  12.0643432   5.26
## model=BMW-1 Series                           17.25888325   9.1152815   3.94
## aux_tax=f.tax-[0,125]                        15.15151515  12.0643432   5.94
## model=Audi-A3                                15.07537688   8.0428954   3.98
## engineSize=f.EngSize-2.1                     11.54791155  12.6005362   8.14
## year=f.Year-2012                             31.57894737   1.6085791   0.38
## model=VW-Passat                              13.82978723   3.4852547   1.88
## model=BMW-3 Series                           11.11111111   7.2386059   4.86
## model=Audi-A1                                12.40875912   4.5576408   2.74
## model=BMW-6 Series                           30.00000000   0.8042895   0.20
## Audi=Audi Yes                                 8.94009217  26.0053619  21.70
## manufacturer=Audi                             8.94009217  26.0053619  21.70
## model=VW-CC                                  27.27272727   0.8042895   0.22
## Audi=Audi No                                  7.04980843  73.9946381  78.30
## year=f.Year-2009 or before                   0.00000000   0.0000000   0.84
## model=Audi-Q5                                 2.15053763   0.5361930   1.86
## model=Mercedes-C Class                        4.63215259   4.5576408   7.34
## model=Mercedes-GLE Class                      0.00000000   0.0000000   1.10
## model=VW-T-Roc                                0.00000000   0.0000000   1.26
## manufacturer=Mercedes                         5.77350111  20.9115282  27.02
## engineSize=f.EngSize-1.3                      0.00000000   0.0000000   1.52
## engineSize=f.EngSize-3                        4.44839858   6.7024129  11.24
## model=Audi-Q2                                 0.00000000   0.0000000   1.60
## engineSize=f.EngSize-1.5                      3.97830018   5.8981233  11.06
## model=Mercedes-GLC Class                      0.00000000   0.0000000   2.38
## engineSize=f.EngSize-1                        2.94840295   3.2171582   8.14
## claHC=claHCPC-5                               0.00000000   0.0000000   2.46
## aux_mpg=f.mpg-(44.8,53.3]                     4.93468795  18.2305630  27.56
## year=f.Year-2020                             0.00000000   0.0000000   6.42
## transmission=f.Trans-SemiAuto                 4.22832981  21.4477212  37.84
## claHC=claHCPC-8                               0.00000000   0.0000000   9.26
## mout=YesMOut                                  0.00000000   0.0000000   9.26
## year=f.Year-2018                             0.00000000   0.0000000   9.86
## claHC=claHCPC-4                               1.57894737   4.0214477  19.00
## aux_mpg=f.mpg-[8.8,44.8]                      1.92307692   6.7024129  26.00
## fuelType=f.Fuel-Petrol                        3.25203252  18.2305630  41.82
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]     1.36000000   4.5576408  25.00
## year=f.Year-2017                             0.11273957   0.2680965  17.74
## aux_price=f.price-(19.5,26]                   0.80321285   2.6809651  24.90
## claHC=claHCPC-2                               0.00000000   0.0000000  21.70
## claHC=claHCPC-1                               0.00000000   0.0000000  22.30
## aux_price=f.price-(26,110]                    0.24000000   0.8042895  25.00
## aux_mileage=f.mileage-(6e+03,1.65e+04]        0.00000000   0.0000000  24.96
## aux_mileage=f.mileage-[4,6e+03]               0.00000000   0.0000000  25.04
## aux_years_sell=f.years_sell-(3,5]             0.07246377   0.2680965  27.60
## year=f.Year-2019                             0.00000000   0.0000000  31.94
## aux_tax=f.tax-(125,145]                       2.19425621  18.2305630  61.98
## aux_years_sell=f.years_sell-[2,3]             0.00000000   0.0000000  38.36
##                                                  p.value      v.test
## claHC=claHCPC-7                              1.166017e-254   34.086580
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]    2.144778e-206   30.656803
```

```
## aux_years_sell=f.years_sell-(6,23)         8.459310e-184  28.911906
## aux_price=f.price-[0.65,14]                2.761398e-85   19.570467
## year=f.Year-2014                           6.360082e-78   18.686634
## aux_tax=f.tax-(145,580]                     3.248724e-54   15.504213
## year=f.Year-2013                           3.500240e-53   15.350767
## year=f.Year-2015                           1.170398e-37   12.826148
## aux_mpg=f.mpg-(61.4,88.3]                   3.899697e-36   12.551516
## fuelType=f.Fuel-Diesel                      6.738721e-24   10.080493
## mout=NoMOut                                 4.072547e-17    8.410791
## transmission=f.Trans-Manual                 4.858579e-16    8.114982
## engineSize=f.EngSize-1.6                    1.076520e-08    5.718210
## claHC=claHCPC-6                             8.345514e-08    5.359494
## model=BMW-1 Series                          3.155896e-06    4.660404
## aux_tax=f.tax-[0,125]                       3.165253e-06    4.659794
## model=Audi-A3                               1.886396e-04    3.733764
## engineSize=f.EngSize-2.1                    2.069129e-03    3.080126
## year=f.Year-2012                            2.225386e-03    3.058378
## model=VW-Passat                             3.054078e-02    2.163005
## model=BMW-3 Series                          3.526198e-02    2.105337
## model=Audi-A1                               3.756744e-02    2.079543
## model=BMW-6 Series                          3.776305e-02    2.077417
## Audi=Audi Yes                               3.932414e-02    2.060779
## manufacturer=Audi                           3.932414e-02    2.060779
## model=VW-CC                                 4.991869e-02    1.960660
## Audi=Audi No                                3.932414e-02   -2.060779
## year=f.Year-2009 or before                  3.799926e-02   -2.074863
## model=Audi-Q5                               3.180642e-02   -2.146835
## model=Mercedes-C Class                      2.521705e-02   -2.238061
## model=Mercedes-GLE Class                    1.372919e-02   -2.464272
## model=VW-T-Roc                              7.327630e-03   -2.681576
## manufacturer=Mercedes                       4.858145e-03   -2.816292
## engineSize=f.EngSize-1.3                    2.635569e-03   -3.007326
## engineSize=f.EngSize-3                      2.355187e-03   -3.041352
## model=Audi-Q2                               1.923030e-03   -3.101869
## engineSize=f.EngSize-1.5                    4.142375e-04   -3.530843
## model=Mercedes-GLC Class                    8.774561e-05   -3.922196
## engineSize=f.EngSize-1                      6.672803e-05   -3.987661
## claHC=claHCPC-5                             6.383834e-05   -3.998154
## aux_mpg=f.mpg-(44.8,53.3]                   1.421468e-05   -4.340519
## year=f.Year-2020                            6.535990e-12   -6.867449
## transmission=f.Trans-SemiAuto               2.003552e-12   -7.034236
## claHC=claHCPC-8                             4.072547e-17   -8.410791
## mout=YesMOut                                4.072547e-17   -8.410791
## year=f.Year-2018                            3.078771e-18   -8.708517
## claHC=claHCPC-4                             9.257139e-19   -8.843735
## aux_mpg=f.mpg-[8.8,44.8]                    3.438861e-23   -9.919087
## fuelType=f.Fuel-Petrol                      8.785181e-24  -10.054404
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]   9.560380e-28  -10.916998
## year=f.Year-2017                            8.828911e-32  -11.731114
## aux_price=f.price-(19.5,26]                 1.988650e-34  -12.236312
## claHC=claHCPC-2                             4.000788e-42  -13.600065
## claHC=claHCPC-1                             1.961284e-43  -13.818868
## aux_price=f.price-(26,110]                  8.321861e-44  -13.880451
## aux_mileage=f.mileage-(6e+03,1.65e+04]      2.267259e-49  -14.770588
## aux_mileage=f.mileage-[4,6e+03]             1.491166e-49  -14.798801
## aux_years_sell=f.years_sell-(3,5]           2.786072e-53  -15.365563
## year=f.Year-2019                            4.510084e-66  -17.169276
## aux_tax=f.tax-(125,145]                     1.530673e-72  -18.013354
## aux_years_sell=f.years_sell-[2,3]           4.022746e-83  -19.314930
##
## $`4`
##                                          Cla/Mod    Mod/Cla Global
## aux_years_sell=f.years_sell-(5,6]       41.9953596 50.4178273  17.24
## year=f.Year-2016                        41.9953596 50.4178273  17.24
```

```
## claHC=claHCPC-6                                 69.2015209  25.3481894   5.26
## aux_tax=f.tax-[0,125]                           60.9427609  25.2089136   5.94
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]       30.0800000  52.3676880  25.00
## claHC=claHCPC-4                                  33.3684211  44.1504178  19.00
## aux_mpg=f.mpg-(61.4,88.3]                        30.7760141  48.6072423  22.68
## aux_price=f.price-(14,19.5]                      28.6516854  49.7214485  24.92
## fuelType=f.Fuel-Diesel                           20.0211119  79.2479109  56.84
## year=f.Year-2015                                 38.9021480  22.7019499   8.38
## mout=NoMOut                                      15.8254353 100.0000000  90.74
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]        25.2000000  43.8718663  25.00
## claHC=claHCPC-7                                  35.1981352  21.0306407   8.58
## engineSize=f.EngSize-2.1                         35.6265356  20.1949861   8.14
## aux_years_sell=f.years_sell-(6,23]               24.0476190  28.1337047  16.80
## aux_price=f.price-[0.65,14]                      21.4455917  37.6044568  25.18
## aux_mpg=f.mpg-(53.3,61.4]                        21.3804714  35.3760446  23.76
## transmission=f.Trans-Manual                      18.8857939  47.2144847  35.90
## model=Mercedes-GLA Class                         36.9047619   4.3175487   1.68
## model=BMW-X1                                     33.7837838   3.4818942   1.48
## model=Mercedes-GL Class                          57.1428571   1.1142061   0.28
## manufacturer=Mercedes                            17.3205033  32.5905292  27.02
## model=BMW-1 Series                               22.8426396   6.2674095   3.94
## model=VW-Jetta                                  100.0000000   0.4178273   0.06
## engineSize=f.EngSize-1.6                         19.5467422   9.6100279   7.06
## model=Mercedes-A Class                           20.3703704   7.6601671   5.40
## Audi=Audi No                                     14.9936143  81.7548747  78.30
## year=f.Year-2017                                 17.0236753  21.0306407  17.74
## model=Mercedes-CL Class                          24.5614035   1.9498607   1.14
## model=Mercedes-GLC Class                         21.0084034   3.4818942   2.38
## model=Audi-Q5                                     7.5268817   0.9749304   1.86
## model=BMW-X5                                      3.0303030   0.1392758   0.66
## fuelType=f.Fuel-Hybrid                            5.4545455   0.4178273   1.10
## year=f.Year-2011                                 0.0000000   0.0000000   0.42
## year=f.Year-2010                                 0.0000000   0.0000000   0.42
## manufacturer=VW                                  12.8052805  27.0194986  30.30
## model=BMW-X2                                      0.0000000   0.0000000   0.44
## model=VW-T-Cross                                  0.0000000   0.0000000   0.50
## model=VW-Arteon                                   0.0000000   0.0000000   0.54
## Audi=Audi Yes                                    12.0737327  18.2451253  21.70
## manufacturer=Audi                                12.0737327  18.2451253  21.70
## engineSize=f.EngSize-4.2 or more                  0.0000000   0.0000000   0.56
## engineSize=f.EngSize-4                            0.0000000   0.0000000   0.56
## model=Mercedes-GLE Class                          3.6363636   0.2785515   1.10
## model=Audi-Q7                                     0.0000000   0.0000000   0.64
## year=f.Year-2009 or before                       0.0000000   0.0000000   0.84
## model=Audi-Q2                                     1.2500000   0.1392758   1.60
## model=VW-T-Roc                                    0.0000000   0.0000000   1.26
## aux_years_sell=f.years_sell-(3,5]                11.1594203  21.4484680  27.60
## year=f.Year-2013                                 2.4793388   0.4178273   2.42
## engineSize=f.EngSize-1.3                          0.0000000   0.0000000   1.52
## engineSize=f.EngSize-1                            6.3882064   3.6211699   8.14
## transmission=f.Trans-SemiAuto                    11.0465116  29.1086351  37.84
## claHC=claHCPC-5                                   0.0000000   0.0000000   2.46
## engineSize=f.EngSize-3                            6.7615658   5.2924791  11.24
## aux_price=f.price-(19.5,26]                       6.5060241  11.2813370  24.90
## year=f.Year-2020                                  0.0000000   0.0000000   6.42
## aux_mpg=f.mpg-(44.8,53.3]                         6.7489115  12.9526462  27.56
## year=f.Year-2018                                  0.6085193   0.4178273   9.86
## aux_tax=f.tax-(125,145]                           9.7773475  42.2005571  61.98
## claHC=claHCPC-8                                   0.0000000   0.0000000   9.26
## mout=YesMOut                                      0.0000000   0.0000000   9.26
## fuelType=f.Fuel-Petrol                            6.8866571  20.0557103  41.82
## aux_mileage=f.mileage-(6e+03,1.65e+04]            2.1634615   3.7604457  24.96
## aux_mpg=f.mpg-[8.8,44.8]                          1.6923077   3.0640669  26.00
## aux_price=f.price-(26,110]                        0.8000000   1.3927577  25.00
```

```
## claHC=claHCPC-2                                0.0000000   0.0000000  21.70
## claHC=claHCPC-1                                0.0000000   0.0000000  22.30
## aux_mileage=f.mileage-[4,6e+03]                0.0000000   0.0000000  25.04
## year=f.Year-2019                               0.0000000   0.0000000  31.94
## aux_years_sell=f.years_sell-[2,3]              0.0000000   0.0000000  38.36
##                                                    p.value      v.test
## aux_years_sell=f.years_sell-(5,6]             8.691034e-114  22.670845
## year=f.Year-2016                              8.691034e-114  22.670845
## claHC=claHCPC-6                               1.737909e-98   21.063006
## aux_tax=f.tax-[0,125]                         1.218668e-83   19.376496
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]     3.238225e-66   17.188496
## claHC=claHCPC-4                               9.493930e-65   16.991494
## aux_mpg=f.mpg-(61.4,88.3]                     1.379169e-62   16.696959
## aux_price=f.price-(14,19.5]                   3.869470e-55   15.640292
## fuelType=f.Fuel-Diesel                        6.289805e-42   13.566934
## year=f.Year-2015                              3.678725e-39   13.091580
## mout=NoMOut                                   1.441926e-33   12.074411
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]     3.381328e-33   12.004097
## claHC=claHCPC-7                               3.442139e-30   11.416921
## engineSize=f.EngSize-2.1                      1.424220e-29   11.292802
## aux_years_sell=f.years_sell-(6,23]            1.237768e-16    8.279420
## aux_price=f.price-[0.65,14]                   1.321879e-15    7.992539
## aux_mpg=f.mpg-(53.3,61.4]                     2.745718e-14    7.609776
## transmission=f.Trans-Manual                   1.739455e-11    6.726372
## model=Mercedes-GLA Class                      2.466582e-07    5.160221
## model=BMW-X1                                  2.383677e-05    4.225541
## model=Mercedes-GL Class                       2.593923e-04    3.652804
## manufacturer=Mercedes                         3.501408e-04    3.575065
## model=BMW-1 Series                            1.140457e-03    3.253368
## model=VW-Jetta                                2.950579e-03    2.972840
## engineSize=f.EngSize-1.6                      5.523694e-03    2.774792
## model=Mercedes-A Class                        5.614217e-03    2.769501
## Audi=Audi No                                  1.393252e-02    2.458998
## year=f.Year-2017                              1.418642e-02    2.452508
## model=Mercedes-CL Class                       3.998521e-02    2.053902
## model=Mercedes-GLC Class                      4.586719e-02    1.996613
## model=Audi-Q5                                 4.695495e-02   -1.986706
## model=BMW-X5                                  4.466727e-02   -2.007774
## fuelType=f.Fuel-Hybrid                        4.412896e-02   -2.012864
## year=f.Year-2011                              3.829501e-02   -2.071683
## year=f.Year-2010                              3.829501e-02   -2.071683
## manufacturer=VW                               3.758395e-02   -2.079364
## model=BMW-X2                                  3.277266e-02   -2.134857
## model=VW-T-Cross                              2.053675e-02   -2.316394
## model=VW-Arteon                               1.503620e-02   -2.431506
## Audi=Audi Yes                                 1.393252e-02   -2.458998
## manufacturer=Audi                             1.393252e-02   -2.458998
## engineSize=f.EngSize-4.2 or more              1.286528e-02   -2.487477
## engineSize=f.EngSize-4                         1.286528e-02   -2.487477
## model=Mercedes-GLE Class                      1.196062e-02   -2.513304
## model=Audi-Q7                                 6.892807e-03   -2.701979
## year=f.Year-2009 or before                    1.444788e-03   -3.185551
## model=Audi-Q2                                 5.788200e-05   -4.021283
## model=VW-T-Roc                                5.369399e-05   -4.038937
## aux_years_sell=f.years_sell-(3,5]             4.856318e-05   -4.062436
## year=f.Year-2013                              1.085192e-05   -4.399463
## engineSize=f.EngSize-1.3                      6.941591e-06   -4.495472
## engineSize=f.EngSize-1                         1.892702e-07   -5.209578
## transmission=f.Trans-SemiAuto                 1.245606e-07   -5.286674
## claHC=claHCPC-5                               4.054885e-09   -5.881939
## engineSize=f.EngSize-3                        3.729325e-09   -5.895773
## aux_price=f.price-(19.5,26]                   1.598754e-22   -9.764515
## year=f.Year-2020                              4.023639e-23   -9.903399
## aux_mpg=f.mpg-(44.8,53.3]                     7.426252e-24  -10.070943
```

```
## year=f.Year-2018                             1.154380e-30 -11.511511
## aux_tax=f.tax-(125,145]                      3.700223e-31 -11.609209
## claHC=claHCPC-8                              1.441926e-33 -12.074411
## mout=YesMOut                                 1.441926e-33 -12.074411
## fuelType=f.Fuel-Petrol                       3.561132e-40 -13.267750
## aux_mileage=f.mileage-(6e+03,1.65e+04]       2.672666e-60 -16.379652
## aux_mpg=f.mpg-[8.8,44.8]                      7.926833e-70 -17.664099
## aux_price=f.price-(26,110]                   1.047479e-80 -19.025567
## claHC=claHCPC-2                              5.675164e-84 -19.415794
## claHC=claHCPC-1                              1.268838e-86 -19.726829
## aux_mileage=f.mileage-[4,6e+03]              5.048643e-99 -21.121482
## year=f.Year-2019                            1.229076e-132 -24.507490
## aux_years_sell=f.years_sell-[2,3]           1.460402e-167 -27.590159
##
## $'5'
##                                    Cla/Mod      Mod/Cla Global
## claHC=claHCPC-1                  59.8206278   93.8115331  22.30
## aux_mpg=f.mpg-[8.8,44.8]         47.9230769   87.6230661  26.00
## aux_years_sell=f.years_sell-[2,3] 36.1835245  97.6090014  38.36
## aux_mileage=f.mileage-[4,6e+03]  43.2108626   76.0900141  25.04
## aux_price=f.price-(26,110]       40.8800000   71.8706048  25.00
## year=f.Year-2020                 72.5856698   32.7707454   6.42
## year=f.Year-2019                 28.8666249   64.8382560  31.94
## fuelType=f.Fuel-Petrol           22.5251076   66.2447257  41.82
## aux_tax=f.tax-(125,145]          19.1352049   83.4036568  61.98
## mout=NoMOut                      15.6711483  100.0000000  90.74
## transmission=f.Trans-SemiAuto    20.4545455   54.4303797  37.84
## engineSize=f.EngSize-3           25.6227758   20.2531646  11.24
## model=Audi-Q5                    43.0107527    5.6258790   1.86
## Audi=Audi Yes                    20.0000000   30.5203938  21.70
## manufacturer=Audi                20.0000000   30.5203938  21.70
## engineSize=f.EngSize-2           17.2679173   50.4922644  41.58
## model=Audi-Q3                    28.1690141    5.6258790   2.84
## model=Mercedes-X-CLASS           72.7272727    1.1251758   0.22
## model=BMW-M4                     72.7272727    1.1251758   0.22
## engineSize=f.EngSize-1.5         20.2531646   15.7524613  11.06
## model=BMW-Z4                     60.0000000    1.2658228   0.30
## model=BMW-M2                    100.0000000    0.7032349   0.10
## model=VW-Amarok                  56.2500000    1.2658228   0.32
## model=VW-Caravelle               75.0000000    0.8438819   0.16
## model=VW-Tiguan Allspace         57.1428571    1.1251758   0.28
## model=VW-Touareg                 40.6250000    1.8284107   0.64
## model=VW-T-Roc                   31.7460317    2.8129395   1.26
## engineSize=f.EngSize-2.3         58.3333333    0.9845288   0.24
## model=Mercedes-GLE Class         30.9090909    2.3909986   1.10
## model=BMW-X2                     40.9090909    1.2658228   0.44
## model=Audi-TT                    35.4838710    1.5471167   0.62
## model=Audi-Q7                    34.3750000    1.5471167   0.64
## engineSize=f.EngSize-2.9         43.7500000    0.9845288   0.32
## model=Audi-Q2                    25.0000000    2.8129395   1.60
## model=Audi-S4                    75.0000000    0.4219409   0.08
## model=VW-Tiguan                  21.3414634    4.9226442   3.28
## engineSize=f.EngSize-1.3         25.0000000    2.6722925   1.52
## model=Mercedes-GLC Class         21.0084034    3.5161744   2.38
## engineSize=f.EngSize-2.5         40.0000000    0.5625879   0.20
## model=BMW-X5                     27.2727273    1.2658228   0.66
## year=f.Year-2011                  0.0000000    0.0000000   0.42
## year=f.Year-2010                  0.0000000    0.0000000   0.42
## model=BMW-4 Series                7.1428571    0.9845288   1.96
## model=BMW-1 Series                9.1370558    2.5316456   3.94
## model=Audi-A3                     9.0452261    2.5316456   3.98
## model=VW-Scirocco                 0.0000000    0.0000000   0.48
## model=VW-Golf                    10.8606557    7.4542897   9.76
## engineSize=f.EngSize-1.8          0.0000000    0.0000000   0.52
```

```
## model=Mercedes-E Class                         8.3333333   2.1097046   3.60
## model=Mercedes-B Class                         3.1746032   0.2812940   1.26
## model=VW-Up                                    4.5454545   0.5625879   1.76
## year=f.Year-2009 or before                     0.0000000   0.0000000   0.84
## model=BMW-5 Series                             3.4883721   0.4219409   1.72
## model=BMW-3 Series                             6.9958848   2.3909986   4.86
## model=VW-Polo                                  8.0459770   3.9381153   6.96
## engineSize=f.EngSize-1                         8.1081081   4.6413502   8.14
## model=Mercedes-A Class                         6.2962963   2.3909986   5.40
## model=Mercedes-C Class                         7.3569482   3.7974684   7.34
## manufacturer=Mercedes                         10.5107328  19.9718706  27.02
## year=f.Year-2013                               0.0000000   0.0000000   2.42
## claHC=claHCPC-5                                0.0000000   0.0000000   2.46
## engineSize=f.EngSize-1.2                       0.0000000   0.0000000   2.50
## Audi=Audi No                                  12.6181354  69.4796062  78.30
## engineSize=f.EngSize-1.6                       3.6827195   1.8284107   7.06
## year=f.Year-2014                               0.0000000   0.0000000   3.94
## engineSize=f.EngSize-1.4                       1.3840830   0.5625879   5.78
## year=f.Year-2018                               3.4482759   2.3909986   9.86
## claHC=claHCPC-6                                0.0000000   0.0000000   5.26
## aux_tax=f.tax-[0,125]                          0.0000000   0.0000000   5.94
## aux_tax=f.tax-(145,580]                        7.3566085  16.5963432  32.08
## aux_mpg=f.mpg-(44.8,53.3]                      6.3860668  12.3769339  27.56
## engineSize=f.EngSize-2.1                       0.4914005   0.2812940   8.14
## year=f.Year-2015                               0.0000000   0.0000000   8.38
## claHC=claHCPC-7                                0.0000000   0.0000000   8.58
## claHC=claHCPC-8                                0.0000000   0.0000000   9.26
## mout=YesMOut                                   0.0000000   0.0000000   9.26
## claHC=claHCPC-2                                4.0552995   6.1884669  21.70
## transmission=f.Trans-Manual                    6.6295265  16.7369902  35.90
## claHC=claHCPC-3                                0.0000000   0.0000000  11.44
## fuelType=f.Fuel-Diesel                         8.1632653  32.6300985  56.84
## aux_price=f.price-(14,19.5]                    2.4077047   4.2194093  24.92
## aux_years_sell=f.years_sell-(6,23]             0.0000000   0.0000000  16.80
## aux_years_sell=f.years_sell-(5,6]              0.0000000   0.0000000  17.24
## year=f.Year-2016                               0.0000000   0.0000000  17.24
## year=f.Year-2017                               0.0000000   0.0000000  17.74
## claHC=claHCPC-4                                0.0000000   0.0000000  19.00
## aux_years_sell=f.years_sell-(3,5]              1.2318841   2.3909986  27.60
## aux_mpg=f.mpg-(61.4,88.3]                      0.0000000   0.0000000  22.68
## aux_price=f.price-[0.65,14]                    0.3971406   0.7032349  25.18
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]      0.2400000   0.4219409  25.00
## aux_mpg=f.mpg-(53.3,61.4]                      0.0000000   0.0000000  23.76
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]      0.0000000   0.0000000  25.00
##                                                      p.value      v.test
## claHC=claHCPC-1                                 0.000000e+00         Inf
## aux_mpg=f.mpg-[8.8,44.8]                       1.979830e-318   38.148947
## aux_years_sell=f.years_sell-[2,3]             9.503307e-299   36.942805
## aux_mileage=f.mileage-[4,6e+03]               1.158575e-217   31.490865
## aux_price=f.price-(26,110]                    9.919362e-184   28.906405
## year=f.Year-2020                              7.417136e-138   24.992279
## year=f.Year-2019                               3.127218e-85   19.564126
## fuelType=f.Fuel-Petrol                         1.348359e-45   14.172890
## aux_tax=f.tax-(125,145]                        9.348948e-41   13.367616
## mout=NoMOut                                    3.209801e-33   12.008404
## transmission=f.Trans-SemiAuto                  3.128992e-22    9.696212
## engineSize=f.EngSize-3                         2.461772e-14    7.623872
## model=Audi-Q5                                  1.078305e-11    6.795643
## Audi=Audi Yes                                  2.641482e-09    5.952456
## manufacturer=Audi                              2.641482e-09    5.952456
## engineSize=f.EngSize-2                         2.327856e-07    5.171047
## model=Audi-Q3                                  1.207455e-05    4.376237
## model=Mercedes-X-CLASS                         1.882045e-05    4.278444
## model=BMW-M4                                   1.882045e-05    4.278444
```

```
## engineSize=f.EngSize-1.5                3.720077e-05   4.124211
## model=BMW-Z4                            5.557538e-05   4.030851
## model=BMW-M2                            5.744413e-05   4.023071
## model=VW-Amarok                         1.126818e-04   3.861524
## model=VW-Caravelle                      1.837535e-04   3.740365
## model=VW-Tiguan Allspace                2.415229e-04   3.671085
## model=VW-Touareg                        2.694874e-04   3.642992
## model=VW-T-Roc                          3.766764e-04   3.555908
## engineSize=f.EngSize-2.3                5.182748e-04   3.471129
## model=Mercedes-GLE Class                1.500701e-03   3.174548
## model=BMW-X2                            2.385987e-03   3.037438
## model=Audi-TT                           3.147471e-03   2.952956
## model=Audi-Q7                           4.234667e-03   2.860131
## engineSize=f.EngSize-2.9                4.771924e-03   2.822040
## model=Audi-Q2                           1.011253e-02   2.571957
## model=Audi-S4                           1.064815e-02   2.554038
## model=VW-Tiguan                         1.180587e-02   2.517894
## engineSize=f.EngSize-1.3                1.220820e-02   2.506069
## model=Mercedes-GLC Class                4.102618e-02   2.043265
## engineSize=f.EngSize-2.5                4.965759e-02   1.962902
## model=BMW-X5                            4.966573e-02   1.962832
## year=f.Year-2011                        3.963457e-02  -2.057537
## year=f.Year-2010                        3.963457e-02  -2.057537
## model=BMW-4 Series                      3.266213e-02  -2.136212
## model=BMW-1 Series                      3.047615e-02  -2.163846
## model=Audi-A3                           2.656040e-02  -2.217918
## model=VW-Scirocco                       2.496189e-02  -2.241992
## model=VW-Golf                           2.199446e-02  -2.290464
## engineSize=f.EngSize-1.8                1.833750e-02  -2.358732
## model=Mercedes-E Class                  1.567274e-02  -2.416449
## model=Mercedes-B Class                  4.666920e-03  -2.829168
## model=VW-Up                             3.867810e-03  -2.888746
## year=f.Year-2009 or before              1.547895e-03  -3.165551
## model=BMW-5 Series                      1.209763e-03  -3.236568
## model=BMW-3 Series                      3.796861e-04  -3.553815
## model=VW-Polo                           2.872707e-04  -3.626516
## engineSize=f.EngSize-1                  9.389403e-05  -3.905852
## model=Mercedes-A Class                  3.036638e-05  -4.170701
## model=Mercedes-C Class                  2.779794e-05  -4.190794
## manufacturer=Mercedes                   2.849985e-06  -4.681345
## year=f.Year-2013                        6.812715e-09  -5.795477
## claHC=claHCPC-5                         4.971630e-09  -5.848119
## engineSize=f.EngSize-1.2                3.627577e-09  -5.900338
## Audi=Audi No                            2.641482e-09  -5.952456
## engineSize=f.EngSize-1.6                1.732264e-11  -6.726975
## year=f.Year-2014                        3.898684e-14  -7.564330
## engineSize=f.EngSize-1.4                4.358769e-15  -7.844155
## year=f.Year-2018                        1.218048e-16  -8.281332
## claHC=claHCPC-6                         9.221499e-19  -8.844165
## aux_tax=f.tax-[0,125]                   3.583146e-21  -9.444146
## aux_tax=f.tax-(145,580]                 1.190742e-23 -10.024405
## aux_mpg=f.mpg-(44.8,53.3]               1.512250e-25 -10.447005
## engineSize=f.EngSize-2.1                1.226150e-25 -10.466882
## year=f.Year-2015                        5.572372e-30 -11.374967
## claHC=claHCPC-7                         1.029821e-30 -11.521352
## claHC=claHCPC-8                         3.209801e-33 -12.008404
## mout=YesMOut                            3.209801e-33 -12.008404
## claHC=claHCPC-2                         1.201597e-33 -12.089401
## transmission=f.Trans-Manual             1.158410e-33 -12.092408
## claHC=claHCPC-3                         2.144461e-41 -13.476714
## fuelType=f.Fuel-Diesel                  8.767134e-45 -14.040837
## aux_price=f.price-(14,19.5]             2.558056e-56 -15.812335
## aux_years_sell=f.years_sell-(6,23]      1.806680e-62 -16.680838
## aux_years_sell=f.years_sell-(5,6]       2.891264e-64 -16.926054
```

```
## year=f.Year-2016                          2.891264e-64 -16.926054
## year=f.Year-2017                          2.556332e-66 -17.202201
## claHC=claHCPC-4                            1.483519e-71 -17.887210
## aux_years_sell=f.years_sell-(3,5]          1.428123e-81 -19.129730
## aux_mpg=f.mpg-(61.4,88.3]                  2.224348e-87 -19.814676
## aux_price=f.price-[0.65,14]                2.452115e-88 -19.925373
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]  3.641227e-91 -20.248783
## aux_mpg=f.mpg-(53.3,61.4]                  3.502880e-92 -20.363806
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]  8.630964e-98 -20.986950
##
## $`6`
##                                              Cla/Mod      Mod/Cla Global
## aux_years_sell=f.years_sell-[2,3]          51.8769552  89.96383363  38.36
## year=f.Year-2019                           58.0463369  83.81555154  31.94
## claHC=claHCPC-2                            61.1981567  60.03616637  21.70
## aux_tax=f.tax-(125,145]                    32.3975476  90.77757685  61.98
## aux_mpg=f.mpg-(44.8,53.3]                  45.9361393  57.23327306  27.56
## aux_mileage=f.mileage-[4,6e+03]            47.3642173  53.61663653  25.04
## aux_mileage=f.mileage-(6e+03,1.65e+04]     39.4230769  44.48462929  24.96
## mout=NoMOut                                24.3773419 100.00000000  90.74
## claHC=claHCPC-1                            39.5515695  39.87341772  22.30
## aux_price=f.price-(19.5,26]                35.4216867  39.87341772  24.90
## aux_price=f.price-(26,110]                 33.7600000  38.15551537  25.00
## engineSize=f.EngSize-1.5                   37.9746835  18.98734177  11.06
## engineSize=f.EngSize-1.3                   67.1052632   4.61121157   1.52
## engineSize=f.EngSize-1                     38.3292383  14.10488246   8.14
## model=VW-T-Cross                           80.0000000   1.80831826   0.50
## model=Mercedes-B Class                     53.9682540   3.07414105   1.26
## fuelType=f.Fuel-Petrol                     25.1554280  47.55877034  41.82
## Audi=Audi No                               23.4227331  82.91139241  78.30
## model=VW-T-Roc                             46.0317460   2.62206148   1.26
## model=BMW-2 Series                         37.6811594   4.70162749   2.76
## model=VW-Arteon                            59.2592593   1.44665461   0.54
## model=Audi-Q2                              41.2500000   2.98372514   1.60
## model=VW-Sharan                            59.0909091   1.17540687   0.44
## model=Mercedes-C Class                     29.1553134   9.67450271   7.34
## transmission=f.Trans-SemiAuto              24.5771670  42.04339964  37.84
## manufacturer=VW                            24.9504950  34.17721519  30.30
## model=VW-Golf                              27.0491803  11.93490054   9.76
## engineSize=f.EngSize-2.2                   60.0000000   0.54249548   0.20
## model=VW-Golf SV                           40.0000000   0.90415913   0.50
## engineSize=f.EngSize-4                      7.1428571   0.18083183   0.56
## model=Mercedes-GLE Class                   10.9090909   0.54249548   1.10
## model=Mercedes-GL Class                     0.0000000   0.00000000   0.28
## model=Audi-A7                               0.0000000   0.00000000   0.28
## model=Mercedes-E Class                     15.5555556   2.53164557   3.60
## model=BMW-Z4                                0.0000000   0.00000000   0.30
## model=VW-Scirocco                           4.1666667   0.09041591   0.48
## model=VW-Tiguan                            14.6341463   2.16998192   3.28
## aux_mpg=f.mpg-[8.8,44.8]                   19.6923077  23.14647378  26.00
## year=f.Year-2012                            0.0000000   0.00000000   0.38
## year=f.Year-2011                            0.0000000   0.00000000   0.42
## year=f.Year-2010                            0.0000000   0.00000000   0.42
## model=Audi-TT                               3.2258065   0.09041591   0.62
## model=Audi-Q7                               3.1250000   0.09041591   0.64
## model=BMW-X5                                3.0303030   0.09041591   0.66
## model=Mercedes-GLA Class                    9.5238095   0.72332731   1.68
## model=Audi-Q3                              11.9718310   1.53707052   2.84
## model=Audi-A1                              11.6788321   1.44665461   2.74
## engineSize=f.EngSize-1.8                    0.0000000   0.00000000   0.52
## engineSize=f.EngSize-4.2 or more            0.0000000   0.00000000   0.56
## model=BMW-1 Series                         12.6903553   2.26039783   3.94
## transmission=f.Trans-Manual                19.0529248  30.92224231  35.90
## year=f.Year-2009 or before                  0.0000000   0.00000000   0.84
```

```
## Audi=Audi Yes                                   17.4193548  17.08860759  21.70
## manufacturer=Audi                               17.4193548  17.08860759  21.70
## fuelType=f.Fuel-Diesel                          19.8803659  51.08499096  56.84
## model=Audi-Q5                                    5.3763441   0.45207957   1.86
## engineSize=f.EngSize-3                           13.7010676   6.96202532  11.24
## aux_mpg=f.mpg-(53.3,61.4]                        15.7407407  16.90777577  23.76
## year=f.Year-2013                                  0.0000000   0.00000000   2.42
## claHC=claHCPC-5                                   0.0000000   0.00000000   2.46
## engineSize=f.EngSize-1.2                          0.0000000   0.00000000   2.50
## aux_price=f.price-(14,19.5]                      14.4462279  16.27486438  24.92
## engineSize=f.EngSize-1.4                          2.7681661   0.72332731   5.78
## year=f.Year-2014                                  0.0000000   0.00000000   3.94
## engineSize=f.EngSize-2.1                          3.9312039   1.44665461   8.14
## claHC=claHCPC-6                                   0.0000000   0.00000000   5.26
## aux_tax=f.tax-[0,125]                             0.0000000   0.00000000   5.94
## year=f.Year-2015                                  0.0000000   0.00000000   8.38
## claHC=claHCPC-7                                   0.0000000   0.00000000   8.58
## claHC=claHCPC-8                                   0.0000000   0.00000000   9.26
## mout=YesMOut                                      0.0000000   0.00000000   9.26
## aux_years_sell=f.years_sell-(3,5]                 8.0434783  10.03616637  27.60
## claHC=claHCPC-3                                    0.1748252   0.09041591  11.44
## aux_price=f.price-[0.65,14]                        5.0039714   5.69620253  25.18
## aux_tax=f.tax-(145,580]                            6.3591022   9.22242315  32.08
## year=f.Year-2017                                   0.6764374   0.54249548  17.74
## aux_mpg=f.mpg-(61.4,88.3]                          2.6455026   2.71247740  22.68
## aux_years_sell=f.years_sell-(6,23]                 0.0000000   0.00000000  16.80
## aux_years_sell=f.years_sell-(5,6]                  0.0000000   0.00000000  17.24
## year=f.Year-2016                                   0.0000000   0.00000000  17.24
## claHC=claHCPC-4                                    0.0000000   0.00000000  19.00
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]          1.6800000   1.89873418  25.00
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]          0.0000000   0.00000000  25.00
##                                                  p.value      v.test
## aux_years_sell=f.years_sell-[2,3]                0.000000e+00      Inf
## year=f.Year-2019                                 0.000000e+00      Inf
## claHC=claHCPC-2                                  1.908044e-235  32.764168
## aux_tax=f.tax-(125,145]                          4.457140e-129  24.171318
## aux_mpg=f.mpg-(44.8,53.3]                        3.895312e-127  23.985977
## aux_mileage=f.mileage-[4,6e+03]                  1.578623e-123  23.637724
## aux_mileage=f.mileage-(6e+03,1.65e+04]           9.066073e-60   16.305187
## mout=NoMOut                                      7.756236e-54   15.448215
## claHC=claHCPC-1                                  4.180239e-52   15.189036
## aux_price=f.price-(19.5,26]                      2.236167e-36   12.595473
## aux_price=f.price-(26,110]                       1.432529e-28   11.088129
## engineSize=f.EngSize-1.5                         2.242617e-19    9.000710
## engineSize=f.EngSize-1.3                         3.838244e-17    8.417738
## engineSize=f.EngSize-1                           1.000428e-14    7.739202
## model=VW-T-Cross                                 1.216146e-09    6.078100
## model=Mercedes-B Class                           3.601490e-08    5.509356
## fuelType=f.Fuel-Petrol                           1.261879e-05    4.366613
## Audi=Audi No                                     1.747069e-05    4.294983
## model=VW-T-Roc                                   2.576400e-05    4.208001
## model=BMW-2 Series                               2.744141e-05    4.193722
## model=VW-Arteon                                  3.709295e-05    4.124879
## model=Audi-Q2                                    1.163716e-04    3.853646
## model=VW-Sharan                                  2.189539e-04    3.696080
## model=Mercedes-C Class                           1.057009e-03    3.274896
## transmission=f.Trans-SemiAuto                    1.151757e-03    3.250566
## manufacturer=VW                                  1.606470e-03    3.154730
## model=VW-Golf                                    6.794399e-03    2.706757
## engineSize=f.EngSize-2.2                         1.222805e-02    2.505494
## model=VW-Golf SV                                 4.528875e-02    2.001963
## engineSize=f.EngSize-4                           4.364003e-02   -2.017532
## model=Mercedes-GLE Class                         3.538296e-02   -2.103948
## model=Mercedes-GL Class                          3.004094e-02   -2.169550
```

```
## model=Audi-A7                                    3.004094e-02  -2.169550
## model=Mercedes-E Class                            2.644303e-02  -2.219643
## model=BMW-Z4                                      2.337723e-02  -2.267213
## model=VW-Scirocco                                 2.161140e-02  -2.297129
## model=VW-Tiguan                                   1.521268e-02  -2.427276
## aux_mpg=f.mpg-[8.8,44.8]                          1.357520e-02  -2.468312
## year=f.Year-2012                                  8.567663e-03  -2.628840
## year=f.Year-2011                                  5.184989e-03  -2.795311
## year=f.Year-2010                                  5.184989e-03  -2.795311
## model=Audi-TT                                     4.560746e-03  -2.836525
## model=Audi-Q7                                     3.639725e-03  -2.907807
## model=BMW-X5                                      2.902629e-03  -2.977866
## model=Mercedes-GLA Class                          2.662119e-03  -3.004278
## model=Audi-Q3                                     1.815328e-03  -3.118892
## model=Audi-A1                                     1.592940e-03  -3.157196
## engineSize=f.EngSize-1.8                          1.475793e-03  -3.179402
## engineSize=f.EngSize-4.2 or more                  8.924046e-04  -3.322419
## model=BMW-1 Series                                6.202737e-04  -3.422591
## transmission=f.Trans-Manual                       8.212616e-05  -3.938109
## year=f.Year-2009 or before                        2.621279e-05  -4.204096
## Audi=Audi Yes                                     1.747069e-05  -4.294983
## manufacturer=Audi                                 1.747069e-05  -4.294983
## fuelType=f.Fuel-Diesel                            1.276456e-05  -4.364103
## model=Audi-Q5                                     9.722592e-06  -4.423253
## engineSize=f.EngSize-3                            9.373129e-08  -5.338476
## aux_mpg=f.mpg-(53.3,61.4]                         4.666976e-10  -6.229912
## year=f.Year-2013                                  4.787150e-14  -7.537596
## claHC=claHCPC-5                                   2.862615e-14  -7.604385
## engineSize=f.EngSize-1.2                          1.711372e-14  -7.670642
## aux_price=f.price-(14,19.5]                       7.083588e-15  -7.782980
## engineSize=f.EngSize-1.4                          3.522120e-22  -9.684125
## year=f.Year-2014                                  1.317880e-22  -9.784080
## engineSize=f.EngSize-2.1                          1.022144e-26 -10.699604
## claHC=claHCPC-6                                   3.626366e-30 -11.412388
## aux_tax=f.tax-[0,125]                             4.144735e-34 -12.176544
## year=f.Year-2015                                  1.579965e-48 -14.639165
## claHC=claHCPC-7                                   9.936483e-50 -14.826083
## claHC=claHCPC-8                                   7.756236e-54 -15.448215
## mout=YesMOut                                      7.756236e-54 -15.448215
## aux_years_sell=f.years_sell-(3,5]                 3.704365e-57 -15.933594
## claHC=claHCPC-3                                   5.778493e-65 -17.020590
## aux_price=f.price-[0.65,14]                       3.447452e-79 -18.841546
## aux_tax=f.tax-(145,580]                           4.794357e-89 -20.006913
## year=f.Year-2017                                  4.751652e-96 -20.795521
## aux_mpg=f.mpg-(61.4,88.3]                         3.662329e-96 -20.808010
## aux_years_sell=f.years_sell-(6,23]                6.351118e-102 -21.434649
## aux_years_sell=f.years_sell-(5,6]                 6.936596e-105 -21.749810
## year=f.Year-2016                                  6.936596e-105 -21.749810
## claHC=claHCPC-4                                   6.407831e-117 -22.986186
## aux_mileage=f.mileage-(1.65e+04,3.35e+04] 3.561707e-123 -23.603337
## aux_mileage=f.mileage-(3.35e+04,1.16e+05] 2.144720e-160 -26.986223
##
## $`7`
##                                          Cla/Mod    Mod/Cla Global
## claHC=claHCPC-4                          55.57894737  68.0412371  19.00
## aux_mileage=f.mileage-(1.65e+04,3.35e+04] 44.64000000  71.9072165  25.00
## year=f.Year-2017                         46.56144307  53.2216495  17.74
## aux_years_sell=f.years_sell-(3,5]        34.34782609  61.0824742  27.60
## aux_mpg=f.mpg-(53.3,61.4]                29.71380471  45.4896907  23.76
## claHC=claHCPC-3                          37.76223776  27.8350515  11.44
## mout=NoMOut                              17.10381309 100.0000000  90.74
## aux_years_sell=f.years_sell-(5,6]        30.39443155  33.7628866  17.24
## year=f.Year-2016                         30.39443155  33.7628866  17.24
## engineSize=f.EngSize-1.2                 60.00000000   9.6649485   2.50
```

```
## model=VW-Polo                                  38.50574713  17.2680412    6.96
## engineSize=f.EngSize-1.4                        35.64013841  13.2731959    5.78
## aux_price=f.price-(14,19.5]                      22.63242376  36.3402062   24.92
## aux_price=f.price-[0.65,14]                      22.55758539  36.5979381   25.18
## transmission=f.Trans-Manual                      19.88857939  46.0051546   35.90
## aux_mpg=f.mpg-(61.4,88.3]                         21.60493827  31.5721649   22.68
## manufacturer=VW                                  20.19801980  39.4329897   30.30
## engineSize=f.EngSize-1                           26.28992629  13.7886598    8.14
## model=Audi-A1                                    28.46715328   5.0257732    2.74
## model=VW-Up                                      30.68181818   3.4793814    1.76
## engineSize=f.EngSize-2.1                         21.62162162  11.3402062    8.14
## fuelType=f.Fuel-Petrol                           16.88187470  45.4896907   41.82
## aux_tax=f.tax-(145,580]                          17.01995012  35.1804124   32.08
## manufacturer=Mercedes                            13.84159882  24.0979381   27.02
## year=f.Year-2012                                  0.00000000   0.0000000    0.38
## year=f.Year-2018                                 12.37322515   7.8608247    9.86
## model=Audi-Q2                                     7.50000000   0.7731959    1.60
## model=Audi-Q7                                     3.12500000   0.1288660    0.64
## year=f.Year-2011                                  0.00000000   0.0000000    0.42
## year=f.Year-2010                                  0.00000000   0.0000000    0.42
## aux_price=f.price-(19.5,26]                       13.57429719  21.7783505   24.90
## model=BMW-X2                                      0.00000000   0.0000000    0.44
## aux_tax=f.tax-[0,125]                            10.77441077   4.1237113    5.94
## model=VW-T-Cross                                  0.00000000   0.0000000    0.50
## fuelType=f.Fuel-Diesel                           14.32090077  52.4484536   56.84
## transmission=f.Trans-SemiAuto                    13.68921776  33.3762887   37.84
## model=BMW-X5                                      0.00000000   0.0000000    0.66
## year=f.Year-2009 or before                       0.00000000   0.0000000    0.84
## model=Audi-Q5                                     4.30107527   0.5154639    1.86
## engineSize=f.EngSize-3                           10.67615658   7.7319588   11.24
## model=VW-T-Roc                                    1.58730159   0.1288660    1.26
## manufacturer=BMW                                 11.91611058  16.1082474   20.98
## year=f.Year-2015                                  9.30787589   5.0257732    8.38
## transmission=f.Trans-Automatic                   12.18583397  20.6185567   26.26
## engineSize=f.EngSize-1.3                          0.00000000   0.0000000    1.52
## engineSize=f.EngSize-2                           12.12121212  32.4742268   41.58
## year=f.Year-2013                                  0.00000000   0.0000000    2.42
## claHC=claHCPC-5                                   0.00000000   0.0000000    2.46
## engineSize=f.EngSize-1.5                          6.69077758   4.7680412   11.06
## aux_mpg=f.mpg-(44.8,53.3]                         9.94194485  17.6546392   27.56
## aux_mileage=f.mileage-(6e+03,1.65e+04]            9.45512821  15.2061856   24.96
## year=f.Year-2014                                  0.00000000   0.0000000    3.94
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]         7.84000000  12.6288660   25.00
## year=f.Year-2020                                  0.00000000   0.0000000    6.42
## aux_years_sell=f.years_sell-(6,23]                4.64285714   5.0257732   16.80
## claHC=claHCPC-7                                   0.00000000   0.0000000    8.58
## claHC=claHCPC-8                                   0.00000000   0.0000000    9.26
## mout=YesMOut                                      0.00000000   0.0000000    9.26
## aux_price=f.price-(26,110]                        3.28000000   5.2835052   25.00
## aux_mpg=f.mpg-[8.8,44.8]                          3.15384615   5.2835052   26.00
## claHC=claHCPC-2                                   0.00000000   0.0000000   21.70
## claHC=claHCPC-1                                   0.00000000   0.0000000   22.30
## aux_mileage=f.mileage-[4,6e+03]                   0.15974441   0.2577320   25.04
## year=f.Year-2019                                  0.06261741   0.1288660   31.94
## aux_years_sell=f.years_sell-[2,3]                 0.05213764   0.1288660   38.36
##                                                      p.value      v.test
## claHC=claHCPC-4                                  9.855872e-251  33.820499
## aux_mileage=f.mileage-(1.65e+04,3.35e+04] 6.333338e-205  30.546293
## year=f.Year-2017                                 4.871040e-140  25.192249
## aux_years_sell=f.years_sell-(3,5]                1.928153e-102  21.490071
## aux_mpg=f.mpg-(53.3,61.4]                        2.734026e-48   14.601831
## claHC=claHCPC-3                                  1.765170e-44   13.991157
## mout=NoMOut                                      1.803001e-36   12.612450
## aux_years_sell=f.years_sell-(5,6]                7.083154e-35   12.319844
```

```
## year=f.Year-2016                                7.083154e-35  12.319844
## engineSize=f.EngSize-1.2                         1.243602e-30  11.505090
## model=VW-Polo                                    1.536552e-27  10.873805
## engineSize=f.EngSize-1.4                         3.572309e-18   8.691644
## aux_price=f.price-(14,19.5]                       1.026670e-14   7.735909
## aux_price=f.price-[0.65,14]                       1.237720e-14   7.712092
## transmission=f.Trans-Manual                      3.022049e-10   6.297643
## aux_mpg=f.mpg-(61.4,88.3]                         4.527351e-10   6.234669
## manufacturer=VW                                  3.500253e-09   5.906230
## engineSize=f.EngSize-1                            4.939366e-09   5.849202
## model=Audi-A1                                    9.574033e-05   3.901141
## model=VW-Up                                      3.209239e-04   3.597797
## engineSize=f.EngSize-2.1                          6.612808e-04   3.405149
## fuelType=f.Fuel-Petrol                           2.459366e-02   2.247726
## aux_tax=f.tax-(145,580]                          4.533301e-02   2.001551
## manufacturer=Mercedes                            4.473184e-02  -2.007167
## year=f.Year-2012                                 4.032628e-02  -2.050391
## year=f.Year-2018                                 3.846206e-02  -2.069896
## model=Audi-Q2                                    3.526348e-02  -2.105320
## model=Audi-Q7                                    3.523891e-02  -2.105602
## year=f.Year-2011                                 2.873896e-02  -2.187049
## year=f.Year-2010                                 2.873896e-02  -2.187049
## aux_price=f.price-(19.5,26]                       2.732667e-02  -2.206820
## model=BMW-X2                                     2.425986e-02  -2.252989
## aux_tax=f.tax-[0,125]                            1.608499e-02  -2.406981
## model=VW-T-Cross                                 1.458960e-02  -2.442409
## fuelType=f.Fuel-Diesel                           7.388667e-03  -2.678799
## transmission=f.Trans-SemiAuto                    5.043008e-03  -2.804274
## model=BMW-X5                                     3.753302e-03  -2.898184
## year=f.Year-2009 or before                       8.125338e-04  -3.348489
## model=Audi-Q5                                    7.427227e-04  -3.373303
## engineSize=f.EngSize-3                            4.773580e-04  -3.493150
## model=VW-T-Roc                                   3.106208e-04  -3.606278
## manufacturer=BMW                                 2.069153e-04  -3.710420
## year=f.Year-2015                                 1.103406e-04  -3.866650
## transmission=f.Trans-Automatic                   7.517025e-05  -3.959298
## engineSize=f.EngSize-1.3                          2.439569e-06  -4.713116
## engineSize=f.EngSize-2                            1.540060e-08  -5.657040
## year=f.Year-2013                                 1.045445e-09  -6.102313
## claHC=claHCPC-5                                  7.393085e-10  -6.157439
## engineSize=f.EngSize-1.5                          3.447114e-11  -6.626083
## aux_mpg=f.mpg-(44.8,53.3]                         3.312953e-12  -6.963766
## aux_mileage=f.mileage-(6e+03,1.65e+04]            1.033247e-12  -7.126004
## year=f.Year-2014                                 1.792032e-15  -7.954950
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]         4.343463e-20  -9.179190
## year=f.Year-2020                                 4.246968e-25 -10.348589
## aux_years_sell=f.years_sell-(6,23]                1.358796e-26 -10.673190
## claHC=claHCPC-7                                  1.033083e-33 -12.101810
## claHC=claHCPC-8                                  1.803001e-36 -12.612450
## mout=YesMOut                                     1.803001e-36 -12.612450
## aux_price=f.price-(26,110]                        7.753185e-55 -15.595974
## aux_mpg=f.mpg-[8.8,44.8]                          6.609184e-59 -16.183356
## claHC=claHCPC-2                                  2.167923e-91 -20.274314
## claHC=claHCPC-1                                  2.791472e-94 -20.599177
## aux_mileage=f.mileage-[4,6e+03]                   4.498631e-103 -21.557543
## year=f.Year-2019                                 8.078470e-142 -25.354195
## aux_years_sell=f.years_sell-[2,3]                 7.477677e-180 -28.596262
##
## $'8'
##                                                  Cla/Mod    Mod/Cla Global
## claHC=claHCPC-8                                  100.000000 100.0000000   9.26
## mout=YesMOut                                     100.000000 100.0000000   9.26
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]         27.760000  74.9460043  25.00
## aux_years_sell=f.years_sell-(6,23]                27.857143  50.5399568  16.80
```

```
## aux_tax=f.tax-(145,580]                    19.763092  68.4665227  32.08
## aux_price=f.price-[0.65,14]                 21.604448  58.7473002  25.18
## year=f.Year-2009 or before                 100.000000   9.0712743   0.84
## year=f.Year-2011                           100.000000   4.5356371   0.42
## year=f.Year-2010                           100.000000   4.5356371   0.42
## engineSize=f.EngSize-4                       82.142857   4.9676026   0.56
## engineSize=f.EngSize-4.2 or more            75.000000   4.5356371   0.56
## transmission=f.Trans-Automatic              14.166032  40.1727862  26.26
## engineSize=f.EngSize-3                       17.437722  21.1663067  11.24
## year=f.Year-2013                            28.925620   7.5593952   2.42
## fuelType=f.Fuel-Diesel                       11.365236  69.7624190  56.84
## model=Audi-Q8                              100.000000   1.7278618   0.16
## aux_mpg=f.mpg-[8.8,44.8]                    13.384615  37.5809935  26.00
## year=f.Year-2012                            63.157895   2.5917927   0.38
## model=BMW-X7                                100.000000   1.5118790   0.14
## model=Audi-Q7                               43.750000   3.0237581   0.64
## year=f.Year-2015                            16.229117  14.6868251   8.38
## aux_mpg=f.mpg-(61.4,88.3]                    12.962963  31.7494600  22.68
## manufacturer=BMW                            13.060057  29.5896328  20.98
## model=BMW-M5                                100.000000   0.8639309   0.08
## year=f.Year-2014                            17.766497   7.5593952   3.94
## model=BMW-8 Series                           80.000000   0.8639309   0.10
## model=BMW-i8                                100.000000   0.6479482   0.06
## model=Audi-RS6                              100.000000   0.6479482   0.06
## fuelType=f.Fuel-Hybrid                       23.636364   2.8077754   1.10
## engineSize=f.EngSize-1.8                    30.769231   1.7278618   0.52
## model=Audi-A6                                21.126761   3.2397408   1.42
## model=BMW-X5                                 27.272727   1.9438445   0.66
## model=Mercedes-M Class                       50.000000   0.8639309   0.16
## Audi=Audi Yes                                11.520737  26.9978402  21.70
## manufacturer=Audi                            11.520737  26.9978402  21.70
## model=Audi-SQ5                               60.000000   0.6479482   0.10
## model=Mercedes-SL CLASS                      23.684211   1.9438445   0.76
## model=Mercedes-CLC Class                    100.000000   0.4319654   0.04
## model=Audi-R8                               100.000000   0.4319654   0.04
## engineSize=f.EngSize-1.6                     13.314448  10.1511879   7.06
## engineSize=f.EngSize-2.5                     40.000000   0.8639309   0.20
## model=BMW-X3                                 20.833333   2.1598272   0.96
## model=BMW-5 Series                           17.441860   3.2397408   1.72
## model=VW-Passat                              17.021277   3.4557235   1.88
## model=Audi-A4                                15.441176   4.5356371   2.72
## model=BMW-X6                                 42.857143   0.6479482   0.14
## model=BMW-3 Series                           13.580247   7.1274298   4.86
## model=Audi-RS5                               66.666667   0.4319654   0.06
## year=f.Year-2020                             6.230530   4.3196544   6.42
## model=VW-Up                                   3.409091   0.6479482   1.76
## engineSize=f.EngSize-1.4                      5.882353   3.6717063   5.78
## aux_price=f.price-(26,110]                    7.760000  20.9503240  25.00
## model=Mercedes-CL Class                       1.754386   0.2159827   1.14
## model=VW-Golf                                 6.557377   6.9114471   9.76
## model=VW-Tiguan                               4.268293   1.5118790   3.28
## engineSize=f.EngSize-1.2                      3.200000   0.8639309   2.50
## Audi=Audi No                                  8.633461  73.0021598  78.30
## model=Audi-Q2                                 1.250000   0.2159827   1.60
## engineSize=f.EngSize-2                        7.840308  35.2051836  41.58
## model=VW-T-Roc                                0.000000   0.0000000   1.26
## year=f.Year-2017                             6.538895  12.5269978  17.74
## engineSize=f.EngSize-1.3                      0.000000   0.0000000   1.52
## model=Audi-Q3                                 1.408451   0.4319654   2.84
## aux_mpg=f.mpg-(53.3,61.4]                     6.397306  16.4146868  23.76
## claHC=claHCPC-5                               0.000000   0.0000000   2.46
## model=VW-Polo                                 2.873563   2.1598272   6.96
## manufacturer=VW                               6.006601  19.6544276  30.30
## year=f.Year-2018                             3.245436   3.4557235   9.86
```

```
## engineSize=f.EngSize-1.5                          3.254973    3.8876890   11.06
## aux_price=f.price-(14,19.5]                        5.296950   14.2548596   24.92
## transmission=f.Trans-SemiAuto                      6.183932   25.2699784   37.84
## aux_years_sell=f.years_sell-(3,5]                   5.362319   15.9827214   27.60
## engineSize=f.EngSize-1                             1.474201    1.2958963    8.14
## fuelType=f.Fuel-Petrol                             5.978001   26.9978402   41.82
## claHC=claHCPC-6                                    0.000000    0.0000000    5.26
## aux_mpg=f.mpg-(44.8,53.3]                          4.789550   14.2548596   27.56
## aux_mileage=f.mileage-[4,6e+03]                    4.073482   11.0151188   25.04
## claHC=claHCPC-7                                    0.000000    0.0000000    8.58
## aux_mileage=f.mileage-(6e+03,1.65e+04]             2.724359    7.3434125   24.96
## claHC=claHCPC-3                                    0.000000    0.0000000   11.44
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]          2.480000    6.6954644   25.00
## aux_price=f.price-(19.5,26]                        2.248996    6.0475162   24.90
## year=f.Year-2019                                   2.504696    8.6393089   31.94
## aux_years_sell=f.years_sell-[2,3]                   3.128259   12.9589633   38.36
## claHC=claHCPC-4                                    0.000000    0.0000000   19.00
## claHC=claHCPC-2                                    0.000000    0.0000000   21.70
## claHC=claHCPC-1                                    0.000000    0.0000000   22.30
## aux_tax=f.tax-(125,145]                            3.581801   23.9740821   61.98
## mout=NoMOut                                        0.000000    0.0000000   90.74
##                                                      p.value      v.test
## claHC=claHCPC-8                                 0.000000e+00         Inf
## mout=YesMOut                                    0.000000e+00         Inf
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]       1.554868e-126   23.928299
## aux_years_sell=f.years_sell-(6,23]              4.901088e-71    17.820484
## aux_tax=f.tax-(145,580]                         5.062511e-64    16.893041
## aux_price=f.price-[0.65,14]                     5.767433e-59    16.191740
## year=f.Year-2009 or before                     6.914535e-45    14.057649
## year=f.Year-2011                               1.309612e-22     9.784717
## year=f.Year-2010                               1.309612e-22     9.784717
## engineSize=f.EngSize-4                          6.632477e-20     9.133492
## engineSize=f.EngSize-4.2 or more               8.600628e-17     8.322666
## transmission=f.Trans-Automatic                 6.897170e-12     6.859770
## engineSize=f.EngSize-3                          7.943877e-11     6.501659
## year=f.Year-2013                               4.202440e-10     6.246317
## fuelType=f.Fuel-Diesel                          2.200919e-09     5.982238
## model=Audi-Q8                                   5.115807e-09     5.843361
## aux_mpg=f.mpg-[8.8,44.8]                        8.579695e-09     5.756655
## year=f.Year-2012                               1.006358e-08     5.729654
## model=BMW-X7                                    5.601584e-08     5.431074
## model=Audi-Q7                                   3.098228e-07     5.117372
## year=f.Year-2015                               2.091759e-06     4.744351
## aux_mpg=f.mpg-(61.4,88.3]                       2.343987e-06     4.721251
## manufacturer=BMW                                4.253532e-06     4.598593
## model=BMW-M5                                    7.266462e-05     3.967388
## year=f.Year-2014                               1.422709e-04     3.804187
## model=BMW-8 Series                             3.432952e-04     3.580227
## model=BMW-i8                                    7.893589e-04     3.356499
## model=Audi-RS6                                  7.893589e-04     3.356499
## fuelType=f.Fuel-Hybrid                          1.539956e-03     3.167047
## engineSize=f.EngSize-1.8                        2.115019e-03     3.073587
## model=Audi-A6                                   2.351547e-03     3.041817
## model=BMW-X5                                    2.911931e-03     2.976885
## model=Mercedes-M Class                          4.048421e-03     2.874364
## Audi=Audi Yes                                   4.528525e-03     2.838788
## manufacturer=Audi                               4.528525e-03     2.838788
## model=Audi-SQ5                                  7.180295e-03     2.688365
## model=Mercedes-SL CLASS                         8.421713e-03     2.634678
## model=Mercedes-CLC Class                        8.557952e-03     2.629226
## model=Audi-R8                                   8.557952e-03     2.629226
## engineSize=f.EngSize-1.6                        9.398039e-03     2.597225
## engineSize=f.EngSize-2.5                        1.082174e-02     2.548403
## model=BMW-X3                                    1.462839e-02     2.441450
```

```
## model=BMW-5 Series                            1.638753e-02   2.400168
## model=VW-Passat                               1.670834e-02   2.393064
## model=Audi-A4                                 1.911364e-02   2.343307
## model=BMW-X6                                   2.282115e-02   2.276416
## model=BMW-3 Series                             2.361209e-02   2.263383
## model=Audi-RS5                                 2.488450e-02   2.243191
## year=f.Year-2020                               4.530707e-02  -2.001792
## model=VW-Up                                    4.031697e-02  -2.050487
## engineSize=f.EngSize-1.4                       3.364805e-02  -2.124264
## aux_price=f.price-(26,110]                     3.250104e-02  -2.138194
## model=Mercedes-CL Class                        3.001385e-02  -2.169908
## model=VW-Golf                                  2.525909e-02  -2.237417
## model=VW-Tiguan                                1.623524e-02  -2.403584
## engineSize=f.EngSize-1.2                       9.418223e-03  -2.596488
## Audi=Audi No                                   4.528525e-03  -2.838788
## model=Audi-Q2                                  4.062357e-03  -2.873279
## engineSize=f.EngSize-2                         3.294183e-03  -2.938863
## model=VW-T-Roc                                 2.107941e-03  -3.074587
## year=f.Year-2017                               1.438391e-03  -3.186834
## engineSize=f.EngSize-1.3                       5.850247e-04  -3.438464
## model=Audi-Q3                                  1.178440e-04  -3.850568
## aux_mpg=f.mpg-(53.3,61.4]                      5.578170e-05  -4.029980
## claHC=claHCPC-5                                5.515425e-06  -4.544162
## model=VW-Polo                                  1.482869e-06  -4.813531
## manufacturer=VW                                6.133813e-08  -5.414856
## year=f.Year-2018                               5.937028e-08  -5.420687
## engineSize=f.EngSize-1.5                       8.133131e-09  -5.765676
## aux_price=f.price-(14,19.5]                    4.645667e-09  -5.859391
## transmission=f.Trans-SemiAuto                  1.998420e-09  -5.997935
## aux_years_sell=f.years_sell-(3,5]              7.634609e-10  -6.152344
## engineSize=f.EngSize-1                         1.688770e-11  -6.730676
## fuelType=f.Fuel-Petrol                         4.072047e-12  -6.934658
## claHC=claHCPC-6                                3.836788e-12  -6.943066
## aux_mpg=f.mpg-(44.8,53.3]                      1.077617e-12  -7.120211
## aux_mileage=f.mileage-[4,6e+03]                3.386259e-15  -7.875779
## claHC=claHCPC-7                                1.070250e-19  -9.081565
## aux_mileage=f.mileage-(6e+03,1.65e+04]         1.424402e-24 -10.232071
## claHC=claHCPC-3                                1.931360e-26 -10.640478
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]      1.025706e-26 -10.699281
## aux_price=f.price-(19.5,26]                    1.077181e-28 -11.113607
## year=f.Year-2019                               1.216673e-35 -12.461109
## aux_years_sell=f.years_sell-[2,3]              1.127852e-36 -12.649363
## claHC=claHCPC-4                                1.934579e-45 -14.147521
## claHC=claHCPC-2                                1.098165e-52 -15.276416
## claHC=claHCPC-1                                2.479313e-54 -15.521565
## aux_tax=f.tax-(125,145]                        1.927642e-68 -17.483090
## mout=NoMOut                                    0.000000e+00       -Inf
##
##
## Link between the cluster variable and the quantitative variables
## ================================================================
##                Eta2 P-value
## price      0.2982252       0
## mileage    0.6964978       0
## tax        0.6185663       0
## mpg        0.4429289       0
## years_sell 0.6365673       0
## totalMOE   0.3487223       0
##
## Description of each cluster by quantitative variables
## ====================================================
## $`1`
##             v.test Mean in category Overall mean sd in category   Overall sd
## tax       52.523839     2.009455e+02    146.98985   4.914306e+00 1.158247e+01
```

```
## years_sell  9.705326       6.629032e+00       4.78660   1.160282e+00 2.140435e+00
## mileage     6.627876       3.549942e+04   22887.97553   1.329314e+04 2.145413e+04
## totalMOE   -6.549321       8.064516e-03       0.28340   8.943981e-02 4.740089e-01
## mpg        -8.236646       4.434113e+01      52.73678   3.828775e+00 1.149277e+01
##                     p.value
## tax        0.000000e+00
## years_sell 2.861605e-22
## mileage    3.405509e-11
## totalMOE   5.779944e-11
## mpg        1.771051e-16
##
## $`2`
##                v.test Mean in category Overall mean sd in category   Overall sd
## mpg          5.704380       5.498114e+01      52.73678       9.1079260 1.149277e+01
## tax         -2.109435       1.461534e+02     146.98985       3.2605102 1.158247e+01
## years_sell  -8.170094      4.187929e+00       4.78660       0.8504447 2.140435e+00
## mileage    -10.906645       1.487744e+04   22887.97553    7071.6430472 2.145413e+04
## totalMOE   -13.322290       6.721536e-02       0.28340      0.2503946 4.740089e-01
##                     p.value
## mpg        1.167672e-08
## tax        3.490702e-02
## years_sell 3.081500e-16
## mileage    1.071380e-27
## totalMOE   1.717577e-40
##
## $`3`
##                v.test Mean in category Overall mean sd in category   Overall sd
## mileage     26.10795       5.079012e+04   22887.97553    9825.0311877 2.145413e+04
## years_sell  25.86314      7.544236e+00       4.78660       1.0617908 2.140435e+00
## totalMOE    16.83713       6.809651e-01       0.28340       0.4885687 4.740089e-01
## mpg         14.81617       6.121910e+01      52.73678      10.4800946 1.149277e+01
## price      -17.33829       1.210273e+04   21470.24440    3841.9262489 1.084587e+04
##                     p.value
## mileage    2.961352e-150
## years_sell 1.731510e-147
## totalMOE   1.304120e-63
## mpg        1.151664e-49
## price      2.418448e-67
##
## $`4`
##                v.test Mean in category Overall mean sd in category   Overall sd
## mpg         22.79082       6.178377e+01      52.73678       8.0810658 1.149277e+01
## years_sell  18.05177      6.121170e+00       4.78660       0.8231151 2.140435e+00
## totalMOE    17.82348       5.752089e-01       0.28340       0.5109371 4.740089e-01
## mileage     15.26178       3.419728e+04   22887.97553    8964.2957270 2.145413e+04
## price      -16.27041       1.537512e+04   21470.24440    4106.3903423 1.084587e+04
## tax        -16.40878       1.404254e+02     146.98985       9.5662194 1.158247e+01
##                     p.value
## mpg        5.655160e-115
## years_sell 7.640095e-73
## totalMOE   4.645423e-71
## mileage    1.374451e-52
## price      1.600768e-59
## tax        1.654976e-60
##
## $`5`
##                v.test Mean in category Overall mean sd in category   Overall sd
## price       28.77146       3.231021e+04   21470.24440    9324.6594877 1.084587e+04
## tax         -3.03193       1.457700e+02     146.98985       2.0590789 1.158247e+01
## totalMOE   -15.41747       2.953586e-02       0.28340       0.1693030 4.740089e-01
## mileage    -25.41671       3.945705e+03   22887.97553    3386.2346032 2.145413e+04
## years_sell -28.11417      2.696203e+00       4.78660       0.5092392 2.140435e+00
## mpg        -36.30737       3.824169e+01      52.73678       5.8350457 1.149277e+01
##                     p.value
```

```
## price      4.882434e-182
## tax          2.429958e-03
## totalMOE    1.248967e-53
## mileage     1.648172e-142
## years_sell 6.574774e-174
## mpg          1.237999e-288
##
## $`6`
##              v.test Mean in category Overall mean sd in category   Overall sd
## price       12.11927     2.495859e+04  21470.24440    7283.7586905 1.084587e+04
## tax         -5.28326     1.453659e+02    146.98985       1.7928301 1.158247e+01
## mpg        -12.03842     4.906503e+01     52.73678       5.9178361 1.149277e+01
## totalMOE   -21.52236     1.265823e-02      0.28340       0.1117944 4.740089e-01
## mileage    -29.21722     6.252749e+03  22887.97553    4567.0783652 2.145413e+04
## years_sell -30.67194     3.044304e+00      4.78660       0.4197100 2.140435e+00
##                 p.value
## price       8.349683e-34
## tax         1.269054e-07
## mpg         2.231806e-33
## totalMOE    9.613859e-103
## mileage     1.171989e-187
## years_sell 1.347870e-206
##
## $`7`
##              v.test Mean in category Overall mean sd in category   Overall sd
## mpg         16.197092     5.887937e+01     52.73678       7.4301955 1.149277e+01
## totalMOE     9.646081     4.342784e-01      0.28340       0.5135386 4.740089e-01
## years_sell   8.075262     5.356959e+00      4.78660       0.7035646 2.140435e+00
## tax         -4.313967     1.453411e+02    146.98985       5.6501052 1.158247e+01
## price      -13.774791     1.654033e+04  21470.24440    5578.5112052 1.084587e+04
##                 p.value
## mpg         5.286835e-59
## totalMOE    5.107026e-22
## years_sell 6.733191e-16
## tax         1.603507e-05
## price       3.614265e-43
##
## $`8`
##              v.test Mean in category Overall mean sd in category   Overall sd
## mileage     37.630812     5.863228e+04  22887.97553   31918.640845 2.145413e+04
## years_sell 27.162493     7.360691e+00      4.78660       3.588067 2.140435e+00
## totalMOE    20.252281     7.084233e-01      0.28340       0.605299 4.740089e-01
## tax         11.573894     1.529250e+02    146.98985      15.573121 1.158247e+01
## mpg         -2.777691     5.132340e+01     52.73678      15.551143 1.149277e+01
##                 p.value
## mileage     0.000000e+00
## years_sell 1.802722e-162
## totalMOE    3.391667e-91
## tax         5.588725e-31
## mpg         5.474665e-03
```

We start with the description of the categorical variables that characterize the clusters:

Cluster 1: Cluster one has cars with few years_sell, low mpg, medium taxes, low mileage and high price. Also, cars with semiAuto transmission and cars with petrol as fuel predominate. We can say this because these categories are overrepresented in the cluster.

Cluster 1: Cluster one has cars with high mileage and many years_sell. Also, non-Audi cars predominate.

Cluster 2: Cluster two has cars with medium years_sell, high mpg, low price and medium-high mileage . Also, cars with diesel as fuel predominate.

Cluster 3: Cluster three has cars with high taxes, many years_sell, high mileage and low mpg. Also, non-Audi cars and cars with engineSize 2 predominate.

Cluster 4: Cluster four has cars with few years_sell, medium taxes, low mileage, high price and medium-low mpg. Also, non-Audi cars and cars with diesel as fuel predominate.

Cluster 5: Cluster five has cars with high mileage, many years_sell, low price, high taxes and high mpg. Also, cars with diesel as fuel and cars with manual transmission predominate.

Cluster 6: Cluster six has cars with low mpg, few years_sell, low mileage, high price and medium taxes. Also, cars with petrol as fuel, cars with semiAuto transmission, cars with engineSize 2 and non-Audi cars predominate.

Cluster 7: Cluster seven has cars with medium-few years_sell, medium taxes, medium mileage, medium price and medium mpg. Also, non-Audi cars predominate.

Cluster 8: Cluster of multivariant outliers.

Regarding quantitative variables:

Cluster 1: As we can see mpg, years_sell and mileage means are greater in cluster 1 than in the overall means. Also, we can see that price and tax means are lower in cluster 1 than in the overall means. So we can say that cluster 1 is a cluster of cheap cars with high mpg, many years_sell, high mileage and low tax.

Cluster 2: As we can see mpg and years_sell means are greater in cluster 2 than in the overall means. Also, we can see that tax and price means are lower in cluster 2 than in the overall means. So we can say that cluster 2 is a cluster of cheap cars with high mpg, many years_sell and low tax.

Cluster 3: As we can see tax, years_sell and mileage means are greater in cluster 3 than in the overall means. Also, we can see that mpg mean is lower in cluster 3 than in the overall mean. So we can say that cluster 3 is a cluster of cars with high tax, many years_sell, high mileage and low mpg.

Cluster 4: As we can see price mean is greater in cluster 4 than in the overall mean. Also, we can see that tax, mpg, mileage and years_sell means are lower in cluster 4 than in the overall means. So we can say that cluster 4 is a cluster of expensive cars with low tax, low mpg, low mileage and few years_sell.

Cluster 5: As we can see mileage, years_sell and mpg means are greater in cluster 5 than in the overall means. Also, we can see that price mean is lower in cluster 5 than in the overall mean. So we can say that cluster 5 is a cluster of cheap cars with high mileage, many years_sell and high mpg.

Cluster 6: As we can see price mean is greater in cluster 6 than in the overall mean. Also, we can see that tax, mileage, years_sell and mpg means are lower in cluster 6 than in the overall means. So we can say that cluster 6 is a cluster of expensive cars and low tax, low mileage, few years_sell and low mpg.

Cluster 7: As we can see mpg mean is greater in cluster 7 than in the overall mean. Also, we can see that tax, years_sell and mileage means are lower in cluster 7 than in the overall means. So we can say that cluster 7 is a cluster of cars with high mpg, low tax, few years_sell and low mileage.

Cluster 8: Cluster of multivariate outliers.

5 CA

```
par(mfrow=c(1,1))
```

```
tt<-table(df[,c("aux_price","aux_tax")])
tt
```

```
##                      aux_tax
## aux_price          f.tax-[0,125] f.tax-(125,145] f.tax-(145,580]
##    f.price-[0.65,14]           95             495             669
##    f.price-(14,19.5]          147             671             428
##    f.price-(19.5,26]           50             912             283
##    f.price-(26,110]             5            1021             224
```

```
res.ca<-CA(tt)
```

CA factor map
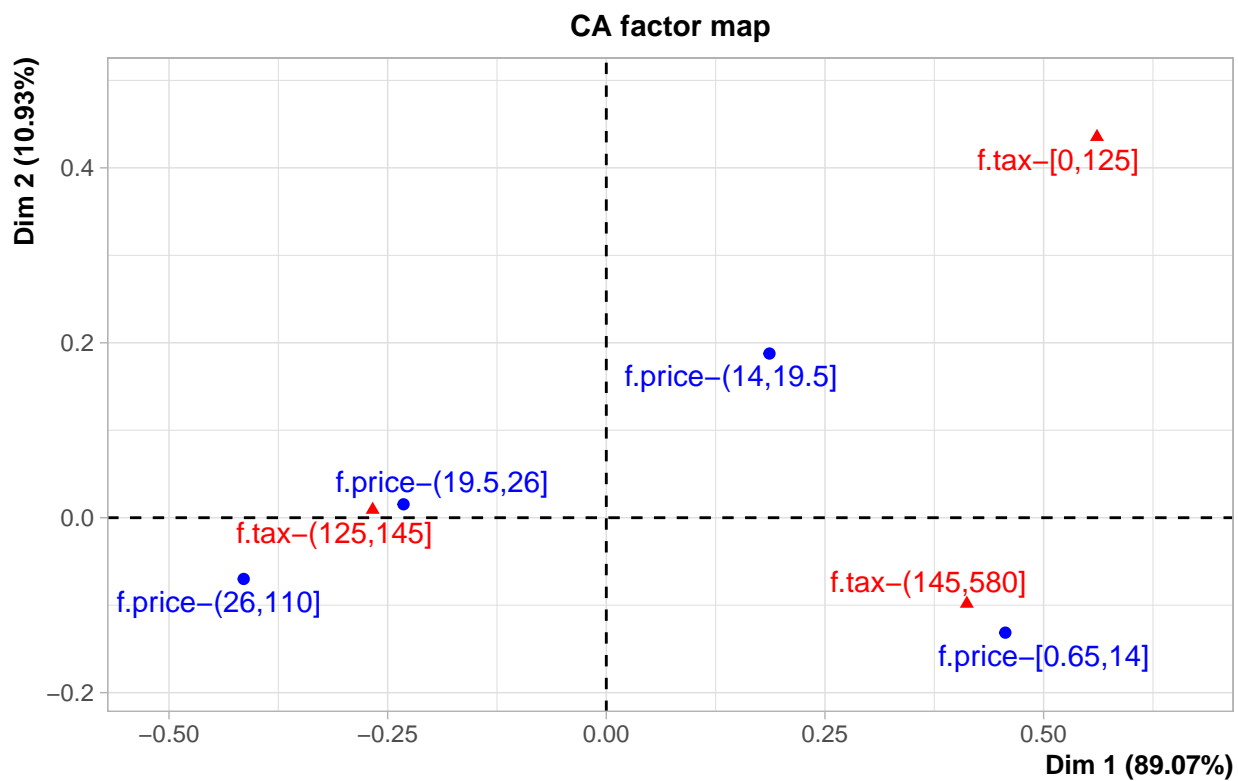

```
# lines(res.ca$row$coord[,1],res.ca$row$coord[,2],lwd=2,col="blue")
chisq.test(tt)
```

```
##
##  Pearson's Chi-squared test
##
## data:  tt
## X-squared = 659.26, df = 6, p-value < 2.2e-16
```

```
names(res.ca)
```

```
## [1] "eig"  "call" "row"  "col"  "svd"
```

```
fviz_eig(res.ca) #Same outputs as PCA
```

Scree plot
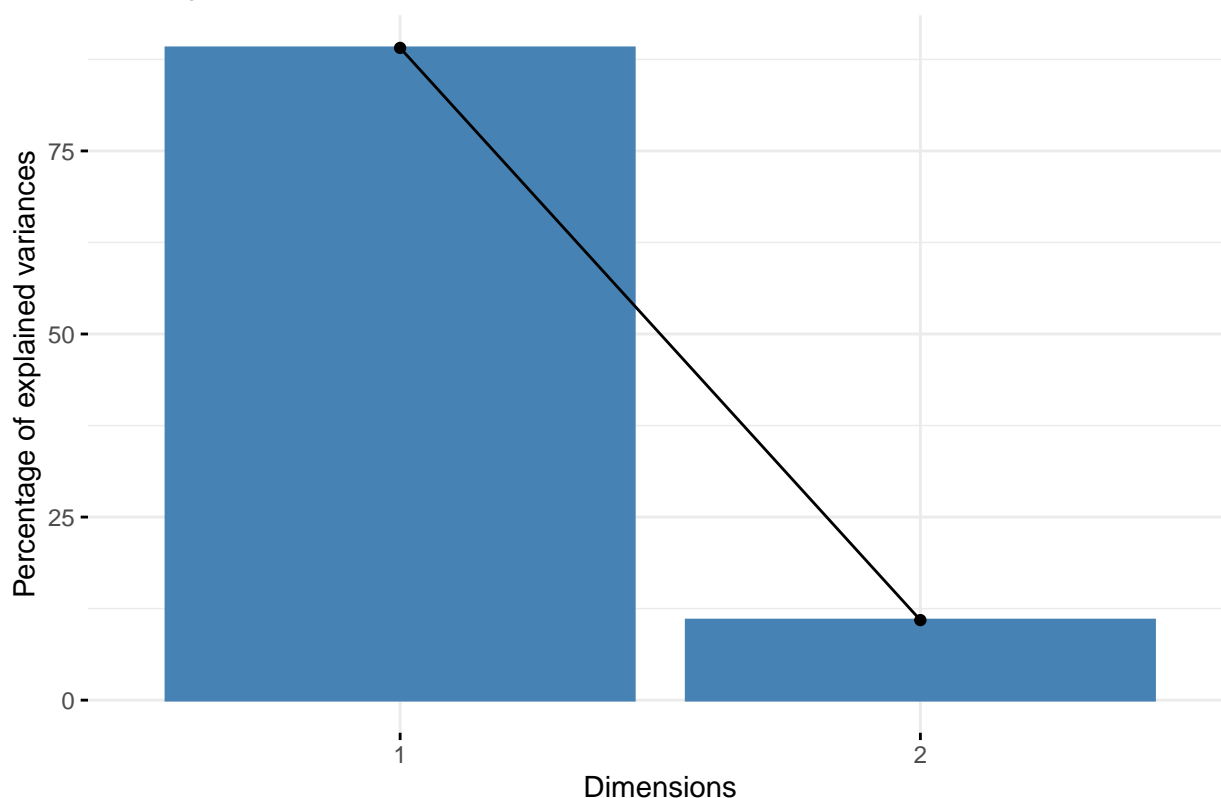

```
summary(res.ca,dig=2)
```

```
##
## Call:
## CA(X = tt)
##
## The chi square of independence between the two variables is equal to 659.2639 (p-value =  3.804822e-1
##
## Eigenvalues
##                      Dim.1   Dim.2
## Variance             0.117   0.014
## % of var.           89.071  10.929
## Cumulative % of var. 89.071 100.000
##
## Rows
##                     Iner*1000    Dim.1    ctr   cos2    Dim.2     ctr   cos2
## f.price-[0.65,14] |    56.763 |  0.456 44.631  0.923 | -0.131 30.173  0.077 |
## f.price-(14,19.5] |    17.452 |  0.187  7.385  0.497 |  0.188 60.917  0.503 |
## f.price-(19.5,26] |    13.441 | -0.232 11.395  0.996 |  0.015  0.407  0.004 |
## f.price-(26,110]  |    44.197 | -0.415 36.589  0.972 | -0.070  8.503  0.028 |
##
## Columns
##                     Iner*1000    Dim.1    ctr   cos2    Dim.2     ctr   cos2
## f.tax-[0,125]     |    29.957 |  0.561 15.920  0.624 |  0.435 78.140  0.376 |
## f.tax-(125,145]   |    44.281 | -0.267 37.661  0.999 |  0.009  0.359  0.001 |
## f.tax-(145,580]   |    57.614 |  0.412 46.419  0.946 | -0.098 21.501  0.054 |
```

```
plot( res.ca, cex=0.8, graph.type = "classic" )
lines( res.ca$row$coord[,1], res.ca$row$coord[,2], col="blue", lwd = 2 )
lines( res.ca$col$coord[,1], res.ca$col$coord[,2], col="red", lwd = 2 )
```

CA factor map
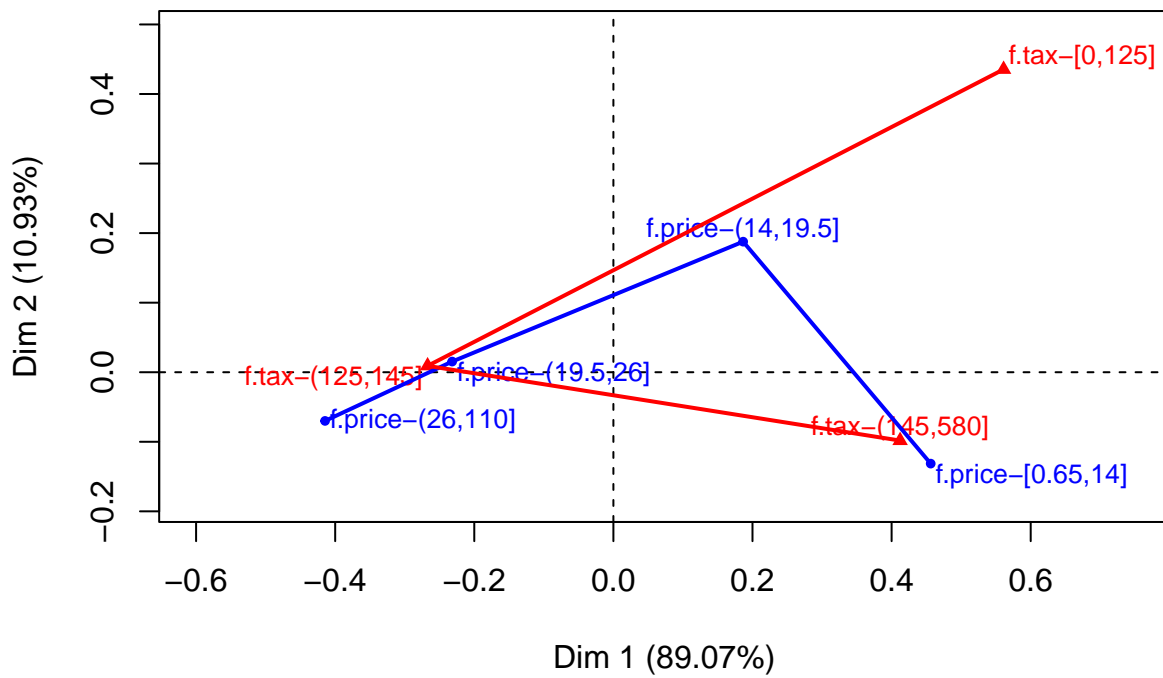

```
fviz_ca_biplot(res.ca,repel=TRUE)+theme_bw()
```

CA – Biplot
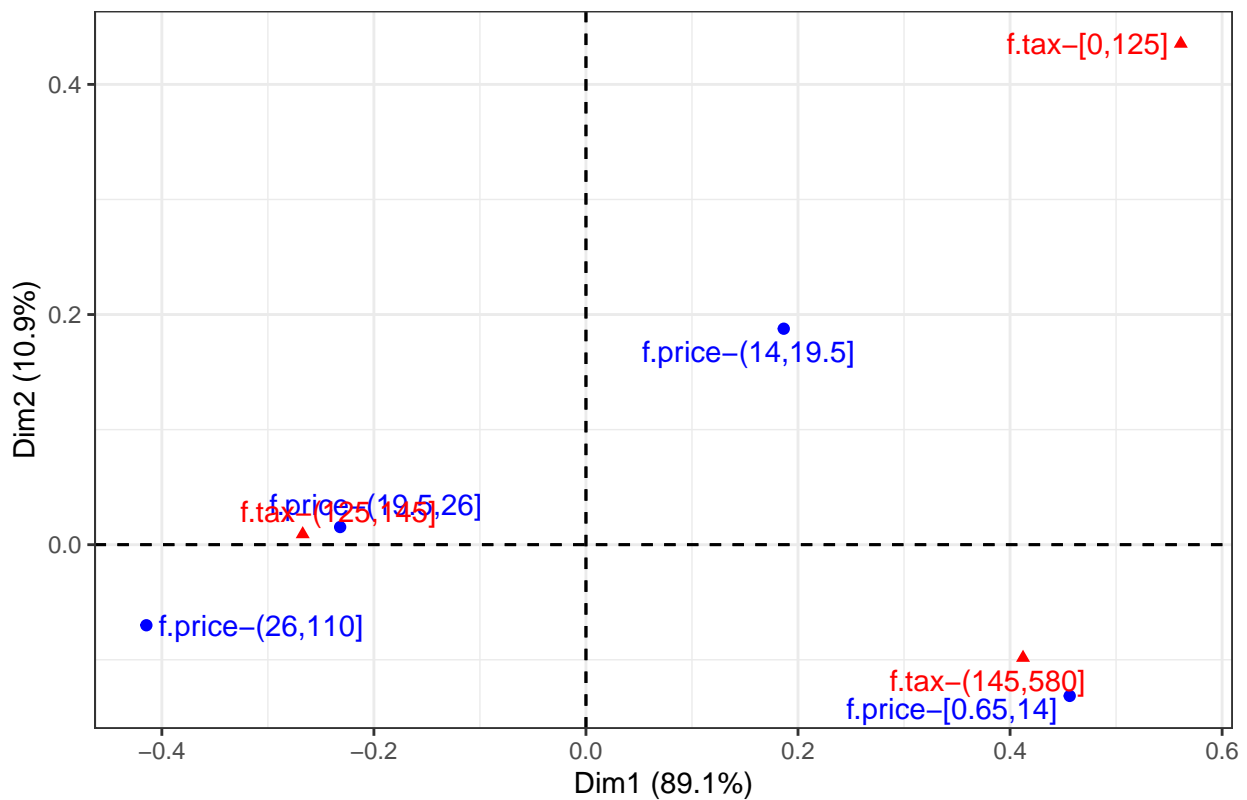
As we can see aux_price and aux_tax variables are not independent because the p-value is less than 0.05. Also, we can see that the cheapest cars have the highest taxes and the most expensive cars have average/medium taxes.

6 MCA

The objectives of MCA are close to PCA objectives: similarity among individuals/ similarity among variables. Also, generalization of CA objectives: relationships among the categories.

```
par(mfrow=c(1,1))
llvout<-which(df$mout=="YesMOut");length(llvout) #Multivariate outliers
```

```
## [1] 463
```

```
res.mca<-MCA(df[,c(vars_dis[c(3:4,6:11)],"price", "Audi") ],quali.sup=c(4,10),quanti.sup=9 , ind.sup=llv
```

MCA factor map

Variables representation

Supplementary quantitative variables
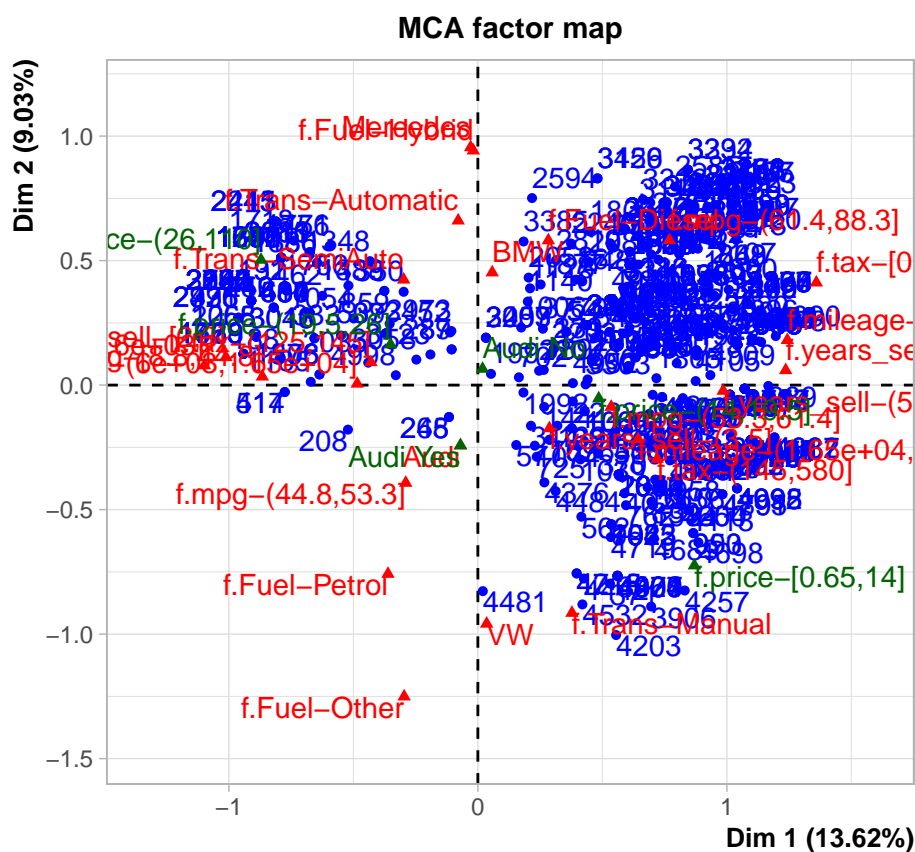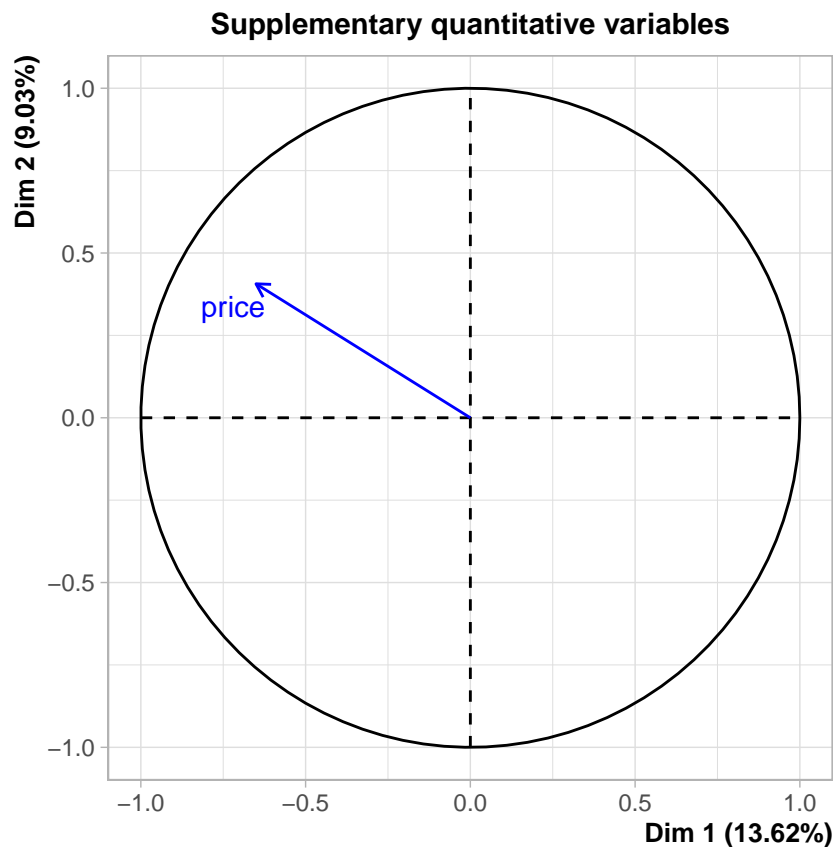
We can see that supplementary variable price is in the second quadrant (i.e. has a negative first dimension and a positive second dimension).

6.1 Eigenvalues and dominant axes analysis

```
mean(res.mca$eig[,1])
```

```
## [1] 0.1428571
```

```
summary(res.mca)
```

```
##
## Call:
## MCA(X = df[, c(vars_dis[c(3:4, 6:11)], "price", "Audi")], ind.sup = llvout,
##     quanti.sup = 9, quali.sup = c(4, 10))
##
##
## Eigenvalues
##                     Dim.1   Dim.2   Dim.3   Dim.4   Dim.5   Dim.6   Dim.7
## Variance            0.370   0.245   0.221   0.184   0.166   0.160   0.154
## % of var.          13.620   9.031   8.152   6.762   6.099   5.906   5.668
## Cumulative % of var. 13.620 22.651  30.803  37.566  43.664  49.570  55.237
##                     Dim.8   Dim.9   Dim.10  Dim.11  Dim.12  Dim.13  Dim.14
## Variance            0.151   0.146   0.135   0.132   0.125   0.123   0.102
## % of var.           5.559   5.362   4.990   4.849   4.605   4.533   3.758
## Cumulative % of var. 60.796 66.159  71.148  75.997  80.601  85.134  88.892
##                     Dim.15  Dim.16  Dim.17  Dim.18  Dim.19
## Variance            0.084   0.079   0.066   0.049   0.023
## % of var.           3.088   2.915   2.441   1.816   0.847
## Cumulative % of var. 91.980 94.895  97.337  99.153 100.000
##
## Individuals (the 10 first)
##                     Dim.1    ctr   cos2    Dim.2    ctr    cos2    Dim.3    ctr
```

```
## 1                     |  0.665  0.026  0.155 | -0.733  0.048  0.188 | -0.165  0.003
## 2                     |  0.865  0.045  0.229 | -0.594  0.032  0.108 |  0.892  0.079
## 3                     |  0.330  0.007  0.045 |  0.370  0.012  0.057 | -0.581  0.034
## 4                     | -0.677  0.027  0.229 | -0.584  0.031  0.171 |  0.336  0.011
## 5                     | -0.070  0.000  0.002 | -0.298  0.008  0.038 | -0.447  0.020
## 6                     |  0.038  0.000  0.001 | -0.752  0.051  0.264 | -0.492  0.024
## 7                     |  0.601  0.022  0.140 | -0.041  0.000  0.001 | -0.341  0.012
## 8                     |  0.130  0.001  0.007 | -0.557  0.028  0.120 | -0.298  0.009
## 9                     | -0.540  0.017  0.154 |  0.167  0.003  0.015 | -0.009  0.000
## 10                    | -0.827  0.041  0.334 | -0.096  0.001  0.005 |  0.104  0.001
##                          cos2
## 1                       0.010 |
## 2                       0.243 |
## 3                       0.140 |
## 4                       0.057 |
## 5                       0.086 |
## 6                       0.113 |
## 7                       0.045 |
## 8                       0.034 |
## 9                       0.000 |
## 10                      0.005 |
##
## Supplementary individuals (the 10 first)
##                      Dim.1   cos2    Dim.2   cos2    Dim.3   cos2
## 14                   |  0.905  0.254 |  0.416  0.054 |  0.566  0.099 |
## 31                   | -0.768  0.270 |  0.380  0.066 |  0.442  0.089 |
## 37                   | -0.370  0.065 |  0.208  0.020 | -0.327  0.051 |
## 39                   |  0.823  0.217 | -0.296  0.028 |  1.082  0.376 |
## 57                   |  0.154  0.009 | -0.240  0.022 |  0.436  0.071 |
## 72                   |  0.588  0.120 |  0.290  0.029 |  0.587  0.120 |
## 79                   |  0.528  0.088 |  0.213  0.014 |  1.148  0.416 |
## 87                   | -0.105  0.005 |  0.144  0.010 | -0.453  0.097 |
## 138                  |  0.605  0.128 |  0.066  0.002 |  0.608  0.130 |
## 149                  |  1.012  0.336 | -0.039  0.000 |  0.521  0.089 |
##
## Categories (the 10 first)
##                      Dim.1    ctr    cos2   v.test     Dim.2    ctr    cos2
## f.Trans-Manual     |  0.378  1.988  0.080  19.102 | -0.915  17.583  0.472
## f.Trans-SemiAuto   | -0.298  1.342  0.057 -16.087 |  0.423   4.087  0.115
## f.Trans-Automatic  | -0.079  0.060  0.002  -3.055 |  0.661   6.318  0.144
## f.Fuel-Diesel      |  0.283  1.719  0.100  21.300 |  0.581  10.927  0.422
## f.Fuel-Hybrid      | -0.018  0.000  0.000  -0.118 |  0.942   0.479  0.008
## f.Fuel-Other       | -0.296  0.007  0.000  -0.937 | -1.251   0.201  0.003
## f.Fuel-Petrol      | -0.361  2.180  0.100 -21.249 | -0.758  14.523  0.440
## Audi               | -0.070  0.040  0.001  -2.434 | -0.242   0.724  0.016
## BMW                |  0.058  0.026  0.001   1.947 |  0.452   2.396  0.051
## Mercedes           | -0.029  0.009  0.000  -1.195 |  0.955  14.535  0.343
##                      v.test    Dim.3    ctr    cos2   v.test
## f.Trans-Manual     -46.256 | -0.010  0.002  0.000  -0.518 |
## f.Trans-SemiAuto    22.858 | -0.079  0.157  0.004  -4.255 |
## f.Trans-Automatic   25.579 |  0.139  0.310  0.006   5.381 |
## f.Fuel-Diesel       43.728 | -0.035  0.043  0.002  -2.620 |
## f.Fuel-Hybrid        6.132 | -0.360  0.077  0.001  -2.342 |
## f.Fuel-Other        -3.959 |  0.199  0.006  0.000   0.631 |
## f.Fuel-Petrol      -44.663 |  0.051  0.074  0.002   3.021 |
## Audi                -8.455 |  0.311  1.318  0.026  10.835 |
## BMW                 15.279 |  0.250  0.812  0.016   8.448 |
## Mercedes            39.461 | -0.348  2.135  0.046 -14.370 |
##
## Categorical variables (eta2)
##                      Dim.1 Dim.2 Dim.3
## transmission       | 0.088 0.480 0.007 |
## fuelType           | 0.101 0.448 0.003 |
## manufacturer       | 0.002 0.591 0.067 |
```

```
## aux_mileage      | 0.801 0.021 0.583 |
## aux_tax          | 0.375 0.040 0.143 |
## aux_mpg          | 0.409 0.120 0.139 |
## aux_years_sell   | 0.811 0.014 0.606 |
##
## Supplementary categories
##                     Dim.1   cos2  v.test    Dim.2   cos2  v.test     Dim.3
## f.price-[0.65,14] |  0.869  0.210  30.878 | -0.725  0.146 -25.729 |   0.170
## f.price-(14,19.5] |  0.486  0.083  19.386 | -0.054  0.001  -2.147 |  -0.163
## f.price-(19.5,26] | -0.351  0.045 -14.302 |  0.163  0.010   6.653 |  -0.174
## f.price-(26,110]  | -0.871  0.258 -34.241 |  0.503  0.086  19.776 |   0.204
## Audi No           |  0.019  0.001   2.434 |  0.065  0.016   8.455 |  -0.083
## Audi Yes          | -0.070  0.001  -2.434 | -0.242  0.016  -8.455 |   0.311
##                     cos2  v.test
## f.price-[0.65,14]  0.008   6.047 |
## f.price-(14,19.5]  0.009  -6.489 |
## f.price-(19.5,26]  0.011  -7.094 |
## f.price-(26,110]   0.014   8.026 |
## Audi No            0.026 -10.835 |
## Audi Yes           0.026  10.835 |
##
## Supplementary categorical variables (eta2)
##                     Dim.1 Dim.2 Dim.3
## aux_price         | 0.452 0.186 0.032 |
## Audi              | 0.001 0.016 0.026 |
##
## Supplementary continuous variable
##                    Dim.1   Dim.2   Dim.3
## price             | -0.650 | 0.407 | 0.048 |
```

```
fviz_eig(res.mca)
```
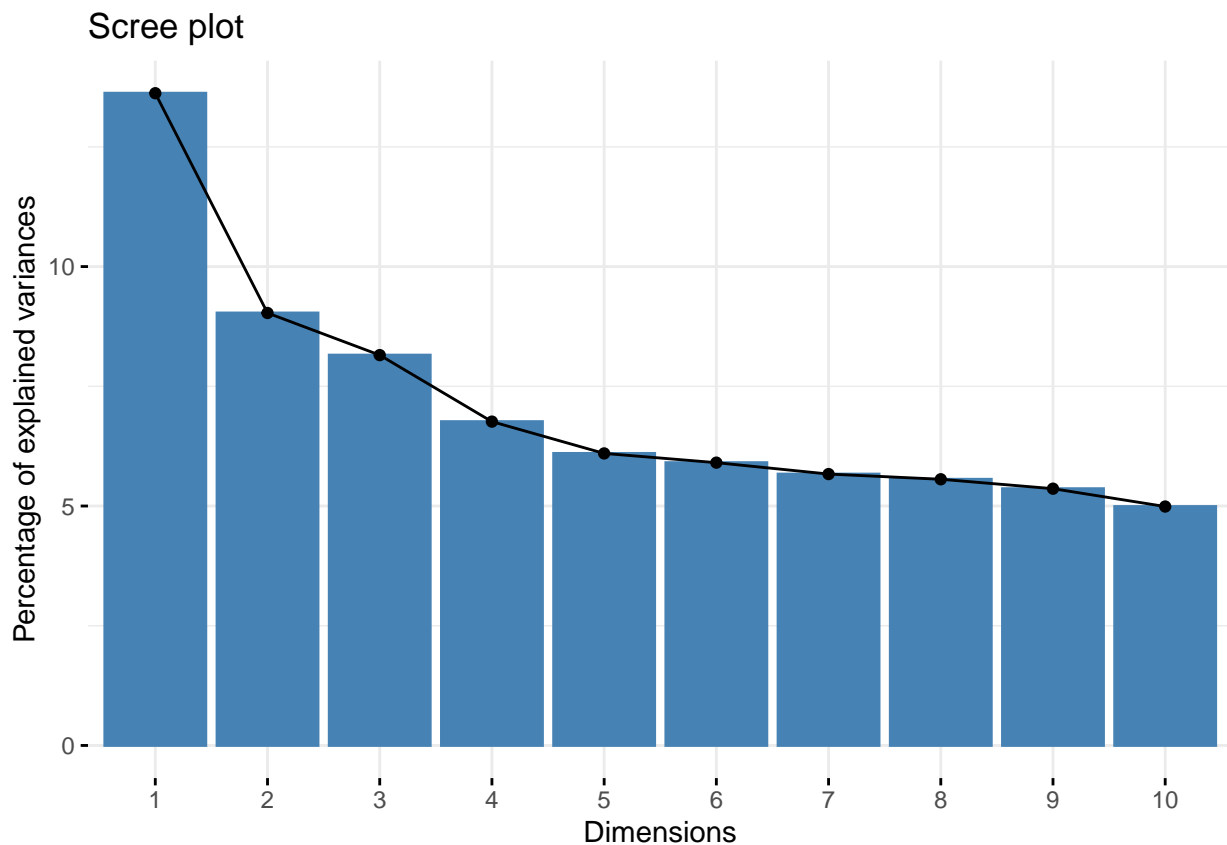

according to Elbow's rule we can pick up to 4 dimensions, the ones that brings more variability among planes.

6.2 Individuals point of view

```
fviz_contrib(res.mca, choice = "ind", axes = 1:4, top = 10)
```

Contribution of individuals to Dim−1−2−3−4
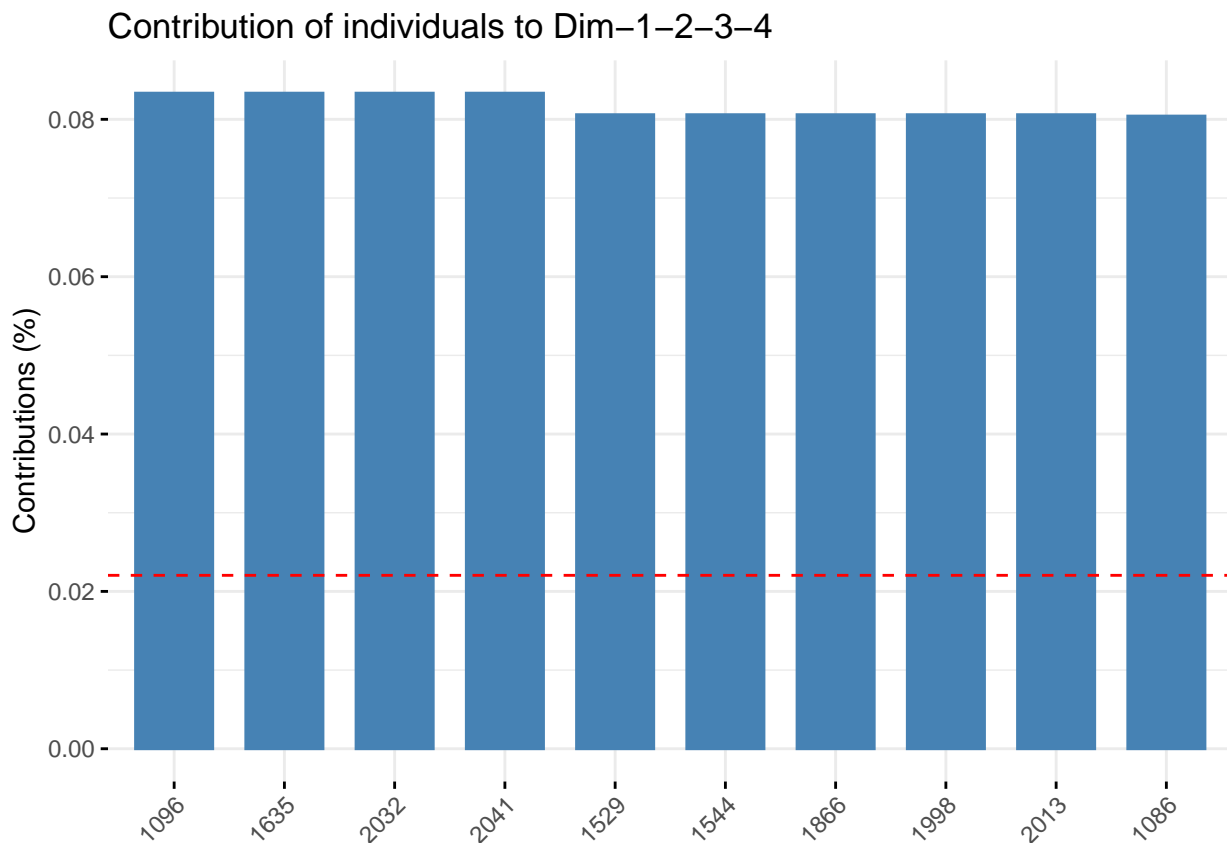
As we can see from the Contribution of individuals to Dim-1-2-3-4 plot, the 10 most contributive individuals in descending order are 1096 1635 2032 2041 1529 1544 1866 1998 2013 1086

6.3 Interpreting map of categories

```
fviz_mca_var(res.mca, repel=TRUE)
```

Variable categories – MCA
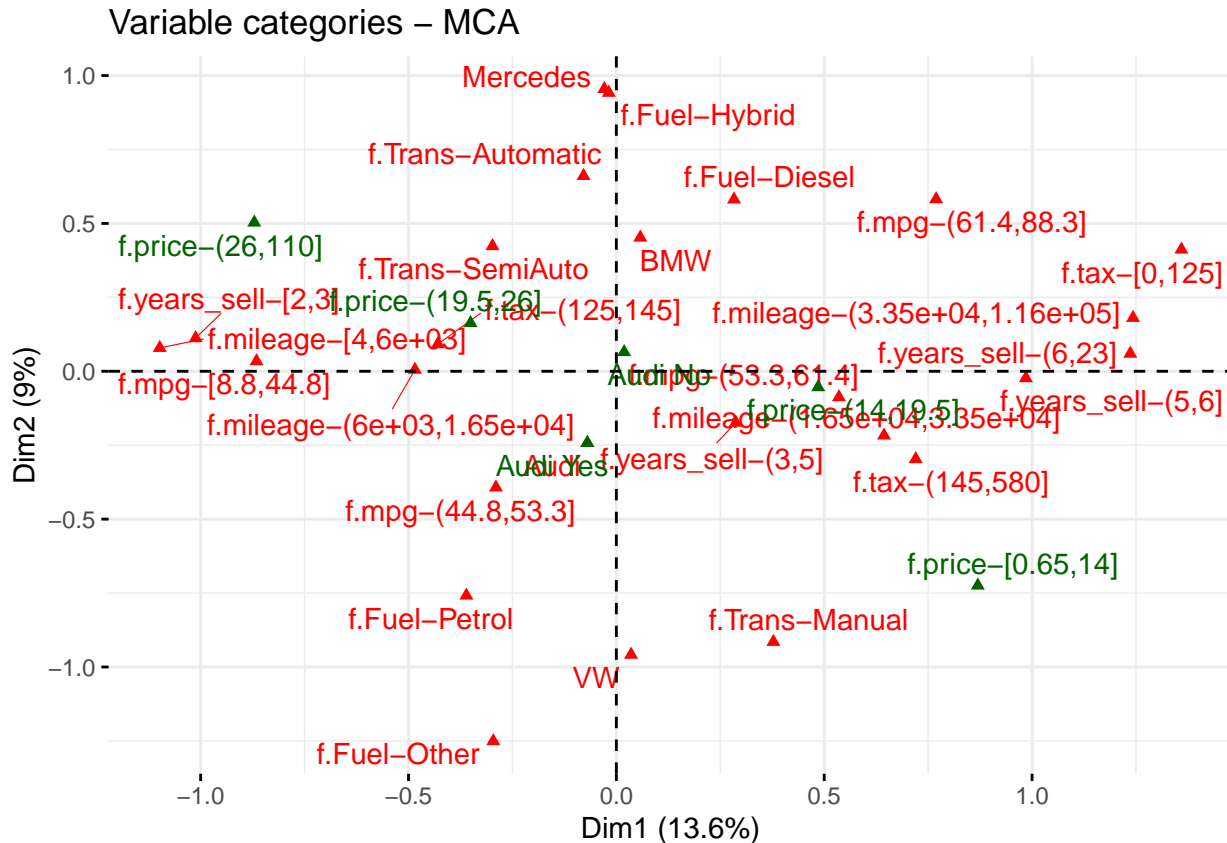
As we can see all the categories are sparse around the center of mass. In the first dimension we have as extremes f.years_sell-[2,3], f.mileage-[4,6e+03] in the negative side and in the other one we have f.years_sell-(6,23], f.mpg-(61.4,88.3]. For the dimension 2 as extremes we can find f.Fuel-Hybrid and f.Fuel-Other. This extreames they are going to be poorly repsented in that dimensions.

6.4 Interpreting the axes association to factor map

We can see/distinguish four clouds of variables (variables in the same cloud means they are related): First: manufacturer, transmission and fuelType variables. Second: Audi variable. Third: aux_price, price, aux_mpg and aux_tax variables. Forth: aux_mileage and aux_years_sell variables.

As we can see the cheapest cars are VW, have manual transmission, high taxes, medium years_sell, medium-high mileage and medium-high mpg. As we can see the most expensive cars are Mercedes, hybrid, have automatic or semi-automatic transmission, medium taxes, few years_sell, low mileage and low mpg.

As we can see Audi cars are petrol or other and have medium-low mpg.

As we can see supplementary variable price is in the second quadrant (i.e. has a negative first dimension and a positive second dimension) which corresponds to the most expensive cars.

6.5 Hierarchical Clustering (from MCA)

```
res.mca<-MCA(df[,c(vars_dis[c(3:4,6:11)],"price") ],quali.sup=c(4,6),quanti.sup=9 , ind.sup=llvout, ncp
```

MCA factor map

MCA factor map

Variables representation

Supplementary quantitative variables
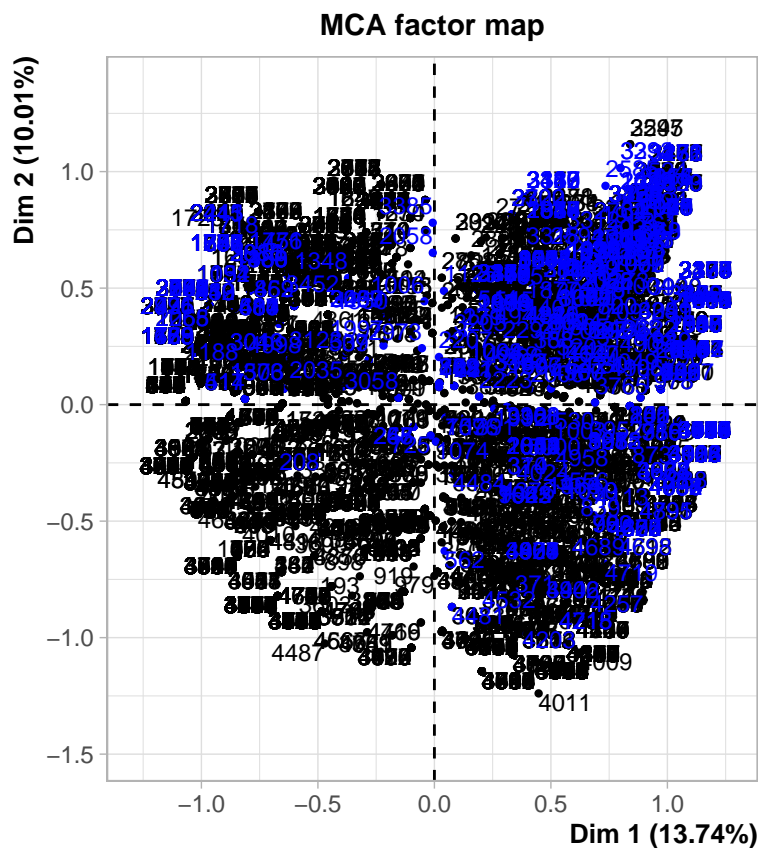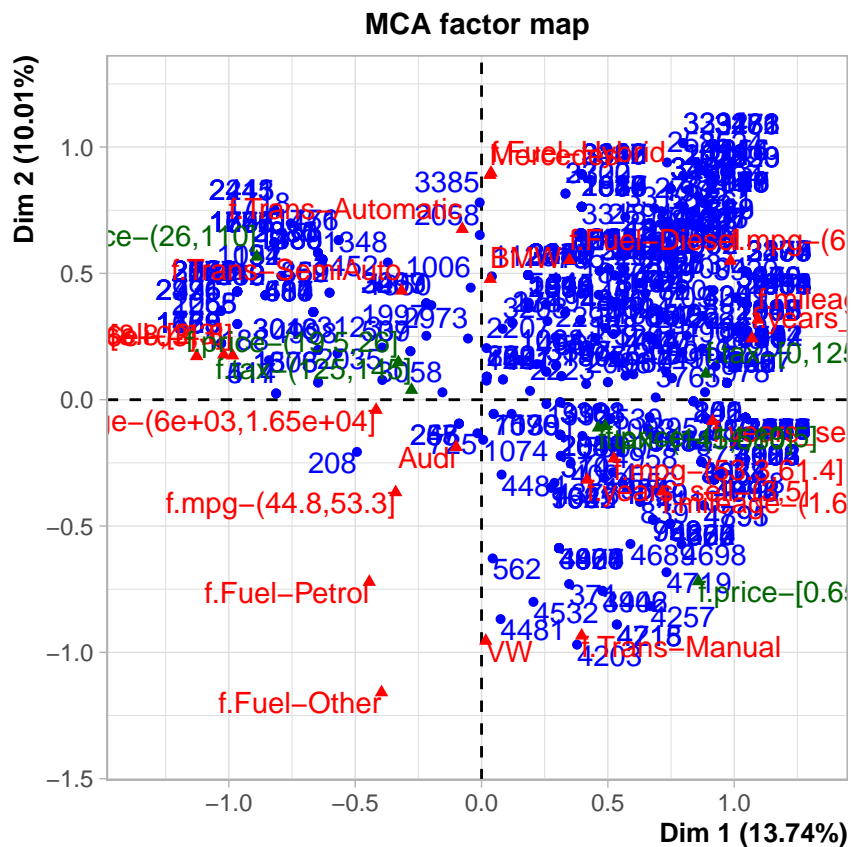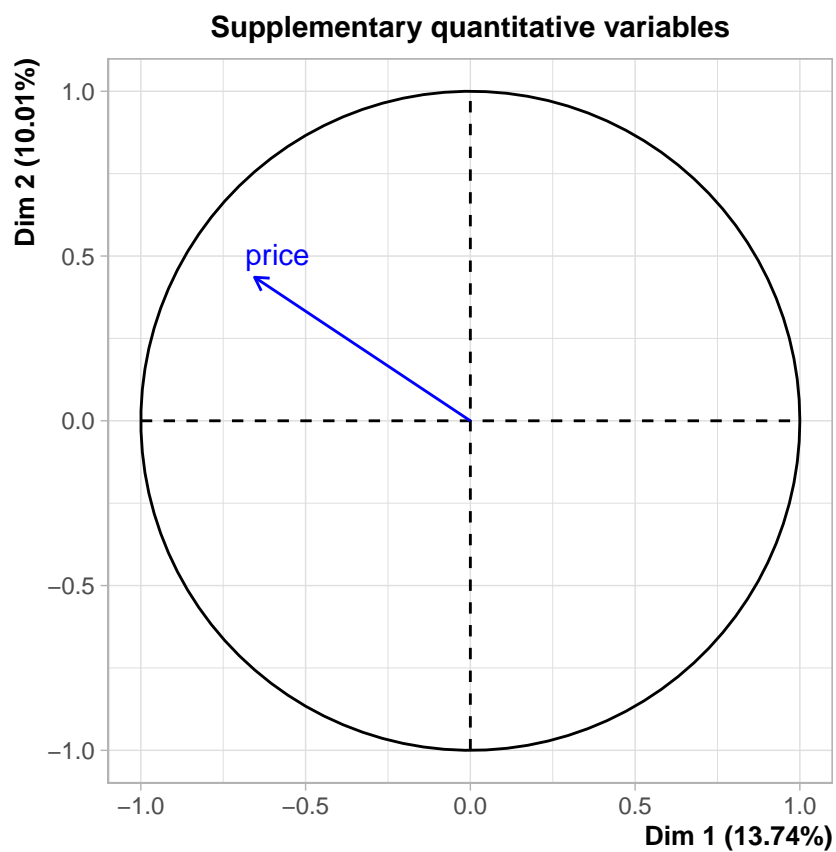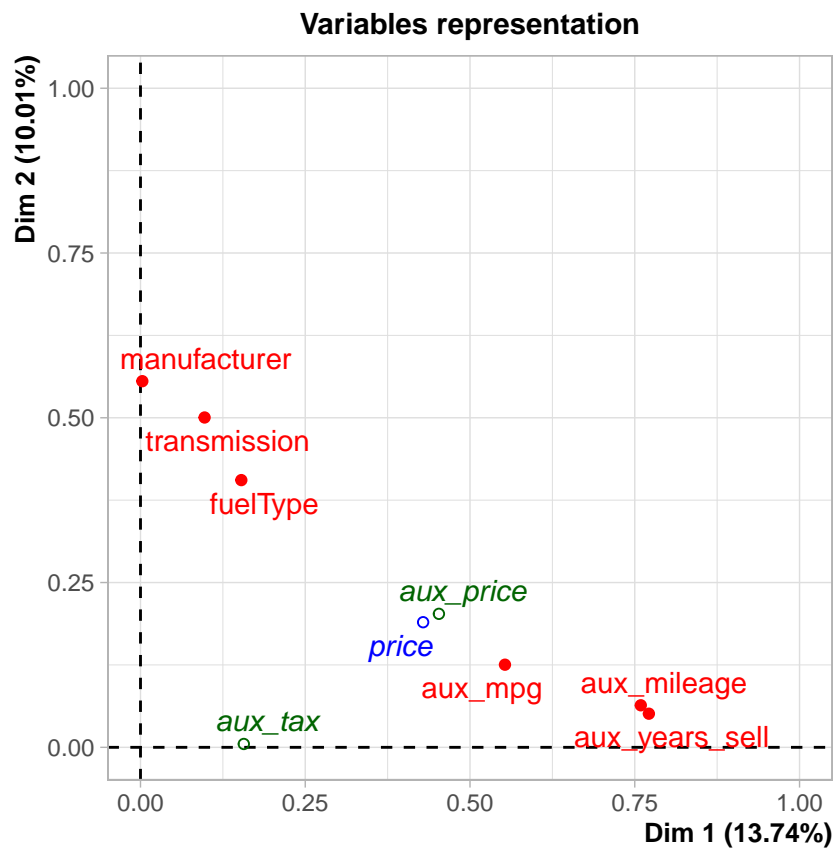

```
res.hcmc<-HCPC(res.mca,nb.clust=7,order=TRUE)
```

Hierarchical Clustering

Hierarchical Classification

inertia gain

Hierarchical clustering on the factor map

cluster 1
cluster 2
cluster 3
cluster 4
cluster 5
cluster 6
cluster 7

height

Dim 2 (10.01%)

Dim 1 (13.74%)

Factor map

Dim 1 (13.74%)
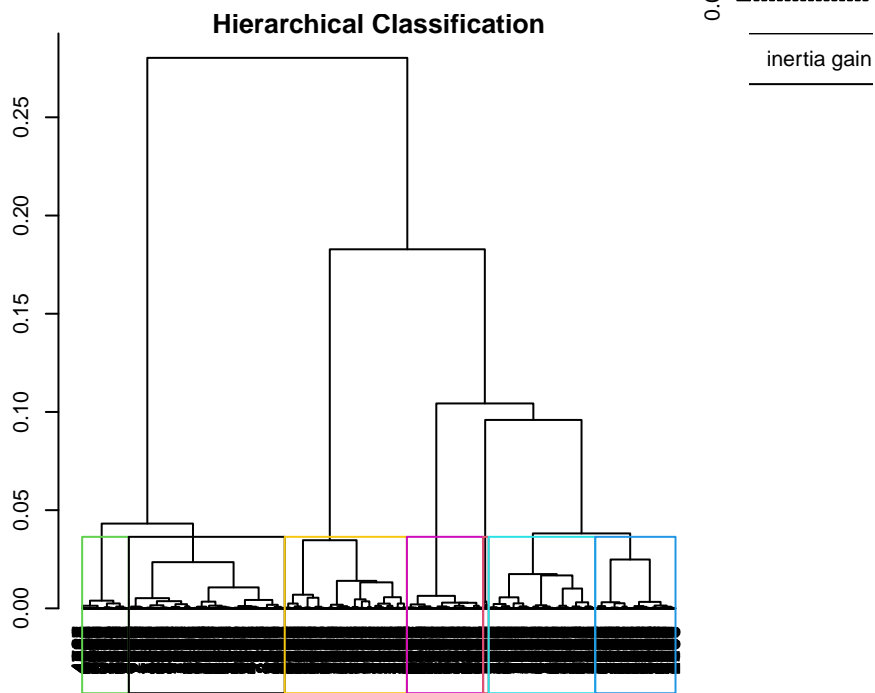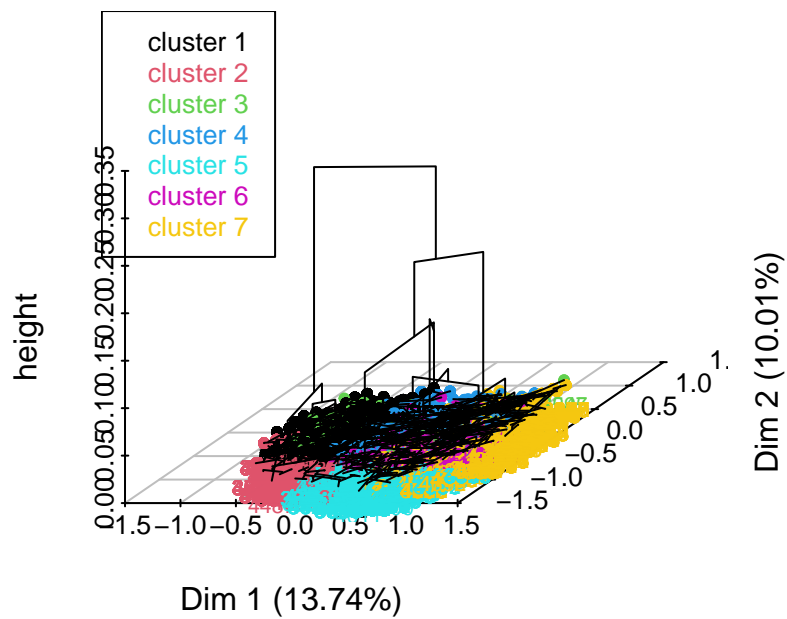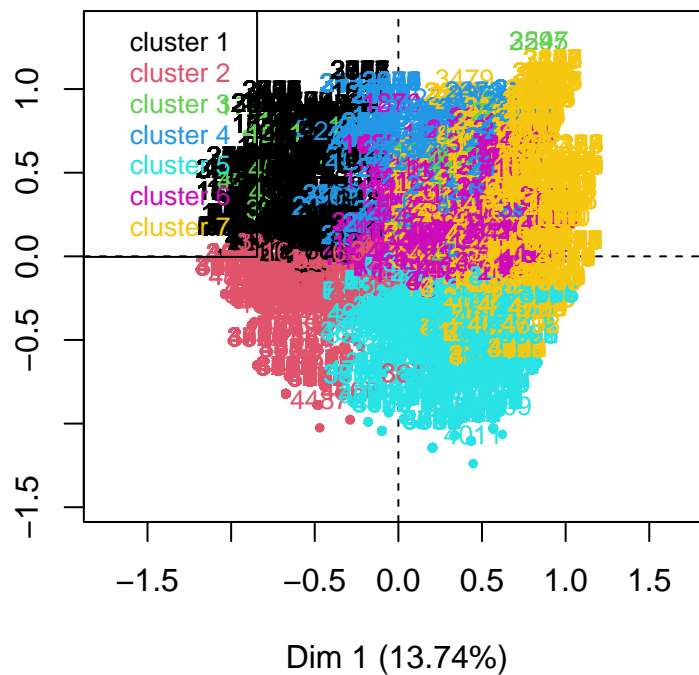
```
res.hcmc$desc.var
```

```
##
## Link between the cluster variable and the categorical variables (chi-square test)
## =================================================================================
##                    p.value df
## transmission   0.000000e+00 12
## fuelType       0.000000e+00 18
## manufacturer   0.000000e+00 18
## aux_price      0.000000e+00 18
## aux_mileage    0.000000e+00 18
## aux_mpg        0.000000e+00 18
## aux_years_sell 0.000000e+00 18
## aux_tax       1.583016e-215 12
##
## Description of each cluster by the categories
## =============================================
## $'1'
##                                          Cla/Mod      Mod/Cla      Global
## aux_years_sell=f.years_sell-[2,3]       60.0107643 95.95524957 40.9521710
## aux_price=f.price-(26,110]              67.6496097 67.12564544 25.4132687
## aux_mileage=f.mileage-[4,6e+03]         62.7810158 64.88812392 26.4712365
## aux_mpg=f.mpg-[8.8,44.8]                55.4174067 53.70051635 24.8181618
## aux_tax=f.tax-(125,145]                 34.1030790 87.69363167 65.8584968
## transmission=f.Trans-SemiAuto           39.6056338 60.49913941 39.1227683
## transmission=f.Trans-Automatic          36.8234250 35.71428571 24.8402028
## manufacturer=BMW                        37.1710526 29.17383821 20.1013886
## aux_mileage=f.mileage-(6e+03,1.65e+04]  32.7841845 34.25129088 26.7577695
## manufacturer=Audi                       31.8750000 26.33390706 21.1593564
## manufacturer=Mercedes                   30.7816277 32.87435456 27.3528764
## aux_mpg=f.mpg-(44.8,53.3]               29.6493902 33.47676420 28.9177871
## aux_price=f.price-(19.5,26]             28.7592440 30.12048193 26.8238924
## fuelType=f.Fuel-Hybrid                   0.0000000  0.00000000  0.9257218
## aux_tax=f.tax-[0,125]                    0.0000000  0.00000000  5.7747410
## aux_mpg=f.mpg-(53.3,61.4]                9.9820144  9.55249570 24.5095878
```

```
## aux_tax=f.tax-(145,580]                        11.1111111 12.30636833 28.3667622
## manufacturer=VW                                 9.4803371 11.61790017 31.3863787
## aux_years_sell=f.years_sell-(6,23]              0.4950495  0.25817556 13.3568437
## aux_mpg=f.mpg-(61.4,88.3]                       3.8500507  3.27022375 21.7544633
## aux_years_sell=f.years_sell-(5,6]               0.2607562  0.17211704 16.9054441
## aux_price=f.price-(14,19.5]                     2.7118644  2.75387263 26.0083756
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]       0.1107420  0.08605852 19.9030196
## aux_years_sell=f.years_sell-(3,5]               3.2159265  3.61445783 28.7855411
## aux_price=f.price-[0.65,14]                     0.0000000  0.00000000 21.7544633
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]       0.7383101  0.77452668 26.8679744
## transmission=f.Trans-Manual                     2.6911315  3.78657487 36.0370289
##                                                     p.value     v.test
## aux_years_sell=f.years_sell-[2,3]               0.000000e+00        Inf
## aux_price=f.price-(26,110]                      7.156435e-290  36.385737
## aux_mileage=f.mileage-[4,6e+03]                 1.235055e-240  33.126493
## aux_mpg=f.mpg-[8.8,44.8]                        2.333833e-141  25.312382
## aux_tax=f.tax-(125,145]                         3.562930e-83   19.321197
## transmission=f.Trans-SemiAuto                   5.523844e-66   17.157503
## transmission=f.Trans-Automatic                  3.040842e-22    9.699129
## manufacturer=BMW                                3.726310e-18    8.686849
## aux_mileage=f.mileage-(6e+03,1.65e+04]          4.705933e-11    6.579954
## manufacturer=Audi                               8.574555e-07    4.921814
## manufacturer=Mercedes                           1.325643e-06    4.835870
## aux_mpg=f.mpg-(44.8,53.3]                       8.229781e-05    3.937608
## aux_price=f.price-(19.5,26]                     3.518326e-03    2.918400
## fuelType=f.Fuel-Hybrid                          3.755169e-06   -4.624492
## aux_tax=f.tax-[0,125]                           1.425553e-35  -12.448468
## aux_mpg=f.mpg-(53.3,61.4]                       5.156970e-49  -14.715100
## aux_tax=f.tax-(145,580]                         3.425338e-50  -14.897424
## manufacturer=VW                                 8.095465e-72  -17.920936
## aux_years_sell=f.years_sell-(6,23]              6.592617e-79  -18.807203
## aux_mpg=f.mpg-(61.4,88.3]                       1.952390e-90  -20.165881
## aux_years_sell=f.years_sell-(5,6]               1.062964e-105 -21.835702
## aux_price=f.price-(14,19.5]                     9.441191e-128 -24.044890
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]       4.326915e-130 -24.267451
## aux_years_sell=f.years_sell-(3,5]               1.012562e-136 -24.887640
## aux_price=f.price-[0.65,14]                     5.630994e-147 -25.817567
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]       7.753698e-169 -27.696221
## transmission=f.Trans-Manual                     6.914705e-195 -29.780855
##
## $`2`
##                                                  Cla/Mod    Mod/Cla     Global
## aux_years_sell=f.years_sell-[2,3]               29.3864370 94.1379310 40.9521710
## manufacturer=VW                                 30.7584270 75.5172414 31.3863787
## aux_mileage=f.mileage-[4,6e+03]                 31.8068276 65.8620690 26.4712365
## fuelType=f.Fuel-Petrol                          24.1098678 81.7241379 43.3325986
## transmission=f.Trans-Manual                     24.5871560 69.3103448 36.0370289
## aux_mpg=f.mpg-(44.8,53.3]                       23.4756098 53.1034483 28.9177871
## aux_tax=f.tax-(125,145]                         16.7001339 86.0344828 65.8584968
## aux_price=f.price-(19.5,26]                     20.4601479 42.9310345 26.8238924
## aux_mpg=f.mpg-[8.8,44.8]                        19.6269982 38.1034483 24.8181618
## fuelType=f.Fuel-Other                           60.0000000  1.0344828  0.2204100
## aux_mileage=f.mileage-(6e+03,1.65e+04]          15.0741351 31.5517241 26.7577695
## aux_price=f.price-(14,19.5]                     14.6610169 29.8275862 26.0083756
## manufacturer=Audi                               10.3125000 17.0689655 21.1593564
## fuelType=f.Fuel-Hybrid                           0.0000000  0.0000000  0.9257218
## aux_price=f.price-(26,110]                       8.0659150 16.0344828 25.4132687
## aux_price=f.price-[0.65,14]                      6.5856130 11.2068966 21.7544633
## aux_tax=f.tax-[0,125]                            0.0000000  0.0000000  5.7747410
## transmission=f.Trans-Automatic                   5.9449867 11.5517241 24.8402028
## aux_tax=f.tax-(145,580]                          6.2937063 13.9655172 28.3667622
## manufacturer=BMW                                 3.3991228  5.3448276 20.1013886
## transmission=f.Trans-SemiAuto                    6.2535211 19.1379310 39.1227683
## aux_mpg=f.mpg-(53.3,61.4]                        3.8669065  7.4137931 24.5095878
```

```
## aux_years_sell=f.years_sell-(6,23]          0.8250825  0.8620690 13.3568437
## aux_years_sell=f.years_sell-(5,6]           0.2607562  0.3448276 16.9054441
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]   0.8859358  1.3793103 19.9030196
## aux_mpg=f.mpg-(61.4,88.3]                    0.8105370  1.3793103 21.7544633
## aux_years_sell=f.years_sell-(3,5]           2.0673813  4.6551724 28.7855411
## manufacturer=Mercedes                        0.9669621  2.0689655 27.3528764
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]   0.5742412  1.2068966 26.8679744
## fuelType=f.Fuel-Diesel                       3.9698293 17.2413793 55.5212696
##                                                 p.value      v.test
## aux_years_sell=f.years_sell-[2,3]           3.400904e-187  29.180778
## manufacturer=VW                             7.289749e-123  23.573027
## aux_mileage=f.mileage-[4,6e+03]             9.595664e-103  21.522450
## fuelType=f.Fuel-Petrol                      1.145637e-91   20.305673
## transmission=f.Trans-Manual                 1.976190e-68   17.481672
## aux_mpg=f.mpg-(44.8,53.3]                   1.878396e-39   13.142530
## aux_tax=f.tax-(125,145]                     1.503327e-31   11.685982
## aux_price=f.price-(19.5,26]                 2.260825e-19    8.999823
## aux_mpg=f.mpg-[8.8,44.8]                    2.587744e-14    7.617431
## fuelType=f.Fuel-Other                       6.124429e-04    3.426043
## aux_mileage=f.mileage-(6e+03,1.65e+04]      5.891577e-03    2.753755
## aux_price=f.price-(14,19.5]                 2.641753e-02    2.220018
## manufacturer=Audi                           8.597103e-03   -2.627673
## fuelType=f.Fuel-Hybrid                      3.111182e-03   -2.956534
## aux_price=f.price-(26,110]                  7.437921e-09   -5.780725
## aux_price=f.price-[0.65,14]                 2.343803e-12   -7.012331
## aux_tax=f.tax-[0,125]                       8.630020e-17   -8.322262
## transmission=f.Trans-Automatic             2.203217e-17   -8.482545
## aux_tax=f.tax-(145,580]                     2.536068e-18   -8.730474
## manufacturer=BMW                            1.087318e-26  -10.693874
## transmission=f.Trans-SemiAuto              3.282347e-28  -11.013702
## aux_mpg=f.mpg-(53.3,61.4]                   7.489931e-30  -11.349136
## aux_years_sell=f.years_sell-(6,23]          1.599133e-31  -11.680732
## aux_years_sell=f.years_sell-(5,6]           5.460322e-47  -14.396282
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]  8.797085e-48  -14.521951
## aux_mpg=f.mpg-(61.4,88.3]                   8.373941e-54  -15.443274
## aux_years_sell=f.years_sell-(3,5]           1.430849e-55  -15.703517
## manufacturer=Mercedes                       1.307471e-67  -17.373605
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]  6.057785e-73  -18.064583
## fuelType=f.Fuel-Diesel                      1.189898e-91  -20.303811
##
## $`3`
##                                  Cla/Mod     Mod/Cla     Global       p.value
## fuelType=f.Fuel-Hybrid         100.0000000 100.000000   0.9257218  4.426488e-103
## manufacturer=BMW                 2.9605263  64.285714  20.1013886  5.416173e-10
## transmission=f.Trans-Automatic   2.3957409  64.285714  24.8402028  7.678985e-08
## aux_mpg=f.mpg-(53.3,61.4]        1.9784173  52.380952  24.5095878  1.101042e-04
## aux_mpg=f.mpg-[8.8,44.8]         0.3552398   9.523810  24.8181618  1.446723e-02
## manufacturer=VW                  0.4213483  14.285714  31.3863787  1.236833e-02
## manufacturer=Audi                0.2083333   4.761905  21.1593564  3.860339e-03
## aux_mpg=f.mpg-(61.4,88.3]        0.2026342   4.761905  21.7544633  2.976962e-03
## aux_price=f.price-[0.65,14]      0.2026342   4.761905  21.7544633  2.976962e-03
## transmission=f.Trans-Manual      0.0000000   0.000000  36.0370289  6.341645e-09
## fuelType=f.Fuel-Petrol           0.0000000   0.000000  43.3325986  3.770847e-11
## fuelType=f.Fuel-Diesel           0.0000000   0.000000  55.5212696  1.313682e-15
##                                     v.test
## fuelType=f.Fuel-Hybrid           21.558291
## manufacturer=BMW                  6.206546
## transmission=f.Trans-Automatic    5.374513
## aux_mpg=f.mpg-(53.3,61.4]         3.867173
## aux_mpg=f.mpg-[8.8,44.8]         -2.445448
## manufacturer=VW                  -2.501457
## manufacturer=Audi                -2.889354
## aux_mpg=f.mpg-(61.4,88.3]        -2.970107
## aux_price=f.price-[0.65,14]      -2.970107
```

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## transmission=f.Trans-Manual      -5.807490
## fuelType=f.Fuel-Petrol          -6.612813
## fuelType=f.Fuel-Diesel          -7.993305
##
## $`4`
##                                          Cla/Mod    Mod/Cla    Global
## manufacturer=Mercedes                    45.0443191 90.4530744 27.3528764
## fuelType=f.Fuel-Diesel                   22.3104407 90.9385113 55.5212696
## aux_mpg=f.mpg-(61.4,88.3]                31.7122594 50.6472492 21.7544633
## transmission=f.Trans-SemiAuto            24.3943662 70.0647249 39.1227683
## aux_years_sell=f.years_sell-(3,5]        27.0290965 57.1197411 28.7855411
## aux_mileage=f.mileage-(6e+03,1.65e+04]   23.8879736 46.9255663 26.7577695
## aux_price=f.price-(19.5,26]              21.4461791 42.2330097 26.8238924
## aux_mileage=f.mileage-(1.65e+04,3.35e+04] 19.3601313 38.1877023 26.8679744
## aux_tax=f.tax-(125,145]                  15.3949130 74.4336570 65.8584968
## aux_price=f.price-(26,110]               15.8716392 29.6116505 25.4132687
## fuelType=f.Fuel-Hybrid                    0.0000000  0.0000000  0.9257218
## aux_tax=f.tax-(145,580]                   9.0909091 18.9320388 28.3667622
## aux_mpg=f.mpg-[8.8,44.8]                  8.0817052 14.7249191 24.8181618
## aux_mileage=f.mileage-(3.35e+04,1.16e+05] 6.2015504  9.0614887 19.9030196
## aux_years_sell=f.years_sell-(6,23]        2.6402640  2.5889968 13.3568437
## manufacturer=Audi                         4.6875000  7.2815534 21.1593564
## aux_years_sell=f.years_sell-[2,3]         7.5349839 22.6537217 40.9521710
## aux_mileage=f.mileage-[4,6e+03]           2.9975021  5.8252427 26.4712365
## aux_mpg=f.mpg-(44.8,53.3]                 3.2774390  6.9579288 28.9177871
## aux_price=f.price-[0.65,14]               1.4184397  2.2653722 21.7544633
## manufacturer=BMW                          0.9868421  1.4563107 20.1013886
## transmission=f.Trans-Manual               1.7125382  4.5307443 36.0370289
## fuelType=f.Fuel-Petrol                    2.8484232  9.0614887 43.3325986
## manufacturer=VW                           0.3511236  0.8090615 31.3863787
##                                             p.value     v.test
## manufacturer=Mercedes                    9.617737e-287  36.187375
## fuelType=f.Fuel-Diesel                    2.770468e-94  20.599543
## aux_mpg=f.mpg-(61.4,88.3]                 9.020572e-67  17.262447
## transmission=f.Trans-SemiAuto             3.834556e-63  16.773176
## aux_years_sell=f.years_sell-(3,5]         3.411001e-57  15.938752
## aux_mileage=f.mileage-(6e+03,1.65e+04]    3.096977e-31  11.624418
## aux_price=f.price-(19.5,26]               3.640300e-19   8.947377
## aux_mileage=f.mileage-(1.65e+04,3.35e+04] 3.484564e-11   6.624487
## aux_tax=f.tax-(125,145]                   8.327413e-07   4.927534
## aux_price=f.price-(26,110]                1.090149e-02   2.545841
## fuelType=f.Fuel-Hybrid                    2.070091e-03  -3.079988
## aux_tax=f.tax-(145,580]                   7.412306e-09  -5.781306
## aux_mpg=f.mpg-[8.8,44.8]                  6.107346e-11  -6.541087
## aux_mileage=f.mileage-(3.35e+04,1.16e+05] 5.164738e-15  -7.822834
## aux_years_sell=f.years_sell-(6,23]        7.379623e-23  -9.842577
## manufacturer=Audi                         1.403509e-23 -10.008151
## aux_years_sell=f.years_sell-[2,3]         1.000624e-24 -10.266206
## aux_mileage=f.mileage-[4,6e+03]           3.747217e-45 -14.100944
## aux_mpg=f.mpg-(44.8,53.3]                 2.969083e-47 -14.438340
## aux_price=f.price-[0.65,14]               8.780199e-51 -14.988121
## manufacturer=BMW                          3.438260e-51 -15.050270
## transmission=f.Trans-Manual               4.075786e-88 -19.899920
## fuelType=f.Fuel-Petrol                    2.737874e-89 -20.034827
## manufacturer=VW                          1.391270e-100 -21.290470
##
## $`5`
##                                          Cla/Mod    Mod/Cla    Global
## transmission=f.Trans-Manual              40.1834862 83.059418 36.0370289
## fuelType=f.Fuel-Petrol                   33.8758901 84.197219 43.3325986
## aux_mileage=f.mileage-(1.65e+04,3.35e+04] 40.2789171 62.073325 26.8679744
## manufacturer=VW                          37.1488764 66.877370 31.3863787
## aux_years_sell=f.years_sell-(3,5]        38.5145482 63.590392 28.7855411
## aux_price=f.price-[0.65,14]              43.1610942 53.855879 21.7544633
```

```
## aux_mpg=f.mpg-(53.3,61.4]                    34.0827338 47.914033 24.5095878
## aux_years_sell=f.years_sell-(5,6]            28.6831812 27.812895 16.9054441
## aux_tax=f.tax-(145,580]                      23.1546232 37.673831 28.3667622
## aux_price=f.price-(14,19.5]                  22.2033898 33.122630 26.0083756
## manufacturer=Audi                            20.3125000 24.652339 21.1593564
## fuelType=f.Fuel-Hybrid                        0.0000000  0.000000  0.9257218
## aux_mpg=f.mpg-(61.4,88.3]                    11.9554205 14.917826 21.7544633
## aux_tax=f.tax-(125,145]                      14.9598394 56.510746 65.8584968
## aux_years_sell=f.years_sell-(6,23]            7.9207921  6.068268 13.3568437
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]     6.6445183  7.585335 19.9030196
## aux_price=f.price-(19.5,26]                   7.7239113 11.883692 26.8238924
## manufacturer=BMW                              4.2763158  4.930468 20.1013886
## aux_mpg=f.mpg-[8.8,44.8]                      5.4174067  7.711757 24.8181618
## transmission=f.Trans-SemiAuto                 6.4225352 14.412137 39.1227683
## transmission=f.Trans-Automatic               1.7746229  2.528445 24.8402028
## manufacturer=Mercedes                         2.2562450  3.539823 27.3528764
## aux_price=f.price-(26,110]                    0.7805724  1.137800 25.4132687
## aux_mileage=f.mileage-[4,6e+03]               0.9991674  1.517067 26.4712365
## fuelType=f.Fuel-Diesel                        4.8431917 15.423515 55.5212696
## aux_years_sell=f.years_sell-[2,3]             1.0764263  2.528445 40.9521710
##                                                  p.value     v.test
## transmission=f.Trans-Manual                  1.631088e-199  30.136110
## fuelType=f.Fuel-Petrol                       5.456663e-150  26.084567
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]    1.557121e-119  23.246119
## manufacturer=VW                              2.874883e-115  22.820426
## aux_years_sell=f.years_sell-(3,5]            5.394079e-114  22.691834
## aux_price=f.price-[0.65,14]                  5.461198e-110  22.282509
## aux_mpg=f.mpg-(53.3,61.4]                     3.465748e-57  15.937756
## aux_years_sell=f.years_sell-(5,6]            1.294980e-17   8.544139
## aux_tax=f.tax-(145,580]                      4.059203e-10   6.251734
## aux_price=f.price-(14,19.5]                  8.712810e-07   4.918684
## manufacturer=Audi                            9.022451e-03   2.611202
## fuelType=f.Fuel-Hybrid                       3.076354e-04  -3.608784
## aux_mpg=f.mpg-(61.4,88.3]                    1.159638e-07  -5.299746
## aux_tax=f.tax-(125,145]                      1.809558e-09  -6.014040
## aux_years_sell=f.years_sell-(6,23]           7.854913e-13  -7.163663
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]    2.383781e-25 -10.403744
## aux_price=f.price-(19.5,26]                  8.262647e-29 -11.137255
## manufacturer=BMW                             1.001366e-39 -13.190037
## aux_mpg=f.mpg-[8.8,44.8]                      2.422969e-41 -13.467700
## transmission=f.Trans-SemiAuto                8.488913e-62 -16.588154
## transmission=f.Trans-Automatic               3.382875e-78 -18.720293
## manufacturer=Mercedes                        7.800522e-81 -19.041012
## aux_price=f.price-(26,110]                   6.043165e-96 -20.783983
## aux_mileage=f.mileage-[4,6e+03]              9.722781e-97 -20.871503
## fuelType=f.Fuel-Diesel                      7.086249e-145 -25.629889
## aux_years_sell=f.years_sell-[2,3]           3.716738e-167 -27.556325
##
## $'6'
##                                                  Cla/Mod   Mod/Cla    Global
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]    31.4191961 71.455224 26.8679744
## aux_years_sell=f.years_sell-(3,5]            25.1148545 61.194030 28.7855411
## manufacturer=BMW                             28.6184211 48.694030 20.1013886
## fuelType=f.Fuel-Diesel                       17.4672489 82.089552 55.5212696
## transmission=f.Trans-Automatic               20.3194321 42.723881 24.8402028
## aux_price=f.price-(14,19.5]                  19.3220339 42.537313 26.0083756
## aux_years_sell=f.years_sell-(5,6]            21.6427640 30.970149 16.9054441
## aux_mpg=f.mpg-(53.3,61.4]                    17.2661871 35.820896 24.5095878
## aux_tax=f.tax-[0,125]                        22.9007634 11.194030  5.7747410
## aux_price=f.price-(19.5,26]                  15.5299918 35.261194 26.8238924
## aux_mpg=f.mpg-(61.4,88.3]                    15.2988855 28.171642 21.7544633
## aux_tax=f.tax-(125,145]                      10.8433735 60.447761 65.8584968
## fuelType=f.Fuel-Hybrid                        0.0000000  0.000000  0.9257218
## aux_mileage=f.mileage-(6e+03,1.65e+04]        8.5667216 19.402985 26.7577695
```

```
## aux_price=f.price-[0.65,14]                     5.8763931 10.820896 21.7544633
## manufacturer=Mercedes                           6.5269944 15.111940 27.3528764
## aux_years_sell=f.years_sell-(6,23]              3.6303630  4.104478 13.3568437
## manufacturer=VW                                  6.4606742 17.164179 31.3863787
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]       4.7619048  8.022388 19.9030196
## aux_price=f.price-(26,110]                       5.2905464 11.380597 25.4132687
## transmission=f.Trans-Manual                      6.3608563 19.402985 36.0370289
## aux_mpg=f.mpg-[8.8,44.8]                         4.2628774  8.955224 24.8181618
## fuelType=f.Fuel-Petrol                           4.8830112 17.910448 43.3325986
## aux_mileage=f.mileage-[4,6e+03]                  0.4995837  1.119403 26.4712365
## aux_years_sell=f.years_sell-[2,3]               1.0764263  3.731343 40.9521710
##                                                    p.value      v.test
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]       8.368688e-119  23.173798
## aux_years_sell=f.years_sell-(3,5]               8.639538e-63  16.724849
## manufacturer=BMW                                 1.081720e-57  16.010366
## fuelType=f.Fuel-Diesel                           4.439560e-43  13.759930
## transmission=f.Trans-Automatic                   3.165975e-22   9.695013
## aux_price=f.price-(14,19.5]                      6.533912e-19   8.882560
## aux_years_sell=f.years_sell-(5,6]               7.328017e-18   8.609656
## aux_mpg=f.mpg-(53.3,61.4]                        4.136185e-10   6.248800
## aux_tax=f.tax-[0,125]                            1.947520e-07   5.204278
## aux_price=f.price-(19.5,26]                      4.630245e-06   4.580880
## aux_mpg=f.mpg-(61.4,88.3]                        1.882795e-04   3.734244
## aux_tax=f.tax-(125,145]                          5.335875e-03  -2.786025
## fuelType=f.Fuel-Hybrid                           4.962230e-03  -2.809475
## aux_mileage=f.mileage-(6e+03,1.65e+04]          2.614388e-05  -4.204691
## aux_price=f.price-[0.65,14]                      3.045979e-12  -6.975586
## manufacturer=Mercedes                            1.097297e-12  -7.117717
## aux_years_sell=f.years_sell-(6,23]              4.638560e-14  -7.541708
## manufacturer=VW                                  2.520660e-15  -7.912601
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]       1.259899e-15  -7.998455
## aux_price=f.price-(26,110]                       1.522664e-17  -8.525412
## transmission=f.Trans-Manual                      5.646611e-19  -8.898776
## aux_mpg=f.mpg-[8.8,44.8]                         4.380748e-23  -9.894894
## fuelType=f.Fuel-Petrol                           6.753236e-40 -13.219700
## aux_mileage=f.mileage-[4,6e+03]                  1.908771e-66 -17.219117
## aux_years_sell=f.years_sell-[2,3]               2.819903e-99 -21.148977
##
## $`7`
##                                                    Cla/Mod    Mod/Cla    Global
## aux_years_sell=f.years_sell-(6,23]              83.828383 62.8712871 13.3568437
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]       80.620155 90.0990099 19.9030196
## aux_price=f.price-[0.65,14]                      42.755826 52.2277228 21.7544633
## aux_tax=f.tax-(145,580]                          37.606838 59.9009901 28.3667622
## aux_mpg=f.mpg-(61.4,88.3]                        36.170213 44.1831683 21.7544633
## fuelType=f.Fuel-Diesel                           25.565701 79.7029703 55.5212696
## aux_years_sell=f.years_sell-(5,6]               33.898305 32.1782178 16.9054441
## aux_tax=f.tax-[0,125]                            43.893130 14.2326733  5.7747410
## transmission=f.Trans-Manual                      24.464832 49.5049505 36.0370289
## aux_price=f.price-(14,19.5]                      26.186441 38.2425743 26.0083756
## manufacturer=BMW                                 22.587719 25.4950495 20.1013886
## manufacturer=Audi                                21.979167 26.1138614 21.1593564
## manufacturer=VW                                  15.379213 27.1039604 31.3863787
## fuelType=f.Fuel-Hybrid                            0.000000  0.0000000  0.9257218
## manufacturer=Mercedes                            13.859790 21.2871287 27.3528764
## aux_mpg=f.mpg-(44.8,53.3]                        13.719512 22.2772277 28.9177871
## transmission=f.Trans-SemiAuto                    11.042254 24.2574257 39.1227683
## aux_mpg=f.mpg-[8.8,44.8]                          6.838366  9.5297030 24.8181618
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]        6.316653  9.5297030 26.8679744
## aux_price=f.price-(19.5,26]                       4.930156  7.4257426 26.8238924
## fuelType=f.Fuel-Petrol                            8.290946 20.1732673 43.3325986
## aux_years_sell=f.years_sell-(3,5]                3.062787  4.9504950 28.7855411
## aux_price=f.price-(26,110]                        1.474415  2.1039604 25.4132687
## aux_mileage=f.mileage-(6e+03,1.65e+04]           0.247117  0.3712871 26.7577695
```

```
## aux_mileage=f.mileage-[4,6e+03]              0.000000   0.0000000 26.4712365
## aux_tax=f.tax-(125,145]                      6.994645  25.8663366 65.8584968
## aux_years_sell=f.years_sell-[2,3]            0.000000   0.0000000 40.9521710
##                                                    p.value      v.test
## aux_years_sell=f.years_sell-(6,23]           0.000000e+00         Inf
## aux_mileage=f.mileage-(3.35e+04,1.16e+05]    0.000000e+00         Inf
## aux_price=f.price-[0.65,14]                  2.150747e-102  21.484998
## aux_tax=f.tax-(145,580]                      3.615116e-97   20.918744
## aux_mpg=f.mpg-(61.4,88.3]                    1.393280e-57   15.994610
## fuelType=f.Fuel-Diesel                       4.182675e-56   15.781332
## aux_years_sell=f.years_sell-(5,6]            6.804828e-33   11.946095
## aux_tax=f.tax-[0,125]                        4.002022e-24   10.131563
## transmission=f.Trans-Manual                  4.799652e-18    8.658035
## aux_price=f.price-(14,19.5]                  2.432967e-17    8.470999
## manufacturer=BMW                             3.721547e-05    4.124120
## manufacturer=Audi                            1.920235e-04    3.729285
## manufacturer=VW                              3.523599e-03   -2.917933
## fuelType=f.Fuel-Hybrid                       2.538701e-04   -3.658324
## manufacturer=Mercedes                        1.385980e-05   -4.346071
## aux_mpg=f.mpg-(44.8,53.3]                    2.888325e-06   -4.678606
## transmission=f.Trans-SemiAuto                1.189735e-22   -9.794424
## aux_mpg=f.mpg-[8.8,44.8]                     3.563054e-33  -11.999765
## aux_mileage=f.mileage-(1.65e+04,3.35e+04]    2.369639e-40  -13.298245
## aux_price=f.price-(19.5,26]                  8.313087e-52  -15.143902
## fuelType=f.Fuel-Petrol                       5.184358e-52  -15.174917
## aux_years_sell=f.years_sell-(3,5]            1.021287e-77  -18.661345
## aux_price=f.price-(26,110]                   3.564819e-87  -19.790919
## aux_mileage=f.mileage-(6e+03,1.65e+04]       2.608156e-116 -22.925152
## aux_mileage=f.mileage-[4,6e+03]              9.712356e-122 -23.463118
## aux_tax=f.tax-(125,145]                      2.624637e-147 -25.847073
## aux_years_sell=f.years_sell-[2,3]            1.707051e-211 -31.037032
##
##
## Link between the cluster variable and the quantitative variables
## ================================================================
##          Eta2 P-value
## price 0.5195974        0
##
## Description of each cluster by quantitative variables
## =====================================================
## $'1'
##        v.test Mean in category Overall mean sd in category Overall sd p.value
## price 41.43601         30884.28     21432.75       8160.892     9014.2       0
##
## $'2'
## NULL
##
## $'3'
## NULL
##
## $'4'
##        v.test Mean in category Overall mean sd in category Overall sd
## price 7.164779        23847.58     21432.75       6605.73     9014.2
##             p.value
## price 7.791208e-13
##
## $'5'
##         v.test Mean in category Overall mean sd in category Overall sd
## price -24.18122        14389.63     21432.75       4772.528     9014.2
##              p.value
## price 3.506524e-129
##
## $'6'
##         v.test Mean in category Overall mean sd in category Overall sd
```

```
## price -3.941876          19991.31      21432.75       5365.283      9014.2
##          p.value
## price 8.084679e-05
##
## $'7'
##          v.test Mean in category Overall mean sd in category Overall sd
## price -25.53296         14091.29      21432.75       4650.705      9014.2
##          p.value
## price 8.489782e-144
```

We start with the description of the categorical variables that characterize the clusters:

Cluster 1: Cluster one has cars with few years_sell, low mpg, medium taxes, low mileage and high price. Also, cars with semiAuto transmission and cars with petrol as fuel predominate. We can say this because these categories are overrepresented in the cluster.

Cluster 1: Cluster one has cars with low mpg, few years_sell, high price, low mileage and medium taxes. Also, cars with semiAuto transmission and cars with petrol as fuel predominate.

Cluster 2: Cluster two has cars with years_sell, low mileage, medium-low mpg and medium price. Also, cars with Manual transmission, VW cars and cars with petrol as fuel predominate.

Cluster 3: Cluster three has cars with few years_sell, high price, medium taxes and low mileage. Also, cars with diesel as fuel, Mercedes cars and cars with semiAuto transmission predominate.

Cluster 4: Cluster four has cars medium-high mpg. Also, BMW cars, cars with Hybrid as fuel and cars with Automatic transmission predominate.

Cluster 5: Cluster five has cars with medium years_sell, low price and medium-high mileage. Also, cars with petrol as fuel, VW cars and cars with Manual transmission predominate.

Cluster 6: Cluster six has cars with medium years_sell, medium taxes and medium-high mileage. Also, cars with diesel as fuel and Mercedes cars predominate.

Cluster 7: Cluster seven has cars with many years_sell, high mileage, low price and high taxes. Also, cars with diesel as fuel and cars with Manual transmission predominate.

Cluster 8: Cluster of multivariant outliers.

Regarding quantitative variables:

Cluster 1: As we can see price mean is greater in cluster 1 than in the overall mean. So we can say that cluster 1 is a cluster of expensive cars.

Cluster 2: As we can see price mean is lower in cluster 2 than in the overall mean. So we can say that cluster 2 is a cluster of cheap cars.

Cluster 3: As we can see price mean is greater in cluster 3 than in the overall mean. So we can say that cluster 3 is a cluster of expensive cars.

Cluster 4:

Cluster 5: As we can see price mean is lower in cluster 5 than in the overall mean. So we can say that cluster 5 is a cluster of cheap cars.

Cluster 6: As we can see price mean is lower in cluster 6 than in the overall mean. So we can say that cluster 6 is a cluster of cheap cars.

Cluster 7: As we can see price mean is lower in cluster 7 than in the overall mean. So we can say that cluster 7 is a cluster of cheap cars.

Cluster 8: Cluster of multivariant outliers.

```
res.hcmc$desc.ind$para
```

```
## Cluster: 1
##     4080     4572     4668     4811     4837
## 0.2001048 0.2001048 0.2001048 0.2001048 0.2001048
## -----------------------------------------------------------
## Cluster: 2
##     2232     2462     2517     2519     2546
## 0.256154 0.256154 0.256154 0.256154 0.256154
```

```
## ------------------------------------------------------------
## Cluster: 3
##      1798      1566      1910      1912      1207
## 0.3998184 0.5102478 0.5465382 0.5469002 0.5804125
## ------------------------------------------------------------
## Cluster: 4
##       2202       2647       2781       2800       2830
## 0.05683111 0.05683111 0.05683111 0.05683111 0.13987522
## ------------------------------------------------------------
## Cluster: 5
##      4637      4644      4645      4653      4787
## 0.1959336 0.1959336 0.1959336 0.1959336 0.1959336
## ------------------------------------------------------------
## Cluster: 6
##       390       576       754       950      4008
## 0.1704410 0.1704410 0.1704410 0.1704410 0.1739674
## ------------------------------------------------------------
## Cluster: 7
##       3558       4083       4988       3278        170
## 0.08275986 0.08275986 0.08275986 0.24191637 0.25105414
```

```
res.hcmc$desc.ind$dist
```

```
## Cluster: 1
##      1264      1398      1470      1841      1223
## 1.319121 1.319121 1.319121 1.319121 1.312312
## ------------------------------------------------------------
## Cluster: 2
##      4663      4010      4487      4500      4853
## 1.580000 1.451916 1.357618 1.287922 1.287922
## ------------------------------------------------------------
## Cluster: 3
##      1102      1210      1626      1663      1530
## 3.579648 3.579648 3.579648 3.579648 3.446600
## ------------------------------------------------------------
## Cluster: 4
##      2455      2570      2704      2752      2855
## 1.108616 1.108616 1.108616 1.108616 1.108616
## ------------------------------------------------------------
## Cluster: 5
##      4009      4011      4026      3494      3496
## 1.638576 1.603633 1.411582 1.237199 1.237199
## ------------------------------------------------------------
## Cluster: 6
##      1092      1279      1529      1544      1866
## 1.277418 1.277418 1.277418 1.277418 1.277418
## ------------------------------------------------------------
## Cluster: 7
##       97       198       209       217       223
## 1.801917 1.801917 1.801917 1.801917 1.801917
```

The parangons of cluster 1 are 160, 426, 432, 471 and 501. The parangons of cluster 2 are 3498, 3508, 3516, 3517 and 3518. The parangons of cluster 3 are 2532, 2148, 2348, 2388 and 2403. The parangons of cluster 4 are 1798, 1566, 1910, 1912 and 1196. The parangons of cluster 5 are 3321, 3374, 3643, 3814 and 36. The parangons of cluster 6 are 2167, 2239, 2265, 2650 and 2686. The parangons of cluster 7 are 3558, 4083, 4988, 3278 and 4094.

The dist/distants of cluster 1 are 35, 40, 46, 69 and 91. The dist/distants of cluster 2 are 4487, 4010, 4663, 4009 and 4026. The dist/distants of cluster 3 are 2266, 2274, 2285, 2287 and 2384. The dist/distants of cluster 4 are 1530, 1989, 2023, 1910 and 1102. The dist/distants of cluster 5 are 4011, 174, 317, 1 and 73. The dist/distants of cluster 6 are 1092, 1279, 1529, 1544 and 1866. The dist/distants of cluster 7 are 3552, 3575, 3590, 3618 and 3647.

We have created a new variable indicating the cluster to which the individual belongs after the Hierarchical clustering.

```
df$clamHC<-8
df[ row.names(res.hcmc$data.clust), "clamHC" ]<-res.hcmc$data.clust$clust
df$clamHC<-factor(df$clamHC)
levels( df$clamHC ) <- paste0("claHCMC-",levels( df$clamHC ) )
```

6.6 Comparisons

```
table(df$clamHC,df$claHC)
```

```
##
##           claHCPC-1 claHCPC-2 claHCPC-3 claHCPC-4 claHCPC-5 claHCPC-6
##  claHCMC-1     723       427        10         0         2         0
##  claHCMC-2     324       242         9         0         5         0
##  claHCMC-3       4        14         7        10         0         1
##  claHCMC-4      40       207        69       246        10        41
##  claHCMC-5      15       116       224       358        12        46
##  claHCMC-6       9        79       148       207        29        60
##  claHCMC-7       0         0       105       129        65       115
##  claHCMC-8       0         0         0         0         0         0
##
##           claHCPC-7 claHCPC-8
##  claHCMC-1       0         0
##  claHCMC-2       0         0
##  claHCMC-3       6         0
##  claHCMC-4       5         0
##  claHCMC-5      20         0
##  claHCMC-6       4         0
##  claHCMC-7     394         0
##  claHCMC-8       0       463
```

```
table(df$clamHC,df$claKM)
```

```
##
##              1    2    3    4    5    6    7    8
##  claHCMC-1   2   41    0    0  507  612    0    0
##  claHCMC-2   5   10    1    0  187  373    4    0
##  claHCMC-3   0    4    4    3    6   11   14    0
##  claHCMC-4  10  244    1  121    9   62  171    0
##  claHCMC-5  12  278    3  111    0   32  355    0
##  claHCMC-6  29  151    5  135    2   16  198    0
##  claHCMC-7  66    1  359  348    0    0   34    0
##  claHCMC-8   0    0    0    0    0    0    0  463
```