

## Model 3

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#K-means Clustering

```
library(dplyr)
## Warning: package 'dplyr' was built under R version 4.2.2
library(ggplot2)
## Warning: package 'ggplot2' was built under R version 4.2.2
library(stringr)
## Warning: package 'stringr' was built under R version 4.2.2
library(gridExtra)
## Warning: package 'gridExtra' was built under R version 4.2.2
library(factoextra)
## Warning: package 'factoextra' was built under R version 4.2.2
library(tidyverse)
## Warning: package 'tidyverse' was built under R version 4.2.2
## Warning: package 'tibble' was built under R version 4.2.2
## Warning: package 'tidyr' was built under R version 4.2.2
## Warning: package 'readr' was built under R version 4.2.2
## Warning: package 'purrr' was built under R version 4.2.2
## Warning: package 'forcats' was built under R version 4.2.2
library(cluster)
library(readr)
library(mclust)
## Warning: package 'mclust' was built under R version 4.2.2
library(tidyr)
library(tibble)
library(purrr)
library(utis)
```

```
radiomics_completedata <- read_csv("C:/STAT 371/Final
Project/radiomics_completedata.csv")
View(radiomics_completedata)
Rad<-radiomics_completedata
```

#To remove any missing value that might be present in the data, type this:

```
Rad <- na.omit(Rad)
```

#we start by scaling/standardizing the data

```
Rad <- scale(Rad[, -c(1,2)])
head(Rad)
```

```
##           Failure Entropy_cooc.W.ADC GLNU_align.H.PET Min_hist.PET
Max_hist.PET
## [1,] 1.1985789          0.55290547        -0.57063689   -0.4541408   -
0.4361311
## [2,] -0.7212472        -0.06486729        -0.78903636    0.4998369
0.1486951
## [3,] 2.7926271          0.45990825        -0.06024275   -1.1504338   -
1.1768823
## [4,] -0.4442487         1.14318298         2.67468822   -0.4446190   -
0.1516658
## [5,] 0.6898772          0.34499368        -0.06740573   -0.9887407   -
1.1061760
## [6,] -1.1289054         0.84917904         0.07354603   -1.1864923   -
1.2223057
##           Mean_hist.PET Variance_hist.PET Standard_Deviation_hist.PET
## [1,] -0.4204856        -0.2625994        -0.2362506
## [2,] 0.3153953         0.3949731         0.2970175
## [3,] -1.1362283        -0.8957972        -1.1289710
## [4,] -0.3486295        -0.2802885        -0.2534091
## [5,] -1.1155134        -0.9335606        -1.2398300
## [6,] -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
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## [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

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## [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

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## [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

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## [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

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## [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
## [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

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##      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

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## [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
## [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

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## [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				
## [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				

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## [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
## [2,] -0.8657505 -0.59178935 -0.5187498 -0.35175571
## [3,] 0.6090364 -0.01830709 -0.3635494 1.08498263

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## [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

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## [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
##      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

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## [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
## [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

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##      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
## [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

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## [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
## [1,]           0.432890709          -0.3950162          -0.6536208

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## [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

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## [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
## [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

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## [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
```

#function to compute total within-cluster sum of square

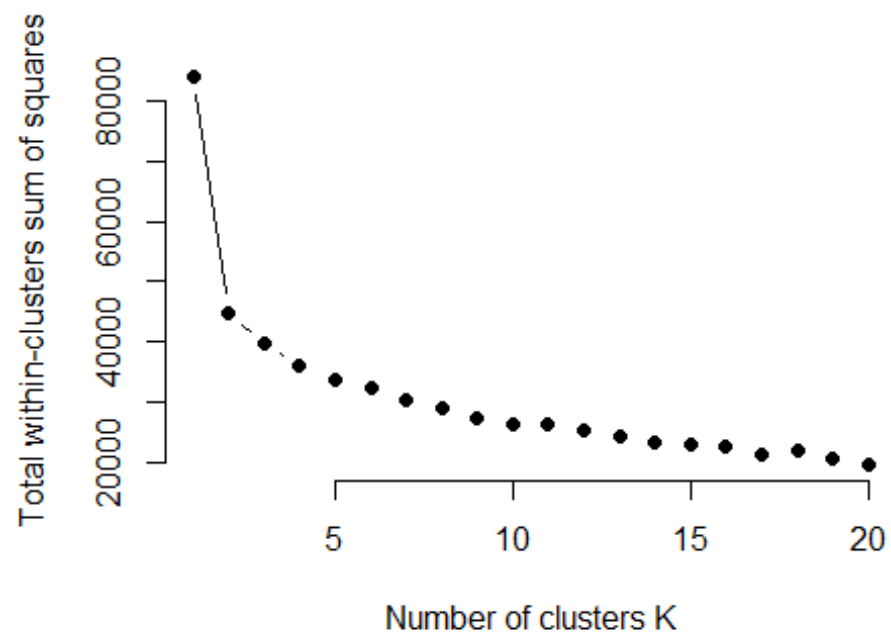
```
set.seed(123)
wss <- function(k) {
  kmeans(Rad, k, nstart = 10 )$tot.withinss
}
```

## Compute and plot wss for k = 1 to k = 20

```
k.values <- 1:20
```

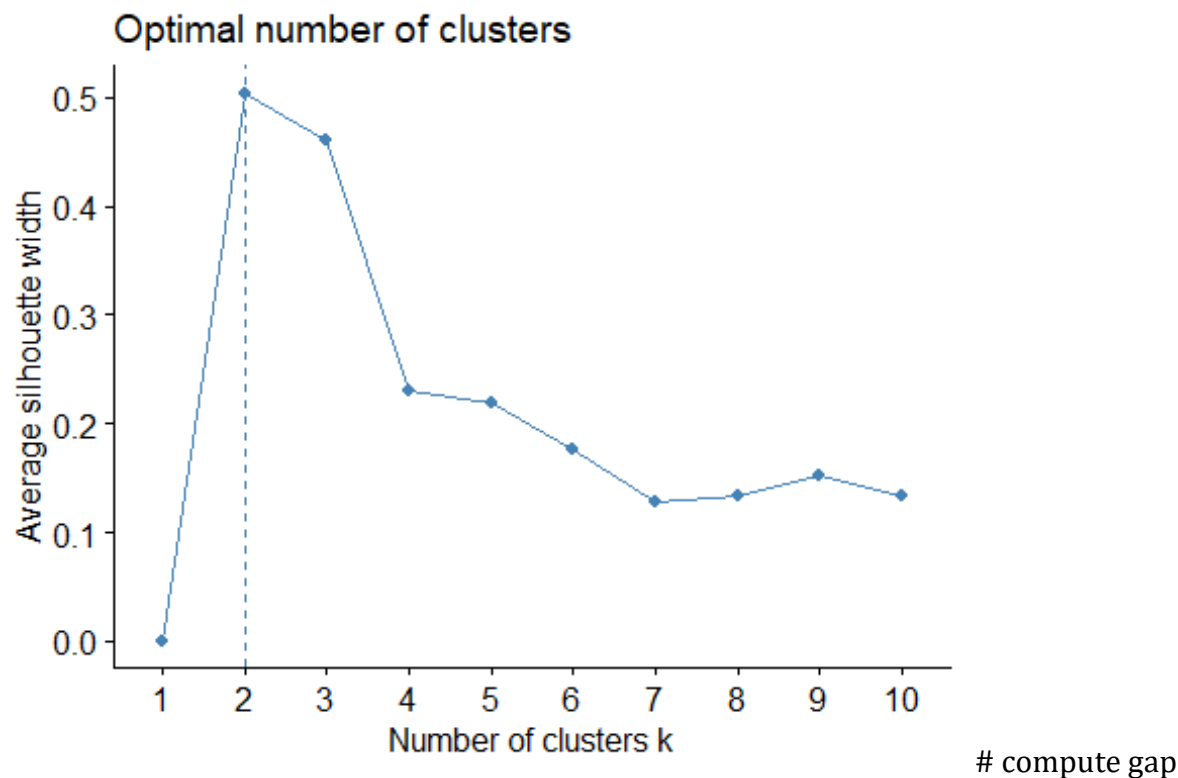
### extract wss for 2-15 clusters

```
wss_values <- map_dbl(k.values, wss)
plot(k.values, wss_values,
     type="b", pch = 19, frame = FALSE,
     xlab="Number of clusters K",
     ylab="Total within-clusters sum of squares")
```



#or use the silhouette

```
fviz_nbclust(Rad, kmeans, method = "silhouette")
```



statistic

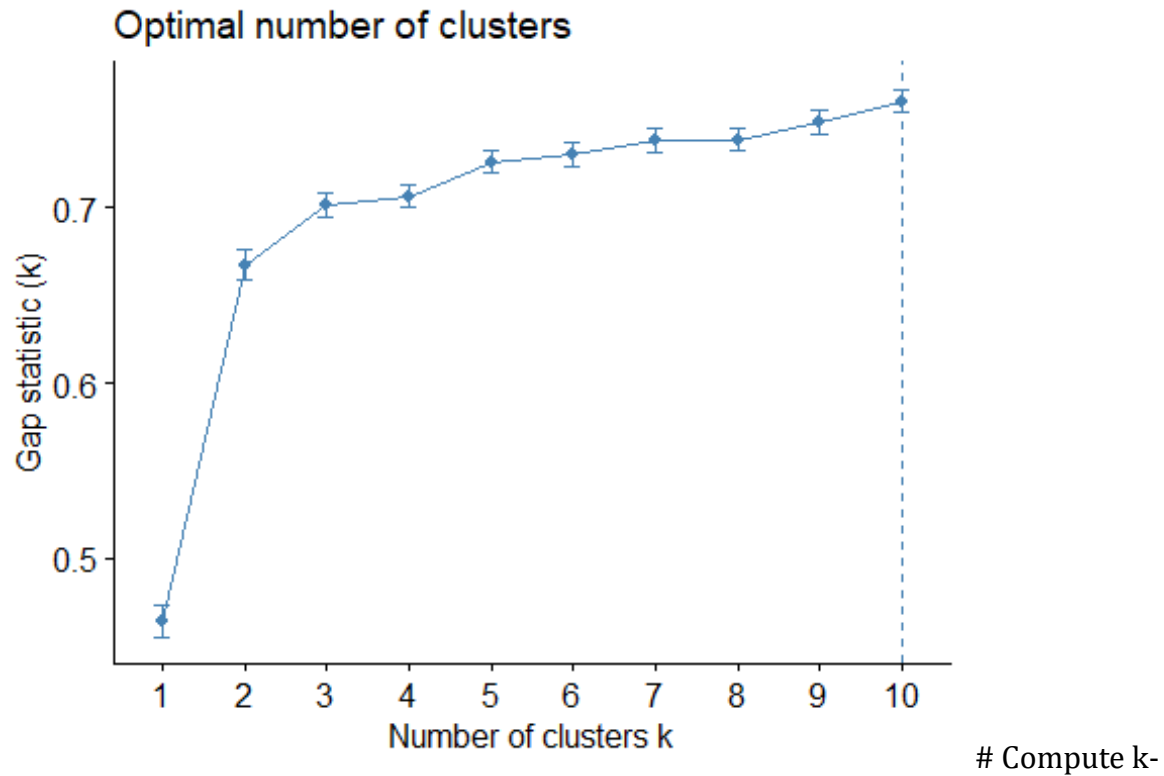
```
set.seed(123)
gap_stat <- clusGap(Rad, FUN = kmeans, nstart = 25,
                   K.max = 10, B = 50)
```

## Print the result

```
print(gap_stat, method = "firstmax")

## Clustering Gap statistic ["clusGap"] from call:
## clusGap(x = Rad, FUNcluster = kmeans, K.max = 10, B = 50, nstart = 25)
## B=50 simulated reference sets, k = 1..10; spaceH0="scaledPCA"
## --> Number of clusters (method 'firstmax'): 10
##      logW    E.logW      gap    SE.sim
## [1,] 7.171204 7.635853 0.4646496 0.009379996
## [2,] 6.879524 7.546674 0.6671493 0.008786338
## [3,] 6.798848 7.500436 0.7015873 0.007082545
## [4,] 6.760004 7.466467 0.7064633 0.006632270
## [5,] 6.715614 7.441579 0.7259645 0.006374244
## [6,] 6.689522 7.419633 0.7301115 0.006603869
## [7,] 6.661683 7.399745 0.7380616 0.006654018
## [8,] 6.643211 7.381624 0.7384134 0.006480643
## [9,] 6.616471 7.365139 0.7486677 0.006484664
## [10,] 6.588968 7.349544 0.7605765 0.006453097

fviz_gap_stat(gap_stat)
```



means clustering with k = 2

```
set.seed(123)
final <- kmeans(Rad, 2, nstart = 25)
print(final)
```

```
## K-means clustering with 2 clusters of sizes 50, 147
##
## Cluster means:
##      Failure Entropy_cooc.W.ADC GLNU_align.H.PET Min_hist.PET
Max_hist.PET
## 1 -0.0014733768      0.04845450      -0.07901100      0.9204612
0.9468341
## 2  0.0005011486      -0.01648112      0.02687449      -0.3130820  -
0.3220524
##   Mean_hist.PET Variance_hist.PET Standard_Deviation_hist.PET
Skewness_hist.PET
## 1      0.9216792      0.4594337      0.9319222
0.9115602
## 2     -0.3134963     -0.1562700     -0.3169804  -
0.3100545
##   Kurtosis_hist.PET Energy_hist.PET Entropy_hist.PET AUC_hist.PET
H_suv.PET
## 1      0.25274217      0.6864958      1.5003007      1.6957546
0.9652219
## 2     -0.08596673     -0.2335020     -0.5103064     -0.5767873  -
0.3283068
```



```

## Volume.PET X3D_surface.PET ratio_3ds_vol.PET ratio_3ds_vol_norm.PET
## 1 0.5900077 0.3802612 0.9436984 0.9622506
## 2 -0.2006829 -0.1293406 -0.3209858 -0.3272961
## irregularity.PET tumor_length.PET Compactness_v1.PET Compactness_v2.PET
## 1 1.6522842 1.0256292 0.8807232 0.4324058
## 2 -0.5620014 -0.3488535 -0.2995657 -0.1470768
## Spherical_disproportion.PET Sphericity.PET Asphericity.PET
Center_of_mass.PET
## 1 0.9622506 0.4460709 0.9240341
0.6358358
## 2 -0.3272961 -0.1517248 -0.3142973 -
0.2162707
## Max_3D_diam.PET Major_axis_length.PET Minor_axis_length.PET
## 1 0.8259982 0.8904297 1.1433164
## 2 -0.2809518 -0.3028672 -0.3888831
## Least_axis_length.PET Elongation.PET Flatness.PET Max_cooc.L.PET
## 1 0.9772289 1.4563692 1.3553445 0.7290795
## 2 -0.3323908 -0.4953637 -0.4610015 -0.2479862
## Average_cooc.L.PET Variance_cooc.L.PET Entropy_cooc.L.PET
DAVE_cooc.L.PET
## 1 1.389215 1.1041050 1.6813985
1.2936781
## 2 -0.472522 -0.3755459 -0.5719043 -
0.4400266
## DVAR_cooc.L.PET DENT_cooc.L.PET SAVE_cooc.L.PET SVAR_cooc.L.PET
## 1 1.1366603 1.6603800 1.3889879 1.1209781
## 2 -0.3866192 -0.5647551 -0.4724449 -0.3812851
## SENT_cooc.L.PET ASM_cooc.L.PET Contrast_cooc.L.PET
Dissimilarity_cooc.L.PET
## 1 1.6614758 0.6775498 0.9285775
1.2936781
## 2 -0.5651278 -0.2304591 -0.3158427 -
0.4400266
## Inv_diff_cooc.L.PET Inv_diff_norm_cooc.L.PET IDM_cooc.L.PET
## 1 1.443028 1.6979660 1.2814891
## 2 -0.490826 -0.5775395 -0.4358807
## IDM_norm_cooc.L.PET Inv_var_cooc.L.PET Correlation_cooc.L.PET
## 1 1.7046571 1.2896785 1.123648
## 2 -0.5798153 -0.4386661 -0.382193
## Autocorrelation_cooc.L.PET Tendency_cooc.L.PET Shade_cooc.L.PET
## 1 1.0338012 1.1209781 0.5578271
## 2 -0.3516331 -0.3812851 -0.1897371
## Prominence_cooc.L.PET IC1_.L.PET IC2_.L.PET Coarseness_vdif_.L.PET
## 1 0.7889007 -0.6341334 1.5273752 0.7537450
## 2 -0.2683336 0.2156916 -0.5195154 -0.2563758
## Contrast_vdif_.L.PET Busyness_vdif_.L.PET Complexity_vdif_.L.PET
## 1 0.3878173 0.5565230 1.2153015
## 2 -0.1319107 -0.1892936 -0.4133678
## Strength_vdif_.L.PET SRE_align.L.PET LRE_align.L.PET GLNU_align.L.PET
## 1 0.4934069 1.706523 1.6948229 0.4587983

```

```

## 2          -0.1678255          -0.580450          -0.5764704          -0.1560539
##  RLNU_align.L.PET RP_align.L.PET LGRE_align.L.PET HGRE_align.L.PET
## 1          0.4189336          1.7061400          1.0408063          1.0700373
## 2          -0.1424944          -0.5803197          -0.3540158          -0.3639583
##  LGSRE_align.L.PET HGSRE_align.L.PET LGHRE_align.L.PET HGLRE_align.L.PET
## 1          1.048281          1.0672364          1.0052958          1.078233
## 2          -0.356558          -0.3630056          -0.3419373          -0.366746
##  GLNU_norm_align.L.PET RLNU_norm_align.L.PET GLVAR_align.L.PET
## 1          1.1041018          1.7034139          1.1510468
## 2          -0.3755448          -0.5793925          -0.3915125
##  RLVAR_align.L.PET Entropy_align.L.PET SZSE.L.PET LZSE.L.PET LGLZE.L.PET
## 1          1.0474522          1.6880661  1.6676802  1.1852630  1.0601400
## 2          -0.3562762          -0.5741722 -0.5672382 -0.4031507 -0.3605919
##  HGLZE.L.PET SZLGE.L.PET SZHGE.L.PET LZLGE.L.PET LZHGE.L.PET
GLNU_area.L.PET
## 1  1.0866745  1.0735299  1.0776043  0.8457163  0.8914749
0.4621309
## 2 -0.3696172 -0.3651462 -0.3665321 -0.2876586 -0.3032228 -
0.1571874
##  ZSNU.L.PET ZSP.L.PET GLNU_norm.L.PET ZSNU_norm.L.PET GLVAR_area.L.PET
## 1  0.4218710  1.679008          1.1042309          1.681848          1.1694826
## 2 -0.1434935 -0.571091          -0.3755887          -0.572057          -0.3977832
##  ZSVAR.L.PET Entropy_area.L.PET Max_cooc.H.PET Average_cooc.H.PET
## 1  0.7548095          1.6893793          0.5052232          1.6652563
## 2 -0.2567379          -0.5746188          -0.1718446          -0.5664137
##  Variance_cooc.H.PET Entropy_cooc.H.PET DAVE_cooc.H.PET DVAR_cooc.H.PET
## 1          1.4721984          1.4404122          1.5079528          1.4645709
## 2          -0.5007478          -0.4899361          -0.5129091          -0.4981534
##  DENT_cooc.H.PET SAVE_cooc.H.PET SVAR_cooc.H.PET SENT_cooc.H.PET
## 1          1.3368883          1.6782221          1.4484331          1.1582831
## 2          -0.4547239          -0.5708239          -0.4926643          -0.3939739
##  ASM_cooc.H.PET Contrast_cooc.H.PET Dissimilarity_cooc.H.PET
## 1          0.4701159          1.344935          1.5079528
## 2          -0.1599034          -0.457461          -0.5129091
##  Inv_diff_cooc.H.PET Inv_diff_norm_cooc.H.PET IDM_cooc.H.PET
## 1          1.1377441          1.6996628          0.9576980
## 2          -0.3869878          -0.5781166          -0.3257476
##  IDM_norm_cooc.H.PET Inv_var_cooc.H.PET Correlation_cooc.H.PET
## 1          1.7052806          0.9554037          1.1365587
## 2          -0.5800274          -0.3249672          -0.3865846
##  Autocorrelation_cooc.H.PET Tendency_cooc.H.PET Shade_cooc.H.PET
## 1          1.5649714          1.4092944          -0.7124616
## 2          -0.5323032          -0.4793518          0.2423339
##  Prominence_cooc.H.PET IC1_d.H.PET IC2_d.H.PET Coarseness_vdif.H.PET
## 1          1.0427158 -0.23095606  1.3345708          0.6663547
## 2          -0.3546653  0.07855648 -0.4539356          -0.2266512
##  Contrast_vdif.H.PET Busyness_vdif.H.PET Complexity_vdif.H.PET
## 1          0.4860224          0.25301766          1.0958360
## 2          -0.1653138          -0.08606043          -0.3727333
##  Strength_vdif.H.PET SRE_align.H.PET LRE_align.H.PET RLNU_align.H.PET

```

```

## 1      0.03112072      1.6638495      1.0890098      0.4166644
## 2      -0.01058528     -0.5659352     -0.3704115     -0.1417226
##  RP_align.H.PET LGRE_align.H.PET HGRE_align.H.PET LGSRE_align.H.PET
## 1      1.6436641      0.7082866      1.5743684      0.7040204
## 2      -0.5590694      -0.2409138     -0.5354994     -0.2394627
##  HGSRE_align.H.PET LGHRE_align.H.PET HGLRE_align.H.PET
GLNU_norm_align.H.PET
## 1      1.6533952      0.7311054      0.7453460
0.8572435
## 2      -0.5623793     -0.2486753     -0.2535191     -
0.2915794
##  RLNU_norm_align.H.PET GLVAR_align.H.PET RLVAR_align.H.PET
Entropy_align.H.PET
## 1      1.5584253      1.4161797      0.4776867
1.550297
## 2      -0.5300766     -0.4816938     -0.1624785     -
0.527312
##  SZSE.H.PET LZSE.H.PET LGLZE.H.PET HGLZE.H.PET SZLGE.H.PET SZHGE.H.PET
## 1  1.4671263 -0.09759617  0.7096710  1.4890573  0.6984264  1.4294579
## 2 -0.4990226  0.03319598 -0.2413847 -0.5064821 -0.2375600 -0.4862102
##  LZLGE.H.PET LZHGE.H.PET GLNU_area.H.PET ZSNU.H.PET ZSP.H.PET
## 1  0.001044652 -0.08592571  0.4835029  0.3648643  1.1565208
## 2 -0.000355324  0.02922643 -0.1644568 -0.1241035 -0.3933744
##  GLNU_norm.H.PET ZSNU_norm.H.PET GLVAR_area.H.PET ZSVAR_H.PET
## 1      0.8791603      1.2441418      1.3802703 -0.09449223
## 2      -0.2990341     -0.4231775     -0.4694797  0.03214021
##  Entropy_area.H.PET Max_cooc.W.PET Average_cooc.W.PET Variance_cooc.W.PET
## 1      1.6279234      0.5502762      0.9151412      0.4579807
## 2      -0.5537154     -0.1871688     -0.3112725     -0.1557757
##  Entropy_cooc.W.PET DAVE_cooc.W.PET DVAR_cooc.W.PET DENT_cooc.W.PET
## 1      1.4784780      0.9564701      0.5165571      1.450023
## 2      -0.5028837     -0.3253300     -0.1756997     -0.493205
##  SAVE_cooc.W.PET SVAR_cooc.W.PET SENT_cooc.W.PET ASM_cooc.W.PET
## 1      0.9140050      0.4135667      1.5336398      0.5955603
## 2      -0.3108861     -0.1406689     -0.5216462     -0.2025715
##  Contrast_cooc.W.PET Dissimilarity_cooc.W.PET Inv_diff_cooc.W.PET
## 1      0.5325478      0.9564701      1.2750883
## 2      -0.1811387     -0.3253300     -0.4337035
##  Inv_diff_norm_cooc.W.PET IDM_cooc.W.PET IDM_norm_cooc.W.PET
## 1      1.6983343      1.044167      1.7048157
## 2      -0.5776647     -0.355159      -0.5798693
##  Inv_var_cooc.W.PET Correlation_cooc.W.PET Autocorrelation_cooc.W.PET
## 1      1.1637708      1.1228422      0.4576739
## 2      -0.3958404     -0.3819191     -0.1556714
##  Tendency_cooc.W.PET Shade_cooc.W.PET Prominence_cooc.W.PET IC1_d.W.PET
## 1      0.4135667      0.07642004      0.022900737 -0.26887955
## 2      -0.1406689     -0.02599321     -0.007789366  0.09145563
##  IC2_d.W.PET Coarseness_vdif.W.PET Contrast_vdif.W.PET
Busyness_vdif.W.PET
## 1  1.4455561      0.7071892      0.8252351

```

```

0.4153574
## 2 -0.4916858 -0.2405405 -0.2806922 -
0.1412780
## Complexity_vdif.W.PET Strength_vdif.W.PET SRE_align.W.PET
LRE_align.W.PET
## 1 0.2991726 0.4249851 1.697315
1.4801473
## 2 -0.1017594 -0.1445527 -0.577318 -
0.5034515
## GLNU_align.W.PET RLNU_align.W.PET RP_align.W.PET LGRE_align.W.PET
## 1 0.4738278 0.4182280 1.6901986 0.8300003
## 2 -0.1611659 -0.1422544 -0.5748975 -0.2823130
## HGRE_align.W.PET LGSRE_align.W.PET HGSRE_align.W.PET LGHRE_align.W.PET
## 1 0.4630749 0.8904857 0.4557129 0.5563026
## 2 -0.1575085 -0.3028863 -0.1550044 -0.1892186
## HGLRE_align.W.PET GLNU_norm_align.W.PET RLNU_norm_align.W.PET
## 1 0.4921754 0.8494549 1.658483
## 2 -0.1674066 -0.2889302 -0.564110
## GLVAR_align.W.PET RLVAR_align.W.PET Entropy_align.W.PET SZSE.W.PET
## 1 0.4593218 0.5957178 1.5543465 1.6121174
## 2 -0.1562319 -0.2026251 -0.5286893 -0.5483392
## LZSE.W.PET LGLZE.W.PET HGLZE.W.PET SZLGE.W.PET SZHGE.W.PET LZLGE.W.PET
## 1 0.21517025 0.8709408 0.4690713 0.9938480 0.4481637 -0.004326372
## 2 -0.07318716 -0.2962384 -0.1595481 -0.3380435 -0.1524366 0.001471555
## LZHGE.W.PET GLNU_area.W.PET ZSNU.W.PET ZSP.W.PET GLNU_norm.W.PET
## 1 0.5263985 0.4910918 0.3971868 1.4948131 0.8826796
## 2 -0.1790471 -0.1670380 -0.1350976 -0.5084398 -0.3002311
## ZSNU_norm.W.PET GLVAR_area.W.PET ZSVAR.W.PET Entropy_area.W.PET
Min_hist.ADC
## 1 1.4869647 0.4655759 0.06408427 1.6167770
0.5724098
## 2 -0.5057703 -0.1583592 -0.02179737 -0.5499242 -
0.1946972
## Max_hist.ADC Mean_hist.ADC Variance_hist.ADC Standard_Deviation_hist.ADC
## 1 1.5075750 1.4864908 0.7599395 1.2359485
## 2 -0.5127806 -0.5056091 -0.2584828 -0.4203906
## Skewness_hist.ADC Kurtosis_hist.ADC Energy_hist.ADC Entropy_hist.ADC
## 1 0.3899909 0.4662845 0.7015053 1.6284344
## 2 -0.1326500 -0.1586002 -0.2386073 -0.5538893
## AUC_hist.ADC Volume.ADC X3D_surface.ADC ratio_3ds_vol.ADC
## 1 1.6655300 0.5687484 0.7349831 1.1042095
## 2 -0.5665068 -0.1934518 -0.2499942 -0.3755815
## ratio_3ds_vol_norm.ADC irregularity.ADC Compactness_v1.ADC
Compactness_v2.ADC
## 1 1.6106322 1.6397737 1.1221987
1.3007130
## 2 -0.5478341 -0.5577462 -0.3817002 -
0.4424194
## Spherical_disproportion.ADC Sphericity.ADC Asphericity.ADC
Center_of_mass.ADC

```

```

## 1          1.6106322      1.6242350      1.1989866
0.5373920
## 2          -0.5478341      -0.5524609      -0.4078186      -
0.1827864
##   Max_3D_diam.ADC Major_axis_length.ADC Minor_axis_length.ADC
## 1          1.0866100          1.2316275          1.1312333
## 2          -0.3695952          -0.4189209          -0.3847732
##   Least_axis_length.ADC Elongation.ADC Flatness.ADC Max_cooc.L.ADC
## 1          1.0417403          1.4824827          1.4052040          0.8250964
## 2          -0.3543334          -0.5042458          -0.4779606          -0.2806450
##   Average_cooc.L.ADC Variance_cooc.L.ADC Entropy_cooc.L.ADC
DAVE_cooc.L.ADC
## 1          1.456079          0.9533869          1.6827114
1.2819538
## 2          -0.495265          -0.3242813          -0.5723508      -
0.4360387
##   DVAR_cooc.L.ADC DENT_cooc.L.ADC SAVE_cooc.L.ADC SVAR_cooc.L.ADC
## 1          0.9295089          1.6521421          1.4558899          0.9317704
## 2          -0.3161595          -0.5619531          -0.4952006          -0.3169287
##   SENT_cooc.L.ADC ASM_cooc.L.ADC Contrast_cooc.L.ADC
Dissimilarity_cooc.L.ADC
## 1          1.2584756          0.7127202          0.8811662
1.2819538
## 2          -0.4280529          -0.2424218          -0.2997164      -
0.4360387
##   Inv_diff_cooc.L.ADC Inv_diff_norm_cooc.L.ADC IDM_cooc.L.ADC
## 1          1.5058302          1.7039344          1.3642322
## 2          -0.5121871          -0.5795695          -0.4640245
##   IDM_norm_cooc.L.ADC Inv_var_cooc.L.ADC Correlation_cooc.L.ADC
## 1          1.7073272          1.379898          1.2216811
## 2          -0.5807235          -0.469353          -0.4155378
##   Autocorrelation_.L.ADC Tendency_cooc.L.ADC Shade_.L.ADC
Prominence_cooc.L.ADC
## 1          1.1050198          0.9317704          0.29259000
0.5515288
## 2          -0.3758571          -0.3169287          -0.09952041      -
0.1875948
##   IC1_.L.ADC IC2_.L.ADC Coarseness_vdif_.L.ADC Contrast_vdif_.L.ADC
## 1 -0.6732168  1.5121032          0.6939723          0.6587722
## 2  0.2289853 -0.5143208          -0.2360450          -0.2240722
##   Busyness_vdif_.L.ADC Complexity_vdif_.L.ADC Strength_vdif_.L.ADC
## 1          0.6475886          1.2753146          0.4214397
## 2          -0.2202682          -0.4337805          -0.1433468
##   SRE_align.L.ADC LRE_align.L.ADC GLNU_align.L.ADC RLNU_align.L.ADC
## 1          1.7052408          1.6811893          0.5682374          0.5910147
## 2          -0.5800139          -0.5718331          -0.1932780          -0.2010254
##   RP_align.L.ADC LGRE_align.L.ADC HGRE_align.L.ADC LGSRE_align.L.ADC
## 1          1.7034645          0.7243458          1.2086645          0.7235521
## 2          -0.5794097          -0.2463761          -0.4111104          -0.2461061
##   HGSRE_align.L.ADC LGHRE_align.L.ADC HGLRE_align.L.ADC

```

```

GLNU_norm_align.L.ADC
## 1      1.2124123      0.7234431      1.1801466
1.2291014
## 2      -0.4123852      -0.2460691      -0.4014104      -
0.4180617
##  RLNU_norm_align.L.ADC GLVAR_align.L.ADC RLVAR_align.L.ADC
Entropy_align.L.ADC
## 1      1.6955541      0.9930121      1.1385331
1.6982212
## 2      -0.5767191      -0.3377592      -0.3872562      -
0.5776262
##  SZSE.L.ADC LZSE.L.ADC LGLZE.L.ADC HGLZE.L.ADC SZLGE.L.ADC SZHGE.L.ADC
## 1  1.6968578  1.3430968  0.7262967  1.2295659  0.7219542  1.2399482
## 2 -0.5771625 -0.4568356 -0.2470397 -0.4182197 -0.2455627 -0.4217511
##  LZLGE.L.ADC LZHGE.L.ADC GLNU_area.L.ADC ZSNU.L.ADC  ZSP.L.ADC
GLNU_norm.L.ADC
## 1  0.6651854  1.077189      0.5782984  0.5919629  1.6748354
1.2251432
## 2 -0.2262535 -0.366391      -0.1967001 -0.2013479 -0.5696719      -
0.4167154
##  ZSNU_norm.L.ADC GLVAR_area.L.ADC ZSVAR.L.ADC Entropy_area.L.ADC
## 1      1.6570978      1.012871  0.6758567      1.7010816
## 2      -0.5636387      -0.344514 -0.2298832      -0.5785992
##  Max_cooc.H.ADC Average_cooc.H.ADC Variance_cooc.H.ADC Entropy_cooc.H.ADC
## 1      0.7039103      1.6967547      1.7053247      1.7011475
## 2      -0.2394253      -0.5771274      -0.5800424      -0.5786216
##  DAVE_cooc.H.ADC DVAR_cooc.H.ADC DENT_cooc.H.ADC SAVE_cooc.H.ADC
## 1      1.5698813      1.4861394      1.7017575      1.6967573
## 2      -0.5339732      -0.5054896      -0.5788291      -0.5771283
##  SVAR_cooc.H.ADC SENT_cooc.H.ADC ASM_cooc.H.ADC Contrast_cooc.H.ADC
## 1      1.6206816      1.6803084      0.6607170      1.3858879
## 2      -0.5512522      -0.5715335      -0.2247337      -0.4713904
##  Dissimilarity_cooc.H.ADC Inv_diff_cooc.H.ADC Inv_diff_norm_cooc.H.ADC
## 1      1.5698813      1.5546888      1.7028145
## 2      -0.5339732      -0.5288057      -0.5791886
##  IDM_cooc.H.ADC IDM_norm_cooc.H.ADC Inv_var_cooc.H.ADC
Correlation_cooc.H.ADC
## 1      1.4136874      1.7054539      1.4364367
1.1993586
## 2      -0.4808461      -0.5800864      -0.4885839      -
0.4079451
##  Autocorrelation_cooc.H.ADC Tendency_cooc.H.ADC Shade_cooc.H.ADC
## 1      1.6722184      1.6206816      0.3887230
## 2      -0.5687818      -0.5512522      -0.1322187
##  Prominence_cooc.H.ADC IC1_d.H.ADC IC2_d.H.ADC Coarseness_vdif.H.ADC
## 1      1.5404751 -0.5455177  1.5085932      0.6780216
## 2      -0.5239711  0.1855502 -0.5131269      -0.2306196
##  Contrast_vdif.H.ADC Busyness_vdif.H.ADC Complexity_vdif.H.ADC
## 1      1.5316725      0.6153610      1.503704
## 2      -0.5209771      -0.2093065      -0.511464

```

```

## Strength_vdif.H.ADC SRE_align.H.ADC LRE_align.H.ADC GLNU_align.H.ADC
## 1 0.3677298 1.7071497 1.7038845 0.5901231
## 2 -0.1250782 -0.5806632 -0.5795526 -0.2007222
## RLNU_align.H.ADC RP_align.H.ADC LGRE_align.H.ADC HGRE_align.H.ADC
## 1 0.5924412 1.706814 1.0946139 1.7100780
## 2 -0.2015106 -0.580549 -0.3723177 -0.5816592
## LGSRE_align.H.ADC HGSRE_align.H.ADC LGHRE_align.H.ADC HGLRE_align.H.ADC
## 1 1.0760014 1.7093907 1.1710039 1.7053139
## 2 -0.3659869 -0.5814254 -0.3983006 -0.5800387
## GLNU_norm_align.H.ADC RLNU_norm_align.H.ADC GLVAR_align.H.ADC
## 1 0.9735389 1.7053279 1.7100152
## 2 -0.3311357 -0.5800435 -0.5816378
## RLVAR_align.H.ADC Entropy_align.H.ADC SZSE.H.ADC LZSE.H.ADC LGLZE.H.ADC
## 1 1.0687509 1.7093530 1.7049082 1.6336887 1.0589022
## 2 -0.3635207 -0.5814126 -0.5799008 -0.5556764 -0.3601708
## HGLZE.H.ADC SZLGE.H.ADC SZHGE.H.ADC LZLGE.H.ADC LZHGE.H.ADC
GLNU_area.H.ADC
## 1 1.709075 1.0114862 1.7031396 1.0813161 1.5698347
0.5919958
## 2 -0.581318 -0.3440429 -0.5792992 -0.3677946 -0.5339574 -
0.2013591
## ZSNU.H.ADC ZSP.H.ADC GLNU_norm.H.ADC ZSNU_norm.H.ADC GLVAR_area.H.ADC
## 1 0.5972096 1.7013318 0.9745507 1.692802 1.7072803
## 2 -0.2031325 -0.5786843 -0.3314798 -0.575783 -0.5807076
## ZSVAR.H.ADC Entropy_area.H.ADC Max_cooc.W.ADC Average_cooc.W.ADC
## 1 0.8431301 1.7066118 0.6868122 1.199285
## 2 -0.2867790 -0.5804802 -0.2336096 -0.407920
## Variance_cooc.W.ADC DAVE_cooc.W.ADC DVAR_cooc.W.ADC DENT_cooc.W.ADC
## 1 0.7283676 1.3033631 0.7679414 1.6768624
## 2 -0.2477441 -0.4433208 -0.2612045 -0.5703613
## SAVE_cooc.W.ADC SVAR_cooc.W.ADC SENT_cooc.W.ADC ASM_cooc.W.ADC
## 1 1.1909017 0.6843706 1.2023295 0.6601442
## 2 -0.4050686 -0.2327791 -0.4089556 -0.2245389
## Contrast_cooc.W.ADC Dissimilarity_cooc.W.ADC Inv_diff_cooc.W.ADC
## 1 0.7994120 1.3033631 1.3827605
## 2 -0.2719088 -0.4433208 -0.4703267
## Inv_diff_norm_cooc.W.ADC IDM_cooc.W.ADC IDM_norm_cooc.W.ADC
## 1 1.7038802 1.3112119 1.7073083
## 2 -0.5795511 -0.4459904 -0.5807171
## Inv_var_cooc.W.ADC Correlation_cooc.W.ADC Autocorrelation_cooc.W.ADC
## 1 1.3074526 1.2225367 0.8447953
## 2 -0.4447118 -0.4158288 -0.2873453
## Tendency_cooc.W.ADC Shade_cooc.W.ADC Prominence_cooc.W.ADC IC1_d.W.ADC
## 1 0.6843706 0.2567335 0.3775512 0.6756692
## 2 -0.2327791 -0.0873243 -0.1284188 0.2298194
## IC2_d.W.ADC Coarseness_vdif.W.ADC Contrast_vdif.W.ADC
Busyness_vdif.W.ADC
## 1 1.6012140 0.7114542 0.6249552
1.0116700
## 2 -0.5446306 -0.2419912 -0.2125698 -

```

```

0.3441054
## Complexity_vdif.W.ADC Strength_vdif.W.ADC SRE_align.W.ADC
LRE_align.W.ADC
## 1 0.6003182 0.5784705 1.7073214
1.7065667
## 2 -0.2041899 -0.1967587 -0.5807216 -
0.5804649
## GLNU_align.W.ADC RLNU_align.W.ADC RP_align.W.ADC LGRE_align.W.ADC
## 1 0.6326468 0.5857336 1.7071535 0.6918953
## 2 -0.2151860 -0.1992291 -0.5806645 -0.2353386
## HGRE_align.W.ADC LGSRE_align.W.ADC HGSRE_align.W.ADC LGHRE_align.W.ADC
## 1 0.8626770 0.6918084 0.8616174 0.6894568
## 2 -0.2934276 -0.2353090 -0.2930672 -0.2345091
## HGLRE_align.W.ADC GLNU_norm_align.W.ADC RLNU_norm_align.W.ADC
## 1 0.866512 0.9154487 1.7063312
## 2 -0.294732 -0.3113771 -0.5803848
## GLVAR_align.W.ADC RLVAR_align.W.ADC Entropy_align.W.ADC SZSE.W.ADC
LZSE.W.ADC
## 1 0.7640782 0.9834635 1.661714 1.7066974
1.6823970
## 2 -0.2598905 -0.3345114 -0.565209 -0.5805093 -
0.5722439
## LGLZE.W.ADC HGLZE.W.ADC SZLGE.W.ADC SZHGE.W.ADC LZLGE.W.ADC LZHGE.W.ADC
## 1 0.6918923 0.8639228 0.6899145 0.8602645 0.6450074 0.8755515
## 2 -0.2353375 -0.2938513 -0.2346648 -0.2926070 -0.2193903 -0.2978066
## GLNU_area.W.ADC ZSNU.W.ADC ZSP.W.ADC GLNU_norm.W.ADC ZSNU_norm.W.ADC
## 1 0.6327545 0.5822861 1.7050925 0.9137899 1.699026
## 2 -0.2152226 -0.1980565 -0.5799634 -0.3108129 -0.577900
## GLVAR_area.W.ADC ZSVAR.W.ADC Entropy_area.W.ADC
## 1 0.7713592 1.0785430 1.672228
## 2 -0.2623671 -0.3668514 -0.568785
##
## Clustering vector:
## [1] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
2 2 2
## [38] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
2 2 2
## [75] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
2 2 2
## [112] 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
2 2 1
## [149] 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1
## [186] 1 1 1 1 1 1 1 1 1 1 1 1
##
## Within cluster sum of squares by cluster:
## [1] 21058.70 23808.27
## (between_SS / total_SS = 46.6 %)
##
## Available components:

```





```
purrr::map_dbl(m, ac)

## average single complete ward
## 0.7616680 0.7098672 0.8489113 0.9654737
```

#compute divisive hierarchical clustering

```
diana <- diana(Rad)
diana$dc

## [1] 0.8428381
```

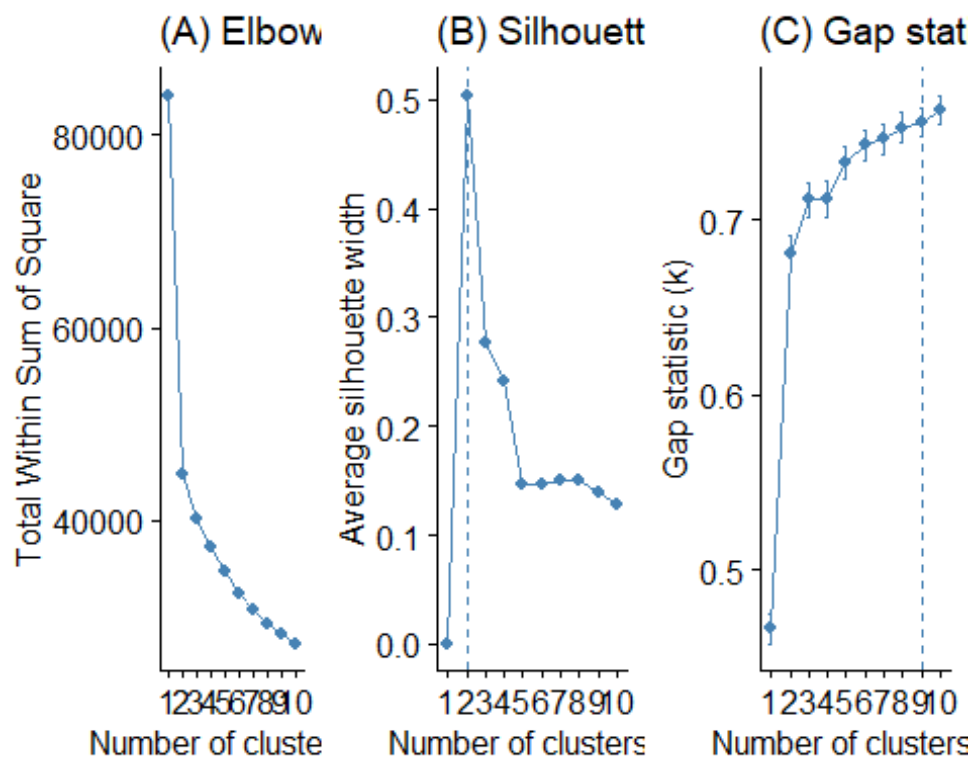
#Plot cluster results

```
p_EM <- fviz_nbclust(Rad, FUN = hcut, method = "wss",
                     k.max = 10) +
  ggtitle("(A) Elbow method")

p_SM <- fviz_nbclust(Rad, FUN = hcut, method = "silhouette",
                     k.max = 10) +
  ggtitle("(B) Silhouette method")

p_GS <- fviz_nbclust(Rad, FUN = hcut, method = "gap_stat",
                     k.max = 10) +
  ggtitle("(C) Gap statistic")

gridExtra::grid.arrange(p_EM, p_SM, p_GS, nrow = 1)
```



#Dendrogram for the Radiomic dataset

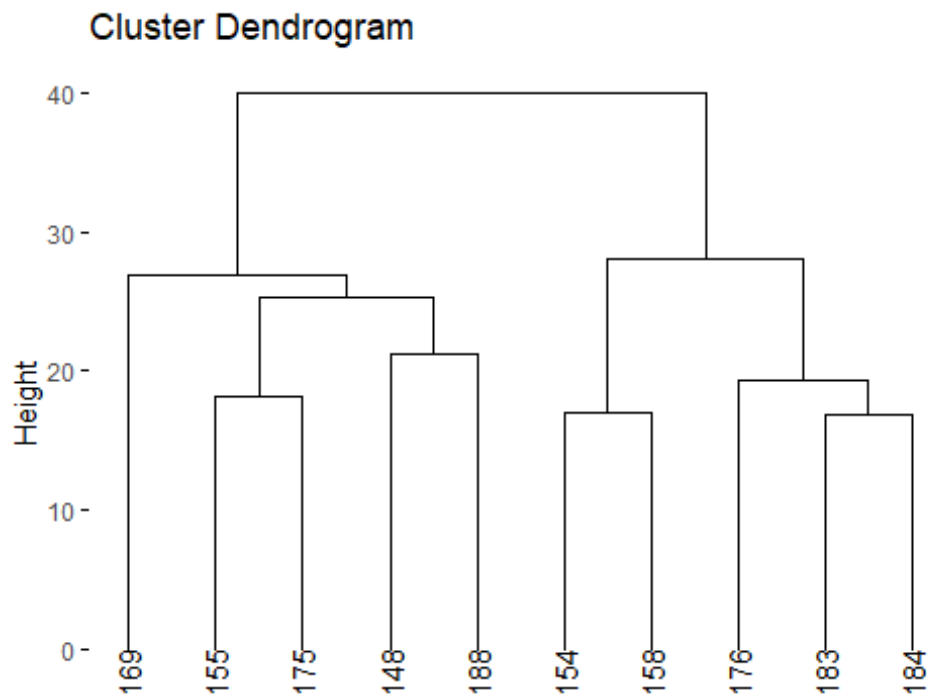
```

hc_final <- hclust(d, method = "ward.D2" )
dend_plot <- fviz_dend(hc_final)

## Warning: The `<scale>` argument of `guides()` cannot be `FALSE`. Use
"none" instead as
## of ggplot2 3.3.4.
## i The deprecated feature was likely used in the factoextra package.
## Please report the issue at
<]8;;https://github.com/kassambara/factoextra/issueshttps://github.com/kassam
bara/factoextra/issues]8;;>.

dend_data <- attr(dend_plot, "dendrogram")
dend_cuts <- cut(dend_data, h = 70.5)
fviz_dend(dend_cuts$lower[[1]])

```



#Number of members in each cluster

```

hc_final <- hclust(d, method = "ward.D2" )
sub_grp <- cutree(hc_final, k = 2)
table(sub_grp)

## sub_grp
## 1 2
## 147 50

```

## Plot full dendrogram

```
fviz_dend(  
  hc_final,  
  k = 2,  
  horiz = TRUE,  
  rect = TRUE,  
  rect_fill = TRUE,  
  rect_border = "jco",  
  k_colors = "jco",  
  cex = 0.1)
```

## Cluster Dendrogram

