Final Project (Hierarchical Clustering)

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Helper Packages

```
library(dplyr)       # for data manipulation
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(ggplot2)     # for data visualization
library(cluster)     # for general clustering algorithms
library(factoextra)  # for visualizing cluster results
```

```
## Welcome! Want to learn more? See two factoextra-related books at https://goo.gl/ve3WBa
```

```
library(readr)
library(modeldata)
library(dplyr)
library(tidyverse)
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.2 --
```

```
## v tibble  3.1.8     v stringr 1.4.1
## v tidyr   1.2.1     v forcats 0.5.2
## v purrr   0.3.5
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(recipes)
```

```
##
## Attaching package: 'recipes'
##
## The following object is masked from 'package:stringr':
##
##     fixed
##
## The following object is masked from 'package:stats':
##
##     step
```

loading dataset

```
radiomics <- read.csv("radiomics.csv")
attach(radiomics)
```

```
X1 <- radiomics %>%
  select_if(is.numeric)
```

#we start by scaling/standardizing the data

```
df <- scale(X1)
head(df)
```

```
##      Failure.binary    Failure Entropy_cooc.W.ADC GLNU_align.H.PET Min_hist.PET
## [1,]     -0.7160785  1.1985789         0.55290547      -0.57063689   -0.4541408
## [2,]      1.3894061 -0.7212472        -0.06486729      -0.78903636    0.4998369
## [3,]     -0.7160785  2.7926271         0.45990825      -0.06024275   -1.1504338
## [4,]      1.3894061 -0.4442487         1.14318298       2.67468822   -0.4446190
## [5,]     -0.7160785  0.6898772         0.34499368      -0.06740573   -0.9887407
## [6,]      1.3894061 -1.1289054         0.84917904       0.07354603   -1.1864923
##      Max_hist.PET Mean_hist.PET Variance_hist.PET Standard_Deviation_hist.PET
## [1,]   -0.4361311    -0.4204856        -0.2625994                   -0.2362506
## [2,]    0.1486951     0.3153953         0.3949731                    0.2970175
## [3,]   -1.1768823    -1.1362283        -0.8957972                   -1.1289710
## [4,]   -0.1516658    -0.3486295        -0.2802885                   -0.2534091
## [5,]   -1.1061760    -1.1155134        -0.9335606                   -1.2398300
## [6,]   -1.2223057    -1.2048611        -0.9289185                   -1.2246350
##      Skewness_hist.PET Kurtosis_hist.PET Energy_hist.PET Entropy_hist.PET
## [1,]        -0.3229376        -0.2730969      0.05021980       -0.3798553
## [2,]        -0.1769772        -0.2664840      0.09191129       -0.7468252
## [3,]        -0.9586986        -0.4718456      0.04744499       -0.3704894
## [4,]        -0.1155757         0.1199784     -0.01242149       -0.1570421
## [5,]         0.9580073         0.9071980      0.15326924       -0.8531740
## [6,]        -0.4355546        -0.1910724      0.05514509       -0.1536498
##      AUC_hist.PET  H_suv.PET  Volume.PET X3D_surface.PET ratio_3ds_vol.PET
## [1,]   -0.5675836 -0.1211439 -0.77134265      -0.5201102        -0.2282413
```

```
## [2,]   -0.5634659  0.9495392 -0.86978222      -0.4310874         0.4221576
## [3,]   -0.5814501 -1.0718855 -0.48494090      -0.1551558        -0.2483619
## [4,]   -0.4067915 -0.3934530  0.05871532       0.2442709        -0.7007345
## [5,]   -0.4082919 -1.2107989 -0.42285136      -0.4502135         0.4091793
## [6,]   -0.5643056 -1.1009679 -0.76048331      -0.3917880        -0.0350387
##      ratio_3ds_vol_norm.PET irregularity.PET tumor_length.PET
## [1,]           -0.376749051       -0.4041462       -0.4993850
## [2,]            0.001181975       -0.2594920       -0.6246547
## [3,]           -0.113559448       -0.5006828       -0.3144097
## [4,]           -0.069268090       -0.7786312        0.3678334
## [5,]           -0.004442091       -0.3960864       -0.6910089
## [6,]           -0.185715505       -0.4839717       -0.4467293
##      Compactness_v1.PET Compactness_v2.PET Spherical_disproportion.PET
## [1,]        -0.07197872         -0.4249126                -0.376749051
## [2,]        -0.08449944         -0.4265812                 0.001181975
## [3,]        -0.08158664         -0.4262617                -0.113559448
## [4,]        -0.08276045         -0.4263918                -0.069268090
## [5,]        -0.08436902         -0.4265693                -0.004442091
## [6,]        -0.07941290         -0.4259895                -0.185715505
##      Sphericity.PET Asphericity.PET Center_of_mass.PET Max_3D_diam.PET
## [1,]     -0.4428932     -0.36463396        -0.03050325     -0.66406536
## [2,]     -0.5051973      0.02005061        -0.32639266     -0.75236400
## [3,]     -0.4897787     -0.09674122        -0.58411455     -0.53368216
## [4,]     -0.4960147     -0.05165838         0.04330285     -0.05279069
## [5,]     -0.5044949      0.01432605        -0.40817644     -0.79913502
## [6,]     -0.4787394     -0.17018669        -0.69694662     -0.62695008
##      Major_axis_length.PET Minor_axis_length.PET Least_axis_length.PET
## [1,]           -0.77986887            -0.8104678            -0.5530902
## [2,]           -0.76712458            -0.7488362            -0.7395741
## [3,]           -0.45235010            -0.6156914            -0.4296651
## [4,]           -0.06489845             0.4300517             0.7399041
## [5,]           -0.74622189            -0.8991212            -0.7280052
## [6,]           -0.57774168            -0.5623790            -0.9903323
##      Elongation.PET Flatness.PET Max_cooc.L.PET Average_cooc.L.PET
## [1,]     -0.3767912    0.0388863     0.01907240        -0.38679684
## [2,]     -0.3002178   -0.3471572     0.13070498        -0.47577094
## [3,]     -0.6833310   -0.4444301     0.01953020         0.01393894
## [4,]     -0.1112560    0.3031255     0.05256218        -0.85110310
## [5,]     -0.6012065   -0.3723581     0.10827282        -1.07572238
## [6,]     -0.4089789   -1.0862675     0.03231337        -0.34383121
##      Variance_cooc.L.PET Entropy_cooc.L.PET DAVE_cooc.L.PET DVAR_cooc.L.PET
## [1,]         -0.10747089         -0.4982927     -0.32209112      -0.4376118
## [2,]          0.09064602         -0.5860237      0.01715114       0.2839811
## [3,]         -0.07644599         -0.4564828     -0.25478670      -0.4201798
## [4,]         -1.08067728         -0.5975811     -1.01842876      -1.0814113
## [5,]         -0.70694040         -0.6879367     -0.57943763      -0.5145756
## [6,]         -0.33459330         -0.4952102     -0.35338811      -0.3880621
##      DENT_cooc.L.PET SAVE_cooc.L.PET SVAR_cooc.L.PET SENT_cooc.L.PET
## [1,]      -0.4886194     -0.38709402     -0.02670287      -0.4370125
## [2,]      -0.3924968     -0.47610489     -0.05030249      -0.4522504
## [3,]      -0.4853888      0.01380756      0.01642425      -0.4160760
## [4,]      -0.7736715     -0.85159235     -1.03759534      -0.5918277
## [5,]      -0.5799860     -1.07630456     -0.76817505      -0.6137263
## [6,]      -0.5037470     -0.34411057     -0.33550372      -0.4628880
```

```
##      ASM_cooc.L.PET Contrast_cooc.L.PET Dissimilarity_cooc.L.PET
## [1,]     0.08567996          -0.2213217              -0.32209112
## [2,]     0.09647507           0.3022677               0.01715114
## [3,]     0.08186129          -0.2136907              -0.25478670
## [4,]     0.09955938          -1.0037577              -1.01842876
## [5,]     0.11134587          -0.5146244              -0.57943763
## [6,]     0.08443155          -0.2881716              -0.35338811
##      Inv_diff_cooc.L.PET Inv_diff_norm_cooc.L.PET IDM_cooc.L.PET
## [1,]         -0.56676432               -0.5763209     -0.5299735
## [2,]         -0.65677272               -0.6263249     -0.5765204
## [3,]         -0.67304907               -0.5908391     -0.6595578
## [4,]          0.01529491               -0.4583262      0.1580695
## [5,]         -0.35540218               -0.5329963     -0.2767734
## [6,]         -0.55940955               -0.5726633     -0.5141966
##      IDM_norm_cooc.L.PET Inv_var_cooc.L.PET Correlation_cooc.L.PET
## [1,]          -0.5673986         -0.5326148             -0.2395619
## [2,]          -0.6053420         -0.5811335             -0.8363785
## [3,]          -0.5704381         -0.6177360             -0.2158561
## [4,]          -0.5056711          0.2132500              0.1061216
## [5,]          -0.5441814         -0.2387626             -0.5520434
## [6,]          -0.5628242         -0.5072913             -0.4179359
##      Autocorrelation_cooc.L.PET Tendency_cooc.L.PET Shade_cooc.L.PET
## [1,]                 -0.2329996         -0.02670287        0.1671657
## [2,]                 -0.4242598         -0.05030249       -0.2480649
## [3,]                  0.3938654          0.01642425       -1.0691758
## [4,]                 -0.9158615         -1.03759534       -0.4177156
## [5,]                 -1.1530657         -0.76817505        0.7271944
## [6,]                 -0.2233890         -0.33550372       -0.3600608
##      Prominence_cooc.L.PET IC1_.L.PET IC2_.L.PET Coarseness_vdif_.L.PET
## [1,]            0.03098815 0.28708958 -0.3388377            0.006376387
## [2,]           -0.09787370 0.07137519 -0.2700784            0.002781345
## [3,]           -0.10490242 0.48311676 -0.4270856            0.062882324
## [4,]           -0.99146297 0.85653165 -0.7163131           -0.265687089
## [5,]           -0.21532057 0.51165900 -0.5122657            0.091004827
## [6,]           -0.28337792 0.45766703 -0.4241077            0.056388055
##      Contrast_vdif_.L.PET Busyness_vdif_.L.PET Complexity_vdif_.L.PET
## [1,]          -0.20028108           -0.5370115             -0.2662241
## [2,]           0.04845588           -0.5588516              0.1658987
## [3,]          -0.20399173           -0.6279787             -0.4553060
## [4,]          -0.56421930            0.3930587             -0.9080359
## [5,]          -0.28542101           -0.5535294             -0.2924139
## [6,]          -0.26453325           -0.5919696             -0.4582705
##      Strength_vdif_.L.PET SRE_align.L.PET LRE_align.L.PET GLNU_align.L.PET
## [1,]          -0.26986044      -0.5491186      -0.6008961       -0.5518738
## [2,]          -0.08939775      -0.5417070      -0.6286505       -0.5804090
## [3,]          -0.33357336      -0.5429081      -0.6287202       -0.5689426
## [4,]          -0.74161019      -0.5790227      -0.4805041        0.8278520
## [5,]           0.36980693      -0.5500234      -0.6039683       -0.5451300
## [6,]          -0.29834594      -0.5507824      -0.6004473       -0.5535866
##      RLNU_align.L.PET RP_align.L.PET LGRE_align.L.PET HGRE_align.L.PET
## [1,]       -0.5464275     -0.5474571       -0.1363764       -0.2927891
## [2,]       -0.6108530     -0.5377614       -0.1015623       -0.3788537
## [3,]       -0.5406625     -0.5385648       -0.5363455        0.2550858
## [4,]        0.8204210     -0.5874610       -0.3920716       -0.8757658
```

```
## [5,]       -0.6113202     -0.5474295        0.3215672       -1.1367241
## [6,]       -0.5389372     -0.5485107       -0.3905515       -0.1862284
##      LGSRE_align.L.PET HGSRE_align.L.PET LGHRE_align.L.PET HGLRE_align.L.PET
## [1,]        -0.1309227        -0.2892810        -0.1586271        -0.3027382
## [2,]        -0.1020941        -0.3648331        -0.1043141        -0.4335426
## [3,]        -0.5281412         0.2543553        -0.5656372         0.2540986
## [4,]        -0.3977173        -0.8798431        -0.3696846        -0.8559685
## [5,]         0.3336016        -1.1252892         0.2682880        -1.1814830
## [6,]        -0.3835794        -0.1800162        -0.4177003        -0.2110612
##      GLNU_norm_align.L.PET RLNU_norm_align.L.PET GLVAR_align.L.PET
## [1,]           -0.23873077            -0.5367407       -0.10514870
## [2,]           -0.09112146            -0.5172827        0.02719377
## [3,]           -0.32104774            -0.5210072        0.04708212
## [4,]           -0.12102818            -0.6136212       -1.05093564
## [5,]            0.11402955            -0.5396152       -0.91313817
## [6,]           -0.27069541            -0.5414162       -0.24895053
##      RLVAR_align.L.PET Entropy_align.L.PET SZSE.L.PET LZSE.L.PET LGLZE.L.PET
## [1,]        -0.2613329          -0.5213924 -0.5416124 -0.4480602  -0.1553823
## [2,]        -0.3774656          -0.6055192 -0.4622829 -0.6146387  -0.1132355
## [3,]        -0.3933670          -0.4724149 -0.4319895 -0.7703556  -0.5185679
## [4,]         0.2721998          -0.5657969 -0.5905909 -0.1684870  -0.3934762
## [5,]        -0.2978019          -0.7451479 -0.4515025 -0.7298394   0.3609374
## [6,]        -0.2810142          -0.5060910 -0.5189079 -0.5211468  -0.4243495
##      HGLZE.L.PET SZLGE.L.PET SZHGE.L.PET LZLGE.L.PET LZHGE.L.PET
## [1,]  -0.2984560 -0.17106728  -0.2942719 -0.15397307 -0.18606625
## [2,]  -0.3730995 -0.09242262  -0.3163762 -0.18984205 -0.54236685
## [3,]   0.2138548 -0.44960709   0.2507497 -0.67073190 -0.04279253
## [4,]  -0.8741513 -0.39730122  -0.8709436 -0.29205659 -0.65872610
## [5,]  -1.1420153  0.44865547  -1.0646965 -0.02980072 -1.18830026
## [6,]  -0.2275594 -0.43201249  -0.2525831 -0.40630438 -0.17656210
##      GLNU_area.L.PET ZSNU.L.PET  ZSP.L.PET GLNU_norm.L.PET ZSNU_norm.L.PET
## [1,]      -0.5527994 -0.5530418 -0.5621738     -0.23689556      -0.6190040
## [2,]      -0.5773325 -0.5984956 -0.4628174     -0.09957407      -0.4177144
## [3,]      -0.5580437 -0.5054842 -0.4019440     -0.31340711      -0.3386244
## [4,]       0.7972658  0.7243773 -0.6566870     -0.11705626      -0.7292502
## [5,]      -0.5331460 -0.5925559 -0.4268835      0.12451086      -0.3925193
## [6,]      -0.5487210 -0.5364744 -0.5302461     -0.25610439      -0.5629950
##      GLVAR_area.L.PET ZSVAR.L.PET Entropy_area.L.PET Max_cooc.H.PET
## [1,]     -0.121204529  -0.2226564         -0.5000553     -0.5622647
## [2,]      0.000753596  -0.4137605         -0.6362274     -0.4644195
## [3,]      0.026274426  -0.8362779         -0.5442329      0.5340130
## [4,]     -1.045590634   0.4721232         -0.4937376     -0.4910382
## [5,]     -0.907213368  -0.7751321         -0.7925323      2.5493588
## [6,]     -0.293935425  -0.3715063         -0.5139189      0.9182000
##      Average_cooc.H.PET Variance_cooc.H.PET Entropy_cooc.H.PET DAVE_cooc.H.PET
## [1,]        -0.62173115          -0.3926613         -0.4405901      -0.4245348
## [2,]        -0.65760120          -0.3614375         -0.1978581      -0.2002922
## [3,]        -0.34277170          -0.6153275         -1.2304855      -0.6542876
## [4,]        -0.71683325          -0.2257862         -0.4815188      -0.5565737
## [5,]        -0.09109055          -1.8853813         -1.4739615      -1.4624814
## [6,]        -0.26774039          -1.0272260         -1.3894649      -0.9100846
##      DVAR_cooc.H.PET DENT_cooc.H.PET SAVE_cooc.H.PET SVAR_cooc.H.PET
## [1,]      -0.5066538      0.08192889     -0.57021320     -0.21121323
## [2,]      -0.3071158     -0.83264259     -0.69322153     -0.51771839
```

```
## [3,]      -0.3422576     -0.01496272     -0.28179187     -0.04897359
## [4,]      -0.5352219     -0.06855070     -0.66854100     -0.06049054
## [5,]      -1.5091037     -0.27142899     -0.02157412     -0.22370520
## [6,]      -0.4729899     -1.36710074     -0.20421566     -1.12758322
##      SENT_cooc.H.PET ASM_cooc.H.PET Contrast_cooc.H.PET
## [1,]      0.07030056     -0.4257044          -0.4150674
## [2,]      0.21849474     -0.4923348          -0.1059010
## [3,]     -0.73909827      0.5293038          -0.5606912
## [4,]      0.03408701     -0.3939640          -0.5503855
## [5,]     -0.99227968      2.2056453          -1.5501224
## [6,]     -0.90558682      1.1479491          -0.8152598
##      Dissimilarity_cooc.H.PET Inv_diff_cooc.H.PET Inv_diff_norm_cooc.H.PET
## [1,]               -0.4245348          -0.6699941               -0.5752921
## [2,]               -0.2002922          -0.8857913               -0.6152984
## [3,]               -0.6542876           0.3565728               -0.5209539
## [4,]               -0.5565737          -0.4667711               -0.5490693
## [5,]               -1.4624814           1.0615198               -0.3715120
## [6,]               -0.9100846           0.7501870               -0.4686586
##      IDM_cooc.H.PET IDM_norm_cooc.H.PET Inv_var_cooc_.H.PET
## [1,]     -0.6523898          -0.5628068           0.1245932
## [2,]     -0.8819195          -0.5876552           0.1626292
## [3,]      0.5268363          -0.5524530          -0.4195061
## [4,]     -0.4271592          -0.5507795           0.1827693
## [5,]      1.2525912          -0.4665595          -0.1515276
## [6,]      0.9497298          -0.5320201          -0.4759560
##      Correlation_cooc.H.PET Autocorrelation_cooc.H.PET Tendency_cooc.H.PET
## [1,]             -0.2531664                -0.63574265         -0.34548858
## [2,]             -0.7097902                -0.72995330         -0.46719366
## [3,]             -0.3204338                -0.12798663         -0.58987505
## [4,]              0.1572312                -0.75877292         -0.03028623
## [5,]             -0.8038649                 0.31634762         -1.89802896
## [6,]             -0.5377799                -0.01075648         -1.04995447
##      Shade_cooc.H.PET Prominence_cooc.H.PET IC1_d.H.PET IC2_d.H.PET
## [1,]       0.56115327            -0.2771646  0.45844723 -0.34880559
## [2,]      -0.03213742            -0.3832531  0.84097312 -0.70922702
## [3,]      -0.06440384            -0.7224845  0.08064715 -0.49617333
## [4,]      -0.39054358             0.3271375 -0.02579697  0.03019033
## [5,]       1.54978365            -1.7264583  0.44273864 -0.93060958
## [6,]       0.53842843            -1.2412690  0.22017194 -0.70937241
##      Coarseness_vdif.H.PET Contrast_vdif.H.PET Busyness_vdif.H.PET
## [1,]            0.09720863          -0.4274453          -0.3638887
## [2,]            0.12838981          -0.5671546          -0.3703971
## [3,]            0.06302159           0.7225133          -0.3477636
## [4,]            0.04310330          -0.4836185          -0.2468294
## [5,]            0.08210694          -0.5418056          -0.3667598
## [6,]            0.05664774           1.0600966          -0.3404997
##      Complexity_vdif.H.PET Strength_vdif.H.PET SRE_align.H.PET LRE_align.H.PET
## [1,]           -0.10931813         -0.13025494      -0.4307026      -0.7195651
## [2,]            0.06155045         -0.09260654      -0.3447791      -0.9067290
## [3,]           -0.19946129         -0.11406009      -0.7812458       0.3824637
## [4,]           -0.23521590         -0.23919622      -0.5220265      -0.4651246
## [5,]           -0.72923006          0.08722946      -0.8618153       0.6020573
## [6,]           -0.27546607         -0.11599525      -0.9130679       1.0286387
##      RLNU_align.H.PET RP_align.H.PET LGRE_align.H.PET HGRE_align.H.PET
```

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## [1,]       -0.4971654     -0.4065909       0.06392089     -0.698132947
## [2,]       -0.5420981     -0.2896583       0.06421447     -0.740884690
## [3,]       -0.5852595     -0.8520852       0.03404939     -0.378161662
## [4,]        0.7194380     -0.5294515       0.10054467     -0.674598529
## [5,]       -0.6316801     -0.9156443       0.01379255      0.456615365
## [6,]       -0.6029308     -0.9873040       0.02311363     -0.008001338
##      LGSRE_align.H.PET HGSRE_align.H.PET LGHRE_align.H.PET HGLRE_align.H.PET
## [1,]        0.06778299       -0.59041968       0.037835342        -0.6802823
## [2,]        0.06870144       -0.53088745       0.033125985        -0.8573161
## [3,]        0.03611506       -0.76247426       0.027942041         0.6873551
## [4,]        0.09794468       -0.65688536       0.117419836        -0.4979682
## [5,]        0.01822378        0.09512599      -0.005644076         1.0274090
## [6,]        0.02524069       -0.48738896       0.028964227         1.2343204
##      GLNU_norm_align.H.PET RLNU_norm_align.H.PET GLVAR_align.H.PET
## [1,]            -0.5712362            -0.3120397        -0.3721453
## [2,]            -0.7030578            -0.1079673        -0.4355544
## [3,]             0.5316701            -0.9704621        -0.6625075
## [4,]            -0.6317852            -0.5049737        -0.1576847
## [5,]             1.5299799            -1.0850209        -1.8601022
## [6,]             0.9385123            -1.1496499        -0.9735944
##      RLVAR_align.H.PET Entropy_align.H.PET  SZSE.H.PET  LZSE.H.PET LGLZE.H.PET
## [1,]        -0.5834915          -0.4736414 -0.34821000 -0.20713789 0.054010198
## [2,]        -0.8037182          -0.3905964  0.08296996 -0.21972745 0.057224946
## [3,]         0.7441584          -0.8867673 -0.85184571 -0.11558937 0.031689625
## [4,]        -0.2617379          -0.2985495 -0.46659449 -0.14463396 0.093281256
## [5,]         0.9596641          -1.0911927 -0.98364474  0.01824329 0.007396366
## [6,]         1.4877490          -0.8924170 -0.98401691  0.20956309 0.019378605
##      HGLZE.H.PET SZLGE.H.PET   SZHGE.H.PET LZLGE.H.PET  LZHGE.H.PET
## [1,]  -0.2901933  0.06374556 -3.657487e-01  -0.2540270 -0.233853915
## [2,]  -0.7831293  0.07546816 -9.234150e-02  -0.2869748 -0.243886393
## [3,]  -0.3822321  0.04154588 -9.771746e-01  -0.2005686 -0.095484736
## [4,]   0.5268357  0.08796006 -5.579603e-01  -0.0380075 -0.186879336
## [5,]   0.7261377  0.02594017 -2.874186e-05  -0.1199001  0.006637164
## [6,]  -0.1268240  0.03231433 -7.223679e-01   0.1643966  0.194571350
##      GLNU_area.H.PET ZSNU.H.PET  ZSP.H.PET GLNU_norm.H.PET ZSNU_norm.H.PET
## [1,]      -0.5444686 -0.4601965 -0.2248134      -0.5806037      -0.3162951
## [2,]      -0.5796658 -0.3824687  0.5127672      -0.6979911       0.5518249
## [3,]      -0.4288636 -0.5618607 -0.9285878       0.7417602      -1.0206540
## [4,]       0.5390657  0.1940260 -0.6128852      -0.6306111      -0.5107478
## [5,]      -0.5810817 -0.5874970 -1.1161831       0.8761277      -1.1255136
## [6,]      -0.5459613 -0.5864810 -1.2948336       1.0030056      -1.1804675
##      GLVAR_area.H.PET ZSVAR_H.PET Entropy_area.H.PET Max_cooc.W.PET
## [1,]       -0.4224700 -0.22265827         -0.4736178     -0.3461950
## [2,]       -0.4601605 -0.23141569         -0.6802143     -0.3036564
## [3,]       -0.7321688 -0.14238329         -0.7186979      0.2207037
## [4,]       -0.1013358 -0.15967750         -0.2259535     -0.3351671
## [5,]       -1.7481942 -0.01198442         -0.7802805      1.4412203
## [6,]       -0.8220885  0.15839447         -0.7566641      0.5149649
##      Average_cooc.W.PET Variance_cooc.W.PET Entropy_cooc.W.PET DAVE_cooc.W.PET
## [1,]        -0.31008562          -0.2564173         -0.3380333      -0.2540337
## [2,]         0.02683964           0.4493676         -0.1736199       0.5364988
## [3,]        -1.03175940          -0.8969181         -1.0345685      -1.1339433
## [4,]        -0.24731569          -0.3130037         -0.3440762      -0.4552820
## [5,]        -1.25206094          -0.9213654         -1.2576617      -1.2034308
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## [6,]        -1.16802267          -0.9303583         -1.1793425      -1.2258890
##      DVAR_cooc.W.PET DENT_cooc.W.PET SAVE_cooc.W.PET SVAR_cooc.W.PET
## [1,]      -0.3193107    -0.342943902     -0.31038212      -0.2282020
## [2,]       0.6942880     0.002238598      0.02661683       0.3098894
## [3,]      -0.9433432    -1.093835590     -1.03221397      -0.8431674
## [4,]      -0.4197731    -0.444514652     -0.24759852      -0.2424063
## [5,]      -0.9378081    -1.135682315     -1.25256366      -0.8712021
## [6,]      -0.9628533    -1.208596176     -1.16850700      -0.8775841
##      SENT_cooc.W.PET ASM_cooc.W.PET Contrast_cooc.W.PET
## [1,]      -0.3159465     -0.2006869          -0.3075340
## [2,]      -0.1467601     -0.2333697           0.7742948
## [3,]      -0.9419763      0.3324825          -0.9576910
## [4,]      -0.3128799     -0.1888046          -0.4700373
## [5,]      -1.1559564      1.2294011          -0.9705620
## [6,]      -1.0917096      0.6973497          -0.9855880
##      Dissimilarity_cooc.W.PET Inv_diff_cooc.W.PET Inv_diff_norm_cooc.W.PET
## [1,]               -0.2540337          -0.6374300               -0.5764903
## [2,]                0.5364988          -0.9304053               -0.6353259
## [3,]               -1.1339433           0.2901524               -0.5694748
## [4,]               -0.4552820          -0.4626158               -0.4639086
## [5,]               -1.2034308           0.5487330               -0.5218385
## [6,]               -1.2258890           0.5258770               -0.5432064
##      IDM_cooc.W.PET IDM_norm_cooc.W.PET Inv_var_cooc.W.PET
## [1,]     -0.6315742          -0.5654455         -0.5757397
## [2,]     -0.9114075          -0.6095647         -0.9126200
## [3,]      0.5091234          -0.5606607          0.5282510
## [4,]     -0.4247365          -0.5072004         -0.3646175
## [5,]      0.8605536          -0.5446135          0.6301697
## [6,]      0.8382954          -0.5500768          0.7959910
##      Correlation_cooc.W.PET Autocorrelation_cooc.W.PET Tendency_cooc.W.PET
## [1,]             -0.2399351               -0.32079144          -0.2282020
## [2,]             -0.8269017                0.03559253           0.3098894
## [3,]             -0.2251579               -0.85647530          -0.8431674
## [4,]              0.1173220               -0.25478504          -0.2424063
## [5,]             -0.6005036               -0.93362150          -0.8712021
## [6,]             -0.4364399               -0.90992639          -0.8775841
##      Shade_cooc.W.PET Prominence_cooc.W.PET IC1_d.W.PET IC2_d.W.PET
## [1,]      -0.19389610           -0.24361420   0.5027180  -0.4267892
## [2,]      -0.07709063           -0.06025639   0.4614179  -0.3295264
## [3,]      -0.38075702           -0.33892430   0.2495240  -0.5747430
## [4,]      -0.12206509           -0.20994984   0.1738307  -0.1890252
## [5,]      -0.36726449           -0.33872045   0.7187278  -1.0350664
## [6,]      -0.37810446           -0.33964929   0.4437719  -0.7867358
##      Coarseness_vdif.W.PET Contrast_vdif.W.PET Busyness_vdif.W.PET
## [1,]         -0.0550313004          -0.1846450          -0.6979653
## [2,]         -0.0353358511           0.9808822          -0.8409454
## [3,]          0.0153602863          -0.8804405           0.3359712
## [4,]         -0.3110467938          -0.8000340          -0.2967495
## [5,]          0.0257529944          -1.0090603           0.7166976
## [6,]          0.0007597987          -1.0067613           0.9729224
##      Complexity_vdif.W.PET Strength_vdif.W.PET SRE_align.W.PET LRE_align.W.PET
## [1,]           -0.39496588          -0.1487983      -0.4965600     -0.73910542
## [2,]            0.08320976           0.4339190      -0.4598340     -0.85727668
## [3,]           -0.66954127          -0.5979340      -0.6654328     -0.06739247
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## [4,]           -0.23711930          -0.4828870      -0.5398142     -0.58157466
## [5,]           -0.66792434          -0.5191096      -0.6972780      0.02047286
## [6,]           -0.67367185          -0.6067205      -0.7279147      0.21868188
##      GLNU_align.W.PET RLNU_align.W.PET RP_align.W.PET LGRE_align.W.PET
## [1,]       -0.6559981       -0.5172076     -0.4802142       -0.4017177
## [2,]       -0.7533293       -0.5729297     -0.4299235       -0.5396006
## [3,]       -0.3788126       -0.5646645     -0.7036969        0.3462367
## [4,]        0.8307024        0.7825295     -0.5386015       -0.7522301
## [5,]       -0.3210012       -0.6191293     -0.7329976        1.5284294
## [6,]       -0.2465460       -0.5756284     -0.7771379        0.7543122
##      HGRE_align.W.PET LGSRE_align.W.PET HGSRE_align.W.PET LGHRE_align.W.PET
## [1,]      -0.34486770        -0.3723193       -0.33818074        -0.4632262
## [2,]       0.06469248        -0.5229899        0.08716306        -0.5574876
## [3,]      -0.87260946         0.3282319       -0.87478027         0.3281300
## [4,]      -0.22356683        -0.7627312       -0.23166000        -0.6670154
## [5,]      -0.93382896         1.4011158       -0.92610182         1.7315839
## [6,]      -0.91329204         0.6876126       -0.91131785         0.9541545
##      HGLRE_align.W.PET GLNU_norm_align.W.PET RLNU_norm_align.W.PET
## [1,]       -0.37252766            -0.5138900            -0.4173834
## [2,]       -0.02056866            -0.6106199            -0.3241975
## [3,]       -0.85434001             0.4207051            -0.7968581
## [4,]       -0.18712885            -0.5748071            -0.5214981
## [5,]       -0.96930814             1.5193572            -0.8584130
## [6,]       -0.91848578             0.8671484            -0.9133916
##      GLVAR_align.W.PET RLVAR_align.W.PET Entropy_align.W.PET SZSE.W.PET
## [1,]        -0.2669606        -0.5628902          -0.4498174 -0.3984842
## [2,]         0.3757256        -0.7613964          -0.3576058 -0.2078345
## [3,]        -0.8976031         0.6493112          -0.9123703 -0.7071376
## [4,]        -0.2715007        -0.2778154          -0.3176612 -0.5128944
## [5,]        -0.9318581         0.7263114          -1.1552447 -0.8303329
## [6,]        -0.9287314         1.1021073          -0.9927288 -0.8940003
##       LZSE.W.PET LGLZE.W.PET HGLZE.W.PET SZLGE.W.PET SZHGE.W.PET LZLGE.W.PET
## [1,] -0.46022593  -0.4680080 -0.33029582  -0.4203553  -0.3108175  -0.2805442
## [2,] -0.54971957  -0.5314592  0.04470571  -0.3837420   0.0993072  -0.3230801
## [3,]  0.03171704   0.6608786 -0.88997048   0.7774380  -0.8762190  -0.1395594
## [4,] -0.28978468  -0.7610457 -0.19725000  -0.7649478  -0.2307742  -0.3033265
## [5,]  0.08014995   1.4982016 -0.93506566   1.1046276  -0.9059600   0.3616331
## [6,]  0.87001336   0.8734152 -0.92196939   0.8204223  -0.9076839   0.7265043
##      LZHGE.W.PET GLNU_area.W.PET ZSNU.W.PET   ZSP.W.PET GLNU_norm.W.PET
## [1,] -0.52340377      -0.6041965 -0.4721573 -0.30839336      -0.5218836
## [2,] -0.39643071      -0.6842908 -0.4825369 -0.02030225      -0.6162192
## [3,] -0.71605820      -0.3854504 -0.5551402 -0.83267422       0.5443641
## [4,]  0.08085406       0.7306191  0.4949157 -0.54623479      -0.5823999
## [5,] -1.09354081      -0.4252048 -0.6000846 -0.93920220       1.3583335
## [6,] -0.76011879      -0.4022340 -0.5913780 -1.18035989       0.9434539
##      ZSNU_norm.W.PET GLVAR_area.W.PET ZSVAR.W.PET Entropy_area.W.PET
## [1,]      -0.3200057       -0.2766605 -0.38203018         -0.5014727
## [2,]       0.1255877        0.3303703 -0.43457258         -0.5477755
## [3,]      -0.8898751       -0.8956246  0.03827969         -0.8589846
## [4,]      -0.5494782       -0.2378244 -0.23636331         -0.2711087
## [5,]      -1.0798617       -0.9244211  0.02117985         -0.9273561
## [6,]      -1.1754135       -0.9261313  0.79391402         -0.7747854
##      Min_hist.ADC Max_hist.ADC Mean_hist.ADC Variance_hist.ADC
## [1,]    0.4113126  -0.54142188    -0.3871858        0.03649101
```

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## [2,]   -0.8657505  -0.59178935    -0.5187498       -0.35175571
## [3,]    0.6090364  -0.01830709    -0.3635494        1.08498263
## [4,]   -0.8657505  -0.01035433    -0.4584202        0.28753584
## [5,]   -0.8657505  -0.43450146    -0.7453425       -0.00565879
## [6,]   -0.8657505  -0.33818472    -0.2100562        2.18699161
##      Standard_Deviation_hist.ADC Skewness_hist.ADC Kurtosis_hist.ADC
## [1,]                -0.13239011         0.7601872        -0.3645347
## [2,]                -0.42773754        -1.3132101         0.3555531
## [3,]                 0.51133519         1.4014854         0.8837421
## [4,]                 0.03833017        -0.3335022        -0.4827438
## [5,]                -0.16242576        -0.2284111        -0.2927585
## [6,]                 1.05521496        -0.9234665        -1.3820906
##      Energy_hist.ADC Entropy_hist.ADC AUC_hist.ADC  Volume.ADC X3D_surface.ADC
## [1,]      0.17139759       -0.8808510   -0.5517312 -0.77171573     -0.83357781
## [2,]      0.08084621       -0.6160912   -0.6811442 -0.83529619     -0.72636952
## [3,]      0.05339560       -0.4708601   -0.3709215 -0.51840678     -0.56229596
## [4,]      0.03164901       -0.3251680   -0.5582428  0.05016931     -0.07719641
## [5,]      0.06337764       -0.5427299   -0.6274542 -0.48828960     -0.55940723
## [6,]      0.04876108       -0.4722479   -0.6852396 -0.73987664     -0.52085076
##      ratio_3ds_vol.ADC ratio_3ds_vol_norm.ADC irregularity.ADC
## [1,]        0.40738565             -0.5102350       -0.3109450
## [2,]       -0.20351364             -0.7309093       -0.5307282
## [3,]       -0.51516250             -0.7887529       -0.7548838
## [4,]       -0.52782472             -0.3401354       -0.6841516
## [5,]       -0.47939174             -0.7465117       -0.7114444
## [6,]       -0.05784537             -0.2591402       -0.5710146
##      Compactness_v1.ADC Compactness_v2.ADC Spherical_disproportion.ADC
## [1,]       -0.159269319        -0.56541295                  -0.5102350
## [2,]       -0.015731983         0.01693002                  -0.7309093
## [3,]        0.029338740         0.21805452                  -0.7887529
## [4,]       -0.247114169        -0.87441235                  -0.3401354
## [5,]       -0.003961922         0.06881245                  -0.7465117
## [6,]       -0.283572652        -0.99205523                  -0.2591402
##      Sphericity.ADC Asphericity.ADC Center_of_mass.ADC Max_3D_diam.ADC
## [1,]     -0.5761452     -0.32810533         -0.1599647      -0.9223406
## [2,]     -0.3377117     -0.79595554         -0.1345429      -0.7388407
## [3,]     -0.2658503     -0.91858954          0.3122768      -0.6298715
## [4,]     -0.7287679      0.03252177          0.1652700      -0.2750518
## [5,]     -0.3187759     -0.82903405         -0.5223026      -0.7007593
## [6,]     -0.7938125      0.20423907          0.4204525      -0.5900804
##      Major_axis_length.ADC Minor_axis_length.ADC Least_axis_length.ADC
## [1,]            -0.6363554            -1.0694709           -1.04883852
## [2,]            -0.9347200            -0.7650734           -0.59483948
## [3,]            -0.7330537            -0.4762489           -0.49092760
## [4,]            -0.2806023            -0.2509627           -0.07836234
## [5,]            -0.8147554            -0.5239350           -0.25589410
## [6,]            -0.4516336            -0.5552712           -0.67678823
##      Elongation.ADC Flatness.ADC Max_cooc.L.ADC Average_cooc.L.ADC
## [1,]     -1.2658333   -1.2879681    0.171468447        -0.72089326
## [2,]     -0.2578859    0.0237260   -0.034142536        -0.04429305
## [3,]     -0.1144291   -0.1805273    0.040404448        -1.19070915
## [4,]     -0.4660035   -0.2184426    0.008852003        -0.58873748
## [5,]     -0.0340415    0.4388721   -0.001549901        -0.53186871
## [6,]     -0.6741211   -0.8646448   -0.110769901        -0.10171762
```

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##      Variance_cooc.L.ADC Entropy_cooc.L.ADC DAVE_cooc.L.ADC DVAR_cooc.L.ADC
## [1,]           0.5592857         -0.6503058      0.10801881       1.3404697
## [2,]          -0.7145134         -0.6089983     -0.58519579      -0.6443482
## [3,]           0.9512078         -0.5126260     -0.21463352       0.9153432
## [4,]          -0.7749119         -0.6127855     -0.86737881      -0.9051946
## [5,]          -0.6271330         -0.5521907     -0.48832913      -0.5937073
## [6,]           1.2476170         -0.3423719      0.05653072       0.5625945
##      DENT_cooc.L.ADC SAVE_cooc.L.ADC SVAR_cooc.L.ADC SENT_cooc.L.ADC
## [1,]      -0.3378751      -0.7211984       0.4168868     -0.21422274
## [2,]      -0.6023649      -0.0444083      -0.7316081     -1.15215699
## [3,]      -0.4453804      -1.1911468       1.1761980      0.07552317
## [4,]      -0.7262579      -0.5890055      -0.6872803     -0.18692032
## [5,]      -0.5615696      -0.5321207      -0.6497936     -0.21904233
## [6,]      -0.3536147      -0.1018483       1.5473657     -0.82480441
##      ASM_cooc.L.ADC Contrast_cooc.L.ADC Dissimilarity_cooc.L.ADC
## [1,]     0.11178526           0.8024997               0.10801881
## [2,]     0.07978965          -0.5875537              -0.58519579
## [3,]     0.08346730           0.3370790              -0.21463352
## [4,]     0.08199624          -0.8708007              -0.86737881
## [5,]     0.06728562          -0.4988646              -0.48832913
## [6,]     0.03933543           0.4319138               0.05653072
##      Inv_diff_cooc.L.ADC Inv_diff_norm_cooc.L.ADC IDM_cooc.L.ADC
## [1,]          -0.5144491               -0.6074400     -0.4025260
## [2,]          -0.4760492               -0.5436049     -0.4563809
## [3,]          -0.4172269               -0.5736895     -0.3203856
## [4,]          -0.2068187               -0.5106365     -0.1014070
## [5,]          -0.5230063               -0.5549202     -0.5010570
## [6,]          -0.7006237               -0.6088330     -0.6849128
##      IDM_norm_cooc.L.ADC Inv_var_cooc.L.ADC Correlation_cooc.L.ADC
## [1,]          -0.5963440         -0.4473741            -0.70471165
## [2,]          -0.5504203         -0.4239707            -0.51812159
## [3,]          -0.5792879         -0.3081512             0.09412942
## [4,]          -0.5395436         -0.1032327             0.06038360
## [5,]          -0.5542055         -0.4796230            -0.52975022
## [6,]          -0.5864250         -0.6883192             0.18917254
##      Autocorrelation_.L.ADC Tendency_cooc.L.ADC Shade_.L.ADC
## [1,]             -0.6998238           0.4168868    1.5643914
## [2,]              0.2354008          -0.7316081   -0.8436388
## [3,]             -1.1120988           1.1761980    4.1522294
## [4,]             -0.5602964          -0.6872803   -0.3582556
## [5,]             -0.4952326          -0.6497936   -0.3648893
## [6,]              0.2695015           1.5473657   -1.0298872
##      Prominence_cooc.L.ADC IC1_.L.ADC  IC2_.L.ADC Coarseness_vdif_.L.ADC
## [1,]             0.9559151 -0.6883999  0.02448574            0.301907443
## [2,]            -0.6151097  0.5967581 -0.55782502            0.056613103
## [3,]             3.9832025  0.1773429 -0.27185532           -0.075963314
## [4,]            -0.7096757  0.3808910 -0.41652989           -0.139734248
## [5,]            -0.6136209  0.6439494 -0.57515917            0.008225508
## [6,]             1.2401564 -0.1924172 -0.05807723           -0.003801467
##      Contrast_vdif_.L.ADC Busyness_vdif_.L.ADC Complexity_vdif_.L.ADC
## [1,]            0.6409048           -0.6365437              0.2240702
## [2,]           -0.4518571           -0.6250681             -0.8182427
## [3,]           -0.0702796           -0.1905094              0.5372433
## [4,]           -0.6427148           -0.2282567             -0.9070155
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## [5,]           -0.3561751           -0.5381510             -0.6730924
## [6,]            0.3844799           -0.5798298              0.2904589
##      Strength_vdif_.L.ADC SRE_align.L.ADC LRE_align.L.ADC GLNU_align.L.ADC
## [1,]           1.08878436      -0.5432046      -0.6178635       -0.6261970
## [2,]          -0.05349273      -0.5458232      -0.6137933       -0.5441134
## [3,]           0.06221020      -0.5607702      -0.5566774       -0.4608465
## [4,]          -0.48069605      -0.5791469      -0.4858621       -0.1783430
## [5,]          -0.20159009      -0.5426021      -0.6154515       -0.5346359
## [6,]          -0.09788725      -0.5308298      -0.6668765       -0.5690912
##      RLNU_align.L.ADC RP_align.L.ADC LGRE_align.L.ADC HGRE_align.L.ADC
## [1,]       -0.6678444     -0.5353171     6.109942e-02      -0.54292539
## [2,]       -0.5747492     -0.5400544    -3.801424e-02       0.06789313
## [3,]       -0.4549755     -0.5598945     2.092792e-01      -1.12656204
## [4,]       -0.1430350     -0.5840029     2.904285e-02      -0.62025951
## [5,]       -0.5426892     -0.5370995    -6.973871e-05      -0.53892281
## [6,]       -0.5195656     -0.5193700    -4.259375e-02       0.35906171
##      LGSRE_align.L.ADC HGSRE_align.L.ADC LGHRE_align.L.ADC HGLRE_align.L.ADC
## [1,]       0.067623844       -0.52408648        0.02829577        -0.6071760
## [2,]      -0.030420066        0.06957377       -0.07624384         0.0513619
## [3,]       0.206135542       -1.12804770        0.21305610        -1.1064162
## [4,]       0.029459100       -0.63542049        0.03082241        -0.5596155
## [5,]       0.007086664       -0.53418758       -0.03644930        -0.5476899
## [6,]      -0.035355162        0.38423936       -0.07877047         0.2569200
##      GLNU_norm_align.L.ADC RLNU_norm_align.L.ADC GLVAR_align.L.ADC
## [1,]            -0.1203279            -0.5125345         0.6524756
## [2,]            -0.1128336            -0.5226589        -0.6881227
## [3,]            -0.2225712            -0.5600825         0.6739622
## [4,]            -0.1730555            -0.6053373        -0.7581559
## [5,]            -0.2306008            -0.5127052        -0.5532662
## [6,]            -0.5276951            -0.4824053         0.9801508
##      RLVAR_align.L.ADC Entropy_align.L.ADC SZSE.L.ADC LZSE.L.ADC LGLZE.L.ADC
## [1,]       -0.44582763          -0.5883206 -0.5014454 -0.7450547  0.07253492
## [2,]       -0.43730678          -0.6382575 -0.5322334 -0.6801099 -0.02713914
## [3,]       -0.24658490          -0.5106176 -0.6485655 -0.2386096  0.20773636
## [4,]       -0.01198974          -0.5812684 -0.5869649 -0.4695587  0.01990175
## [5,]       -0.41790827          -0.5837223 -0.5609116 -0.5131342  0.01661218
## [6,]       -0.61298122          -0.3955007 -0.5031381 -0.7854992 -0.03306038
##      HGLZE.L.ADC  SZLGE.L.ADC SZHGE.L.ADC  LZLGE.L.ADC  LZHGE.L.ADC
## [1,] -0.52116543  0.087641058  -0.4531762 -0.069331476 -0.722525947
## [2,]  0.03776169 -0.008292571   0.0300991 -0.173528216 -0.081345974
## [3,] -1.11061311  0.182242275  -1.1424450  0.296453924 -0.948870970
## [4,] -0.63424587  0.014691528  -0.6650952  0.001412627 -0.518685568
## [5,] -0.56442366  0.033678392  -0.5884310 -0.124720269 -0.445679435
## [6,]  0.31736403 -0.014621525   0.3350138 -0.178463851  0.008986928
##      GLNU_area.L.ADC ZSNU.L.ADC  ZSP.L.ADC GLNU_norm.L.ADC ZSNU_norm.L.ADC
## [1,]      -0.6384152 -0.6668395 -0.4462596      -0.1479371      -0.4206376
## [2,]      -0.5460429 -0.5690748 -0.4875722      -0.0875094      -0.4944409
## [3,]      -0.4826914 -0.4871185 -0.6694902      -0.2477384      -0.7518699
## [4,]      -0.1566395 -0.1301000 -0.5806975      -0.1514916      -0.6179428
## [5,]      -0.5424265 -0.5463444 -0.5542942      -0.2193018      -0.5559436
## [6,]      -0.5719915 -0.5041938 -0.4347400      -0.5039407      -0.4273670
##      GLVAR_area.L.ADC ZSVAR.L.ADC Entropy_area.L.ADC Max_cooc.H.ADC
## [1,]        0.6575768  -0.6125949         -0.6257851     0.08340477
## [2,]       -0.6983670  -0.5654684         -0.6568559     0.06727003
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## [3,]        0.6482625  -0.0599094         -0.4381783     0.14134316
## [4,]       -0.7672453  -0.3265400         -0.5720668     0.08230468
## [5,]       -0.5238385  -0.3514997         -0.5622679     0.05736917
## [6,]        0.9330886  -0.6811584         -0.4352778     0.09513913
##      Average_cooc.H.ADC Variance_cooc.H.ADC Entropy_cooc.H.ADC DAVE_cooc.H.ADC
## [1,]         -0.6642144          -0.6262628         -0.5135162      -0.4035709
## [2,]         -0.3985375          -0.6128917         -0.5879123      -0.4490907
## [3,]         -0.6189469          -0.4471629         -0.5521140      -0.6742298
## [4,]         -0.6063365          -0.6286703         -0.5364986      -0.8378865
## [5,]         -0.5691155          -0.6641421         -0.5449454      -0.4736239
## [6,]         -0.6231404          -0.4813925         -0.5896604      -0.8362281
##      DVAR_cooc.H.ADC DENT_cooc.H.ADC SAVE_cooc.H.ADC SVAR_cooc.H.ADC
## [1,]      -0.3457743      -0.5427089      -0.6645724      -0.7020362
## [2,]      -0.5347957      -0.5544867      -0.3987956      -0.6241406
## [3,]      -0.5346473      -0.6002605      -0.6192882      -0.2874587
## [4,]      -0.9205151      -0.6518222      -0.6066727      -0.3859861
## [5,]      -0.4721307      -0.5533171      -0.5694384      -0.6923536
## [6,]      -0.7161951      -0.6504806      -0.6234836      -0.2260366
##      SENT_cooc.H.ADC ASM_cooc.H.ADC Contrast_cooc.H.ADC
## [1,]      -0.4477105      0.1131243          -0.2927716
## [2,]      -0.8491975      0.1057101          -0.4138414
## [3,]      -0.4815200      0.1071929          -0.6417886
## [4,]      -0.5326087      0.1049686          -0.9390283
## [5,]      -0.6034431      0.1053393          -0.4160171
## [6,]      -0.6221580      0.1086758          -0.8597653
##      Dissimilarity_cooc.H.ADC Inv_diff_cooc.H.ADC Inv_diff_norm_cooc.H.ADC
## [1,]               -0.4035709          -0.5126398               -0.5783293
## [2,]               -0.4490907          -0.5808371               -0.5733662
## [3,]               -0.6742298          -0.2457501               -0.5284852
## [4,]               -0.8378865          -0.2186128               -0.5034298
## [5,]               -0.4736239          -0.4714618               -0.5669623
## [6,]               -0.8362281          -0.1572588               -0.4994273
##      IDM_cooc.H.ADC IDM_norm_cooc.H.ADC Inv_var_cooc.H.ADC
## [1,]    -0.40456384          -0.5739996         -0.3372000
## [2,]    -0.54895368          -0.5659544         -0.5233714
## [3,]    -0.08509688          -0.5433796         -0.1120096
## [4,]    -0.08864455          -0.5199402         -0.1261824
## [5,]    -0.37192535          -0.5650898         -0.3945912
## [6,]    -0.01644963          -0.5240950         -0.0437701
##      Correlation_cooc.H.ADC Autocorrelation_cooc.H.ADC Tendency_cooc.H.ADC
## [1,]            -0.63608177                -0.7706165          -0.7020362
## [2,]            -0.47456466                -0.2722283          -0.6241406
## [3,]            -0.05904703                -0.5731530          -0.2874587
## [4,]             0.15083503                -0.5416515          -0.3859861
## [5,]            -0.52544743                -0.5940408          -0.6923536
## [6,]             0.16376241                -0.5453615          -0.2260366
##      Shade_cooc.H.ADC Prominence_cooc.H.ADC IC1_d.H.ADC IC2_d.H.ADC
## [1,]       0.46889817           -0.74536242 -0.86166650   0.1157107
## [2,]      -1.70131741           -0.65856794  0.39133994  -0.4319173
## [3,]       1.06718493           -0.06008993  0.32513388  -0.3774947
## [4,]      -0.05494861           -0.37044251  0.47315352  -0.5048832
## [5,]      -0.73786494           -0.72042827  0.41273734  -0.4502685
## [6,]      -0.59074557           -0.18983207 -0.06392116  -0.1380789
##      Coarseness_vdif.H.ADC Contrast_vdif.H.ADC Busyness_vdif.H.ADC
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## [1,]           0.432890709          -0.3950162          -0.6536208
## [2,]           0.039522006          -0.4548965          -0.5597792
## [3,]          -0.040985354          -0.8123096          -0.4779572
## [4,]          -0.118627683          -0.9057013          -0.2214241
## [5,]          -0.003453453          -0.4205023          -0.5253460
## [6,]           0.024050841          -0.8595558          -0.5485642
##      Complexity_vdif.H.ADC Strength_vdif.H.ADC SRE_align.H.ADC LRE_align.H.ADC
## [1,]            -0.3862680           0.6749416      -0.5481444      -0.6114778
## [2,]            -0.4645300          -0.1073982      -0.5503490      -0.6055486
## [3,]            -0.8080180          -0.2687408      -0.5658265      -0.5257023
## [4,]            -0.9119357          -0.4237682      -0.5698948      -0.5249950
## [5,]            -0.4395621          -0.1935487      -0.5570991      -0.5768597
## [6,]            -0.8775011          -0.1408891      -0.5622128      -0.5591346
##      GLNU_align.H.ADC RLNU_align.H.ADC RP_align.H.ADC LGRE_align.H.ADC
## [1,]       -0.6633318       -0.6673924     -0.5430933      -0.05398431
## [2,]       -0.5756171       -0.5768691     -0.5458591      -0.06489495
## [3,]       -0.4595511       -0.4614202     -0.5695632      -0.04650273
## [4,]       -0.1470269       -0.1457125     -0.5725348      -0.08952181
## [5,]       -0.5471152       -0.5488348     -0.5553682      -0.08016984
## [6,]       -0.5305406       -0.5323010     -0.5613571      -0.08110504
##      HGRE_align.H.ADC LGSRE_align.H.ADC HGSRE_align.H.ADC LGHRE_align.H.ADC
## [1,]       -0.5745603       -0.03280154        -0.5618821       -0.18267144
## [2,]       -0.5854319       -0.04755818        -0.5775831       -0.17825372
## [3,]       -0.6087517       -0.02903388        -0.6283839       -0.15292546
## [4,]       -0.5810819       -0.09402591        -0.5874477       -0.05779723
## [5,]       -0.5828703       -0.06985013        -0.5794468       -0.15204192
## [6,]       -0.5771240       -0.08178103        -0.5736937       -0.08695418
##      HGLRE_align.H.ADC GLNU_norm_align.H.ADC RLNU_norm_align.H.ADC
## [1,]        -0.6171972           -0.03604207            -0.5265624
## [2,]        -0.6180332           -0.03900875            -0.5334162
## [3,]        -0.4831156           -0.03966801            -0.5729308
## [4,]        -0.5612980           -0.04131616            -0.5840042
## [5,]        -0.5953627           -0.03900875            -0.5507607
## [6,]        -0.5951628           -0.04065690            -0.5636524
##      GLVAR_align.H.ADC RLVAR_align.H.ADC Entropy_align.H.ADC SZSE.H.ADC
## [1,]        -0.5708740       -0.36484507          -0.6043268 -0.5346854
## [2,]        -0.5719358       -0.34004504          -0.5926918 -0.5422640
## [3,]        -0.5977942        0.12336936          -0.5713589 -0.6095598
## [4,]        -0.5819026        0.05502511          -0.5597051 -0.5735377
## [5,]        -0.5722561       -0.19845421          -0.5843242 -0.5572108
## [6,]        -0.5843167       -0.12722623          -0.5780064 -0.5901219
##      LZSE.H.ADC   LGLZE.H.ADC HGLZE.H.ADC  SZLGE.H.ADC SZHGE.H.ADC LZLGE.H.ADC
## [1,] -0.6981364  0.0666177435  -0.5767674  0.155938519  -0.5473062  -0.5353574
## [2,] -0.6958561  0.0001856309  -0.5725235  0.041762582  -0.5478138  -0.4547178
## [3,]  0.1545871 -0.0501129685  -0.6777485 -0.064694419  -0.7376807  -0.1269569
## [4,] -0.5155250 -0.0861761153  -0.5757788 -0.097821522  -0.5824360  -0.2065126
## [5,] -0.5454259 -0.0453678176  -0.6186968  0.006384122  -0.6369542  -0.2160507
## [6,] -0.4498940 -0.1643129334  -0.5594243 -0.157321658  -0.5874992   0.2944499
##      LZHGE.H.ADC GLNU_area.H.ADC ZSNU.H.ADC  ZSP.H.ADC GLNU_norm.H.ADC
## [1,]  -0.6768543      -0.6642705 -0.6725977 -0.5168683     -0.03152093
## [2,]  -0.7175082      -0.5751688 -0.5778406 -0.5216097     -0.04041668
## [3,]   0.9150997      -0.4667660 -0.4846950 -0.6662111     -0.03316829
## [4,]  -0.5488053      -0.1441447 -0.1388711 -0.5778396     -0.04239351
## [5,]  -0.4799949      -0.5478389 -0.5519269 -0.5613757     -0.03876932
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## [6,]  -0.5599065      -0.5333562 -0.5436026 -0.5982111     -0.03975773
##      ZSNU_norm.H.ADC GLVAR_area.H.ADC ZSVAR.H.ADC Entropy_area.H.ADC
## [1,]      -0.4954016       -0.5622214 -0.64742792         -0.6439049
## [2,]      -0.5166242       -0.5370231 -0.67651322         -0.6007301
## [3,]      -0.6745847       -0.6936563  2.35951019         -0.5334676
## [4,]      -0.5900432       -0.5806360 -0.24612217         -0.5508851
## [5,]      -0.5486951       -0.5619809 -0.24897717         -0.5892300
## [6,]      -0.6317154       -0.6210024 -0.09837599         -0.5535874
##      Max_cooc.W.ADC Average_cooc.W.ADC Variance_cooc.W.ADC DAVE_cooc.W.ADC
## [1,]     0.19349133        -0.84300136          -0.0154161     -0.13255040
## [2,]     0.08644844         0.11675254          -0.3782130     -0.33716774
## [3,]     0.08425643        -0.93506685           1.3339103      0.14095967
## [4,]     0.05722171         0.09734604           0.2202409     -0.17910738
## [5,]     0.07658442        -0.19741735          -0.1038016     -0.04782845
## [6,]     0.07220041         0.33324944           2.4174995      0.83171075
##      DVAR_cooc.W.ADC DENT_cooc.W.ADC SAVE_cooc.W.ADC SVAR_cooc.W.ADC
## [1,]      0.61946231      -0.4834815      -0.8470091      -0.1239002
## [2,]     -0.33068080      -0.5288387       0.1400958      -0.3998223
## [3,]      1.55899175      -0.4091896      -0.9416984       1.3894965
## [4,]     -0.03977472      -0.4771018       0.1201363       0.2845655
## [5,]     -0.05742292      -0.4533533      -0.1830273      -0.1595859
## [6,]      1.81350274      -0.2720697       0.3627625       2.5166759
##      SENT_cooc.W.ADC ASM_cooc.W.ADC Contrast_cooc.W.ADC
## [1,]      -0.2297138     0.12046668          0.33932322
## [2,]      -1.1487708     0.10453142         -0.27039311
## [3,]       0.1752058     0.10267849          1.02076598
## [4,]      -0.0319484     0.09897261         -0.01102572
## [5,]      -0.1411365     0.10193731          0.08810514
## [6,]      -0.7842625     0.09934320          1.85507756
##      Dissimilarity_cooc.W.ADC Inv_diff_cooc.W.ADC Inv_diff_norm_cooc.W.ADC
## [1,]              -0.13255040          -0.1553491               -0.6079427
## [2,]              -0.33716774          -0.4606680               -0.5438010
## [3,]               0.14095967          -0.3883356               -0.5742573
## [4,]              -0.17910738          -0.4560997               -0.5109719
## [5,]              -0.04782845          -0.5316046               -0.5551029
## [6,]               0.83171075          -0.7241103               -0.6098508
##      IDM_cooc.W.ADC IDM_norm_cooc.W.ADC Inv_var_cooc.W.ADC
## [1,]    -0.03349743          -0.5973520        -0.04727434
## [2,]    -0.49096209          -0.5502015        -0.51116122
## [3,]    -0.37454564          -0.5799243        -0.34876260
## [4,]    -0.44995630          -0.5392978        -0.47829938
## [5,]    -0.51956613          -0.5542619        -0.57573855
## [6,]    -0.69179048          -0.5872923        -0.70852330
##      Correlation_cooc.W.ADC Autocorrelation_cooc.W.ADC Tendency_cooc.W.ADC
## [1,]            -0.70519175                -0.82825568          -0.1239002
## [2,]            -0.51902018                 0.40596504          -0.3998223
## [3,]             0.09406992                -0.81538896           1.3894965
## [4,]             0.05818005                 0.41742441           0.2845655
## [5,]            -0.52509677                -0.06977856          -0.1595859
## [6,]             0.19000410                 0.94845945           2.5166759
##      Shade_cooc.W.ADC Prominence_cooc.W.ADC  IC1_d.W.ADC IC2_d.W.ADC
## [1,]      0.748492311           -0.11542708 -0.903263171  -0.1907350
## [2,]     -0.849230344           -0.35816223  0.001800882  -0.3183774
## [3,]      5.445020127            3.59414354 -0.093125575  -0.2756556
```

```
## [4,]     -0.006023108            0.08908301  0.541318048  -0.4760088
## [5,]     -0.210118336           -0.22271379 -0.075272999  -0.2837085
## [6,]     -1.349842393            2.39969624 -1.208111301  -0.1245345
##      Coarseness_vdif.W.ADC Contrast_vdif.W.ADC Busyness_vdif.W.ADC
## [1,]            0.27382766          2.05493666          -0.3772693
## [2,]            0.07761691         -0.14928773          -0.5719455
## [3,]           -0.04800583          0.18526528          -0.1397398
## [4,]           -0.10722798         -0.40258421          -0.3596382
## [5,]            0.02976063          0.00417449          -0.5038700
## [6,]            0.01689925          0.99857484          -0.5979023
##      Complexity_vdif.W.ADC Strength_vdif.W.ADC SRE_align.W.ADC LRE_align.W.ADC
## [1,]            -0.6073412           1.4669901      -0.5607394      -0.5636282
## [2,]            -0.4755028           0.3446350      -0.5544960      -0.5851724
## [3,]             0.4134439           1.4197272      -0.5563057      -0.5759453
## [4,]             0.1805608          -0.3174056      -0.5581606      -0.5711293
## [5,]            -0.2096065           0.3114865      -0.5550163      -0.5809744
## [6,]             0.7943650           1.3787764      -0.5492932      -0.6052889
##      GLNU_align.W.ADC RLNU_align.W.ADC RP_align.W.ADC LGRE_align.W.ADC
## [1,]       -0.6918875       -0.6585680     -0.5598492      0.102514356
## [2,]       -0.6123816       -0.5705684     -0.5523782      0.011942997
## [3,]       -0.5149668       -0.4530326     -0.5552168      0.016044342
## [4,]       -0.3228389       -0.1392104     -0.5572378      0.066969370
## [5,]       -0.6154673       -0.5417353     -0.5534228      0.005790981
## [6,]       -0.6590509       -0.5222697     -0.5454068     -0.003095266
##      HGRE_align.W.ADC LGSRE_align.W.ADC HGSRE_align.W.ADC LGHRE_align.W.ADC
## [1,]      -0.72391839        0.10748791       -0.72254855       0.077168309
## [2,]       0.31043574        0.01660389        0.31244050      -0.012162463
## [3,]      -0.74102269        0.02037644       -0.73855319      -0.006809308
## [4,]       0.48049736        0.06598993        0.48251611       0.075830020
## [5,]      -0.02339079        0.01043064       -0.02076085      -0.018184762
## [6,]       1.12446188        0.00117076        1.13430855      -0.026883639
##      HGLRE_align.W.ADC GLNU_norm_align.W.ADC RLNU_norm_align.W.ADC
## [1,]       -0.72942321            0.11990386            -0.5601024
## [2,]        0.30239721           -0.03442756            -0.5440640
## [3,]       -0.74942271           -0.08728526            -0.5487189
## [4,]        0.47104532           -0.16167757            -0.5538576
## [5,]       -0.03187296           -0.11012500            -0.5451701
## [6,]        1.08473714           -0.22269232            -0.5301456
##      GLVAR_align.W.ADC RLVAR_align.W.ADC Entropy_align.W.ADC SZSE.W.ADC
## [1,]      0.0390388995       -0.07189017          -0.4489178 -0.5288302
## [2,]     -0.3518347261       -0.16482743          -0.5433374 -0.5737026
## [3,]      1.0925597603       -0.10788699          -0.5008749 -0.5217499
## [4,]      0.2872015907       -0.09381551          -0.3577119 -0.5381157
## [5,]     -0.0005432957       -0.13472099          -0.4469533 -0.5472388
## [6,]      2.1850902501       -0.26889098          -0.2581106 -0.5320105
##      LZSE.W.ADC LGLZE.W.ADC HGLZE.W.ADC SZLGE.W.ADC SZHGE.W.ADC LZLGE.W.ADC
## [1,] -0.6847176 0.113374483 -0.71989596  0.12431381 -0.70418503  0.01531010
## [2,] -0.6013426 0.022597678  0.30739854  0.03294163  0.30621407 -0.06733775
## [3,] -0.4855176 0.026380045 -0.74098507  0.03571049 -0.74294693 -0.05805147
## [4,] -0.6310472 0.053200465  0.47987855  0.04436315  0.49296111  0.07659951
## [5,] -0.5737353 0.016064499 -0.03008663  0.02636560 -0.02934976 -0.07290951
## [6,] -0.6652514 0.006780508  1.11776106  0.01667461  1.13227954 -0.08157670
##      LZHGE.W.ADC GLNU_area.W.ADC ZSNU.W.ADC  ZSP.W.ADC GLNU_norm.W.ADC
## [1,] -0.78023810      -0.6914700 -0.6513787 -0.5068231      0.07698041
```

```
## [2,]  0.29762888      -0.6100327 -0.5660417 -0.5606797     -0.06244984
## [3,] -0.72852195      -0.5190294 -0.4563908 -0.5221702      0.26861743
## [4,]  0.42004184      -0.3130419 -0.1207423 -0.5237049     -0.18723674
## [5,] -0.01111977      -0.6144844 -0.5366044 -0.5410354      0.27657578
## [6,]  1.02554608      -0.6568667 -0.5137505 -0.5128675     -0.24612851
##      ZSNU_norm.W.ADC GLVAR_area.W.ADC ZSVAR.W.ADC Entropy_area.W.ADC
## [1,]      -0.4888097      0.040207659 -0.70463402         -0.7414506
## [2,]      -0.5444800     -0.353463617 -0.42606449         -0.5771180
## [3,]      -0.5868989      1.070427270  0.09854219         -0.4508095
## [4,]      -0.5112910      0.284745010 -0.48028511         -0.4046157
## [5,]      -0.5328275      0.002215947 -0.23584790         -0.4859857
## [6,]      -0.4964165      2.154394753 -0.62125871         -0.3202609
```

Identifying best method to be used.

```
method <- c( "average", "single", "complete", "ward")
names(method) <- c( "average", "single", "complete", "ward")
```

```
K<- function(x) {
  agnes(df, method = x)$ac
}

sapply(method, K)
```

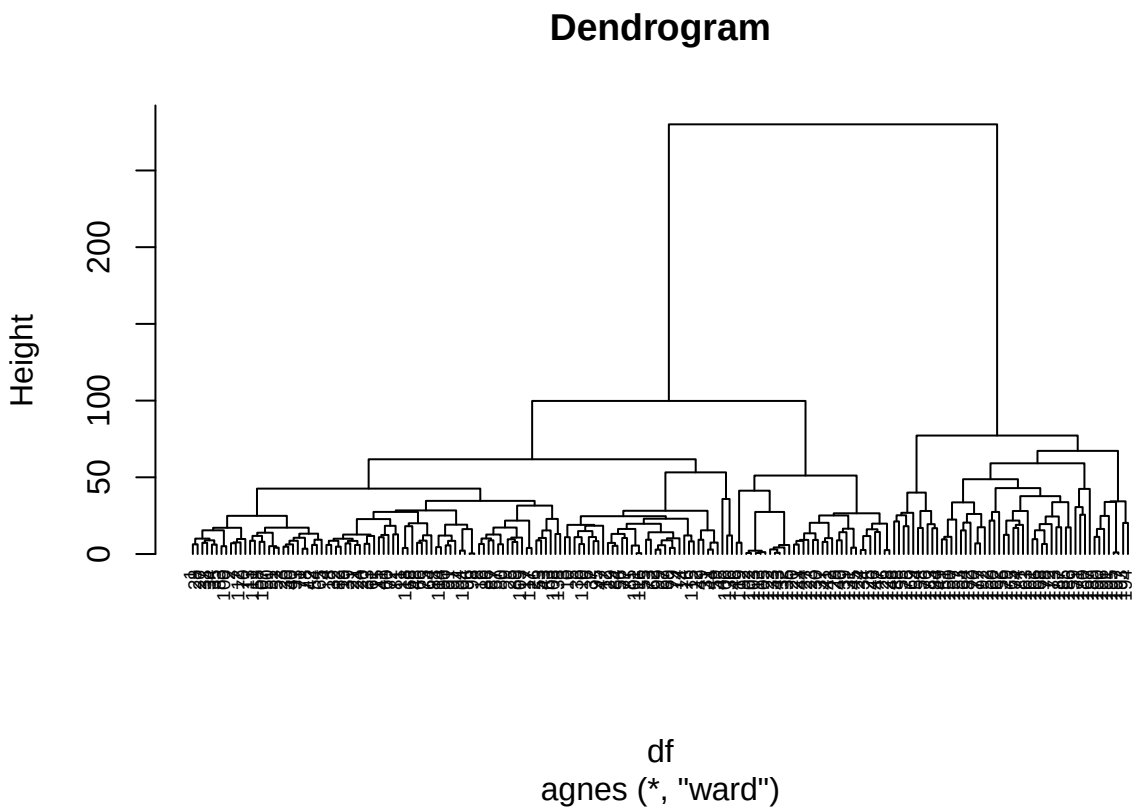
```
##   average    single  complete      ward
## 0.7583130 0.7077038 0.8477769 0.9649937
```

the result shows that ward has a lowest variance sin it produces the highest agglomerative coefficient.

```
clust <- agnes(df, method = "ward")
```

creating dendogram tree

```
dendotree <-pltree(clust, cex = 0.6, hang = -1, main = "Dendrogram")
```

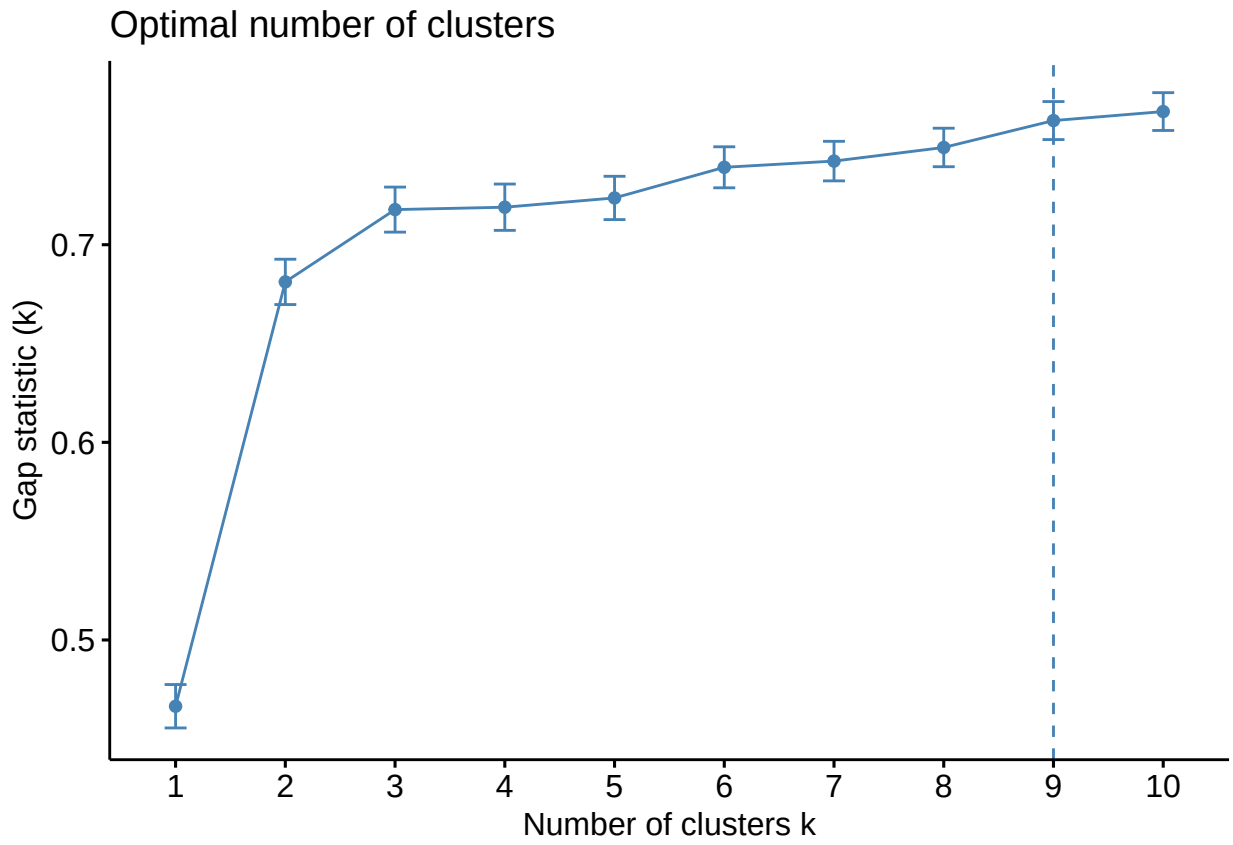


#calculate gap statistic for each number of clusters (up to 10 clusters)

```
gap_stat <- clusGap(df, FUN = hcut, nstart = 25, K.max = 10,)
```

#produce plot of clusters vs. gap statistic

```
fviz_gap_stat(gap_stat)
```



#compute distance matrix

```
d <- dist(df, method = "euclidean")
```

#perform hierarchical clustering using Ward's method

```
final_clust <- hclust(d, method = "ward.D2" )
```

#cutting the dendrogram into 2 clusters

```
dendonew <- cutree(final_clust, k = 2)
```

#find number of observations in each cluster

```
table(dendonew)
```

```
## dendonew
##   1   2
## 147  50
```

#append cluster labels to original data

```
final_data <- cbind(radiomics, cluster = dendonew)
head(final_data)
```

```
##   Institution Failure.binary  Failure Entropy_cooc.W.ADC GLNU_align.H.PET
## 1           A              0 49.30000           12.85352         46.25635
## 2           A              1 12.56667           12.21115         27.45454
## 3           A              0 79.80000           12.75682         90.19570
## 4           A              1 17.86667           13.46730        325.64333
## 5           A              0 39.56667           12.63733         89.57904
## 6           A              1  4.76667           13.16159        101.71345
##   Min_hist.PET Max_hist.PET Mean_hist.PET Variance_hist.PET
## 1    6.249117    17.825541      9.783773          6.814365
## 2   11.005214    26.469077     15.426640         12.932074
## 3    2.777718     6.877486      4.295330          0.923425
## 4    6.296588    22.029843     10.334779          6.649795
## 5    3.583846     7.922501      4.454175          0.572094
## 6    2.597947     6.206142      3.769041          0.615282
##   Standard_Deviation_hist.PET Skewness_hist.PET Kurtosis_hist.PET
## 1                       2.612479          0.688533         -0.339727
## 2                       3.598298          0.789526         -0.319613
## 3                       0.962163          0.248637         -0.944246
## 4                       2.580759          0.832011          0.855861
## 5                       0.757225          1.574845          3.250288
## 6                       0.785315          0.610611         -0.090239
##   Energy_hist.PET Entropy_hist.PET AUC_hist.PET H_suv.PET Volume.PET
## 1        0.005095         9.629587     0.506553  1.123930  13751.970
## 2        0.006297         8.072951     0.507519  1.927281   9327.705
## 3        0.005015         9.669316     0.503300  0.410573  26624.003
## 4        0.003289        10.574730     0.544274  0.919612  51058.073
## 5        0.008066         7.621834     0.543922  0.306344  29414.553
## 6        0.005237        10.589120     0.507322  0.388752  14240.032
##   X3D_surface.PET ratio_3ds_vol.PET ratio_3ds_vol_norm.PET irregularity.PET
## 1        5622.519          3.214263               15.91400         2.212137
## 2        8356.832          4.848032               21.09429         2.348324
## 3       16832.003          3.163721               19.52154         2.121251
## 4       29100.294          2.027384               20.12864         1.859572
## 5        7769.379          4.815431               21.01721         2.219725
## 6        9563.905          3.699578               18.53249         2.136984
##   tumor_length.PET Compactness_v1.PET Compactness_v2.PET
## 1         44.04796           0.003366           0.002778
## 2         39.39796           0.003078           0.002637
## 3         50.91422           0.003145           0.002664
## 4         76.23900           0.003118           0.002653
## 5         36.93490           0.003081           0.002638
## 6         46.00253           0.003195           0.002687
##   Spherical_disproportion.PET Sphericity.PET Asphericity.PET Center_of_mass.PET
## 1                    15.91400       0.065378        14.91400           0.811086
## 2                    21.09429       0.049942        20.09429           0.587732
## 3                    19.52154       0.053762        18.52154           0.393189
## 4                    20.12864       0.052217        19.12864           0.866799
## 5                    21.01721       0.050116        20.01721           0.525997
## 6                    18.53249       0.056497        17.53249           0.308017
##   Max_3D_diam.PET Major_axis_length.PET Minor_axis_length.PET
## 1        44.04796              34.60475              25.88546
## 2        39.39796              35.13100              27.30539
## 3        50.91422              48.12896              30.37293
## 4        76.23900              64.12797              54.46594
```

```
## 5        36.93490              35.99413              23.84296
## 6        46.00253              42.95117              31.60120
##   Least_axis_length.PET Elongation.PET Flatness.PET Max_cooc.L.PET
## 1              24.98484       0.750543     0.724516       0.005020
## 2              21.15130       0.779759     0.604571       0.008190
## 3              27.52209       0.633585     0.574348       0.005033
## 4              51.56490       0.851856     0.806616       0.005971
## 5              21.38912       0.664919     0.596741       0.007553
## 6              15.99647       0.738262     0.374927       0.005396
##   Average_cooc.L.PET Variance_cooc.L.PET Entropy_cooc.L.PET DAVE_cooc.L.PET
## 1           22.87750            205.6627          10.688721       11.857838
## 2           21.90654            226.6299          10.291026       13.993568
## 3           27.25065            208.9461          10.878250       12.281559
## 4           17.81061            102.6657          10.238635        7.473982
## 5           15.35938            142.2193           9.829042       10.237690
## 6           23.34637            181.6257          10.702694       11.660805
##   DVAR_cooc.L.PET DENT_cooc.L.PET SAVE_cooc.L.PET SVAR_cooc.L.PET
## 1        84.21646        4.997454        45.75246        587.8808
## 2       129.35103        5.205762        43.81055        581.4143
## 3        85.30680        5.004455        54.49878        599.6980
## 4        43.94774        4.379716        35.61869        310.8875
## 5        79.40248        4.799453        30.71623        384.7110
## 6        87.31571        4.964671        46.69022        503.2667
##   SENT_cooc.L.PET ASM_cooc.L.PET Contrast_cooc.L.PET Dissimilarity_cooc.L.PET
## 1        6.530649       0.003302           234.76478                11.857838
## 2        6.489125       0.003596           325.10017                13.993568
## 3        6.587702       0.003198           236.08136                12.281559
## 4        6.108770       0.003680            99.77033                 7.473982
## 5        6.049095       0.004001           184.16098                10.237690
## 6        6.460137       0.003268           223.23109                11.660805
##   Inv_diff_cooc.L.PET Inv_diff_norm_cooc.L.PET IDM_cooc.L.PET
## 1            0.165784                 0.858670       0.088949
## 2            0.156018                 0.839093       0.085385
## 3            0.154252                 0.852986       0.079027
## 4            0.228938                 0.904866       0.141631
## 5            0.188717                 0.875632       0.108336
## 6            0.166582                 0.860102       0.090157
##   IDM_norm_cooc.L.PET Inv_var_cooc.L.PET Correlation_cooc.L.PET
## 1            0.953919           0.091308               0.431777
## 2            0.937653           0.087501               0.285278
## 3            0.952616           0.084629               0.437596
## 4            0.980381           0.149832               0.516631
## 5            0.963872           0.114365               0.355073
## 6            0.955880           0.093295               0.387992
##   Autocorrelation_cooc.L.PET Tendency_cooc.L.PET Shade_cooc.L.PET
## 1                   611.5456            587.8808        6860.4448
## 2                   543.8667            581.4143        4691.7137
## 3                   833.3669            599.6980         403.0883
## 4                   369.9095            310.8875        3805.6356
## 5                   285.9728            384.7110        9785.4495
## 6                   614.9464            503.2667        4106.7640
##   Prominence_cooc.L.PET IC1_.L.PET IC2_.L.PET Coarseness_vdif_.L.PET
## 1              869822.0  -0.083966   0.789572               0.014320
## 2              803734.5  -0.096731   0.814047               0.014196
```

```
## 3              800129.8  -0.072366   0.758160               0.016269
## 4              345452.5  -0.050269   0.655209               0.004936
## 5              743501.3  -0.070677   0.727840               0.017239
## 6              708597.7  -0.073872   0.759220               0.016045
##   Contrast_vdif_.L.PET Busyness_vdif_.L.PET Complexity_vdif_.L.PET
## 1             1.021460            0.087378               17053.35
## 2             1.510199            0.080209               21289.19
## 3             1.014169            0.057518               15199.89
## 4             0.306364            0.392674               10762.05
## 5             0.854170            0.081956               16796.63
## 6             0.895212            0.069338               15170.83
##   Strength_vdif_.L.PET SRE_align.L.PET LRE_align.L.PET GLNU_align.L.PET
## 1             27.40494        0.986583        1.070671        10.162131
## 2             35.76496        0.989835        1.057129         8.416510
## 3             24.45341        0.989308        1.057095         9.117958
## 4              5.55092        0.973462        1.129413        94.565775
## 5             57.03783        0.986186        1.069172        10.574675
## 6             26.08534        0.985853        1.070890        10.057347
##   RLNU_align.L.PET RP_align.L.PET LGRE_align.L.PET HGRE_align.L.PET
## 1         383.8912       0.981089         0.063695         590.1484
## 2         263.3486       0.985313         0.065825         560.1103
## 3         394.6779       0.984963         0.039224         781.3663
## 4        2941.3190       0.963661         0.048051         386.6793
## 5         262.4745       0.981101         0.091713         295.6003
## 6         397.9059       0.980630         0.048144         627.3399
##   LGSRE_align.L.PET HGSRE_align.L.PET LGHRE_align.L.PET HGLRE_align.L.PET
## 1          0.062491          580.5855          0.068738          631.5734
## 2          0.064212          554.5346          0.072438          583.5148
## 3          0.038778          768.0350          0.041011          836.1597
## 4          0.046564          376.9558          0.054360          428.3121
## 5          0.090222          292.3243          0.097821          308.7154
## 6          0.047408          618.2607          0.051089          665.2563
##   GLNU_norm_align.L.PET RLNU_norm_align.L.PET GLVAR_align.L.PET
## 1              0.027914              0.961445          201.5094
## 2              0.033437              0.969710          214.6379
## 3              0.024834              0.968128          216.6109
## 4              0.032318              0.928789          107.6866
## 5              0.041113              0.960224          121.3562
## 6              0.026718              0.959459          187.2442
##   RLVAR_align.L.PET Entropy_align.L.PET SZSE.L.PET LZSE.L.PET LGLZE.L.PET
## 1          0.025908            5.586143   0.926936   1.384001    0.062262
## 2          0.021453            5.385714   0.961338   1.244838    0.064793
## 3          0.020843            5.702830   0.974475   1.114749    0.040452
## 4          0.046375            5.480351   0.905696   1.617562    0.047964
## 5          0.024509            5.053054   0.966013   1.148597    0.093268
## 6          0.025153            5.622598   0.936782   1.322943    0.046110
##   HGLZE.L.PET SZLGE.L.PET SZHGE.L.PET LZLGE.L.PET LZHGE.L.PET GLNU_area.L.PET
## 1    592.5775    0.056127    553.5787    0.089951    831.7709        9.166018
## 2    566.7718    0.060570    546.1829    0.086532    650.3679        7.817915
## 3    769.6933    0.040391    735.9377    0.040694    904.7157        8.877842
## 4    393.5484    0.043346    360.6300    0.076789    591.1260       83.352565
## 5    300.9426    0.091138    295.8022    0.101787    321.5044       10.245976
## 6    617.0878    0.041385    567.5274    0.065899    836.6098        9.390127
##   ZSNU.L.PET ZSP.L.PET GLNU_norm.L.PET ZSNU_norm.L.PET GLVAR_area.L.PET
```

```
## 1   301.1987  0.899841        0.027499        0.823228         201.7881
## 2   233.4102  0.941158        0.032589        0.900252         213.9100
## 3   372.1247  0.966472        0.024663        0.930516         216.4466
## 4  2206.3053  0.860538        0.031941        0.781042         109.9100
## 5   242.2684  0.956101        0.040895        0.909893         123.6639
## 6   325.9069  0.913118        0.026787        0.844660         184.6198
##   ZSVAR.L.PET Entropy_area.L.PET Max_cooc.H.PET Average_cooc.H.PET
## 1    0.142022           5.886187       0.031232           39.87474
## 2    0.109793           5.546278       0.043568           39.22729
## 3    0.038537           5.775912       0.169447           44.90994
## 4    0.259194           5.901957       0.040212           38.15816
## 5    0.048849           5.156114       0.423535           49.45276
## 6    0.116919           5.851581       0.217884           46.26425
##   Variance_cooc.H.PET Entropy_cooc.H.PET DAVE_cooc.H.PET DVAR_cooc.H.PET
## 1           255.25108           6.344137       13.397288        131.6433
## 2           259.22064           7.168339       14.938851        146.5065
## 3           226.94291           3.662030       11.817845        143.8888
## 4           276.46636           6.205163       12.489582        129.5153
## 5            65.47745           2.835302        6.261891         56.9727
## 6           174.57711           3.122212       10.059360        134.1508
##   DENT_cooc.H.PET SAVE_cooc.H.PET SVAR_cooc.H.PET SENT_cooc.H.PET
## 1        4.528843        79.74696        769.9364        5.285948
## 2        2.880112        75.45206        667.2773        5.693972
## 3        4.354173        89.81735        824.2760        3.057425
## 4        4.257568        76.31379        820.4186        5.186241
## 5        3.891832        98.90299        765.7524        2.360339
## 6        1.916625        92.52596        463.0127        2.599031
##   ASM_cooc.H.PET Contrast_cooc.H.PET Dissimilarity_cooc.H.PET
## 1       0.017558            311.0628                13.397288
## 2       0.012079            369.6002                14.938851
## 3       0.096088            283.4905                11.817845
## 4       0.020168            285.4418                12.489582
## 5       0.233933             96.1523                 6.261891
## 6       0.146959            235.2907                10.059360
##   Inv_diff_cooc.H.PET Inv_diff_norm_cooc.H.PET IDM_cooc.H.PET
## 1            0.240428                0.846191       0.181276
## 2            0.198536                0.831014       0.137656
## 3            0.439712                0.866805       0.405377
## 4            0.279879                0.856139       0.224079
## 5            0.576561                0.923498       0.543300
## 6            0.516123                0.886644       0.485744
##   IDM_norm_cooc.H.PET Inv_var_cooc_.H.PET Correlation_cooc.H.PET
## 1            0.940222            0.030684               0.393202
## 2            0.929828            0.032006               0.289621
## 3            0.944553            0.011773               0.377943
## 4            0.945253            0.032706               0.486297
## 5            0.980482            0.021087               0.268281
## 6            0.953100            0.009811               0.328640
##   Autocorrelation_cooc.H.PET Tendency_cooc.H.PET Shade_cooc.H.PET
## 1                   1689.514            709.9364        -2209.927
## 2                   1613.004            667.2773        -4195.799
## 3                   2101.874            624.2760        -4303.802
## 4                   1589.599            820.4186        -5395.462
## 5                   2462.728            165.7524         1099.232
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## 6                  2197.079           463.0127       -2285.992
##   Prominence_cooc.H.PET IC1_d.H.PET IC2_d.H.PET Coarseness_vdif.H.PET
## 1            1028531.31   -0.043805    0.512217              0.004319
## 2             957339.84   -0.023569    0.418010              0.005180
## 3             729696.02   -0.063791    0.473698              0.003375
## 4            1434052.83   -0.069422    0.611279              0.002825
## 5              55971.88   -0.044636    0.360145              0.003902
## 6             381561.77   -0.056410    0.417972              0.003199
##   Contrast_vdif.H.PET Busyness_vdif.H.PET Complexity_vdif.H.PET
## 1            49.10863            0.141647              25517.13
## 2            28.26579            0.103194              28339.01
## 3           220.66779            0.236919              24028.42
## 4            40.72831            0.833266              23437.94
## 5            32.04753            0.124684              15279.35
## 6           271.03091            0.279836              22773.21
##   Strength_vdif.H.PET SRE_align.H.PET LRE_align.H.PET RLNU_align.H.PET
## 1            19.64713        0.917833        1.449477        291.82356
## 2            25.47241        0.953059        1.241419        227.49063
## 3            22.15293        0.774121        2.674531        165.69391
## 4             2.79079        0.880393        1.732322       2033.70698
## 5            53.29819        0.741090        2.918639         99.23077
## 6            21.85351        0.720078        3.392842        140.39293
##   RP_align.H.PET LGRE_align.H.PET HGRE_align.H.PET LGSRE_align.H.PET
## 1       0.888556         0.004341         1569.763          0.004198
## 2       0.935326         0.004349         1536.186          0.004223
## 3       0.710370         0.003527         1821.062          0.003336
## 4       0.839415         0.005339         1588.246          0.005019
## 5       0.684948         0.002975         2476.679          0.002849
## 6       0.656286         0.003229         2111.778          0.003040
##   HGSRE_align.H.PET LGHRE_align.H.PET HGLRE_align.H.PET GLNU_norm_align.H.PET
## 1          1433.081          0.005120          2278.993              0.130158
## 2          1472.727          0.004991          1836.812              0.108781
## 3          1318.500          0.004849          5694.966              0.309012
## 4          1388.818          0.007300          2734.362              0.120339
## 5          1889.628          0.003929          6544.325              0.470904
## 6          1501.696          0.004877          7061.132              0.374988
##   RLNU_norm_align.H.PET GLVAR_align.H.PET RLVAR_align.H.PET Entropy_align.H.PET
## 1              0.805658         271.94120          0.166759            3.665844
## 2              0.881876         263.05257          0.089416            3.807145
## 3              0.559747         231.23849          0.633026            2.962910
## 4              0.733600         302.00409          0.279758            3.963763
## 5              0.516961          63.36076          0.708711            2.615080
## 6              0.492823         187.63061          0.894173            2.953297
##   SZSE.H.PET LZSE.H.PET LGLZE.H.PET HGLZE.H.PET SZLGE.H.PET SZHGE.H.PET
## 1   0.729896   6.346008    0.004206    1945.242    0.003751   1205.4141
## 2   0.889774   1.945761    0.004294    1541.326    0.004071   1371.5287
## 3   0.543152  38.343615    0.003595    1869.824    0.003145    833.9286
## 4   0.686000  28.192087    0.005281    2614.722    0.004412   1088.6316
## 5   0.494282  85.120177    0.002930    2778.032    0.002719   1427.6154
## 6   0.494144 151.989372    0.003258    2079.108    0.002893    988.7421
##   LZLGE.H.PET LZHGE.H.PET GLNU_area.H.PET ZSNU.H.PET ZSP.H.PET GLNU_norm.H.PET
## 1    0.014967    9278.763        28.21123  112.61992  0.564877        0.125177
## 2    0.007054    2730.177        23.91083  171.00253  0.829245        0.106933
## 3    0.027806   99597.669        42.33586   36.25834  0.312626        0.330695
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## 4    0.066848   39940.885       160.59767  604.01684  0.425782        0.117405
## 5    0.047180  166256.576        23.73782   17.00253  0.245387        0.351578
## 6    0.115459  288928.476        28.02885   17.76569  0.181354        0.371297
##   ZSNU_norm.H.PET GLVAR_area.H.PET ZSVAR_H.PET Entropy_area.H.PET
## 1        0.492171        263.01858    3.183797           4.580974
## 2        0.749255        257.55868    0.482612           4.158935
## 3        0.283583        218.15517   27.944240           4.080320
## 4        0.434586        309.53854   22.609920           5.086907
## 5        0.252530         70.97225   68.165160           3.954518
## 6        0.236256        205.12926  120.717731           4.002762
##   Max_cooc.W.PET Average_cooc.W.PET Variance_cooc.W.PET Entropy_cooc.W.PET
## 1       0.013277           8.741717           27.724284           8.310617
## 2       0.015738          10.946398           54.254568           8.954940
## 3       0.046074           4.019422            3.648015           5.580950
## 4       0.013915           9.152454           25.597213           8.286935
## 5       0.116685           2.577872            2.729045           4.706665
## 6       0.063098           3.127779            2.391005           5.013592
##   DAVE_cooc.W.PET DVAR_cooc.W.PET DENT_cooc.W.PET SAVE_cooc.W.PET
## 1        4.361115       12.870015        3.611785       17.480905
## 2        6.845926       31.128005        4.224171       21.890266
## 3        1.595373        1.629296        2.279633        8.036314
## 4        3.728549       11.060383        3.431589       18.302378
## 5        1.376959        1.728999        2.205393        5.153215
## 6        1.306368        1.277859        2.076037        6.253029
##   SVAR_cooc.W.PET SENT_cooc.W.PET ASM_cooc.W.PET Contrast_cooc.W.PET
## 1       79.024802        5.099087       0.006555           31.867274
## 2      139.053134        5.483416       0.005298           77.960077
## 3       10.420558        3.676978       0.027061            4.166444
## 4       77.440194        5.106053       0.007012           24.943599
## 5        7.293066        3.190894       0.061557            3.618055
## 6        6.581107        3.336839       0.041094            2.977854
##   Dissimilarity_cooc.W.PET Inv_diff_cooc.W.PET Inv_diff_norm_cooc.W.PET
## 1                 4.361115            0.306285                 0.861048
## 2                 6.845926            0.244001                 0.837985
## 3                 1.595373            0.503481                 0.863798
## 4                 3.728549            0.343449                 0.905179
## 5                 1.376959            0.558453                 0.882471
## 6                 1.306368            0.553594                 0.874095
##   IDM_cooc.W.PET IDM_norm_cooc.W.PET Inv_var_cooc.W.PET Correlation_cooc.W.PET
## 1       0.213874            0.955388           0.224294               0.427805
## 2       0.158456            0.936467           0.164222               0.284054
## 3       0.439777            0.957440           0.421156               0.431424
## 4       0.254836            0.980367           0.261941               0.515299
## 5       0.509374            0.964322           0.439330               0.339500
## 6       0.504966            0.961979           0.468899               0.379680
##   Autocorrelation_cooc.W.PET Tendency_cooc.W.PET Shade_cooc.W.PET
## 1                  88.165309           79.024802       341.143402
## 2                 135.044039          139.053134       552.913441
## 3                  17.701479           10.420558         2.361775
## 4                  96.847788           77.440194       471.374078
## 5                   7.553672            7.293066        26.823935
## 6                  10.670526            6.581107         7.170907
##   Prominence_cooc.W.PET IC1_d.W.PET IC2_d.W.PET Coarseness_vdif.W.PET
## 1            15813.1737   -0.042283    0.565302              0.015034
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## 2            45767.4163   -0.044029    0.591913              0.015811
## 3              242.8423   -0.052987    0.524822              0.017811
## 4            21312.7505   -0.056187    0.630354              0.004934
## 5              276.1447   -0.033151    0.398878              0.018221
## 6              124.4042   -0.044775    0.466821              0.017235
##   Contrast_vdif.W.PET Busyness_vdif.W.PET Complexity_vdif.W.PET
## 1            0.294464            0.717283             869.48613
## 2            0.599158            0.420854            2313.88985
## 3            0.112568            2.860859              40.08855
## 4            0.133588            1.549091            1346.28621
## 5            0.078944            3.650188              44.97271
## 6            0.079545            4.181398              27.61148
##   Strength_vdif.W.PET SRE_align.W.PET LRE_align.W.PET GLNU_align.W.PET
## 1            3.919855        0.961787        1.191350         24.97624
## 2            8.341981        0.977438        1.116168         14.88136
## 3            0.511453        0.889821        1.618702         53.72505
## 4            1.384522        0.943354        1.291573        179.17215
## 5            1.109636        0.876250        1.674603         59.72108
## 6            0.444774        0.863194        1.800706         67.44333
##   RLNU_align.W.PET RP_align.W.PET LGRE_align.W.PET HGRE_align.W.PET
## 1         347.5995       0.947236         0.150278        85.345885
## 2         250.6373       0.968373         0.127690       139.175484
## 3         265.0196       0.853307         0.272808        15.983362
## 4        2609.2747       0.922696         0.092857       101.288786
## 5         170.2453       0.840992         0.466475         7.937118
## 6         245.9412       0.822440         0.339659        10.636341
##   LGSRE_align.W.PET HGSRE_align.W.PET LGHRE_align.W.PET HGLRE_align.W.PET
## 1          0.144360         82.365395          0.178628          98.96776
## 2          0.122525        136.722689          0.150485         150.71592
## 3          0.245883         13.790048          0.414898          28.12741
## 4          0.087782         95.978334          0.117784         126.22675
## 5          0.401364          7.231352          0.833918          11.22377
## 6          0.297964          9.120687          0.601806          18.69612
##   GLNU_norm_align.W.PET RLNU_norm_align.W.PET GLVAR_align.W.PET
## 1              0.067162              0.901536         27.361255
## 2              0.058138              0.938874         51.482886
## 3              0.154351              0.749487          3.691659
## 4              0.061479              0.859819         27.190856
## 5              0.256845              0.724823          2.405984
## 6              0.196000              0.702794          2.523334
##   RLVAR_align.W.PET Entropy_align.W.PET SZSE.W.PET LZSE.W.PET LGLZE.W.PET
## 1          0.069370            4.413771   0.862196   2.111226    0.136626
## 2          0.043126            4.601911   0.939019   1.436265    0.126898
## 3          0.229632            3.470022   0.737823   5.821460    0.309701
## 4          0.107059            4.683410   0.816094   3.396694    0.091699
## 5          0.239812            2.974484   0.688181   6.186741    0.438075
## 6          0.289495            3.306066   0.662526  12.143891    0.342286
##   HGLZE.W.PET SZLGE.W.PET SZHGE.W.PET LZLGE.W.PET LZHGE.W.PET GLNU_area.W.PET
## 1   88.918679    0.112325   79.094274    0.392257   161.03980        20.13918
## 2  138.464377    0.116457  128.987889    0.195656   189.79771        13.47643
## 3   14.973723    0.247502   10.310508    1.043890   117.40582        38.33586
## 4  106.496868    0.073436   88.831921    0.286957   297.89713       131.17762
## 5    9.015688    0.284427    6.692377    3.360406    31.91043        35.02885
## 6   10.745985    0.252353    6.482655    5.046844   107.42661        36.93970
```

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##   ZSNU.W.PET ZSP.W.PET GLNU_norm.W.PET ZSNU_norm.W.PET GLVAR_area.W.PET
## 1  224.38141  0.789816        0.065066        0.699359        27.622423
## 2  211.55675  0.901447        0.056642        0.852145        50.978030
## 3  121.85027  0.586665        0.160280        0.503961         3.807675
## 4 1419.26821  0.697656        0.059662        0.620677        29.116647
## 5   66.31832  0.545387        0.232966        0.438818         2.699725
## 6   77.07583  0.451942        0.195918        0.406055         2.633927
##   ZSVAR.W.PET Entropy_area.W.PET Min_hist.ADC Max_hist.ADC Mean_hist.ADC
## 1    0.497852           4.937916    549.00253     2268.003      1238.232
## 2    0.198720           4.834988      0.00253     2211.003      1158.946
## 3    2.890741           4.143192    634.00253     2860.003      1252.476
## 4    1.327156           5.449999      0.00253     2869.003      1195.303
## 5    2.793389           3.991207      0.00253     2389.003      1022.390
## 6    7.192684           4.330361      0.00253     2498.003      1344.979
##   Variance_hist.ADC Standard_Deviation_hist.ADC Skewness_hist.ADC
## 1         113473.17                     336.8603           1.05752
## 2          83953.26                     289.7494          -0.49105
## 3         193194.07                     439.5410           1.53649
## 4         132561.08                     364.0919           0.24067
## 5         110268.35                     332.0693           0.31916
## 6         276984.10                     526.2953          -0.19996
##   Kurtosis_hist.ADC Energy_hist.ADC Entropy_hist.ADC AUC_hist.ADC Volume.ADC
## 1           0.39978         0.00757          7.72697      0.52307   14702.81
## 2           1.41215         0.00503          8.82392      0.49147   11850.17
## 3           2.15473         0.00426          9.42564      0.56722   26067.89
## 4           0.23359         0.00365         10.02927      0.52148   51577.90
## 5           0.50069         0.00454          9.12787      0.50458   27419.14
## 6          -1.03080         0.00413          9.41989      0.49047   16131.31
##   X3D_surface.ADC ratio_3ds_vol.ADC ratio_3ds_vol_norm.ADC irregularity.ADC
## 1        2621.908           0.39370                1.52762          1.93975
## 2        3814.097           0.27791                1.37006          1.76130
## 3        5638.645           0.21884                1.32876          1.57930
## 4       11033.100           0.21644                1.64907          1.63673
## 5        5670.769           0.22562                1.35892          1.61457
## 6        6099.528           0.30552                1.70690          1.72859
##   Compactness_v1.ADC Compactness_v2.ADC Spherical_disproportion.ADC
## 1            0.03070            0.28444                     1.52762
## 2            0.03570            0.39354                     1.37006
## 3            0.03727            0.43122                     1.32876
## 4            0.02764            0.22655                     1.64907
## 5            0.03611            0.40326                     1.35892
## 6            0.02637            0.20451                     1.70690
##   Sphericity.ADC Asphericity.ADC Center_of_mass.ADC Max_3D_diam.ADC
## 1        0.65823         0.52762            0.97407        46.80855
## 2        0.73378         0.37006            1.00173        57.64178
## 3        0.75655         0.32876            1.48789        64.07496
## 4        0.60987         0.64907            1.32794        85.02235
## 5        0.73978         0.35892            0.57983        59.88998
## 6        0.58926         0.70690            1.60559        66.42410
##   Major_axis_length.ADC Minor_axis_length.ADC Least_axis_length.ADC
## 1              45.53640              20.24517              13.58989
## 2              35.07877              28.70241              23.63536
## 3              42.14714              36.72698              25.93458
## 4              58.00549              42.98623              35.06326
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## 5              39.28351              35.40209              31.13508
## 6              52.01087              34.53146              21.82211
##   Elongation.ADC Flatness.ADC Max_cooc.L.ADC Average_cooc.L.ADC
## 1        0.44709      0.30093        0.01362           24.26969
## 2        0.82074      0.67629        0.00769           34.15443
## 3        0.87392      0.61784        0.00984           17.40595
## 4        0.74359      0.60699        0.00893           26.20041
## 5        0.90372      0.79509        0.00863           27.03123
## 6        0.66644      0.42207        0.00548           33.31549
##   Variance_cooc.L.ADC Entropy_cooc.L.ADC DAVE_cooc.L.ADC DVAR_cooc.L.ADC
## 1           135.95808            9.35172         9.33833        95.10941
## 2            60.59539            9.52569         6.58341        31.97649
## 3           159.14565            9.93157         8.05607        81.58702
## 4            57.02199            9.50974         5.46198        23.67951
## 5            65.76514            9.76494         6.96837        33.58727
## 6           176.68232           10.64861         9.13371        70.36682
##   DENT_cooc.L.ADC SAVE_cooc.L.ADC SVAR_cooc.L.ADC SENT_cooc.L.ADC
## 1         4.68745        48.53685        361.5607         4.49616
## 2         4.18551        68.30632        167.0920         2.32433
## 3         4.48343        34.80936        490.1310         5.16708
## 4         3.95039        52.39829        174.5978         4.55938
## 5         4.26293        54.05993        180.9453         4.48500
## 6         4.65758        66.62846        552.9789         3.08233
##   ASM_cooc.L.ADC Contrast_cooc.L.ADC Dissimilarity_cooc.L.ADC
## 1        0.00535           182.26652                 9.33833
## 2        0.00448            75.28447                 6.58341
## 3        0.00458           146.44656                 8.05607
## 4        0.00454            53.48506                 5.46198
## 5        0.00414            82.11021                 6.96837
## 6        0.00338           153.74529                 9.13371
##   Inv_diff_cooc.L.ADC Inv_diff_norm_cooc.L.ADC IDM_cooc.L.ADC
## 1             0.23569                 0.88844        0.15619
## 2             0.24103                 0.91456        0.15044
## 3             0.24921                 0.90225        0.16496
## 4             0.27847                 0.92805        0.18834
## 5             0.23450                 0.90993        0.14567
## 6             0.20980                 0.88787        0.12604
##   IDM_norm_cooc.L.ADC Inv_var_cooc.L.ADC Correlation_cooc.L.ADC
## 1             0.96528            0.15633                0.33222
## 2             0.98542            0.15887                0.38132
## 3             0.97276            0.17144                0.54243
## 4             0.99019            0.19368                0.53355
## 5             0.98376            0.15283                0.37826
## 6             0.96963            0.13018                0.56744
##   Autocorrelation_.L.ADC Tendency_cooc.L.ADC Shade_.L.ADC Prominence_cooc.L.ADC
## 1               633.7211            361.5607    7639.8939             517154.08
## 2              1189.3065            167.0920   -1156.8109             112937.29
## 3               388.8025            490.1310   17093.4493            1296059.93
## 4               716.6097            174.5978     616.3283              88605.95
## 5               755.2618            180.9453     592.0947             113320.37
## 6              1209.5645            552.9789   -1837.1897             590287.94
##   IC1_.L.ADC IC2_.L.ADC Coarseness_vdif_.L.ADC Contrast_vdif_.L.ADC
## 1   -0.11842    0.83912               0.02135              0.71307
## 2   -0.05061    0.63924               0.01258              0.23808
```

```
## 3   -0.07274    0.73740               0.00784              0.40394
## 4   -0.06200    0.68774               0.00556              0.15512
## 5   -0.04812    0.63329               0.01085              0.27967
## 6   -0.09225    0.81078               0.01042              0.60161
##   Busyness_vdif_.L.ADC Complexity_vdif_.L.ADC Strength_vdif_.L.ADC
## 1              0.04811               8748.919             30.44366
## 2              0.05243               5213.433             10.85376
## 3              0.21602               9811.189             12.83805
## 4              0.20181               4912.319              3.52728
## 5              0.08515               5705.778              8.31391
## 6              0.06946               8974.106             10.09240
##   SRE_align.L.ADC LRE_align.L.ADC GLNU_align.L.ADC RLNU_align.L.ADC
## 1         0.97677         1.11587          9.40856         232.7602
## 2         0.97564         1.11803         26.43616         645.9593
## 3         0.96919         1.14834         43.70925        1177.5699
## 4         0.96126         1.18592        102.31243        2562.1046
## 5         0.97703         1.11715         28.40221         788.2562
## 6         0.98211         1.08986         21.25471         890.8892
##   RP_align.L.ADC LGRE_align.L.ADC HGRE_align.L.ADC LGSRE_align.L.ADC
## 1        0.96871          0.00908         831.5410           0.00900
## 2        0.96669          0.00605        1191.1595           0.00602
## 3        0.95823          0.01361         487.9258           0.01321
## 4        0.94795          0.00810         786.0107           0.00784
## 5        0.96795          0.00721         833.8975           0.00716
## 6        0.97551          0.00591        1362.5846           0.00587
##   HGSRE_align.L.ADC LGHRE_align.L.ADC HGLRE_align.L.ADC GLNU_norm_align.L.ADC
## 1          820.9252           0.00946          876.2823               0.04038
## 2         1157.5280           0.00615         1335.5219               0.04066
## 3          478.4817           0.01531          528.1310               0.03656
## 4          757.7992           0.00954          909.4492               0.03841
## 5          815.1979           0.00741          917.7657               0.03626
## 6         1335.9421           0.00607         1478.8704               0.02516
##   RLNU_norm_align.L.ADC GLVAR_align.L.ADC RLVAR_align.L.ADC Entropy_align.L.ADC
## 1               0.93826         154.93296           0.04141              5.29371
## 2               0.93411          69.45486           0.04188              5.17751
## 3               0.91877         156.30297           0.05240              5.47452
## 4               0.90022          64.98946           0.06534              5.31012
## 5               0.93819          78.05347           0.04295              5.30441
## 6               0.95061         175.82591           0.03219              5.74239
##   SZSE.L.ADC LZSE.L.ADC LGLZE.L.ADC HGLZE.L.ADC SZLGE.L.ADC SZHGE.L.ADC
## 1    0.93703    1.33159     0.00927    858.5837     0.00905    831.8537
## 2    0.92448    1.39444     0.00624   1184.8610     0.00617   1086.4222
## 3    0.87706    1.82170     0.01338    514.4899     0.01189    468.7768
## 4    0.90217    1.59820     0.00767    792.5723     0.00686    720.2240
## 5    0.91279    1.55603     0.00757    833.3315     0.00743    760.6074
## 6    0.93634    1.29245     0.00606   1348.0807     0.00598   1247.0381
##   LZLGE.L.ADC LZHGE.L.ADC GLNU_area.L.ADC ZSNU.L.ADC ZSP.L.ADC GLNU_norm.L.ADC
## 1     0.01042    981.8102         8.25894   197.1051   0.91304         0.03781
## 2     0.00662   1681.2171        24.10984   524.4053   0.89683         0.04002
## 3     0.02376    734.9103        34.98083   798.7819   0.82545         0.03416
## 4     0.01300   1204.1618        90.93063  1994.0215   0.86029         0.03768
## 5     0.00840   1283.7978        24.73040   600.5032   0.87065         0.03520
## 6     0.00644   1779.7534        19.65712   741.6164   0.91756         0.02479
##   ZSNU_norm.L.ADC GLVAR_area.L.ADC ZSVAR.L.ADC Entropy_area.L.ADC
```

```
## 1         0.84485        158.37071     0.12535            5.53926
## 2         0.81809         71.19097     0.14408            5.46224
## 3         0.72475        157.77185     0.34501            6.00431
## 4         0.77331         66.76247     0.23904            5.67242
## 5         0.79579         82.41219     0.22912            5.69671
## 6         0.84241        176.08461     0.09810            6.01150
##   Max_cooc.H.ADC Average_cooc.H.ADC Variance_cooc.H.ADC Entropy_cooc.H.ADC
## 1        0.00464           29.95976            310.9790           11.72265
## 2        0.00420           33.61846            312.8265           11.35537
## 3        0.00622           30.58315            335.7248           11.53210
## 4        0.00461           30.75681            310.6464           11.60919
## 5        0.00393           31.26939            305.7453           11.56749
## 6        0.00496           30.52540            330.9954           11.34674
##   DAVE_cooc.H.ADC DVAR_cooc.H.ADC DENT_cooc.H.ADC SAVE_cooc.H.ADC
## 1        15.71847        162.7022         5.37436        59.91700
## 2        15.39980        148.1637         5.34697        67.23440
## 3        13.82367        148.1751         5.24052        61.16377
## 4        12.67796        118.4962         5.12061        61.51110
## 5        15.22805        152.9835         5.34969        62.53624
## 6        12.68957        134.2114         5.12373        61.04826
##   SVAR_cooc.H.ADC SENT_cooc.H.ADC ASM_cooc.H.ADC Contrast_cooc.H.ADC
## 1        834.2180         3.87272        0.00312            409.6931
## 2        866.0614         3.21841        0.00292            385.2396
## 3       1003.6953         3.81762        0.00296            339.1990
## 4        963.4178         3.73436        0.00290            279.1628
## 5        838.1762         3.61892        0.00291            384.8001
## 6       1028.8043         3.58842        0.00300            295.1723
##   Dissimilarity_cooc.H.ADC Inv_diff_cooc.H.ADC Inv_diff_norm_cooc.H.ADC
## 1                 15.71847             0.14449                  0.82408
## 2                 15.39980             0.13871                  0.82594
## 3                 13.82367             0.16711                  0.84276
## 4                 12.67796             0.16941                  0.85215
## 5                 15.22805             0.14798                  0.82834
## 6                 12.68957             0.17461                  0.85365
##   IDM_cooc.H.ADC IDM_norm_cooc.H.ADC Inv_var_cooc.H.ADC Correlation_cooc.H.ADC
## 1        0.07807             0.92422            0.08536                0.34381
## 2        0.06993             0.92757            0.07472                0.38679
## 3        0.09608             0.93697            0.09823                0.49736
## 4        0.09588             0.94673            0.09742                0.55321
## 5        0.07991             0.92793            0.08208                0.37325
## 6        0.09995             0.94500            0.10213                0.55665
##   Autocorrelation_cooc.H.ADC Tendency_cooc.H.ADC Shade_cooc.H.ADC
## 1                   1003.570            834.2180       4888.58538
## 2                   1250.239            866.0614      -4080.74039
## 3                   1101.301           1003.6953       7361.25628
## 4                   1116.892            963.4178       2723.56893
## 5                   1090.963            838.1762        -98.86912
## 6                   1115.056           1028.8043        509.16337
##   Prominence_cooc.H.ADC IC1_d.H.ADC IC2_d.H.ADC Coarseness_vdif.H.ADC
## 1               1518300    -0.15943     0.92667               0.02421
## 2               1589114    -0.05988     0.72703               0.01048
## 3               2077405    -0.06514     0.74687               0.00767
## 4               1824192    -0.05338     0.70043               0.00496
## 5               1538643    -0.05818     0.72034               0.00898
```

```
## 6               1971550    -0.09605     0.83415              0.00994
##   Contrast_vdif.H.ADC Busyness_vdif.H.ADC Complexity_vdif.H.ADC
## 1             1.85757             0.03586              16806.66
## 2             1.80534             0.09301              16186.56
## 3             1.49359             0.14284              13464.93
## 4             1.41213             0.29907              12641.54
## 5             1.83534             0.11398              16384.39
## 6             1.45238             0.09984              12914.39
##   Strength_vdif.H.ADC SRE_align.H.ADC LRE_align.H.ADC GLNU_align.H.ADC
## 1            29.66079         0.99220         1.04664          4.07230
## 2            10.90410         0.99123         1.04949         11.31108
## 3             7.03589         0.98442         1.08787         20.88959
## 4             3.31909         0.98263         1.08821         46.68109
## 5             8.83863         0.98826         1.06328         13.66324
## 6            10.10115         0.98601         1.07180         15.03108
##   RLNU_align.H.ADC RP_align.H.ADC LGRE_align.H.ADC HGRE_align.H.ADC
## 1         246.9236        0.98876          0.02752         1363.457
## 2         687.6470        0.98755          0.02717         1357.005
## 3        1249.7235        0.97718          0.02776         1343.165
## 4        2786.7832        0.97588          0.02638         1359.587
## 5         824.1350        0.98339          0.02668         1358.525
## 6         904.6320        0.98077          0.02665         1361.936
##   LGSRE_align.H.ADC HGSRE_align.H.ADC LGHRE_align.H.ADC HGLRE_align.H.ADC
## 1           0.02695          1349.190           0.02979          1430.871
## 2           0.02648          1340.025           0.02994          1430.336
## 3           0.02707          1310.372           0.03080          1516.790
## 4           0.02500          1334.267           0.03403          1466.691
## 5           0.02577          1338.937           0.03083          1444.863
## 6           0.02539          1342.295           0.03304          1444.991
##   GLNU_norm_align.H.ADC RLNU_norm_align.H.ADC GLVAR_align.H.ADC
## 1               0.01859               0.97614          329.5023
## 2               0.01850               0.97320          329.3505
## 3               0.01848               0.95625          325.6524
## 4               0.01843               0.95150          327.9251
## 5               0.01850               0.96576          329.3047
## 6               0.01845               0.96023          327.5799
##   RLVAR_align.H.ADC Entropy_align.H.ADC SZSE.H.ADC LZSE.H.ADC LGLZE.H.ADC
## 1           0.01753             6.01510    0.96829    1.15763     0.02871
## 2           0.01839             6.04615    0.96505    1.15896     0.02661
## 3           0.03446             6.10308    0.93628    1.65499     0.02502
## 4           0.03209             6.13418    0.95168    1.26414     0.02388
## 5           0.02330             6.06848    0.95866    1.24670     0.02517
## 6           0.02577             6.08534    0.94459    1.30242     0.02141
##   HGLZE.H.ADC SZLGE.H.ADC SZHGE.H.ADC LZLGE.H.ADC LZHGE.H.ADC GLNU_area.H.ADC
## 1    1353.052     0.02838    1303.023     0.03004    1618.472         3.99028
## 2    1355.552     0.02483    1302.738     0.03376    1584.380        10.95282
## 3    1293.549     0.02152    1196.086     0.04888    2953.476        19.42358
## 4    1353.634     0.02049    1283.290     0.04521    1725.853        44.63370
## 5    1328.345     0.02373    1252.666     0.04477    1783.557        13.08842
## 6    1363.271     0.01864    1280.446     0.06832    1716.544        14.22012
##   ZSNU.H.ADC ZSP.H.ADC GLNU_norm.H.ADC ZSNU_norm.H.ADC GLVAR_area.H.ADC
## 1   223.9086   0.95584         0.01881         0.91643         324.0822
## 2   619.2862   0.95385         0.01854         0.90792         327.6186
## 3  1007.9399   0.89316         0.01876         0.84458         305.6363
```

```
## 4  2450.9039   0.93025         0.01848         0.87848         321.4979
## 5   727.4123   0.93716         0.01859         0.89506         324.1160
## 6   762.1457   0.92170         0.01856         0.86177         315.8327
##   ZSVAR.H.ADC Entropy_area.H.ADC Max_cooc.W.ADC Average_cooc.W.ADC
## 1     0.05727            6.06723        0.00675           65.37977
## 2     0.05401            6.18594        0.00382          118.60405
## 3     0.39430            6.37088        0.00376           60.27417
## 4     0.10225            6.32299        0.00302          117.52784
## 5     0.10193            6.21756        0.00355          101.18139
## 6     0.11881            6.31556        0.00343          130.61014
##   Variance_cooc.W.ADC DAVE_cooc.W.ADC DVAR_cooc.W.ADC DENT_cooc.W.ADC
## 1           1010.0875        25.43812        706.5272         6.06338
## 2            746.1691        23.15154        390.8192         5.94785
## 3           1991.6618        28.49457       1018.7085         6.25261
## 4           1181.5174        24.91785        487.4797         6.07963
## 5            945.7911        26.38488        481.6157         6.14012
## 6           2779.9243        36.21365       1103.2759         6.60187
##   SAVE_cooc.W.ADC SVAR_cooc.W.ADC SENT_cooc.W.ADC ASM_cooc.W.ADC
## 1        130.7570        2686.849         5.54316        0.00323
## 2        237.2056        2057.975         2.77584        0.00280
## 3        120.5458        6136.137         6.76239        0.00275
## 4        235.0531        3617.812         6.13864        0.00265
## 5        202.3602        2605.515         5.80987        0.00273
## 6        261.2178        8705.171         3.87339        0.00266
##   Contrast_cooc.W.ADC Dissimilarity_cooc.W.ADC Inv_diff_cooc.W.ADC
## 1            1353.496                25.43812             0.12826
## 2             926.696                23.15154             0.10420
## 3            1830.505                28.49457             0.10990
## 4            1108.253                24.91785             0.10456
## 5            1177.644                26.38488             0.09861
## 6            2414.521                36.21365             0.08344
##   Inv_diff_norm_cooc.W.ADC IDM_cooc.W.ADC IDM_norm_cooc.W.ADC
## 1                  0.88720        0.06987             0.96438
## 2                  0.91342        0.04700             0.98505
## 3                  0.90097        0.05282             0.97202
## 4                  0.92684        0.04905             0.98983
## 5                  0.90880        0.04557             0.98327
## 6                  0.88642        0.03696             0.96879
##   Inv_var_cooc.W.ADC Correlation_cooc.W.ADC Autocorrelation_cooc.W.ADC
## 1            0.07218                0.33254                   4607.525
## 2            0.04790                0.38156                  14349.142
## 3            0.05640                0.54299                   4709.081
## 4            0.04962                0.53354                  14439.590
## 5            0.04452                0.37996                  10594.131
## 6            0.03757                0.56825                  18631.013
##   Tendency_cooc.W.ADC Shade_cooc.W.ADC Prominence_cooc.W.ADC IC1_d.W.ADC
## 1            2686.849        154504.57              28492973    -0.20561
## 2            2057.975        -49857.50              17100002    -0.13210
## 3            6136.137        755229.72             202604689    -0.13981
## 4            3617.812         57995.75              38091821    -0.08828
## 5            2605.515         31890.26              23457384    -0.13836
## 6            8705.171       -113889.96             146542333    -0.23037
##   IC2_d.W.ADC Coarseness_vdif.W.ADC Contrast_vdif.W.ADC Busyness_vdif.W.ADC
## 1     0.96152               0.01818             4.78265             0.01774
```

```
## 2     0.91270               0.01162             1.49489             0.00979
## 3     0.92904               0.00742             1.99390             0.02744
## 4     0.85241               0.00544             1.11708             0.01846
## 5     0.92596               0.01002             1.72379             0.01257
## 6     0.98684               0.00959             3.20701             0.00873
##   Complexity_vdif.W.ADC Strength_vdif.W.ADC SRE_align.W.ADC LRE_align.W.ADC
## 1              94483.95           120.21874         0.99193         1.04495
## 2             123984.35            70.45906         0.99469         1.03484
## 3             322896.60           118.12334         0.99389         1.03917
## 4             270786.27            41.10745         0.99307         1.04143
## 5             183481.75            68.98942         0.99446         1.03681
## 6             408132.18           116.30778         0.99699         1.02540
##   GLNU_align.W.ADC RLNU_align.W.ADC RP_align.W.ADC LGRE_align.W.ADC
## 1          4.26622         246.5777        0.98876          0.00683
## 2          8.60033         696.8829        0.99205          0.00418
## 3         13.91071        1298.3291        0.99080          0.00430
## 4         24.38419        2904.1988        0.98991          0.00579
## 5          8.43212         844.4260        0.99159          0.00400
## 6          6.05624         944.0342        0.99512          0.00374
##   HGRE_align.W.ADC LGSRE_align.W.ADC HGSRE_align.W.ADC LGHRE_align.W.ADC
## 1         5992.756           0.00683          5952.927           0.00685
## 2        14395.425           0.00418         14281.115           0.00418
## 3         5853.808           0.00429          5824.143           0.00434
## 4        15776.936           0.00562         15649.652           0.00681
## 5        11683.555           0.00400         11599.962           0.00400
## 6        21008.240           0.00373         20894.393           0.00374
##   HGLRE_align.W.ADC GLNU_norm_align.W.ADC RLNU_norm_align.W.ADC
## 1          6152.074               0.01935               0.97502
## 2         14868.922               0.01462               0.98198
## 3          5983.117               0.01300               0.97996
## 4         16293.667               0.01072               0.97773
## 5         12044.998               0.01230               0.98150
## 6         21478.153               0.00885               0.98802
##   GLVAR_align.W.ADC RLVAR_align.W.ADC Entropy_align.W.ADC SZSE.W.ADC LZSE.W.ADC
## 1         1139.4041           0.01629             6.94511    0.98460    1.07424
## 2          842.8456           0.01345             6.67452    0.96527    1.11797
## 3         1938.7178           0.01519             6.79621    0.98765    1.17872
## 4         1327.6869           0.01562             7.20649    0.98060    1.10239
## 5         1109.3728           0.01437             6.95074    0.97667    1.13245
## 6         2767.6284           0.01027             7.49193    0.98323    1.08445
##   LGLZE.W.ADC HGLZE.W.ADC SZLGE.W.ADC SZHGE.W.ADC LZLGE.W.ADC LZHGE.W.ADC
## 1     0.00686    6055.150     0.00686    6018.454     0.00690    6201.935
## 2     0.00422   14407.506     0.00422   14026.413     0.00423   16054.013
## 3     0.00433    5883.686     0.00430    5711.245     0.00453    6674.638
## 4     0.00511   15809.845     0.00455   15506.485     0.00888   17172.910
## 5     0.00403   11663.603     0.00403   11366.888     0.00405   13231.943
## 6     0.00376   20996.110     0.00375   20573.429     0.00377   22707.428
##   GLNU_area.W.ADC ZSNU.W.ADC ZSP.W.ADC GLNU_norm.W.ADC ZSNU_norm.W.ADC
## 1         4.13400   239.2894   0.97918         0.01899         0.95586
## 2         8.37627   644.7370   0.95637         0.01461         0.93288
## 3        13.11686  1165.7026   0.97268         0.02501         0.91537
## 4        23.84726  2760.4129   0.97203         0.01069         0.94658
## 5         8.14437   784.5973   0.96469         0.02526         0.93769
## 6         5.93657   893.1791   0.97662         0.00884         0.95272
```

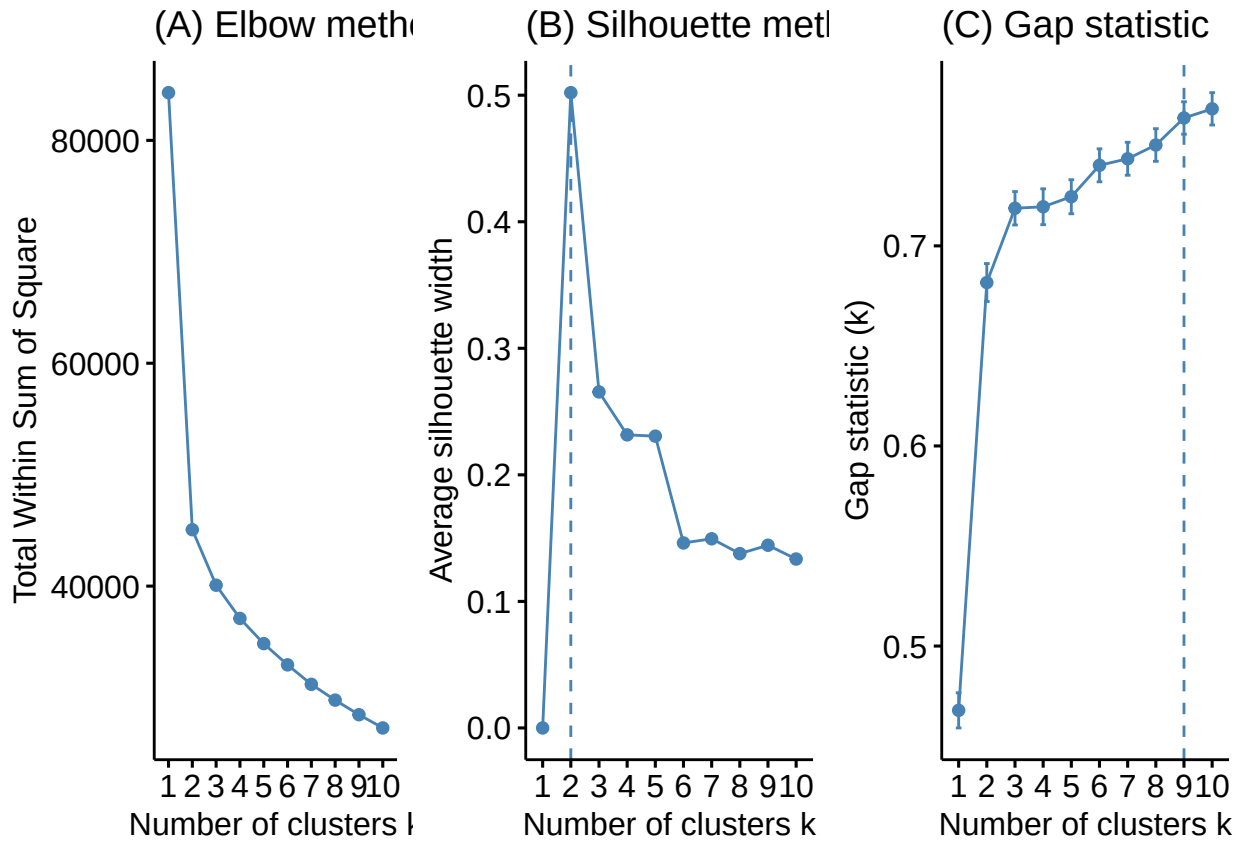
```
##   GLVAR_area.W.ADC ZSVAR.W.ADC Entropy_area.W.ADC cluster
## 1        1145.1050     0.02586            6.28632       1
## 2         847.5254     0.04153            6.77853       1
## 3        1923.8571     0.07104            7.15685       1
## 4        1329.9529     0.03848            7.29521       1
## 5        1116.3867     0.05223            7.05149       1
## 6        2743.2376     0.03055            7.54787       1
```

Plotting cluster with different methods for comparison

```
p1 <- fviz_nbclust(df, FUN = hcut, method = "wss",
                   k.max = 10) +
  ggtitle("(A) Elbow method")
p2 <- fviz_nbclust(df, FUN = hcut, method = "silhouette",
                   k.max = 10) +
  ggtitle("(B) Silhouette method")
p3 <- fviz_nbclust(df, FUN = hcut, method = "gap_stat",
                   k.max = 10) +
  ggtitle("(C) Gap statistic")
```

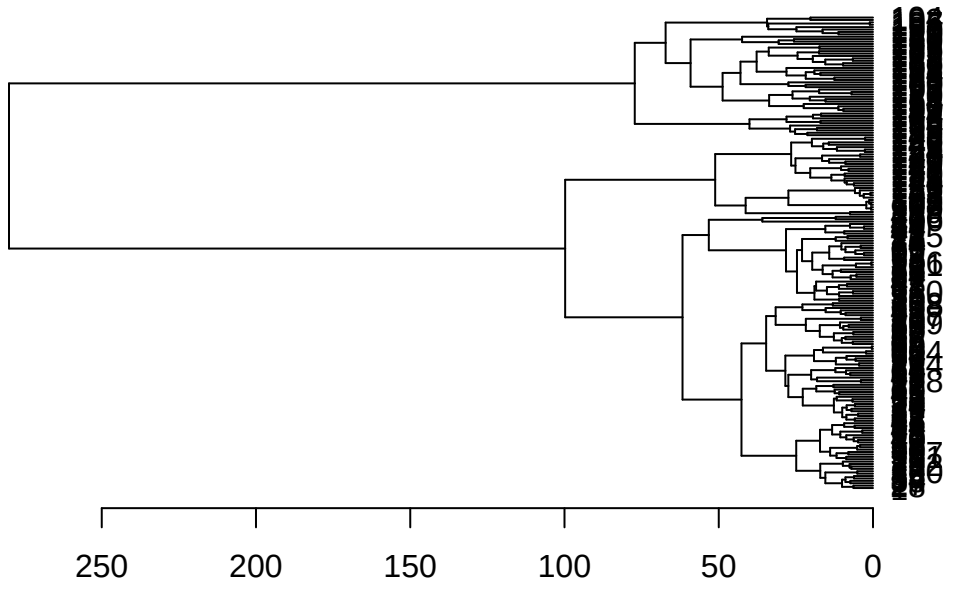
Display plots side by side

```
gridExtra::grid.arrange(p1, p2, p3, nrow = 1)
```

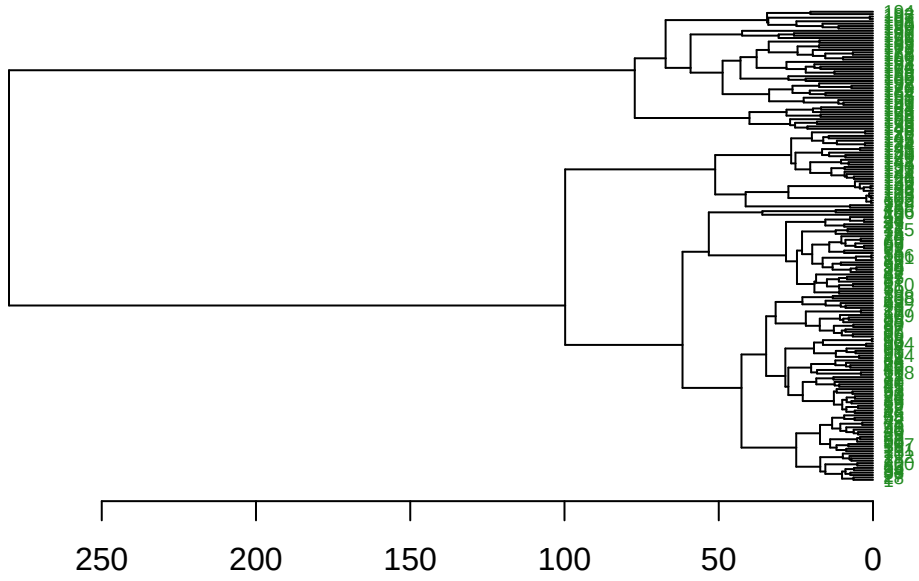


#Plot full dendogram

```
agn  <- as.dendrogram(as.hclust(clust))
dagn2 <- as.dendrogram(as.hclust(clust), hang = 0.2)
op <- par(mar = par("mar") + c(0,0,0, 2)) # more space to the right
plot(dagn2, horiz = TRUE)
```




```
plot(agn, horiz = TRUE, center = TRUE,
     nodePar = list(lab.cex = 0.6, lab.col = "forest green", pch = NA),
     main = deparse(agn$call))
```




```
par(op)
```

###———————— END————————###